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1) The tissue in plants that brings water upward from the roots
2) A leading global water technology company

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Xylem Inc.
9333 N. 49th Street
Brown Deer WI 53223, USA
Tel: +1-(414)-365-2200
Fax: +1-(414)-365-2210
sanitaire@xylemleads.com
www.sanitaire.com

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The original instruction is in English. All non-English instructions are translations of the original instruction.

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INSTALLATION TIPS FOR FINE BUBBLE AERATION SYSTEMS

GENERAL INSTALLATION TIPS

1. Follow Sanitaire O&M manual and Sanitaire Erection drawings when installing equipment.

2. Persons that will be installing the Sanitaire equipment are encouraged to view the "SANITAIRE INSTALLATION VIDEO".

3. All pipe sections provided by Xylem have part numbers marked on them.

4. Each wood box crate of parts provided by Xylem has a Bill of Materials attached to the out side of the crate identifying the contents.

5. Each wooden pallet racks of air distributors have the contents indicated in permanent marker on one of the corner vertical wood members.

6. Contact Xylem if / when discrepancy between equipment / drawings / site conditions occurs.

7. Installing Contractor must have a copy of the Sanitaire Installation, Operation & Maintenance manual on site.

8. Installing Contractor must have a copy of the Sanitaire Erection drawings on site. The Sanitaire erection drawings are located in the back folder of the O&M manual. The Sanitaire erection drawings have part numbers marked at each pipe section. The Sanitaire erection drawings are designated E-1, E-2 etc. for sheet numbers in the lower right hand corner of the drawing. Drawings designated S-1, S-2 etc. must not be used for installation of equipment.

9. Contact Xylem if you do not have a copy of the O&M manual or Sanitaire erection drawings.

10. Xylem provides Construction spares for contractors use during installation and commissioning of the Sanitaire equipment. Construction spares are extras of items provided as well as materials that may be required to repair manifolds or air distributors on site if breakage occurs. Quantities vary per contract. The list of contractor spares provided by Xylem is at the end of the BOM located in the back of the Sanitaire O&M manual.

11. Xylem does not provide PVC solvent cement or primer for pipe repairs. Any PVC solvent cement and primer rated for the specific size pipe which needs repairs may be used.

DROPLEGS

1. Follow Sanitaire O&M manual and Sanitaire Erection drawings when installing equipment.

2. Install dropleg prior to any other aeration equipment.

3. Dimensional locations for all components of the Sanitaire Aeration System are referenced to the dropleg.

4. Be sure upper stainless steel droplg is adequately supported prior to installing the manifold and lower PVC dropleg.

SUPPORTS

1. Follow Sanitaire O&M manual and Sanitaire Erection drawings when installing equipment.

2. Be sure all hardware is installed per the support details on the Sanitaire drawings. All washers, plate washers and nuts must be located per the Sanitaire support details.

3. All support hardware must be checked to be "wrench tight" after leveling of equipment and prior to filling basins.

4. Note that anchor bolts are offset 2 3/4" from the center of the support rod on the manifold supports which require two anchor bolts. This must be considered when installing anchors so that interference does not occur between support clamp and air distributor saddle connections. See Figure 1 attached.

5. Pay special attention to the orientation of the "LOCATING PLATE" which is installed on the single anchor bolt 4" pipe supports. The locating plate must be installed such that the bent tabs are located inside the support rod bend radius. See Figure 2 attached.

6. Be sure to follow Sanitaire drawings when installing supports. Sloped tank floors require support rods of varying lengths. Sanitaire drawings will indicate the part number of the correct support to be located at specific locations.

7. Sanitaire manifold supports and air distributor guide supports are designed with oversized clamps which allow the pipe to move freely through the support during expansion / contraction cycles. Do not modify clamps to grip tight on the pipe.

MANIFOLDS

1. Follow Sanitaire O&M manual and Sanitaire Erection drawings when installing equipment.

2. Only install manifolds after upper dropleg has been installed and properly supported.

3. Be sure to follow Sanitaire erection drawings. Identify the correct part number of pipe section for installation at the specific location.

4. The lower PVC dropleg must be cut to required length and solvent cemented into the PVC manifold. Sanitaire does not provide PVC solvent cement or primer for pipe repairs. Any PVC solvent cement and primer rated for the specific size pipe which needs repairs may be used.

5. Take care not to damage the 4" nozzle connections that the air distributors attach to. Damaged connections must be repaired prior to installation of air distributors.

AIR DISTRIBUTORS

1. Follow Sanitaire O&M manual and Sanitaire Erection drawings when installing equipment.

2. Identify the correct part number of pipe section for installation at the specific location.

3. Take care not to damage the Fixed Joint end connections on the air distributors. Damaged connections must be repaired prior to installation of air distributors.

4. Membrane diffusers may be pre-installed on the air distributors prior to installing air distributors in tank. Ceramic diffusers can not be pre-installed on the air distributors due to their excessive weight.

5. Xylem recommends installing one (1) air distributor with supports prior to drilling all air distributor support anchors. If interference occurs between support and diffuser assembly the anchor spacing can be adjusted prior to further installation. See Figure 3 attached.

6. Tip for connecting / assembling 4" Fixed Joints: Fixed joint O-ring may be dipped in a diluted solution of dish washing soap. This acts as a lubricant and will reduce the friction of the joint when assembling. Rotating the pipe in an alternating CW / CCW action while pushing the joint together will ease installation. See Figure 4 attached.

7. Tighten Fixed Joint retainer rings by hand only. Do not use a strap wrench or other tools to tighten fixed joint.

8. Do not use the any type of grease on the Fixed Joint O-ring. The Xylem provided Huskey 350 silicone lubricant is used during installation of the diffusers.

DIFFUSERS

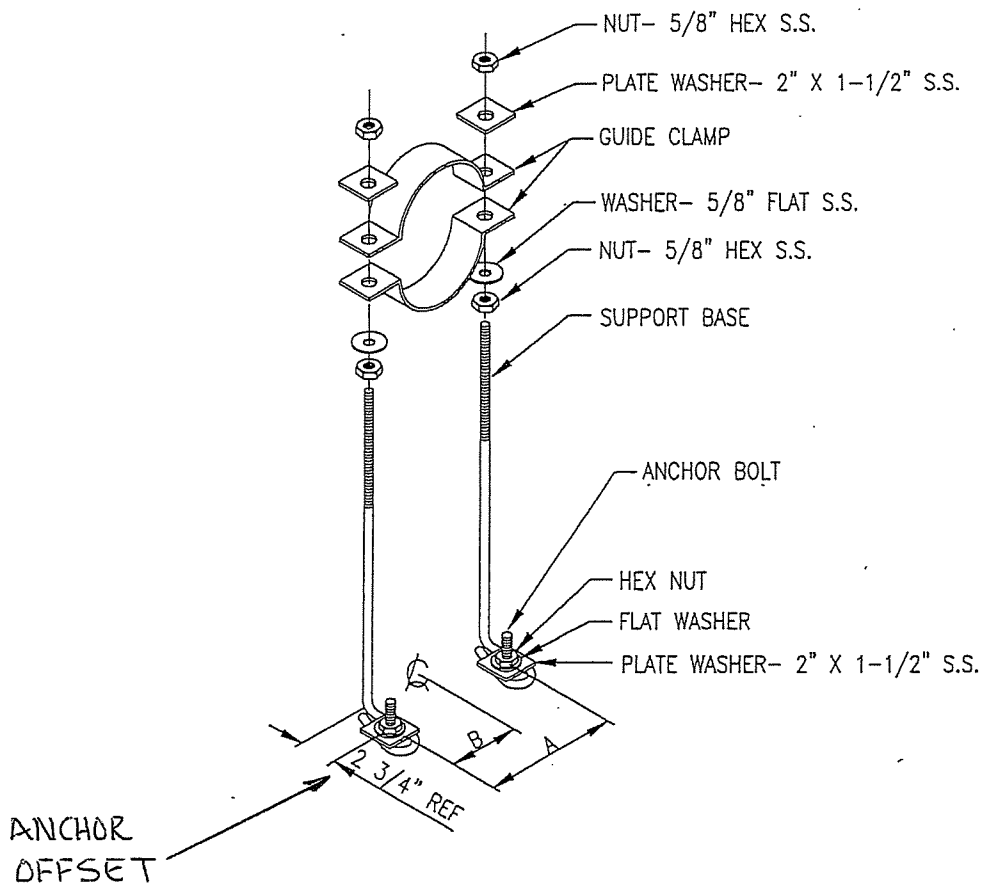
1. Follow Sanitaire O&M manual and Sanitaire Erection drawings when installing equipment.

2. Be sure to correctly identify the type of diffuser to be installed at the specific location. Some projects require more than one type of diffuser to be provided for installation in various structures. Sanitaire provides 7" & 9" SSII membranes, 9" SSII-LP membranes, 7" & 9" ceramic disc diffusers. The shipping containers identify the type of diffuser. The Sanitaire erection drawings identify the type of diffuser to be installed at specific structures.

3. Prior to installing the diffuser assembly, be sure the diffuser orifice is clear of debris. The diffuser orifice is located at the bottom center of the diffuser holder bowl. See Figures 5 & 6 attached.

4. Do not use excessive silicone lubricant when installing the diffusers. The lubricant only prevents the diffuser o-ring from "creeping" due to friction from the retainer ring as it is tightened. The silicone lubricant does not aid in sealing the diffuser assembly to be air tight. For membrane diffusers: use a small "dab" of silicone at four points on the underside of the retainer ring that seats on the diffuser. The grease will be spread out as the retainer ring spins on the diffuser. See Figures 5 & 6 attached.

5. Install the diffuser retainer rings hand tight and then use diffuser wrench (provided by Xylem) to tighten an additional 90º or one quarter turn. Over-tightening will cause the diffuser to leak. See Figures 5 & 6 attached.



SIMPLE SUPPORT

FIGURE 1

SANITAIRE®

WATER POLLUTION CONTROL CORP

MILWAUKEE, WISCONSIN

BE SURE TABS ARE LOCATED
INSIDE BEND RADIUS OF
SUPPORT ROD BASE.

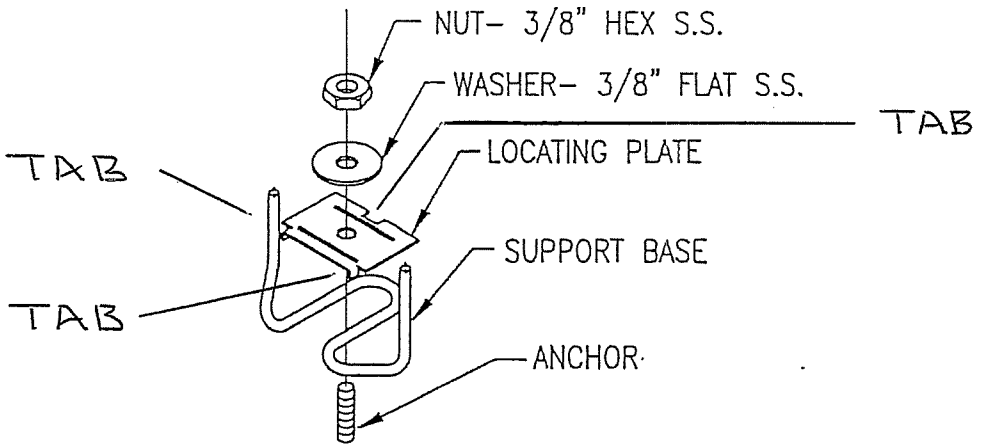


FIGURE 2

SANITAIRE®
WATER POLLUTION CONTROL CORP
MILWAUKEE, WISCONSIN

NOTE: SUPPORT SPACING

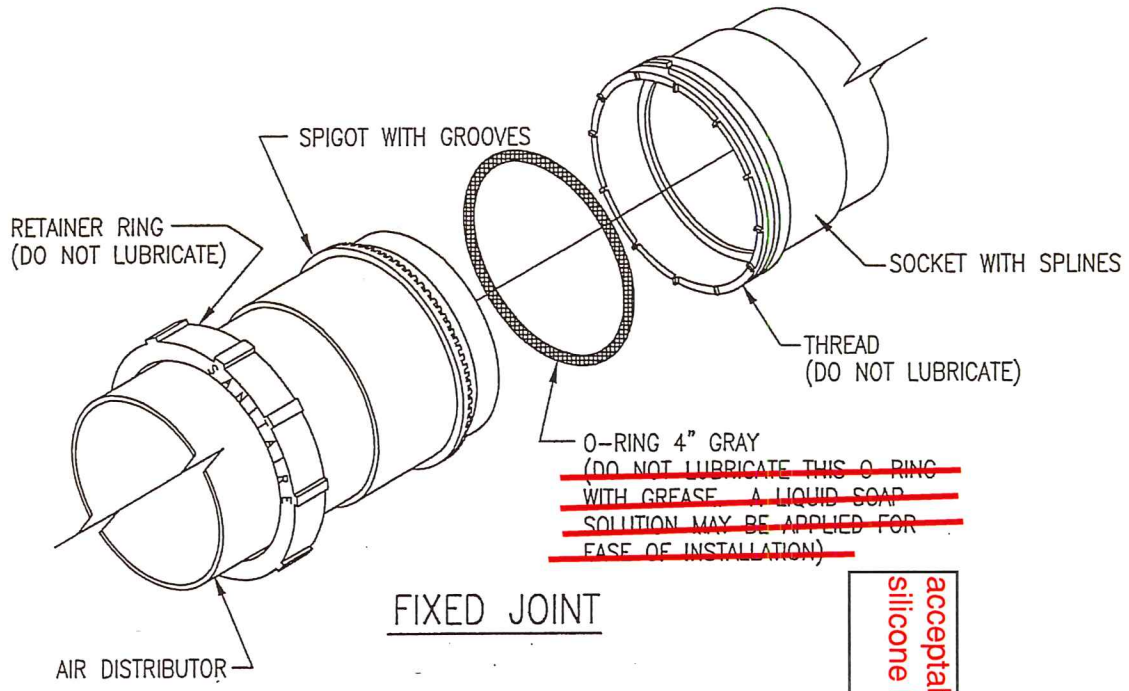
Every attempt has been made to insure locational dimensions of the supports are correct. However, after one line of air distributor anchors for any grid type have been installed, the locations must be checked for proper clearances by installing the supplied air headers. Spacing between lines must be checked for fit with the cross manifold and drain line. Any discrepancies or interferences must be brought to the attention of SANITAIRE prior to further installation.

The actual support anchor locations must be indexed from the centerline of the manifold. The actual accumulative dimensional error from the manifold to the anchor bolt must not exceed ± 3/4".

FIGURE 3

SANITAIRE®
WATER POLLUTION CONTROL CORP
MILWAUKEE, WISCONSIN

1/30/98



FIXED JOINT

FIGURE 4

acceptable to use silicone lubricant

FIXED JOINT DETAIL

SANITAIRE®
WATER POLLUTION CONTROL CORP
MILWAUKEE, WISCONSIN

SANITAIRE DECANTER ASSEMBLY



INSTALLATION, OPERATION, & MAINTENANCE MANUAL

Rev 1.3, 051910

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1.0 RECEIVING

The following installation instructions are divided into several different sections, depending on the weir length and style of the decanter(s) for your particular project. From the mechanical drawings provided, determine your decanter's weir length and style, and then follow the instructions in the appropriate section.

1.1 Unloading Instructions

INSPECT EQUIPMENT FOR ANY SHIPPING RELATED DAMAGE PRIOR TO UNLOADING AND REPORT ANY DAMAGE IMMEDIATELY TO SANITAIRE.

1.1.1 Small Decanters

Small decanters (1'-6" to 6'-0") are shipped with all accessories in enclosed shipping crates. Accessories are defined as connecting rods, actuator supports, hardware, etc. Typical packing arrangements for a pair of decanters are shown in Table 1:

Decanter Size	Packing Arrangement
1'-6"	One crate for both units and their accessories
3'-0" – 6'-0"	One crate for each decanter and its accessories

Table 1 - Small Decanter Packing Arrangements

The approximate weight of each crate is 500 to 900 pounds. The crate can be unloaded with a forklift or similar piece of equipment. ALWAYS OBSERVE SAFE UNLOADING PRACTICES.

NOTE: These are typical packing arrangements and may vary depending on project specifics. Please review the packing list upon receipt and contact Sanitaire if you believe a piece of equipment is missing.

1.1.2 Large Decanters

Large decanters (7'-6" and above) for projects in the United States, Canada, and Mexico are shipped via truck. Typically, a pair of decanters is shipped in an "A" frame arrangement as shown in Figure 1.



Figure 1 - "A"-Frame Decanters

Generally, a crane or large forklift is used to unload the decanters. Please refer to Table 2 below for assistance in determining what type of equipment will be used to unload the decanters at your particular jobsite.

Decanter Size	Approximate "A"-Frame Assembly Weight [lbs.]
7'-6"	2,150
10'-0"	2,650
12'-6"	3,100
15'-0"	3,900
17'-6"	4,350
20'-0"	4,900
22'-6"	5,400

25'-0"	5,900
27'-6"	6,350
30'-0"	6,900
35'-0"	9,950
40'-0"	11,250

Table 2 - Estimated "A"-Frame Assembly Weight

When unloading the units, ALWAYS use the lifting lugs on the decanters. NEVER lift the decanters by the trough. ALWAYS OBSERVE SAFE UNLOADING PRACTICES. The accessories for large decanters will be shipped in enclosed crates. Accessories are defined as connecting rods, actuator supports, hardware, etc.

NOTE: These are typical packing arrangements and may vary depending on project specifics. Please review the packing list upon receipt and contact Sanitaire if you believe a piece of equipment is missing.

1.1.3 Actuators

The decanter actuators are shipped in enclosed crates or boxes. Typically, two actuators are shipped in one box and can be unloaded with a forklift. The approximate weight of each crate is 300 to 600 pounds.

1.1.4 Containerized

Decanters and decanter actuators for overseas projects are generally shipped in open-top, or removable top, containers. Packing arrangements can vary widely due to the overall size of the decanters, as well as the project. Other equipment for the project may also be shipped in the same container as the decanters. Figure 2 below shows just one example of how container may be packed.

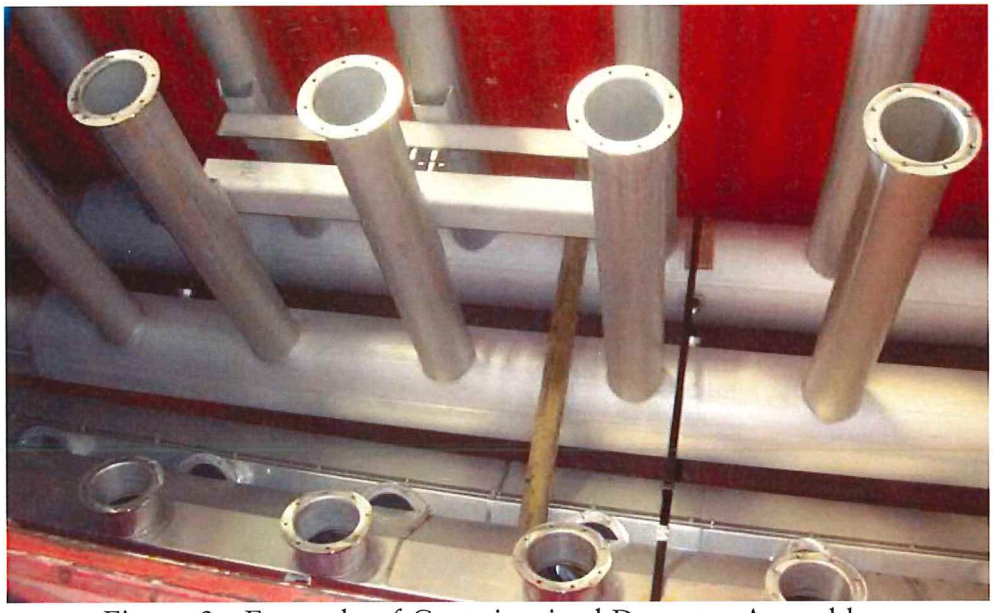


Figure 2 - Example of Containerized Decanter Assembly

Sanitaire can provide project specific pictures or unloading instructions upon request.

NOTE: Please review the packing list upon receipt and contact Sanitaire if you believe a piece of equipment is missing.

1.2 Site Storage

The decanters can be stored outside. They should be kept out of the way of construction equipment and other site activities to prevent damage. The decanters should also be kept on wooden blocks to prevent them from sinking into the ground. Leave the units packaged until they are ready to be installed.

The actuators should be left in their shipping crates until they are ready to be installed. Sanitaire recommends storing the actuators indoors, if possible. Otherwise, they should be covered with plastic and kept out of wet areas.

2.0 INSTALLATION

The following installation instructions are divided into several different sections, depending on the weir length and style of the decanter(s) for your particular project. From the mechanical drawings provided, determine your decanter's weir length and style, and then follow the instructions in the appropriate section.

PLEASE NOTE: The following installation instructions assume that the tank structure has been constructed in accordance with the contract specifications and drawings and is within the tolerances set forth in those documents. Sanitaire will not assume liability for undocumented deviations from the contract documents that result in the improper installation of the decanter assembly.

PLEASE NOTE: The use of the Sanitaire-supplied hardware is required for a proper installation. Refer to the Sanitaire drawings for a listing of hardware provided for this project. Sanitaire will not assume liability for unauthorized hardware substitutions.

2.1 Small Decanters

The following instructions apply to small decanters. Small decanters have weir lengths from 1'-6" through 6'-0". Refer to Drawing M20 for correct hardware size and location.

1. Ensure wall pipe plate flange is plumb. This is critical for maintaining a level weir.
2. Connect decanter to wall pipe flange. Leave bolts finger-tight and temporarily support decanter.
3. Install connecting rod to the decanter with the hardware provided. This is a bolted connection with double nuts. Refer to Figure 3 below.

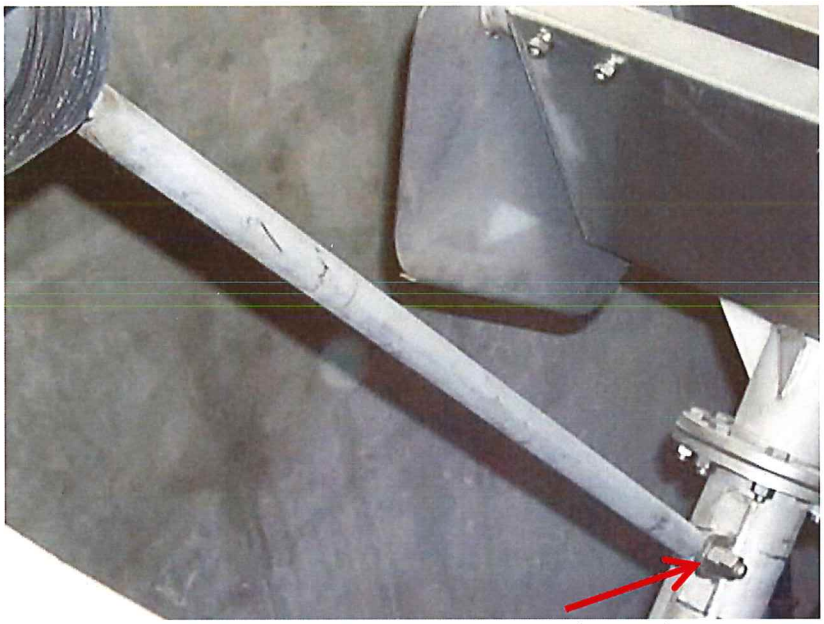


Figure 3 - Small Decanter Connecting Rod Attachment (2.1)

4. Using Sanitaire Drawing C10, mark the anchor bolt locations for the actuator support assembly on the walkway. Occasionally, a small decanter may be mounted to the face of the tank wall, instead of on the top of the tank.
5. Connect the actuator pivot bracket to the actuator (nuts and bolts) and actuator support base (pins and cotter pins) with the hardware provided. Refer to Figure 4 below. In addition, bolt the connecting rod flange to the actuator jackscrew flange. Leave the bolts finger-tight for now.

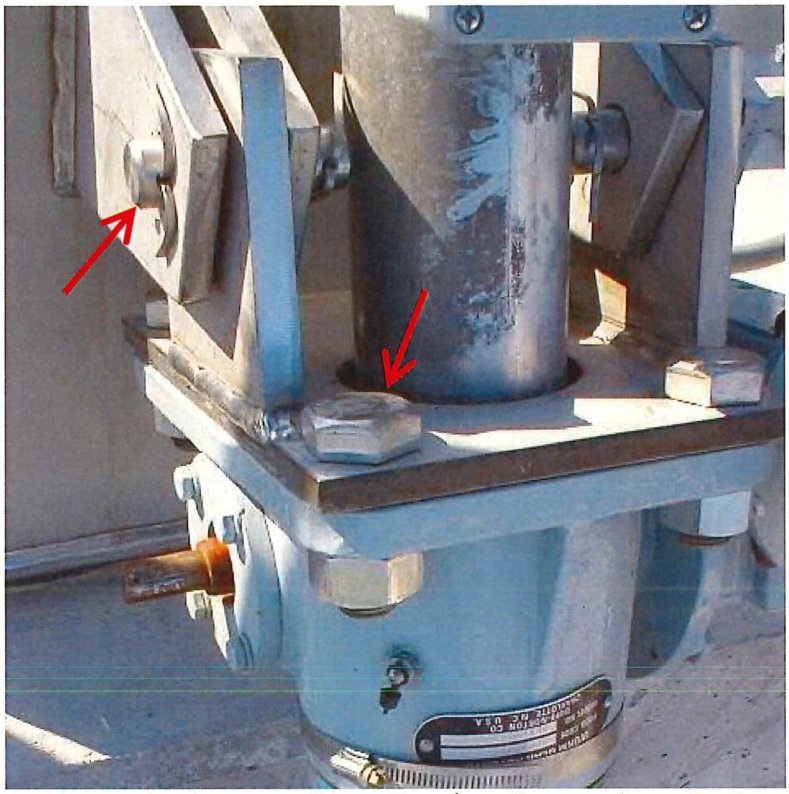


Figure 4 - Actuator Pivot Bracket Connections (2.1)

6. Line up the holes in the actuator support base with the marks made in Step 4. Stroke out the actuator by hand (rotate actuator flange counter-clockwise) as needed to line up the marks and support base holes.
7. Ensure that the actuator and decanter are aligned per the drawings. Adjust as needed to ensure proper alignment and operation. Once the alignment is verified, back-drill the holes for the anchors.
8. Disconnect the actuator from the connecting rod and actuator support base. Finish installing the actuator support base anchors per the anchor bolt manufacturer's instructions. Be sure to allow the necessary cure time.
9. Once the anchors are set, connect the actuator support assembly to the anchors. Be sure to use the plate washers provided (shown on Drawing M20) and shim the support 1" above the top of the tank. DO NOT GROUT THE ACTUATOR SUPPORT BASE UNTIL A SANITAIRE REPRESENTATIVE HAS CONFIRMED THE INSTALLATION AND LEVEL OF THE ASSEMBLY. Next, attach the actuator to the support base and connecting rod.
10. The weir is to be level at the Park and BWL positions, according to the following tolerances:
    - Weir length $\leq$ 5'-0" $\rightarrow$ $\pm$3/16"
    - Weir length = 6'-0" $\rightarrow$ $\pm$1/4"
11. Adjust the unit at the wall pipe and downcomer flanges, as necessary, to achieve these tolerances. Once the weir is level, wrench-tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field.
12. The unit is now completely installed and any temporary supports, rigging, etc. can be removed.

13. At this point, go to Sections 2.3 and 2.4 for the installation instructions of the limit switches and local decanter control station. Once those items are installed, return to Step 14 below and complete the installation.
14. Prior to operating the decanter assembly with power, unscrew the jackscrew cover pipe and push back the flexible boot (loosen the upper band clamp). While the unit is operating, do not allow the mechanical stops to come in contact with the actuator housing. This may damage the unit and void the warranty. The top stop nut is shown in Figure 5 below.

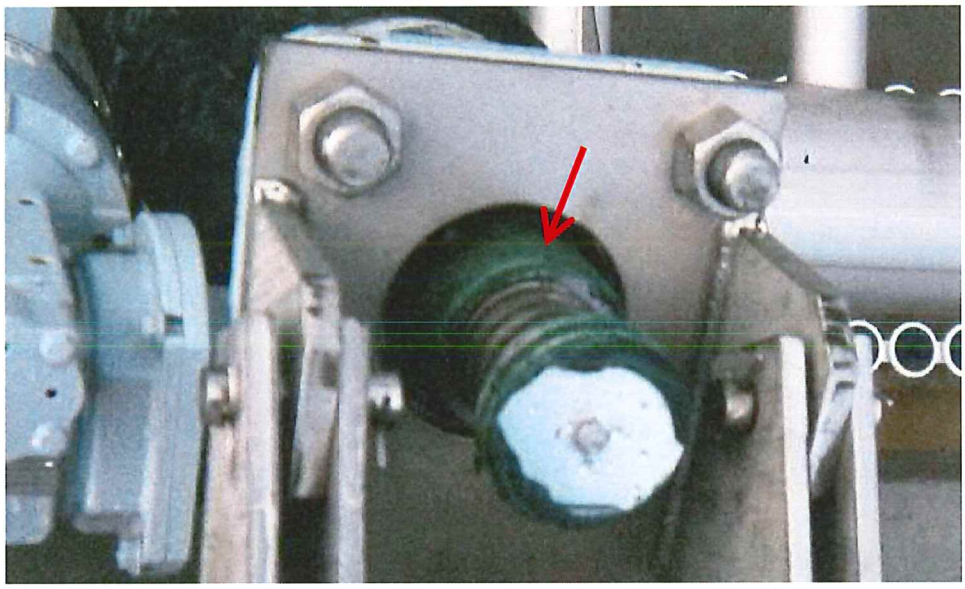


Figure 5 - Stop Nut on Actuator Screw (2.1)

15. Using the local decanter control panel, raise and lower the decanter to verify the weir level tolerances at the Park and BWL positions.

The decanter assembly is now ready to be commissioned by a Sanitaire representative.

2.2 Large Decanters

The following installation instructions are divided into several different sections, depending on the weir length and style of the decanter(s) for your particular project. From the mechanical drawings provided, determine your decanter's weir length and style, and then follow the instructions in the appropriate section.

2.2.1 Split Downcomers

The installation procedure of a decanter with split (flanged) downcomers will be identical to one of the following sections after the decanter is fully assembled. Once the following steps are completed to assemble the decanter, go to one of the following sections based on whether the decanter is a wall design or elbow design. Assemble the decanter sub-assemblies per the following instructions.

1. Identify each of the decanter sub-assemblies. One is the collector pipe sub-assembly and the other is weir sub-assembly. Each sub-assembly is match marked with a letter (A, B, C, etc.). In addition, refer to Sanitaire Drawing M20 for the correct hardware and gasket size.
2. Align each sub-assembly on a flat surface using blocking as necessary so the units are not subjected to any twisting or other misalignment. Leave all shipping restraints in place at this point.
3. Using the hardware provided, bolt the sub-assemblies together and wrench-tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field.

Proceed to the correct section based on the style of your decanter assembly to complete the installation of the decanter assembly.

2.2.2 Single Unit – Wall Design (Effluent Box Discharge)

Please note the following items before beginning installation:

a. The wall plate, pipe stub, and bearing ring assembly are pre-assembled at the factory and identified as a matched set. DO NOT DISASSEMBLE OR INTERCHANGE COMPONENTS.

b. The Forsheda seal (at the seal and bearing assembly) is covered at the factory with a black wire loom. See Figure 6 below. This protects the seal from solar UV radiation. Leave the wire loom in place until the unit is commissioned or submerged in water. When this cover is removed by an authorized Sanitaire representative, the seal area will be cleaned and the seal will be pushed into place.



Figure 6 – Forsheda Seal Protection (2.2.2)

1. Clean and prime the back of the wall plate and concrete effluent box per the elastomeric sealant manufacturer's instructions. Apply a ¾" bead of sealant between the wall plate and concrete wall prior to installing the wall plate. Sealant must be applied around the perimeter of the wall plate and around each bolt hole.
2. Position the wall plate assembly against the effluent box at the collector centerline elevation shown on the drawings provided and temporarily hold it in place. The four slotted holes in the wall plate should be vertical. Refer to Figure 7 below.

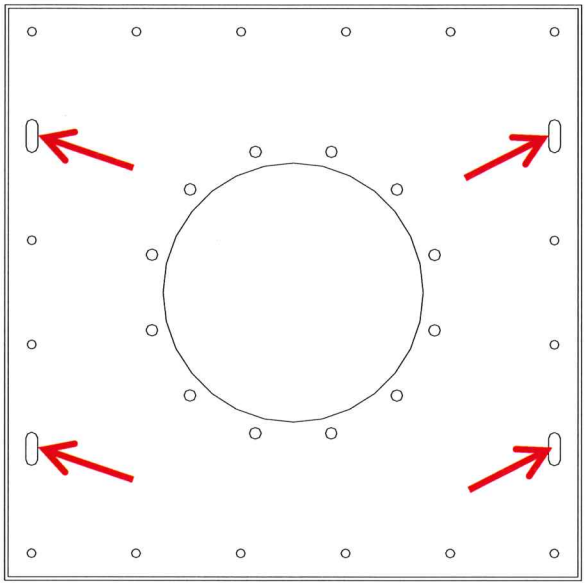


Figure 7 - Slotted Holes in Wall Plate (2.2.2)

3. Using the wall plate as a template, install one (1) expansion anchor in the center of each of the four slotted holes in the wall plate. The remaining anchors will be installed later.
4. You are now ready to install the decanter itself. Using the lifting lugs on the decanter, lower it into position with a crane or similar piece of equipment. While still attached to the crane, mate up the collector pipe flange with the stub pipe flange, including gasket, and bolt together with the hardware provided.
5. With the decanter near level, position the pedestal support and proceed with installing the adhesive anchors per the anchor bolt manufacturer's instructions. Temporary shims may be necessary to hold the decanter in position while the adhesive anchors cure. Once the anchors are set, use the jacking nuts and lower plate washers (refer to Drawing M20) to ensure that the collector centerline elevation is correct and level per the Sanitaire drawings. DO NOT GROUT THE PEDESTAL SUPPORT UNTIL A SANITAIRE REPRESENTATIVE HAS CONFIRMED THE INSTALLATION AND LEVEL OF THE UNIT.
6. Once the collector centerline elevation is verified, ensure the nuts on the four wall plate anchors are tight as well as the nuts on the pedestal support anchors.
7. Using Sanitaire Drawing C10 and/or C11, mark the anchor bolt locations for the actuator support on the top of the walkway.
8. Install the connecting rod to the decanter with the pin and cotter pins provided. Refer to Figure 8 below.

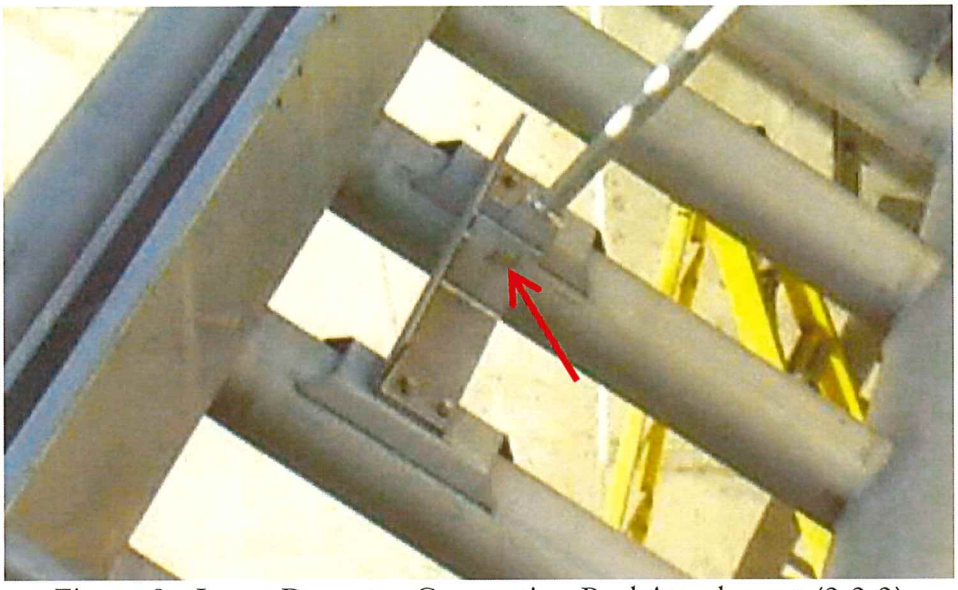


Figure 8 - Large Decanter Connecting Rod Attachment (2.2.2)

9. Connect the actuator pivot bracket to the actuator (nuts and bolts) and actuator support base (pins and cotter pins) with the hardware provided. Refer to Figure 9 below. In addition, bolt the connecting rod flange to the actuator jackscrew flange. Leave the bolts finger-tight for now.

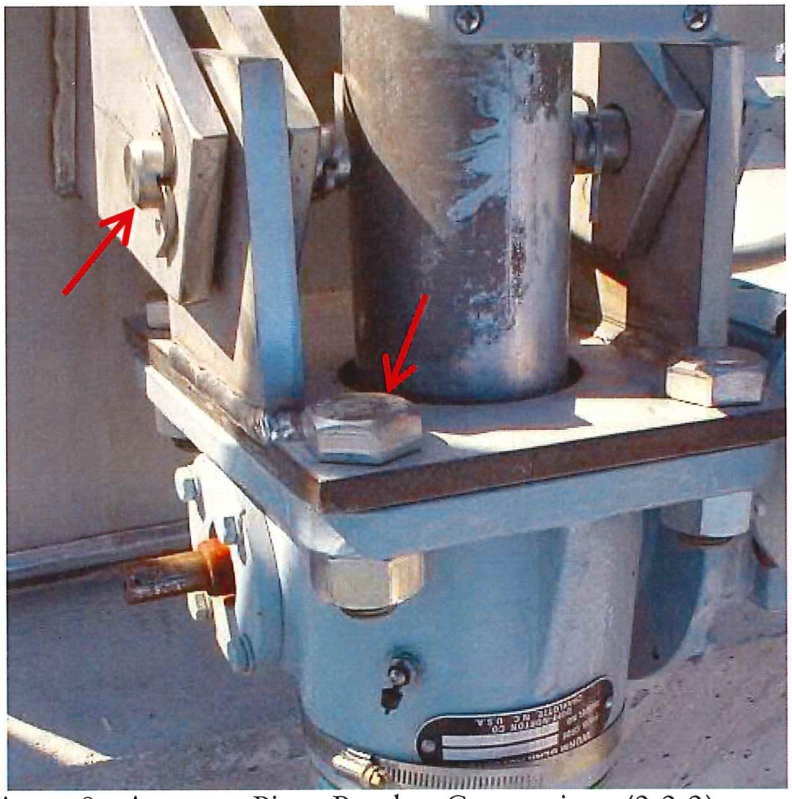


Figure 9 - Actuator Pivot Bracket Connections (2.2.2)

10. Line up the holes in the actuator support base with the marks made in Step 7. Stroke out the actuator by hand (rotate actuator flange counter-clockwise) as needed to line up the marks and support base holes.

11. Ensure that the actuator and decanter are aligned per the drawings. Adjust as needed to ensure proper alignment and operation. Once the alignment is verified, back-drill the holes for the anchors.
12. Disconnect the actuator from the connecting rod and actuator support base. Finish installing the actuator support base anchors per the anchor bolt manufacturer's instructions. Be sure to allow the necessary cure time and use the plate washers provided. Shim the actuator support base 1" above the top of the tank to allow for grouting and leveling. DO NOT GROUT THE ACTUATOR SUPPORT BASE UNTIL A SANITAIRE REPRESENTATIVE HAS CONFIRMED THE INSTALLATION AND LEVEL OF THE ASSEMBLY.
13. Once the anchors are set, permanently connect the actuator to the connecting rod and actuator support base. Wrench-tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field.
14. Install the remaining expansion anchors at the wall plate.
15. The unit is now completely installed and any temporary supports, rigging, etc. can be removed.
16. At this point, go to Sections 2.3 and 2.4 for the installation instructions of the limit switches and local decanter control station. Once those items are installed, return to Step 17 below and complete the installation.
17. Prior to operating the decanter assembly with power, unscrew the jackscrew cover pipe and push back the flexible boot (loosen the upper band clamp). While the unit is operating, do not allow the mechanical stops to come in contact with the actuator housing. This may damage the unit and void the warranty. The top stop nut is shown in Figure 10 below.

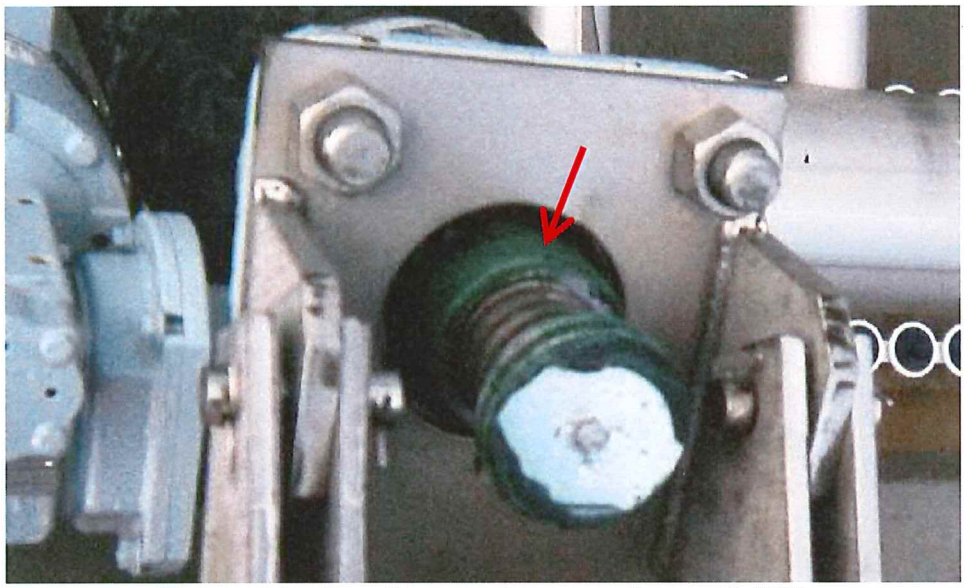


Figure 10 - Stop Nut on Actuator Screw (2.2.2)

18. Using the local decanter control panel, raise and lower the decanter to verify the weir level tolerances at the Park and BWL positions. The level at each position has the following weir tolerance:
    - ±3/8"

19. Adjust the decanter at the bearing pedestal using the jacking nuts, as necessary, to achieve the specified tolerance.
20. Reinstall the actuator boot and jackscrew cover pipe. **Apply teflon tape or pipe dope to the cover pipe threads to prevent the ingress of water.**

The decanter assembly is now ready to be commissioned by a Sanitaire representative.

2.2.3 Single Unit – Elbow Design

Please note the following items before beginning installation:

a. The pipe stub and bearing ring assembly are pre-assembled at the factory and identified as a matched set. DO NOT DISASSEMBLE OR INTERCHANGE COMPONENTS.

b. The Forsheda seal (at the seal and bearing assembly) is covered at the factory with a black wire loom. See Figure 11 below. This protects the seal from solar UV radiation. Leave the wire loom in place until the unit is commissioned or submerged in water. When this cover is removed by an authorized Sanitaire representative, the seal area will be cleaned and the seal will be pushed into place.



Figure 11 - Forsheda Seal Protection (2.2.3)

1. Ensure wall pipe plate flange is plumb. This is critical for maintaining a level weir.
2. Bolt the discharge elbow to the wall pipe, including gasket. Refer to Drawing M20 for the correct hardware and gasket size. If the wall pipe is provided by others, then the gasket and hardware is also provided by others. Ensure the elbow remains level and tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field. Refer to Figure 12 after Step 3.
3. Bolt the seal and bearing assembly to the discharge elbow, including gasket. Refer to Sanitaire drawing M20 for the correct hardware and gasket size. Tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field. Remove any temporary shipping restraints and ensure that the dimension from the face of the bearing ring flange to the face of the wall pipe flange is 7 ½", as shown on Drawing M20. Refer to Figure 12 below.

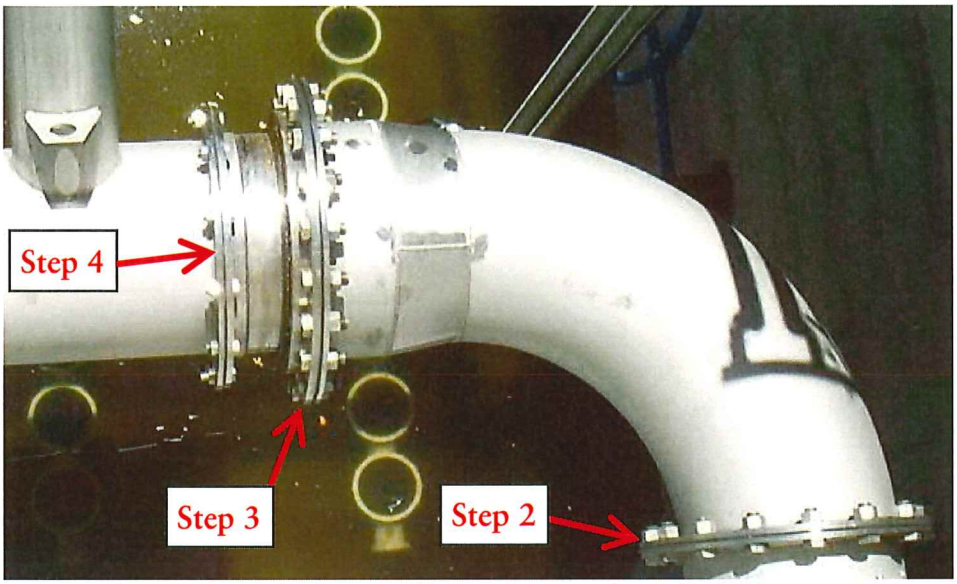


Figure 12 - Discharge Elbow Connections (2.2.3)

4. You are now ready to install the decanter itself. Using the lifting lugs on the decanter, lower it into position with a crane or similar piece of equipment. While still attached to the crane, mate up the collector pipe flange with the pipe stub flange and bolt together with the hardware and gasket provided. Do not tighten the hardware at this time. Refer to Figure 12 above.
5. With the decanter near level, position the pedestal support and proceed with installing the adhesive anchors per the anchor bolt manufacturer's instructions. Temporary shims may be necessary to hold the decanter in position while the adhesive anchors cure. Once the anchors are set, use the jacking nuts and lower plate washers (refer to Drawing M20) to ensure that the collector centerline elevation is correct and level per the Sanitaire drawings. DO NOT GROUT THE PEDESTAL SUPPORT UNTIL A SANITAIRE REPRESENTATIVE HAS CONFIRMED THE INSTALLATION AND LEVEL OF THE UNIT.
6. Once the collector centerline elevation is verified, ensure the hardware at the collector pipe flange is tight, as well as the nuts on the pedestal support anchors.
7. Using Sanitaire Drawing C10 and/or C11, mark the anchor bolt locations for the actuator support on the top of the walkway.
8. Install the connecting rod to the decanter with the hardware provided by Sanitaire. Refer to Figure 13 below.

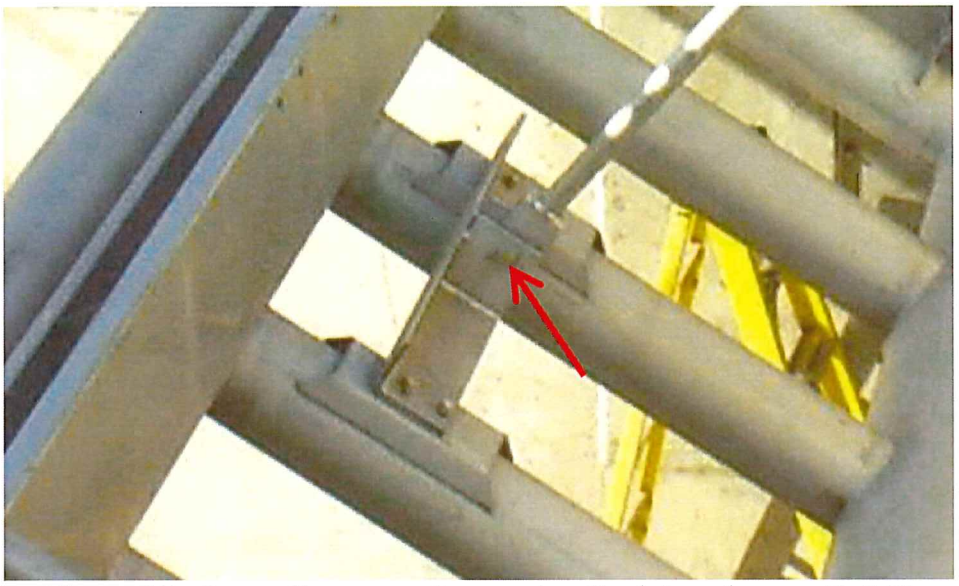


Figure 13 - Large Decanter Connecting Rod Attachment (2.2.3)

9. Connect the actuator pivot bracket to the actuator (nuts and bolts) and actuator support base (pins and cotter pins) with the hardware provided by Sanitaire. Refer to Figure 14 below. In addition, bolt the connecting rod flange to the actuator jackscrew flange. Leave the bolts finger-tight for now.

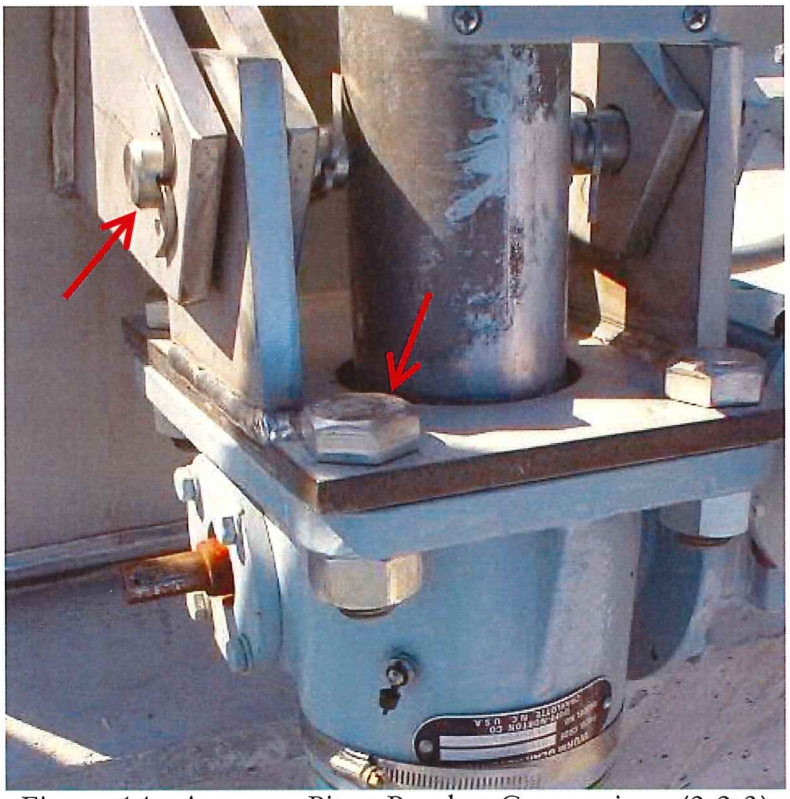


Figure 14 - Actuator Pivot Bracket Connections (2.2.3)

10. Line up the holes in the actuator support base with the marks made in Step 7. Stroke out the actuator by hand (rotate actuator flange counter-clockwise) as needed to line up the marks and support base holes.

11. Ensure that the actuator and decanter are aligned per the drawings. Adjust as needed to ensure proper alignment and operation. Once the alignment is verified, back-drill the holes for the anchors.
12. Disconnect the actuator from the connecting rod and actuator support base. Finish installing the actuator support base anchors per the anchor bolt manufacturer's instructions. Be sure to allow the necessary cure time and use the plate washers provided. Shim the actuator support base 1" above the top of the tank to allow for grouting and leveling. DO NOT GROUT THE ACTUATOR SUPPORT BASE UNTIL A SANITAIRE REPRESENTATIVE HAS CONFIRMED THE INSTALLATION AND LEVEL OF THE ASSEMBLY.
13. Once the anchors are set, permanently connect the actuator to the connecting rod and actuator support base. Wrench-tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field.
14. The unit is now completely installed and any temporary supports, rigging, etc. can be removed.
15. At this point, go to Sections 2.3 and 2.4 for the installation instructions of the limit switches and local decanter control station. Once those items are installed, return to Step 16 below and complete the installation.
16. Prior to operating the decanter assembly with power, unscrew the jackscrew cover pipe and push back the flexible boot (loosen the upper band clamp). While the unit is operating, do not allow the mechanical stops to come in contact with the actuator housing. This may damage the unit and void the warranty. The top stop nut is shown in Figure 15 below.

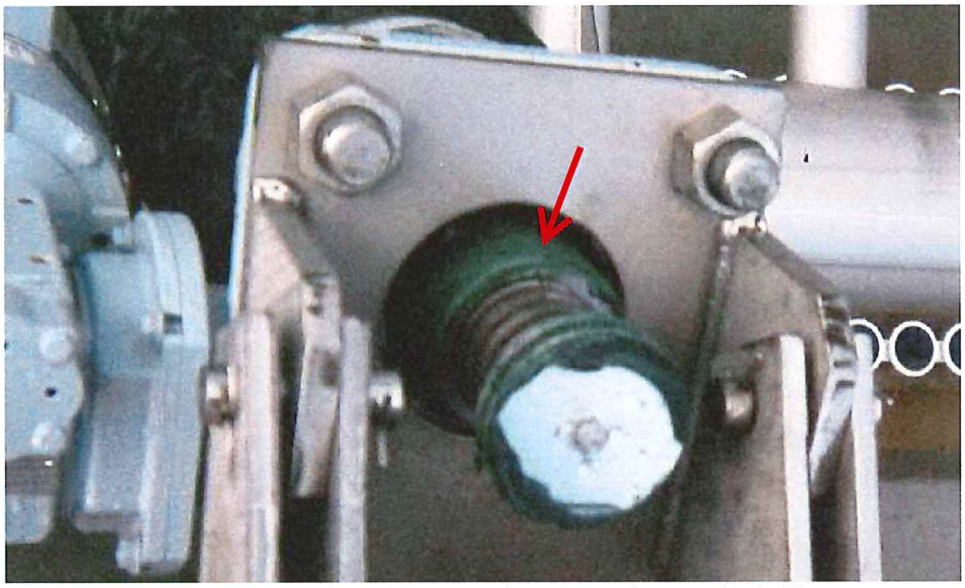


Figure 15 - Stop Nut on Actuator Screw (2.2.3)

17. Using the local decanter control panel, raise and lower the decanter to verify the weir level tolerances at the Park and BWL positions. The level at each position has the following weir tolerance:
    - ±3/8"
18. Adjust the decanter at the bearing pedestal using the jacking nuts, as necessary, to achieve the specified tolerance.

19. Reinstall the actuator boot and jackscrew cover pipe. **Apply teflon tape or pipe dope to the cover pipe threads to prevent the ingress of water.**

The decanter assembly is now ready to be commissioned by a Sanitaire representative.

2.2.4 Dual units – Wall Design (Effluent Box Discharge)

Please note the following items before beginning installation:

a. Each dual decanter assembly has been assembled at the factory to ensure proper operation and level between each weir. As a result, each decanter and each end of the truss is match marked with a letter (A, B, C, etc.). Locate these markings and match the decanters with its correct truss. FAILURE TO DO SO MAY RESULT IN RE-INSTALLING THE UNITS IN THE CORRECT MANNER.

b. Each wall plate, pipe stub, and bearing ring assembly are pre-assembled at the factory and identified as a matched set. DO NOT DISASSEMBLE OR INTERCHANGE COMPONENTS.

c. The Forsheda seal (at the seal and bearing assembly) is covered at the factory with a black wire loom. See Figure 16 below. This protects the seal from solar UV radiation. Leave the wire loom in place until the unit is commissioned or submerged in water. When this cover is removed by an authorized Sanitaire representative, the seal area will be cleaned and the seal will be pushed into place.



Figure 16 - Forsheda Seal Protection (2.2.4)

Apply Steps 1 through 6 to each decanter.

1. Clean and prime the back of the wall plate and concrete effluent box per the elastomeric sealant manufacturer's instructions. Apply a ¾" bead of sealant between the wall plate and concrete wall prior to installing the wall plate. Sealant must be applied around the perimeter of the wall plate and around each bolt hole.
2. Position the wall plate assembly against the effluent box at the collector centerline elevation shown on the drawings provided and temporarily hold it in place. The four slotted holes in the wall plate should be vertical. Refer to Figure 17 below.

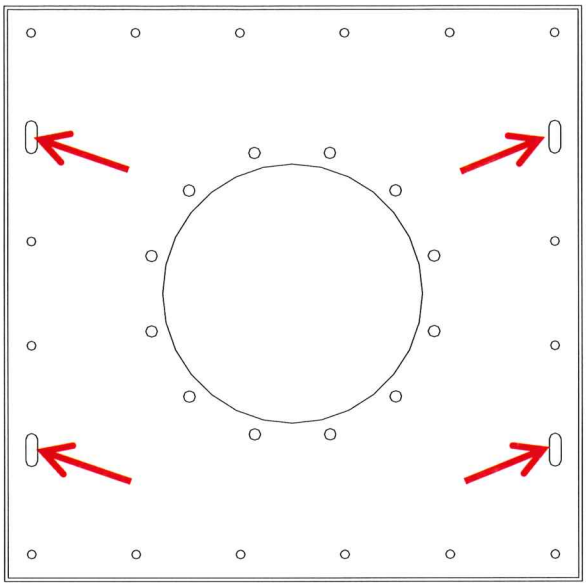


Figure 17 - Slotted Holes in Wall Plate (2.2.4)

3. Using the wall plate as a template, install one (1) expansion anchor in the center of each of the four slotted holes in the wall plate. The remaining anchors will be installed later.
4. You are now ready to install the decanter itself. Using the lifting lugs on the decanter, lower it into position with a crane or similar piece of equipment. While still attached to the crane, mate up the collector pipe flange with the stub pipe flange, including gasket, and bolt together with the hardware provided.
5. With the decanter near level, position the pedestal support and proceed with installing the adhesive anchors per the anchor bolt manufacturer's instructions. Temporary shims may be necessary to hold the decanter in position while the adhesive anchors cure. Once the anchors are set, use the jacking nuts and lower plate washers (refer to Drawing M20) to ensure that the collector centerline elevation is correct and level per the Sanitaire drawings. DO NOT GROUT THE PEDESTAL SUPPORT UNTIL A SANITAIRE REPRESENTATIVE HAS CONFIRMED THE INSTALLATION AND LEVEL OF THE UNIT.
6. Once the collector centerline elevation is verified, ensure the nuts on the four wall plate anchors are tight as well as the nuts on the pedestal support anchors.
7. You are now ready to install the truss. Bring both decanters into the same position relative to each other; a position approximately half way between Park and BWL positions is typical.
8. Align both decanters and temporarily support them (4"x4" wood columns) at each end of the each decanter. Avoid twisting the units and resting any temporary supports on any installed equipment, such as the air distributors for the aeration system.
9. Attach the truss to each decanter using the connecting pins and cotter pins supplied by Sanitaire. Refer to Figure 18 below. Ensure that the cotter pins are fully installed.

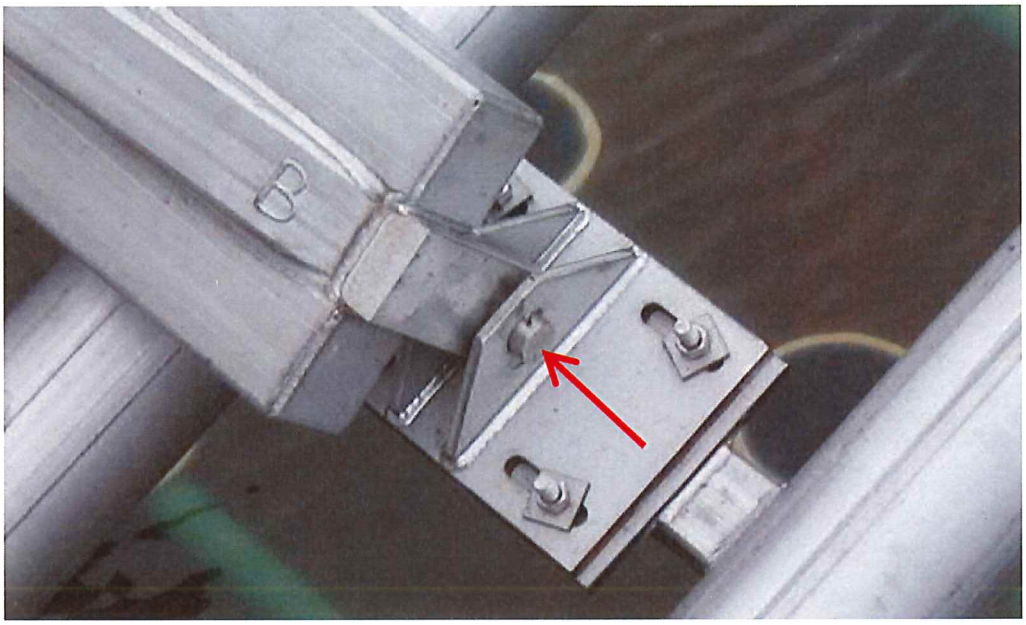


Figure 18 - Truss Connection to Decanter (2.2.4)

10. Attach the dual decanter connecting bracket to both decanters using the hardware supplied. Refer to Figure 19 below. Wrench-tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field.

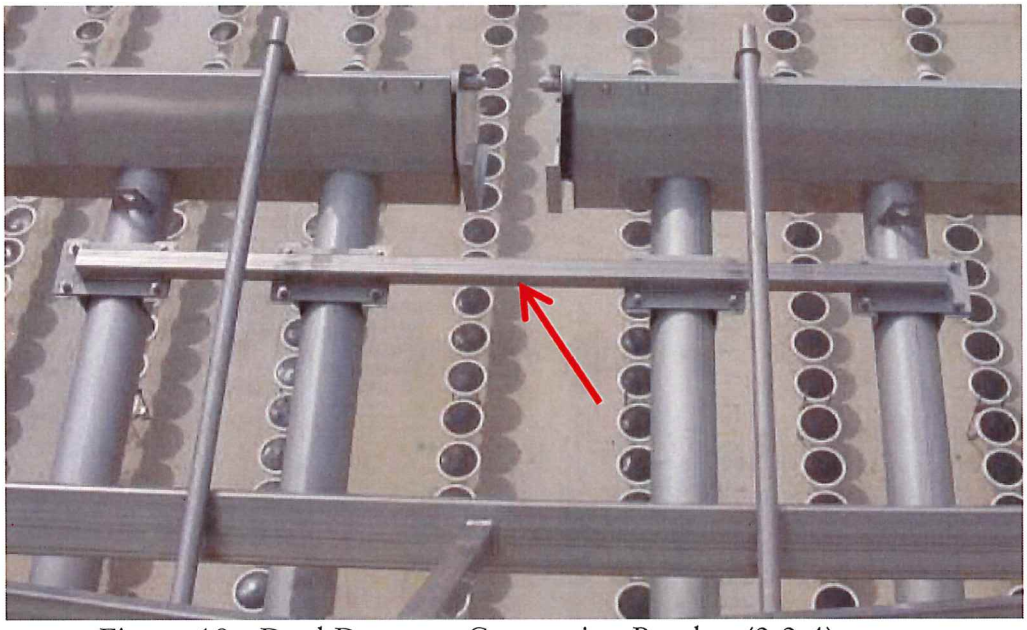


Figure 19 - Dual Decanter Connecting Bracket (2.2.4)

11. Using Sanitaire Drawing C10 and/or C11, mark the anchor bolt locations for the actuator support at the top of the walkway.
12. Connect the actuator pivot bracket to the actuator (nuts and bolts) and actuator support base (pins and cotter pins) with the hardware provided. Refer to Figure 20 below. In addition, bolt the connecting rod flange to the actuator jackscrew flange. Leave the bolts finger-tight for now.

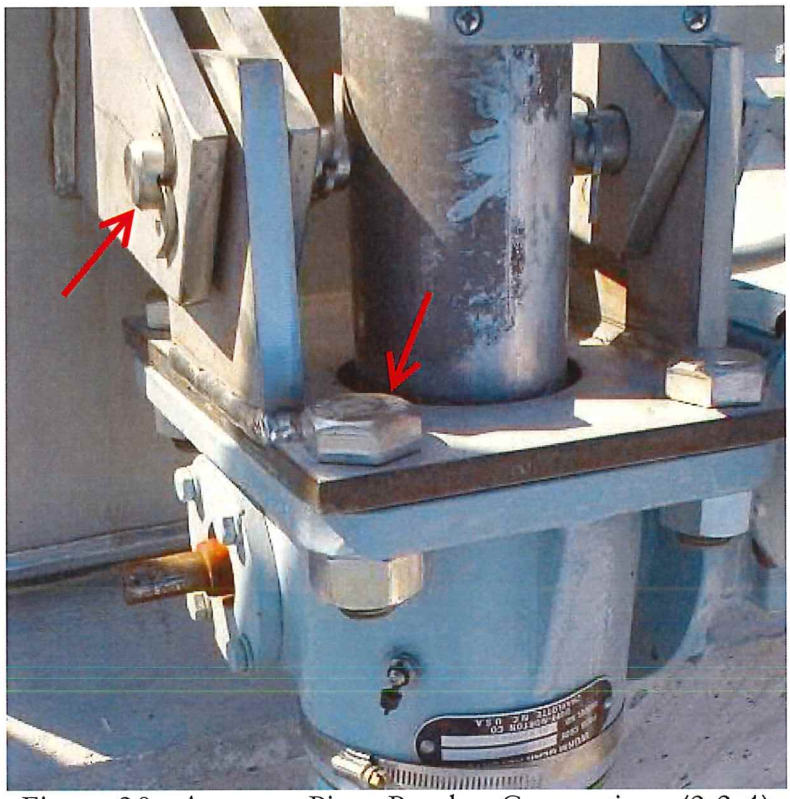


Figure 20 - Actuator Pivot Bracket Connections (2.2.4)

13. Line up the holes in the actuator support base with the marks made in Step 11. Stroke out the actuator by hand (rotate actuator flange counter-clockwise) as needed to line up the marks and support base holes.
14. Ensure that the actuator and decanter are aligned per the drawings. Adjust as needed to ensure proper alignment and operation. Once the alignment is verified, back-drill the holes for the anchors.
15. Disconnect the actuator from the truss and actuator support base. Finish installing the actuator support base anchors per the anchor bolt manufacturer's instructions. Be sure to allow the necessary cure time. Shim the actuator support base 1" above the top of the tank to allow for grouting and leveling. DO NOT GROUT THE ACTUATOR SUPPORT BASE UNTIL A SANITAIRE REPRESENTATIVE HAS CONFIRMED THE INSTALLATION AND LEVEL OF THE ASSEMBLY.
16. Once the anchors are set, permanently connect the actuator to the truss and actuator support base. Wrench-tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field.
17. Install the remaining expansion anchors at the wall plates.
18. The unit is now completely installed and any temporary supports, rigging, etc. can be removed.
19. At this point, go to Sections 2.3 and 2.4 for the installation instructions of the limit switches and local decanter control station. Once those items are installed, return to Step 20 below and complete the installation.
20. Prior to operating the decanter assembly with power, unscrew the jackscrew cover pipe and push back the flexible boot (loosen the upper band clamp). While the unit is operating, do not allow the mechanical stops to come in contact with the

actuator housing. This may damage the unit and void the warranty. The top stop nut is shown in Figure 21 below.

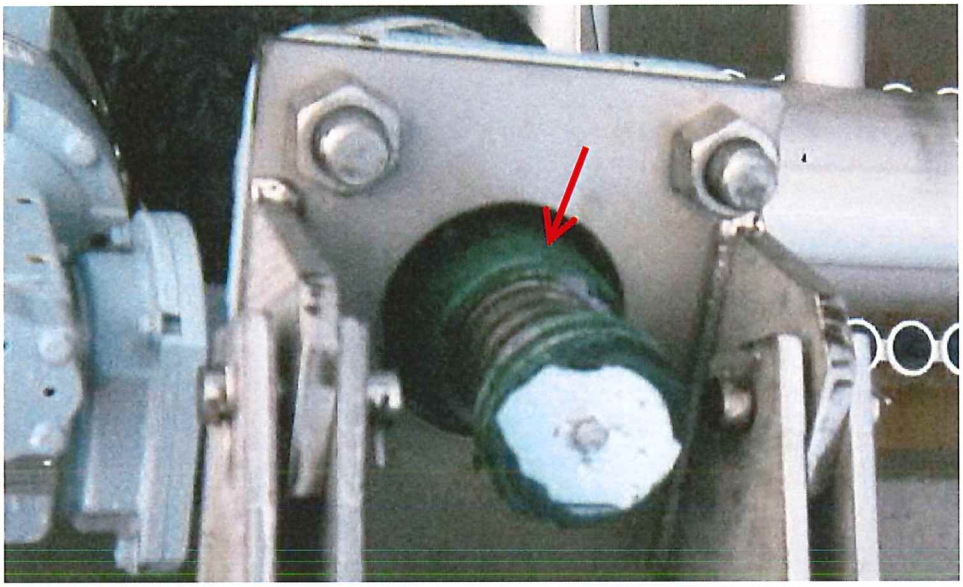


Figure 21 - Stop Nut on Actuator Screw (2.2.4)

21. Using the local decanter control panel, raise and lower the decanter to verify the weir level tolerances at the Park and BWL positions. The level at <u>each</u> position has the following weir tolerance:
    - ±3/8"
22. Adjust the decanter at the bearing pedestal using the jacking nuts, as necessary, to achieve the specified tolerance.
23. Reinstall the actuator boot and jackscrew cover pipe. **Apply teflon tape or pipe dope to the cover pipe threads to prevent the ingress of water.**

The decanter assembly is now ready to be commissioned by a Sanitaire representative.

2.2.5 Dual units – Elbow design

Please note the following items before beginning installation:

a. Each dual decanter assembly has been assembled at the factory to ensure proper operation and level between each weir. As a result, each decanter and each end of the truss is match marked with a letter (A, B, C, etc.). Locate these markings and match the decanters with its correct truss. FAILURE TO DO SO MAY RESULT IN RE-INSTALLING THE UNITS IN THE CORRECT MANNER.

b. The pipe stub and bearing ring assembly are pre-assembled at the factory and identified as a matched set. DO NOT DISASSEMBLE OR INTERCHANGE COMPONENTS.

c. The Forsheda seal (at the seal and bearing assembly) is covered at the factory with a black wire loom. See Figure 22 below. This protects the seal from solar UV radiation. Leave the wire loom in place until the unit is commissioned or submerged in water. When this cover is removed by an authorized Sanitaire representative, the seal area will be cleaned and the seal will be pushed into place.



Figure 22 - Forsheda Seal Protection (2.2.5)

Apply Steps 1 through 6 to each decanter.

1. Ensure wall pipe plate flange is plumb. This is critical for maintaining a level weir.
2. Bolt the discharge elbow to the wall pipe, including gasket. Refer to Drawing M20 for the correct hardware and gasket size. If the wall pipe is provided by others, then the gasket and hardware is also provided by others. Ensure the elbow remains level and tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field. Refer to Figure 23 after Step 3.
3. Bolt the seal and bearing assembly to the discharge elbow, including gasket. Refer to Sanitaire drawing M20 for the correct hardware and gasket size. Tighten all

hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field. Remove any temporary shipping restraints and ensure that the dimension from the face of the bearing ring flange to the face of the wall pipe flange is 7 ½", as shown on Drawing M20. Refer to Figure 23 below.

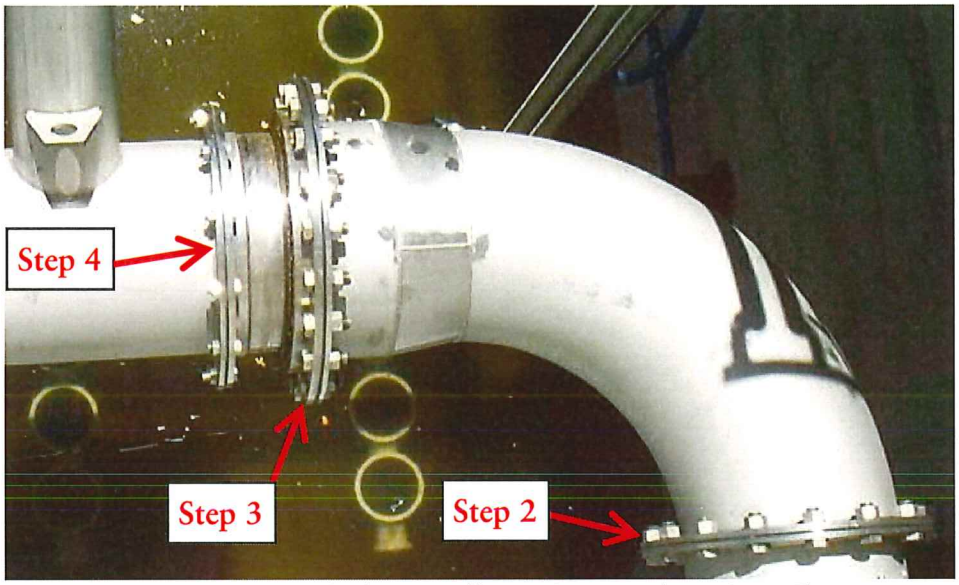


Figure 23 - Discharge Elbow Connections (2.2.5)

4. You are now ready to install the decanter itself. Using the lifting lugs on the decanter, lower it into position with a crane or similar piece of equipment. While still attached to the crane, mate up the collector pipe flange with the pipe stub flange and bolt together with the hardware and gasket provided. Do not tighten the hardware at this time. Refer to Figure 23 above.
5. With the decanter near level, position the pedestal support and proceed with installing the adhesive anchors per the anchor bolt manufacturer's instructions. Temporary shims may be necessary to hold the decanter in position while the adhesive anchors cure. Once the anchors are set, use the jacking nuts and lower plate washers (refer to Drawing M20) to ensure that the collector centerline elevation is correct and level per the ABJ drawings. DO NOT GROUT THE PEDESTAL SUPPORT UNTIL A SANITAIRE REPRESENTATIVE HAS CONFIRMED THE INSTALLATION AND LEVEL OF THE UNIT.
6. Once the collector centerline elevation is verified, ensure the hardware at the collector pipe flange is tight, as well as the nuts on the pedestal support anchors.
7. You are now ready to install the truss. Bring both decanters into the same position relative to each other. A position approximately half way between Park and BWL positions is typical.
8. Align both decanters and temporarily support them (4"x4" wood columns) at each end of the each decanter. Avoid twisting the units and resting any temporary supports on any installed equipment, such as the air distributors for the aeration system.
9. Attach the truss to each decanter using the connecting pins and cotter pins supplied by Sanitaire. Refer to Figure 24 below. Ensure that the cotter pins are fully installed.

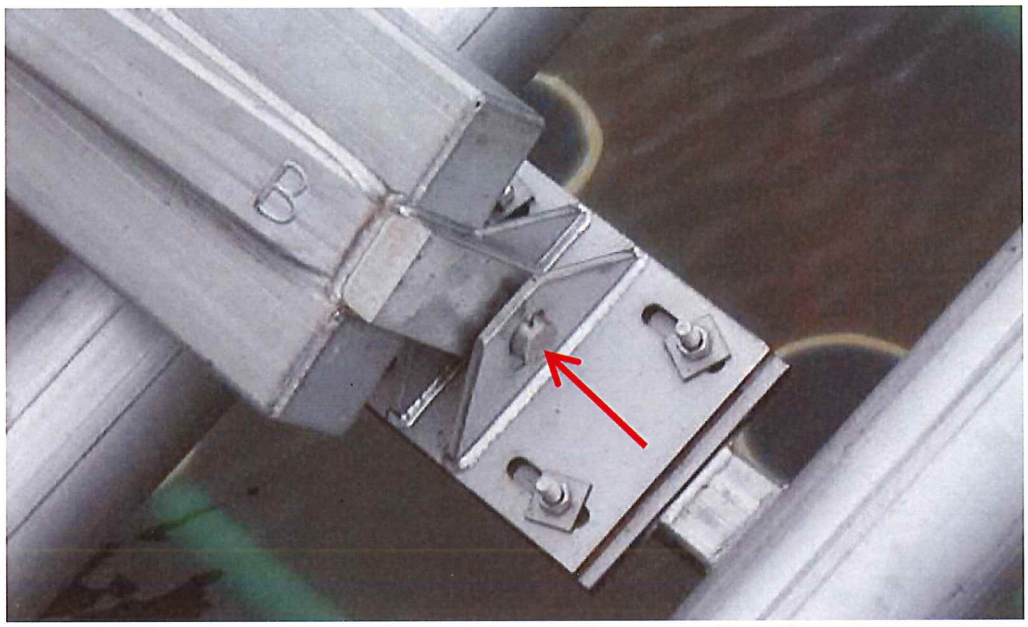


Figure 24 - Truss Connection to Decanter (2.2.5)

10. Attach the dual decanter connecting bracket to both decanters using the hardware supplied by Sanitaire. Refer to Figure 25 below. Wrench-tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field.

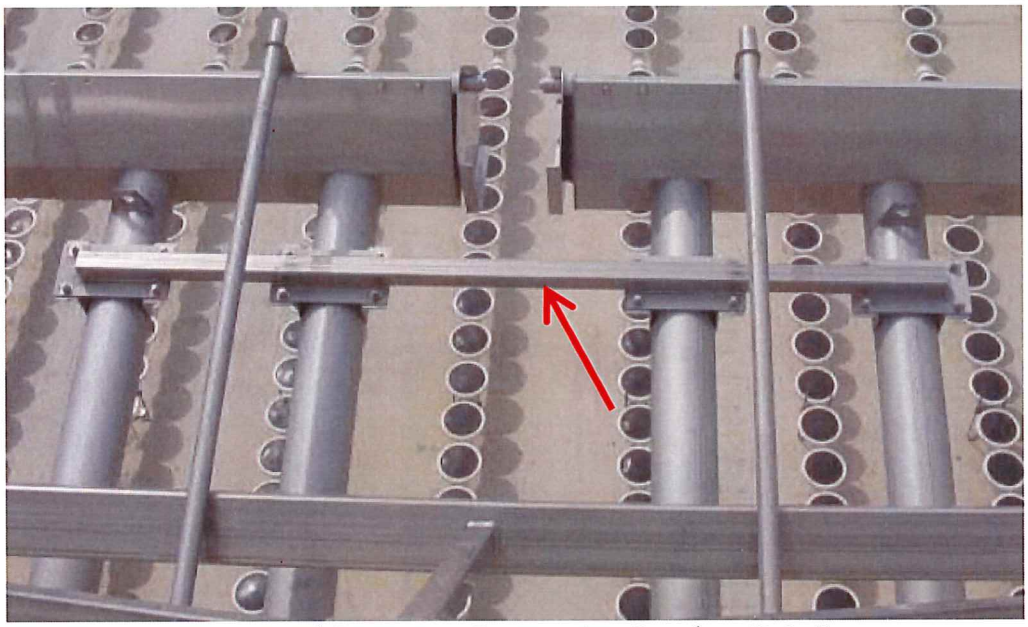


Figure 25 - Dual Decanter Connecting Bracket (2.2.5)

11. Using Sanitaire Drawing C10 and/or C11, mark the anchor bolt locations for the actuator support on the top of the walkway.
12. Connect the actuator pivot bracket to the actuator (nuts and bolts) and actuator support base (pins and cotter pins) with the hardware provided by Sanitaire. Refer to Figure 26 below. In addition, bolt the connecting rod flange to the actuator jackscrew flange. Leave the bolts finger-tight for now.

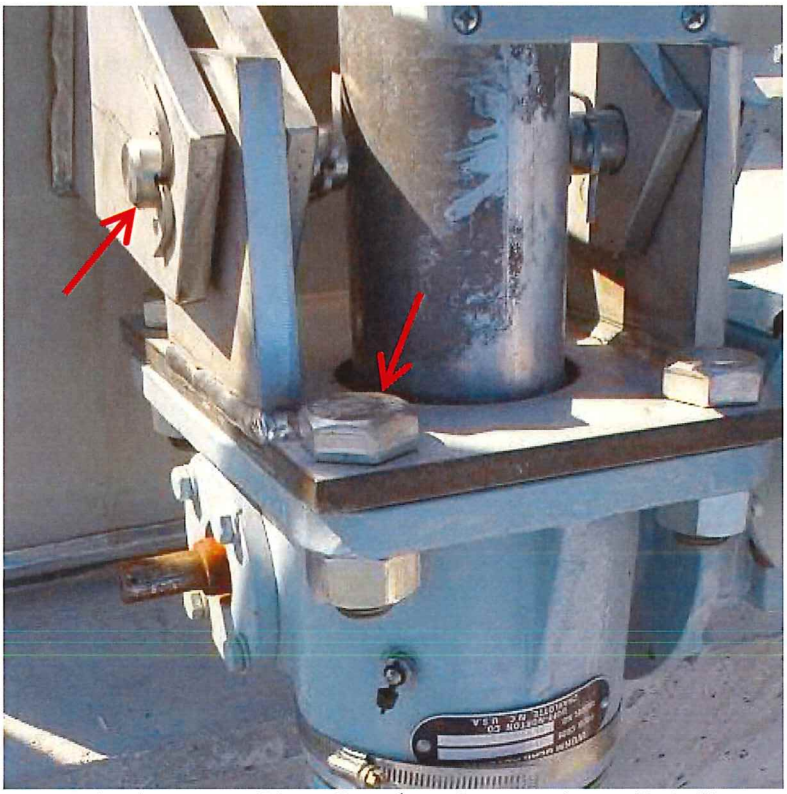


Figure 26 - Actuator Pivot Bracket Connections (2.2.5)

13. Line up the holes in the actuator support base with the marks made in Step 11. Stroke out the actuator by hand (rotate actuator flange counter-clockwise) as needed to line up the marks and support base holes.
14. Ensure that the actuator and decanter are aligned per the drawings. Adjust as needed to ensure proper alignment and operation. Once the alignment is verified, back-drill the holes for the anchors.
15. Disconnect the actuator from the truss and actuator support base. Finish installing the actuator support base anchors per the anchor bolt manufacturer's instructions. Be sure to allow the necessary cure time. Shim the actuator support base 1" above the top of the tank to allow for grouting and leveling. DO NOT GROUT THE ACTUATOR SUPPORT BASE UNTIL A SANITAIRE REPRESENTATIVE HAS CONFIRMED THE INSTALLATION AND LEVEL OF THE ASSEMBLY.
16. Once the anchors are set, permanently connect the actuator to the truss and actuator support base. Wrench-tighten all hardware. Loctite 262 or equal is to be applied to all threaded connections made in the field.
17. Install the remaining expansion anchors at the wall plates.
18. The unit is now completely installed and any temporary supports, rigging, etc. can be removed.
19. At this point, go to Sections 2.3 and 2.4 for the installation instructions of the limit switches and local decanter control station. Once those items are installed, return to Step 20 below and complete the installation.
20. Prior to operating the decanter assembly with power, unscrew the jackscrew cover pipe and push back the flexible boot (loosen the upper band clamp). While the unit is operating, do not allow the mechanical stops to come in contact with the

actuator housing. This may damage the unit and void the warranty. The top stop nut is shown in Figure 27 below.

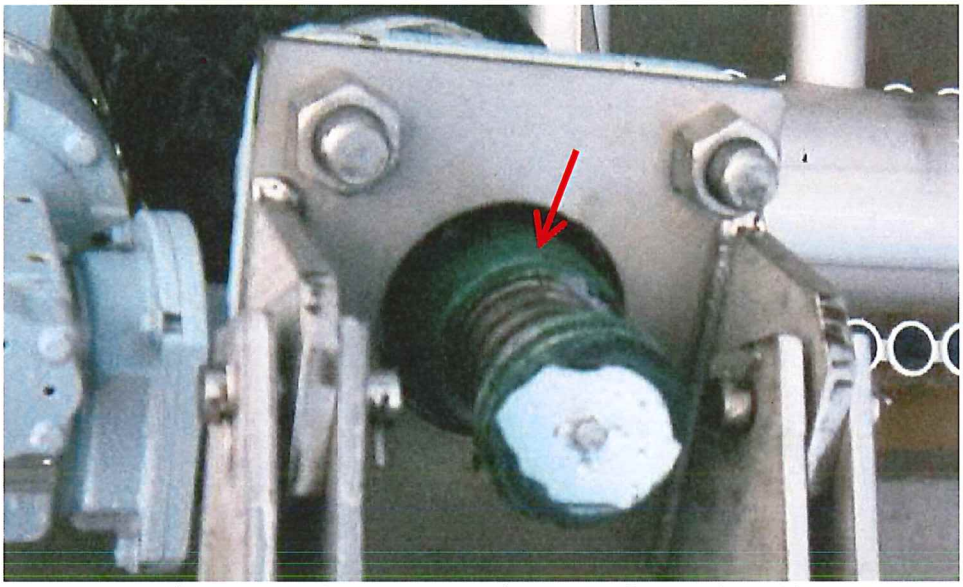


Figure 27 - Stop Nut on Actuator Screw (2.2.5)

21. Using the local decanter control panel, raise and lower the decanter to verify the weir level tolerances at the Park and BWL positions. The level at <u>each</u> position has the following weir tolerance:
    - ±3/8"
22. Adjust the decanter at the bearing pedestal using the jacking nuts, as necessary, to achieve the specified tolerance.
23. Reinstall the actuator boot and jackscrew cover pipe. **Apply teflon tape or pipe dope to the cover pipe threads to prevent the ingress of water.**

The decanter assembly is now ready to be commissioned by a Sanitaire representative.

2.2.6 Multiple dual units – Wall design

A multiple dual decanter assembly is defined as two or more dual units per basin. The installation instructions for each assembly will be identical to those found in Section 2.2.4. Any mechanical interconnections between the actuators will be discussed in Section 2.2.8.

2.2.7 Multiple dual units – Elbow design

A multiple dual decanter assembly is defined as two or more dual units per basin. The installation instructions for each assembly will be identical to those found in Section 2.2.5. Any mechanical interconnections between the actuators will be discussed in Section 2.2.8.

2.2.8 Multiple dual units – Line shafts

After each dual unit assembly has been installed per the instructions above, follow the instructions below to install the motor/gearbox and line shafts between the actuators.

1. Locate and install the gearbox base per the ABJ Drawings. Ensure the base is level. Shim as needed. Then install the gearbox/motor assembly to the base. Use the hardware provided.
2. Install the U-joint companion hubs at the gearbox and actuators. DO NOT TIGHTEN THE SET SCREWS AT THIS TIME.
3. Bring the decanter assemblies to the same elevation.
4. Bolt the line shaft to the U-joint companion hub at the actuator. Then bolt the line shaft to the gearbox U-joint companion hub. Use the hardware provided with the line shaft. There is approximately three inches of slip at the gearbox end of the line shaft to facilitate the installation. Ensure the yokes are 'in-phase'. Then repeat for the other line shaft. Refer to Figure 28 and Figure 29 below.

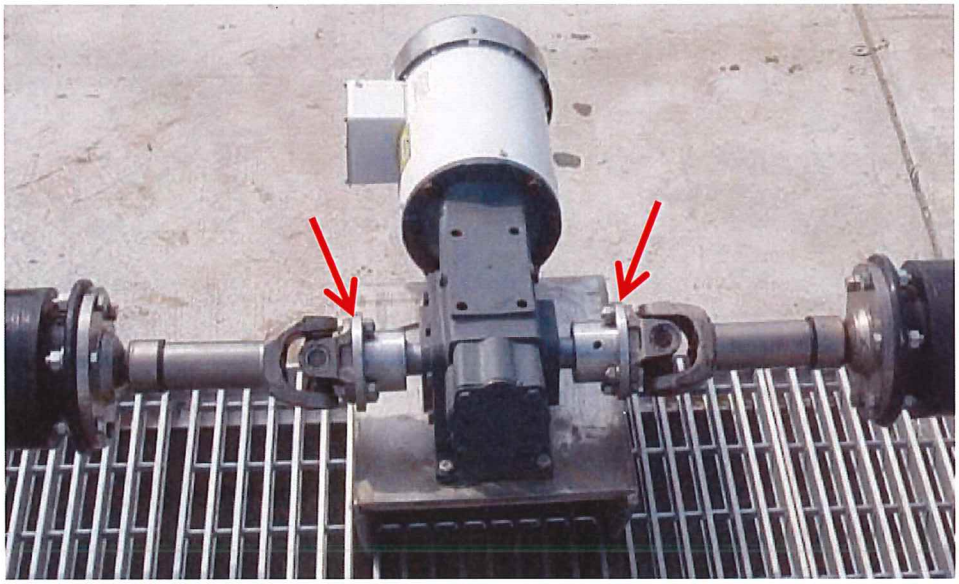


Figure 28 - Line Shaft Connection at Gearbox

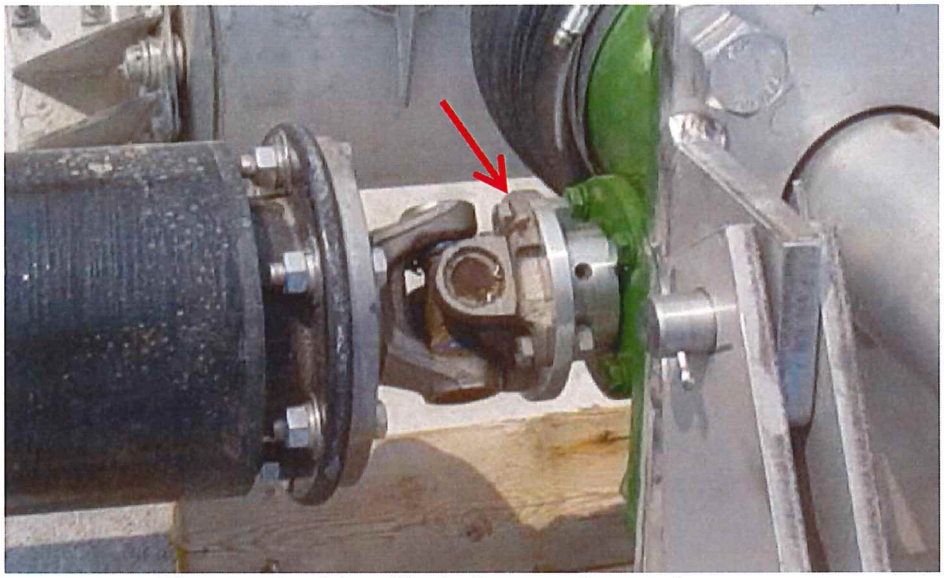


Figure 29 - Line Shaft Connection at Actuator

5. Tighten the set screws on the U-joint companion hubs.
6. Once the line shafts are installed, verify that the decanter assemblies are at the same elevation.

The decanter assembly is now ready to be commissioned by a Sanitaire representative.

2.3 Limit Switches

NOTE: Refer to Sanitaire Drawing M24.

The limit switches and their accessories are typically shipped separately from the decanters and actuators. Each actuator will have two limit switch box assemblies, one upper and one lower. Each limit switch box assembly contains the components shown in Table 3 below:

Description	Quantity
Limit Switch Enclosure	1
Magnetic Limit Switch w/ 20 feet of cable	2
S.S. Self-tapping Screw, #4 x ¾"	4
Magnet (sized based on actuator model)	1 or 2*
Magnet Washer	2
S.S. Bolt, 3/8"-16UNC x 1 ¼" long	1
Hose Clamp, 5"	1

* - Two magnets are required for the Duff-Norton 9002 actuator

Table 3 - Limit Switch Box Assembly Components

Spare limit switches and screws are also included with most shipments. Once all of the components have been located, proceed with installing the limit switches using the following instructions.

1. Remove the actuator aluminum jackscrew cover. Clean out the 3/8" tapped hole in the end of jackscrew. Using the 3/8" bolt supplied, bolt the magnet 'sandwich' (the magnet between the two washers) to the end of the jackscrew. Replace the jackscrew cover.
2. Remove the enclosure cover and drill a hole in one end of the enclosure for the flexible conduit. Install two limit switches in each box. ENSURE THAT ALL FLEXIBLE CONDUIT CONNECTIONS ARE WATERTIGHT. Repeat for the remaining limit switch boxes.
   Please note: Two limit switches are provided per enclosure. The first switch is the primary switch and second switch is provided for redundancy. Each limit switch is provided with an indicating light for maintenance and troubleshooting purposes.
3. Using the hose clamp supplied by Sanitaire, secure each box to the jackscrew cover. The hose clamp slips between the bottom of the enclosure and the mounting plate. It may be necessary to loosen the nuts for the mounting plate to allow the hose clamp to slip through. Retighten nuts after hose clamp is installed.
4. When installing the flexible conduit for the limit switch boxes, ensure that there is sufficient flexible conduit to allow for the adjustment of the boxes up and down on the jackscrew cover. DO NOT USE A COMMON CONDUIT BETWEEN THE LIMIT SWITCH BOXES. THIS CAN HAMPER THE ADJUSTMENT OF THE BOXES AND RESULT IN RE-INSTALLING THE CONDUIT.
5. Figure 30 below shows an example of the completed limit switch installation.



Figure 30 - Completed Limit Switch Assembly

6. The final location of the limit switches and boxes will be determined by a Sanitaire representative at commissioning.
7. Refer to the Sanitaire electrical schematics for all wire termination information at the local decanter control station.

2.4 Local Control Station

Each decanter assembly is provided with a local decanter control station. It typically ships with the main control panel, which is a separate shipment from the decanters and actuators.

The local control station should be located 36" to 48" above the walkway and not more than five feet from the actuator. Sanitaire does not provide any mounting hardware for the local control station. Specific mounting procedures are determined on site, usually by the contract drawings or the electrical contractor.

All wiring and terminations should be done in accordance with the Sanitaire electrical schematics.

3.0 OPERATION AND MAINTENANCE

3.1 Assembly Operation

3.1.1 Automatic Control

The decanter/actuator assembly is controlled through the PLC in the Sanitaire control panel according to the process timeline for this particular project. The selector switch on the decanter local control station at the basin must be in 'Auto'. Operation in automatic mode contains interlocks to stop the decanter from operating during certain events. For example, the decanter will not be allowed to descend unless the air valve is closed. Conversely, at the end of the decant cycle, the unit must be rising for at least two minutes before aeration is allowed for the next cycle. Sanitaire recommends leaving the decanter in 'Auto' at all times.

3.1.2 Manual Control

When there is power to the unit, the decanter can be manually operated via the selector switch at the local control station. The unit can be either raised or lowered at any time.
NOTE: OPERATION OF THE DECANTER IN MANUAL MODE DOES NOT HAVE ANY PLC INTERLOCKS AND CAN RESULT IN SOLIDS CARRYOVER.

In the event of a power outage during a decant cycle, the unit can be manually raised via the worm gear extension shaft, shown in Figure 31 below, on the opposite side of the actuator from the motor.
NOTE: DO NOT ALLOW THE ACTUATOR STOP NUTS TO CONTACT THE ACTUATOR HOUSING AT EITHER THE TOP OR THE BOTTOM OF THE STROKE.



Figure 31 - Actuator Worm Gear Extension Shaft

This extension shaft can be fitted with a ¾" chuck drill powered by a portable generator in order to raise the unit.

If the decanter is in the Park Position during a power outage, Sanitaire recommends leaving the unit in position and allowing the water to simply flow over the weir.

3.2 Preventative Maintenance

3.2.1 Lubrication

3.2.1.1 Decanter

The decanter does not require any regular lubrication. All bearings are designed to be maintenance free for the life of the unit.

3.2.1.2 Actuator

The Duff-Norton actuators require lubrication. The D-N Decanter Actuators are delivered to site packed full of Mobilith SHC 220 Grease. **Do NOT** mix with other greases. Based on extensive factory testing of lubricants, we believe that this is the best grease available for our application, and it is capable of extending the life of the internal gears by 20%. Lubricate (grease) the decanter actuator **monthly** by injecting several (2-3) shots of Mobilith SHC 220 (**no equals**) into the actuator through the grease fitting (Zerk) located on the worm shaft side of the actuator housing. Then remove the plug (located on the opposite side of the housing) and pump additional grease into the housing until grease begins to flow out of the plug hole. Then re-

install the plug. This will ensure good distribution of grease to both sides of the housing.

The Nord gear reducer (between the motor and actuator body) is lubricated for life with oil.

The motor does not require any regular lubrication. It is lubricated for life at the factory.

3.2.2 Visual Inspection

Every week the visible parts of the decanter should be inspected for rags or other debris that may have accumulated on the unit, especially near the weir. This debris can be removed with a water hose.

3.2.3 Hardware Check

Loctite 262 or equal should have been applied to all field installed hardware. However, every month the accessible hardware should be checked for tightness. This hardware includes the nuts and bolts on the actuator support and the anchors for actuator support. All hardware should be wrench-tight.

3.3 Long Term Storage

Long term storage is defined as six months or more after the units have been delivered to the jobsite.

3.3.1 Decanter

3.3.1.1 Prior to Installation

Leave the decanters and the accessories in their 'as-shipped' condition. The decanters can be stored outside. They should be kept out of the way of construction equipment and other site activities to prevent accidental damage. The decanters should also be kept on wooden blocks to prevent them from sinking into the ground. They do not require any special covering or protection from the weather.

3.3.1.2 After Installation

Leave the decanters in the Park Position after the entire assembly has been completely installed. Ensure that the Forsheda seal remains protected from solar UV radiation. Otherwise, they do not require any special covering or protection from the weather. However, if water will be kept in the basin, the water level should be kept at least one foot below the decanter collector pipe to prevent any freezing damage.

3.3.2 Actuator

3.3.2.1 Prior to Installation

Leave the actuators in their shipping crates and store them indoors.

3.3.2.2 After Installation

The actuators should be run in manual through one full cycle (Park Position to Bottom Water Level and back) every week. Grease should be added to the actuator, while it is running, every three months until excess grease comes out of the pressure relief valve. The oil in the gear reducer should be checked every six months.

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Installation, Operation, and Maintenance Manual

90015901_9.0



Flygt 3085

FLYGT
a xylem brand

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1 Introduction and Safety

1.1 Introduction

Purpose of the manual

The purpose of this manual is to provide the necessary information for working with the unit. Read this manual carefully before starting work.

Read and keep the manual

Save this manual for future reference, and keep it readily available at the location of the unit.

Intended use



WARNING:

Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment and the surroundings. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.

Other manuals

See also the safety requirements and information in the original manufacturer's manuals for any other equipment furnished separately for use in this system.

1.2 Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product and its surroundings
- Product malfunction

Hazard levels

Hazard level	Indication
 DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
 WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
 CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:	Notices are used when there is a risk of equipment damage or decreased performance, but not personal injury.

Special symbols

Some hazard categories have specific symbols, as shown in the following table.

Electrical hazard	Magnetic fields hazard
 Electrical Hazard:	 CAUTION:

1.3 User safety

All regulations, codes, and health and safety directives must be observed.

The site

- Observe lockout and tagout procedures before starting work on the product, such as transportation, installation, maintenance, or service.
- Pay attention to the risks presented by gas and vapors in the work area.
- Always be aware of the area surrounding the equipment, and any hazards posed by the site or nearby equipment.

Qualified personnel

This product must be installed, operated, and maintained by qualified personnel only.

Protective equipment and safety devices

- Use personal protective equipment as needed. Examples of personal protective equipment include, but are not limited to, hard hats, safety goggles, protective gloves and shoes, and breathing equipment.
- Make sure that all safety features on the product are functioning and in use at all times when the unit is being operated.

1.4 Ex-approved products

Follow these special handling instructions if you have an Ex-approved unit.

Personnel requirements

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and Xylem authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example, IEC/EN 60079-17).

Xylem disclaims all responsibility for work done by untrained and unauthorized personnel.

Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data.
- The equipment must never run dry during operation. The volute must be filled with liquid during operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.

- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an Ex-approved Xylem representative.
- Only use original Xylem spare parts that are provided by an Ex-approved Xylem representative.
- The thermal contacts that are fitted to the stator windings must be connected correctly to a separate motor control circuit and in use. The thermal contacts shall be connected to a monitoring device, which disconnects the power supply immediately upon activation. This action prevents the rise of temperatures above the temperature value for the approval classification.
- The width of flameproof joints is more than the values specified in the tables of the EN/IEC 60079-1 standard. For information contact the manufacturer.
- The gap of flameproof joints is less than the values specified in Table 2 of the EN/IEC 60079-1 standard. For information contact the manufacturer.
- It is NOT allowed to repair the flameproof joints.
- Ambient temperature: –20°C to 60°C

Guidelines for compliance

Compliance is fulfilled only when you operate the unit within its intended use. Do not change the conditions of the service without the approval of an Ex-approved Xylem representative. When you install or maintain explosion proof products, always comply with the directive and applicable standards (for example, IEC/EN 60079–14).

Monitoring equipment

For additional safety, use condition-monitoring devices. Examples of condition-monitoring devices include, but are not limited to, the following:

- Level indicators
- Temperature detectors in addition to the stator thermal detectors

Any thermal detectors or thermal protection devices delivered with the pump must be installed and in use at all times.

The site owner is responsible for selection, installation, and proper maintenance of functional monitoring equipment for motor protection.

1.5 Special hazards

1.5.1 Biological hazards

The product is designed for use in liquids that can be hazardous to your health. Observe these rules when you work with the product:

- Make sure that all personnel who may come into contact with biological hazards are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.



WARNING: Biological Hazard

Infection risk. Rinse the unit thoroughly with clean water before working on it.

1.5.2 Wash the skin and eyes

Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

Condition	Action
Chemicals or hazardous fluids in eyes	1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.
Chemicals or hazardous fluids on skin	1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least 1 minute. 3. Seek medical attention, if necessary.

1.6 Protecting the environment

Emissions and waste disposal

Observe the local regulations and codes regarding:

- Reporting of emissions to the appropriate authorities
- Sorting, recycling and disposal of solid or liquid waste
- Clean-up of spills

Exceptional sites



CAUTION: Radiation Hazard

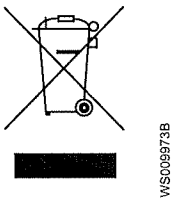
Do NOT send the product to Xylem if it has been exposed to nuclear radiation, unless Xylem has been informed and appropriate actions have been agreed upon.

1.7 End-of-life product disposal

Handle and dispose of all waste in compliance with local laws and regulations.

EU and UK only: Correct disposal of this product — waste electrical and electronic equipment

- EU: Directive 2012/19/EU on waste electrical and electronic equipment (WEEE)
- UK: SI 2013 No. 3113



This marking on the product, accessories or literature indicates that the product should not be disposed of with other waste at the end of its working life.

1.8 Spare parts



CAUTION:

Only use the manufacturer's original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the warranty.

1.9 Warranty

For information about warranty, see the sales contract.

2 Transportation and Storage

2.1 Examine the delivery

2.1.1 Examine the package

1. Examine the package for damaged or missing items upon delivery.
2. Record any damaged or missing items on the receipt and freight bill.
3. If anything is out of order, then file a claim with the shipping company.
   If the product has been picked up at a distributor, make a claim directly to the distributor.

2.1.2 Examine the unit

1. Remove packing materials from the product.
   Dispose of all packing materials in accordance with local regulations.
2. To determine whether any parts have been damaged or are missing, examine the product.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.
   Use care around nails and straps.
4. If there is any issue, then contact a sales representative.

2.2 Transportation guidelines

2.2.1 Precautions



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



Position and fastening

The unit can be transported either horizontally or vertically. Make sure that the unit is correctly fastened during transportation, and cannot roll or fall over.

2.2.2 Lifting

Always inspect the lifting equipment and tackle before starting any work.



WARNING: Crush Hazard

Always lift the unit by its designated lifting points.
Use suitable lifting equipment and ensure that the product is properly harnessed.
Wear personal protective equipment.
Stay clear of cables and suspended loads.

NOTICE:

Never lift the unit by its cables or hose.

Lifting points

The following images show the lifting points for the different installation types. For more information about the installation types, see *Installation* on page 18.

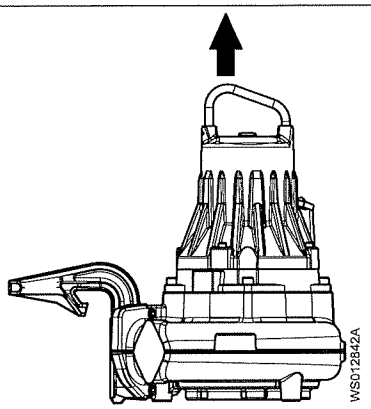


Figure 1: P-, T-, and X-installation

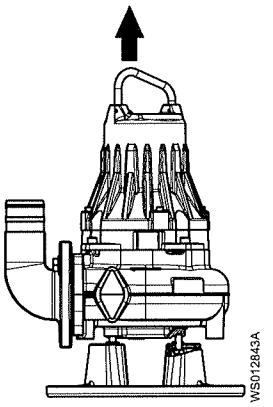


Figure 2: S- and F-installation

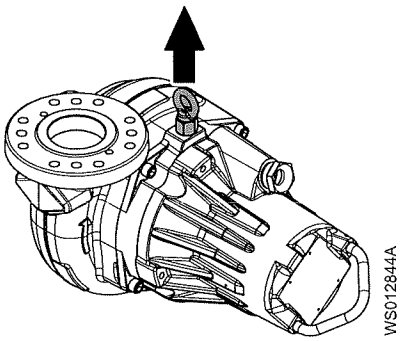


Figure 3: Z-installation, with hydraulic unit

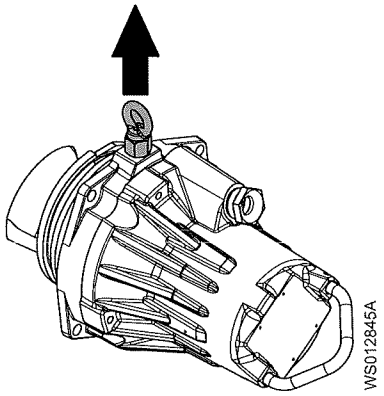


Figure 4: Z-installation, without hydraulic unit

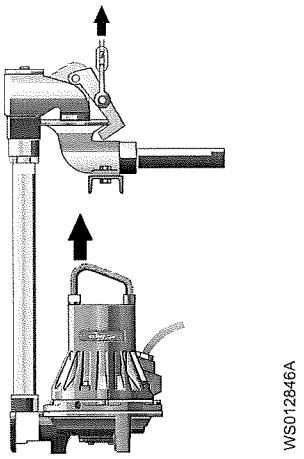


Figure 5: H-installation

Lifting equipment

Lifting equipment is always required to handle the unit. The lifting equipment must fulfill the following requirements:

- The minimum height between the lifting hook and the floor must be sufficient to lift the unit. Contact a Xylem representative for more information.
- The lifting equipment must be able to hoist the unit straight up and down, preferably without the need for resetting the lifting hook.
- The lifting equipment must be correctly anchored and in good condition.
- The lifting equipment must support the weight of the entire assembly. Only authorized personnel may use the lifting equipment.

- The lifting equipment must be dimensioned to lift the unit with any remaining pumped media in it.
- The lifting equipment must not be oversized.



CAUTION: Crush Hazard

Improperly-dimensioned lifting equipment can lead to injury. A site-specific risk analysis must be done.

2.3 Temperature ranges for transportation, handling and storage

Handling at freezing temperature

At temperatures below freezing, the product and all installation equipment, including the lifting gear, must be handled with extreme care.

Make sure that the product is warmed up to a temperature above the freezing point before starting up. Avoid rotating the impeller/propeller by hand at temperatures below the freezing point. The recommended method to warm the unit up is to submerge it in the liquid which will be pumped or mixed.

NOTICE:

Never use a naked flame to thaw the unit.

Unit in as-delivered condition

If the unit is still in the condition in which it left the factory - all packing materials are undisturbed - then the acceptable temperature range during transportation, handling and storage is: –50°C (–58°F) to +60°C (+140°F).

If the unit has been exposed to freezing temperatures, then allow it to reach the ambient temperature of the sump before operating.

Lifting the unit out of liquid

The unit is normally protected from freezing while operating or immersed in liquid, but the impeller/propeller and the shaft seal may freeze if the unit is lifted out of the liquid into a surrounding temperature below freezing.

Follow these guidelines to avoid freezing damage:

1. Empty all pumped liquid, if applicable.
2. Check all liquids used for lubrication or cooling, both oil and water-glycol mixtures, for the presence of unacceptable amounts of water. Change if needed.

Water-glycol mixtures: Units equipped with an internal closed-loop cooling system are filled with a mixture of water and 30% glycol. This mixture remains a flowing liquid at temperatures down to –13°C (9°F). Below –13°C (9°F), the viscosity increases such that the glycol mixture will lose its flow properties. However, the glycol-water mixture will not solidify completely and thus cannot harm the product.

2.4 Storage guidelines

Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

NOTICE:

Protect the product against humidity, heat sources, and mechanical damage.

NOTICE:

Do not place heavy weights on the packed product.

Long-term storage

If the unit is stored for more than six months, then the following apply:

- Before operating the unit after storage, it must be inspected. Special attention must be given to the seals and the cable entry.
- The impeller or propeller must be rotated every other month to prevent the seals from sticking together.

Packaging material stacking limit

If the packaging material has an indicated stacking limit, then it is valid for 23°C (73°F) and 50% relative humidity. Depending on the material, other temperature and humidity ranges can reduce the stacking limit.

3 Product Description

Products included

Pump	Non-explosion proof drive unit	Explosion proof drive unit	High Efficiency motor (LSPM)	D-hydraulic	F-hydraulic	M-hydraulic (Grinder)	Adaptive N ™hydraulic
3085.060	X						X [1]
3085.070		X					X [1]
3085.092		X		X	X		
3085.160	X						X [3]
3085.172	X					X	
3085.183	X			X	X		
3085.190		X					X [3]
3085.760	X						X [2]
3085.770		X					X [2]
3085.891		X				X	
3085.900	X		X				X [3]
3085.910		X	X				X [3]
3085.920	X		X				X [1]
3085.930		X	X				X [1]
3085.960	X		X				X [2]
3085.970		X	X				X [2]

[1] Hard-Iron™
[2] Stainless steel
[3] Cast iron, gray

Pump-specific information

For the specific weight, current, voltage, power ratings, and speed of the pump, see the data plate of the pump.

3.1 Pump design

The pump is submersible, and driven by an electric motor.

Intended use

The product is intended for moving wastewater, sludge, raw and clean water. Always follow the limits that are given in *Technical Reference* on page 72. If there is a question regarding the intended use of the equipment, please contact a local sales and service representative before proceeding.



DANGER: Explosion/Fire Hazard

Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is rated explosion-proof or intrinsically-safe, then see the specific explosion-proof information in the safety chapter before taking any further actions.

NOTICE:

Do NOT use the unit in highly corrosive liquids.

Spare parts

- Modifications to the unit or installation should only be carried out after consulting with Xylem.
- Original spare parts and accessories that are authorized by Xylem are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation. For more information contact your Xylem representative.

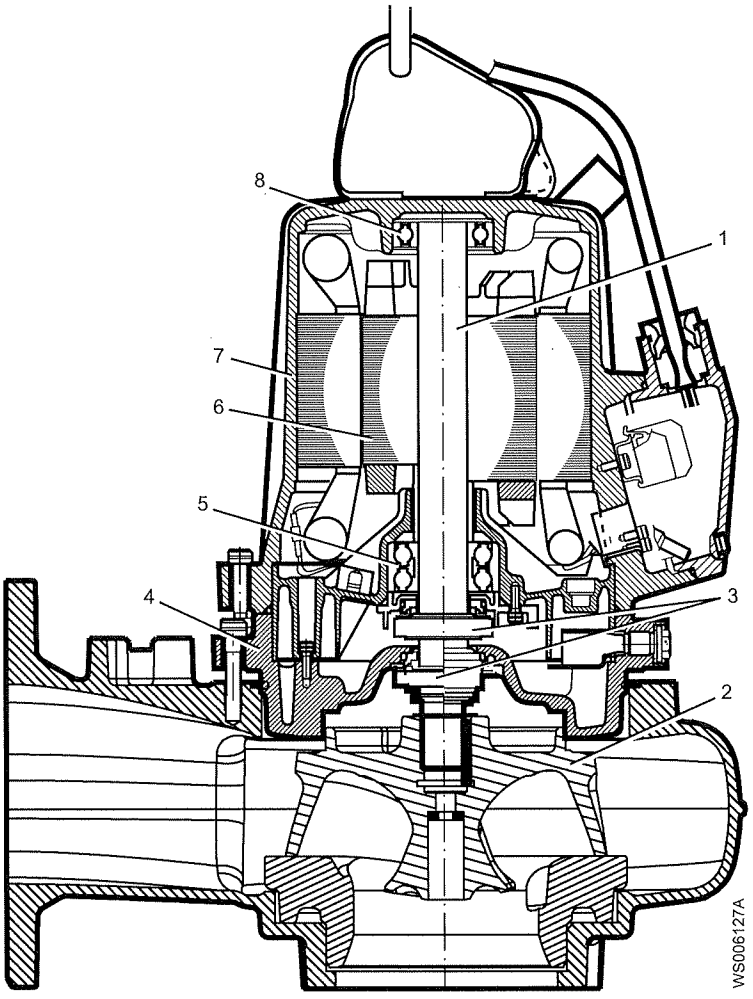
Pressure class

LT	Low head
MT	Medium head
HT	High head
SH	Super high head

Experior™ product concept

Experior™ is a product concept including N-technology, Premium efficiency motor, and the intelligent control SmartRun™.

Parts



Position	Denomination	Description
1	Shaft	The shaft is made of stainless steel with an integrated rotor.

Position	Denomination	Description
2	Impeller	There are multiple types of impellers. For information about the pumps impellers, see Parts List.
3	Mechanical seals	One inner and one outer seal in a combination of materials: • Aluminium oxide Al_2O_3 • Silicon carbide RSiC • Corrosion-resistant cemented carbide WCCR For information about the pumps mechanical seals, see Parts List.
4	Oil housing	The oil housing includes a coolant that lubricates and cools the seals; the housing acts as a buffer between the pumped fluid and the drive unit.
5	Main bearing	The bearing consisting of a two-row angular contact ball bearing.
6	Motor	For information about the motor, see *Technical Reference* on page 72.
7	Stator housing	The pump is cooled by the ambient liquid/air.
8	Support bearing	The bearing consisting of a single-row ball bearing.

3.2 Sensors and monitoring equipment

The following applies to the monitoring equipment of the pump:

- The stator incorporates three thermal contacts connected in series that activate the alarm and stops the pump at overtemperature
- The thermal contacts open at 125°C (257°F).
- Ex-approved pumps must have thermal contacts connected to the control panel.
- The sensors must be connected to either the MiniCAS II monitoring equipment or an equivalent equipment.
- The monitoring equipment must be of a design that makes automatic restart impossible.
- Information in the junction box shows if the pump is equipped with optional sensors.

Optional sensors

FLS FLS is a miniature float switch for detection of liquid in the stator housing. Due to its design it is best suited for pumps in a vertical position. The FLS sensor is installed in the bottom of the stator housing.

CLS CLS is a sensor for detection of water in the oil housing. The sensor initiates an alarm when the oil contains approximately 35% water. The sensor is installed in the bearing housing/bearing holder with its sensing part in the oil housing. The CLS sensor is not applicable to Ex-approved pumps.

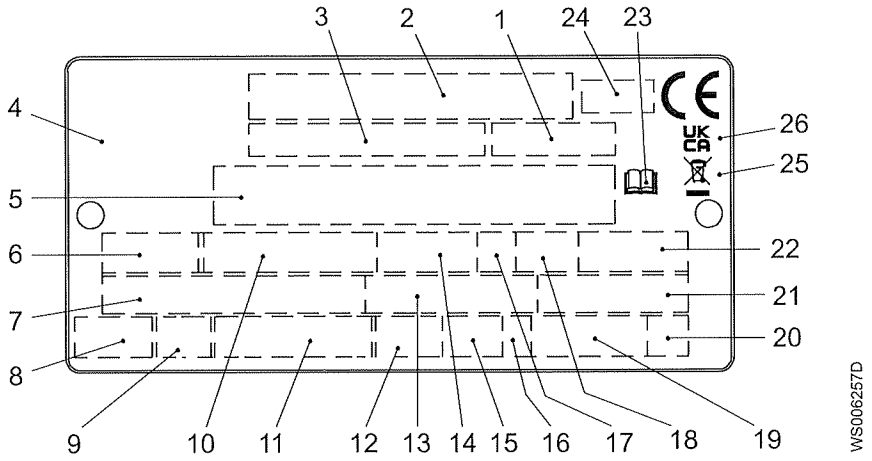
NOTICE:

The CLS sensor body is made of glass. Handle the sensor with care.

One CLS and one FLS sensor can be used in the same pump, if they are connected in parallel.

3.3 The data plate

The data plate is a metal label that is located on the main body of the products. The data plate lists key product specifications. Specially approved products also have an approval plate.



1. Curve code or Propeller code
2. Serial number
3. Product number
4. Country of origin
5. Additional information
6. Phase; type of current; frequency
7. Rated voltage
8. Thermal protection
9. Thermal class
10. Rated shaft power
11. International standard
12. Degree of protection
13. Rated current
14. Rated speed
15. Maximum submergence
16. Direction of rotation: L=left, R=right
17. Duty class
18. Duty factor
19. Product weight
20. Locked rotor code letter
21. Power factor
22. Maximum ambient temperature
23. Read installation manual
24. Notified body, only for EN-approved Ex products
25. WEEE-Directive symbol
26. UKCA marking

Figure 6: The data plate

3.4 Motor regulation

This product is submersible and therefore exempted from the motor efficiency requirement, in accordance with EU commission regulation 2019/1781 Article 2(2)(e).

3.5 Approvals

3.5.1 Product approvals for hazardous locations

3085

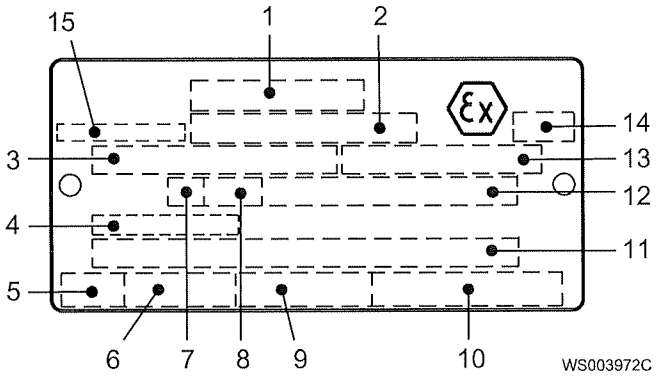
This table shows product approvals for the following products:

- 3085.070
- 3085.092
- 3085.190
- 3085.770
- 3085.891
- 3085.910
- 3085.930
- 3085.970

Type	Approval
European Norm (EN)	• ATEX Directive 2014/34/EU • EN IEC 60079-0:2018, EN 60079-1:2014, EN ISO 80079-36:2016, EN ISO 80079-37:2016 • ⟨Ex⟩ II 2 G Ex db h IIB T4 Gb
IEC	• IECEx scheme 02 • IEC 60079-0:2017, IEC 60079-1:2014-06, ISO 80079-36:2016, ISO 80079-37:2016 • Ex db h IIB T4 Gb
FM (FM Approvals)	• Explosion proof for use in Class I, Div. 1, Group C and D • Dust ignition proof for use in Class II, Div. 1, Group E, F and G • Suitable for use in Class III, Div. 1, Hazardous Locations
CSA Ex	• Explosion proof for use in Class I, Div. 1, Group C and D
UKEx	• UK SI 2016 No. 1107 • EN IEC 60079-0:2018, EN 60079-1:2014, EN ISO 80079-36:2016, EN ISO 80079-37:2016 • ⟨Ex⟩ II 2 G Ex db h IIB T4 Gb

EN approval plate

This illustration describes the EN approval plate and the information that is contained in its fields.

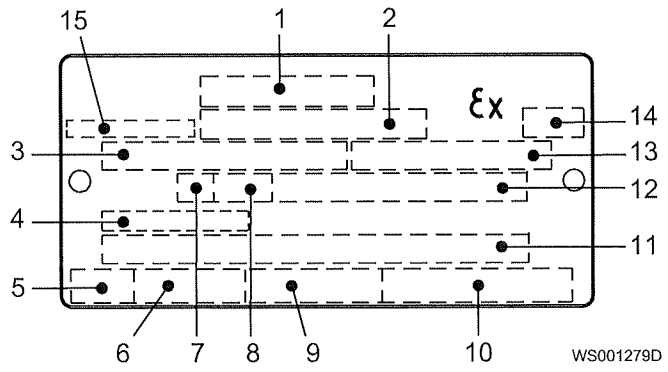


1. Approval
2. Approval authority and Approval number
3. Approved drive unit
4. Cable entry temperature
5. Stall time
6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. ATEX marking
15. Country of origin

IEC approval plate

This illustration describes the IEC approval plate and the information that is contained in its fields.

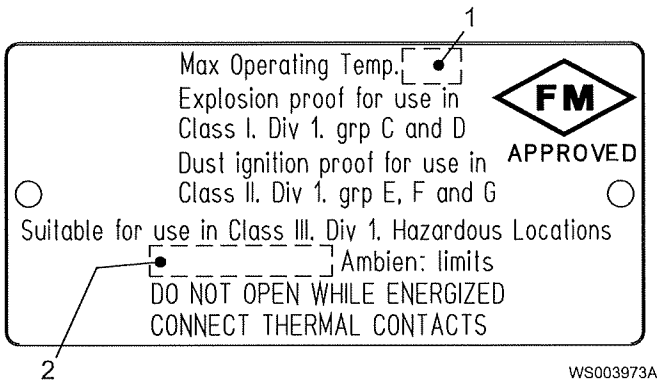
International Norm; not for EU member countries.



1. Approval
2. Approval authority and Approval number
3. Approved drive unit
4. Cable entry temperature
5. Stall time
6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. ATEX marking
15. Country of origin

FM approval plate

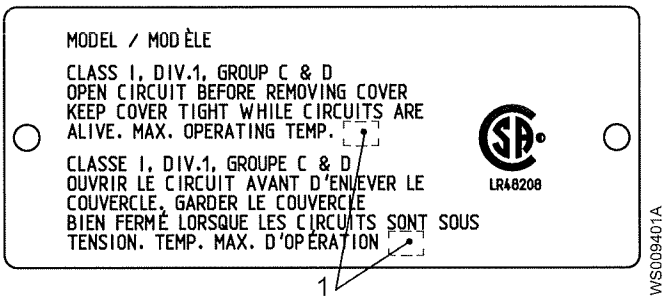
This illustration describes the FM approval plate and the information that is contained in its fields.



1. Temperature class
2. Maximum ambient temperature

CSA approval plate

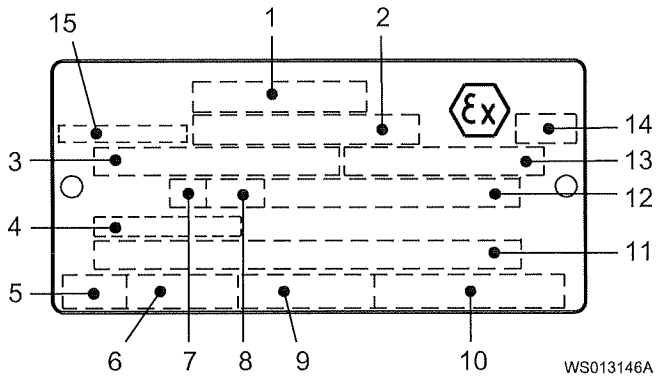
This illustration describes the CSA approval plate and the information that is contained in its fields.



1. Temperature class

United Kingdom: UKEx approval plate

This illustration describes the UKEx approval plate and the information that is contained in its fields.



1. Approval
2. Approval authority and Approval number
3. Approved drive unit
4. Cable entry temperature
5. Stall time
6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. UKEx marking
15. Country of origin

3.6 Product denomination

Reading instruction

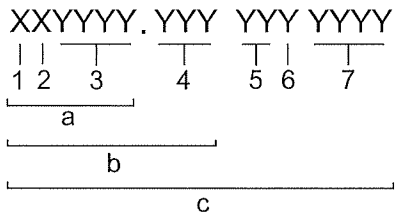
In this section, code characters are illustrated accordingly:

X = letter

Y = digit

The different types of codes are marked up with a, b and c. Code parameters are marked up with numbers.

Codes and parameters



WS006265B

Type of Callout	Number	Indication
Type of code	a	Sales denomination
	b	Product code
	c	Serial number
Parameter	1	Hydraulic end
	2	Type of installation
	3	Sales code
	4	Version
	5	Production year
	6	Production cycle
	7	Running number

4 Installation

4.1 Precautions

Before starting work, make sure that the safety instructions have been read and understood.

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.



DANGER: Inhalation Hazard

Before entering the work area, make sure that the atmosphere contains sufficient oxygen and no toxic gases.

WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

4.1.1 Hazardous atmospheres

DANGER: Explosion/Fire Hazard

Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is rated explosion-proof or intrinsically-safe, then see the specific explosion-proof information in the safety chapter before taking any further actions.

General requirements

These requirements apply:

- Use the pump dimensional drawing in order to ensure proper installation.

Before installing the pump, do the following:

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that equipment is in place so that the unit cannot roll or fall over during the installation process.
- Check the explosion risk before you weld or use electric hand tools.
- Check that the cable and cable entry have not been damaged during transport.
- Always remove all debris and waste material from the sump, inlet piping, and discharge connection, before you install the pump.
- If the unit has a permanent magnet motor, then ensure that you have read and understood all safety instructions regarding permanent magnet motors.

NOTICE:

Do not run the pump dry.

NOTICE:

Never force piping to make a connection with a pump.

Authority regulation

Vent the tank of a sewage station in accordance with local plumbing codes.

Fasteners

- Only use fasteners of the correct size and material.
- Replace all corroded or damaged fasteners.
- Make sure that all the fasteners are correctly tightened and that there are no missing fasteners.

4.2 Install with P-installation

In the P-installation, the pump is installed on a stationary discharge connection, and operates either completely or partially submerged in the pumped liquid. These requirements and instructions only apply when the installation is made according to the dimensional drawing.

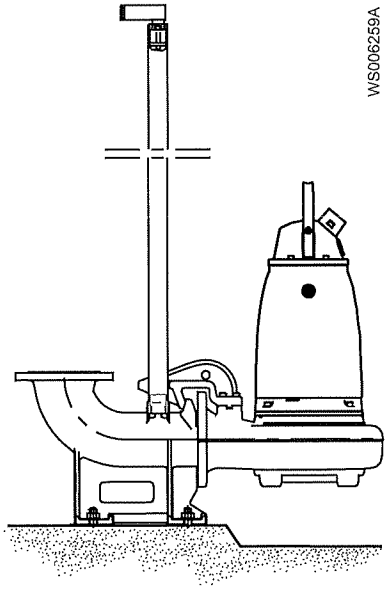


Figure 7: P-installation

These items are required:

- Guide bars
- Guide bar bracket for attaching the guide equipment to the access frame or to the upper part of the sump
- Cable holder for holding the cable
- Access frame (with covers) to which the upper guide bar bracket and cable holder can be attached
- Discharge connection for connecting the pump to the discharge line

  The discharge connection has a flange which fits the pump housing flange and a bracket for attaching the guide equipment.
- Fasteners for the discharge connection
- Anchor bolts

1. Install the access frame:
   a) Place the access frame in position and align it horizontally.
   b) Grout the frame in place.
2. Grout the anchor bolts in place.

   Be careful when you align and position the discharge connection in relation to the access frame.
3. Place the discharge connection in position, and tighten the nuts.

4. Install the guide bars:
   a) Secure the guide bars in the bracket.
   b) Check that the guide bars are placed vertically. Use a level or a plumb line.
5. Connect the discharge pipe to the discharge connection.
6. Lower the pump along the guide bars.

   When it reaches the bottom position, the pump automatically connects to the discharge connection.
7. Secure the motor cable:
   a) Fasten the permanent lifting device to the pump and to the access frame. For example, you can use a stainless-steel lifting chain with shackles.
   b) Fasten the cable to the cable holder.

      Make sure that the cable cannot be sucked into the pump inlet or that it is neither sharply bent, or pinched. Support straps are required for deep installations.
   c) Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

      Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* on page 39.

Clean all debris from the sump before starting the pump.

4.3 Install with S-installation

In the S-installation, the pump is transportable and intended to operate either completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe and stands on a base stand.

These requirements and instructions only apply when the installation is made according to the dimensional drawing. For information about the different installation types, see Parts List.

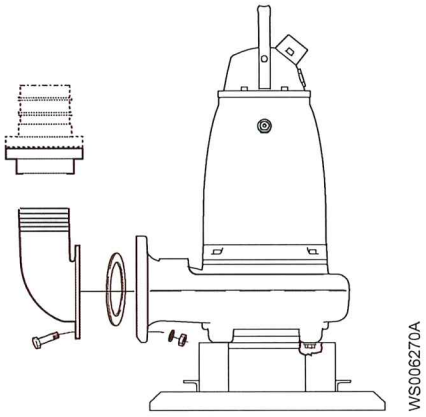


Figure 8: S-installation

1. Run the cable so that it has no sharp bends. Make sure that it is not pinched, and cannot be sucked into the pump inlet.
2. Connect the discharge line.
3. Lower the pump into the sump.
4. Place the pump on the base and make sure it cannot fall over or sink.

   Alternatively, the pump can be suspended with chains just above the sump bottom. Make sure that the pump cannot rotate at start-up or during operation.
5. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

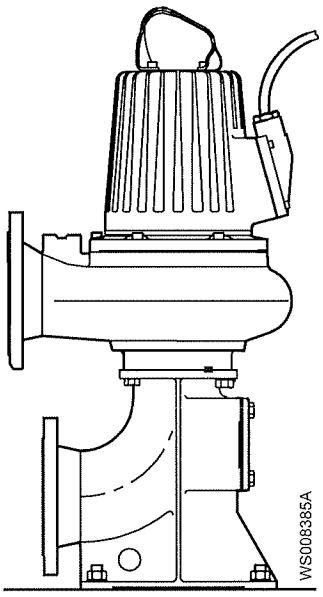
   Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* on page 39.

4.4 Install with T-installation

This installation is not applicable for these versions:

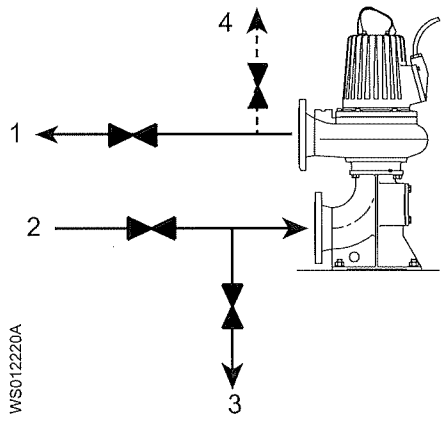
- .172
- .891

In the T-installation, the pump is installed in a vertical position in a dry well next to the wet well. These requirements and instructions only apply when the installation is made according to the dimensional drawing.



These items are required:

- Anchor bolts for anchoring the pump to a base.
- Shut-off valves that allow you to remove the pump from service



1. Outlet line
2. Inlet line
3. Drain
4. Air vent

Figure 9: Shutoff and air vent valves (generic pump shown)

NOTICE:

The risk of freezing is particularly high in T- or Z-installations.

1. Fasten the pump:
   a) Bolt the stationary suction connection to the concrete base.
   b) Bolt the pump to the suction connection.
2. Make sure that the pump is vertical for the T-installation.
3. Connect the suction line and discharge line.

4. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

   Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* on page 39.

EN

5. Make sure that the weight of the pump does not put strain on the piping.

4.5 Install with Z-installation

This installation is not applicable for these versions:

- .172
- .891

In the Z-installation, the pump is installed in a horizontal position on a support stand in a dry well next to the wet well. The following requirements and instructions are for Z-installations that comply to the dimensional drawing.

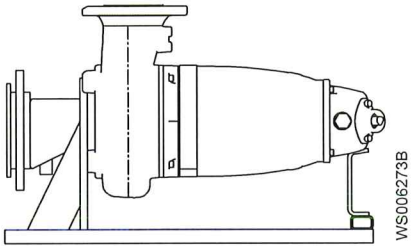
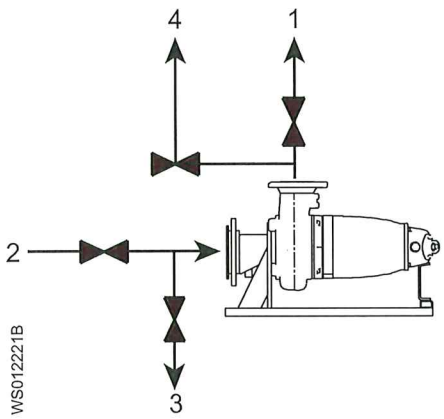


Figure 10: Z-installation

These items are required:

- Anchor bolts for anchoring the pump to a base.
- Shut-off valves that allow you to remove the pump from service



1. Outlet line
2. Inlet line
3. Drain
4. Air vent

Figure 11: Shutoff and air vent valves (generic pump shown)

NOTICE:

The risk of freezing is particularly high in T- or Z-installations.

1. Fasten the pump:
   a) Bolt the stationary suction connection to the concrete base.
   b) Bolt the pump to the suction connection.
2. Make sure that the pump is vertical for the T-installation or horizontal for the Z-installation.
3. Connect the suction line and discharge line.
4. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* on page 39.

5. Make sure that the weight of the pump does not put strain on the piping.

4.6 Install with F-installation

In the F-installation, the pump is free standing and installed primarily in a small sump on a firm surface. The pump is intended to operate completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe and with supporting legs and/or a strainer. These requirements and instructions are for F-installations that comply to the dimensional drawing.

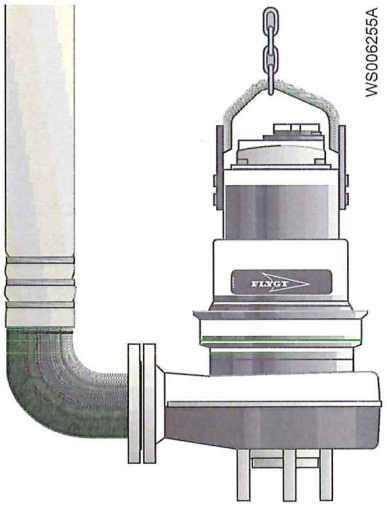


Figure 12: F-installation

These items are required:

- Nipple pipe/Flange/Coupling
- Pipe or hose

1. Run the cable so that is has no sharp bends, is not pinched, and cannot be sucked into the pump inlet.
2. Fit the nipple pipe/flange/coupling.
3. Lower the pump into the sump.
4. Place the pump on the sump bottom and make sure it cannot fall over.
5. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

   Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* on page 39.

4.7 Install with H-installation

This installation is only applicable for the following versions:

- 172
- 891

In the H-installation, the pump is installed with a permanent, quick-connection, suspended arrangement that incorporates an integral non-return valve. The pump is intended to operate completely or partially submerged in the pumped liquid. These requirements and instructions are for H-installations that comply to the dimensional drawing.

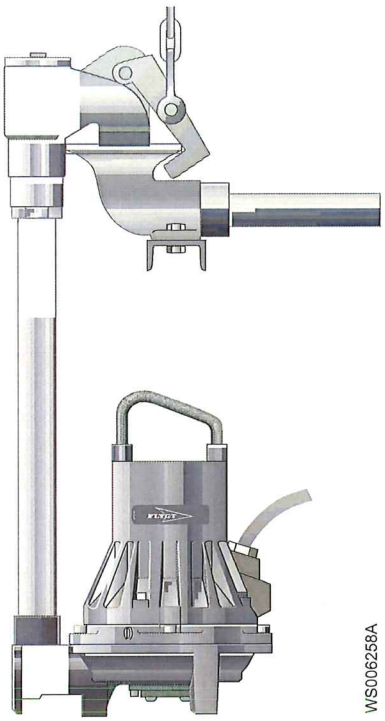


Figure 13: H-installation

These items are required:

- Discharge connection
- Pipe

1. Run the cable so that is has no sharp bends, is not pinched, and cannot be sucked into the pump inlet.
2. Fit the pipe and connect the discharge connection.
3. Lower the pump into the sump.
4. Make sure that the pump is hanging just above the sump bottom.
5. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

   Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* on page 39.

Clean all debris from the sump before you start the pump.

4.8 Install with X-installation

In the X-installation, the pump has no pre-determined mechanical connection. The flange is drilled.

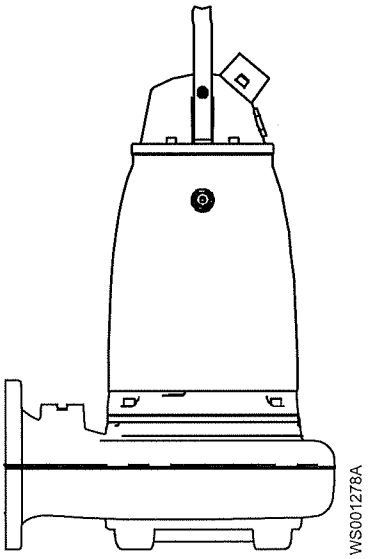


Figure 14: X-installation

NOTICE:

A pump prepared for X-installation is only approved to be used in P- or S-installation. Never use it in T- or Z-installation

For installation instructions, see appropriate mechanical accessories.

4.9 Make the electrical connections

4.9.1 General precautions

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.



WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.

WARNING: Electrical Hazard

There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.

WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.



WARNING: Crush Hazard

Risk of automatic restart.



CAUTION: Electrical Hazard

Prevent cables from becoming sharply bent or damaged.

NOTICE:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the cable ends dry at all times.

Requirements

These general requirements apply for the electrical installation:

- If the pump will be connected to the public mains, then the supply authority must be notified before installing the pump. When the pump is connected to the public power supply, it can cause flickering of incandescent lamps when started.
- The mains voltage and frequency must agree with the specifications on the data plate. If the pump can be connected to different voltages, then follow the specified voltage on the yellow sticker close to the cable entry.
- If the operation can be intermittent, such as S3 periodic duty, then the pump must be supplied with monitoring equipment supporting such operation.
- If stated on the data plate, then the motor is convertible between different voltages.
- The thermal contacts or thermistors must be in use.
- For FM-approved pumps, a leakage sensor must be connected and in use to meet approval requirements.

Motor and short-circuit protection

NOTICE:

A qualified electrician must select the size of motor protection breakers and fuses. The size must be chosen for the specific motor data such as rated current and starting current.

It is important that the short-circuit protection is not over-dimensioned. Over-dimensioned fuses or motor protection breakers decrease the protection for the motor.

- The fuse rating and the cables must be in accordance with the local rules and regulations.
- The fuses and circuit breakers must have the correct rating.
- The pump overload protection must be connected and set to the rated current.

The starting current in direct-on-line start can be up to six times higher than the rated current.

For more information, see the data plate and if applicable, the cable chart for the rated current.

Cables

When cables are installed, these requirements must be followed:

- The cables must be in good condition, not have any sharp bends, and not be pinched.
- The cables must not be damaged and must not have indentations.
- The cables must not be embossed at the cable entry.
- The cable entry seal sleeve and washers must conform to the outer diameter of the cable.
- The minimum bend radius must not be smaller than the accepted value.

- If a cable is reused, a short piece at the end must be peeled off when the cable is refitted. This action is necessary so that the seal sleeve of the cable entry does not close around the cable at the same point again. If the outer jacket of the cable is damaged, then the cable must be replaced.

  Contact a sales or authorized service representative.
- The voltage drop in long cables must be considered. The rated voltage of the drive unit is the voltage that is measured at the cable connection point in the pump.
- If a variable frequency drive (VFD) is used, the screened cable must be used according to the European CE and EMC requirements. For more information, contact a sales or authorized service representative.
- The cable length must be long enough for maintenance work.
- For SUBCAB™ cables, the twisted pair copper foil must be trimmed.
- All unused conductors must be insulated.

4.9.2 Grounding (earthing)

Grounding (earthing) must be done in compliance with all local codes and regulations.



DANGER: Electrical Hazard

All electrical equipment must be grounded (earthed). Test the ground (earth) lead to verify that it is connected correctly and that the path to ground is continuous.



WARNING: Electrical Hazard

Risk of electrical shock. The ground (earth) lead must be sufficiently longer than the phase leads to make sure that the ground lead is the last to become disconnected if the cable is jerked loose.

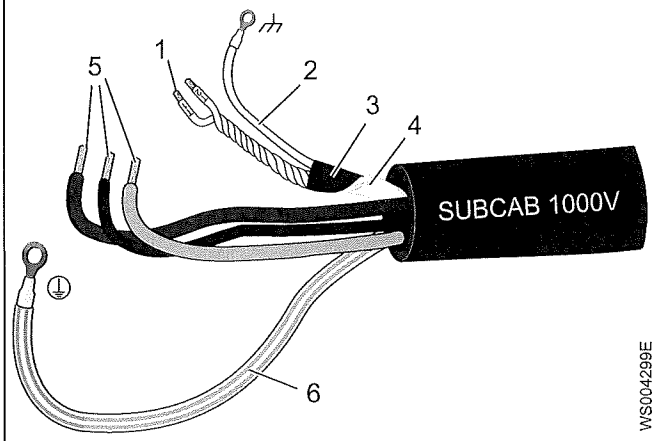
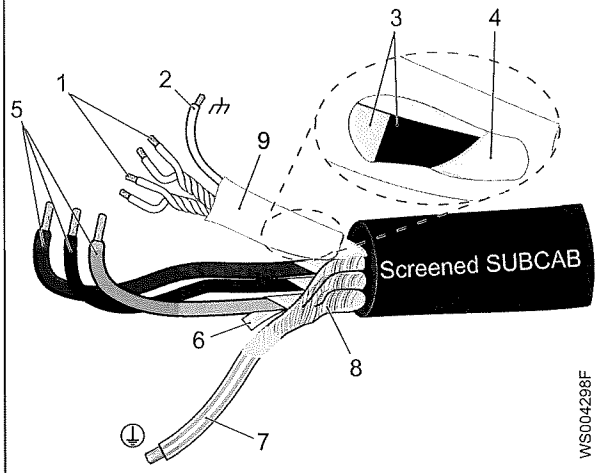


WARNING: Electrical Hazard

Risk of electrical shock or burn. You must connect an additional ground- (earth-) fault protection device to the grounded (earthed) connectors if persons are likely to come into contact with liquids that are also in contact with the pump or pumped liquid.

4.9.3 Prepare the SUBCAB™ cables

This section applies to SUBCAB™ cables with twisted-pair control conductors.

The prepared SUBCAB™ cable	The prepared screened SUBCAB™ cable, without cable lugs
	
1. T1+T2 twisted pairs in control element 2. Drain wire in control element (tinned copper strands) with shrink tube 3. Aluminum and textile layers 4. Insulation jacket or plastic jacket, for the control element 5. Power conductors 6. Ground (earth) conductor with yellow-green shrink tube	1. T1+T2 and T3+T4 twisted pairs in control element 2. Drain wire in control element (tinned copper strands) with shrink tube 3. Aluminum and textile layers 4. Insulation jacket or plastic jacket, for the control element 5. Power conductors 6. Plastic laminated aluminum foil, screen 7. Ground (earth) conductor with yellow-green shrink tube 8. Uncovered screen/braided wire 9. shrink tube

1. Peel off the outer jacket at the end of the cable.
2. Prepare the control element:
   a) Peel the insulation jacket or plastic jacket.
   b) Peel the aluminum and textile layers.

      The aluminum foil is a conductive screen. Do not peel more than necessary, and remove the peeled foil.

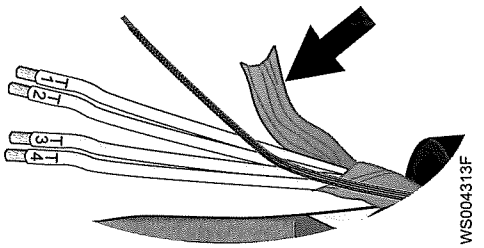


Figure 15: Aluminum foil on the control element.

   c) Put a white shrink tube over the drain wire.
   d) Twist T1+T2 and T3+T4.
   e) Put a shrink tube over the control element.

      Make sure that the conductive aluminum foil and drain wire are covered.
3. Prepare the ground (earth) conductor of the SUBCAB™ cable:
   a) Peel the yellow-green insulation from the ground (earth) conductor.
   b) Check that the ground (earth) conductor is at least 10% longer than the phase conductors in the cabinet.
   c) If applicable, put a cable lug on the ground conductor.
4. Prepare the ground (earth) conductor of the screened SUBCAB™ cable:
   a) Untwist the screens around the power conductors.
   b) Twist all power conductor screens together to create a ground (earth) conductor.
   c) Put a yellow-green shrink tube over the ground (earth) conductor.

Leave a short piece uncovered.

d) Check that the connected ground (earth) conductor has sufficient slack. The conductor must stay connected even if the power conductors are pulled loose.

5. Prepare the power conductors:
   a) Remove the aluminum foil around each power conductor.
   b) Peel the insulation from each power conductor.
6. Prepare the ends of the ground (earth) conductor, the power conductors, and the drain wire:

Connection type	Action
Screw	Fit cable lugs to the ends.
Terminal block	Fit end sleeves or leave the ends as they are.

4.9.4 Connect the motor cable to the pump

NOTICE:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable dry at all times.

1. Remove the entry gland screw from the stator housing.
2. Remove the stator housing.

   This provides access to the terminal board/closed end splices.
3. Remove the terminal board.
4. Check the data plate to see which connections are required for the power supply.
5. Arrange the connections on the terminal board/closed end splices in accordance with the required power supply.
6. Connect the mains leads (L1, L2, L3, and ground (earth)) according to applicable cable chart.

   The ground (earth) lead must be 50 mm (2.0 in.) longer than the phase leads in the junction box of the unit.
7. Make sure that the pump is correctly connected to ground (earth).
8. Make sure that any thermal contacts incorporated in the pump are properly connected to the terminal block/closed end splices.
9. Install the stator housing.
10. Install the entry gland screw.

4.9.5 Connect the motor cable to the starter and monitoring equipment



DANGER: Explosion/Fire Hazard

Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is rated explosion-proof or intrinsically-safe, then see the specific explosion-proof information in the safety chapter before taking any further actions.

NOTICE:

Thermal contacts are incorporated in the pump.

NOTICE:

Thermal contacts must never be exposed to voltages higher than 250 V, breaking current maximum 4 A.

1. If thermal contacts are included in the pump installation, then connect the T1 and T2 control conductors to the MiniCAS II monitoring equipment.

If the temperature of the pumped liquid is above 40°C (104°F), then do not connect the T1 and T2 leads to thermal contacts. This does not apply to Ex-versions of the product.

NOTICE:

The thermal contacts are incorporated in the stator. The thermal contacts must be connected to protect the unit.

2. Connect the mains leads (L1, L2, L3, and ground (earth)) to the starter equipment.
   For information about the phase sequence and the color codes of the leads, see Cable charts.
3. Check the functionality of the monitoring equipment:
   a) Check that the signals and the tripping function work correctly.
   b) Check that the relays, lamps, fuses, and connections are intact.
   Replace any defective equipment.

4.9.6 Cable charts

Description

This topic contains general connection information. It also provides cable charts that show connection alternatives for use with different cables and power supply.

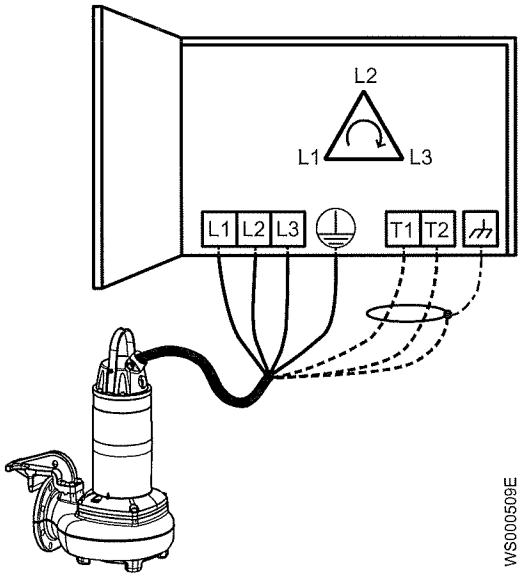
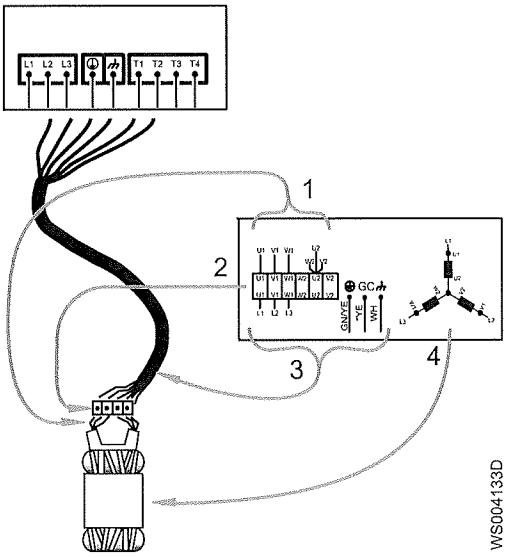


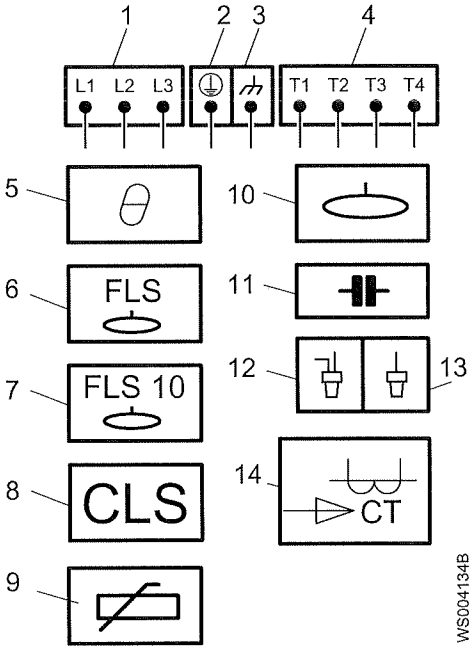
Figure 16: Phase sequence

Connection locations

The figures in this section illustrate how to interpret the connection strip symbols.



1. Stator leads
2. Terminal board
3. Power cable leads
4. Stator (internal connection illustrated)



1. Starter equipment and mains leads (L1, L2, L3)
2. Ground (earth)
3. Functional ground
4. Control leads (T1, T2, T3, T4)
5. Thermal contact
6. FLS
7. FLS 10
8. CLS
9. Thermistor
10. Level sensor
11. Capacitor
12. Crimp connection
13. Crimp isolation
14. Current transformer

Color code standard

Code	Description
BN	Brown
BK	Black
WH	White
OG	Orange
GN	Green
GNYE	Green-Yellow
RD	Red
GY	Grey
BU	Blue
YE	Yellow

4.9.6.1 Colors and markings of leads

Motor connection

Colours and marking of main leads

COLOUR STANDARD	STATOR LEADS
BN=Brown	U1,U5 RD
BK=Black	U2,U6 GN
WH=White	V1,V5 BN
OG=Orange	V2,V6 BU
GN=Green	W1,W5 YE
GN/YE=Green-Yellow	W2,W6 BK
RD=Red	T1,T2 WH/YE
GY=Grey	
BU=Blue	
YE=Yellow	

*SUBCAB AWG
* * Ground Conductor is stranded around cores
GC=Ground Check

863 17 00 (REV 2)

Mains 1~	Mains 3~	SUBCAB 7GX Screenflex 7GX	SUBCAB 4GX Screenflex 4GX	SUBCAB AWG	SUBCAB Screened
1	L1	BK 1	BN	RD	BN
2	L2	BK 2	BK	BK	BK
3	L3	BK 3	GY	WH	GY
	L1	BK 4	-	-	-
	L2	BK 5	-	-	-
	L3	BK 6	-	-	-
⏚		GN/YE	GN/YE	GN/YE	**Screen/PE from cores
⏚		Screen (WH)	Screen (WH)	-	Screen (WH)
GC				YE	-

WS004125E

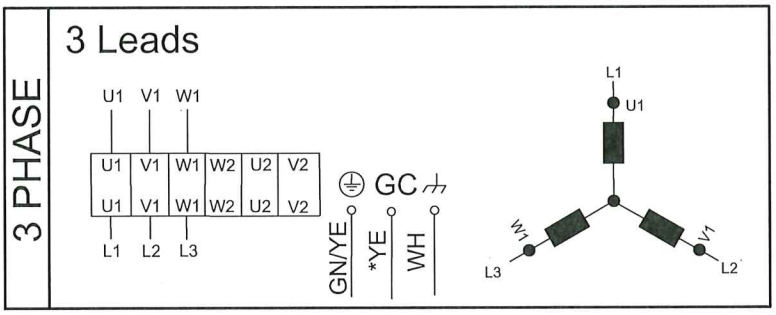
Figure 17: 3–phase and 1–phase without built-in starter

For markings on sensor leads, see *Sensors connection* on page 37.

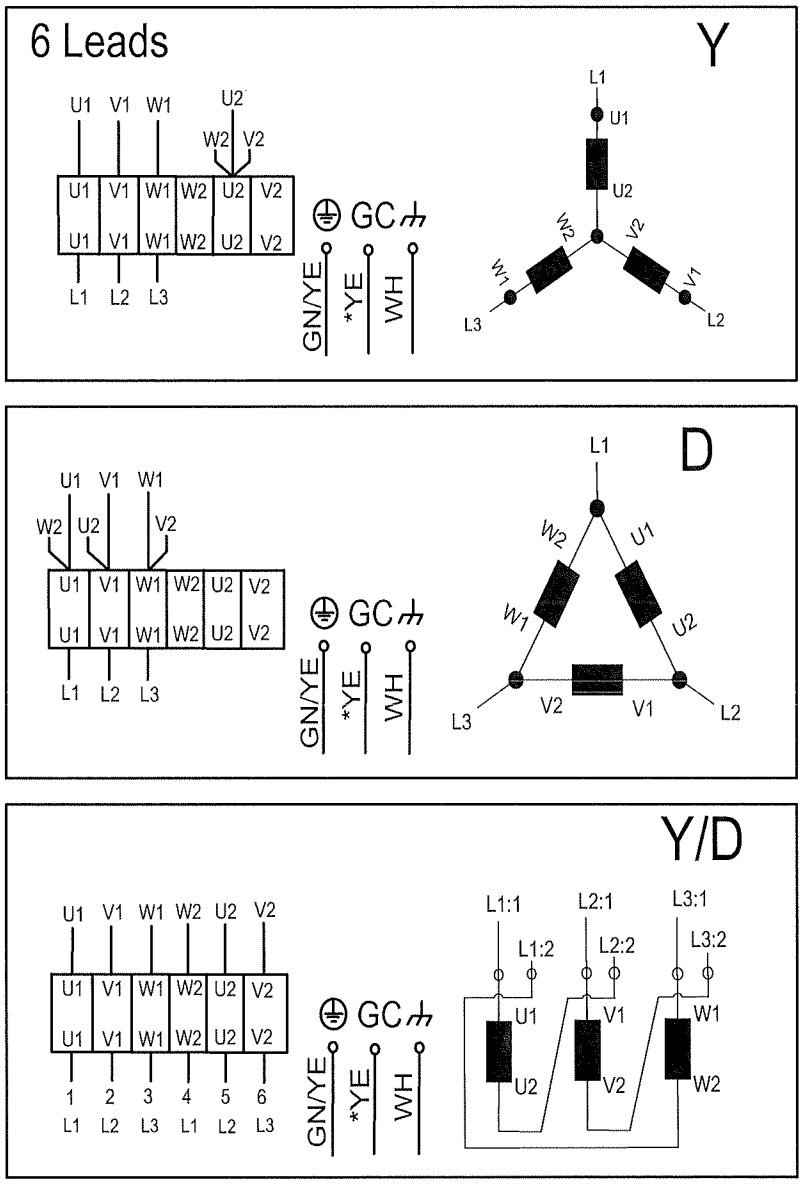
4.9.6.2 Connections included

- *3-phase connection* on page 32
- *1-phase connection* on page 36
- *Sensors connection* on page 37
- *Screened cable connection* on page 37

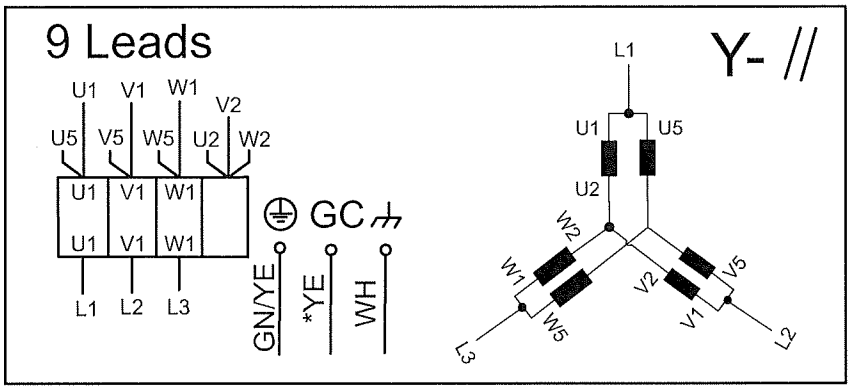
4.9.6.3 3-phase connection



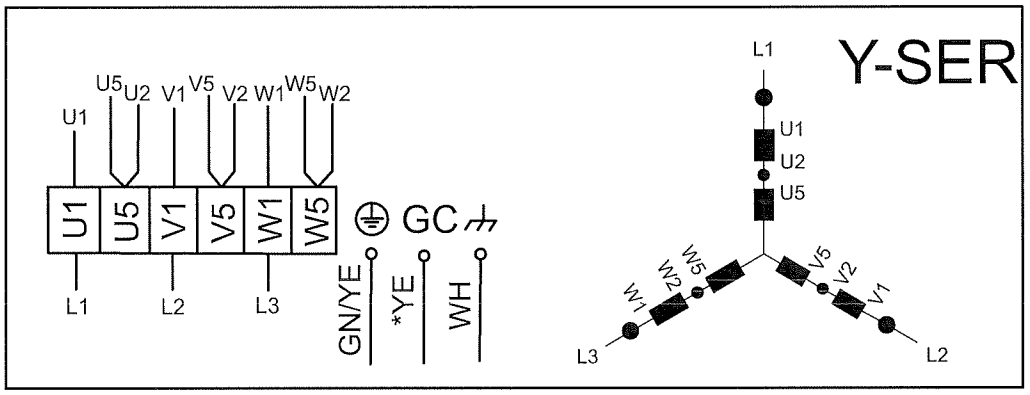
WS009162B

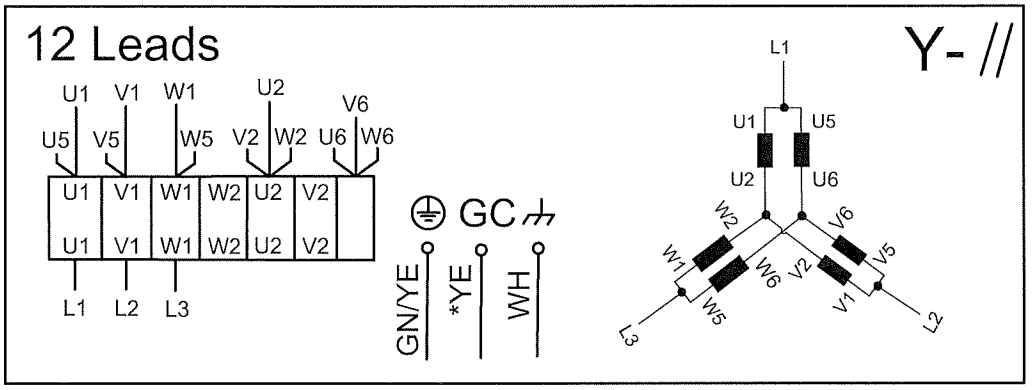

6 Leads
Y
U1 V1 W1 U2 W2 V2
U1 V1 W1 W2 U2 V2
U1 V1 W1 W2 U2 V2
L1 L2 L3
GC
GN/YE
*YE
WH
L1
U1
U2
W2
V2
W1
V1
L3
L2
D
U1 V1 W1 W2 U2 V2
U1 V1 W1 W2 U2 V2
U1 V1 W1 W2 U2 V2
L1 L2 L3
GC
GN/YE
*YE
WH
L1
W2
U1
W1
U2
V2
V1
L3
L2
Y/D
U1 V1 W1 W2 U2 V2
U1 V1 W1 W2 U2 V2
U1 V1 W1 W2 U2 V2
1 2 3 4 5 6
L1 L2 L3 L1 L2 L3
GC
GN/YE
*YE
WH
L1:1
L2:1
L3:1
L1:2
L2:2
L3:2
U1
V1
W1
U2
V2
W2

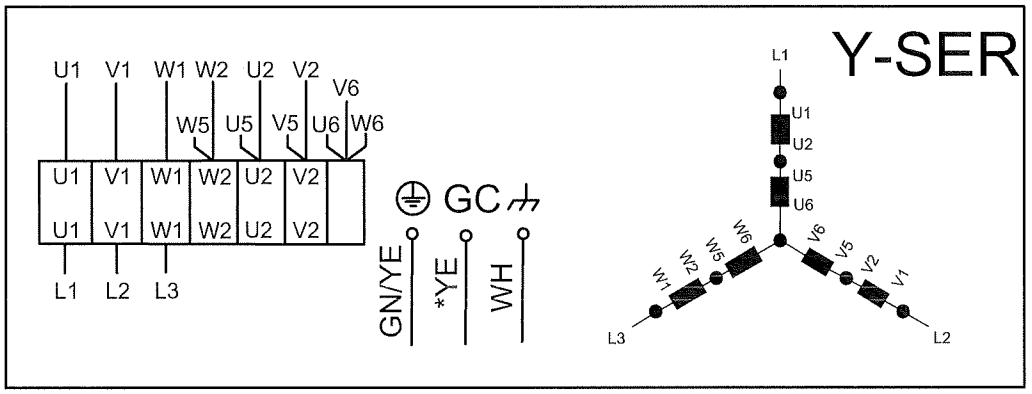
WS004126B

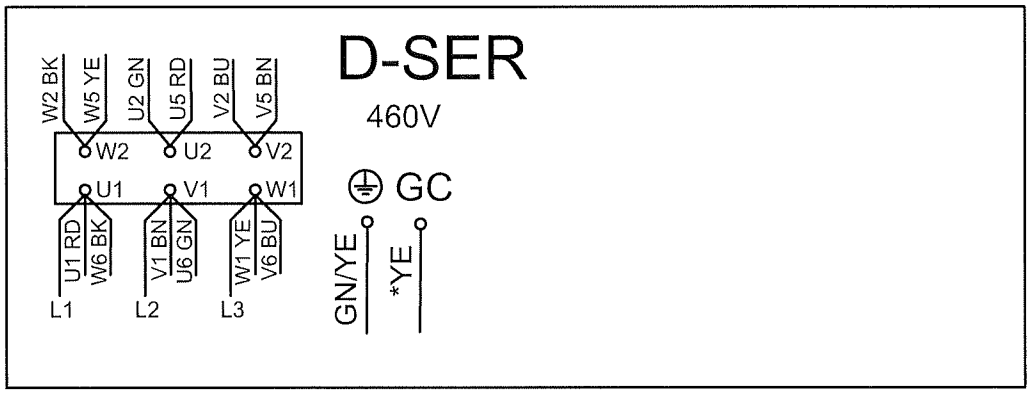

9 Leads
U1 V1 W1 V2
U5 V5 W5 U2 W2
U1 V1 W1
U1 V1 W1
L1 L2 L3
GC
GN/YE
*YE
WH
Y- //
L1
U1 U5
U2
W2 W1
V2 V5
V1
W5
L3
L2

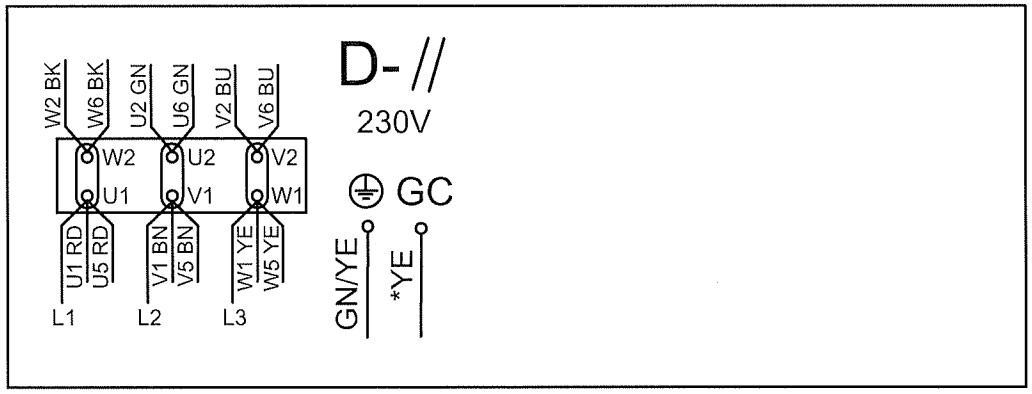
WS004127B


U5 U2 V1 V5 V2 W1 W5 W2
U1
U1 U5 V1 V5 W1 W5
L1 L2 L3
GC
GN/YE
*YE
WH
Y-SER
L1
U1
U2
U5
W5 W2
W1
V5
V2
V1
L3
L2


12 Leads
Y- //
U1 V1 W1 U2 V6
U5 V5 W5 V2 W2 U6 W6
U1 V1 W1 W2 U2 V2
U1 V1 W1 W2 U2 V2
L1 L2 L3
GC
GN/YE
*YE
WH
L1
U1 U5
U2 U6
V6 W2
W1 W6 V2 V5
W5 V1
L3 L2


Y-SER
U1 V1 W1 W2 U2 V2 V6
W5 U5 V5 U6 W6
U1 V1 W1 W2 U2 V2
U1 V1 W1 W2 U2 V2
L1 L2 L3
GC
GN/YE
*YE
WH
L1
U1
U2
U5
U6
W6 V6
W5 V5
W2 V2
W1 V1
L3 L2


D-SER
460V
W2 BK W5 YE U2 GN U5 RD V2 BU V5 BN
W2 U2 V2
U1 V1 W1
U1 RD W6 BK V1 BN U6 GN W1 YE V6 BU
L1 L2 L3
GC
GN/YE
*YE


D- //
230V
W2 BK W6 BK U2 GN U6 GN V2 BU V6 BU
W2 U2 V2
U1 V1 W1
U1 RD U5 RD V1 BN V5 BN W1 YE W5 YE
L1 L2 L3
GC
GN/YE
*YE

WS004128C

4.9.6.4 1-phase connection

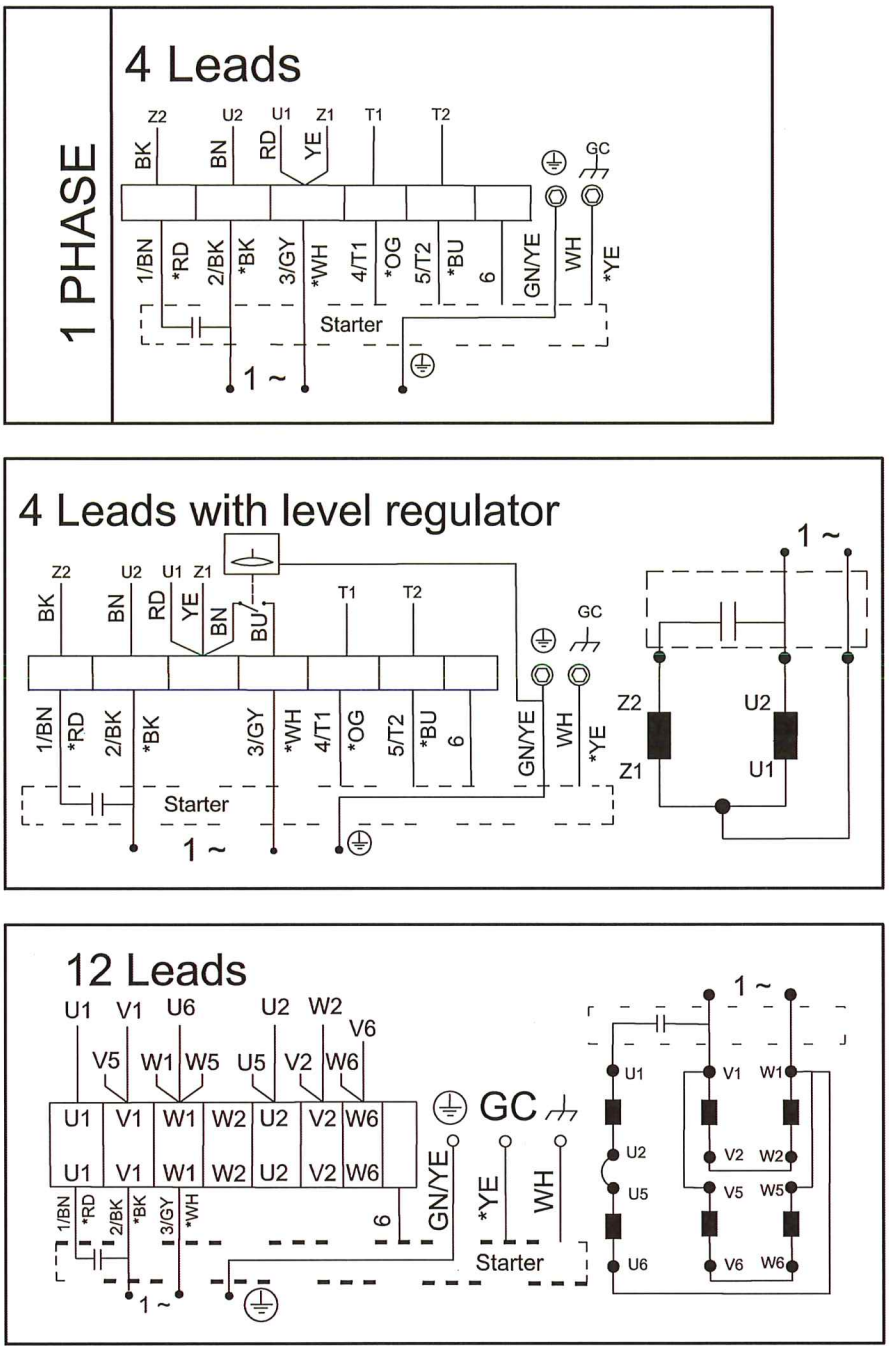
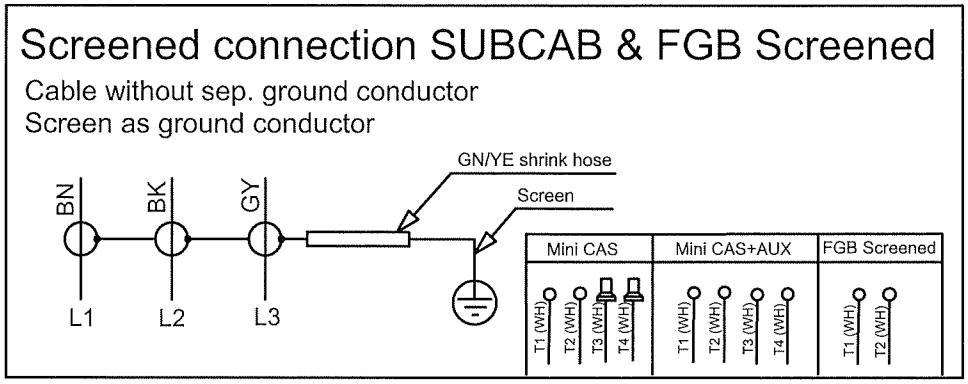
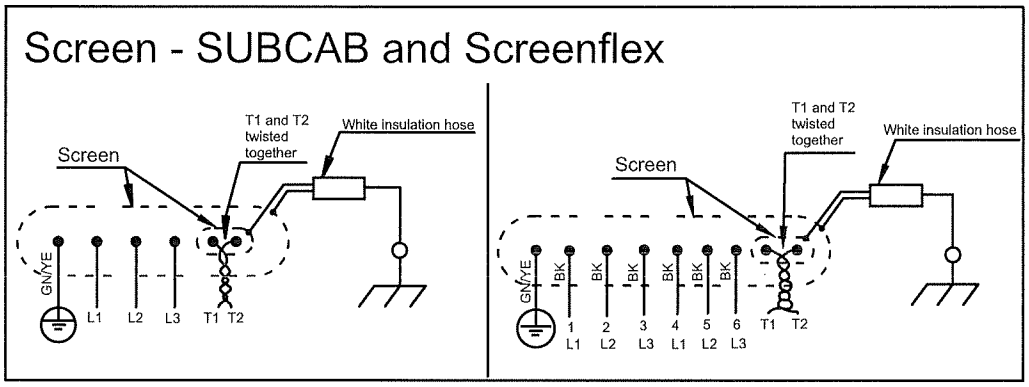


Figure 18: Without built-in starter

For more information, see *Colors and markings of leads* on page 32.

4.9.6.5 Screened cable connection





Sensors connection

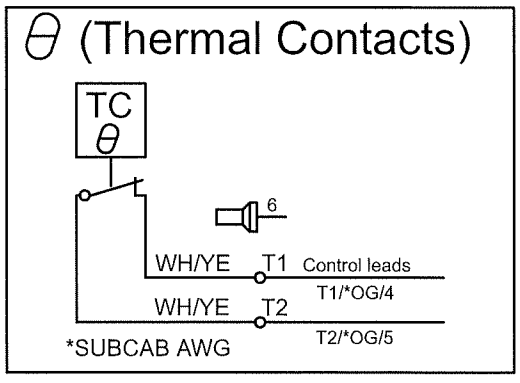
Not all charts are applicable for every product.

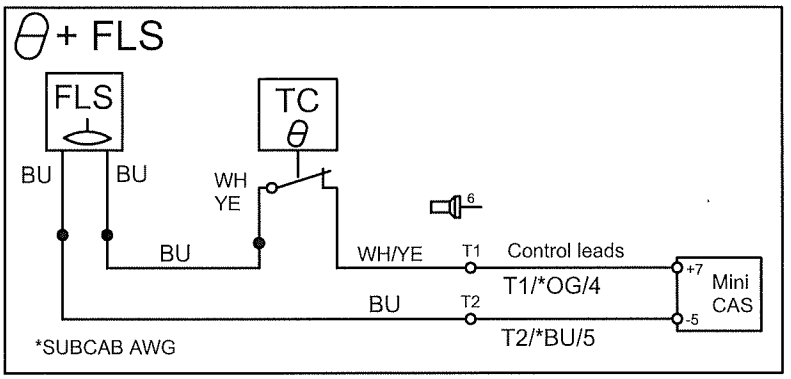
These sensor connections are applicable for 3–phase and 1–phase without built-in starter:

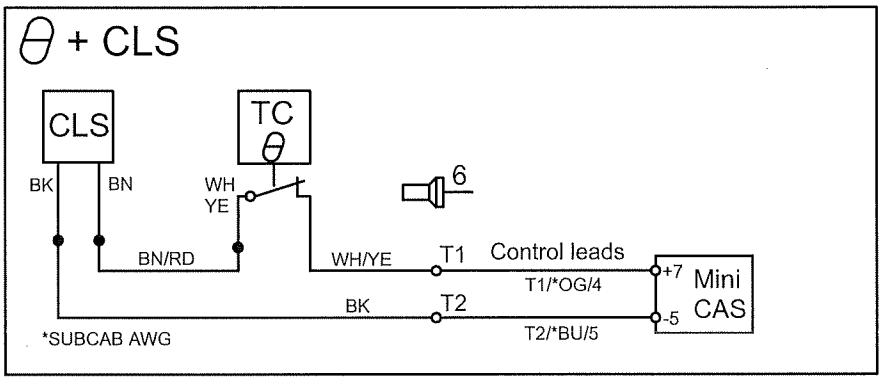
SENSORS

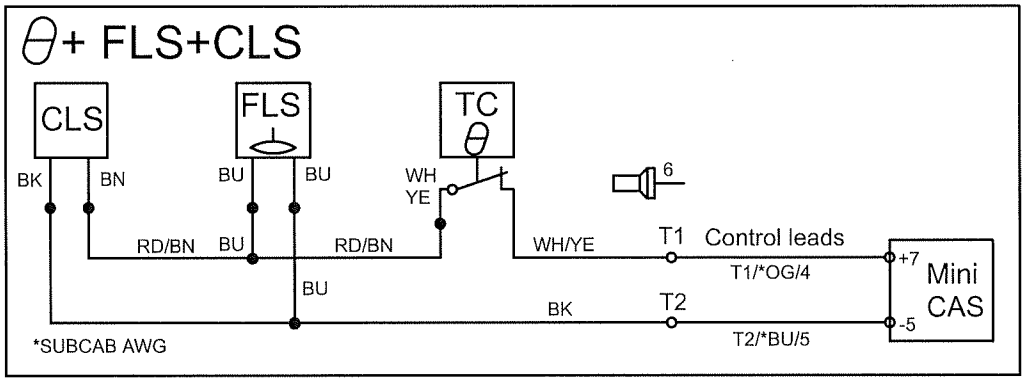
Control	SUBCAB 7GX & 4GX Screenflex	SUBCAB AWG	SUBCAB screened
T1	WH T1	OG	WH T1
T2	WH T2	BU	WH T2
T3	-	-	WH T3
T4	-	-	WH T4
*If Y/D-start, sensors not connected			

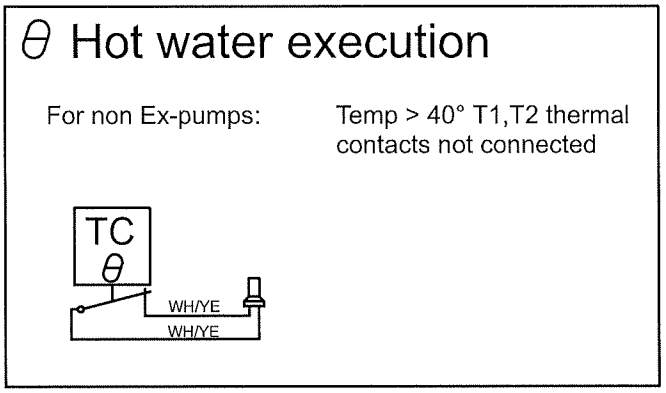
WS004130D











Sensor connection characteristics

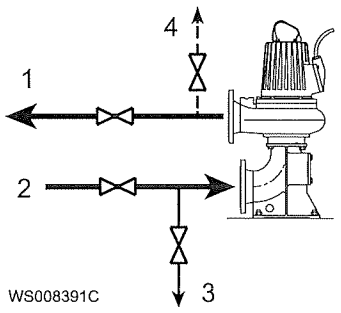
The values have a 10 % tolerance.

Sensors	Value (mA)	Definition
FLS and thermal contact	0	Overtemperature
	7.8	OK
	36	Leakage

Sensors	Value (mA)	Definition
CLS and thermal contact	0	Overtemperature
	5.5	OK
	29	Leakage (5 seconds delay)
CLS, FLS and thermal contact	0	Overtempterature
	13.3	OK
	36–42	Leakage (0/5 seconds delay)

4.10 T-installation: Bleed air before starting pump

1. Open the valve on the air vent line and bleed out the air. See the following figure.



1. Outlet line
2. Inlet line
3. Line to drain
4. Air vent

Figure 19: T-installation

2. Close the valve on the air vent line before the pump is started.

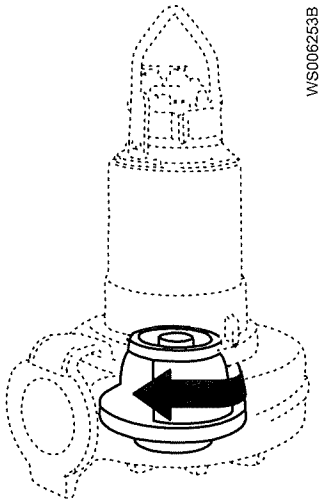
4.11 Check the impeller rotation



CAUTION: Crush Hazard

The starting jerk can be powerful. Make sure nobody is close to the unit when it is started.

1. Start the motor.
2. Stop the motor after a few seconds.
3. Check that the impeller rotates according to this illustration.



The correct direction of impeller rotation is clockwise when you look at the pump from above.

4. If the impeller rotates in the wrong direction, then do one of these steps:
   - If the motor has a 1-phase connection, then contact a sales or authorized service representative.
   - If the motor has a 3-phase connection, then transpose two phase leads and do this procedure again.

5 Operation

5.1 Precautions

Before taking the unit into operation, check the following:

- All recommended safety devices are installed.
- The cable and cable entry have not been damaged.
- All debris and waste material has been removed.

NOTICE:

Never operate the pump with the discharge line blocked, or the discharge valve closed.



WARNING: Crush Hazard

Risk of automatic restart.

Distance to wet areas



WARNING: Electrical Hazard

Risk of electrical shock or burn. You must connect an additional ground- (earth-) fault protection device to the grounded (earthed) connectors if persons are likely to come into contact with liquids that are also in contact with the pump or pumped liquid.



CAUTION: Electrical Hazard

Risk of electrical shock or burn. The equipment manufacturer has not evaluated this unit for use in swimming pools. If used in connection with swimming pools then special safety regulations apply.

Noise level

NOTICE:

The sound power level of the product is lower than 70 dB(A). However, in some installations the resulting sound pressure level may exceed 70 dB(A) at certain operating points on the performance curve. Make sure that you understand the noise level requirements in the environment where the product is installed. Failure to do so may result in hearing loss or violation of local laws.

5.2 Estimate zinc anode replacement intervals

The mass and surface area of the zinc anodes are designed to protect the pump surface for 1 year in sea water with an average temperature of 20°C (68°F). Shorter inspection intervals and anode replacement can be required, depending upon the water temperature and the chemical composition as well as the presence of other metals in the vicinity of the pump.

The rate of zinc consumption, and the appropriate inspection intervals, can be estimated by measuring how much zinc is consumed during the first two months following installation.

Anodes are replaced when the anode mass is reduced to a selected fraction of its initial mass. The recommended interval for the selection fraction is 0.25–0.50 (25–50%).

1. Remove, weigh, and reinstall one or more of the exterior zinc anodes before starting up the pump.
2. After two months, remove and weigh the same zinc anode or anodes again.
3. Divide the lapsed time in days (between steps 1 and 2) by the anode weight loss in grams to get the calculated anode consumption rate (days/gram).

If multiple anodes were weighed, then use the anode which has lost the most weight for this calculation.

4. Calculate future replacement intervals so that they occur when the selected fraction of zinc is remaining.

:N

5.3 Start the pump



CAUTION: Crush Hazard

The starting jerk can be powerful. Make sure nobody is close to the unit when it is started.



CAUTION: Thermal Hazard

The surfaces or parts of the unit may become hot during operation. Allow surfaces to cool before starting work, or wear heat-protective clothing.

NOTICE:

Make sure that the rotation of the impeller is correct. For more information, see Check the impeller rotation.

1. Check the oil level in the oil housing.
2. Remove the fuses or open the circuit breaker, and check that the impeller can rotate freely.



WARNING: Crush Hazard

Never put your hand into the pump housing.

3. Conduct insulation test phase to ground. To pass, the value must exceed 5 megaohms.
4. Check that the monitoring equipment works.
5. Start the pump.

6 Maintenance

6.1 Precautions

Before starting work, make sure that the safety instructions have been read and understood.

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



DANGER: Inhalation Hazard

Before entering the work area, make sure that the atmosphere contains sufficient oxygen and no toxic gases.

WARNING: Biological Hazard

Infection risk. Rinse the unit thoroughly with clean water before working on it.

CAUTION: Crush Hazard

Make sure that the unit cannot roll or fall over and injure people or damage property.

Make sure that you follow these requirements:

- Check the explosion risk before you weld or use electrical hand tools.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product and its components have been thoroughly cleaned.
- Before starting work, make sure that the work area is well-ventilated.
- Do not open any vent or drain valves or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.

Ground continuity verification

A ground (earth) continuity test must always be performed after service.

6.2 Maintenance guidelines

During the maintenance and before reassembly, always remember to perform these tasks:

- Clean all parts thoroughly, particularly O-ring grooves.
- Change all O-rings, gaskets, and seal washers.
- Lubricate all springs, screws, O-rings with grease.

During the reassembly, always make sure that existing index markings are in line.

The reassembled drive unit must always be insulation-tested and the reassembled pump must always be test-run before normal operation.

6.3 Torque values

All screws and nuts must be lubricated to achieve correct tightening torque. Screws that are screwed into stainless steel must have the threads coated with applicable lubricants to prevent seizing.

If there is a question regarding the tightening torques, then contact a sales or authorized service representative.

Screws and nuts

Table 1: Stainless steel, A2 and A4, torque Nm (lbf·ft)

Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
50	1.0 (0.74)	2.0 (1.5)	3.0 (2.2)	8.0 (5.9)	15 (11)	27 (20)	65 (48)	127 (93.7)	220 (162)	434 (320)
70, 80	2.7 (2)	5.4 (4)	9.0 (6.6)	22 (16)	44 (32)	76 (56)	187 (138)	364 (268)	629 (464)	1240 (915)
100	4.1 (3)	8.1 (6)	14 (10)	34 (25)	66 (49)	115 (84.8)	248 (183)	481 (355)	—	—

Table 2: Steel, torque Nm (lbf·ft)

Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
8.8	2.9 (2.1)	5.7 (4.2)	9.8 (7.2)	24 (18)	47 (35)	81 (60)	194 (143)	385 (285)	665 (490)	1310 (966.2)
10.9	4.0 (2.9)	8.1 (6)	14 (10)	33 (24)	65 (48)	114 (84)	277 (204)	541 (399)	935 (689)	1840 (1357)
12.9	4.9 (3.6)	9.7 (7.2)	17 (13)	40 (30)	79 (58)	136 (100)	333 (245)	649 (480)	1120 (825.1)	2210 (1630)

Table 3: Brass, torque Nm (lbf·ft)

M5	M8	M10
2.7 (2.0)	11 (8.1)	22 (16.2)

Hexagon screws with countersunk heads

For hexagon socket head screws with countersunk head, maximum torque for all property classes must be 80% of the values for property class 8.8.

Round nuts with set screws

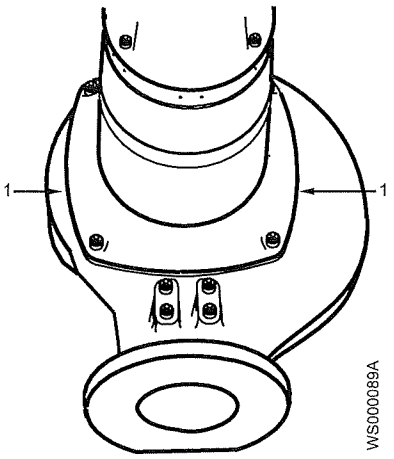
Table 4: Set screw, torque Nm (lbf·ft)

The torque values are only valid for the set screw, and not for the round nut.

M8	M10
18 (13)	35 (26)

6.4 Change the oil

This image shows the plugs that are used to change the oil.



1. Oil plug

Empty the oil

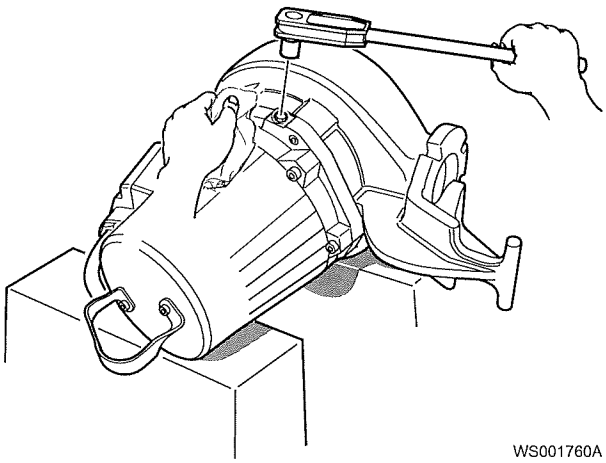


CAUTION: Compressed Gas Hazard

Air inside the chamber may cause parts or liquid to be propelled with force. Be careful when opening. Allow the chamber to de-pressurize before removal of the plug.

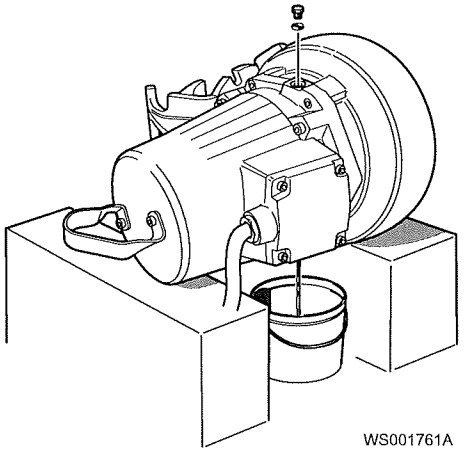
1. Place the pump in a horizontal position and unscrew the oil plug.

   If the pump has a hole with the markings "oil out" it is important that this hole is used for drainage.



2. Place a container under the pump and turn the pump.
3. Unscrew the other oil plug.

   If this hole has the markings "oil in", raise the pump upright for a short period of time during drainage in order to drain all the oil.

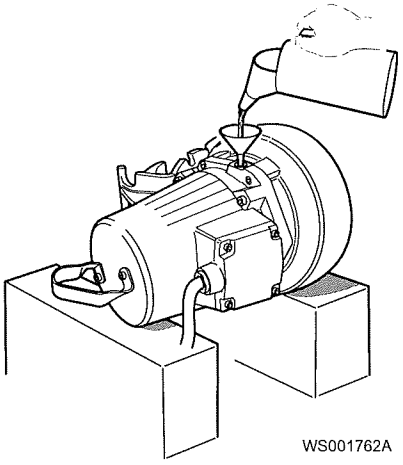


Fill with oil

The oil should be a medical white oil of paraffin type that fulfills FDA 172.878 (a) and viscosity close to VG32. Examples of suitable oil types are the following:

- Statoil MedicWay 32™
- BP Enerpar M 004™
- Shell Ondina 927™
- Shell Ondina X430™

1. Replace the O-rings of the oil plugs.
2. Refit an oil plug in the hole that faces downwards or is marked "oil out", and tighten.
   Tightening torque: 10-40 Nm (7.5-29.5 ft-lb)
3. Fill with oil through the hole on the opposite side or the hole marked "oil in".
   If the hole is marked "oil in", slightly tilt the pump and lower it again in order to fill the pump with the correct quantity.
   Quantity: approximately 1.0 L (1.1 qt).



4. Refit the oil plug and tighten.
   Tightening torque: 10-40 Nm (7.5-29.5 ft-lb).

6.5 Service the pump

Type of maintenance	Purpose	Inspection interval
Initial inspection	A Xylem-authorized personnel checks the pump condition. From the results, the personnel recommends the intervals for the periodical inspection and overhaul for the installation.	Within the first year of operation.

Type of maintenance	Purpose	Inspection interval
Periodical inspection	The inspection prevents operational interruptions and machine breakdowns. The measures to increase performance and pump efficiency are decided for each application. They can include such things as impeller trimming, wear part control and replacement, control of zinc-anodes and control of the stator.	Up to every year Applies to normal applications and operating conditions at media (liquid) temperatures <40°C (104°F).
Overhaul	The overhaul lengthens the operating lifetime of the product. It includes the replacement of key components and the measures that are taken during an inspection.	Up to every three years Applies to normal applications and operating conditions at media (liquid) temperatures <40°C (104°F).

NOTICE:

Shorter intervals may be required when the operating conditions are extreme, for example with very abrasive or corrosive applications or when the liquid temperatures exceed 40°C (104°F).

6.5.1 Inspection

Service item	Action
Cable	1. If the outer jacket is damaged, then replace the cable. 2. Check that the cables do not have any sharp bends and are not pinched.
Connection to power	Check that the connections are properly secured.
Electrical cabinets	Check that they are clean and dry.
Impeller	1. Check the impeller clearance. 2. Adjust the impeller, if necessary.
Stator housing	1. Drain all liquid, if any. 2. Check the resistance of the leakage sensor. Normal value approximately1500 ohms, alarm approximately 430 ohms.
Insulation	Use a megger maximum 1000 V. 1. Check that the resistance between the ground (earth) and phase lead is more than 5 megohms. 2. Conduct a phase-to-phase resistance check.
Junction box	Check that it is clean and dry.
Lifting device	Check that the local safety regulations are followed.
Lifting handle	1. Check the screws. 2. Check the condition of the lifting handle and the chain. 3. If necessary, replace.
O-rings	1. Replace the oil plug O-rings. 2. Replace the O-rings at the entrance or junction cover. 3. Grease the new O-rings.
Overload protection and other protections	Check the correct settings.
Personnel safety devices	Check the guard rails, covers, and other protections.
Rotation direction	Check the impeller rotation.
Oil housing	Fill with new oil, if necessary.
Terminal block/closed end splice	Check that the connections are properly secured.

Service item	Action
Thermal contacts	Normally closed circuit; interval 0–1 ohm.
Voltage and amperage	Check the running values.

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6.5.2 Overhaul

The basic repair kit includes O-rings, seals, and bearings.

For an overhaul, do the following in addition to the tasks listed under Inspection.

Service item	Action
Support and main bearing	Replace the bearings with new bearings.
Mechanical seal	Replace with new seal units.

6.5.3 Service in case of alarm

For information about indication values for sensors, see *Sensors connection* on page 37.

Alarm source	Action
CLS	Check for water in the oil housing. If the oil contains too much water, then do the following: 1. Drain the oil and water. 2. Replace with new oil.
FLS	1. Check for liquid in the stator housing. 2. Drain all liquid, if any. 3. Check the mechanical seal unit, the O-rings, and the cable entry, if liquid was found.
Thermal contact	Check the start and stop levels.
The overload protection	Check that the impeller can rotate freely.

6.6 Replace the impeller

Required tools:

- 6 mm hexagon bit adapter with an extension of at least 125 mm (4.92 in)
- Impeller puller

  If applicable, contact your local sales and service representative for correct type and size.
- Rod (wood or copper) for locking the impeller in position, if applicable
- Two crowbars, if applicable



CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

NOTICE:

When laying the pump on its side, do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

If you fail with the impeller installation, then you must redo the installation procedure from the beginning.

6.6.1 Replace the D-impeller

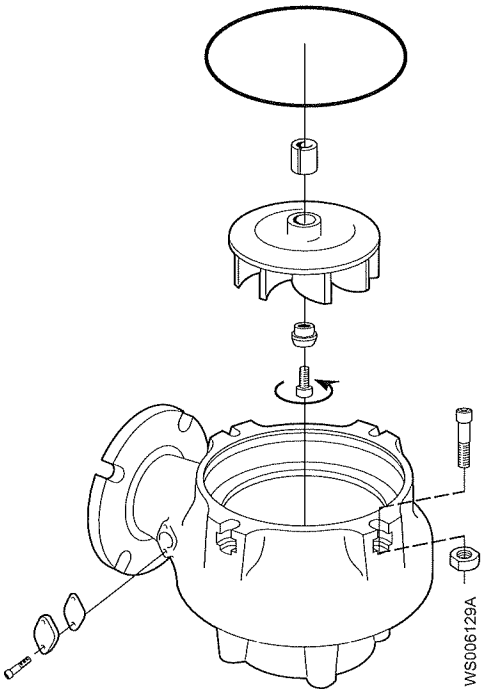


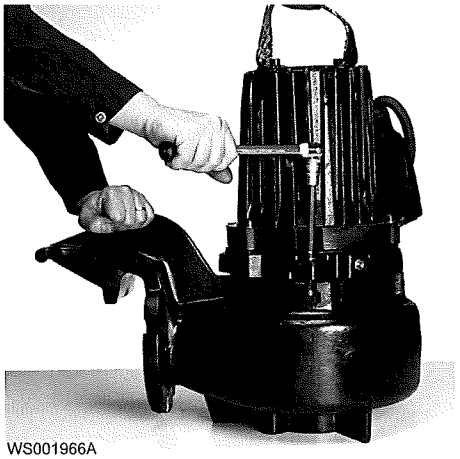
Figure 20: D-impeller

6.6.1.1 Remove the D-impeller

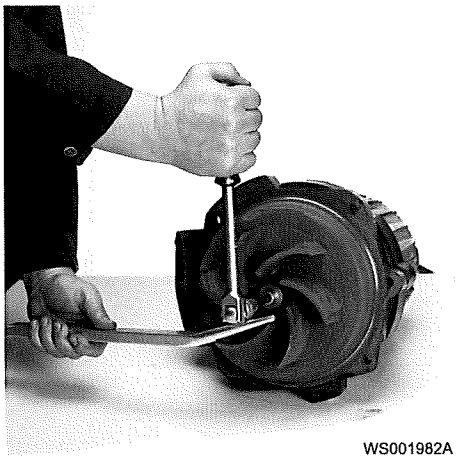
CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

1. Remove the pump housing.



2. Remove the impeller screw.
   If applicable, use the rod.



WS001982A

3. Remove the impeller.

   Use the impeller puller or the crowbars.



WS001978A

4. Remove the conical sleeve.

6.6.1.2 Install the D-impeller

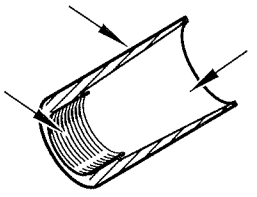
1. Prepare the shaft:
   a) Polish off any flaws by using a fine emery cloth.

      The end of the shaft must be clean and free from burrs.
   b) Coat the inner conical, the outer cylindrical surfaces, and the thread of the conical sleeve with a thin layer of grease.

      The correct lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

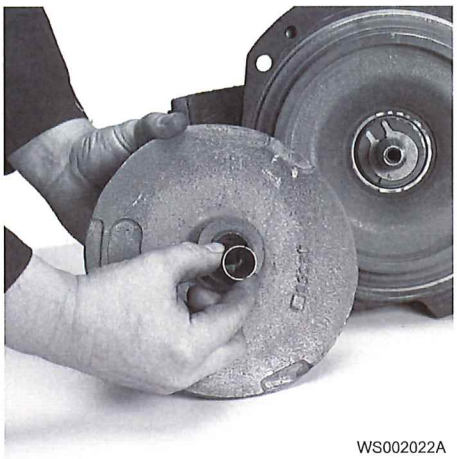
NOTICE:

Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.



WS006895A

2. Mount the impeller:
   a) Fit the conical sleeve onto the shaft.



WS002022A

b) Lubricate the impeller screw threads and contact surface.
   Ensure that all parts are clean.
c) Press the impeller onto the shaft with the impeller screw.

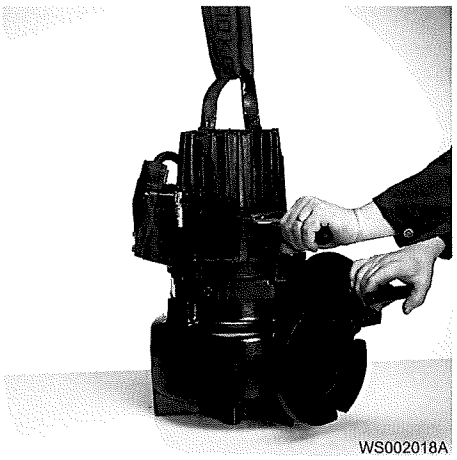
3. Tighten the impeller screw.
   Tightening torque: 34 Nm (25 ft-lb).
   Tighten a further 1/8 turn, 45° after tightening to the correct torque.
   If applicable, use the rod.



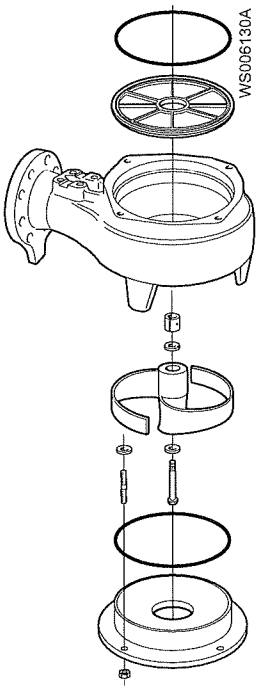
WS001941A

   Check that the impeller can rotate freely.

4. Mount the pump housing:
   a) Fit the pump housing.
   b) Fit and tighten the lubricated screws.
      Tightening torque: 57 Nm (42 lbf·ft)



6.6.2 Replace the F-impeller

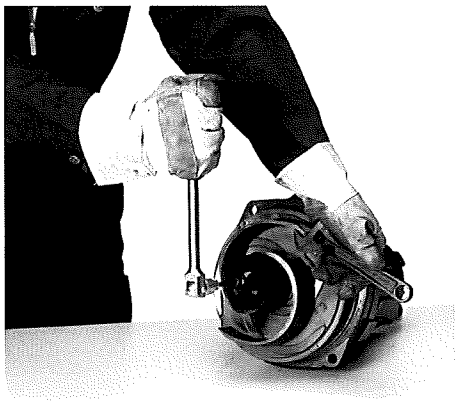


6.6.2.1 Remove the F-impeller

CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

1. Remove the suction cover.
   If necessary, then pry off the suction cover.
2. Remove the impeller screw, the ring, and the washers.
   If applicable, use the rod.



WS001976A

3. Remove the impeller.

   Use the impeller puller or the crowbars.

   Use the impeller screw to push the impeller.

4. Remove the conical sleeve.

6.6.2.2 Install the F-impeller

1. Prepare the shaft:
   a) Polish off any flaws by using a fine emery cloth.

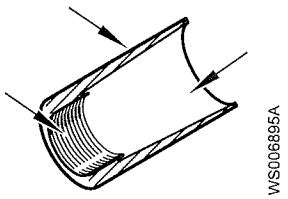
      The end of the shaft must be clean and free from burrs.

   b) Coat the inner conical, the outer cylindrical surfaces, and the thread of the conical sleeve with a thin layer of grease.

      The correct lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

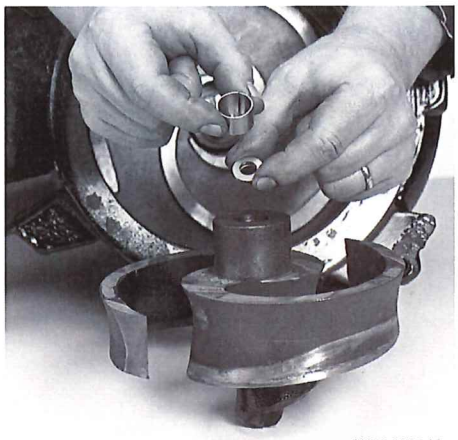
NOTICE:

Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.



WS006895A

2. Mount the impeller:
   a) Fit the conical sleeve onto the shaft.
   b) Fit one adjustment washer with a thickness of 0.25 mm (0.01 in) and two adjustment washers with a thickness of 1 mm (0.04 in) onto the impeller.



WS002021A

c) Lubricate the impeller screw threads and contact surface.

Ensure that all parts are clean.

d) Press the impeller onto the shaft with the impeller screw.

3. Fasten the impeller:

a) Prevent the impeller from rotating by inserting the rod through the pump housing outlet.

b) Tighten the impeller screw.

If applicable, use the rod.

Tightening torque: 30 Nm (22 ft-lb).

Tighten a further 1/8 turn, 45° after tightening to the correct torque.



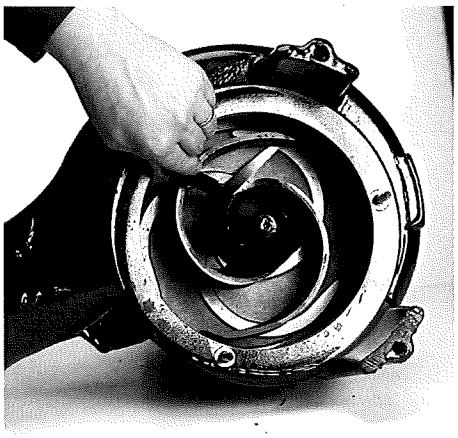
WS001940A

Check that the impeller can rotate freely.

4. Adjust the impeller:

a) Measure the distance between the edge of the impeller and the pump housing cover.

The correct distance should be 0.5-1.5 mm (0.02-0.06 in). Add or remove the appropriate number of adjusting washers in order to achieve correct distance.



WS002107A

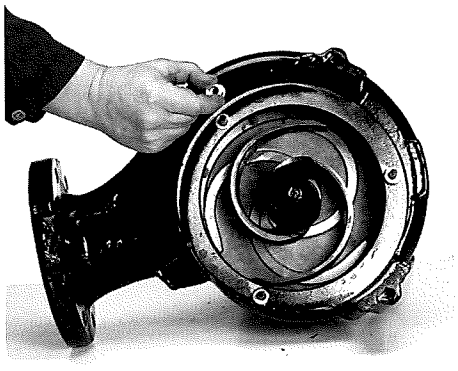
b) Tighten the impeller screw.
   If applicable, use the rod.
   Tightening torque: 30 Nm (22 ft-lb).
   Tighten a further 1/8 turn, 45° after tightening to the correct torque.
   Check that the impeller can rotate freely.

5. Fit a new lubricated O-ring to the into the groove in the pump housing.



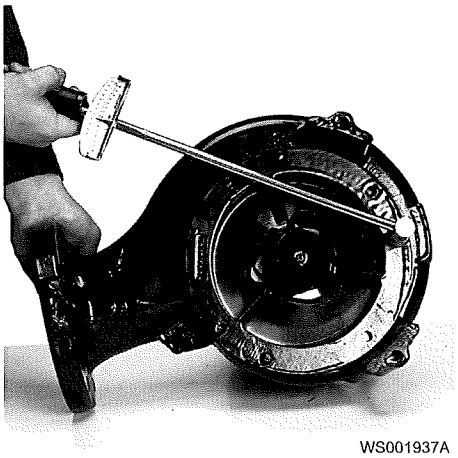
WS002080A

6. Mount the suction cover:
   a) Fit the studs on the pump housing.
      Use Loctite 603 locking liquid in order to secure the studs.
   b) Fit two adjustment washers with a thickness of 1 mm (0.04 in) and six adjustment washers with a thickness of 0.25 mm (0.01 in) onto each stud.



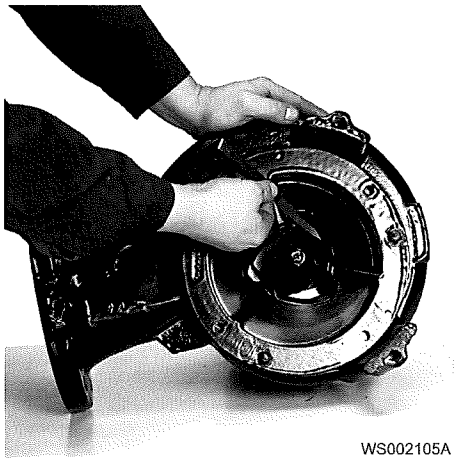
WS002014A

c) Fit the suction cover to the studs.
d) Fit the lock nuts onto the studs.
e) Tighten the nuts.
Tightening torque: 17 Nm (13 ft-lb)



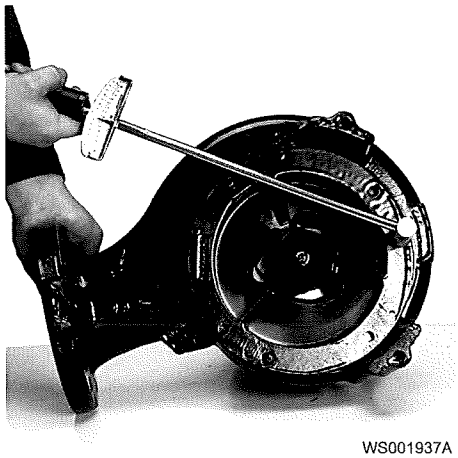
WS001937A

7. Adjust the suction cover:
a) Measure the distance between the impeller and the suction cover.
The correct distance should be 0.5-1 mm (0.02-0.04 in). Add or remove the appropriate number of adjusting washers in order to achieve the correct distance.



WS002105A

b) Tighten the nuts.
Tightening torque: 17 Nm (13 ft-lb).



WS001937A

8. Raise the pump to a vertical position.

Check that the impeller can rotate freely.

6.6.3 Replace the M-impeller

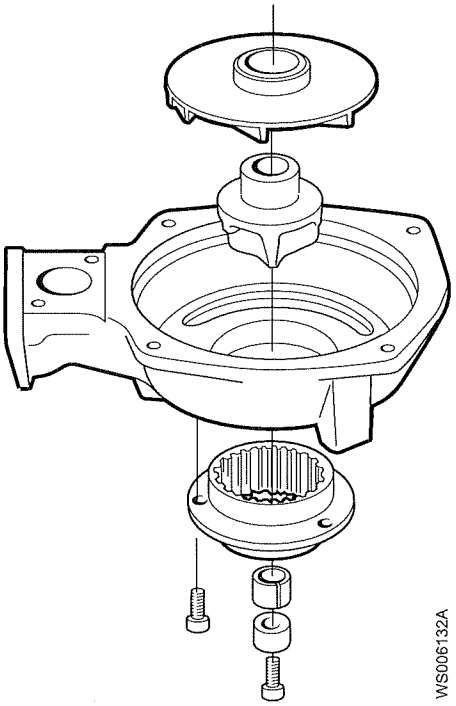


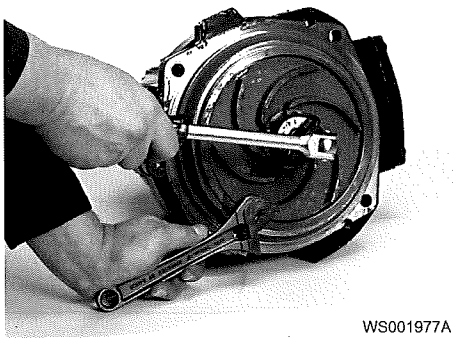
Figure 21: M-impeller

6.6.3.1 Remove the M-impeller

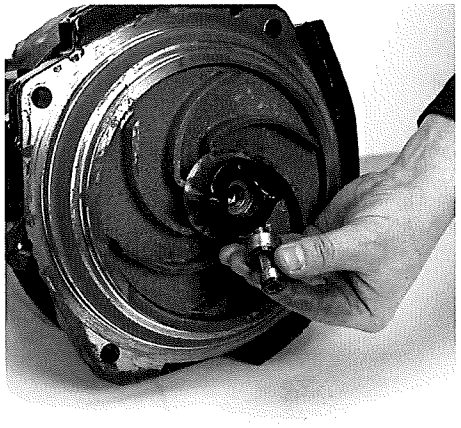
CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

1. Remove the pump housing.
2. Remove the impeller screw and outer sleeve.
   If applicable, use the rod.



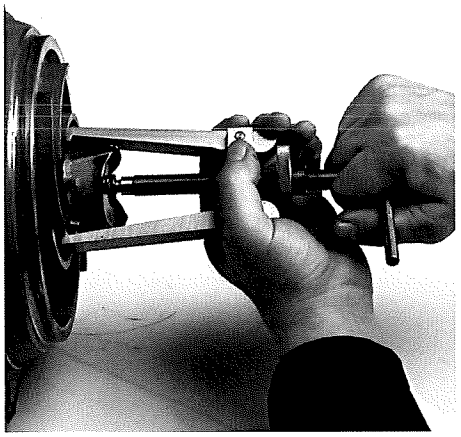
3. Refit the impeller screw.



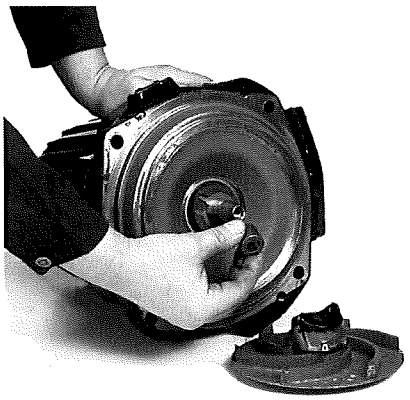
WS001993A

4. Fit the impeller puller and pull off the impeller and cutting wheel.
   Place a protector between the screw head and the impeller puller.

WS002006A



5. Remove the conical sleeve.



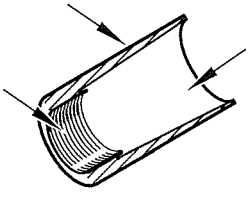
WS001987A

6.6.3.2 Install the M-impeller

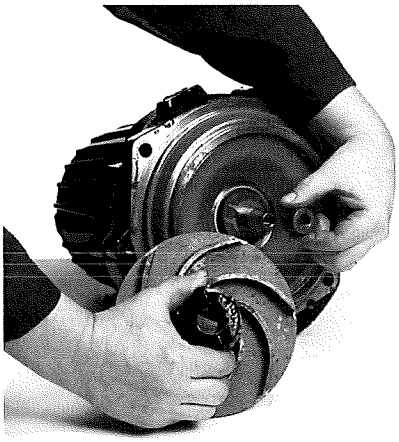
1. Prepare the shaft:
   a) Polish off any flaws by using a fine emery cloth.
      The end of the shaft must be clean and free from burrs.
   b) Coat the inner conical, the outer cylindrical surfaces, and the thread of the conical sleeve with a thin layer of grease.
      The correct lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

NOTICE:

Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.



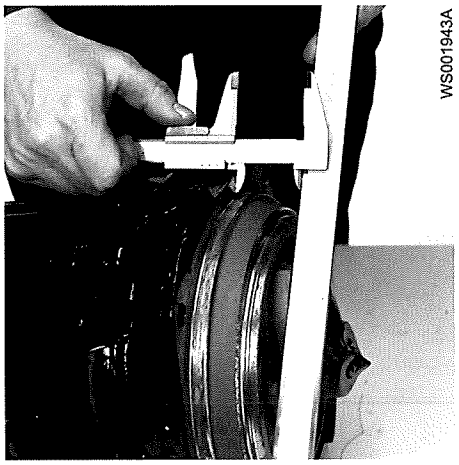
2. Mount the impeller:
   a) Fit the conical sleeve onto the shaft.



   b) Fit the cutting wheel into the impeller.
   c) Fit the outer sleeve onto the lubricated impeller screw.
   d) Fit the impeller with the cutting wheel onto the shaft with the impeller screw.

      Do not tighten the impeller screw.
3. Adjust the impeller:
   a) Use a straightedge and a vernier to measure the distance between the vanes of the impeller and the shoulder for the pump housing on the oil housing bottom.

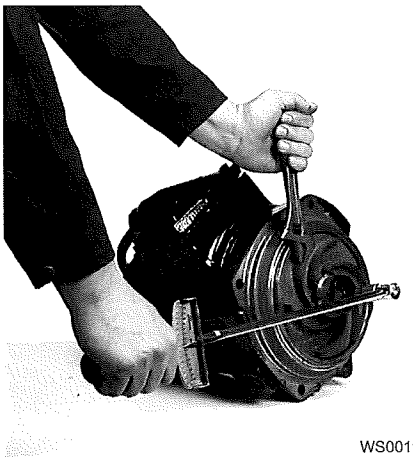
      The correct distance for pressure class LT and HT is 43.5±0.3 mm (1.71±0.01 in.).
   b) Slide the impeller on to the shaft until you reach the correct distance.



4. Tighten the impeller screw.

   If applicable, use the rod.

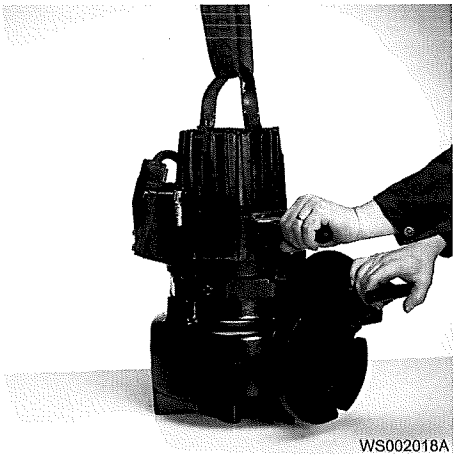
   Tightening torque: 34 Nm (25 ft-lbs)



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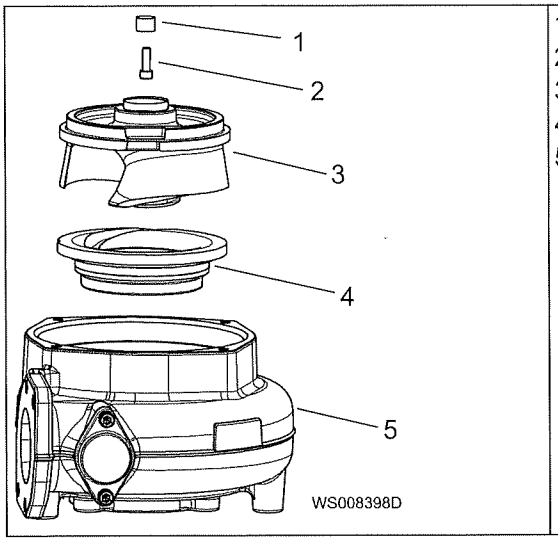
Check that the impeller can rotate freely.

5. Mount the pump housing:
   a) Fit the pump housing.
   b) Fit and tighten the lubricated screws.
      Tightening torque: 57 Nm (42 lbf·ft)

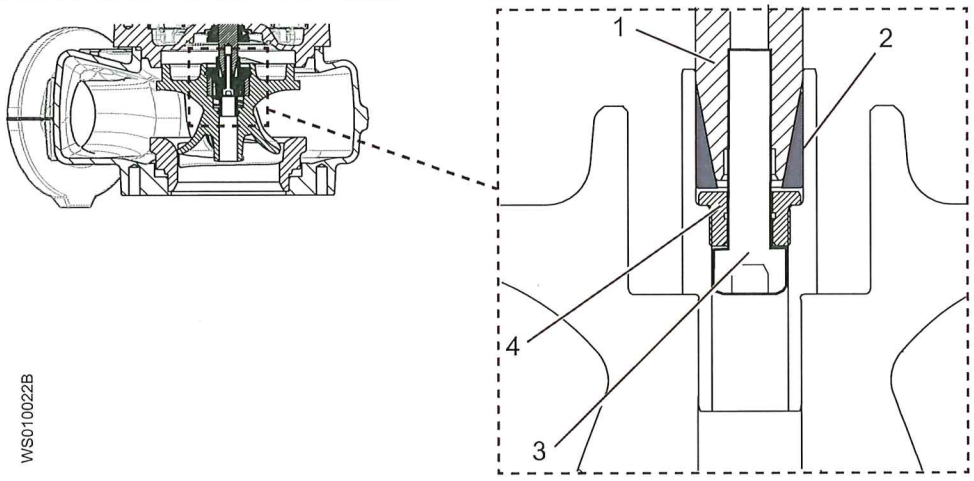


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6.6.4 Replacing the Adaptive N™ impeller



1. Conical sleeve
2. Impeller screw
3. Impeller
4. Insert ring
5. Pump housing



1. Shaft end
2. Conical sleeve
3. Impeller screw
4. Adjusting screw

CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

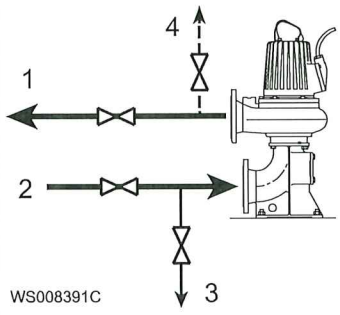
NOTICE:

When laying the pump on its side, do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

6.6.4.1 Prepare the pump for removal: T-, Z-installations

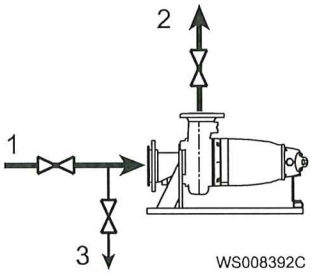
The pump must be removed from the installation to change the impeller.

1. Close the valves on the inlet and outlet lines.
   See the following figures.



1. Outlet line
2. Inlet line
3. Line to drain
4. Air vent

Figure 22: T-installation (generic pump shown)



1. Inlet line
2. Outlet line
3. Line to drain

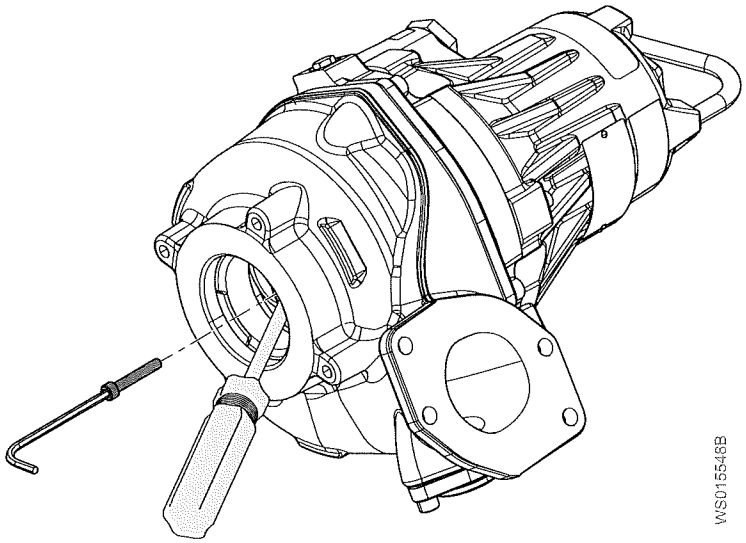
Figure 23: Z-installation (generic pump shown)

2. Drain the pump by opening the valve on the drain line.
3. Remove the pump from the installation.

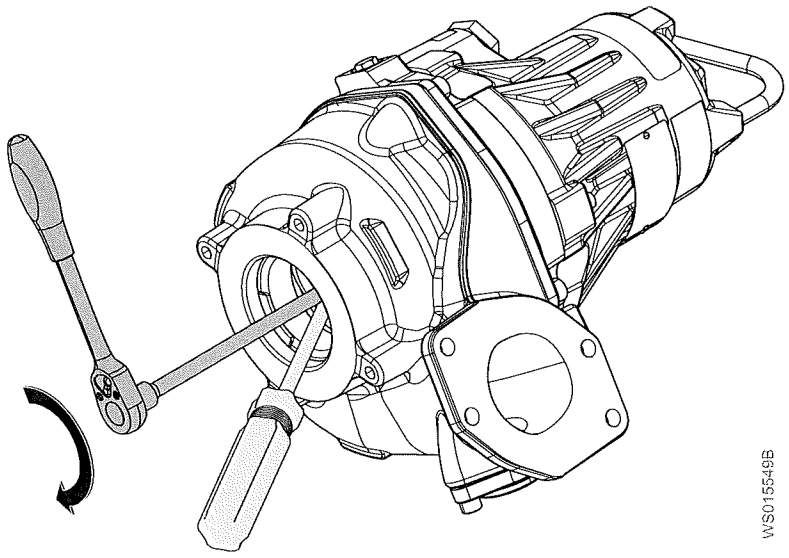
6.6.4.2 Remove the Adaptive N™ impeller: P, S, T, Z installations

To see which pumps are Adaptive N™, see *Product Description* on page 11.

1. Lock the impeller with a screwdriver through the inlet.
2. Remove the impeller screw.



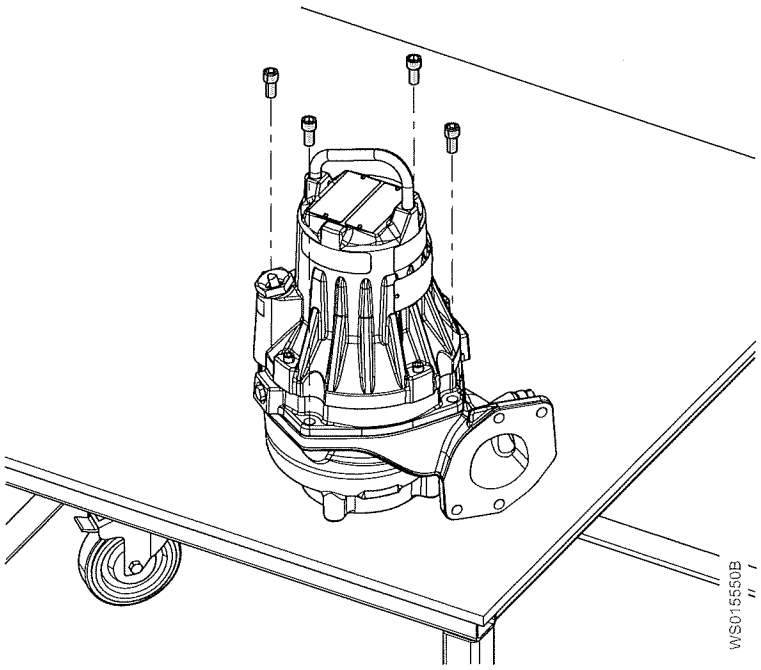
3. Insert a hexagon wrench and turn the adjusting screw clockwise until the impeller comes loose from the shaft.



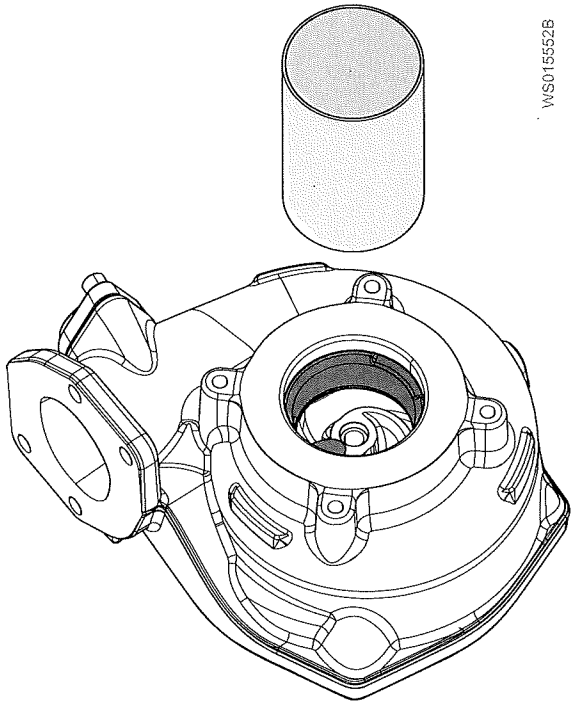
4. Put the pump in a vertical position.
5. Remove the four screws that attach the drive unit to the pump housing.

CAUTION: Crush Hazard

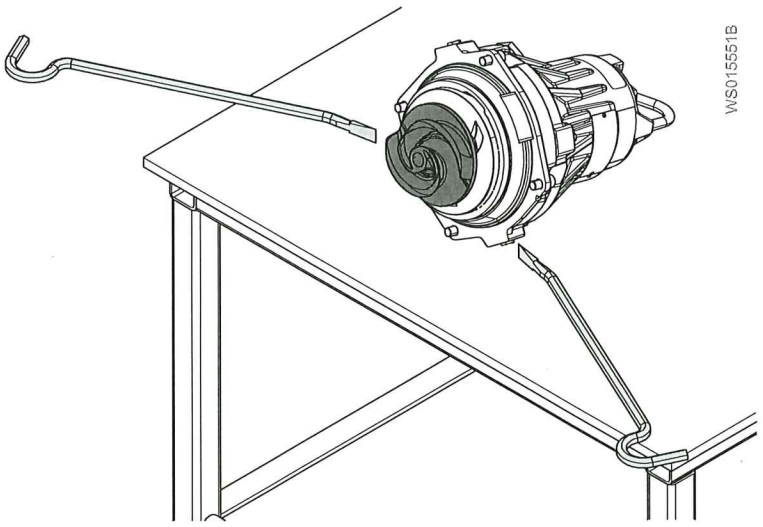
Make sure that the unit cannot roll or fall over and injure people or damage property.



6. Remove the drive unit from the pump housing.
   If the impeller is loose from the shaft, then the impeller rests in the pump housing.
7. Remove the insert ring only if it needs to be replaced:



   a) Turn the pump housing upside down and put it into a hydraulic press.
   b) Put a retention ring on the inlet.
   c) Use a suitable sleeve to press out the insert ring.
   d) Discard the insert ring.
8. If the impeller stays on the shaft, then remove the impeller by force:
   a) Put the drive unit in a horizontal position.
   b) Use crowbars to remove the impeller.



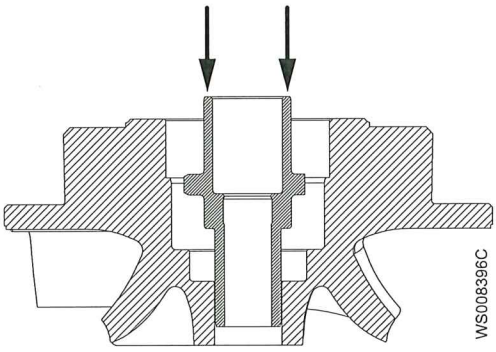
9. Remove the adjusting screw and the conical sleeve.

6.6.4.3 Install the Adaptive N™ impeller: P, S, T, Z installations

To see which pumps are Adaptive N™, see *Product Description* on page 11.

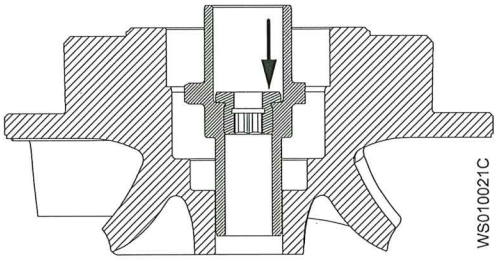
1. Before installing the impeller, check that the sleeve moves freely up and down by pushing it.

   When the sleeve is released, it should be fully pushed out again. If the sleeve does not move freely, or does not come fully out, then replace the impeller unit.



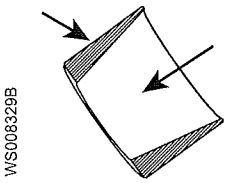
2. Adjust the adjusting screw in the new impeller.

   The correct position is at the bottom without any tightening.



3. Prepare the shaft:
   a) Polish off any flaws by using a fine emery cloth.

      The end of the shaft must be clean and free from burrs.
   b) Coat the inner conic and the outer cylindrical surfaces of the sleeve with a thin layer of grease.

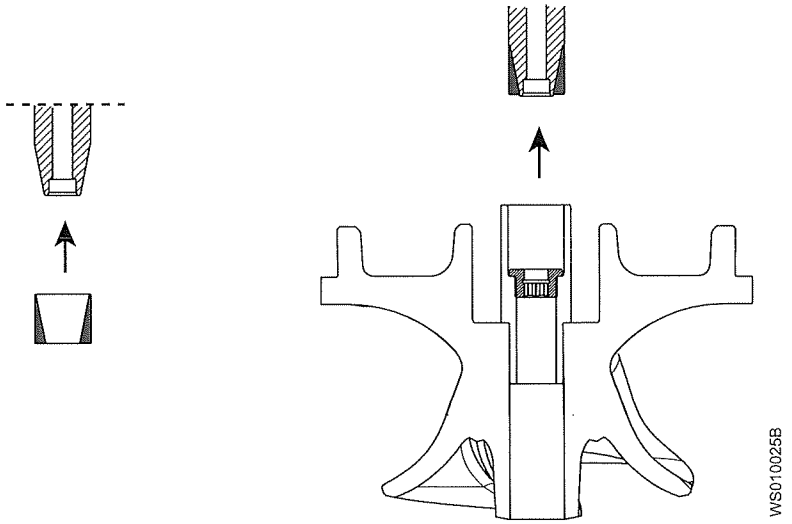


The correct lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

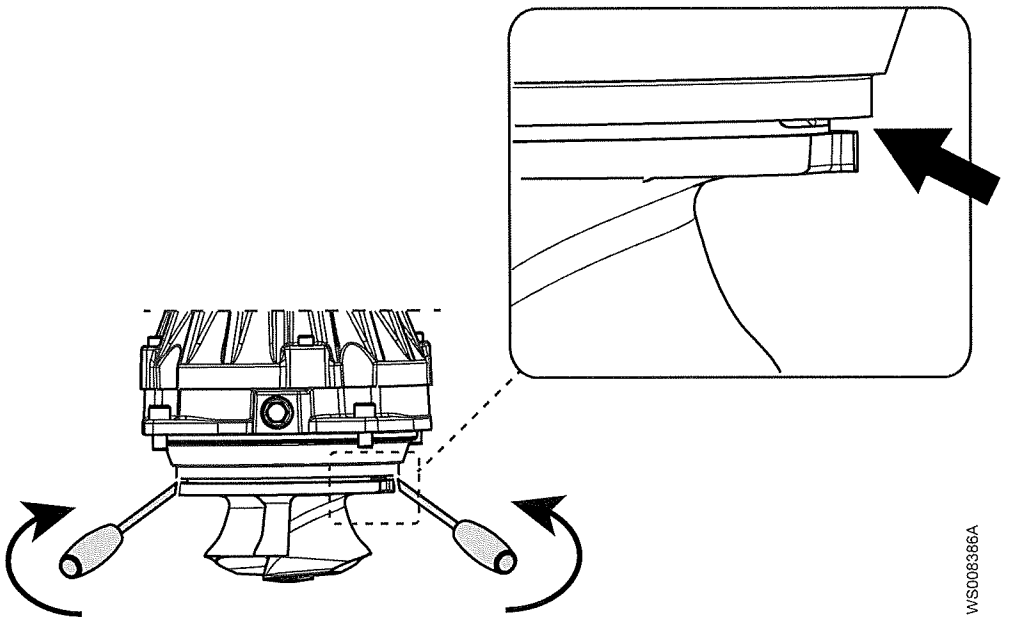
NOTICE:

Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.

4. Install the impeller sleeve and the impeller onto the shaft.



5. Apply grease on the impeller screw and use the screw to attach the impeller in position. Hand-tighten the screw.
6. Check that the impeller is in its lowest position:
   a) Insert two screwdrivers as shown in the following figure, and push the impeller downwards.



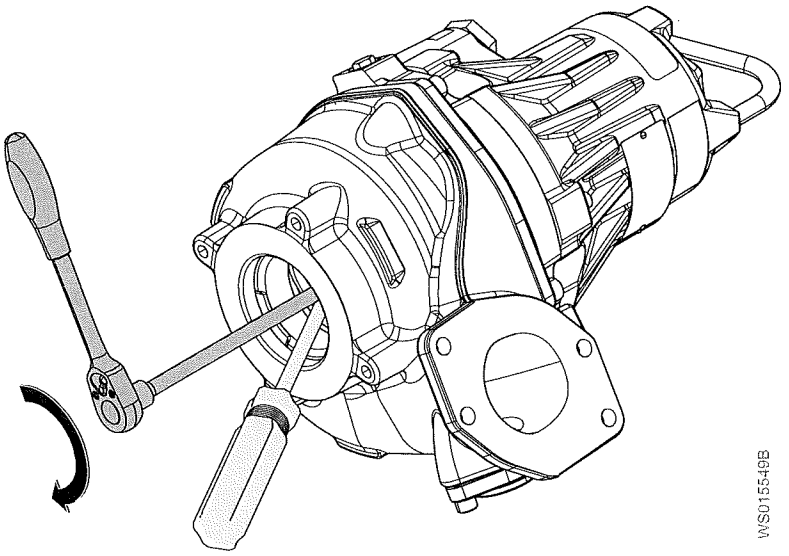
7. If the insert ring has been removed, then use a hydraulic press to install a new insert ring into the pump housing.

   Apply oil on the insert ring.

8. Mount the pump housing:
   a) Fit the pump housing.
   b) Fit and tighten the lubricated screws.

      Tightening torque: 57 Nm (42 lbf·ft)

9. Put the pump in a horizontal position.
10. Remove the impeller screw.
11. Lock the impeller with a screwdriver through the inlet.
12. Turn the adjustment screw clockwise until the impeller barely touches the insert ring.



13. Check that the impeller can rotate freely.

WARNING: Crush Hazard

Beware of the pinch point hazard between the rotating impeller and the guide pin.

14. Tighten the impeller screw.

    Tightening torque: 34 Nm (25 lbf·ft)

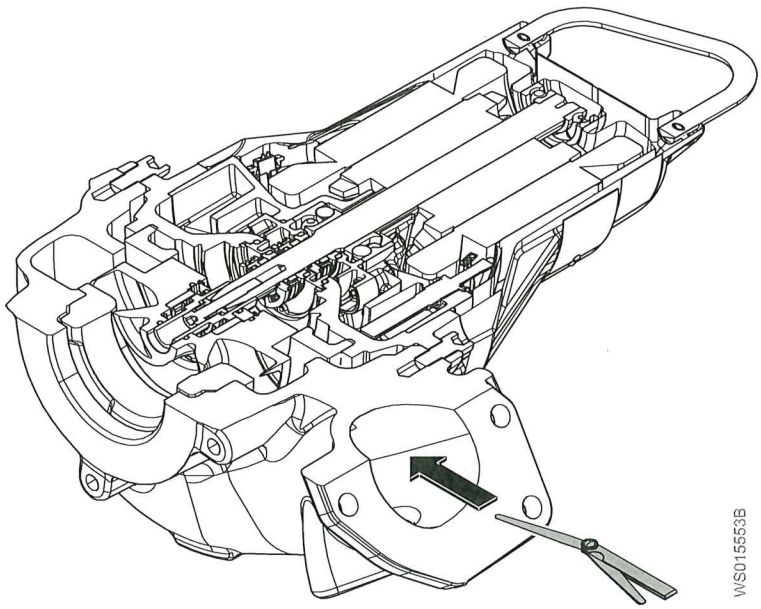
    Tighten a further 1/8 turn, 45°, after tightening to the correct torque.

15. Check that the impeller can rotate freely.

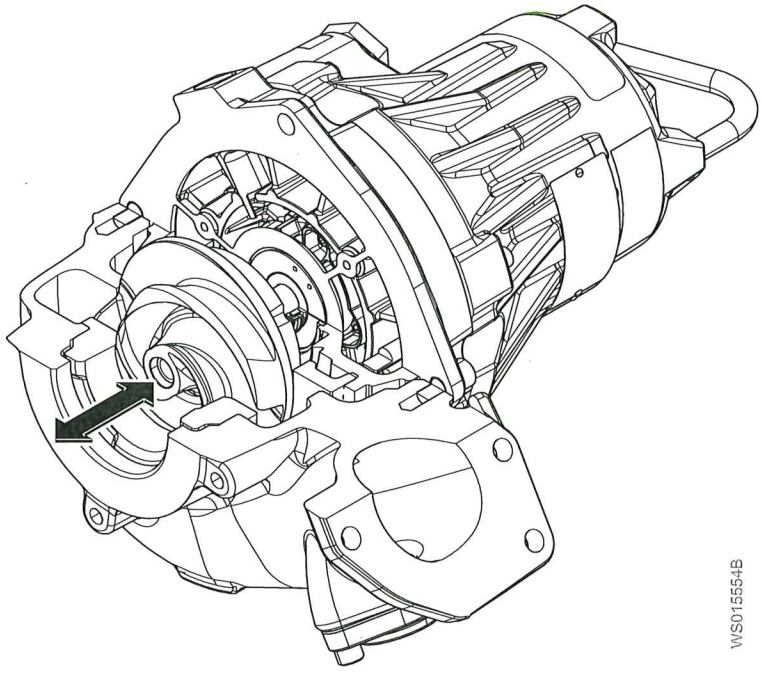
WARNING: Crush Hazard

Beware of the pinch point hazard between the rotating impeller and the guide pin.

16. Check with an extended feeler gauge that the impeller clearance is 0.1–0.6 mm (0.004–0.024 in).



17. To check the adaptive function, press the impeller from the inlet.
    Make sure that the impeller moves both away from the inlet and back again.



18. Reinstall the pump.
    T-installations: See the instructions in *T-installation: Bleed air before starting pump* on page 39.

7 Troubleshooting

7.1 Electrical troubleshooting



DANGER: Electrical Hazard

Troubleshooting a live control panel exposes personnel to hazardous voltages. Electrical troubleshooting must be done by a qualified electrician.

Follow these guidelines when troubleshooting:

- Disconnect and lock out the power supply except when conducting checks that require voltage.
- Make sure that no one is near the unit when the power supply is reconnected.
- When troubleshooting electrical equipment, use the following:
  - Universal instrument multimeter
  - Test lamp (continuity tester)
  - Wiring diagram

7.2 The pump does not start



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.





WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
An alarm signal has been triggered on the control panel.	Check that: • The impeller rotates freely. • The sensor indicators do not indicate an alarm. • The overload protection is not tripped.
The pump does not start automatically, but can be started manually.	Check that: • The start level regulator is functioning. Clean or replace if necessary. • All connections are intact. • The relay and contactor coils are intact. • The control switch (Man/Auto) makes contact in both positions. Check the control circuit and functions.

Cause	Remedy
The installation is not receiving voltage.	Check that: • The main power switch is on. • There is control voltage to the start equipment. • The fuses are intact. • There is voltage in all phases of the supply line. • All fuses have power and that they are securely fastened to the fuse holders. • The overload protection is not tripped. • The motor cable is not damaged.
The impeller is stuck.	Clean: • The impeller • The sump in order to prevent the impeller from clogging again.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

7.3 The pump does not stop when a level sensor is used



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.





WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

Cause	Remedy
The pump is unable to empty the sump to the stop level.	Check that: • There are no leaks from the piping and/or discharge connection. • The impeller is not clogged. • The non-return valve(s) are functioning properly. • The pump has adequate capacity. For information: Contact a sales or authorized service representative.
There is a malfunction in the level-sensing equipment.	• Clean the level regulators. • Check the functioning of the level regulators. • Check the contactor and the control circuit. • Replace all defective items.
The stop level is set too low.	Raise the stop level.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

7.4 The pump starts-stops-starts in rapid sequence

Cause	Remedy
The pump starts due to back-flow which fills the sump to the start level again.	Check that: • The distance between the start and stop levels is sufficient. • The non-return valve(s) work(s) properly. • The length of the discharge pipe between the pump and the first non-return valve is sufficiently short.
The self-holding function of the contactor malfunctions.	Check: • The contactor connections. • The voltage in the control circuit in relation to the rated voltages on the coil. • The functioning of the stop-level regulator. • Whether the voltage drop in the line at the starting surge causes the contactor's self-holding malfunction.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

7.5 The pump runs but the motor protection trips



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.





WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The motor protection is set too low.	Set the motor protection according to the data plate and if applicable the cable chart.
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the wet well. • Check that the impeller is correctly trimmed.
The drive unit cannot receive full voltage on all three phases.	• Check the fuses. Replace fuses that have tripped. • If the fuses are intact, then notify a certified electrician.
The phase currents change, or they are too high.	Contact a sales or authorized service representative.
The insulation between the phases and ground in the stator is defective.	1. Use an insulation tester. Use a 1000 VDC insulation and continuity tester to check that the insulation between the phases, and between any phase and ground, is > 5 megohms. 2. If the insulation is less, then do the following: Contact a sales or authorized service representative.

Cause	Remedy
The density of the pumped fluid is too high.	Make sure that the maximum density is 1100 kg/m³ (9.2 lb/US gal) • Change the impeller, or • Change to a more applicable pump • Contact a sales or authorized service representative.
There is a malfunction in the overload protection.	Replace the overload protection.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

7.6 The pump delivers too little or no water



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.





WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The impeller rotates in the wrong direction.	• If it is a 3-phase pump, then transpose two phase leads. • If it is a 1-phase pump, then do the following: Contact a sales or authorized service representative.
One or more of the valves are set in the wrong positions.	• Reset the valves that are set in the wrong position. • Replace the valves, if necessary. • Check that all valves are correctly installed according to media flow. • Check that all valves open correctly.
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the sump. • Check that the impeller is properly trimmed.
The pipes are obstructed.	To ensure a free flow, clean out the pipes.
The pipes and joints leak.	Find the leaks and seal them.
There are signs of wear on the impeller, pump, and casing.	Replace the worn parts.
The liquid level is too low.	• Check that the level sensor is set correctly. • Depending on the installation type, add a means for priming the pump, such as a foot valve.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

8 Technical Reference

EN

8.1 Application limits

Data	Description
Liquid temperature	40°C (104°F) maximum The pump can be operated at full load only if at least half the stator housing is submerged. 3085.060, 3085.160, 3085.183, 3085.760: • Warm-liquid version: 70°C (158°F) maximum
pH of the pumped media (liquid)	5.5–14
Liquid density	1100 kg/m³ (9.2 lb for each US gal) maximum
Depth of immersion	Maximum 20 m (65 ft)
Other	For the specific weight, current, voltage, power ratings, and speed of the pump, see the data plate of the pump.

8.2 Motor data

Feature	Description
Motor type	3085.060/.070/.092/.160/.172/.183/.190/.760/.770/.891: • Squirrel-cage induction 3085.900/.910/.920/.930/.960/.970: • Line-started, permanent-magnet synchronous motor
Frequency	50 Hz or 60 Hz
Supply	1-phase or 3-phase
Starting method	• Direct on-line • Star-delta • Soft starter Not recommended for LSPM motors • Variable frequency drive (VFD)
Maximum starts for each hour	30 evenly spaced starts for each hour
Code compliance	IEC 60034-1
Voltage variation without overheating	±10%, if it does not run continuously at full load
Voltage imbalance tolerance	2%
Stator insulation class	H (180°C [356°F])

Motor encapsulation

Motor encapsulation is in accordance with IP68.

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1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

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xylem
Let's Solve Water

Xylem Water Solutions Global
Services AB 556782-9253
361 80 Emmaboda
Sweden
Tel: +46-471-24 70 00
Fax: +46-471-24 74 01
https://tpi.xylem.com

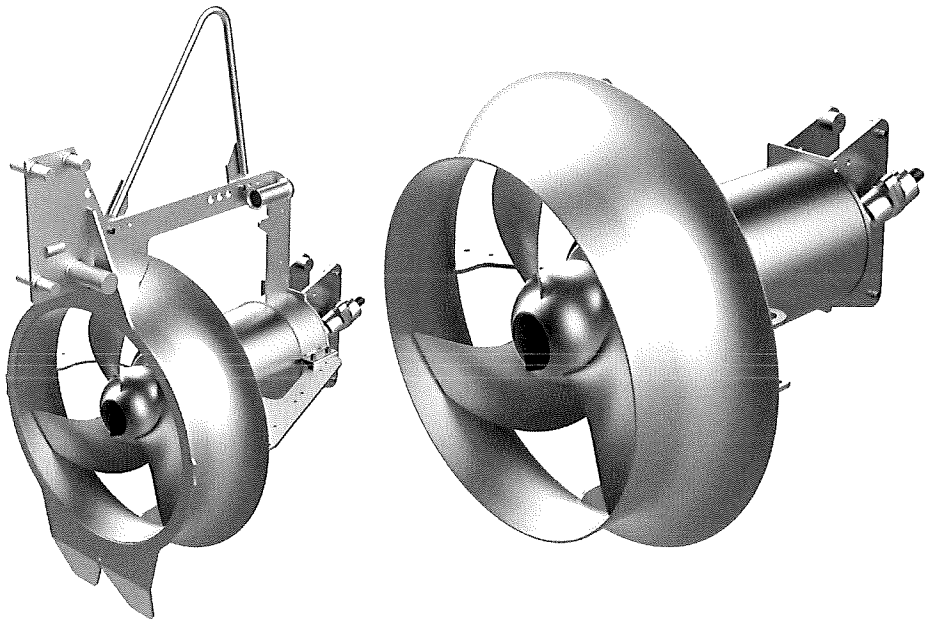
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xylem
Let's Solve Water

Installation, Operation, and
Maintenance Manual

896508_24.0



Flygt SR/PP 4650/4660

4650.310/.390/.412/.492,
4660.310/.390/.412/.492

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1 Introduction and Safety

1.1 Introduction

Purpose of the manual

The purpose of this manual is to provide the necessary information for working with the unit. Read this manual carefully before starting work.

Read and keep the manual

Save this manual for future reference, and keep it readily available at the location of the unit.

Intended use



WARNING:

Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment and the surroundings. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.

Other manuals

See also the safety requirements and information in the original manufacturer's manuals for any other equipment furnished separately for use in this system.

1.2 Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product and its surroundings
- Product malfunction

Hazard levels

Hazard level	Indication
 DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
 WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
 CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:	Notices are used when there is a risk of equipment damage or decreased performance, but not personal injury.

Special symbols

Some hazard categories have specific symbols, as shown in the following table.

Electrical hazard	Magnetic fields hazard
 Electrical Hazard:	 CAUTION:

1.3 User safety

All regulations, codes, and health and safety directives must be observed.

The site

- Observe lockout and tagout procedures before starting work on the product, such as transportation, installation, maintenance, or service.
- Pay attention to the risks presented by gas and vapors in the work area.
- Always be aware of the area surrounding the equipment, and any hazards posed by the site or nearby equipment.

Qualified personnel

This product must be installed, operated, and maintained by qualified personnel only.

Protective equipment and safety devices

- Use personal protective equipment as needed. Examples of personal protective equipment include, but are not limited to, hard hats, safety goggles, protective gloves and shoes, and breathing equipment.
- Make sure that all safety features on the product are functioning and in use at all times when the unit is being operated.

1.4 Ex-approved products

Follow these special handling instructions if you have an Ex-approved unit.

Personnel requirements

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and Xylem authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example, IEC/EN 60079-17).

Xylem disclaims all responsibility for work done by untrained and unauthorized personnel.

Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data.
- You must fully submerge the Ex-approved product during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.

- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an Ex-approved Xylem representative.
- Only use original Xylem spare parts that are provided by an Ex-approved Xylem representative.
- The thermal contacts that are fitted to the stator windings must be connected correctly to a separate motor control circuit and in use. The thermal contacts shall be connected to a monitoring device, which disconnects the power supply immediately upon activation. This action prevents the rise of temperatures above the temperature value for the approval classification.
- The width of flameproof joints is more than the values specified in the tables of the EN/IEC 60079-1 standard. For information contact the manufacturer.
- The gap of flameproof joints is less than the values specified in Table 2 of the EN/IEC 60079-1 standard. For information contact the manufacturer.
- It is NOT allowed to repair the flameproof joints.
- Ambient temperature:

Mixer	Temperature Class	Minimum Ambient Temperature	Maximum Ambient Temperature	Tcable (1)
4650.390, 4650.492, 4650.592, 4660.390, 4660.492	T4	–20°C	40°C	N/A (2)
			50°C	N/A (2)
			60°C	N/A (2)
			70°C	72°C
			80°C	82°C
			90°C	92°C
4650.390, 4650.492, 4650.592, 4660.390, 4660.492	T3	–20°C	40°C	N/A (2)
			50°C	N/A (2)
			60°C	77°C
			70°C	87°C
			80°C	97°C
			90°C	107°C

(1) Tcable: Cable entry temperature is required on the EN-approval and IEC-approval plates.

(2) There is no requirement for Tcable marking on the EN-approval and IEC-approval plates.

Guidelines for compliance

Compliance is fulfilled only when you operate the unit within its intended use. Do not change the conditions of the service without the approval of an Ex-approved Xylem representative. When you install or maintain explosion proof products, always comply with the directive and applicable standards (for example, IEC/EN 60079–14).

Minimum permitted liquid level

See the dimensional drawings of the product for the minimum permitted liquid level according to the approval for explosion proof products. If the information is missing on the dimensional drawing, the product must be fully submerged. Level-sensing equipment must be installed if the product can be operated at less than the minimum submersion depth.

Monitoring equipment

For additional safety, use condition-monitoring devices. Examples of condition-monitoring devices include, but are not limited to, the following:

- Level indicators
- Temperature detectors in addition to the stator thermal detectors

Any thermal detectors or thermal protection devices delivered with the pump must be installed and in use at all times.

The site owner is responsible for selection, installation, and proper maintenance of functional monitoring equipment for motor protection.

1.5 Special hazards

1.5.1 Confined spaces



DANGER: Inhalation Hazard

The chamber or tank where the equipment is installed should be treated as a confined space. Always follow the applicable safety laws, regulations and guidelines for confined spaces.

Never work alone in a confined space. Before entering the space, check that the following requirements are complied with:

- The atmosphere contains sufficient oxygen
- The atmosphere contains no explosive or toxic gases
- If there is a risk of insufficient oxygen or toxic or hazardous gases, then use an airline respirator or self-contained breathing apparatus.
- All energy sources are locked out and tagged out
- Adequate ventilation is in place
- There is a clear path of retreat
- Monitoring is in place for hazards which can develop after entering the confined space
- The applicable safety laws, regulations, and guidelines for confined spaces are understood and followed.

1.5.2 Drowning

Spaces that are not fully drained or dry can pose a risk of drowning. It takes relatively little standing water or other liquid to create a drowning hazard. For example, insufficient oxygen or the presence of a toxic material can make a worker unconscious, which makes them vulnerable to drowning if they fall face down into a small pool of water. Never work alone where there is a risk of drowning.

1.5.3 Biological hazards

The product is designed for use in liquids that can be hazardous to your health. Observe these rules when you work with the product:

- Make sure that all personnel who may come into contact with biological hazards are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.



WARNING: Biological Hazard

Infection risk. Rinse the unit thoroughly with clean water before working on it.

1.5.4 Wash the skin and eyes

Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

Condition	Action
Chemicals or hazardous fluids in eyes	1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.

Condition	Action
Chemicals or hazardous fluids on skin	1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least 1 minute. 3. Seek medical attention, if necessary.

1.6 Protecting the environment

Emissions and waste disposal

Observe the local regulations and codes regarding:

- Reporting of emissions to the appropriate authorities
- Sorting, recycling and disposal of solid or liquid waste
- Clean-up of spills

Exceptional sites



CAUTION: Radiation Hazard

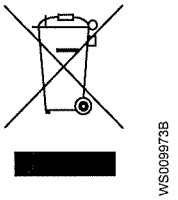
Do NOT send the product to Xylem if it has been exposed to nuclear radiation, unless Xylem has been informed and appropriate actions have been agreed upon.

1.7 End-of-life product disposal

Handle and dispose of all waste in compliance with local laws and regulations.

EU and UK only: Correct disposal of this product — waste electrical and electronic equipment

- EU: Directive 2012/19/EU on waste electrical and electronic equipment (WEEE)
- UK: SI 2013 No. 3113



This marking on the product, accessories or literature indicates that the product should not be disposed of with other waste at the end of its working life.

1.8 Spare parts



CAUTION:

Only use the manufacturer's original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the warranty.

1.9 Warranty

For information about warranty, see the sales contract.

2 Transportation and Storage

2.1 Examine the delivery

2.1.1 Examine the package

1. Examine the package for damaged or missing items upon delivery.
2. Record any damaged or missing items on the receipt and freight bill.
3. If anything is out of order, then file a claim with the shipping company.
   If the product has been picked up at a distributor, make a claim directly to the distributor.

2.1.2 Examine the unit

1. Remove packing materials from the product.
   Dispose of all packing materials in accordance with local regulations.
2. To determine whether any parts have been damaged or are missing, examine the product.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.
   Use care around nails and straps.
4. If there is any issue, then contact a sales representative.

2.2 Lifting guidelines

Position and fastening

The unit can be transported either horizontally or vertically. Make sure that the unit is correctly fastened during transportation, and cannot roll or fall over.

Center of gravity

The center of gravity of the assembled mixer depends on the combination of blades and motor.

2.2.1 Precautions

The precautions needed for transport depend on which situation is applicable:

- A new mixer is installed. See the following:
  - *Lifting* on page 8
- An installed mixer is to be moved to another site, for example for service. See both of the following:
  - *Lifting* on page 8
  - *Prepare for moving an assembled mixer* on page 9

2.2.2 Lifting

Always inspect the lifting equipment and tackle before starting any work.



WARNING: Crush Hazard

Always lift the unit by its designated lifting points.
Use suitable lifting equipment and ensure that the product is properly harnessed.
Wear personal protective equipment.
Stay clear of cables and suspended loads.

NOTICE:

Never lift the unit by its cables or hose.

Lifting equipment

Lifting equipment is always required to handle the unit. The lifting equipment must fulfill the following requirements:

- The minimum height between the lifting hook and the floor must be sufficient to lift the unit. Contact a Xylem representative for more information.
- The lifting equipment must be able to hoist the unit straight up and down, preferably without the need for resetting the lifting hook.
- The lifting equipment must be correctly anchored and in good condition.
- The lifting equipment must support the weight of the entire assembly. Only authorized personnel may use the lifting equipment.
- Two sets of lifting equipment must be used to lift the unit for repair work.
- The lifting equipment must be dimensioned to lift the unit with any remaining pumped media in it.
- The lifting equipment must not be oversized.



CAUTION: Crush Hazard

Improperly-dimensioned lifting equipment can lead to injury. A site-specific risk analysis must be done.

2.2.3 Prepare for moving an assembled mixer

This section describes some additional preparations for moving an assembled mixer. The requirements in these sections also apply when moving an assembled mixer:

- *Precautions* on page 8
- *Lifting* on page 8

A site-specific evaluation is needed. Items to be considered include the following:

- Are special precautions and personal protective equipment needed, at the installation?
- Does any nearby equipment require power lock out?
- Can the mixer be safely transported with the blades attached?

The immediate area surrounding the installed mixer

If the mixer is in service, then special precautions and personal protective equipment might be needed. A site-specific evaluation should be done before approaching the installation. See *Special hazards* on page 6.

Lock out power

Before starting work, the mixer and its control equipment must be locked out so that it cannot be energized. A site-specific evaluation must be done to determine if power lock-out is also needed on nearby equipment.



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

Propeller blades

Depending on the size of the propeller blades, it may be possible to transport the assembled mixer.

- If the blades are too long for safe transport, then the blades or the propeller must be removed.
- If the blades are short, then the mixer can be securely fastened on pallets or equivalent. If stacked pallets are used, then they must be securely strapped together.

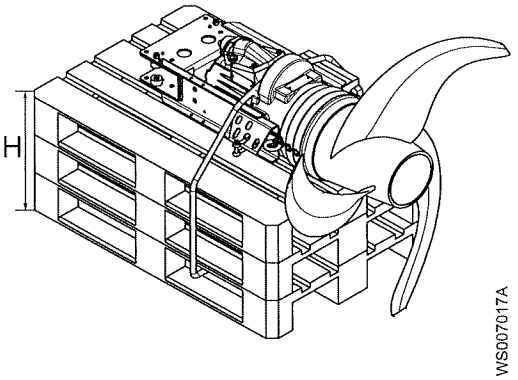


Figure 1: Generic mixer shown. Strapping pallets together is not shown.

H: This is the minimum height needed for the stacked pallets or equivalent.

The height must be greater than the blade length, so that the blades cannot reach the ground.

2.3 Temperature ranges for transportation, handling and storage

Handling at freezing temperature

At temperatures below freezing, the product and all installation equipment, including the lifting gear, must be handled with extreme care.

Make sure that the product is warmed up to a temperature above the freezing point before starting up. Avoid rotating the impeller/propeller by hand at temperatures below the freezing point. The recommended method to warm the unit up is to submerge it in the liquid which will be pumped or mixed.

NOTICE:

Never use a naked flame to thaw the unit.

Unit in as-delivered condition

If the unit is still in the condition in which it left the factory - all packing materials are undisturbed - then the acceptable temperature range during transportation, handling and storage is: –50°C (–58°F) to +60°C (+140°F).

If the unit has been exposed to freezing temperatures, then allow it to reach the ambient temperature of the sump before operating.

Lifting the unit out of liquid

The unit is normally protected from freezing while operating or immersed in liquid, but the impeller/propeller and the shaft seal may freeze if the unit is lifted out of the liquid into a surrounding temperature below freezing.

Follow these guidelines to avoid freezing damage:

1. Empty all pumped liquid, if applicable.
2. Check all liquids used for lubrication or cooling, both oil and water-glycol mixtures, for the presence of unacceptable amounts of water. Change if needed.

Water-glycol mixtures: Units equipped with an internal closed-loop cooling system are filled with a mixture of water and 30% glycol. This mixture remains a flowing liquid at temperatures down to –13°C (9°F). Below –13°C (9°F), the viscosity increases such that the glycol mixture will lose its flow properties. However, the glycol-water mixture will not solidify completely and thus cannot harm the product.

2.4 Storage guidelines

Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

NOTICE:

Protect the product against humidity, heat sources, and mechanical damage.

NOTICE:

Do not place heavy weights on the packed product.

Long-term storage

If the unit is stored for more than six months, then the following apply:

- Before operating the unit after storage, it must be inspected. Special attention must be given to the seals and the cable entry.
- The impeller or propeller must be rotated every other month to prevent the seals from sticking together.

3 Product Description

3.1 General description

Mixer design

The mixer is submersible and driven by an electric motor.

Intended use

The product is intended for moving waste water, sludge, raw and clean water. Always follow the limits given in *Application limits* on page 62. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.

Illustration

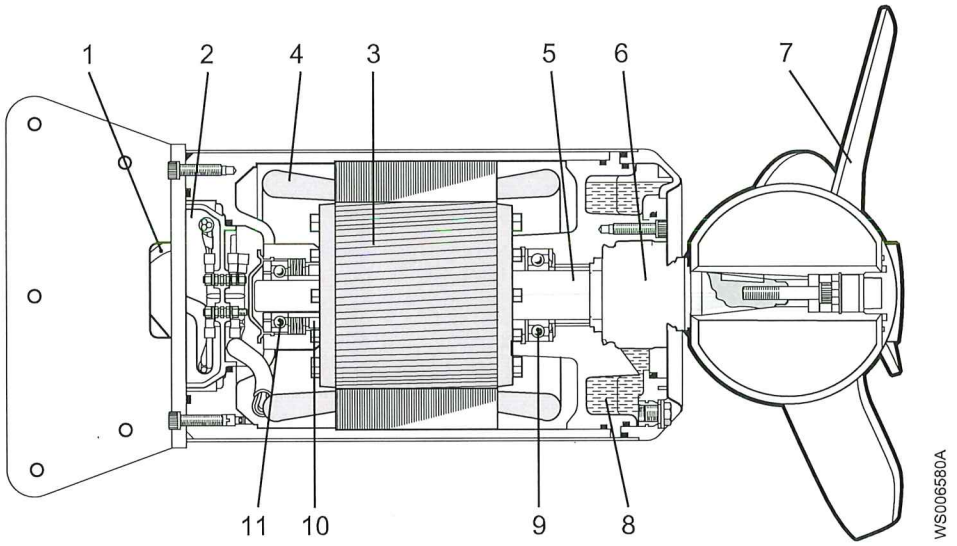


Figure 2: Versions .310 and .390

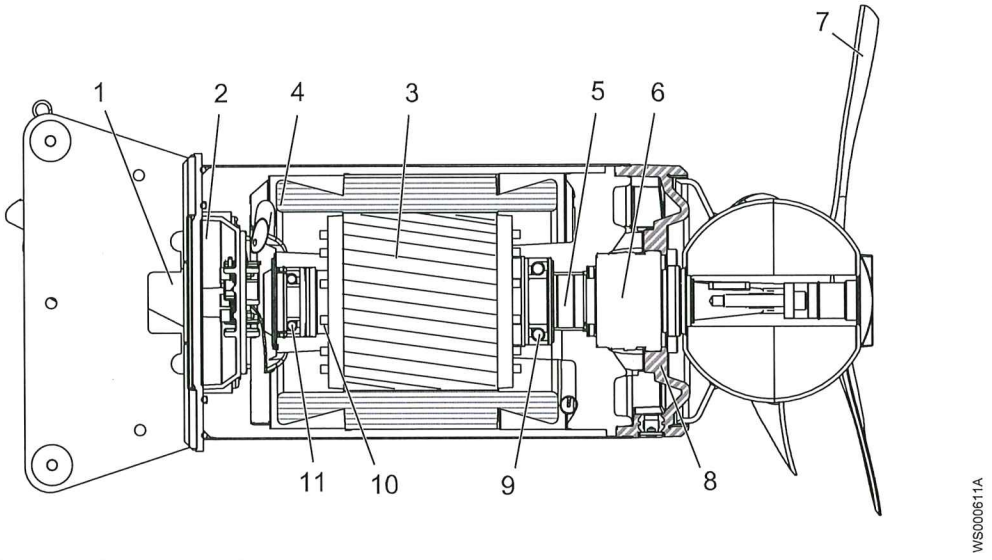


Figure 3: Versions .412 and .492

Parts

Position	Part	Description
1	Cable entry	Spacer sleeve, compressible rubber bushings, and washers to relieve the cable
2	Junction box	Completely sealed off from the surrounding liquid
3	Electric motor	For information about the motor, see *Motor data* on page 62
4	Thermal contacts	For information about the thermal contacts, see Monitoring equipment
5	Shaft	Integrated rotor, completely sealed off from the surrounding liquid
6	Mechanical face seal	One stationary and one rotating seal ring
7	Propeller	Triple-bladed propeller available in different angles and materials
8	Oil housing	A housing with oil that lubricates and cools the seals, and acts as a buffer against penetrating liquid
9	Main bearing	Angular-contact ball bearing
10	Support bearing	Cylindrical roller bearing
11	Support bearing	Angular-contact ball bearing

Monitoring equipment

The following applies to the monitoring equipment of the mixer:

- The stator incorporates thermal contacts connected in series that activates the alarm at overtemperature.
- The thermal contacts open at 140°C (285°F).
- The sensors must be connected to either the MiniCAS II monitoring unit or an equivalent unit.
- The monitoring equipment must be of a design that makes automatic restart impossible.
- The mixer can be equipped with an inspection sensor FLS for sensing the presence of any liquid in the stator housing.
- The mixer can be equipped with a Variable Frequency Drive (VFD).

Spare parts

Modifications to the unit/installation should only be carried out after consulting with the local sales and service representative. Original spare parts and accessories authorized by the manufacturer are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation. For more information contact your local sales and service representative.

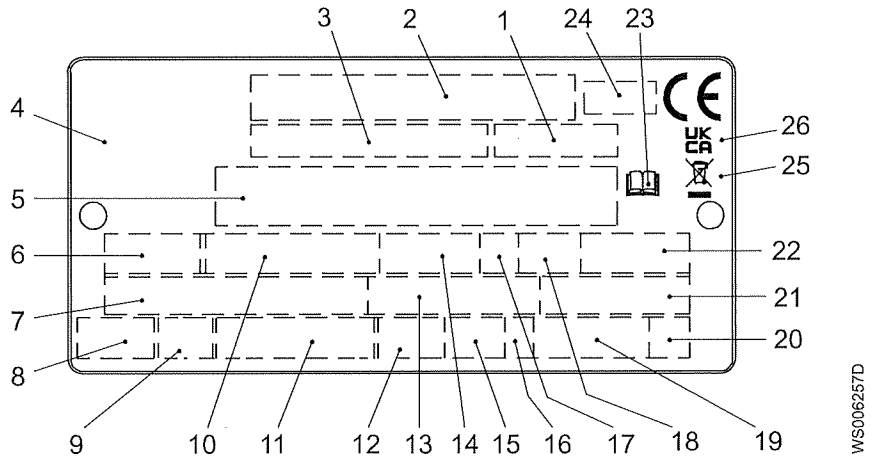
Mixer versions

Standard and Ex-approved versions:

- Stainless steel (ASTM 304)
- High-grade steel (ASTM 316L)
- Warm-liquid version

3.2 The data plate

The data plate is a metal label that is located on the main body of the products. The data plate lists key product specifications. Specially approved products also have an approval plate.



1. Curve code or Propeller code
2. Serial number
3. Product number
4. Country of origin
5. Additional information
6. Phase; type of current; frequency
7. Rated voltage
8. Thermal protection
9. Thermal class
10. Rated shaft power
11. International standard
12. Degree of protection
13. Rated current
14. Rated speed
15. Maximum submergence
16. Direction of rotation: L=left, R=right
17. Duty class
18. Duty factor
19. Product weight
20. Locked rotor code letter
21. Power factor
22. Maximum ambient temperature
23. Read installation manual
24. Notified body, only for EN-approved Ex products
25. WEEE-Directive symbol
26. UKCA marking

Figure 4: The data plate

3.3 Motor regulation

This product is submersible and therefore exempted from the motor efficiency requirement, in accordance with EU commission regulation 2019/1781 Article 2(2)(e).

3.4 Approvals

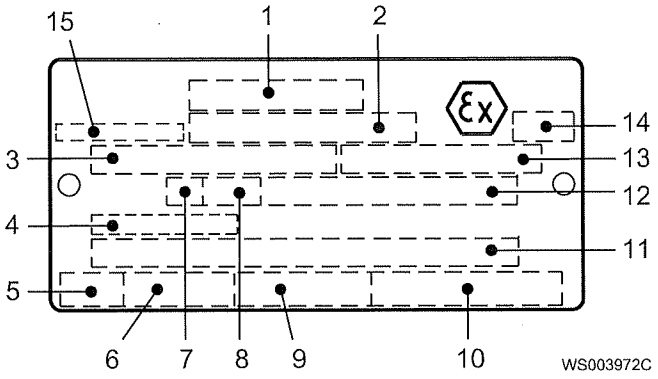
Product approvals for hazardous locations

Product	Approval
4650.390 4650.492 4660.390 4660.492	European Norm (EN) • ATEX Directive • EN IEC 60079-0:2018, EN 60079-1:2014, EN ISO 80079-36:2016, EN ISO 80079-37:2016 • Ⓔx II 2 G Ex db h IIB T3 Gb

Product	Approval
	IEC • IECEx scheme • IEC 60079-0:2017, IEC 60079-1:2014-06, ISO 80079-36:2016, ISO 80079-37:2016 • Ex db h IIB T3 Gb
	FM (FM Approvals) • Explosion proof for use in Class I, Div. 1, Group C and D • Dust ignition proof for use in Class II, Div. 1, Group E, F and G • Suitable for use in Class III, Div. 1, Hazardous Locations
	CSA Ex • Explosion proof for use in Class I, Div. 1, Group C and D
	UKEx • UK SI 2016 No. 1107 • EN IEC 60079-0:2018, EN 60079-1:2014, EN ISO 80079-36:2016, EN ISO 80079-37:2016 • Ⓔx II 2 G Ex db h IIB T3 Gb

EN approval plate

This illustration describes the EN approval plate and the information that is contained in its fields.

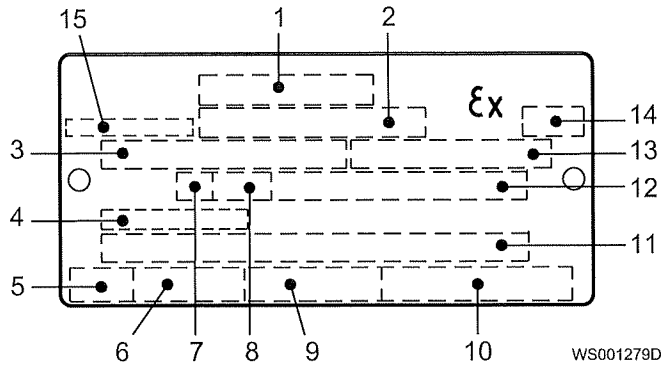


1. Approval
2. Approval authority and Approval number
3. Approved drive unit
4. Cable entry temperature
5. Stall time
6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. ATEX marking
15. Country of origin

IEC approval plate

This illustration describes the IEC approval plate and the information that is contained in its fields.

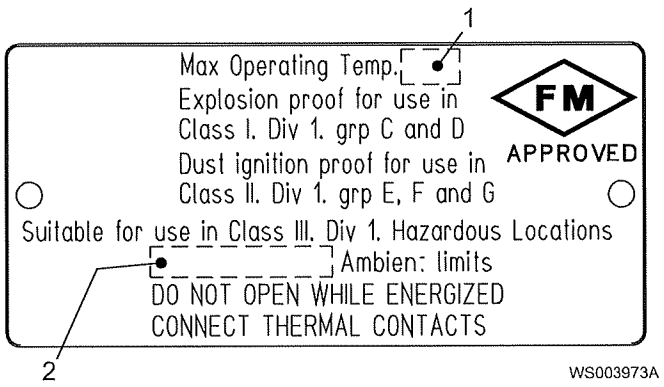
International Norm; not for EU member countries.



1. Approval
2. Approval authority and Approval number
3. Approved drive unit
4. Cable entry temperature
5. Stall time
6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. ATEX marking
15. Country of origin

FM approval plate

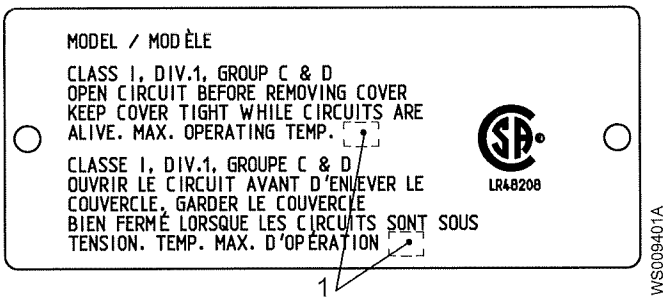
This illustration describes the FM approval plate and the information that is contained in its fields.



1. Temperature class
2. Maximum ambient temperature

CSA approval plate

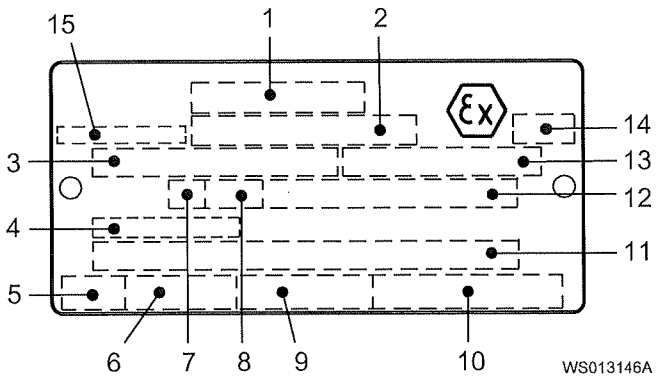
This illustration describes the CSA approval plate and the information that is contained in its fields.



1. Temperature class

United Kingdom: UKEx approval plate

This illustration describes the UKEx approval plate and the information that is contained in its fields.



1. Approval
2. Approval authority and Approval number
3. Approved drive unit
4. Cable entry temperature
5. Stall time
6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. UKEx marking
15. Country of origin

3.5 Product denomination

Reading instruction

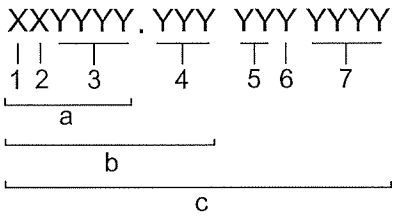
In this section, code characters are illustrated accordingly:

X = letter

Y = digit

The different types of codes are marked up with a, b and c. Code parameters are marked up with numbers.

Codes and parameters



Type of Callout	Number	Indication
Type of code	a	Sales denomination
	b	Product code
	c	Serial number
Parameter	1	Hydraulic end
	2	Type of installation
	3	Sales code
	4	Version
	5	Production year
	6	Production cycle
	7	Running number

4 Installation

4.1 Precautions

Before starting work, make sure that the safety instructions have been read and understood.



DANGER: Inhalation Hazard

The chamber or tank where the equipment is installed should be treated as a confined space. Always follow the applicable safety laws, regulations and guidelines for confined spaces.



WARNING: Crush Hazard

Always lift the unit by its designated lifting points.

Use suitable lifting equipment and ensure that the product is properly harnessed.

Wear personal protective equipment.

Stay clear of cables and suspended loads.



WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

NOTICE:

All mounting to the floor should be made with chemical anchor bolts. The chemical anchor bolts must be dimensioned for the maximum service load, and if applicable, seismic load. The anchor bolts must meet local regulations and codes.

Provide a suitable barrier around the work area, for example, a guard rail.

For information about measurements, see the dimensional drawings of the product.

Vent the tank of a sewage station in accordance with local plumbing codes.

4.1.1 Rotation test

The mixer and the propeller blades must be fully submerged during operation.

A rotation test without submergence is allowed for a brief period of time. For information about testing the direction of propeller rotation, see *Operation* on page 43.

4.2 Requirements

4.2.1 Permanent support of the mixer

Chains can be used for raising and lowering the mixer, but are not recommended for the permanent support of the mixer weight. All chains and chain welds are vulnerable to any sustained dynamic load.

If a chain is used as a permanent support of the mixer, then frequent inspections of the chain are required.

4.2.2 Permanent cable support

Cable handling system overview

When the mixer is installed, it is critically important that a correct cable support system is used. Because of the complexity of designing cable support, it is highly recommended to use the Flygt cable handling system. The Flygt system supplies a guide wire system together with carbine hook-fitted cable holders.

In applications where the Flygt cable handling system is not possible to use, for example in Biogas digester applications, another cable suspension system is needed.

If the cables are supported by another system, then the cable support system must have the following characteristics:

- Cables must be supported in such a manner, that they do not come in contact with any hard surface which could abrade the cable sheathing. Examples of surfaces include the mixer, lifting cables or wires, guide bars and any other hardware.
- Correct strain relief and support at specified intervals must be provided.
- Cables must be supported in such a way that continuous bending back and forth is avoided to prevent damage to the conductors in the cable.

Consequence of an inadequate cable support

The movement of the cable due to inadequate cable support can cause the signal leads to fail. The failure of the signal leads indicates that the other parts of the cable are vulnerable to damage. Continuing to operate the product can result in a hazardous situation. For a safe operation, the cable must be replaced and the support for the cable must be enhanced.

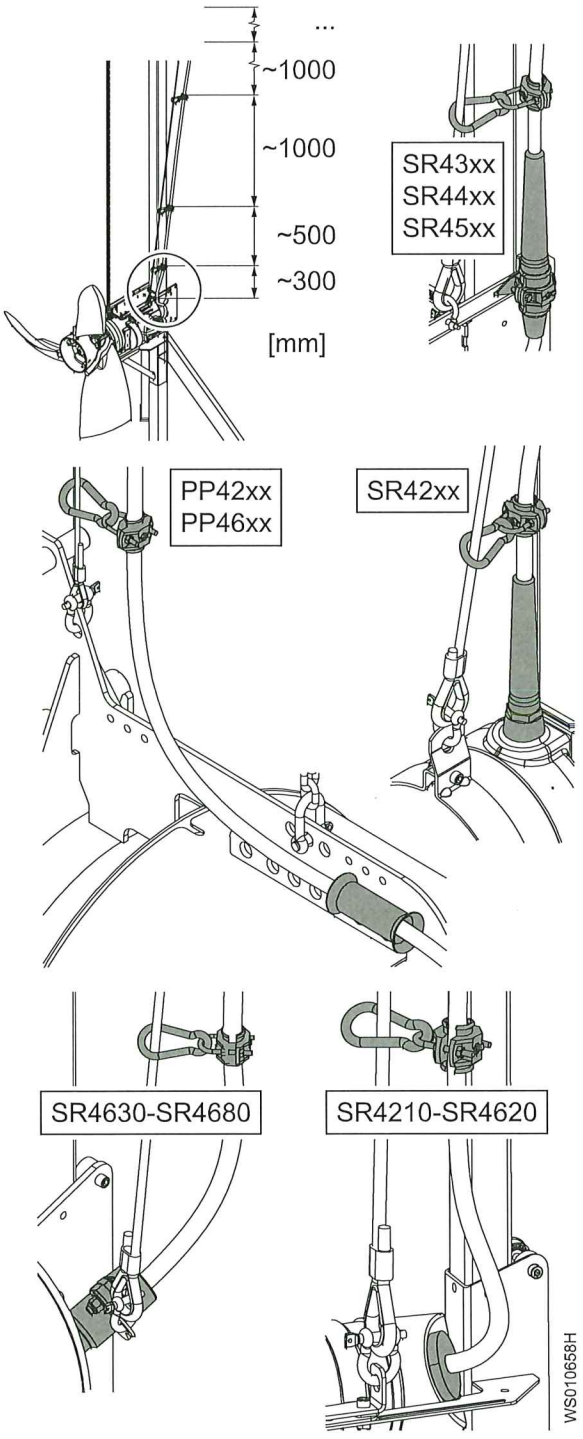
4.3 Install the mixer

4.3.1 Install on a single guide bar

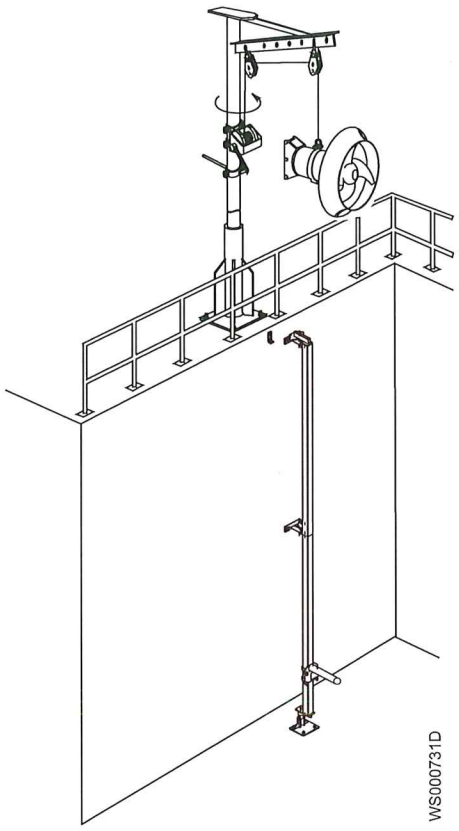
1. Attach the lifting chain or wire to the mixer with a shackle.

   The shackle must be correctly locked.
2. Install the cable kit.
   a) Securely install the top bracket.
   b) Securely install the bracket for the support wire at the cable entrance.
   c) Attach one end of the support wire for the power cable to the bracket at the cable entrance.
   d) Insert cable holders on the power cable at every 1.5 m (4.9 ft) distance.
   e) Place the cable holders to the support wire.

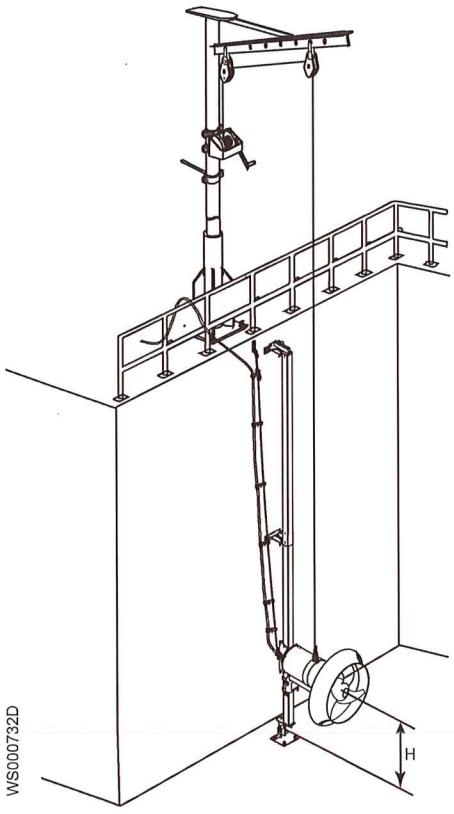
      For more information, see the separate mounting instruction 85 05 29.



3. Attach the top cable holder to the power cable.
   This cable holder is supplied with the mixer.
4. Mount the mixer:
   a) Set the vertical angle.
      For more information, see *Set the vertical angle* on page 34.
   b) Raise the mixer.
   c) Pivot the mixer with the operating bar on the davit.
   d) Lower the mixer onto the guide bar.



5. Position the mixer on the support at the given height “H”.
   For more information, see *Position parameters* on page 30.



6. Attach the other end of the support wire to the bracket.
7. Secure the support wire, and tighten the power cable.

NOTICE:

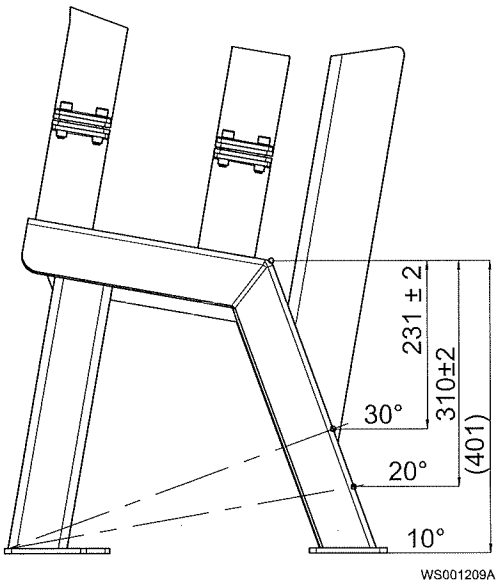
The power cable must not carry the weight of the mixer.

NOTICE:

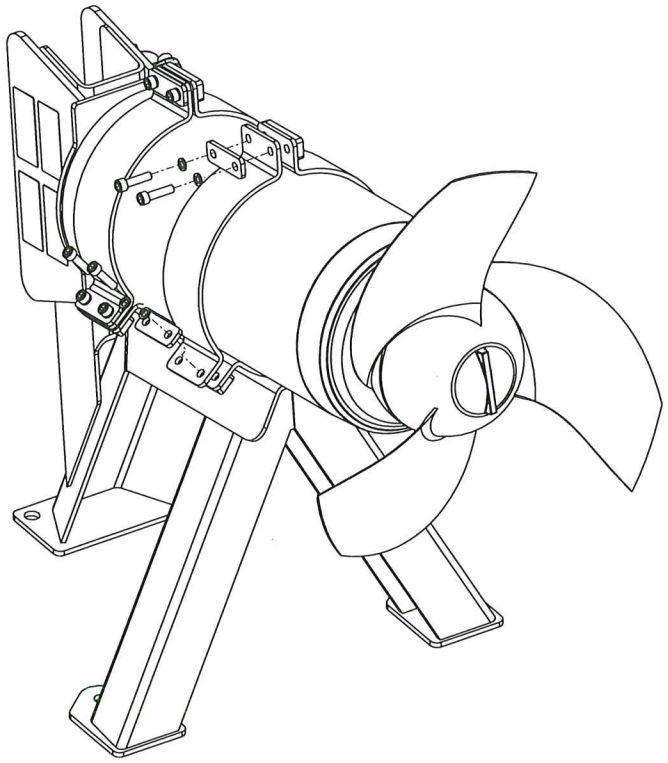
The support wire must be tightly installed and there must be no tension in the power cable.

4.3.2 Install on a bottom stand

1. If needed, cut the legs of the bottom stand to the correct mixer installation angle.
   Angular dimensions refer to propeller shaft angle relative to the horizontal plane.



2. Position and mount the bracket:
   - If the material is concrete, then anchor with chemical anchors.
   - If the material is steel, then anchor with fixing bolts, or weld to steel surface.
3. Mount the mixer onto the bracket and secure it.



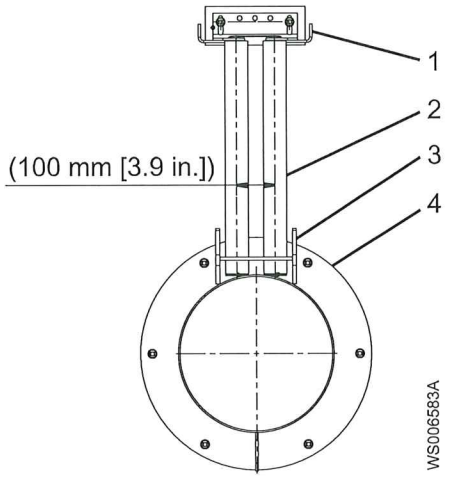
4. Secure the cable to prevent it from being sucked into the mixer propeller.

   The cable can be secured with support grips and a support chain or wire, see *Install on a single guide bar* on page 19.

NOTICE:

The power cable must not carry the weight of the mixer.

4.3.3 Install the mixer as a PP pump



1. Upper guide bracket
2. Guide bars (not supplied)
3. Lower guide bracket
4. Discharge connection

Figure 5: Guide bars and discharge connection

NOTICE:

Make sure that the motor cable cannot be drawn into the propeller.

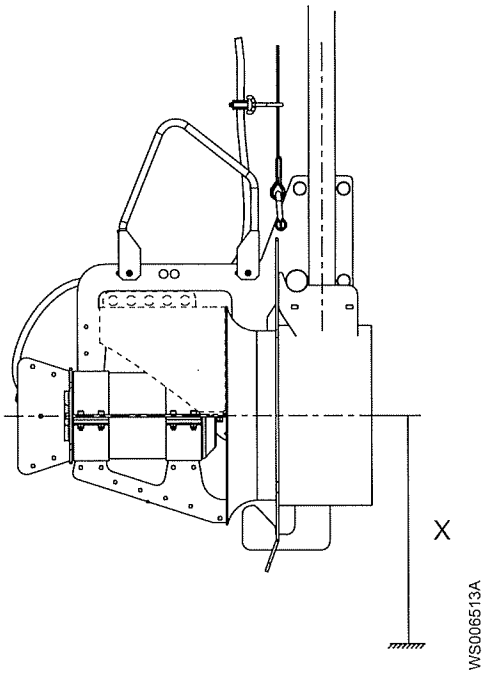
NOTICE:

Make sure that no sharp bends occur during the installation procedure, especially near the entrance flange.

NOTICE:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable dry at all times.

The PP installation requires a minimum distance to the tank bottom. The minimum required distance (X) is 600 mm (24 in.).



1. Fit the discharge flange to the discharge connection:

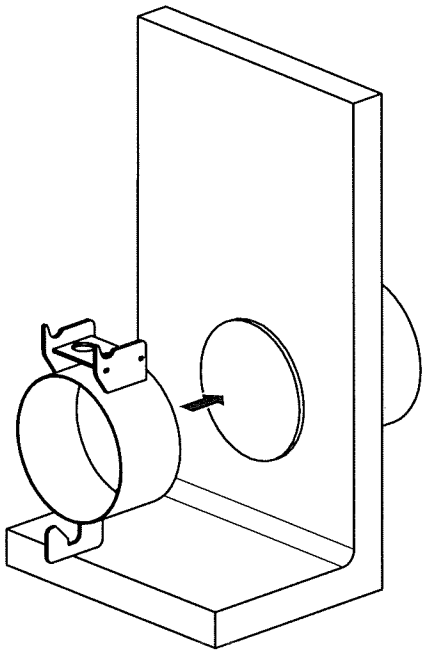
If the discharge connection is...	Then...
Not flanged	Weld the discharge flange and the discharge connection together.
Flanged	Mount the discharge flange to the flanged discharge connection.

Weld the ring perpendicular to the tube.

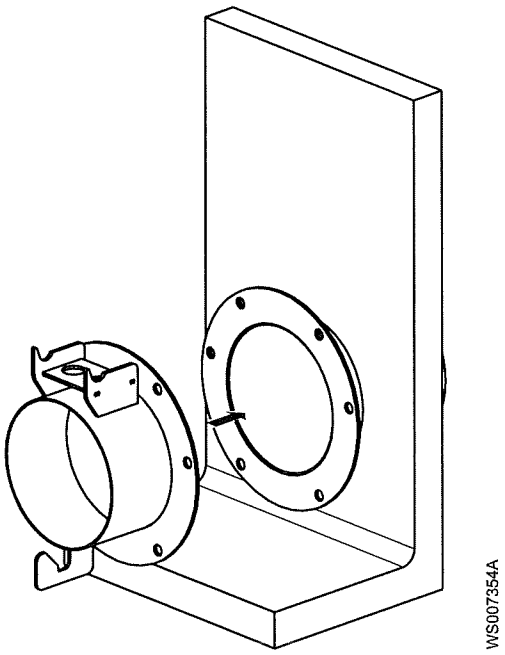
NOTICE:

Pickle and polish all welded joints before they come into contact with the liquid.

Non-flanged discharge connection



Flanged discharge connection



2. Prepare the guide bars:

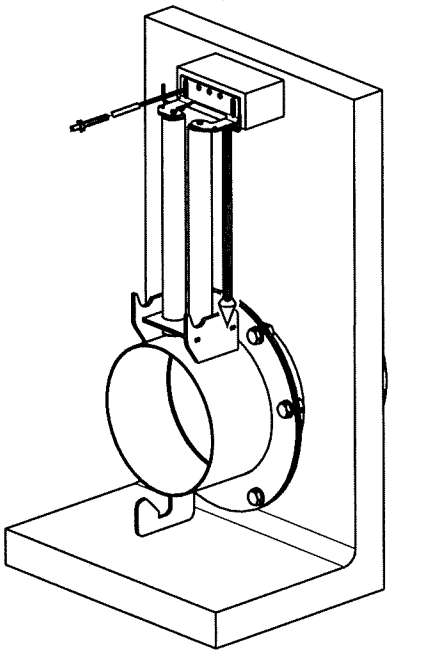
   The guide bars must have a diameter of 60.3 mm (2.37 in.), and a wall thickness of 3.2 mm (0.13 in.).

   a) Carefully measure the correct length for the guide bars.
   b) Cut the bars according to the measurements.

3. Prepare to mount the guide bars:

   Use a plumb line to obtain vertical mounting of the guide bars.

   a) Place the guide bars in the guide bracket on the discharge flange.
   b) Put the upper guide bracket on the guide bars, and mark the drilling holes on the wall.



4. Mount the guide bars:

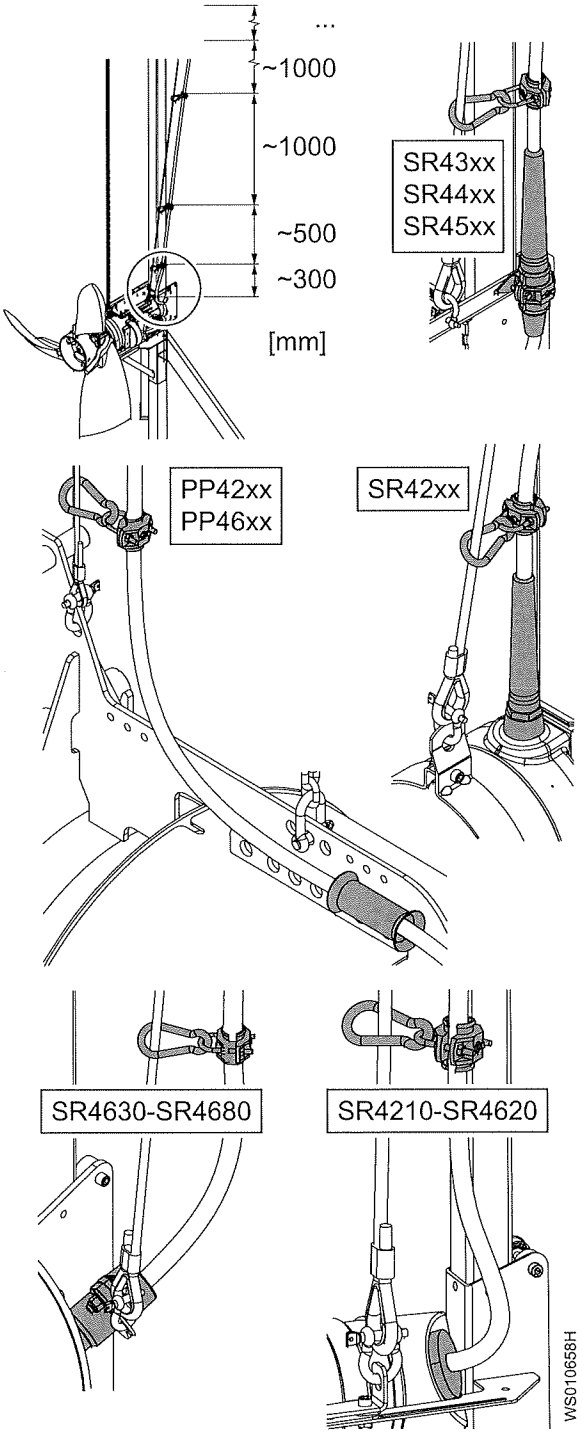
a) Drill the holes for the upper guide bracket.
b) Tap expansion bolts into the holes.
c) Place the upper guide bracket and the guide bars in position and tighten the bolts.

5. Check the installation:
   a) Measure the centerline distance between the guide bars, and verify that it is 100 mm (3.94 in.).
   b) Tighten around the tube.
   c) Check that the discharge connection is fixed to the wall.
6. Attach the lifting chain or wire to the mixer with a shackle.

   The shackle must be correctly locked.
7. Install the cable kit.
   a) Securely install the top bracket.
   b) Attach one end of the support wire for the power cable to the mixer.
   c) Run the power cable through the tube.

      Make sure that the cable is not sharply bent or pinched.
   d) Insert cable holders on the power cable at every 1.5 m (4.9 ft) distance.
   e) Place the cable holders to the support wire.

      For more information, see the separate mounting instruction 85 05 29.



8. Attach the top cable holder to the power cable.
   This cable holder is supplied with the mixer.
9. Prepare to lower the mixer:
   a) Attach a hook to the lifting handle on the mixer.
   b) Lift the mixer onto the guide bars.
10. Lower the mixer along the guide bars until the inlet cone hooks into the ring on the discharge flange.
11. Attach the other end of the support wire to the bracket.
12. Secure the support wire, and tighten the power cable.

NOTICE:

The power cable must not carry the weight of the mixer.

NOTICE:

The support wire must be tightly installed and there must be no tension in the power cable.

4.3.4 Install the mixer on a flange

Mixer installation

When neither guide bar nor bottom stand is applicable in a tank, you can mount the mixer with a flange. The flange-mounted mixer can be installed in the following ways:

- On the wall of a tank
- On an entrance flange, which is mounted in the wall

The entrance flange is normally positioned near the bottom of the tank to enable inspection and cleaning.

Local production of the entrance flange

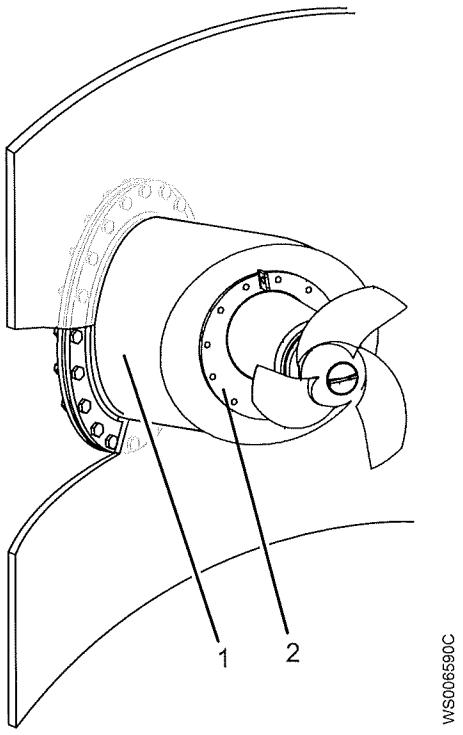
The customer must design and produce the entrance flange. Contact your local sales and service representative for a dimensional drawing proposal, but note the following:

- The proposal allows for adjustments of the mixing angle.
- The customer must modify the proposal according to local demands, flange sizes, and standards.
- The proposal is calculated according to EN 13445.
- For information about measurements for the flange-mounted mixer, see the dimensional drawings of the product.

4.3.4.1 Flange-mounted mixer

Flange-mounted mixer with fixing plate

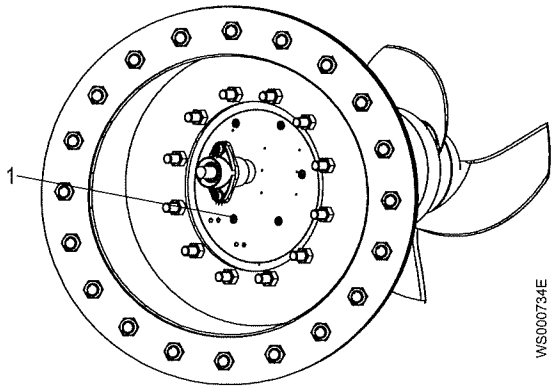
This figure shows a flange-mounted mixer that is installed with a fixing plate adjusted for flange mounting.



1. Entrance flange (optional, not supplied)
2. Fixing plate

Fixing plate connections

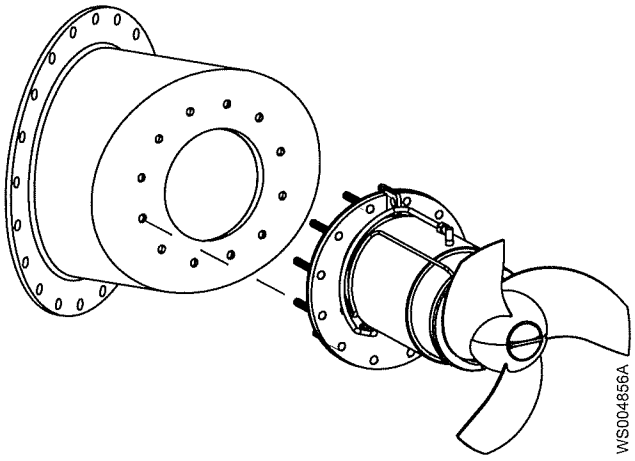
The fixing plate has a hole for the inspection of the stator housing.



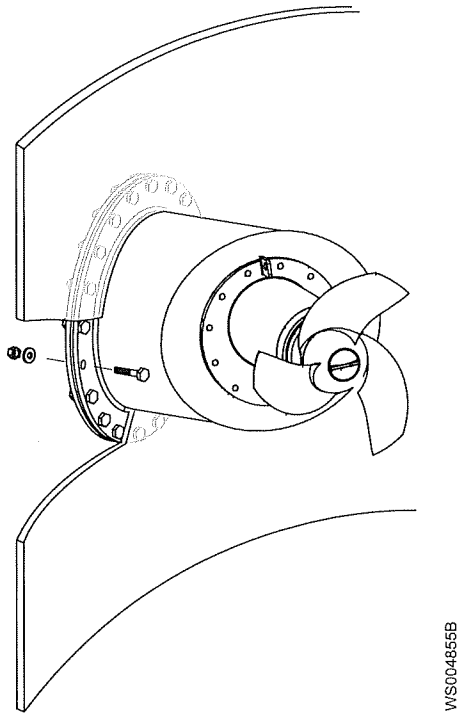
1. Inspection screw for stator housing

4.3.4.2 Install mixer on flange

1. Fit the gasket that is supplied between the fixing plate and the flange of the tank or the entrance flange.
2. Insert the mixer, and fasten the nuts.



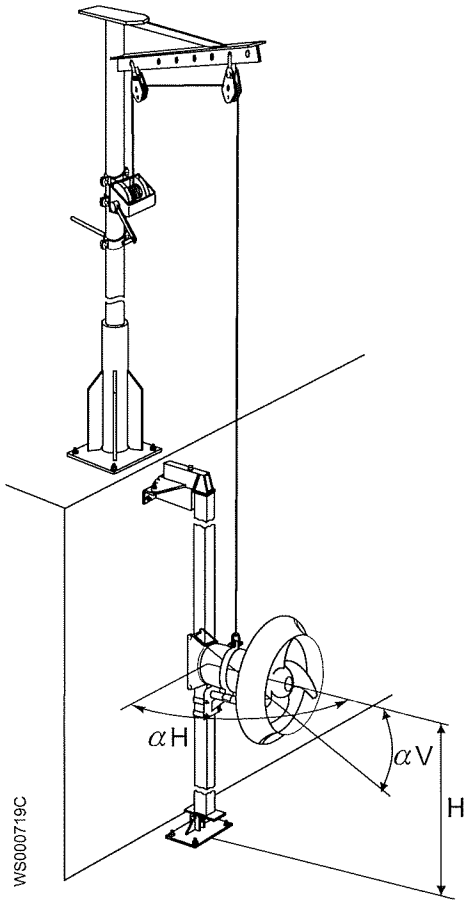
3. If you use an entrance flange, turn it to the desired mixer angle, and mount the entrance flange in the tank wall.



4.4 Position the mixer

Unsymmetrical and swirling inflow to the mixer leads to undesirable mechanical loads that stress both the propeller and the installation equipment. Mixers with two blades are especially sensitive to this type of inflow due to a typical dynamic response to these variations. For more information, please contact your local sales and service representative.

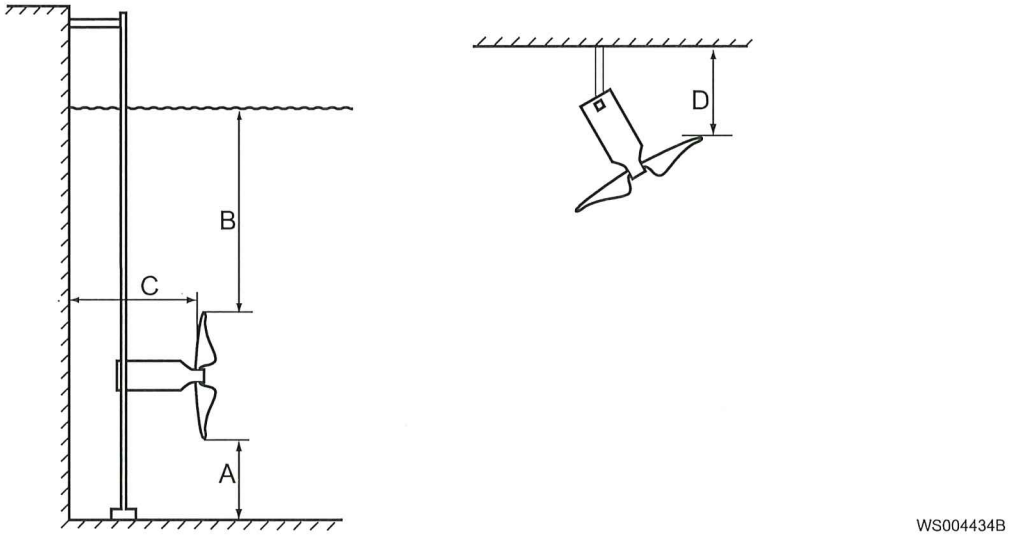
4.4.1 Position parameters



Parameter	Description
H	This parameter represents the height from the tank bottom and is set when the mixer is installed on the guide bar.
α H	This parameter represents the horizontal angle and is set when the mixer is installed on the guide bar.
α V	This parameter represents the vertical angle.

4.4.2 Propeller clearance

This figure shows the propeller clearance. It is the minimum distance between the propeller blade and the surrounding environment.



WS004434B

Minimum propeller clearance

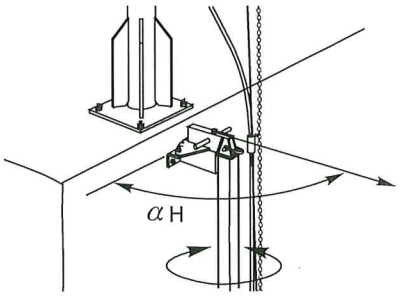
Clearance	Description	Value
A	Peak position of the propeller blade to the bottom of the tank	Propeller diameter
B	Peak position of the propeller blade to the liquid level	See the dimensional drawing
C	Propeller blade to the back wall	1.5 times the propeller diameter
D	Peak position of the propeller blade to the side wall	0.5 times the propeller diameter

Obstacles and walls downstream of the mixer

The clear distance downstream of the mixer must be at least ten times the propeller diameter.

4.4.3 Set the horizontal angle

1. Rotate the guide bar to set the horizontal angle.



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2. Place the indexing screw in the corresponding hole to fasten the angle.
   Make sure to maintain the propeller clearance, see *Propeller clearance* on page 32.

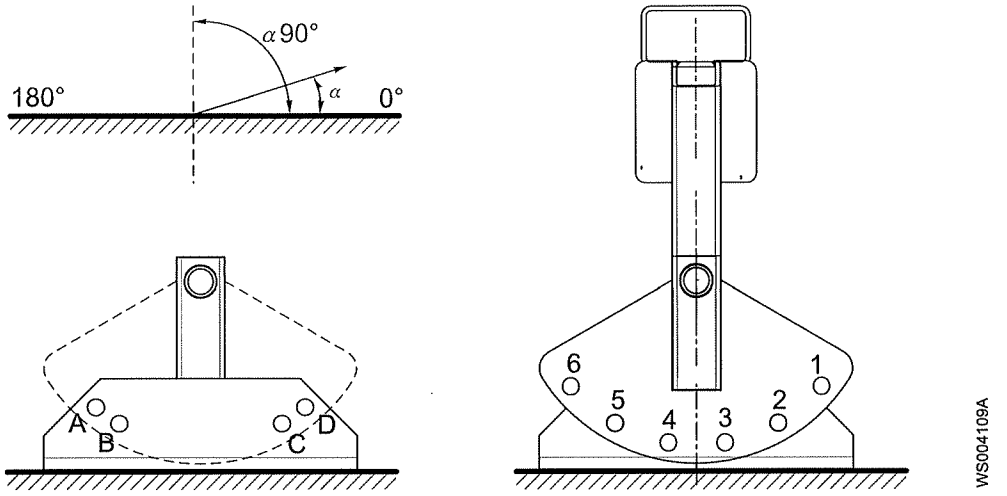


Table 1: Identification of the horizontal angle for 0–90 degrees

αH	Letter	Numeral	Other possible combinations	
			Letter	Numeral
0	A	1	–	–
10	B	1	–	–
20	A	2	–	–
30	B	2	–	–
40	A	3	–	–
50	B	3	–	–
60	A	4	–	–
70	B	4	C	1
80	A	5	D	1
90	B	5	C	2

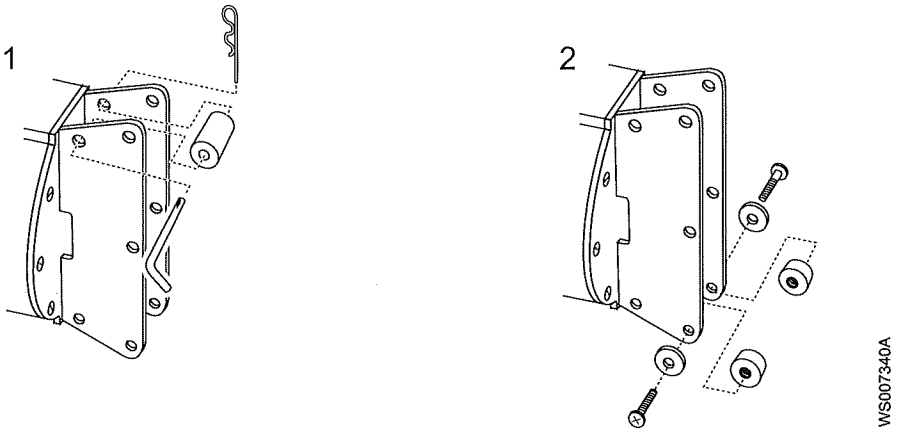
Table 2: Identification of the horizontal angle for 100–180 degrees

αH	Letter	Numeral	Other possible combinations	
			Letter	Numeral
100	A	6	D	2
110	B	6	C	3
120	D	3	–	–
130	C	4	–	–
140	D	4	–	–
150	C	5	–	–
160	D	5	–	–
170	C	6	–	–
180	D	6	–	–

3. Place the cable holders in position on the power cable.
4. Attach the cable holders to the support wire.

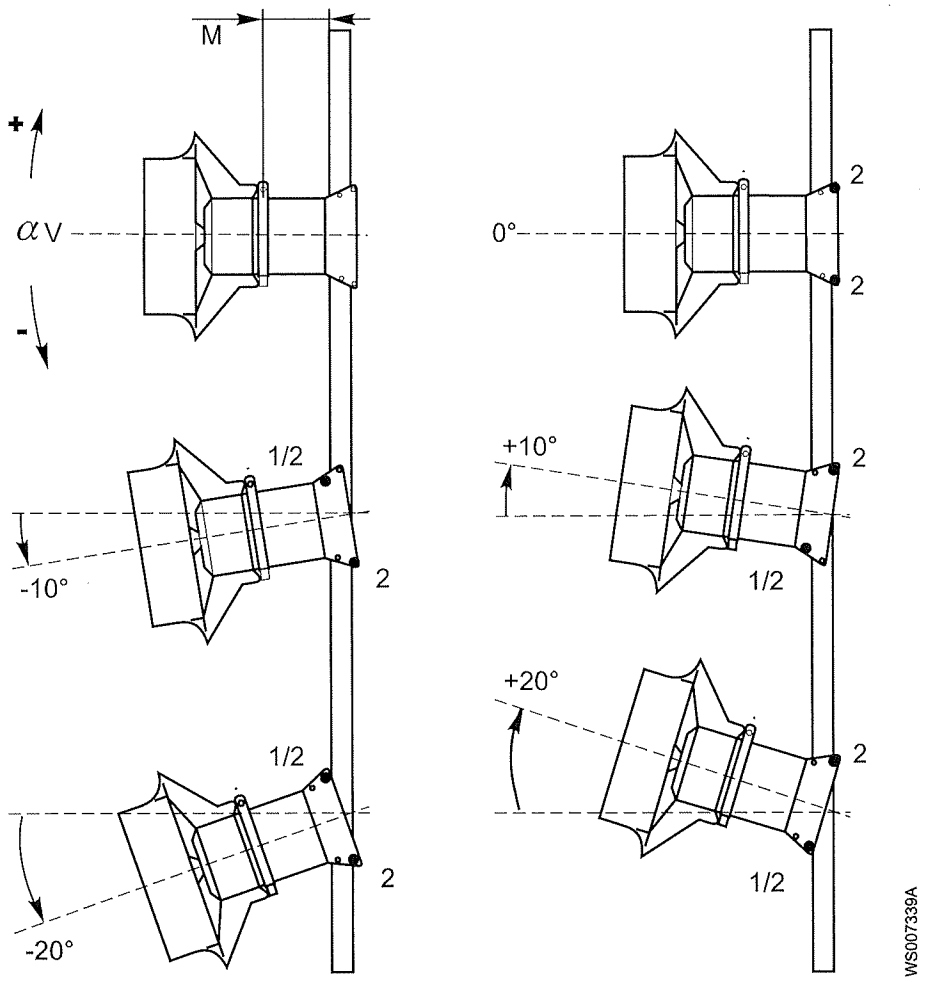
4.4.4 Set the vertical angle

The figures show examples of how to assemble Type-1 rollers and Type-2 rollers on the rear guide of the mixer.



1. Put a set of rollers on the rear guide according to the illustration, to accomplish the correct angle.

   Type-1 rollers can only be used in front of the guide bar. Type-2 rollers can be used either on the front, or the rear, of the guide bar.



2. Check and correct the position of the lifting equipment.

   The M measurement identifies the correct position. See the dimensional drawings for the product.

   Different measurements apply, depending upon whether or not the mixer has a jet ring.

If further fine-tuning is needed for horizontal alignment, then different lifting holes can be selected.

4.5 Electrical installation

4.5.1 Make the electrical connections

General precautions



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.





WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.



WARNING: Electrical Hazard

There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.



CAUTION: Electrical Hazard

Prevent cables from becoming sharply bent or damaged.

Requirements

Check that the following requirements are met:

- The supply authority must be notified before installing the unit if it will be connected to the public mains. When the unit is connected to the public power supply, it may cause flickering of incandescent lamps when started.
- The mains voltage and frequency must agree with the specifications on the data plate.
- The fuses and circuit breakers must have the proper rating, and the unit must be connected to an overload protection (motor protection breaker) that is set to the rated power. See the specifications on the data plate. The starting current in direct-on-line starting can be up to six times higher than the rated current.
- The fuse rating and the cables must be in accordance with the local rules and regulations.
- If intermittent operation is prescribed, the unit must be provided with monitoring equipment supporting such operation.
- For FM-approved mixers, a leakage sensor must be connected and in use in order to meet approval requirements.

Cables

When choosing cables:

- The cables must be in good condition, not have any sharp bends, and not be pinched.
- If a cable has been used before, a short piece must be peeled off when refitting it so that the cable entry seal sleeve does not close around the cable at the same point again. If

the cable covering is damaged, replace the cable (contact a local sales and service representative).

- The cable entry seal sleeve and washers must conform to the outside diameter of the cable.
- A screened cable must be used according to the European CE requirements if a Variable Frequency Drive (VFD) is used. For more information, contact your local sales and service representative (VFD-supplier).
- The voltage drop in long cables must be taken into account. The drive unit's rated voltage is the voltage measured at the terminal board in the upper part of the product.
- For SUBCAB cables, the twisted pair copper foil must be trimmed.

4.5.2 Power isolation

The power supply to the mixer must be designed such that the mixer can be completely isolated from it.

4.5.3 Grounding (earthing)



DANGER: Electrical Hazard

All electrical equipment must be grounded (earthed). Test the ground (earth) lead to verify that it is connected correctly and that the path to ground is continuous.



WARNING: Electrical Hazard

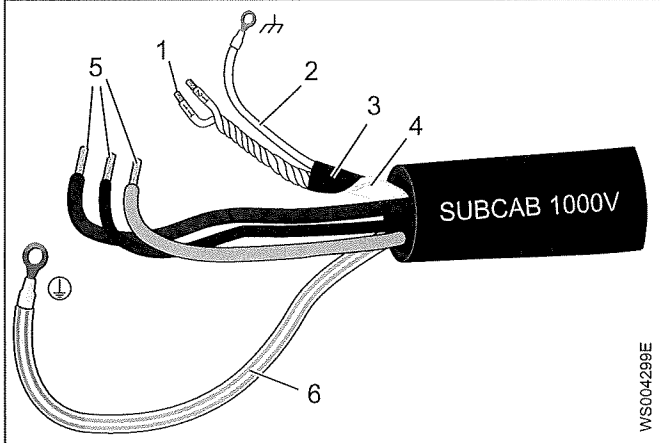
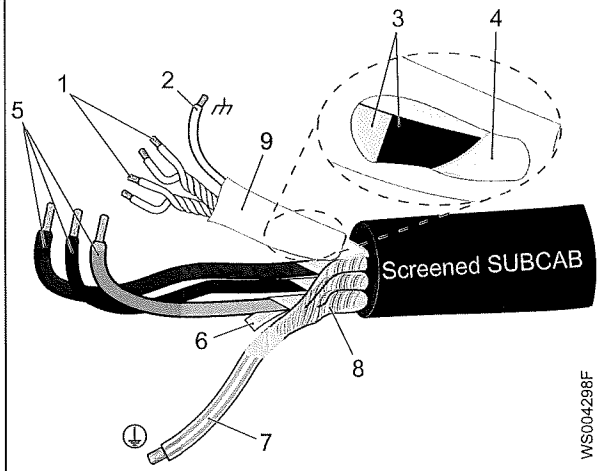
Risk of electrical shock. The ground (earth) lead must be sufficiently longer than the phase leads to make sure that the ground lead is the last to become disconnected if the cable is jerked loose.

4.5.4 Threaded cable entry option

If the threaded cable entry option is used, then the cable protection must be installed in accordance with the accompanying instructions. Improper installation can damage the cables.

4.5.5 Prepare the SUBCAB™ cables

This section applies to SUBCAB™ cables with twisted-pair control conductors.

The prepared SUBCAB™ cable	The prepared screened SUBCAB™ cable, without cable lugs
	
1. T1+T2 twisted pairs in control element 2. Drain wire in control element (tinned copper strands) with shrink tube 3. Aluminum and textile layers 4. Insulation jacket or plastic jacket, for the control element 5. Power conductors 6. Ground (earth) conductor with yellow-green shrink tube	1. T1+T2 and T3+T4 twisted pairs in control element 2. Drain wire in control element (tinned copper strands) with shrink tube 3. Aluminum and textile layers 4. Insulation jacket or plastic jacket, for the control element 5. Power conductors 6. Plastic laminated aluminum foil, screen 7. Ground (earth) conductor with yellow-green shrink tube 8. Uncovered screen/braided wire 9. shrink tube

1. Peel off the outer jacket at the end of the cable.
2. Prepare the control element:
   a) Peel the insulation jacket or plastic jacket.
   b) Peel the aluminum and textile layers.

      The aluminum foil is a conductive screen. Do not peel more than necessary, and remove the peeled foil.

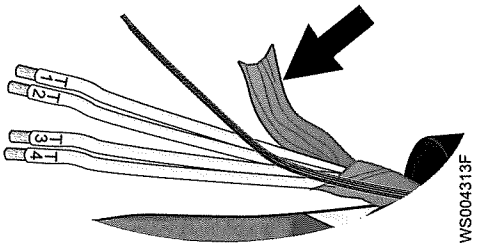


Figure 6: Aluminum foil on the control element.

   c) Put a white shrink tube over the drain wire.
   d) Twist T1+T2 and T3+T4.
   e) Put a shrink tube over the control element.

      Make sure that the conductive aluminum foil and drain wire are covered.
3. Prepare the ground (earth) conductor of the SUBCAB™ cable:
   a) Peel the yellow-green insulation from the ground (earth) conductor.
   b) Check that the ground (earth) conductor is at least 10% longer than the phase conductors in the cabinet.
   c) If applicable, put a cable lug on the ground conductor.
4. Prepare the ground (earth) conductor of the screened SUBCAB™ cable:
   a) Untwist the screens around the power conductors.
   b) Twist all power conductor screens together to create a ground (earth) conductor.
   c) Put a yellow-green shrink tube over the ground (earth) conductor.

Leave a short piece uncovered.

d) Check that the connected ground (earth) conductor has sufficient slack. The conductor must stay connected even if the power conductors are pulled loose.

5. Prepare the power conductors:
   a) Remove the aluminum foil around each power conductor.
   b) Peel the insulation from each power conductor.
6. Prepare the ends of the ground (earth) conductor, the power conductors, and the drain wire:

Connection type	Action
Screw	Fit cable lugs to the ends.
Terminal block	Fit end sleeves or leave the ends as they are.

4.5.6 Connect the motor cable to the mixer

NOTICE:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable dry at all times.

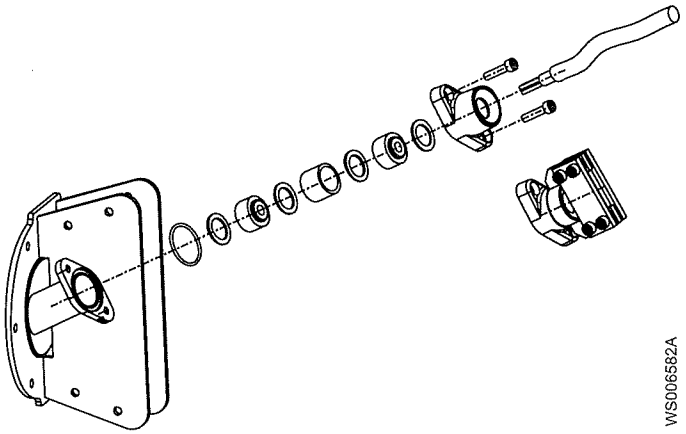


Figure 7: Cable insertion assembly

The mixer is normally delivered with the cable connected.

1. Remove the entrance cover, fixing plate, and O-ring from the mixer housing.
   You will have access to the terminal board.
2. Pull the cable into the junction box.
3. Connect the motor leads, the ground (earth) lead and the control leads.
   Check the data plate to select the correct cable chart.
   The ground (earth) lead must be 140 mm (5.5 in) longer than the phase leads in the junction box of the unit.
4. Make sure that the mixer is correctly connected to ground (earth).
5. Make sure that any thermal contacts are properly connected to the terminal board.
6. Install the O-ring, fixing plate, and entrance cover on the mixer housing.
7. Assemble and fasten the cable entry.
   Make sure that the gland screw bottoms out when fastened.
   For more information about the cable entry, see Parts List.
8. Check the insulation for the connections with a megger.
   The insulation between the phases and between any phase and earth must be > 5 M Ohm.

4.5.7 Connect the motor cable to the starter and monitoring equipment

DANGER: Explosion/Fire Hazard

Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is rated explosion-proof or intrinsically-safe, then see the specific explosion-proof information in the safety chapter before taking any further actions.

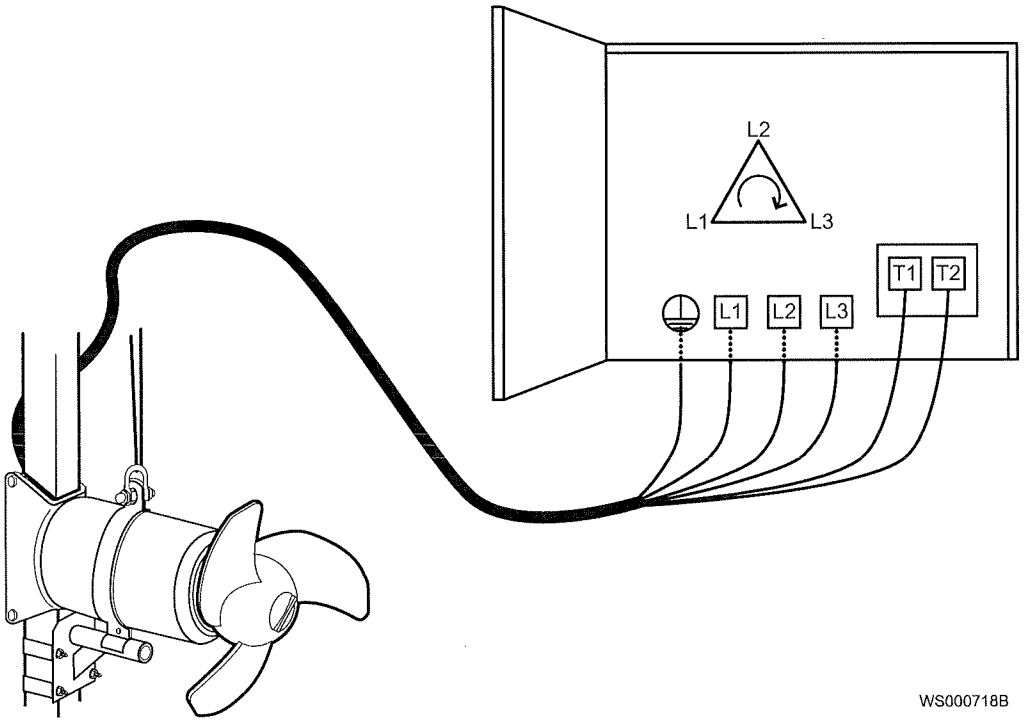


Figure 8: Connection of the motor cable.

1. Connect the T1 and T2 control conductors to the MiniCAS II monitoring equipment.

   NOTICE:

   The thermal contacts are incorporated in the stator. The thermal contacts must be connected to protect the unit.

2. Connect the mains conductors (L1, L2, L3, and ground (earth)) to the starter equipment.

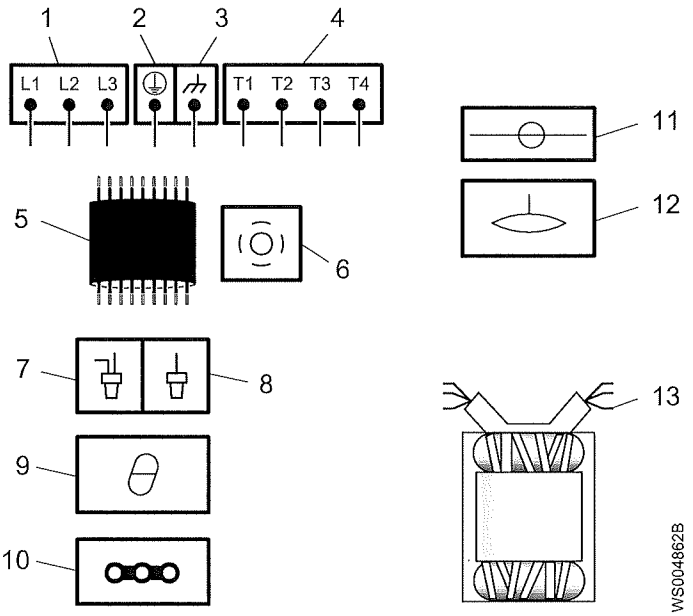
   See the applicable cable charts for the color codes of the conductors.

4.6 Cable charts

This section contains general connection information. It also provides cable charts that show connection alternatives for use with different cables and power supply.

Symbols

The figures in this section illustrate how to interpret the connection strip symbols.



1. Incoming phase cabinet
2. ground (earth)
3. Functional ground
4. Control leads
5. Motor cable
6. Screen
7. Crimp connection
8. Crimp isolation
9. Thermal detector in stator
10. Jumper
11. Terminal board
12. Leakage sensor
13. Stator leads

Color code standard

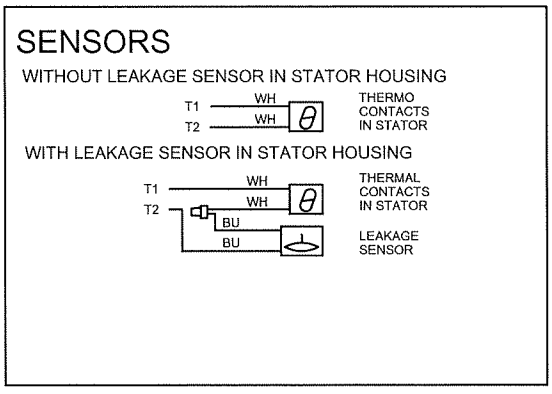
Code	Description
BN	Brown
BK	Black
WH	White
OG	Orange
GN	Green
GNYE	Green-Yellow
RD	Red
GY	Grey
BU	Blue
YE	Yellow

Sensor connections

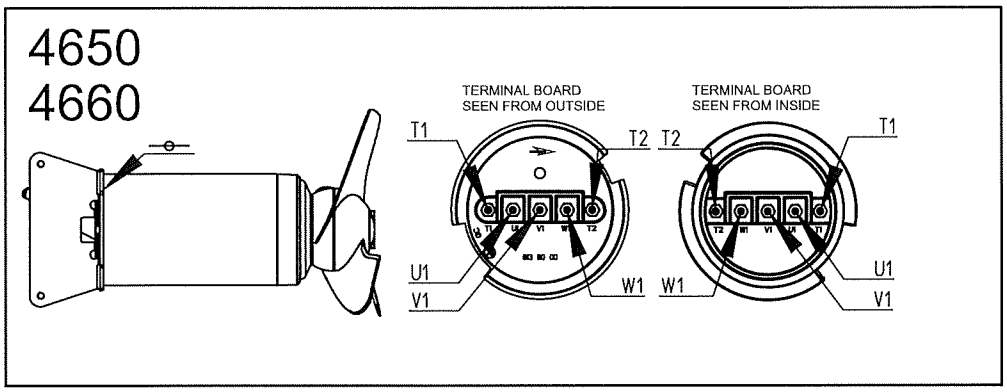
The mixer is always equipped with thermal contacts incorporated in the stator.

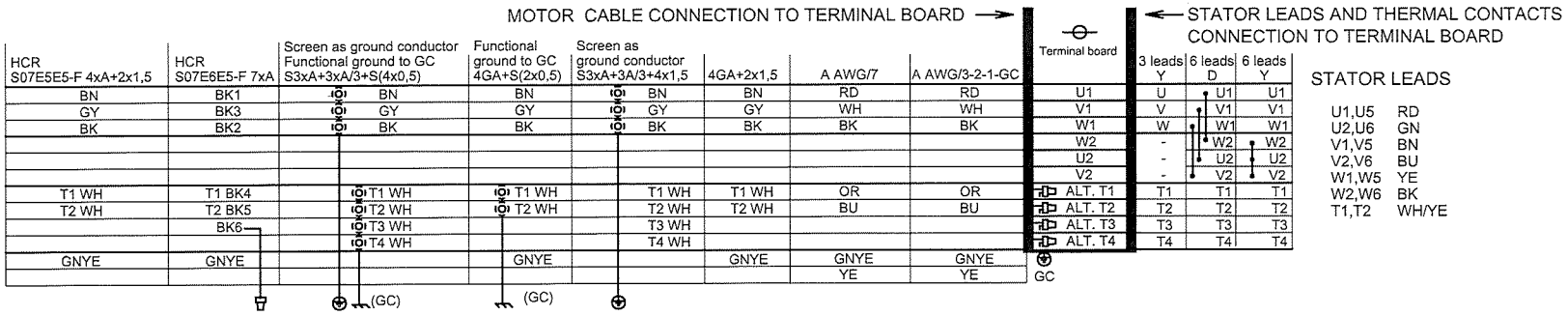
Standard version: The mixer can also have an optional water leakage sensor (FLS).

Ex-approved version: The mixer can also have an optional water leakage sensor (FLS). A leakage sensor is mandatory if the mixer has FM approval.



4.6.1 Cable connections





COLOUR STANDARD

BN=Brown
BK=Black
WH=White
OG=Orange
GN=Green
GNYE=Green-Yellow
RD=Red
GY=Grey
BU=Blue
YE=Yellow

=Terminal board
=Screen
=Ground
=Functional ground
=Jumper
=Crimp connection
=Crimp isolation

GC= Ground check
A = Cable dimension in cable specification

WS004833A

5 Operation

Noise level

The noise level of the unit is normally lower than 70 dB, but in some installations at certain operation points on the performance curve the noise level of 70 dB can be exceeded.

Mixer must be submerged during operation

The mixer and the propeller blades must be fully submerged during operation.

Dry running during service and inspection is only permitted for brief periods of time.

Moving parts



WARNING: Crush Hazard

Moving parts can entangle or crush. Make sure nobody is close to the unit when it is started.

Distance to wet areas



WARNING: Electrical Hazard

Risk of electrical shock or burn. You must connect an additional ground- (earth-) fault protection device to the grounded (earthed) connectors if persons are likely to come into contact with liquids that are also in contact with the pump or pumped liquid.



CAUTION: Electrical Hazard

Risk of electrical shock or burn. The equipment manufacturer has not evaluated this unit for use in swimming pools. If used in connection with swimming pools then special safety regulations apply.

5.1 Power isolation

The power supply to the mixer must be designed such that the mixer can be completely isolated from it.

5.2 Permanent support of the mixer

Chains can be used for raising and lowering the mixer, but are not recommended for the permanent support of the mixer weight. All chains and chain welds are vulnerable to any sustained dynamic load.

If a chain is used as a permanent support of the mixer, then frequent inspections of the chain are required.

5.3 Starting the mixer

5.3.1 Requirements

Maximum number of starts

NOTICE:

The maximum number of starts allowed per hour is 30.

Mixer must be fixed to the guide bar

NOTICE:

Make sure the mixer is fixed to the guide bar before starting the mixer.

Before starting the mixer

Before you start the mixer, the following requirements must be met:

- There is oil in the oil casing.
- The motor cable entry is securely tightened.
- The monitoring equipment incorporated in the product is correctly connected.

5.3.2 Start the mixer



WARNING: Crush Hazard

Moving parts can entangle or crush. Make sure nobody is close to the unit when it is started.

1. Start the motor briefly to check the direction of rotation.

   The correct direction of propeller rotation is counterclockwise when you look at the mixer from the propeller end. See the illustration.

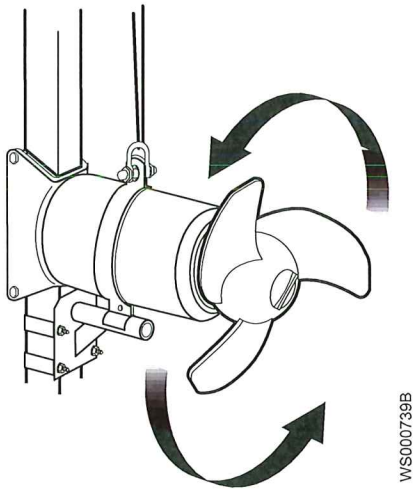


Figure 9: Correct direction of rotation

2. If the direction of rotation is not correct, then do as follows:
   a) Stop the motor.
   b) Disconnect the power supply.
   c) Change positions of two of the three mains leads to the power supply.

      For instructions on how to connect the power supply, see *Electrical installation* on page 35.

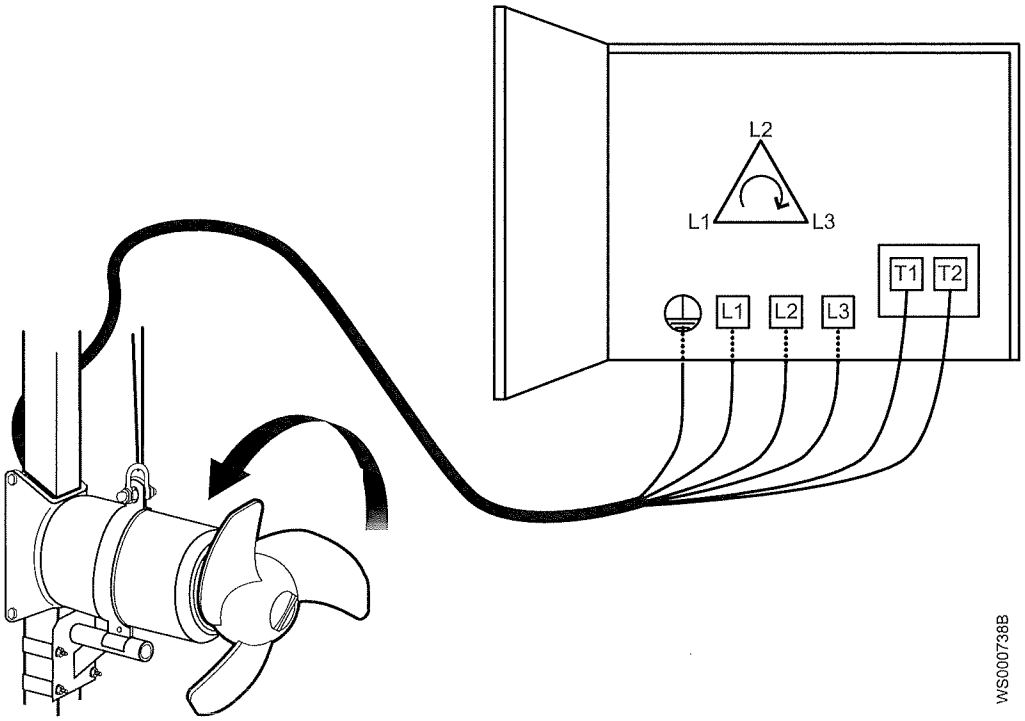


Figure 10: Correct motor cable connection

d) Start the motor briefly to check that the direction of rotation is correct.

6 Maintenance

6.1 Precautions

Before starting work, make sure that the safety instructions have been read and understood.

Through all phases of the mixer maintenance, observe the precautions in *Electrical precautions* on page 47.

Maneuvering and securing the mixer

The mixer must be secured at all times, when it is out of position.



WARNING: Crush Hazard

Make sure that the unit cannot roll or fall over and injure people or damage property.

For lifting and moving the mixer, see *Lifting guidelines* on page 8.

6.1.1 At the installation site

Use caution at the service location

Always approach the service basin or tank with caution. See *Special hazards* on page 6. A site-specific evaluation should be done before starting work.



DANGER: Inhalation Hazard

Before entering the work area, make sure that the atmosphere contains sufficient oxygen and no toxic gases.

Lock out the power before starting work

Before starting work, the mixer and its control equipment must be locked out so that it cannot be energized. A site-specific evaluation must be done to determine if power lock-out is also needed on nearby equipment.



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



See also *Electrical precautions* on page 47.

Rinse the mixer after lifting it out of position



WARNING: Biological Hazard

Infection risk. Rinse the unit thoroughly with clean water before working on it.

Remove blades, or move with blades

See *Prepare for moving an assembled mixer* on page 9.

6.1.2 At the workshop

Inspect for signs of damage or incorrect installation



WARNING: Electrical Hazard

There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.

6.1.2.1 Ventilate the work area

Before starting work, make sure that the work area is well-ventilated.

6.1.2.2 Inspect the work area before permit-required hot work



WARNING: Explosion/Fire Hazard

Before starting any permit-required hot work such as welding, gas cutting, grinding, or using electrical handtools, do the following: 1. Check the explosion risk. 2. Provide sufficient ventilation.

6.1.3 Electrical precautions

Certified electrician



WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.

Handle cables with care



CAUTION: Electrical Hazard

Prevent cables from becoming sharply bent or damaged.

Before connecting power to the mixer

Before connecting power to the mixer, make sure that the precautions in *Electrical installation* on page 35 have been read and understood. This applies whether power is connected for testing, or to re-install the mixer at the service site.

Ground continuity verification

A ground (earth) continuity test must always be performed after service.

6.2 Requirements for maintenance

Stage	Requirement
Before reassembly	• All components must cool off • All parts, particularly O-ring grooves, must be thoroughly cleaned • All O-rings, gaskets, and seal washers must be changed • All springs, screws, and O-rings must be lubricated with grease
At reassembly	Existing index markings must be in line.
Before operation	• The reassembled drive unit must be insulation-tested • The reassembled product must always be test-run

6.3 Torque values

All screws and nuts must be lubricated to achieve correct tightening torque. Screws that are screwed into stainless steel must have the threads coated with applicable lubricants to prevent seizing.

If there is a question regarding the tightening torques, then contact a sales or authorized service representative.

Screws and nuts

Table 3: Stainless steel, A2 and A4, torque Nm (lbf·ft)

Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
50	1.0 (0.74)	2.0 (1.5)	3.0 (2.2)	8.0 (5.9)	15 (11)	27 (20)	65 (48)	127 (93.7)	220 (162)	434 (320)
70, 80	2.7 (2)	5.4 (4)	9.0 (6.6)	22 (16)	44 (32)	76 (56)	187 (138)	364 (268)	629 (464)	1240 (915)
100	4.1 (3)	8.1 (6)	14 (10)	34 (25)	66 (49)	115 (84.8)	248 (183)	481 (355)	—	—

Table 4: Steel, torque Nm (lbf·ft)

Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
8.8	2.9 (2.1)	5.7 (4.2)	9.8 (7.2)	24 (18)	47 (35)	81 (60)	194 (143)	385 (285)	665 (490)	1310 (966.2)
10.9	4.0 (2.9)	8.1 (6)	14 (10)	33 (24)	65 (48)	114 (84)	277 (204)	541 (399)	935 (689)	1840 (1357)
12.9	4.9 (3.6)	9.7 (7.2)	17 (13)	40 (30)	79 (58)	136 (100)	333 (245)	649 (480)	1120 (825.1)	2210 (1630)

Table 5: Brass, torque Nm (lbf·ft)

M5	M8	M10
2.7 (2.0)	11 (8.1)	22 (16.2)

Hexagon screws with countersunk heads

For hexagon socket head screws with countersunk head, maximum torque for all property classes must be 80% of the values for property class 8.8.

Round nuts with set screws

Table 6: Set screw, torque Nm (lbf·ft)

The torque values are only valid for the set screw, and not for the round nut.

M8	M10
18 (13)	35 (26)

6.4 Maintenance intervals

The maintenance intervals for SR 4650/4660 are applicable to different types of maintenance and depend on the application and the operating conditions.

6.4.1 Categorization of operating conditions, SR 4650/4660

Operating conditions, less than 40°C (104°F)

Table 7: Water and wastewater applications

Application	Operating condition
Pumping station	Heavy duty
Retention basin	Heavy duty
Moving bed biofilm reactor (MBBR)	Heavy duty
Seawater	Heavy duty
Others	Normal duty

Table 8: Biogas and agriculture applications

Application	Operating condition
Fluid manure	Normal duty
Digestate	Normal duty
Digester • For example, energy crops and solid manure	Heavy duty
Pre-treatment and hydrolysis • For example, energy crops and solid manure	Heavy duty

Table 9: Municipal sludge applications

Application	Operating condition
Anaerobic stabilized sludge, mezophilic	Normal duty
Aerobic stabilized sludge	Normal duty
Anaerobic stabilized sludge, thermophilic	Heavy duty
Others	Normal duty

Table 10: Drilling mud and industrial process applications

Application	Operating condition
Drilling mud	Heavy duty
Light-duty industry	Normal duty
Heavy-duty industry	For more information, contact the sales and service representative.

Operating conditions, more than 40°C (104°F)

A media temperature above 40°C (104°F) is categorized as heavy duty operating conditions for all applications.

6.4.2 Maintenance schedule, SR 4650/4660

The maintenance intervals are valid if the product is selected, installed, and positioned according to Xylem guidelines.

Type of maintenance	Purpose	Operating condition	Interval
Initial inspection, on-site	• Make sure that the installation is correct. • Determine the recommended maintenance intervals for the specific installation.	All duties	Within the first 3 months of operation
Periodic inspection, on-site	• Assess the general condition of the equipment. • Take measures to minimize the life cycle cost, prevent unplanned downtime, and preserve operation efficiency.		8,000 hours or 2 years, whichever comes first
Overhaul, at an authorized workshop	• Replace wear parts and key components for a long equipment lifetime and for preserving operation efficiency.	Normal duty	32,000 hours or 8 years, whichever comes first
		Heavy duty	16,000 hours or 4 years, whichever comes first

In biogas digester applications, perform the initial inspection after installation or within the first three months of operation.

If the periodic inspections are not performed according to the schedule, then shorten the interval of the overhaul. For more information, contact the sales and service representative.

6.4.3 Maintenance schedule, PP 4650/4660

The maintenance intervals are valid if the product is selected, installed, and positioned according to Xylem guidelines.

Type of maintenance	Purpose	Interval
Initial inspection, on-site	• Make sure that the installation is correct. • Determine the recommended maintenance intervals for the specific installation.	Within the first 3 months of operation
Periodic inspection, on-site	• Assess the general condition of the equipment. • Take measures to minimize the life cycle cost, prevent unplanned downtime, and preserve operation efficiency.	8,000 hours or 2 years, whichever comes first Applies to normal applications and operating conditions at media temperatures less than 40°C (104°F)
Overhaul, at an authorized workshop	• Replace wear parts and key components for a long equipment lifetime and for preserving operation efficiency.	32,000 hours or 8 years, whichever comes first Applies to normal applications and operating conditions at media temperatures less than 40°C (104°F)

If the periodic inspections are not performed according to the schedule, then shorten the interval of the overhaul. For more information, contact the sales and service representative.

6.5 Service actions

6.5.1 Inspections

The initial inspection and periodic inspections are performed on-site.

Service item	Action
Power cable	– Check for damage. If necessary, replace the power cable. – Check the cable support. If necessary, adjust it.
Oil housing	– Check the oil. If necessary, change it. – Replace the O-rings of the filling plug.
Lifting handle	Check the condition. If necessary, replace parts.
Control cabinet	Check the power connections.
Stator protection	– Check the thermal contacts. Normally closed circuit, interval 0–1 ohm. – Check the resistance of the thermistors. The correct value is between 20–250 ohm. The maximum measuring voltage is 2 VDC.
Insulation	Use a megger maximum 1000 V. – Check that the resistance between the ground (earth) and phase lead is more than 5 megohms. – Do a phase-to-phase resistance check, maximum 50 ohm.
Motor condition	Check the running values of the voltage and amperage.
Personal safety	Check the guide rails, covers, and other protections.
Installation equipment and lifting device	Check the mounting and installation conditions. If necessary, replace parts. Follow the local regulations.
Position of the unit	Check the position to get the correct load and to fulfill the process requirements.
Overload protection	Check that the settings are correct.
Propeller	– Check for wear. If necessary, replace parts. – Check the direction of the rotation.
Zinc anode	If applicable, check the consumption. If necessary, replace the zinc anode.

6.5.2 Overhaul

The overhaul is performed at an authorized workshop.

Service item	Action
Bearings	Replace the bearings.
O-rings	Replace the O-rings.
Mechanical seals	Replace the mechanical seals.
Junction box	– Check that the junction box is clean and dry. – Check the power connections.
Other actions	See *Inspections* on page 51.

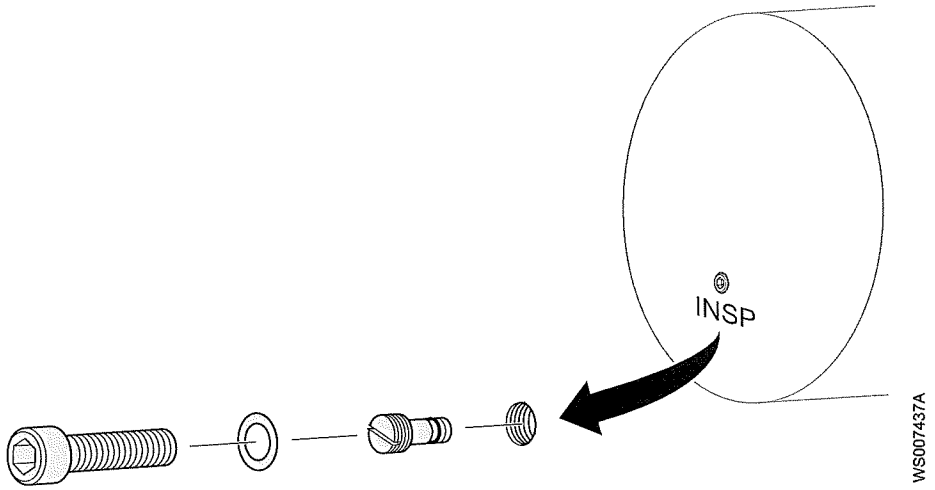
6.5.3 Service in case of alarm

Alarm source	Action
FLS	1. Check the stator housing for any leakage, and drain if necessary. 2. Check mechanical seals and O-rings and replace any damaged seals with new ones.

Alarm source	Action
Thermal contact	1. Check the coolant level (mixer with cooling jacket). 2. Check the connections and the electrical motor. 3. Check the temperature and viscosity of the mixed liquid. 4. Check that the position is according to the installation requirements.
Overload protection	Check that the propeller can rotate freely.

6.6 Inspect the stator housing

1. Remove the inspection screw (marked INSP), and the screw inside to access the stator housing.



2. Check the stator housing for water and oil leakage.

6.7 Change the oil

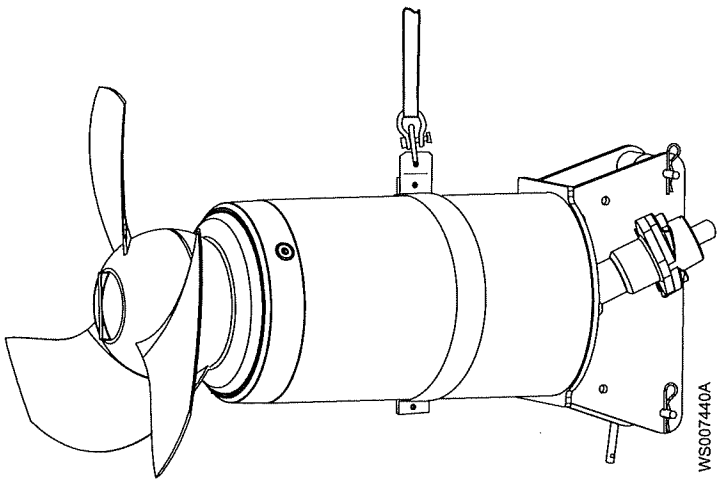
6.7.1 Drain the oil



CAUTION: Compressed Gas Hazard

Air inside the chamber may cause parts or liquid to be propelled with force. Be careful when opening. Allow the chamber to de-pressurize before removal of the plug.

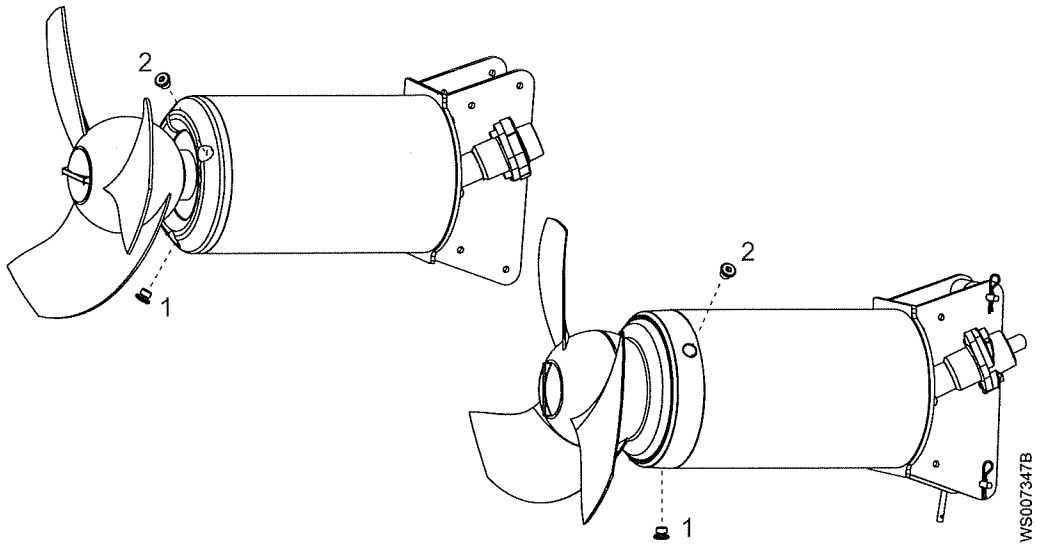
1. Lay the mixer on two supports or suspend the mixer horizontally from an overhead crane.



2. Under the mixer, place a vessel that is large enough to hold the volume of oil that you are draining.

   The oil volume is less than 2 L (2.1 qt).

3. Remove the drain plug.



   It is easier to drain the oil if you also remove the filling plug.

4. When the oil has been drained, re-position the O-ring and the drain plug. Tighten the drain plug.

   Tightening torque: 10–20 Nm (7.4–14.8 ft-lbs).

6.7.2 Fill the oil



CAUTION: Compressed Gas Hazard

Air inside the chamber may cause parts or liquid to be propelled with force. Be careful when opening. Allow the chamber to de-pressurize before removal of the plug.

The mixer is delivered from the factory with paraffin oil with a viscosity close to ISO VG32. Recommended oil: 90 17 52. Examples of suitable oil types are the following:

- Statoil MedicWay 32™
- BP Enerpar M 004™
- Shell Ondina 927™
- Shell Ondina X430™

Depending on the mixer working position, the oil quantity differs.

Table 11: Required oil quantity

Mixer working position	Oil quantity in liters (quarts)
Mixer positioned at 0° to ± 20° from the horizontal axis	Versions .310/.390: 1.20 (1.27) Versions .412/.492: 1.7 (1.8)
Mixer positioned at -90° downwards from the horizontal axis	Versions .310/.390: 1.5 (1.6) Versions .412/.492: 1.95 (2.06)

1. Position the mixer for filling the required oil quantity.
   a) For horizontal working and normal oil quantity, position the mixer horizontally.

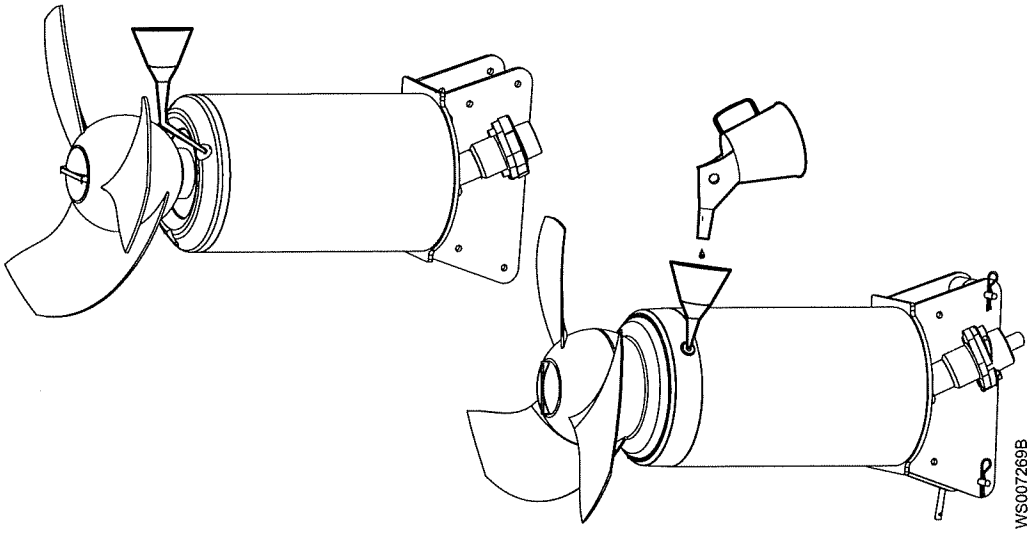


Figure 11: Filling for horizontal working position

   b) For vertical working position, use one of the following methods to fill the maximum oil volume:
      - If the version is .412/.492, then close the filling plug, turn the mixer upside-down, and remove the drain plug.
      - If the version is .310/.390, then place the mixer with the propeller up.

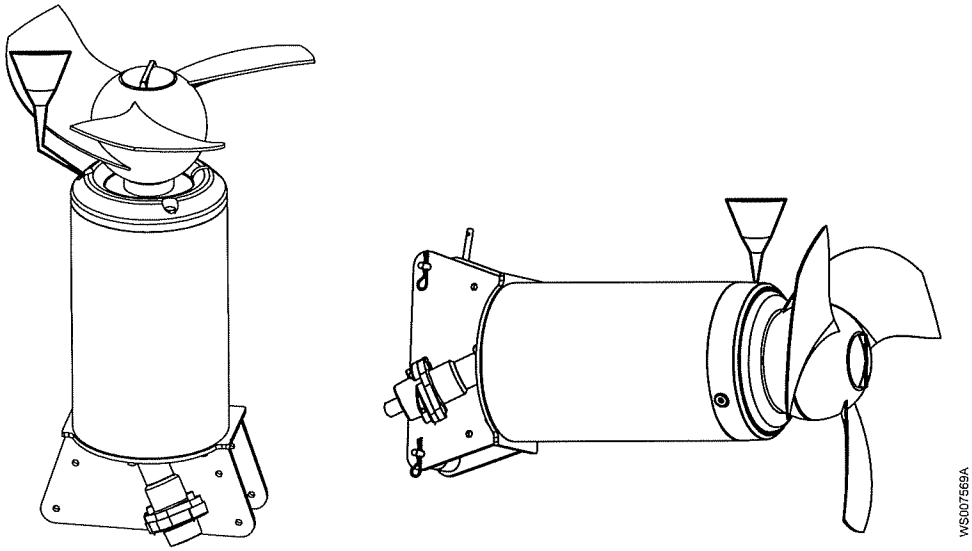


Figure 12: Filling for vertical working position

2. Fill with new oil through the oil filling hole or the drain hole.
3. Replace the O-ring.
4. Put the plug back and tighten it.

Tightening torque: 10–20 Nm (7.4–14.8 ft-lbs).

6.8 Change the propeller

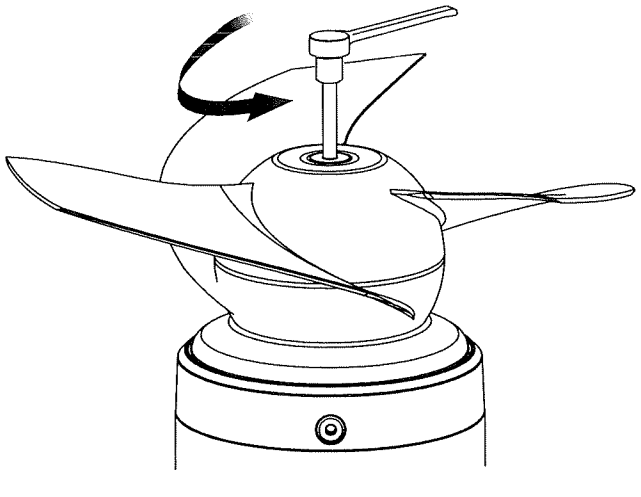
CAUTION: Cutting Hazard
Sharp edges. Wear protective clothing.

The following tools are needed for this procedure:

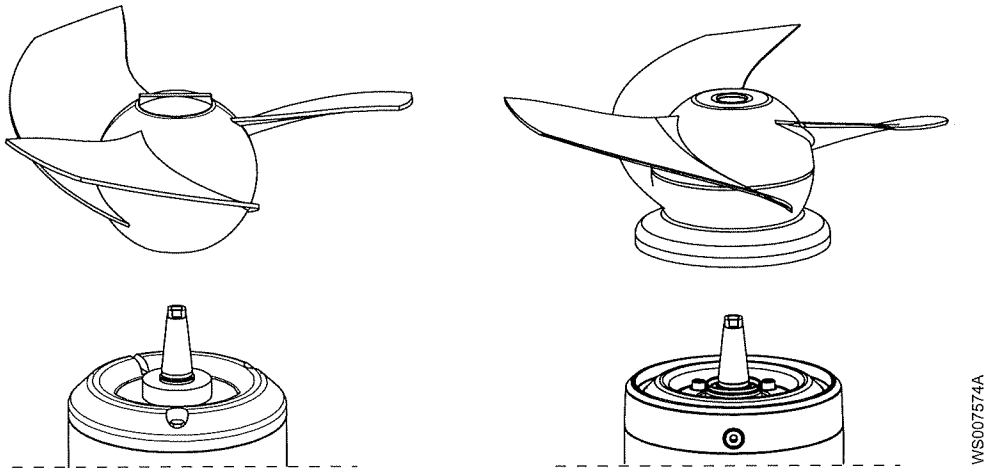
- Hexagon socket wrench
- M1210 hexagon bit adapter (part no 84 14 79), n= 10

6.8.1 Remove the propeller

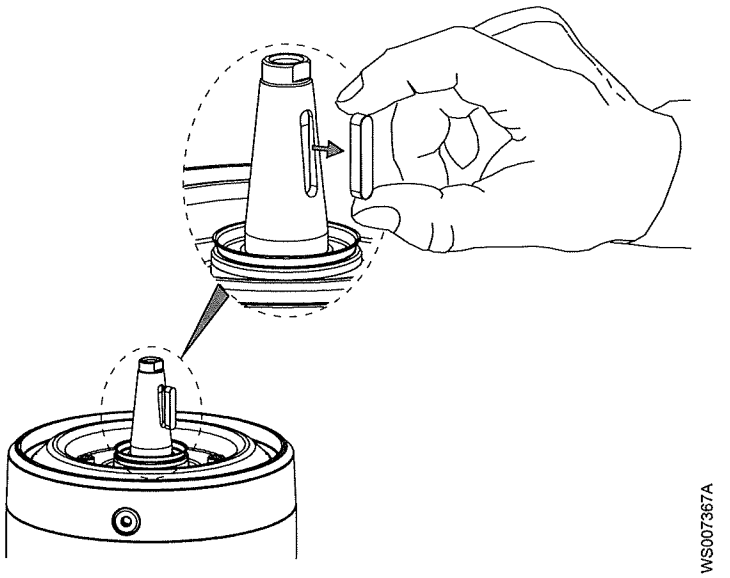
1. Twist off the propeller plug and the O-ring.
2. Loosen the hub screw.
   Use an M12 hexagon bit adapter (part no 84 14 79), n=10.
   As you loosen the screw, the head of the screw presses the propeller outward.



3. Remove the propeller.
   The image shows both mixer versions.

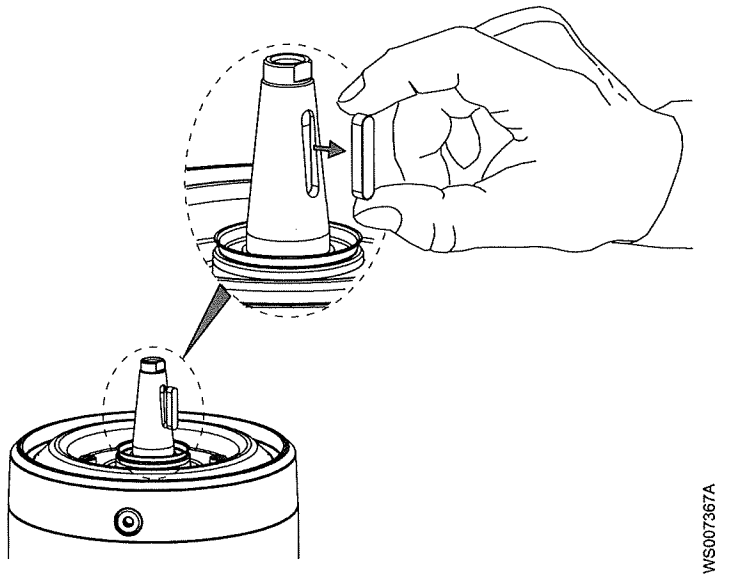


4. Remove the shaft key.
   Handle the shaft key by its ends.



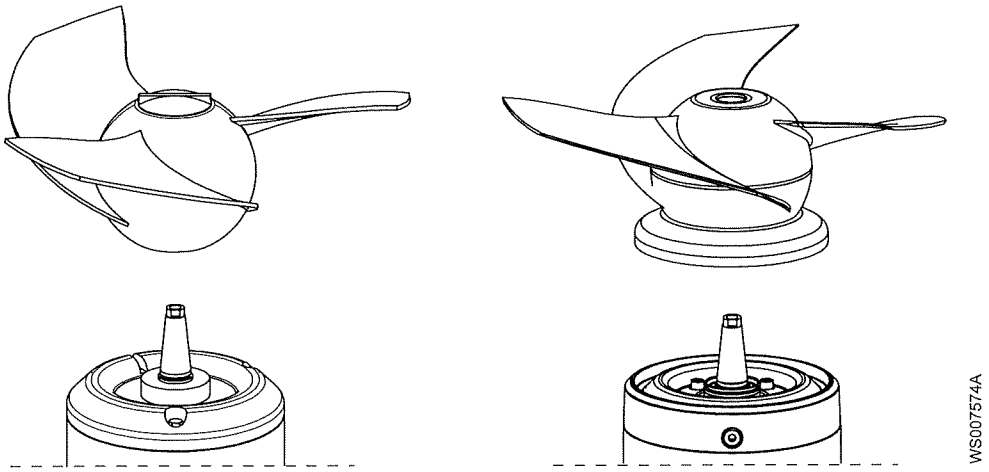
6.8.2 Assemble the propeller

1. Mount the shaft key.
   Handle the shaft key by its ends.

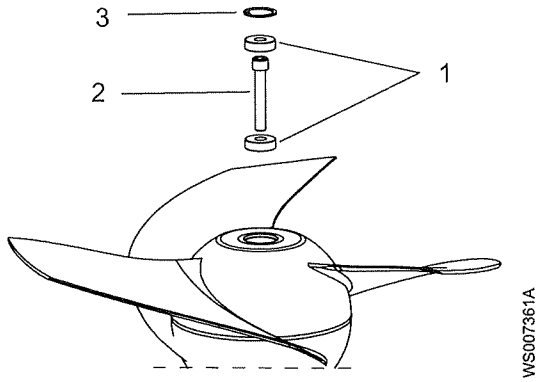


2. Mount the propeller on the shaft.

The image shows both mixer versions.



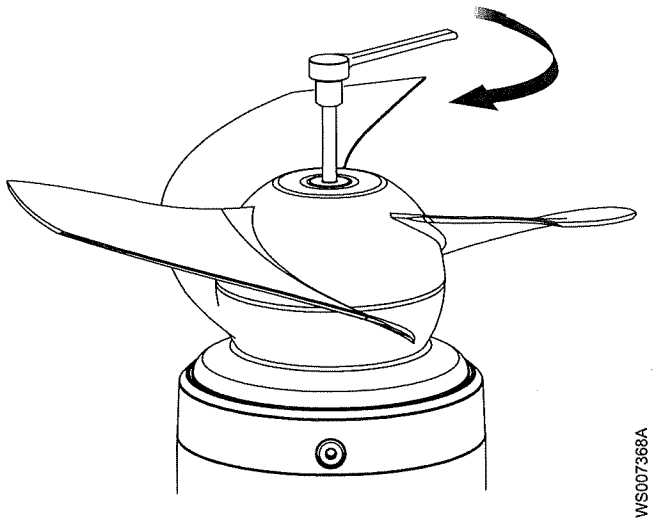
3. Mount the washers, hub screw, and retaining ring inside the propeller.



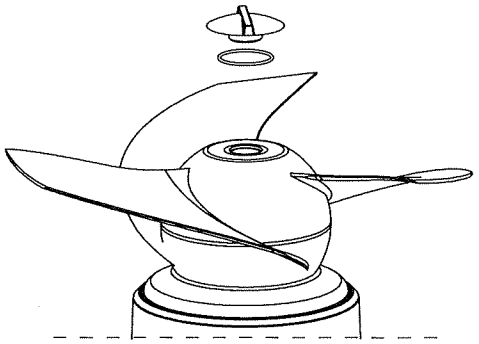
1. Washer
2. Hub screw
3. Retaining ring

4. Tighten the hub screw.

   Tighten to 136 Nm (100 ft-lb).



5. Mount the propeller plug with the O-ring on the propeller.


WS007358A

7 Troubleshooting

7.1 Electrical troubleshooting



DANGER: Electrical Hazard

Troubleshooting a live control panel exposes personnel to hazardous voltages. Electrical troubleshooting must be done by a qualified electrician.

Follow these guidelines when troubleshooting:

- Disconnect and lock out the power supply except when conducting checks that require voltage.
- Make sure that no one is near the unit when the power supply is reconnected.
- When troubleshooting electrical equipment, use the following:
  - Universal instrument multimeter
  - Test lamp (continuity tester)
  - Wiring diagram

7.2 The mixer does not start



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



Cause	Remedy
An alarm signal has been triggered on the control panel.	Check the thermal contacts, and that the overload protection has not tripped.
The mixer does not start automatically, but can be started manually.	Check that: • All connections are intact. • The relay and contactor coils are intact. • The control switch (Man/Auto) makes contact in both positions.
The installation is not receiving voltage.	Check that: • The main power switch is on. • There is control voltage to the start equipment. • The fuses are intact. • There is voltage in all phases of the supply line. • All fuses have power and that they are securely fastened to the fuse holders. • The overload protection is not tripped. • The motor cable is not damaged.
The propeller is stuck.	• Clean the propeller • Clean the jet ring Check the propeller clearance to the jet ring, and that the propeller and shaft can be rotated.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 12.

7.3 The mixer starts-stops-starts in rapid sequence

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



Cause	Remedy
The self-holding function of the contactor malfunctions.	Check the voltage in the control circuit in relation to the rated voltages on the coil, and that the contactor connections are intact.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 12.

7.4 The mixer runs but the motor protection trips

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.



NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The motor protection is set too low.	Set the motor protection according to specifications on the data plate.
There is a malfunction in the overload protection.	Replace the overload protection.
The propeller is difficult to rotate by hand.	• Clean the propeller and the shaft. • Check that the propeller size is correct. • Check the propeller clearance to the jet ring. • Check if the shaft has too much play due to worn out bearing.
The installation does not receive full voltage on all three phases.	• Check the motor fuses. Replace fuses that have tripped. • If the fuses are intact, then notify a certified electrician.
The phase currents vary or are too high.	Contact a sales or authorized service representative.
The rated speed differs from what is stated on the data plate.	Contact a sales or authorized service representative.
The density of the liquid is too high.	• Dilute the liquid. • Change the propeller blades or to a more suitable mixer. • Contact a sales or authorized service representative.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 12.

8 Technical Reference

8.1 Motor data

Feature	Description
Motor type	Squirrel-cage induction motor
Frequency	50 Hz 60 Hz
Supply	3-phase
Starting method	• Direct on-line • Variable frequency drive (VFD)
Maximum starts for each hour	30 evenly spaced starts for each hour
Voltage variation	• Continuously running: Maximum ±5% • Intermittently running: Maximum ±10%
Voltage imbalance between the phases	Maximum of 2%
Stator insulation class	H (180°C [356°F])

Motor encapsulation

Motor encapsulation is in accordance with IP68.

8.2 Application limits

Data	Description
Liquid temperature	Maximum 40°C (104°F) Warm liquid version: 60°C (140°F) or 90°C (195°F)
Liquid density	1100 kg/m³ (9.2 lb for each US gal) maximum
pH of the mixed liquid	1–12
Depth of immersion	Maximum 20 m (65 ft)

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1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

xylem
Let's Solve Water

Xylem Water Solutions Global Services AB 556782-9253
361 80 Emmaboda
Sweden
Tel: +46-471-24 70 00
Fax: +46-471-24 74 01
http://tpi.xyleminc.com
www.xylemwatersolutions.com/contacts/

Visit our Web site for the latest version of this document and more information

The original instruction is in English. All non-English instructions are translations of the original instruction.

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896508_24.0_en-US_2023-04_IOM_Flygt SR/PP 4650/4660

Installation, Operation
and Maintenance Manual



ENM 10

FLYGT
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1 Introduction and Safety

1.1 Introduction

Purpose of the manual

The purpose of this manual is to provide necessary information for installation, operation, and maintenance of the unit.

Read and keep the manual

Save this manual for future reference, and keep it readily available at the location of the unit.



CAUTION:

Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

The equipment, and its functioning, may be impaired if used in a manner not specified by the manufacturer.

Intended use



WARNING:

Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment and the surroundings. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.

1.2 Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product and its surroundings
- Product malfunction

Hazard levels

Hazard level	Indication
 DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
 WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
 CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury

Hazard level	Indication
NOTICE:	Notices are used when there is a risk of equipment damage or decreased performance, but not personal injury.

Special symbols

Some hazard categories have specific symbols, as shown in the following table.

Electrical hazard	Magnetic fields hazard
 Electrical Hazard:	 CAUTION:

1.3 User safety

Introduction

All government regulations, local health and safety directives must be observed.

Prevent danger due to electricity

All danger due to electricity must be avoided. Electrical connections must always be carried out in compliance with the following:

- The standard connections shown in the product documentation that is delivered together with the product
- All international, national, state, and local regulations. (For details, consult the regulations of your local electricity supplier.)

For more information about requirements, see sections dealing specifically with electrical connections.

Power lock-out



DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.

Qualification of personnel



WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.

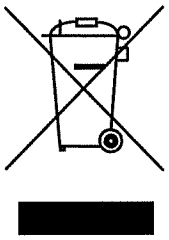
All work on the product must be carried out by certified electricians or Xylem authorized mechanics.

Xylem disclaims all responsibility for work done by untrained, unauthorized personnel.

1.4 End of life product disposal

Handle and dispose of all waste in compliance with local laws and regulations.

EU only: Correct disposal of this product – WEEE Directive on waste electrical and electronic equipment

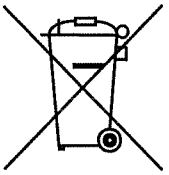


This marking on the product, accessories or literature indicates that the product should not be disposed of with other waste at the end of their working life.

To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate these items from other types of waste and recycle them responsibly to promote the sustainable reuse of material resources.

Waste from electrical and electronic equipment can be returned to the producer or distributor.

EU only: Correct disposal of batteries in this product



This marking on the battery, manual or packaging indicates that the batteries in this product should not be disposed of with other waste at the end of their working life. Where marked, the chemical symbols Hg, Cd or Pb indicate that the battery contains mercury, cadmium or lead above the reference levels in EC Directive 2006/66. If batteries are not properly disposed of, these substances can cause harm to human health or the environment.

To protect natural resources and to promote material re-use, please separate batteries from other types of waste and recycle them through your local, free battery return system.

1.5 Spare parts



CAUTION:

Only use the manufacturer's original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the warranty.

1.6 Warranty

For information about warranty, see the sales contract.

1.7 Support

Xylem only supports products that have been tested and approved. Xylem does not support unapproved equipment.

2 Product Description

2.1 Introduction

Product description

The product is the simplest possible method for level control. A mechanical switch in a plastic casing, freely suspended at the desired height from its own cable. When the liquid level reaches the regulator, the casing will tilt and the mechanical switch will close or break the circuit, thereby starting or stopping a pump or actuating an alarm device. No wear, no maintenance. In sewage pumping stations, for ground water and drainage pumping – in fact, for most level control applications – the product is the ideal solution.

Liquid density

The product is available in different versions for different liquid densities.

Temperature limit

The regulator can withstand up to 60°C (140°F).

Manual coverage

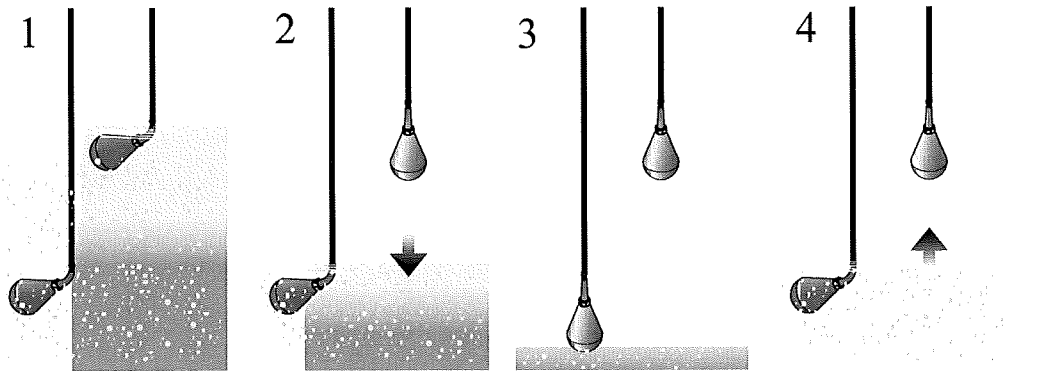
This manual is applicable for the versions shown in the following table:

Version	Casing
Standard	Blue
Ex	Black

Available languages

For manuals in other languages, visit http://tpi.xyleminc.com.

2.2 Process description



WS004996A

1. When the pumped media reaches a predetermined level, the upper level regulator tips over to horizontal position and the pump starts to drain the basin.
2. The basin is drained of fluid.
3. The pump stops when the lower level regulator returns to the vertical position.
4. The basin fills up again. The process restarts.

2.3 Technical data

Materials

Denomination	Standard version	Ex version
Regulator casing	Polypropylene	Polypropylene with black conductive casing
Bend relief	EPDM rubber	NBR-PVC rubber
Cable sheath	PVC	NBR-PVC rubber

The plastic components are welded and screwed together.

Lengths

For liquids with specific density between 0.95 and 1.10 g/cm^3, the following cables are available:

Version	Lengths m (ft)
Standard	• 6 m (20 ft) • 13 m (42 ft) • 20 m (65 ft) • 30 m (100 ft) • 50 m (167 ft)
Ex-version	• 6 m (20 ft) • 13 m (42 ft) • 20 m (65 ft)

2.4 Electrical data

Country	Electrical data
Canada	5 A, 250 V, DC 10 A, 250 V, AC
Denmark	10 A, 250 V, AC
Switzerland	6 A, 250 V, AC
Sweden	10 A, 230 V, AC Resistive load 3 A, 250 V, AC Inductive load 5 A, 30 V, DC Resistive load *1 mA, 5 V, DC, Gold Contact

* Part no: 594 79 19 and 594 79 20

Micro switch

The level regulator contains a micro switch, max rated 250 VAC/10 A.

Low-voltage supply

In many cases, local codes require that the regulator is connected to a low-voltage supply, even though it is approved for a higher voltage.

It is recommended that the regulator is connected to a low-voltage supply, 48 V or 24 V, and a protective transformer.

2.5 Electrical data for Ex-approved installation

Description	Data
Maximum input voltage, U_i	30 V
Maximum input current, I_i	100 mA

Description	Data
Maximum input power, P_i	1.2 W
Depth of immersion	Max 20 m

For cable

Description	Data
Maximum internal capacitance, C_i:	1.6 nF
Maximum internal inductance, L_i:	11.6 µH

Installation

There are special rules that apply to installation in an explosive atmosphere. Intrinsically safe circuits are normally required: Ex i. Use a EX-safety barrier, for example, Prod. No. 84 01 07.

2.6 Approvals and standards

Standard approvals

LVD approval according to EN61058

CSA approval: Certificate Number 1330172

Cl. I Zone 0, Gr. IIC

CL.I Div.1 Gr A, B, C and D

Cl.II Gr. E, F, and G

Ex approvals

IECEx ia IIC T4 Ga: -20°C≤Ta≤60°C

IECEx NEMKO 09.008

ATEX II 1G Ex ia IIC T4

NEMKO 10 ATEX 1082

Applied standards for ATEX and IEC

- EN 60079-0:2012/IEC 60079-0:2011
- EN 60079-11:2012/IEC 60079-11:2011

Intrinsically safe circuits are required for the automatic control system. Use a Zener barrier. For example, part number 84 01 07.

The electrical connections must comply with the Ex regulations of the national submitter.

0080

3 Mechanical Installation

Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 2 have been read and understood.

3.1 General

To conform to local regulations, the regulators are normally connected through a transformer to a low-tension control circuit.

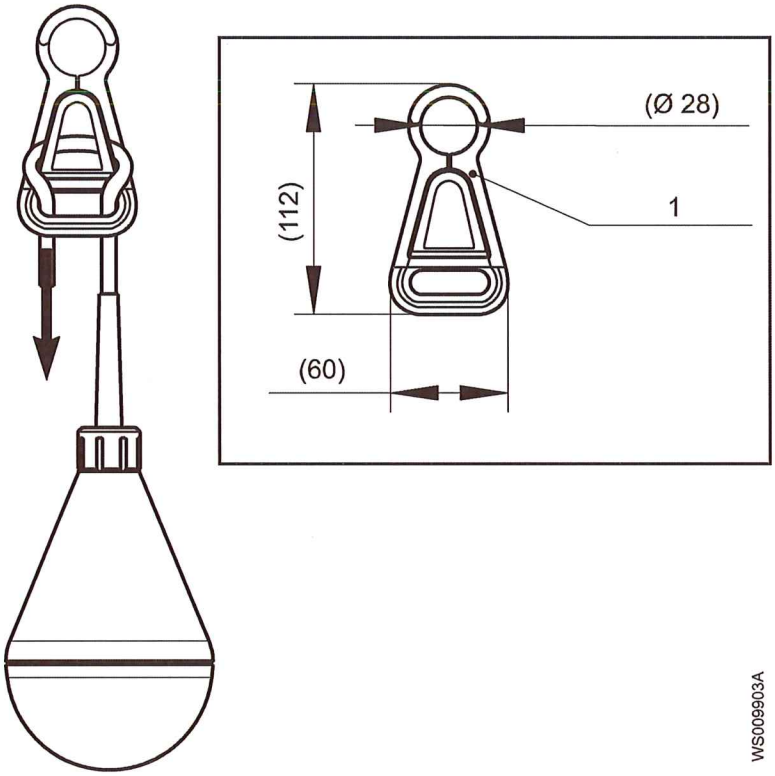
Make sure that two regulators are used, one for starting and one for stopping.

If an alarm is required at a given level, then connect a third regulator.

Identical regulators can be used for all functions.

Make sure that the cables do not become tangled during the installation.

The regulator cables must hang freely from each other.



1. Cable holder

4 Electrical Installation

Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 2 have been read and understood.



DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.



DANGER: Electrical Hazard

All electrical equipment must be grounded (earthed). Test the ground (earth) lead to verify that it is connected correctly and that the path to ground is continuous.



WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.



WARNING: Electrical Hazard

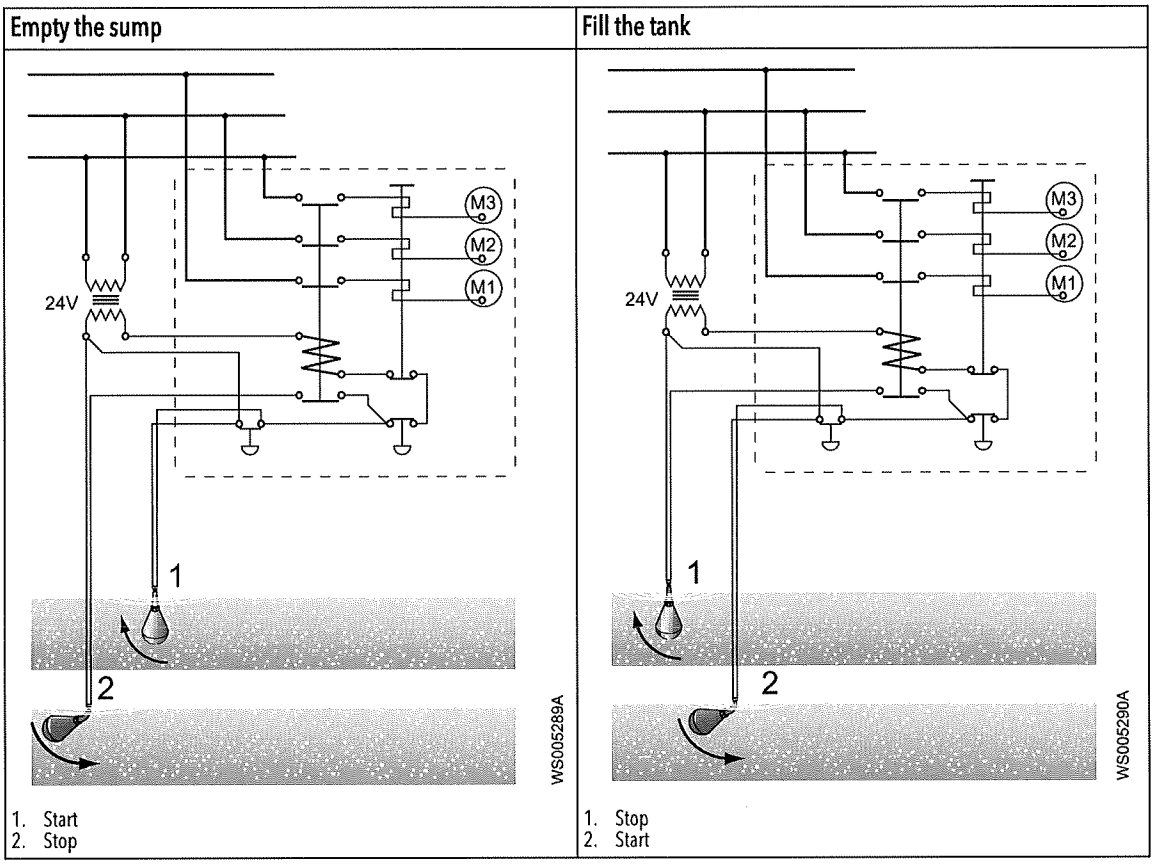
There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.



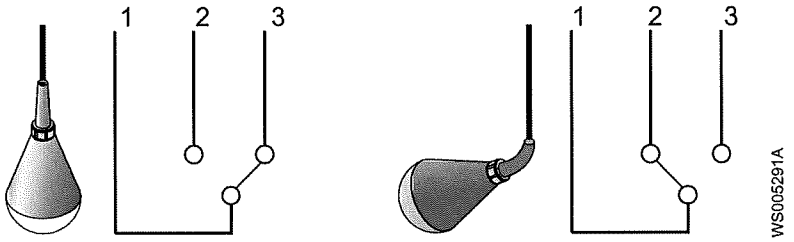
CAUTION: Electrical Hazard

Prevent cables from becoming sharply bent or damaged.

4.1 Wiring diagrams



Connection table



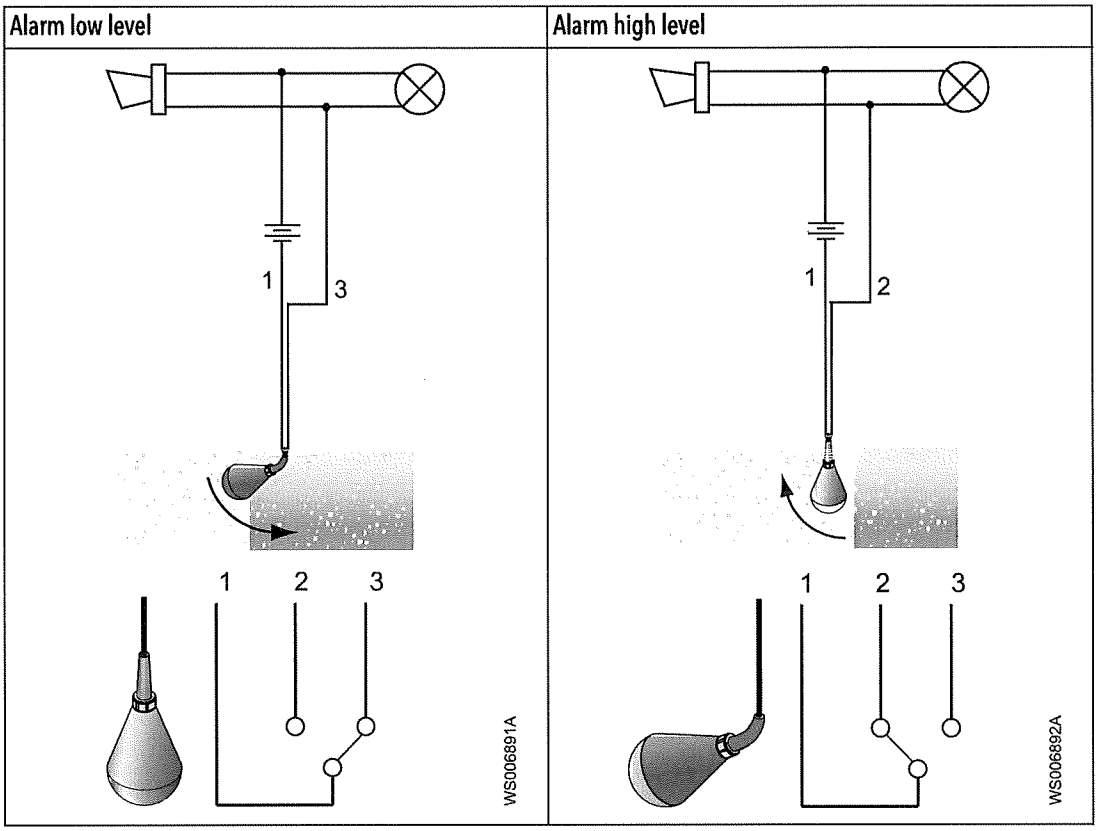
Cable	Connections to empty a sump	Connections to fill a tank
1	X	X
2	X	Insulate
3	Insulate	X

Color code

Cable	1	2	3
Color	EU: Grey US: Red	EU and US: Black	EU: Brown US: White

4.2 Connection for audible or visible alarm

Wiring diagrams



Description of position

Cable	1	2	3
Alarm high level	X	X	Insulate
Alarm low level	X	Insulate	X

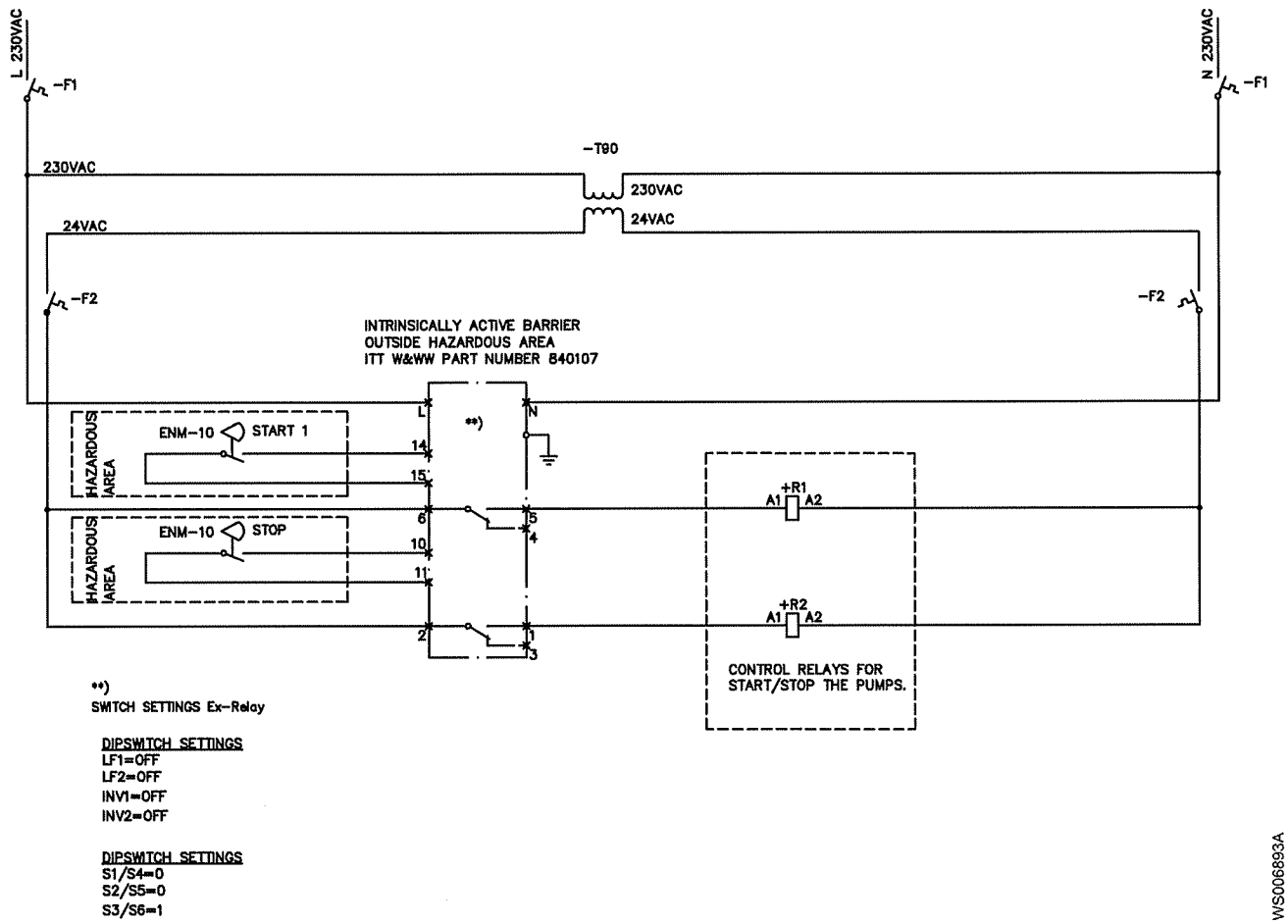
Color code

Cable	1	2	3
Color	EU: Grey US: Red	EU and US: Black	EU: Brown US: White

4.3 Ex-installation

EX-safety barrier

Intrinsically safe circuits are required for the automatic control system. EX-safety barrier (Prod. No. 84 01 07) must be installed.


L 230VAC
-F1
N 230VAC
-F1
-T90
230VAC
230VAC
24VAC
24VAC
-F2
-F2
INTRINSICALLY ACTIVE BARRIER
OUTSIDE HAZARDOUS AREA
ITT W&WW PART NUMBER 840107
HAZARDOUS AREA
ENM-10 START 1
HAZARDOUS AREA
ENM-10 STOP
L
N
**)
14
15
6
10
11
2
5
4
1
3
+R1
A1 A2
+R2
A1 A2
CONTROL RELAYS FOR
START/STOP THE PUMPS.
**)
SWITCH SETTINGS Ex-Relay
DIPSWITCH SETTINGS
LF1=OFF
LF2=OFF
INV1=OFF
INV2=OFF
DIPSWITCH SETTINGS
S1/S4=0
S2/S5=0
S3/S6=1
WS006893A

5 Maintenance

5.1 General

To ensure its continual operation:

- Clean the product, especially when fat/grease covers the plastic surface
- Make an occular inspection of the regulator. Make sure neither cable, protective sleeve or plastic casing show any signs of damage.
- A damaged regulator cannot be repaired in any way, due to the hermetic encapsulation. If the product is found to be damaged, replace it with a new one.

EX-installations

Make absolutely sure that the Ex-barrier is operating correctly.

- The LED changes when the switch is toggled.

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1) The tissue in plants that brings water upward from the roots
2) A leading global water technology company

We're a global team unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

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Refer to www.xylemwatersolutions.com/contacts/ for contact details of your local sales and service representative.

xylem
Let's Solve Water

Xylem Water Solutions
Manufacturing AB
361 80 Emmaboda
Sweden
Tel: +46 471 24 70 00
Fax: +46 471 24 74 01
http://tpi.xyleminc.com

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The original instruction is in English. All non-English instructions are translations of the original instruction.

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Installation, Operation, and
Maintenance manual

885830_2.0



LTU 801

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1 Introduction and Safety

1.1 Introduction

Purpose of the manual

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1.2 Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product and its surroundings
- Product malfunction

Hazard levels

Hazard level	Indication
 DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
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Special symbols

Some hazard categories have specific symbols, as shown in the following table.

Electrical hazard	Magnetic fields hazard
 Electrical Hazard:	 CAUTION:

1.3 User safety

Introduction

All government regulations, local health and safety directives must be observed.

Prevent danger due to electricity

All danger due to electricity must be avoided. Electrical connections must always be carried out in compliance with the following:

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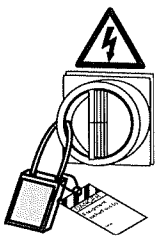
For more information about requirements, see sections dealing specifically with electrical connections.

Power lock-out



DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.



Qualification of personnel



WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.

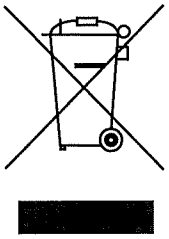
All work on the product must be carried out by certified electricians or Xylem authorized mechanics.

Xylem disclaims all responsibility for work done by untrained, unauthorized personnel.

1.4 End of life product disposal

Handle and dispose of all waste in compliance with local laws and regulations.

EU only: Correct disposal of this product – WEEE Directive on waste electrical and electronic equipment

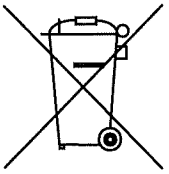


This marking on the product, accessories or literature indicates that the product should not be disposed of with other waste at the end of its working life.

To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate these items from other types of waste and recycle them responsibly to promote the sustainable reuse of material resources.

Waste from electrical and electronic equipment can be returned to the producer or distributor.

EU only: Correct disposal of batteries in this product



This marking on the battery, manual or packaging indicates that the batteries in this product should not be disposed of with other waste at the end of its working life. Where marked, the chemical symbols Hg, Cd or Pb indicate that the battery contains mercury, cadmium or lead above the reference levels in EC Directive 2006/66. If batteries are not properly disposed of, these substances can cause harm to human health or the environment.

To protect natural resources and to promote material re-use, please separate batteries from other types of waste and recycle them through your local, free battery return system.

1.5 Spare parts



CAUTION:

Only use the manufacturer's original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the warranty.

1.6 Warranty

For information about warranty, see the sales contract.

1.7 Support

Xylem only supports products that have been tested and approved. Xylem does not support unapproved equipment.

2 Product Description

2.1 Product design

The unit is a submersible level transmitter that measures and transmits liquid levels. The unit includes a sensor and a cable holder.

The preset measuring range is changed using a USB (Universal Serial Bus) interface and a computer software.

Intended use

The unit is used in these locations.

- Pump stations
- Sewage treatment plants
- Public utilities
- Industrial processing tanks
- Drains
- Open channels

Media applications

The unit is used in these media.

- Wastewater
- Process water
- Acids, bases and ferric chloride

  However, a pH value of less than 4 can reduce the lifespan of the unit. For more information, contact the local sales and service representative.

Parts

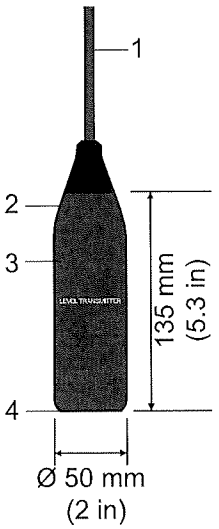


Figure 1: Without threaded top

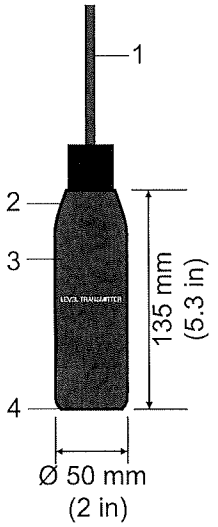


Figure 2: With threaded top

Part	Denomination	Material
1	Cable	PUR (polyurethane)
2	Housing	Ryton PPS (polyphenylene sulfide)
3	Measurement cell packing	Silicone
4	Diaphragm	99.9% pure ceramic (Al_2O_3)

2.2 Technical data

Electrical specifications

Data	Description
Stability and linearity	Maximum ± 0.2% full scale (FS)
Measurement range accuracy	Maximum ± 0.1% FS at 10–30°C (50–86°F) Maximum ± 0.2% FS at full temperature range
Measurement principle	Relative pressure with a ceramic diaphragm
Long-term stability	Maximum ± 0.1% FS per year
Power supply	10–30 V DC, 12–30 V DC for cable lengths more than 110 m (360.9 ft)
Output signal	2-wire 4–20 mA, passive signal
Degree of protection	IP 68

Temperature specifications

Feature	Description
Range	-10–70°C (14–158°F)
Zero drift deviation	Maximum ± 0.02% per °C
FS deviation	Maximum ± 0.01% per °C

Cable specifications

Data	Description
Diameter	Ø 8.75 mm (0.34 in) Minimum 8.5 mm (0.33 in), maximum 9.0 mm (0.35 in) tolerance
Wire specification	2 x 0.5 mm^2 (20 AWG) for pressure 5 x 0.15 mm^2 (24 AWG) for data
Length	For more information, see *Technical Reference* on page 14 .

2.3 Approvals and standards

Directive	Description
EMC 2014/30/EU	EN 61326-1, EN 61326-2-3 EN 55011, 61000-4-2, 61000-4-3, 61000-4-4, 61000-4-5, 61000-4-6, 61000-4-8, EN 61000-6-4, EN 61000-6-2
ATEX 2014/34/EU	EN 60079-0, EN 60079-11 II 2G Ex ia IIC T6 (-20°C≤Ta≤40°C) II 2G Ex ia IIC T5 (-20°C≤Ta≤50°C) II 2G Ex ia IIC T4 (-20°C≤Ta≤80°C)
UL	UL 913 UL 60079-0, UL 60079-11 by UL 913

If the unit is installed in an explosive atmosphere, then use an approved Zener barrier or isolator.

E254912

3 Mechanical Installation

3.1 Precautions

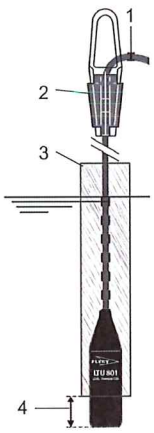
Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 2 have been read and understood.

3.2 Install the unit

Follow these guidelines to avoid damaging the unit.

- Do not drop the unit into the liquid.
- Do not allow sharp objects to penetrate the diaphragm.
- Avoid overpressure. For more information, see *Technical Reference* on page 14 .

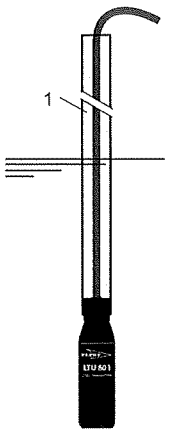
3.2.1 Install without threaded top



1. Cable, diameter 8.5–9.0 mm (0.33–0.35 in)
2. Cable bracket
3. Protective pipe, nominal diameter ≥ 75 mm (3 in)
4. Height clearance between the pipe and unit bottom, 25–50 mm (1–2 in)

1. Attach a hook above the location of measurement.
   The hook has to be strong enough to support the weight of the cable.
2. Carefully lower the unit until it is at the bottom of its range, ≥ 4 mA.
   Do not exceed the depth range of the unit.
3. If necessary, attach the unit correctly to the cable bracket.
4. If the unit is used in a location with turbulence, then install a pipe. The pipe protects the unit from hitting the walls or other objects.
   The pipe cannot cover at least 25 mm (0.98 in) of the bottom of unit.

3.2.2 Install with threaded top



1. Protective pipe, nominal diameter 25.4 mm (1 in)

1. Install the unit onto a pipe.
2. Install the pipe tightly at the measuring location.
3. Lower the unit carefully into the liquid.

4 Electrical Installation

Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 2 have been read and understood.

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.



DANGER: Electrical Hazard

All electrical equipment must be grounded (earthed). Test the ground (earth) lead to verify that it is connected correctly and that the path to ground is continuous.

WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.

WARNING: Electrical Hazard

There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.

CAUTION: Electrical Hazard

Prevent cables from becoming sharply bent or damaged.

4.1 Wiring

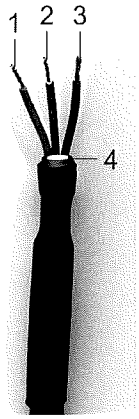


Figure 3: A cable that is delivered from the factory

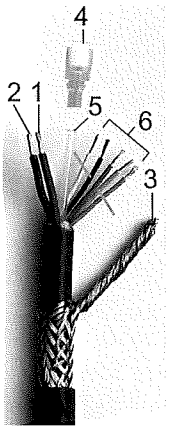


Figure 4: A cable that is cut and stripped

Number	Color	Description
1	Red or white	10–30 V DC
2	Brown	4–20 mA, out
3	Black	Protective earth (PE) connection (ground), screen
4	–	Moisture filter keeps moisture out of the air pressure compensation tube and the internal electronics of the unit
5	Transparent	Air pressure compensation tube
6	–	Programming wires

The red or white, brown, and black wires are numbered 1, 2 and 3 in the factory.

4.1.1 Prepare the cable

Do not connect any of the programming wires to avoid damage to the unit.

Do not connect a programming wire to the unit or try to program the unit while it is located in a hazardous area.

Do not block or squeeze the air pressure compensation tube.

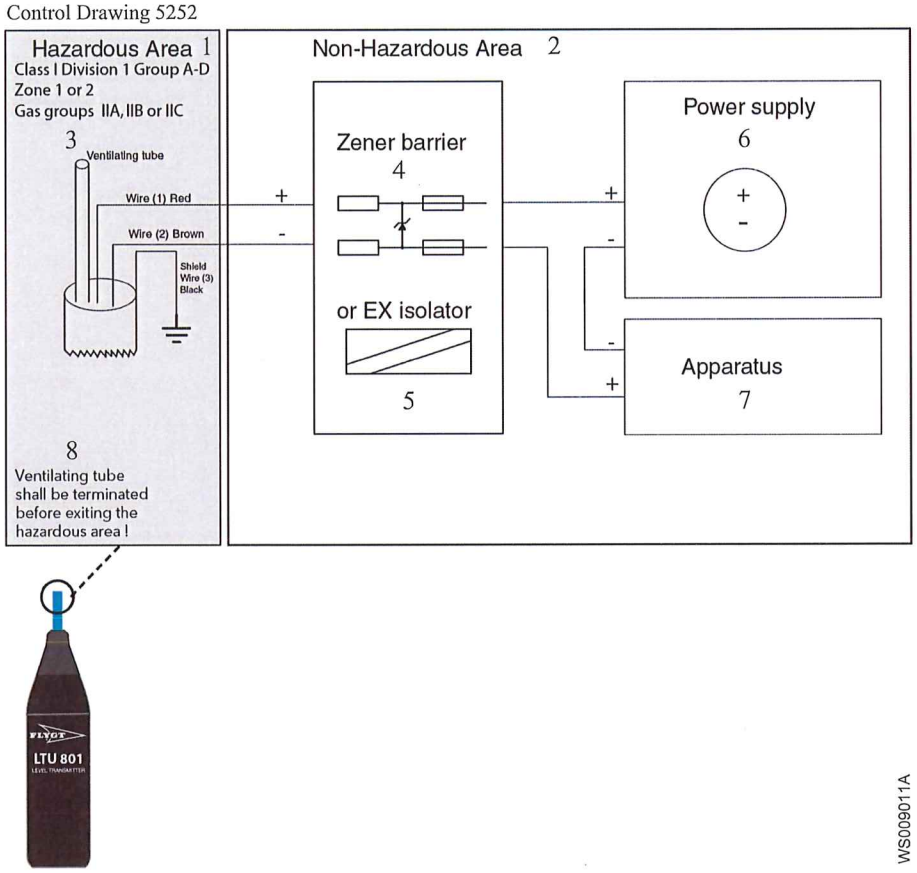
Make sure that no moisture enters the air pressure compensation tube.

Do not cut or remove the moisture filter.

- If the cable is cut and stripped, then connect the shield as wire number 3.
- Cut the programming wires in different lengths to prevent them from short circuit.
- If the cable is cut or spliced, then carefully reposition the moisture filter.

4.1.2 Zener barrier connection

Control Drawing 5252



1. Hazardous Area, Class I Division 1 Group A-D, Zone 1 or 2, Gas groups IIA, IIB, or IIC, T4/T5/T6
2. Non-hazardous Area
3. Ventilation tube
4. Zener barrier
5. EX Isolator
6. Power supply
7. Apparatus
8. The ventilation tube must be terminated before it leaves a hazardous area

Characteristics

Data	Value
Maximum input voltage	30 V DC
Maximum input electric current	0.101 A
Maximum input power	0.75 W
Internal capacitance (Ci)	3.5 nF/m + capacitance cable
Internal inductance (Li)	7 µH + inductance cable
Capacitance (C) cable	0.8 nF/m
Inductance (L) cable	1.5 µH/m

Parameters

These parameters apply:

- When the Ci and Li of the connected unit exceeds 1% of the Co, external capacitance, and Lo, external inductance, parameters, excluding the cable. Then 50% of the Co and Lo parameters apply and cannot be exceeded.
- The maximum cable length is calculated based on the internal capacity, 3.5 nF, and internal self-induction, 7 µH, of the unit. The cable capacity, 0.8 nF/m, and self-induction, 1.5 µH/m, is added.

- These two values are added to calculate the total capacity and total self-induction.
- The maximum capacity and self-induction for the connection are indicated on the Zener barrier or isolator.

  These two values cannot be exceeded.

4.2 Connect the unit

1. Connect the red or white wire to the power supply output.
2. Connect the brown wire to the 4–20 mA analog input.
3. Connect the black wire to the signal ground connection.

4.3 Increase the cable length

When the cable is extended, the complete capacity and self-induction cannot exceed the maximum specifications.

Use a shielded cable to prevent electrical disturbances.

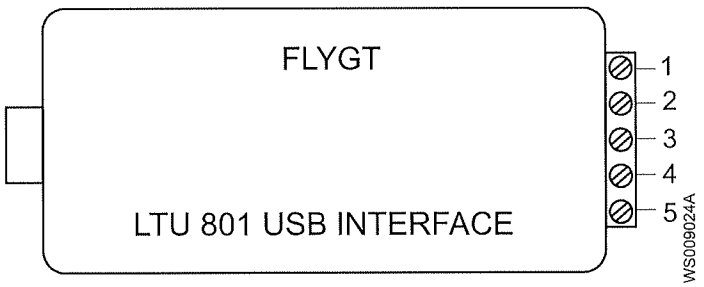
Do not allow signal cables in the proximity of power cables.

- Splice it with another cable.
- Use a junction box to extend the cable.

  The pressure equalization hose in the cable makes a direct splice impossible. For more information, contact the sales and service representative.

4.4 Prepare to rescale the measuring range

The unit must have a separate supply of 10–30 V DC from the installation.



1. Green
2. Brown
3. Gray
4. White
5. Yellow

Figure 5: Wiring connection

The unit can be programmed to any measuring range, 0–0.3 m (0–0.98 ft) to 0–300 m (0–984.2 ft).

1. Install the computer software from http://tpi.xyleminc.com. For more information, contact the sales and service representative.
2. Connect the USB interface to the computer.
3. Disconnect and reconnect the USB interface to the computer.
4. Connect the programming wires from the unit to the USB interface.

   The unit is ready for changes in the settings.

   The computer software automatically finds the USB interface.
5. Click **Read**.
6. Select a new range for the unit.

   The range is 30–100%.
7. Follow the instructions in the computer software to transfer the information to the unit.

5 Maintenance

5.1 Precautions

Before starting work, make sure that the safety instructions in the chapter *Introduction and Safety* on page 2 have been read and understood.

Cleaning

If the unit has buildup or a clogged diaphragm, clean the unit by rinsing it with a mild detergent.

6 Technical Reference

Measuring ranges

Table 1: Without threaded top

Measuring range, m	Overpressure, bar	Cable length, m	UL certification	Part number
0–2	6	12	-	84 62 30
0–5	10	12	-	84 62 31
0–5	10	30	-	84 62 33
0–5	10	50	-	84 62 34
0–10	10	12	-	84 62 35
0–10	10	25	-	84 62 36

Table 2: With threaded top

Measuring range, m	Overpressure, bar	Cable length, m	UL certification	Part number
0–5	10	12	-	84 62 32

Options

- Free computer software for USB interface that is downloadable from TPI
- Non-standard cable lengths
- Non-standard measuring range

For more information, contact the local sales and service representative.

Accessories and spare parts

Item	Accessory	Spare part	Part number
Operator panel for level indication	x	-	83 45 30
Junction box, including: • Protection for cable ends and air tube for cable splicing • Surge arrestor • VFD (variable frequency drive) noise or interference protection • Extra moisture protection The junction box is rated IP 67 and can be mounted outdoors.	x	-	83 95 05
Zener barrier for installation in hazardous areas	x	-	84 30 55
USB interface	x	-	85 00 43
Cable holder	-	x	83 21 74 or 83 73 88

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services, and agricultural settings. With its October 2016 acquisition of Sensus, Xylem added smart metering, network technologies and advanced data analytics for water, gas and electric utilities to its portfolio of solutions. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

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Let's Solve Water

Xylem Water Solutions Global Services AB
361 80 Emmaboda
Sweden
Tel: +46-471-24 70 00
Fax: +46-471-24 74 01
http://tpi.xyleminc.com
www.xylemwatersolutions.com/contacts/

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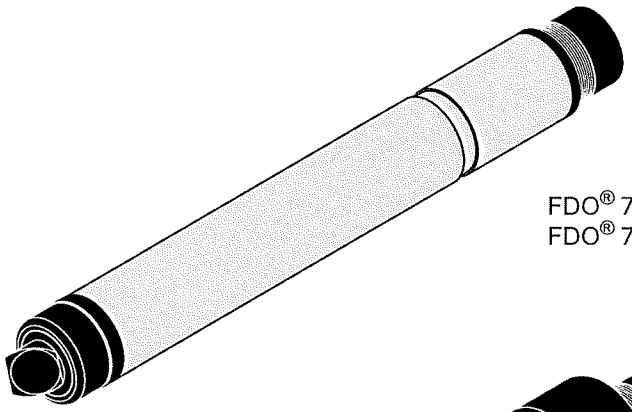
The original instruction is in English. All non-English instructions are translations of the original instruction.

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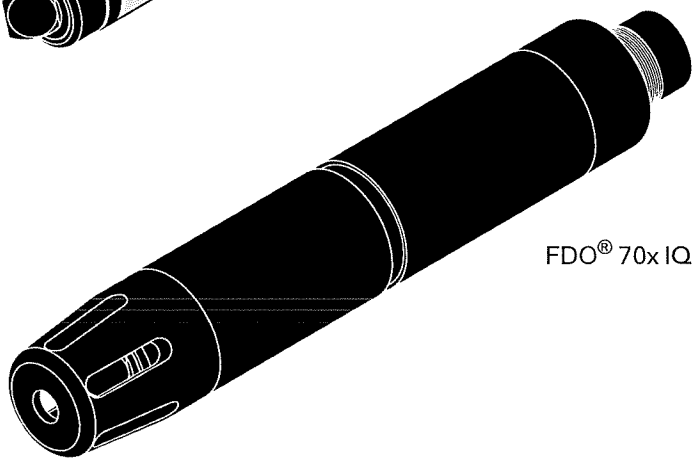
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OPERATING MANUAL

ba76014d03 05/2014



FDO® 70x IQ
FDO® 70x IQ H



FDO® 70x IQ SW

FDO® 70x IQ
FDO® 70x IQ SW
FDO® 70x IQ H

OPTICAL SENSOR FOR DISSOLVED OXYGEN

YSI®

a xylem brand



For the most recent version of the manual, please visit www.ysi.com.

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Yellow Springs, OH 45387 USA
Tel: +1 937-767-7241
800-765-4974
Email: environmental@ysi.com
Internet: www.ysi.com

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1 Overview

1.1 How to use this component operating manual

Structure of the IQ SENSORNET operating manual

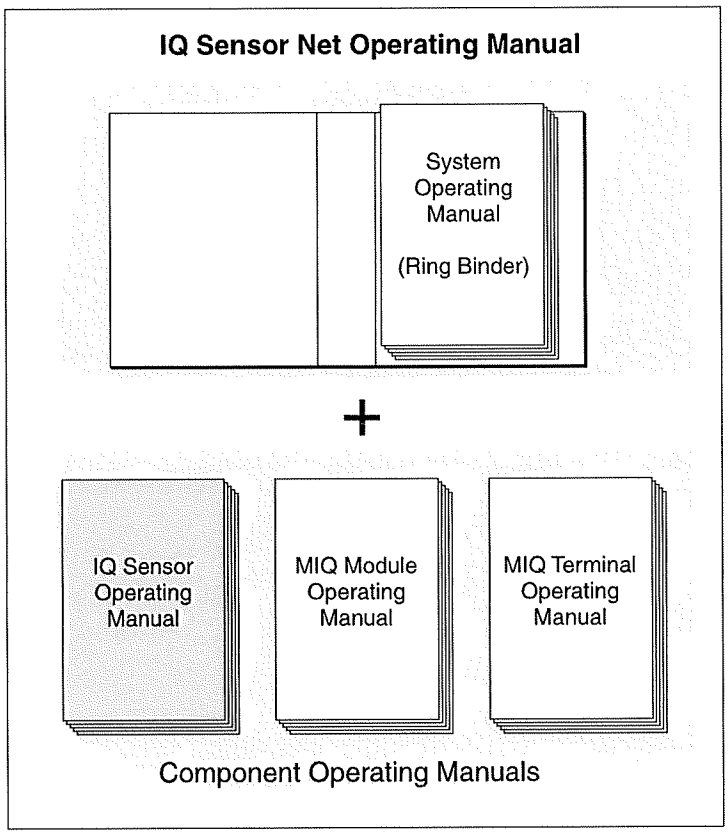


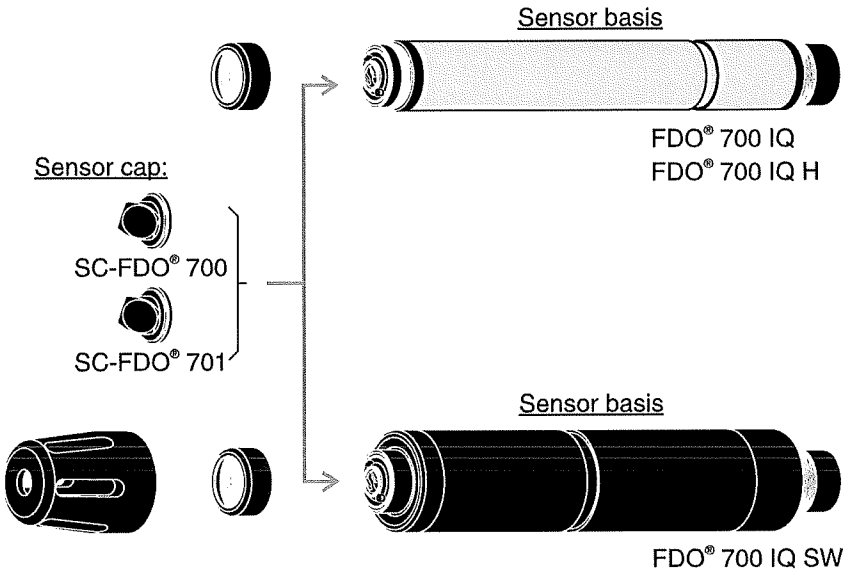
Fig. 1-1 Structure of the IQ SENSORNET operating manual

The IQ SENSOR NET operating manual has a modular structure like the IQ SENSORNET system itself. It consists of a system operating manual and the operating manuals of all the components used.

Please file this component operating manual into the ring binder of the system operating manual.

1.2 Sensor models

The FDO® 70x IQ ... consists of a sensor basis equipped with different sensor cap types, depending on the model:



Sensor models

Sensor model	Sensor basis	Sensor cap
FDO® 700 IQ	FDO® 700 IQ *	SC-FDO® 700
FDO® 700 IQ SW	FDO® 700 IQ SW *	SC-FDO® 700
FDO® 701 IQ	FDO® 700 IQ *	SC-FDO® 701
FDO® 701 IQ SW	FDO® 700 IQ SW *	SC-FDO® 701
FDO® 700 IQ H	FDO® 700 IQ H **	SC-FDO® 700
FDO® 701 IQ H	FDO® 701 IQ H **	SC-FDO® 701

* Type designation on the name plate in the plug head connector

** Type designation on the name plate on the shaft

The sensor cap primarily determines the measuring characteristics of the sensor as a whole. Thus the sensor can be adapted to the measuring job by exchanging the type of sensor cap. The specifications of the individual sensor cap types are given in chapter 7 TECHNICAL DATA.

H models

The sensor models FDO® 700 IQ H and FDO® 701 IQ H are rated for use in Class I Division 2 hazardous locations (see chapter 2.3 for details).

SW models

Compared to the standard models, the sea water models of the sensors (SW models) are optimized concerning their resistance to corrosion in sea water and brackish water.

1.3 Recommended fields of application

Sensor model	Recommended field of application.
FDO® 700 IQ FDO® 701 IQ	Stationary measurements in water/wastewater applications in non-hazardous locations only.
FDO® 700 IQ H FDO® 701 IQ H	Stationary measurements in water/wastewater applications in Class I Division 2 hazardous locations.
FDO® 700 IQ SW FDO® 701 IQ SW	Stationary measurements in seawater, aquaculture. The FDO® 70x IQ SW is equipped with a protective hood that is prepared for the connection of the MSK FDO® CS cleaning set for compressed air-driven sensor cleaning (order information, see section 5.5 REPLACEMENT PARTS AND ACCESSORIES).

1.4 Structure

Structure

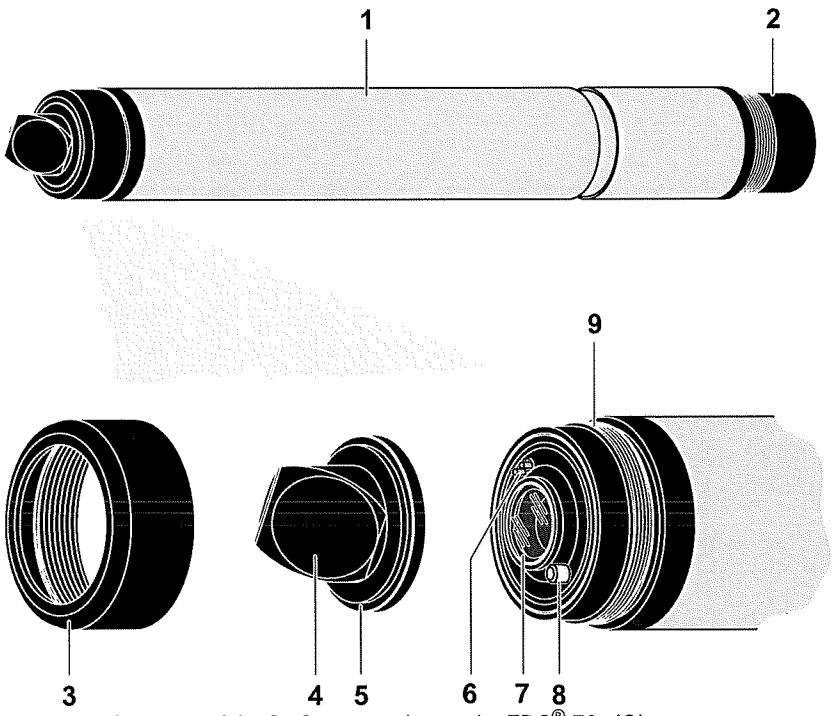


Fig. 1-2 Structure of the D. O. sensor (example: FDO® 70x IQ)

1	Shaft
2	Plug head connector
3	Fixing ring
4	Sensor membrane
5	Sensor cap with memory chip
6	Gold-plated contact pins for memory chip
7	Measurement window
8	Temperature sensor and locking device
9	Sensor head

Sensor cap with memory chip

A memory chip is integrated in the sensor cap. The following data is stored on the memory chip:

- Type designation of the sensor cap
- Series number
- Data of the factory calibration

Intelligent membrane (IQMC technology)

For each membrane the individual calibration values are determined by a factory calibration and stored on the memory chip of the sensor cap, ensuring maximum accuracy over the whole lifetime of the sensor.

2 Safety

2.1 Safety information

2.1.1 Hazard warnings in this operating manual

The hazard warnings are defined for the following levels of danger:



⚠DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



⚠WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



⚠CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



NOTICE

NOTICE is used to address practices not related to personal injury.

2.1.2 Safety information on the product

Note all labels, information signs and safety symbols on the product.

2.2 Safe operation

2.2.1 Authorized use

The authorized use of the FDO® 70x IQ ... comprises its use as a D.O. sensor in the IQ SENSORNET.
The technical specifications according to chapter 7 TECHNICAL DATA must be observed. Only operation according to the instructions in this operating manual is authorized.

Any other use is considered to be **unauthorized**. Unauthorized use invalidates any claims with regard to the guarantee.

2.2.2 Requirements for safe operation

Note the following points for safe operation:

- The product may only be operated according to the authorized use specified above.
- The product may only be supplied with power by the energy sources specified in this operating manual.
- The product may only be operated under the environmental conditions specified in this operating manual.
- The product or its components may only be opened if this is required for installation and maintenance work and described in the operating manual.

2.2.3 Unauthorized use

The product must not be put into operation if:

- it is visibly damaged (e.g. after being transported)
- it was stored under adverse conditions for a lengthy period of time (storing conditions, see chapter 7 TECHNICAL DATA)

2.3 Hazardous location use (FDO® 70x IQ H models)

⚠DANGER

Explosion hazard.
Only hazardous location rated sensor models ("Hazloc Sensor") must be used in hazardous locations. Read the name plate on the sensor shaft and verify that the sensor is rated for your specific application.

Rated sensor models

The following sensor models are rated for hazardous location use:

- FDO® 700 IQ H (YSI-Order No. 207065Y)
- FDO® 701 IQ H (YSI-Order No. 207066Y)

Hazardous location rated sensors are identified by the name plate with the rating details engraved on the sensor shaft:

Name plate of a Hazloc sensor (example)

YSI.

FDO 700 IQ H

Hazloc Sensor
Rated: Class I Division2 Groups ######
Class I Zone 2 Group ######
######
Control Drawing NO 28123

Intertek
2001759
CONFORMS TO
#########
################
CERTIFIED TO
####################
################

⚠DANGER

Explosion hazard.
The associated apparatus MIQ/BB1 (YSI part no. 207001Y) has to be used for connection. Refer to the following documents for proper installation:

- **Control drawing, YSI document no. 28123 (see MIQ/BB1 operating manual)**
- **MIQ/BB1 operating manual**
- **All applicable electrical code regulations.**

⚠DANGER

Explosion hazard.
This product does not meet the requirements of the directive 94/9/EC (ATEX).

3 Commissioning

3.1 Scope of delivery

- Sensor, consisting of sensor basis and sensor cap
- Operating manual.

3.2 Installation

Safety guidelines for installation in a hazardous location (H-models only)



⚠DANGER

Explosion hazard.
Only hazardous location rated sensor models ("Hazloc Sensor") must be used in hazardous locations. Verify the rating on the product name plate on the sensor shaft.
The associated apparatus MIQ/BB1 (YSI part no. 207001Y) has to be used for connection. Refer to the following documents for proper installation:

- **Control drawing, YSI document no. 28123 (see MIQ/BB1 operating manual)**
- **MIQ/BB1 operating manual**
- **All applicable electrical code regulations.**

Connection cable

A sensor connection cable of the SACIQ or SACIQ SW type is required to connect the sensor. The cable is available in different lengths. Compared to the standard model SACIQ, the SACIQ SW sensor connection cable is optimized regarding its corrosion resistance in seawater and brackish water and adapted for use in conjunction with the FDO 70x IQ SW. Information on this and other IQ SENSORNET accessories is given in the YSI catalog and on the Internet.



⚠DANGER

Explosion hazard.
For hazardous location use only the cable types listed in the control drawing must be used.



How to connect the SACIQ (SW) sensor connection cable to the terminal strip of a MIQ module is described in chapter 3 INSTALLATION of the IQ SENSORNET system operating manual.

Are the plug connections dry?

Before connecting the sensor and sensor connection cable, please make sure the plug connections are dry. If moisture gets into the plug connections, first dry the plug connections (dab them dry or blow them dry using compressed air).

Do not suspend the sensor on the sensor connection cable. Use a sensor holder or armature. Information on this and other IQ SENSORNET accessories is given in the YSI catalog and on the Internet.

Connecting the sensor to the sensor connection cable

1	Take the protective caps off the plug connections of the sensor and the SACIQ (SW) sensor connection cable and keep them safe.
2	Plug the jack of the SACIQ (SW) sensor connection cable onto the plug head connector of the sensor. At the same time, rotate the socket so that the pin in the plug head connector (1) clicks into one of the two holes in the socket.
3	Then screw the coupling ring (2) of the sensor connection cable onto the sensor up to the stop.

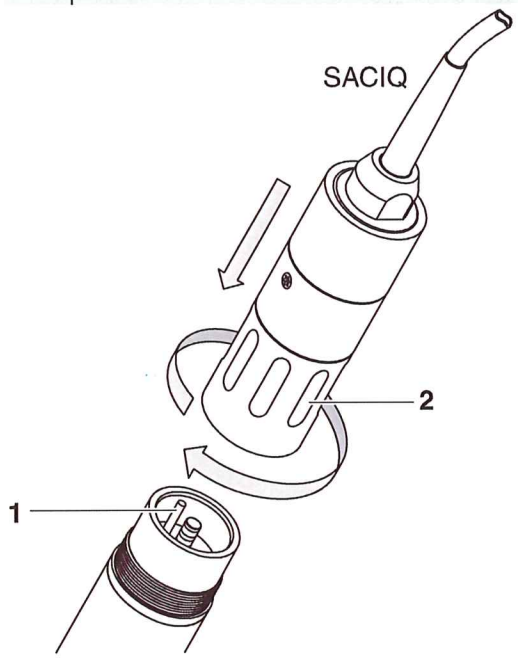


Fig. 3-1 Connecting the sensor

3.3 Commissioning / Getting the instrument ready for measuring

Identification in the IQ SENSORNET

Both the sensor cap and sensor basis (sensor without cap) have a series number of their own. The sensor has to be equipped with a sensor cap for a successful login to the IQ SENSORNET. The operable sensor is displayed as follows in the list of sensors:

- *Model*: Model designation of the sensor cap (="SC FDO 70x")
- *Ser. no.*: Series number of the sensor cap
- *Sensor name*: The series number of the sensor basis is preset here. You can change this entry as necessary by entering a user-defined name.

Commissioning steps

1	Pull the protective cap off the sensor.
2	If required, assign a user-defined name to the sensor (see relevant IQ SENSORNET system operating manual).
3	When using IQ SENSORNET without automatic air pressure compensation the mean air pressure value or the location altitude has to be entered (for more detailed information see the relevant IQ SENSORNET system operating manual).
4	Set the sensor (see section 3.4).

3.4 FDO® 70x IQ ... setting table

Setting	Selection/values	Explanation
Measuring mode	• *Concentration* • *Saturation*	Unit of the measured value on the measured value display.
Measuring range Concentration	• *0 ... 20.00 mg/l* • *0 ... 20.00 ppm*	These measuring ranges are available for selection.
Measuring range Saturation	• *0 ... 200.0 %*	The measuring range is set permanently.
Response time t90	• 150 .. 300 s (with SC-FDO® 700) or • 60 ... 300 s (with SC-FDO® 701)	Response time of the signal filter. Depending on the sample matrix, the measured values may fluctuate more or less. A signal filter in the sensor reduces the fluctuation range of the measured value. The signal filter is characterized by the *Response time t90*. This is the time after which 90 % of a signal change is displayed. The setting range depends on the sensor cap type.
Calibration	• *Factory calibration* • *User calibration* • *active* • *abort*	Determines which calibration data the measured value calculation will be based on. The active calibration is displayed in the calibration history. The selection, *User calibration* is only displayed if valid data of a *User calibration* is stored in the sensor. *active* indicates that the sensor is being calibrated. If *abort* is selected, the active calibration is canceled the next time the setting table is quit with *Save and quit*.
Test	• *active* • *abort*	*active* indicates that the sensor is being checked. If *abort* is selected, the active check is canceled the next time the setting table is quit with *Save and quit*.
Temperature mode	• *°C* • *°F*	Unit of the measured temperature value (Celsius, Fahrenheit).

Setting	Selection/values	Explanation
Temp. adjustment	-1.5 K ... +1.5 K	The temperature compensation enables the temperature display to be balanced (shifting of the zero point by ±1.5K). Notes: ● Due to the thermal capacity of the sensor, it is necessary to place it in a container with at least 2 liters of water. ● Leave the sensor in this container for at least 15 minutes while stirring occasionally until the balancing can be performed. With temperature differences between the water and sensor > 10 °C, leave the sensor for at least 1 hour in this container while stirring occasionally until the balancing can be performed.
Salinity	● *On* ● *Off*	Determines whether the entered salinity should be taken into account.
Salinity input	2.0 ... 70.0	The entry of the salinity enables a salt content correction that compensates for the effect of salt contents > 0.1 % on the oxygen measurement. The salt content correction is recommended for measurements in salt-contaminated wastewater (salinity ≥ 2.0 corresponding to a conductivity of ≥ 3.4 mS/cm at a reference temperature T_{REF} = 20 °C).
Sensor cap data	● *Do not download* ● *Transmit to log book*	Generates a log book message with all data stored in the sensor cap when the settings are quit with *Save and quit* (see section 1.2). When opening the menu again the setting is reset to *Do not download*.
Save and quit		The system confirms the saving of the settings and the display switches to the next higher level.
Quit		The display switches to the next higher level without saving the new settings.

Carrying out settings

Using **<S>**, switch from the measured value display to the main menu of the settings. Then navigate to the setting menu (setting table) of the sensor. The exact procedure is given in the relevant IQ SENSORNET system operating manual.

4 Measuring / Operation

4.1 Measuring



⚠WARNING

Chemical or biological hazard.
Contact with the sample can be harmful to the user. Depending on the type of sample, suitable protective measures must be taken (protective clothing, goggles, etc.).

Note the data given in section 7.2 APPLICATION CONDITIONS, especially the minimum immersion depth of the sensor (> 50 mm). The measured value is available immediately on submersing.



If keeping the sensor clean is a problem, we recommend using the compressed air-driven cleaning system with the CH cleaning head (see section 5.5 REPLACEMENT PARTS AND ACCESSORIES).

4.2 Function check and user calibration

4.2.1 General information

Factory calibration

The FDO® 70x IQ ... is factory calibrated. In the recommended application (see section 1.3 RECOMMENDED FIELDS OF APPLICATION), the measuring characteristics of the sensor cap remain stable for the specified service life. Thus, a user calibration is not usually required.

When does a function check or user calibration make sense?

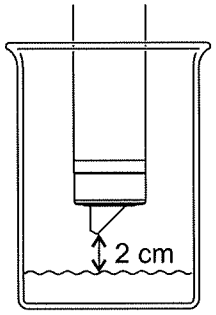
A function check or user calibration can be useful in the following special cases:

- If the measured values appear to be implausible and it is assumed that the service life of the sensor cap is over
- Routinely within the framework of the company quality assurance.

Check or calibration medium

Select one of the following two variants depending on the air temperature at the calibration site:

- With air temperatures over 5 °C, the function check and user calibration ideally take place in water vapor-saturated air. To do so, position the sensor approx. 2 cm above a water surface, for example in a narrow bucket or similar container with water. The membrane must be clean and dry for this.



- With air temperatures under 5 °C we recommend performing the function check and user calibration not in air but in air-saturated water that has a higher temperature. You obtain air-saturated water by pouring water several times in and out of two vessels so that it sparkles.

4.2.2 Function check

A function check is the simplest way to determine whether the sensor needs to be cleaned or user-calibrated.

Principle

The function check can either be done in water vapor-saturated air or in air-saturated water (see CHECK OR CALIBRATION MEDIUM on page 4-1).

Steps

Generally, a check on the IQ SENSORNET is carried out as follows. System specific details are given in the respective IQ SENSORNET system operating manual.

1	Switch to the measured value display with **<M>** and select the FDO® 70x IQ ... sensor.
2	Press **<C>**. The next step switches on the maintenance condition for the sensor. A corresponding message appears on the display.
3	Confirm the note with **<OK>**. The maintenance condition is active.
4	Select the *TEST* procedure and press **<OK>**.
5	Put the sensor into the calibration position (water vapor-saturated air or air-saturated water - see section 4.2.1).
6	Press **<OK>**. The sensor starts the check. The display switches to the measured value display. The *CAL* indicator flashes instead of the main measured value. At the same time, the momentary relative slope flashes as the secondary measured value with the addition of *TEST*. The process ends automatically as soon as the measured values meet the criterion for the stability control. With a great temperature difference between the sensor and the environment this may take a while. Subsequently, the main measured value and temperature are displayed.

7	Put the sensor in the measuring position again.
8	Wait for the measured value to be largely stable (temperature adjustment).
9	Switch off the maintenance condition.

Canceling the check

As long as the determination of the relative slope has not yet been started (step 6), you can quit the check with **<M>** or **<ESC>**.

The running determination of the relative slope (after pressing **<OK>** in step 6) can be aborted as follows:

1	Open the setting table (see section 3.4).
2	In the *Test* menu item, select the *abort* setting and then quit the setting table with *Save and quit*.

Evaluation

The result of the check is entered in the log book of the sensor. If the relative slope is outside the tolerance range (0.90 ... 1.10), the check is assessed as erroneous.



The information recorded in the log book entry is partly identical with that of the calibration history. The calibration history is described in detail in section 4.2.4 CALIBRATION HISTORY.

4.2.3 User calibration

Principle

The user calibration can either be done in water vapor-saturated air or in air-saturated water (see CHECK OR CALIBRATION MEDIUM on page 4-1). With the calibration procedure, the relative slope of the sensor is determined. The calibration is evaluated based on the relative slope and the intensity (successful <-> unsuccessful).

The result of the user calibration is stored in the calibration record and calibration history respectively and can be viewed afterwards (see respective IQ SENSORNET system operating manual).



We want to point out that the factory calibration of the membrane is highly precise due to the IQMC technology. If you still want to carry out a user calibration, influences due to environmental conditions have to be taken into account.

Steps

Generally, a user calibration on the IQ SENSORNET is carried out as follows. System specific details are given in the respective IQ SENSORNET system operating manual.

1	Switch to the measured value display with **<M>** and select the FDO® 70x IQ ... sensor.
2	Press **<C>**. The next step switches on the maintenance condition for the sensor. A corresponding message appears on the display.
3	Confirm the note with **<OK>**. The maintenance condition is active.
4	Select the *CALIBRATION* procedure and press **<OK>**.
5	Put the sensor into the calibration position (water vapor-saturated air or air-saturated water - see section 4.2.1).
6	Press **<OK>**. The sensor determines the calibration data. The display switches to the measured value display. The *CAL* indicator flashes instead of the main measured value. At the same time, the momentary relative slope flashes as the secondary measured value. The process ends automatically as soon as the measured values meet the criterion for the stability control. With a great temperature difference between the sensor and the environment this may take a while. Subsequently, the main measured value and temperature are displayed.
7	If the user calibration was successful, bring the sensor into the measuring position again.
8	Wait for the measured value to be largely stable (temperature adjustment).
9	Switch off the maintenance condition.

Canceling the user calibration

As long as the determination of the calibration data has not yet been started (step 6), you can quit the calibration routine with **<M>** or **<ESC>**.

The running determination of calibration data (after pressing **<OK>** in step 6) can be aborted as follows:

1	Open the setting table (see section 3.4).
2	In the *Calibration* menu item, select the *abort* setting and then quit the setting table with *Save and quit*.

After the user calibration was canceled the sensor again works with the calibration data that was used before the canceled user calibration.

Possible results of the user calibration

The calibration data is evaluated by the system. A calibration can have the following results:

Display	Explanation
Measured value display	Sensor was successfully calibrated. The calibration data can be viewed in the calibration history (section 4.2.4).
"----"	The sensor could not be calibrated. The sensor is blocked for further measurement. Notes on possible causes are given in the log book of the sensor.

4.2.4 Calibration history

Calibration history (available in the IQ SENSORNET systems 184 XT and 2020 XT only)

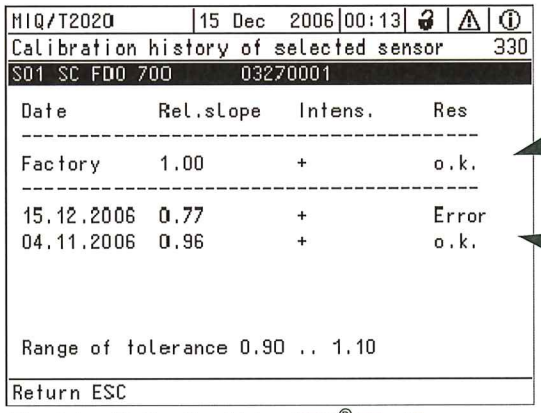


Fig. 4-1 Calibration historyFDO® 70x IQ ...

The calibration history contains the following information:

Date	Calibration date (*Factory* = factory calibration)
Rel.slope	Relative slope (non-dimensional)
Intens.	Intensity: **+** : sufficient - : too low
Res	Evaluation of the calibration *o.k.* : Calibration successful. The new calibration data was taken over for measurement. *Error* : Calibration unsuccessful. Invalid calibration data were discarded. Measurement was continued with the last valid values.

The calibration history is stored in the sensor basis. If another sensor cap (with different series number) is mounted, the calibration history is deleted and cannot be restored afterwards.

4.2.5 Reactivating previous calibration data

The FDO® 70x IQ ... enables you to reactivate the last valid user calibration or the factory calibration. Thus you can immediately go on measuring if a calibration procedure failed or you suspect that the calibration conditions were not optimally met.



Reactivating old calibration data is only a temporary solution. Please take into account that the sensor might thus possibly provide incorrect measured values. Please make sure the sensor works correctly by carrying out a function check and/or recalibration.

Reactivating calibration data

1	Open the setting table (see section 3.4).
2	In the *Calibration* menu item, select the *User calibration* or *Factory calibration* setting and then quit the setting table with *Save and quit*.

5 Maintenance, cleaning, replacement parts

5.1 General maintenance instructions

⚠WARNING



Chemical or biological hazard.
Contact with the sample can be harmful to the user. Depending on the type of sample, suitable protective measures must be taken (protective clothing, goggles, etc.).

Maintenance condition

We recommend to switch on the maintenance condition each time the sensor is taken out of the measuring position. This avoids unwanted reactions of linked outputs. For more detailed information on the maintenance condition please refer to the respective IQ SENSORNET system operating manual.



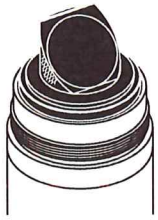
We do not recommend unscrewing the sensor from the sensor connection cable in order to do maintenance work. Otherwise, moisture and/or dirt can get into the plug connection where it can cause contact problems.

If you would like to disconnect the sensor from the sensor connection cable, please note the following points:

- Before disconnecting the sensor from the SACIQ (SW) sensor connection cable, the sensor has to be cleaned on the outside (see section 5.4.1).
- Unscrew the sensor from the SACIQ (SW) sensor connection cable.
- Place a protective cap on the sensor plug head connector and on the SACIQ (SW) sensor connection cable each time so that no moisture or dirt can get on the contacting surfaces.
- In corrosive environments, close the socket of the sensor connection cable with the screwable SACIQ-Plug when it is dry in order to protect the electrical contacts from corrosion. The protective plug is available as an accessory (see section 5.5 REPLACEMENT PARTS AND ACCESSORIES). It is included in the standard scope of delivery of the SACIQ SW sensor connection cable.

5.2 Handling of the sensor cap

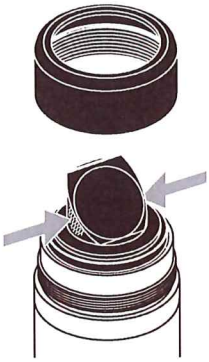
Despite its exterior robustness, the sensor is an optical high precision instrument. Therefore, special care should be taken when doing any maintenance or cleaning work:



- Dirt and moisture under the sensor cap can affect the functioning and shorten the service life of the sensor cap. Therefore, make sure the working environment is clean and dry prior to removing the sensor cap.
- Please do not touch the outer sensor membrane with your fingers. Touch the sensor cap at the sides only (shaded area in figure on the left).
- Avoid any great mechanical stress of the sensor membrane (pressure, scratches).
- Exposure to light, particularly daylight of the interior of the sensor cap will, by-and-by, affect the measurement characteristics and shorten the service life of the sensor cap. Therefore, the interior of the sensor cap should not be exposed to direct sunlight. Avoid any exposure to light that exceeds the extent required for necessary maintenance and cleaning activities. Store dismantled sensor caps in a light-protected environment only.

5.3 Exchanging the sensor cap

Removing the sensor cap

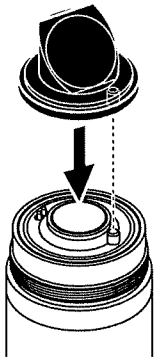


1	Pull the sensor out of the sample.
2	Clean the outside of the sensor (see section 5.4.1).
3	Unscrew the fixing ring from the sensor by hand.
4	Thoroughly clean and dry the sensor head once again.
5	Grasp the sensor cap on the sides (arrows in figure on the left) and remove it by pulling it away from the sensor in a straight upward direction.

NOTICE

Do not push any tools or other sharp objects between the sealing surfaces. This might damage the sealing surfaces.

Mounting the sensor cap



6	Check the front surface of the sensor for absolute cleanness and clean it if necessary (see section 5.4.1).
7	Thoroughly clean the thread of the fixing ring.
8	Place the new sensor cap on the sensor so that the temperature sensor fits into the hole inside the sensor cap (see figure opposite).
9	Put the fixing ring on the sensor head and screw it tight by hand.

5.4 Cleaning the sensor

5.4.1 Exterior cleaning

Dirt on the sensor can affect the measuring characteristics. Biological deposits for example, consume oxygen and can, when occurring on the sensor cap membrane, impair the responding behavior and cause values that are too low. Therefore, we recommend regular visual inspections and exterior cleaning as necessary.

Pay attention to the following points for cleaning:

- First, thoroughly rinse the sensor with tapwater to remove loosely adhering dirt.
- Rough dirt on the sensor shaft can be brushed off with a soft brush. Attention: Do not use the brush in the area of the sensor membrane. Risk of damage!
- The sensor cap including the sensor membrane should be wiped with a soft and moist microfiber cloth.
- In the case of persisting dirt you can add some household washing-up liquid to the tapwater. Attention: Never use any alcohol for cleaning!
- If the are any salt or lime deposits, the sensor can be cleaned with aqueous citric acid solution (10 % weight percent).

5.4.2 Interior cleaning of sensor cap and sensor head

If moisture or dirt have penetrated under the sensor cap, e.g. because the sensor cap is damaged, you can make the sensor ready for operation again as follows:

NOTICE

Only use nonabrasive, alcohol-free detergents, as otherwise the optical surfaces could be damaged.

1	Remove the sensor cap (see section 5.3).
2	Clean the sensor head and sensor cap: – Rinse all inner surfaces with tapwater – Remove contamination containing fat and oil with warm water and household washing-up liquid
3	Dry all surfaces with a clean, lint free cloth. A lint-free cloth such as a microfiber cloth used to clean eyeglasses is suitable.
4	Allow the sensor and sensor cap to dry completely at a dry location so moisture can evaporate even from corners difficult to access. When doing, so protect the inside of the sensor cap from light.

If the sensor cap is visibly damaged it has to be replaced.

5.5 Replacement parts and accessories

Description	Model	Order no.
Sensor cap	SC-FDO® 700	201 654Y
Sensor cap	SC-FDO® 701	201 655Y
Protective screw cap for sensor connection cable	SACIQ-Plug	480 065Y
Protective hood against damage caused by fish, with connection for the MSK FDO® CS cleaning set	MSK FDO®	205 253Y
Cleaning set for connection of the protective hood MSK FDO® to a valve module or Cleaning Air Box	MSK FDO® CS	205 254Y

Components for compressed air cleaning system

Description	Model	Order no.
Cleaning head	CH	900 107Y
Active valve module (does not require a free relay output in the IQ SENSORNET system)	MIQ/CHV PLUS	480 018Y
Valve module for the IQ SENSORNET system 182 (external relay and compressed air supply)	DIQ/CHV	472 007Y
Air compressor to be triggered by relay, power supply 115 V AC	Cleaning Air Box - 115 VAC	480 017Y
Air compressor to be triggered by relay, power supply 230 V AC	Cleaning Air Box - 230 VAC	480 019Y



Information on further IQ SENSORNET accessories is given in the YSI catalog and on the Internet.

6 What to do if...

Sensor does not appear in the measured value display and list of sensors

Cause	Remedy
– Sensor cap not mounted or defective	– Sensor cap (see section 5.3) – Replace a defective sensor cap as necessary

Measured value implausible

Cause	Remedy
– Coating on sensor cap	– Clean the outside of the sensor (see section 5.4.1)
– Service life of the sensor cap over	– Check the sensor (see section 4.2.2) – Replace the sensor cap as necessary (see section 5.3)
– Dirt inside the sensor cap and sensor head. – Fixing ring not properly tightened. – Sensor cap untight or defective.	– Dismantle sensor cap – Clean the insides of the sensor cap and sensor head (see section 5.4.2) – Mount the sensor cap correctly and tighten the fixing ring as far as it will go (see section 5.3) – Replace a defective sensor cap as necessary

Measured value fluctuating heavily

Cause	Remedy
– Coating on sensor cap	– Clean the outside of the sensor (see section 5.4.1)
– Service life of the sensor cap over	– See point "Measured value implausible"
– Dirt inside the sensor cap and sensor head. – Fixing ring not properly tightened. – Sensor cap untight or defective.	– See point "Measured value implausible"

Measured value invalid ("----" displayed)

Cause	Remedy
– User calibration unsuccessful. The sensor is blocked for measurement.	– As a temporary measure to quickly restore the readiness for service: Activate the factory calibration (see section 4.2.5) – For exact measurements, carry out a function check and repeat the user calibration if necessary.

Incorrect temperature display

Cause	Remedy
– Temperature sensor defective	– Return the sensor

7 Technical data

7.1 General measurement characteristics



The measurement characteristics are primarily determined by the sensor cap type. The relevant data are given in the sections 7.6 and 7.7.

Measuring principle

Optical measurement based on photoluminescence.

Measurement in water

According to solubility function according to ISO 5814

Measurement in salt-contaminated wastewater

Salinity input from 2.0 ... 70.0;
corresponds to 3.4 mS/cm ... 86.2 mS/cm at T_{REF} 20 °C
(salinity measurement according to IOT = International Oceanographic Tables)

Temperature measurement

Temperature sensor	Integrated NTC
Measuring range	- 5 °C ... + 50 °C (23 ... 122 °F)
Accuracy	± 0.5 K
Resolution	0.1 K

Temperature compensation

In the range -5 °C ... + 50 °C (23 ... 122 °F)

7.2 Application conditions

Pressure resistance

Sensor with connected SACIQ (SW) sensor connection cable:

Max. allowed overpressure	10^6 Pa (10 bar)

The sensor meets all requirements according to article 3(3) of 97/23/EC ("pressure equipment directive").

Type of protection

Sensor with connected SACIQ (SW) sensor connection cable:

IP 68, 10 bar (10^6 Pa)

Immersion depth

Min. 10 cm; max. 100 m depth

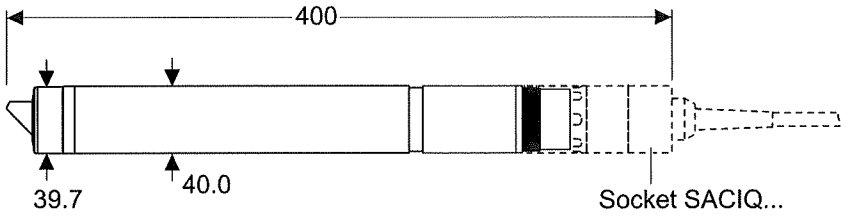
Operating position

Any

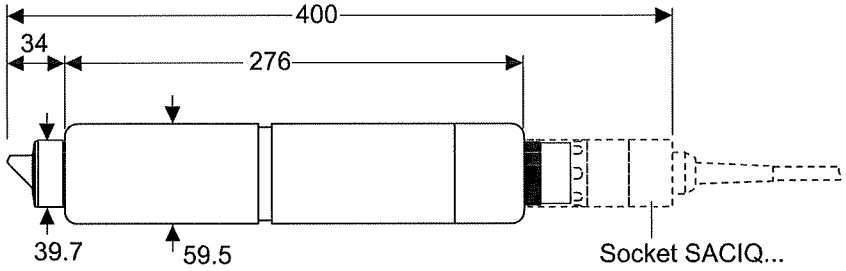
7.3 General data

Dimensions

FDO 70x IQ (H):



FDO 70x IQ SW:



Weight (without sensor connection cable)

FDO® 70x IQ (H)	Approx. 900 g
FDO® 70x IQ SW	Approx. 1500 g

Connection technique

Connection via SACIQ (SW) sensor connection cable

Material

Shaft: – FDO® 70x IQ – FDO® 70x IQ SW	V4A stainless steel 1.4571 * POM
Plug head connector housing	POM
Sensor head	POM and PVC
Sensor cap	See section 7.6 or section 7.7
Plug, 3-pole	ETFE (blue) Tefzel®
Fixing ring	POM
Protective hood (FDO® 70x IQ SW)	POM

* Stainless steel can be corrodible if there are chloride concentrations of 500 mg/L or more. For applications in such media we recommend to use the SW sensors.

Automatic sensor monitoring (SensCheck function)

Monitoring of the membrane function

7.4 Instrument safety

7.4.1 General instrument safety

Applicable norms	– UL 61010-1 – CAN/CSA C22.2 # 61010.1

7.4.2 Hazardous location ratings (H models)

Applicable directives and standards

In addition to the standards listed in chapter 7.4.1, the FDO® 70x IQ H conforms to the following directives and standards:

- ANSI/ISA-12.12.01
- CAN/CSA C22.2 # 213

The FDO® 70x IQ H is a non-incendive electrical equipment for use in Class I Division 2 hazardous locations.

Hazardous location rating

FDO® 700 IQ H FDO® 701 IQ H	Class I Division 2 Groups A, B, C, D T6 Class I Zone 2 Group IIC T6
Associated apparatus	MIQ/BB1, YSI part no. 207001Y
Control Drawing	YSI document no. 28123

7.5 Electrical data

Rated voltage (non-H models)	24 V DC via the IQ SENSORNET (for more details, see chapter TECHNICAL DATA of the IQ SENSORNET system operating manual)
Voltage range (H models)	14 V DC ... 24 V DC via the MIQ/BB1 barrier box (=associated apparatus)
Power consumption	0.7 W
Protective class	III

7.6 Technical data of the SC-FDO® 700

Measuring ranges and resolutions

D. O. partial pressure 0 ... 400 hPa

Measuring mode	Adjustable measuring range	Resolution
D. O. concentration	0 ... 20.00 mg/L 0 ... 20.00 ppm	0.01 mg/L 0.01 ppm
D. O. saturation	0 ... 200.0 %	0.1 %

Measurement accuracy

In the range	Accuracy
< 1 mg/L (ppm)	± 0.05 mg/L (ppm)
> 1 mg/L (ppm)	± 0.1 mg/L (ppm)

Repeatability

± 0.05 mg/L (ppm) according to EN ISO 15839

Response time

t_{90} (90 % of the final display value after) < 150 s according to EN ISO 15839
t_{95} (95 % of the final display value after) < 200 s according to EN ISO 15839

Minimum approach flow

No incident flow required

Interferences

Non-sensitive to against hydrogen sulfide, chlorine, and ionogenic substances

Allowed temperature range

Measuring medium	- 5 °C ... + 50 °C (23 ... 122 °F)
Storage/transport	- 10 °C ... + 50 °C (14 ... 122 °F)

Allowed pH range of the test sample

4 ... 12

Calibration procedure

Factory calibration by means of IQMC (Intelligent Membrane Calibration) procedure. User calibration possible in water vapor-saturated air or air-saturated water.

Material

PMMA, PVC and silicone

Working life

2 years guaranteed with authorized use

7.7 Technical data of the SC-FDO® 701

Measuring ranges and resolutions

D. O. partial pressure 0 ... 400 hPa

Measuring mode	Adjustable measuring range	Resolution
D. O. concentration	0 ... 20.00 mg/L 0 ... 20.00 ppm	0.01 mg/L 0.01 ppm
D. O. saturation	0 ... 200.0 %	0.1 %

Measurement accuracy

In the range	Accuracy
< 1 mg/L (ppm)	± 0.05 mg/L (ppm)
> 1 mg/L (ppm)	± 0.1 mg/L (ppm)

Repeatability

± 0.05 mg/L (ppm) according to EN ISO 15839

Response time

t_{90} (90 % of the final display value after) < 60 s according to EN ISO 15839
t_{95} (95 % of the final display value after) < 80 s according to EN ISO 15839

Minimum approach flow

No incident flow required

Interferences

Non-sensitive to against hydrogen sulfide, chlorine, and ionogenic substances

Allowed temperature range

Measuring medium	-5 °C ... + 40 °C (23 ... 104 °F)
Storage/transport	- 10 °C ... + 40 °C (-33 ... 104 °F)

Allowed pH range of the test sample

4 ... 12

Calibration procedure

Factory calibration by means of IQMC (Intelligent Membrane Calibration) procedure. User calibration possible in water vapor-saturated air or air-saturated water.

Material

PMMA, PVC and silicone

Working life

6 months guaranteed for authorized use under the specified environmental conditions

8 Contact Information

8.1 Ordering & Technical Support

Telephone: (800) 897-4151
(937) 767-7241
Monday through Friday, 8:00 AM to 5:00 PM ET

Fax: (937) 767-1058

Email: environmental@ysi.com

Mail: YSI Incorporated
1725 Brannum Lane
Yellow Springs, OH 45387
USA

Internet: www.ysi.com

When placing an order please have the following information available:

YSI account number (if available)	Name and Phone Number
Model number or brief description	Billing and shipping address
Quantity	Purchase Order or Credit Card

8.2 Service Information

YSI has authorized service centers throughout the United States and Internationally. For the nearest service center information, please visit www.ysi.com and click 'Support' or contact YSI Technical Support directly at 800-897-4151.

When returning a product for service, include the Product Return form with cleaning certification. The form must be completely filled out for an YSI Service Center to accept the instrument for service. The Product Return form may be downloaded at www.ysi.com and clicking on the 'Support' tab.

9 Indexes

9.1 Explanation of the messages

This chapter contains a list of all the message codes and related message texts that can occur in the log book of the IQ SENSORNET system for the FDO® 70x IQ ... sensor.

Information on the contents and structure of the log book, and how to call it up, is given in the LOG BOOK chapter of the IQ SENSORNET system operating manual.

The last three digits of the message code identify the source of the message:

- 334 = SC FDO 700 (sensor cap SC-FDO® 700)
- 335 = SC FDO 701 (sensor cap SC-FDO® 701)
- 531 = FDO700IQ (sensor basis / component class, adapter ADA)

9.1.1 Error messages

Message code	Message text
EA133x	*Meas. range exceeded or undercut* ** Check process* ** Select other meas. range*
EA233x	*Sensor temperature too high!* ** Check process and application*
EA333x	*Sensor temperature too low!* ** Check process and application*
EAP33x	*Measurement interfered* ** SensCheck: Sensor cap is missing, leaky, depleted, or defective* ** Clean sensor and space between cap and sensor according to op.instructions* ** Screw on sensor cap securely* ** Replace sensor cap*
EAP531	*Measurement interfered* ** SensCheck: Sensor cap is missing, leaky, depleted, or defective* ** Clean sensor and space between cap and sensor according to op.instructions* ** Screw on sensor cap securely* ** Replace sensor cap*

Message code	Message text
EC833x	*Sensor could not be calibrated,* *sensor blocked for measurement* *Cause: instable signal* ** Check temperature adjustment* ** Check calibration conditions (see operating manual)* ** Repeat calibration*
EC933x	*Calibration error, measurement disabled* *Cause: Sensor cap is missing, leaky, depleted, or defective* ** Clean sensor and space between cap and sensor according to op.instructions* ** Screw on sensor cap securely* ** Repeat calibration* ** Replace sensor cap*
EI133x	*Operational voltage too low* ** Check installation and cable lengths, Follow installation instructions* ** Power supply module(s) overloaded, add power supply module(s)* ** Check terminal and module connections* ** Defective components, replace components*
EI233x	*Operational voltage too low, no operation possible* ** Check installation and cable lengths, Follow installation instructions* ** Power supply module(s) overloaded, add power supply module(s)* ** Check terminal and module connections* ** Defective components,* *replace components*
ES133x	*Component hardware defective* ** Contact service*

9.1.2 Info messages

Message code	Message text
IC133x	*Sensor has been successfully calibrated* ** For calibration data, see calibration history*
IC333x	*Factory calibration has been activated. Make sure the sensor operates correctly.*
IC433x	*Last valid calibration has been activated. Make sure the sensor operates correctly.*
IC533x	*Invalid user calibration has been replaced by last valid user calibration. Caution! Wrong measured values possible. Carry out a new successful calibration to make sure the sensor operates correctly.*es correctly.
IC633x	*The invalid user calibration was replaced by the factory calibration. Caution! Wrong measured values possible. Check whether the sensor operates correctly or carry out a new successful calibration.user calibration.*
IC733x	This message displays the result of the last check (see section 4.2.2)
IS133x	This message displays the information stored in the sensor cap (see section 1.2)

9.2 Status info

The status info is a coded piece of information on the current status of a sensor. Each sensor sends this status info to the controller. The status info of sensors consists of 32 bits, each of which can have the value 0 or 1.

Status info, general structure

0 1 2 3 4 5 6 7	8 9 10 11 12 13 14 15	
1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	(general)
0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	(internal)
16 17 18 19 20 21 22 23	24 25 26 27 28 29 30 31	

The bits 0 - 15 are reserved for general information.
The bits 16 - 21 are reserved for internal service information.

You obtain the status info:

- via a manual query in the *Einstellungen/Settings/Service/List of all components* menu (see system operating manual)
- by an automated query
  - from a superordinate process control (e. g. when connected to the Profibus)
  - from the IQ Data Server (see IQ SENSORNET Software Pack operating manual)

The evaluation of the status info, e.g. in the case of an automated query, has to be made individually for each bit.

Status info

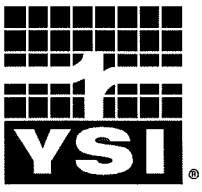
Status bit	Explanation
Bit 0	*Component hardware defective*
Bit 1	Sensor cap missing, untight, depleted or defective
Bit 2-31	-

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're 12,500 people unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

For more information on how Xylem can help you, go to www.xyleminc.com



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YSI
1725 Brannum Lane
Yellow Springs, OH 45387
Tel: +1 937-767-7241; 800-765-4974
Fax: +1 937-767-1058
Email: environmental@ysi.com
Web: www.ysi.com

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City of Aumsville, Oregon
Sequencing Batch Reactor Equipment
for
The Aumsville Wastewater Treatment Plant Improvements

Section 17: Annual O&M

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O&M Requirements

A. O & M Procedures

NOTE: We have provided the typical person-hours required for typical equipment operation and maintenance. The labor rate to be estimated by OTHERS.

The following lists estimated regular maintenance to be expected for each piece of equipment.

Decanters and Decanter Drives: Check actuator and motor gear box, and lubrication (monthly). Check seal on limit switch enclosure (monthly). Check actuator for free travel over entire operating stroke and any signs of binding/noise (monthly) [1 hr/decanter/month].

Aeration Blowers: Check inlet filters, lubrication levels, and grease fittings (weekly). Clean or replace inlet filter when inlet manometer shows excess clogging. Inspect and adjust belt and sheaves between motor and blower (monthly). Change blower oil every 1000-1500 hours. Grease blower bearings. Re-grease motor bearings [0.5 hr/blower/month].

Fine Bubble Aeration System: The SANITAIRE® fine bubble aeration system is designed to give maintenance free service. Should any reason to enter the basin occur, the ICEAS® continuous influent feature allows the operator to take a basin out of service temporarily without disrupting the rest of the process, **Only the ICEAS® process offers this feature**.
[Diffuser Replacement @ 10 years, replacement time 25 diffusers per man-hour]

Valves: Check limit switches and seal on limit switch enclosure (monthly) [0.5 hr/valve/month].

Control Panel: The control equipment will need no regular service.

Pumps & Mixers: Inspect pump/mixer assembly monthly for signs of rag build up and/or binding. Inspect pump oil monthly for level and signs of water intrusion. Add oil as needed. Replace oil and seals as indicated if there is evidence of water intrusion [1.0 hr/pump/month].

Aumsville, OR - Preliminary ICEAS O&M

based on 11-15-2024 design

Quantity of Basins	2

OPERATING COSTS - MECHANICAL EQUIPMENT; FOR 2 BASINS EXISTING AVERAGE ANNUAL FLOW

Equipment Item		Operated During	Quantity Operating	Motor HP	Time Operating per day	Energy Usage/day	Energy costs / year
Fine Bubble Diffuser Grid		Aeration		N/A			
Blower		Aeration	2	40	10	596.56 kW	$ 21,774.44
Blower		Digester	2	40	24	1431.74 kW	$ 52,258.66
Flygt Mixer		Anaerobic/Anoxic	2	11	24	393.73 kW	$ 14,371.13
WAS Pump		Settle/Decant	2	3	2.7	12.08 kW	$ 440.93
Digested Sludge Pump			2	3	8	35.79 kW	$ 1,306.47
Decanter		Settle/Decant	2	0.75	6	6.71 kW	$ 244.96
TOTAL						**2476.62 kW**	**$ 90,396.59**

Provided energy cost:	$	0.100	kW-hr

Diffusers / Basin ICEAS	616
Cost/diffuser	$8.20
Estimated Time to change diffuser	3.0
Man-hours required to change diffusers in one basin	30.8

Time frame	**20 year(s)**

Diffusers / Basin Digester	328
Cost/diffuser	$8.20
Estimated Time to change diffuser	3.0
Man-hours required to change diffusers in one basin	16.4

Time frame	**20 year(s)**

MAINTENANCE: ESTIMATED MATERIAL COSTS FOR 2 BASINS

Equipment Item	equipment quantity	Accessories to be replaced	Frequency of Replacement		*Estimated* Material Unit Cost	Material Cost over 20 years
Decanter	2	(1) Limit Switch	1 x	5 year(s)	$ 300	$ 2,400
		Actuator Spare Parts Kit: Seal, Bearings, Gasket	1 x	5 year(s)	$ 1,950	$ 15,600
Blowers	5	Oil & Grease	1 x	1 year(s)	$ 15	$ 1,500
		Bearings/Blower	1 x	10 year(s)	$ 1,000	$ 10,000
		Motor Bearings/Blower	1 x	10 year(s)	$ 1,000	$ 10,000
		Inlet Filter	1 x	3 year(s)	$ 300	$ 10,000
ICEAS FB Aeration Grid	2	Membranes Replacement	1 x	10 year(s)	$ 5,051	$ 20,205
Digester FB Aeration Grid	2	Membranes Replacement	1 x	10 year(s)	$ 2,690	$ 10,758
Air Control Valves	4	None	N/A		$ -	
Waste Sludge Pumps	2	Oil	1 x	1 year(s)	$ 25	$ 1,000
		Seals	1 x	3 year(s)	$ 150	$ 2,000
Digested Sludge Pumps	2	Oil	1 x	1 year(s)	$ 25	$ 1,000
		Seals	1 x	3 year(s)	$ 150	$ 2,000
Mixers	4	Oil	1 x	1 year(s)	$ 25	$ 2,000
		Seals	1 x	3 year(s)	$ 150	$ 4,000
Control Panel	1	None	N/A		$ -	
TOTAL						**$ 92,463**

MAINTENANCE: ESTIMATED LABOR FOR 2 BASINS

Equipment Item	equipment quantity	Service Required	Frequency of Service		*Estimated* Service Time per occurrence	Service time over 20 years
Decanter	2	Check actuator, motor gear box. Lubrication. Check seal on limit switch enclosure	12 x	1 year(s)	1.00 hour(s)	480.00 hour(s)
ICEAS Blowers	2	Check inlet filters, lubrication levels, crease fittings.	52 x	1 year(s)	0.25 hour(s)	520.00 hour(s)
		Inspect, adjust belt and sheaves between motor and blower	12 x	1 year(s)	0.25 hour(s)	120.00 hour(s)
		Change blower oil every 1000-1500 hours	5.84 x	1 year(s)	0.50 hour(s)	116.80 hour(s)
		Grease blower bearings, regrease motor bearings	1 x	3 year(s)	0.50 hour(s)	6.67 hour(s)
Digester Blowers	2	Check inlet filters, lubrication levels, crease fittings.	52 x	1 year(s)	0.25 hour(s)	520.00 hour(s)
		Inspect, adjust belt and sheaves between motor and blower	12 x	1 year(s)	0.25 hour(s)	120.00 hour(s)
		Change blower oil every 1000-1500 hours	5.84 x	1 year(s)	0.50 hour(s)	116.80 hour(s)
		Grease blower bearings, regrease motor bearings	1 x	3 year(s)	0.50 hour(s)	6.67 hour(s)
Fine Bubble Aeration Grid	2	Membranes replacement	1 x	10 year(s)	30.80 hour(s)	123.20 hour(s)
Air Control Valves	2	Check limit switches and seals on limit switch enclosure	12	1 year(s)	0.50 hour(s)	240.00 hour(s)
Waste Sludge Pumps	2	Inspect for rag buildup, binding.	12 x	1 year(s)	1.00 hour(s)	480.00 hour(s)
		Inspect, adjust oil level and for signs of water intrusion	12 x	1 year(s)		
Mixers	0	Inspect for rag buildup, binding.	12 x	1 year(s)	1.00 hour(s)	0.00 hour(s)
		Inspect, adjust oil level and for signs of water intrusion	12 x	1 year(s)		
Control Panel	1	None	N/A		0.00 hour(s)	
TOTAL						2850.13 hour(s)

Assumed labor cost:	$ 100.00	per hour
Average labor (for routine maintenance)	2.74	hours per week
Labor cost per week	**$ 274.05**	

City of Aumsville, Oregon
Sequencing Batch Reactor Equipment
for
The Aumsville Wastewater Treatment Plant Improvements

Section 18: Spare Parts

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City of Aumsville, Oregon
Sequencing Batch Reactor Equipment
for
The Aumsville Wastewater Treatment Plant Improvements

Provided Spares:

A. 25 diffuser elements and gaskets
B. 10 diffuser holder retainer rings
C. 5 air distributor supports
D. 3 manifold supports
E. 3 air distributor sections
F. 10 air distributor repair couplings
G. 5 fixed joint assemblies

*There are no recommended spare parts other than "Constructions Spares" which will be itemized on the shipping list when project submittals are released by engineering.

**A list of common aeration spares/replacement parts with costs is included in this section.

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Effective April 1, 2024

2024 Sanitaire USA Aftermarket Parts Pricing (USD)

Item Description	Sanitaire Ref.	Part Number	List Price by Quantity 1-249	250-999	1000-4999	5000+
Coarse Bubble Diffusers						
D-12 (316L)	D-12S6DF	0000007587204	$ 88.00			
D-24 (304L)	D-24S4DF	0000007587200	$ 89.00			
D-24 (316 L)	D-24S6DF	0000007587203	$ 122.00			
9" Fine Bubble Diffusers						
Silver Series II 9" Membrane Disc	2261-WE9	1400000619730	$ 8.20	$ 7.70	$ 7.20	$ 6.70
Silver Series II LP (Low Pressure) 9" Membrane Disc	2261-LP9	1400000619731	$ 8.20	$ 7.70	$ 7.20	$ 6.70
9" Membrane PVC Base Plate [used with 2300 style holders only]	2223-1SP	0000007585200	$ 8.30	$ 7.80	$ 7.30	$ 6.80
9" Ceramic Diffuser	2301-2C9	0000007586200	$ 30.00	$ 29.00	$ 28.00	$ 27.00
9" Ceramic Diffuser O-Ring	2331-109	0000007586301	$ 4.80	$ 4.30	$ 3.80	$ 3.30
9" PVC Retaining Ring [same for membranes & ceramics]	2300-2P9	1400000610798	$ 5.60	$ 5.10	$ 4.60	$ 4.10
9" Diffuser Wrench	WRENCH-9	0000007588400	$ 117.00			
7" Fine Bubble Diffusers						
Silver Series II 7" Membrane Disc	2231-WE7	1400000619732	$ 8.20	$ 7.70	$ 7.20	$ 6.70
7" Membrane PVC Base Plate	2167-LSP	1400000610709	$ 7.40	$ 6.90	$ 6.40	$ 5.90
7" Ceramic Diffuser	2402-1C7	0000007586400	$ 40.00	$ 39.00	$ 38.00	$ 37.00
7" Ceramic Diffuser O-ring	2331-207	0000007586304	$ 7.00	$ 6.50	$ 6.00	$ 5.50
7" PVC Retaining Ring [same for membranes & ceramics]	2403-2P7	1400000617012	$ 5.60	$ 5.10	$ 4.60	$ 4.10
7" Diffuser Wrench	WRENCH-7	0000007588401	$ 120.00			
Lubricant						
Silicone Lubricant - 15oz [Covers ~200 diffusers]	HVS350-1	0000000800489	$ 88.00			
Silicone Lubricant - 4-lb Pail [Covers ~1000 diffusers]	HVS350-4	0000000800490	$ 211.00			
Silicone Lubricant - 8-lb Pail [Covers ~2000 diffusers]	HVS350-8	0000000800491	$ 341.00			
Air Distributor Repair Kits (1 Diffuser Holder Each)						
Order diffusers, base plates, retaining rings, end caps, and/or fixed joint parts separately if needed.						
9" 2300-Style Holder Air Distributor Repair Kit: Includes (1) 2-ft long pipe section (0.237" wall PVC) with (1) 9" 2300-style holder and (2) glued couplings [4SEW-CPL]	2300-01-DIST	1400000619608	$ 100.00			
9" 1633-Style Holder Air Distributor Repair Kit: Includes (1) 2-ft long pipe section (0.237" wall PVC) with (1) 9" 1633-style holder and (2) glued couplings [4SEW-CPL]	1633-01-DIST	1400000619611	$ 107.00			
7" 2300-Style Holder Air Distributor Repair Kit:	2403-01-DIST	1400000619614	$ 106.00			
Air Distributor Sections						
Order diffusers, base plates, retaining rings, couplings, fixed joint parts, and/or end caps separately if needed.						
5-ft Air Distributor Section with (5) 9" 2300 Style Holders 12" holder spacing; 13/64" orifice; 0.237" wall PVC; plain pipe ends	2300-05-DIST	1400000619609	$ 150.00			
5-ft Air Distributor Section with (5) 9" 1633-Style Holders 12" holder spacing; 13/64" orifice; 0.237" wall PVC; plain pipe ends	1633-05-DIST	1400000619612	$ 142.00			
10-ft Air Distributor Section with (10) 9" 2300-Style Holders 12" holder spacing; 13/64" orifice; 0.237" wall PVC; plain pipe ends	2300-10-DIST	1400000619610	$ 258.00			
10-ft Air Distributor Section with (10) 9" 1633-Style Holders	1633-10-DIST	1400000619613	$ 251.00			
Air Distributor PVC Parts						
4" Sewer Size PVC Glued Coupling	4SEW-CPL	0000000800413	$ 4.30			
4" Fixed (Spline) Joint Assembly - Includes socket end [2250-3SJ], spigot end/4" retaining ring [2250-1SJ], and 4" grey o-ring [2351-1G4]	2250-ASSY	1400000610748	$ 17.00			
4" Fixed (Spline) Joint Socket End	2250-3SJ	0000007403700	$ 4.40			
4" Fixed (Spline) Joint Spigot End/4" Retaining Ring	2250-1SJ	0000007403600	$ 13.00			
4" Grey O-Ring [For Fixed Joints and Removable End Caps]	2351-1G4	1400000610808	$ 3.70			
4" PVC Removable End Cap/Retaining Ring [order 4" grey o-ring separately, 2351-1G4]	2250-ECA	1400000610753	$ 12.00			
4" Split Repair Retaining Ring [to replace a 4" fixed joint retaining ring without dissembling the joint]	2299-REP	0000007406600	$ 20.00			
PVC Manifold Saddle Repair Kits						
6" Manifold Spline Joint Saddle Repair Kit: Includes (1) 6"x4" Spline Joint Saddle and (2) stainless steel worm gear clamps	6SADDLEREP	1400000611115	$ 70.00			
8" Manifold Spline Joint Saddle Repair Kit: Includes (1) 8"x4" Spline Joint Saddle and (2) stainless steel worm gear clamps	8SADDLEREP	1400000611122	$ 73.00			
Fine Bubble Orifice Plug Items						
EPDM Orifice Plug - 5/16" x 1/2"	516X12PG	0000007591600	$ 1.05			
Orifice Plug Installation Tool	PLG-TOOL	0000007595600	$ 285.00			
Snap Cap Continuous Purge Items						
Snap Cap Diffuser - 3/4" NPT	34-SNAP	1400000624004	$ 15.00			
Snap Cap Diffuser - 3/8" NPT	38-SNAP	1400000624003	$ 15.00			
Continuous Purge Orifice Insert - 3/8"	237-Y2	1400000624002	$ 2.20			

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VOLUME 6 OF 6

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CITY OF AUMSVILLE

Project Manual:
SPECIFICATIONS AND CONTRACT DOCUMENTS

For

AUMSVILLE WASTEWATER TREATMENT PLANT IMPROVEMENTS



JO 2599.3220.0

May 2026

WESTECH ENGINEERING, INC.
3841 Fairview Industrial Dr. SE. ~ Suite 100
Salem, OR 97302-1192
(503) 585-2474

THE CITY OF AUMSVILLE
WASTEWATER TREATMENT PLANT IMPROVEMENTS

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THE CITY OF AUMSVILLE
WASTEWATER TREATMENT PLANT IMPROVEMENTS

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5. **DRAWINGS UNDER SEPARATE COVER**

See drawing Sheet G002 for sheet index of construction drawings.

APPENDIX F

AUMSVILLE WASTEWATER TREATMENT PLANT DISSOLVED AIR FLOATATION EQUIPMENT (DAF) PROCUREMENT CONTRACT

DAF EQUIPMENT PROCUREMENT CONTRACT

CITY OF AUMSVILLE, OREGON

REQUEST FOR PROPOSALS

for purchase of

SEQUENCING BATCH REACTOR EQUIPMENT
AND
DISSOLVED AIR FLOATATION EQUIPMENT
FOR
THE AUMSVILLE WASTEWATER TREATMENT PLANT IMPROVEMENTS



Prepared for

City of Aumsville
595 Main Street
Aumsville, OR 97325

Prepared By

Westech Engineering, Inc.
3841 Fairview Industrial Drive SE, Suite 100
Salem, OR 97302
(503) 585-2474

JO 2599.3220.0

NOTICE OF AWARD

TO: Krofta Technologies, LLC
401 South Street
Dalton, MA 01027

RE: Aumsville Wastewater Treatment Plant
Dissolved Air Floatation Equipment
JO 2599.3220.0

The Owner represented by the undersigned has considered the Proposal dated December 9, 2024, submitted by you for the above-described work.

It appearing that it is to the best interest of said Owner to accept your Proposal in the amount of **Seven Hundred Seventy-Two Thousand Four Hundred Eight-Five dollars and no cents ($772,485.00).**

You are hereby notified that your Proposal has been accepted for items:

Aumsville Wastewater Treatment Plant
Dissolved Air Floatation Equipment

You are required by this Notice and Instructions to Bidders to execute the formal contract with the undersigned Owner and to furnish all required bonds *(including Payment, Performance and other bonds as required)*, as well as evidence of insurance coverage as set forth in the general and supplemental conditions of the contract documents, within ten (10) calendar days from the date on this Notice *(ie. date it was sent to you)*.

If you fail to execute said Contract and to furnish said Bonds within ten (10) calendar days from the date of this Notice, said Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your Proposal as abandoned and to award the work covered by your Proposal to another, or to re-advertise the work or otherwise dispose thereof as the Owner may see fit.

Dated December 24, 2024.

City of Aumsville, Owner

Christopher J. Brugato, P.E.
Project Manager

cc:

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 11/14/2024

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER Crystal IBC, LLC 32 Old Slip Fl 17 New York NY 10005	**CONTACT NAME:** Stephanie Anguiano **PHONE (A/C, No, Ext):** 628-279-0515 **FAX (A/C, No):** **E-MAIL ADDRESS:** Stephanie.Anguiano@alliant.com
INSURED KROFTEC-01 Krofta Technologies LLC 401 South Street Dalton, MA 01226	**INSURER(S) AFFORDING COVERAGE** — **NAIC #** **INSURER A :** Trumbull Insurance Company — 27120 **INSURER B :** Hartford Insurance Group — 914 **INSURER C :** HDI Global Insurance Company — 41343 **INSURER D :** **INSURER E :** **INSURER F :**

COVERAGES **CERTIFICATE NUMBER:** 855850398 **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
C	X **COMMERCIAL GENERAL LIABILITY** X CLAIMS-MADE ☐ OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: X POLICY ☐ PRO-JECT ☐ LOC OTHER:			GLD1356708	1/1/2024	1/1/2025	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 1,000,000 $ 100,000 $ 5,000 $ 1,000,000 $ 1,000,000 $ 2,000,000
A	**AUTOMOBILE LIABILITY** X ANY AUTO OWNED AUTOS ONLY ☐ SCHEDULED AUTOS X HIRED AUTOS ONLY X NON-OWNED AUTOS ONLY			10UENHV1199	8/1/2024	8/1/2025	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 1,000,000 $ $ $
C	X **UMBRELLA LIAB** X OCCUR **EXCESS LIAB** ☐ CLAIMS-MADE DED X RETENTION $ 45,000			CUD1358108	1/1/2024	1/1/2025	EACH OCCURRENCE AGGREGATE Personal & Ad Injury	$ 5,000,000 $ 5,000,000 $ 5,000,000
B	**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** Y/N ANYPROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? ☐ **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below	N/A		10WBAP8081	8/1/2024	8/1/2025	X PER STATUTE ☐ OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	 $ 1,000,000 $ 1,000,000 $ 1,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

Westech Engineering Inc., all of whom respective officers, directors, partners, employees, agents and other consultants and subcontractors of each and any of all such are included as additional insureds where required by written contract as respects to liability arising out of the operations of the named insured.

CERTIFICATE HOLDER

Westech Engineering Inc.
3841 Fairview Industrial Drive SE Suite 100
Salem, OR 97333

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

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Aumsville, Oregon
Wastewater Treatment Plant Improvements
DAF Equipment
NOTICE OF INTENT TO AWARD

OWNER: **City of Aumsville, Oregon**

TO: All Bidders

DATE: December 17, 2024

This document constitutes the Owner's notice that it intends to award a contract for the above referenced work to **Krofta Technologies** contingent upon authorization and approval of this award by the City Council and the applicable funding agency.

The total combined score for each proposal is listed in the following table.

Rating Category	Krofta Technologies	AWC Water Solutions Ltd
Proposal responsiveness, completeness, organization and Clarity (30 points max.)	30	10
Completeness of the proposed equipment package and expected performance of the proposed equipment (45 points max.)	45	45
Experience of the supplier including number of similar installations (45 points max.)	45	37
Expected responsiveness and service of the supplier considering location of service representatives, track record for other Northwest systems, and ongoing operator training and user-group opportunities. (45 points max.)	40	37
Expected ease and cost of operation and maintenance. (45 points max.)	33	35
Cost (90 points max.)	90	45
Total Score	**283**	**209**

Owner's issuance of the Notice of Award will be not occur sooner than seven (7) calendar days following the issuance of this Notice, or after Owner affirms this award in the event of a timely filed protest, whichever is later.

Proposer list:

- AWC Water Solutions Ltd., 9087A 18th Street, Langley, BC, Canada V1M 3B1
- Krofta Technologies LLC., 401 South Street, PO Box 7, Dalton, MA USA 01227

encl:
cc w/encl:

- Mr. Matt Etzel, City of Aumsville

Aumsville, Oregon
Request for Proposals Sequencing Batch Reactor Equipment and Dissolved Air Floatation Equipment for the Aumsville Wastewater Treatment Plant Improvements
ADDENDUM NO. 2

OWNER: **City of Aumsville, Oregon**

TO: All Plan Holders

FROM: Westech Engineering, Inc.

DATE: **11/19/2024**

This Addendum, plus attachments, is an integral part of the contract documents and shall be treated as such. Bidder shall acknowledge receipt of this addendum on the Bid Form.

Copies of the Addendum will be made available through the same on-line plan distribution system as outlined in the Invitation to Bid, and are available for downloading by all bidders. Notice to all parties who obtain bidding documents from the on-line plan distribution system will be via email *(based on the information provided by the bidder when the original bidding documents were downloaded)*.

Each prospective bidder shall be responsible for verifying the number of addendum issued 72 hours prior to bid opening. Failure by the prospective bidders to verify the number of Addendum issued, or failure of the Addendum to be delivered to or downloaded by prospective bidders in a timely manner, shall not be grounds for a bid protest.

BIDDING REQUIREMENTS

1. Invitation to Bid

    a. The bid date and time are hereby changed to the dates and times listed below. The bid location remains unchanged.
        1) Revised bid closing time: 2:00 p.m. on December 12, 2024.

SPECIFICATIONS

2. Section 11300, Packaged DAF Equipment.

    a. Paragraph 1.1.b.15. – Delete this paragraph and replace with the following paragraph. Flow meters will be provided by the General Contractor.
    "15) Digested sludge pumps to pump digested sludge from the aerobic digesters to the sludge storage lagoon."

    b. Paragraph 1.6.a.2.b. – Delete this paragraph entirely.

    c. Paragraph 1.7.a – Delete this paragraph and replace with the following.
    "a. Supplier shall warrant all equipment furnished to be free from defects in materials and workmanship under normal use and service for a period of two years after the date that the goods are delivered to the point of destination and the Buyer has deemed the goods to be received for the purposes of Paragraph 9.02.B.2 of the General Conditions. The entire equipment package shall be warranted to meet all functional and performance requirements."

    d. Paragraph 2.6.d.2. Stainless steel manifolds are acceptable in lieu of PVC manifolds.

e. Paragraph 2.6.g. Stainless steel manifolds are acceptable in lieu of PVC manifolds.

3. Section 11400, Packaged DAF Equipment.

a. Paragraph 1.6.2.c - Delete this paragraph and replace with the following.

"c) Fill out and provide the prequalification form included on page 9 of the Instructions to Bidders."

b. Paragraph 1.7.a – Delete this paragraph and replace with the following.
"a. Supplier shall warrant all equipment furnished to be free from defects in materials and workmanship under normal use and service for a period of two years after the date that the goods are delivered to the point of destination and the Buyer has deemed the goods to be received for the purposes of Paragraph 9.02.B.2 of the General Conditions. The entire equipment package shall be warranted to meet all functional and performance requirements."

4. Section 17090 Packaged Control System Requirements.

a. Paragraph 1.3 Submittals (D) (2) Operator Interface Terminal Submittals. Delete paragraph 2: ~~Assume a minimum of three (3) rounds of submittals with the OWNER and ENGINEER~~

b. Paragraph 1.6 Control Panel Requirements and Standards (D) (16) Insulated Wire Ferrules. *Change sentence to read: "24-VDC or **120-VAC** digital input and output circuits.*

c. Paragraph 1.6 Control Panel Requirements and Standards (E). *Clarification – The packaged system vendor will not be required to change their equipment names or process ID numbers to match and Owner standard. The use of the vendor's standard names and ID numbers will be acceptable.*

d. Paragraph 2.2 (Y) Insulated Wire Ferrules. *Remove this language from the specification. Wire ferrules are not required within the control panel.*

e. Paragraph 2.2 (Z) Wire Identification Labels, Paragraph (2). Edit paragraph as follows: "*Wire identification labels shall be **adhesive** ~~machine printed, non-adhesive, wire marker heat shrink~~ sleeves with identification numbers that match the approved submittals".*

— End of Body of Addendum *(attachments, if any, after this page)* —

Aumsville, Oregon
Request for Proposals Sequencing Batch Reactor Equipment and Dissolved Air Floatation Equipment for the Aumsville Wastewater Treatment Plant Improvements
ADDENDUM NO. 1

OWNER: **City of Aumsville, Oregon**

TO: All Plan Holders

FROM: Westech Engineering, Inc.

DATE: **11/14/2024**

This Addendum, plus attachments, is an integral part of the contract documents and shall be treated as such. Bidder shall acknowledge receipt of this addendum on the Bid Form.

Copies of the Addendum will be made available through the same on-line plan distribution system as outlined in the Invitation to Bid, and are available for downloading by all bidders. Notice to all parties who obtain bidding documents from the on-line plan distribution system will be via email *(based on the information provided by the bidder when the original bidding documents were downloaded)*.

Each prospective bidder shall be responsible for verifying the number of addendum issued 72 hours prior to bid opening. Failure by the prospective bidders to verify the number of Addendum issued, or failure of the Addendum to be delivered to or downloaded by prospective bidders in a timely manner, shall not be grounds for a bid protest.

1. Pre-Qualified Bidders. The following bidders have submitted pre-qualification statements as required and been prequalified for this project *(listed in alphabetic order)*, and are authorized to submit bids on this project.
   a. Sequencing Batch Reactor Equipment Suppliers
      - Aqua-Aerobic Systems, Inc.
      - Xylem Sanitaire
   b. Dissolved Air Floatation Equipment
      - See item #3 below.

BIDDING REQUIREMENTS

2. Invitation to Bid
   a. The bid date, time and location remain unchanged.

3. Instructions to Bidders – Article 3 Qualifications of Bidders
   a. Dissolved Air Floatation Equipment. The City received a prequalification form from only one supplier. To encourage competition, Article 3 of the Instructions to Bidders is hereby changed as follows.

      The City will accept proposals from firms that did not submit a prequalification statement. However, the City will only consider awarding the project to firms that meet the minimum experience requirements listed in the Invitation to Bid. This change in the Request for Proposals shall only apply to the Dissolved Air Floatation Equipment Suppliers and not to the Sequencing Batch Reactor Equipment Suppliers.

— End of Body of Addendum *(attachments, if any, after this page)* —

THE CITY OF AUMSVILLE
SBR AND DAF EQUIPMENT PROCUREMENT

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4.	**SPECIFICATIONS**	
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11400	Packaged DAF Equipment	11
16090	Packaged Electrical System Requirements	9
16447	Low Voltage Motor Control Centers	16
17090	Packaged Control System Requirements	20

APPENDIX

Appendix A Wastewater Treatment Plant Improvements Preliminary Drawings

PART 1:

PROPOSAL REQUIREMENTS

INVITATION FOR PROPOSALS

Pursuant to ORS 279B.060, governing competitive sealed proposals, the City of Aumsville (City) is conducting a formal selection procedure to procure proposals from sequencing batch reactor (SBR) suppliers and dissolved air floatation clarifier (DAF) suppliers to provide equipment and services related to City's wastewater treatment system expansion. The City plans to award to the highest ranked proposer selected from those suppliers submitting proposals.

Sealed responses marked "**Proposal for SBR System Supplier**" or "**Proposal for DAF System Supplier**" will be received on behalf of the **City of Aumsville** ("Owner"), by Christopher J. Brugato, P.E., of Westech Engineering, Inc. at 3841 Fairview Industrial Drive SE, Suite 100, Salem, Oregon 97302-1192, until solicitation closing at 2:00 p.m. local time on December 4, 2024. Responses received after this time will be rejected as non-responsive. Proposers shall submit proposals in a sealed opaque envelope, plainly marked "Request for Proposals for SBR System Supplier" or "Supplier for DAF System Supplier" to Christopher J. Brugato, P.E., of Westech Engineering, Inc. at 3841 Fairview Industrial Drive SE, Suite 100, Salem, Oregon 97302-1192. Proposers may submit a proposal for either the SBR system or the DAF system or both. Proposers submitting proposals for both systems shall submit separate sealed proposals for each system. Faxed proposals or proposals sent by email will be rejected as non-responsive.

Proposals will only be considered from suppliers that meet the following minimum prequalification requirements. Proposers shall submit the prequalification form as described in the Information for Proposers. The prequalification forms shall be submitted prior to 2:00 p.m. local time on November 13, 2024. Prequalification forms received after this time will be rejected as non-responsive.

The SBR and DAF equipment supplier equipment shall satisfy the following prequalification requirements.

1. The SBR equipment supplier shall have similar equipment installed and operating in at least five similar facilities in Oregon or Washington.
2. The DAF equipment supplier shall have similar equipment installed and operating in at least five similar facilities in the United States.
3. The SBR installed in similar facilities shall have a minimum treatment capacity of 0.5 million gallons per day (MGD) on an average dry weather basis.
4. The DAF equipment installed in similar facilities shall have a minimum treatment capacity of 200 gallons per minute.
5. Each of the referenced installations shall have been operational for a minimum of 2 years.

Proposals will be opened (at the above address) immediately after the solicitation closing time and only the name of the proposing firms will be read aloud. In accordance with ORS 279B.060(6), the content of each proposal will not be available for inspection until after the notice of intent to award the proposal is issued.

Complete digital (pdf) copies of the Request for Proposals package are available at http://www.westech-eng.com (under the Currently Bidding tab). The digital RPF

Documents may be downloaded for a non-refundable payment of $25 by inputting QuestCDN eBidDoc Number listed on the project information sheet available through the website link above. Assistance with free QuestCDN registration, document downloading or working with the project information may be obtained at QuestCDN.com, at 952-233-1632, or via email at info@questcdn.com.

Copies of the complete Request for Proposals package may be examined at:

1. City of Aumsville, City Hall, 595 Main Street, Aumsville, OR 97325
2. Westech Engineering Inc., 3841 Fairview Industrial Dr. SE, Suite 100, Salem, OR 97302

All questions concerning the proposal or scope of work should be directed to Christopher J. Brugato, P.E., Westech Engineering, Inc., (503) 585-2474.

This project is subject to the Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953. Absent an approved waiver, all iron, steel, manufactured products, and construction materials used in this project must be produced in the United States. All proposers shall complete and submit the certification form included in the Request for Proposal Package. The following waivers apply to this Contract: BABA De Minimus, Small Grants, and Minor Components.

The City reserves the right to amend the RFP, extend the deadline for submittal, waive minor irregularities, informalities, or failures to conform to the RFP requirements, reject any proposal not in compliance with all proscribed public contracting procedures and requirements, including the requirement to demonstrate responsibility pursuant to ORS 279B.110, contact proposers and request additional information to clarity submitted proposals; and to reject for good cause and without liability therefore any and all proposals, and upon a finding that it is in the public interest to do so, cancel the RFP at any time prior to contract execution in accordance with ORS 279B.120.

Publication Dates:
Daily Journal of Commerce: 10/23 & 10/28, 2024
Statesman Journal: 10/28, 2024

INSTRUCTIONS TO BIDDERS FOR PROCUREMENT CONTRACTS

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INSTRUCTIONS TO BIDDERS FOR PROCUREMENT CONTRACT

ARTICLE 1—DEFINED TERMS

1.01 Terms used in these Instructions to Bidders will have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below.

A. *Issuing Office*—The office from which the Procurement Bidding Documents are to be issued and where the bidding procedures are to be administered.

B. Engineer: Westech Engineering, Inc. 3841 Fairview Industrial Dr. SE, Suite 100, Salem, Oregon, 97302, Phone (503) 585-2474. Project Manager: Christopher J. Brugato, cbrugato@westech-eng.com

C. Proposer, Supplier, Contractor, Bidder, Seller, Offeror: The entity submitting a proposal to furnish goods in response to this solicitation.

D. Buyer or Owner: The City of Aumsville, Oregon

E. General Contractor or Construction Contractor: The firm that will be retained by the Owner to construction the wastewater treatment plant equipment and install the SBR and DAF equipment.

F. Construction Contract: The work performed by the Construction Contractor which will include the installation of the goods furnished in response to this solicitation.

G. Proposal or Bid: The offer made in response to this solicitation.

ARTICLE 2—PROCUREMENT BIDDING DOCUMENTS

2.01 Bidder may obtain complete sets of the Procurement Bidding Documents in the manner described in the Invitation For Proposals.

2.02 Bidder must use a complete set of the Procurement Bidding Documents in preparing the Bid; neither Buyer nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Procurement Bidding Documents.

2.03 Buyer and Engineer make copies of Procurement Bidding Documents available on the above terms only for obtaining Bids for furnishing Goods and Special Services, and do not authorize or confer a license for any other use.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

3.01 Buyer may at any time conduct such investigations as Buyer deems necessary to establish the responsibility, qualifications, and financial ability of Bidder, and after the opening of Bids may require a Bidder to submit documentation of its qualifications, including but not limited to financial data and documentation of previous experience providing goods and services comparable to the specified Goods and Special Services.

3.02 Bidder is to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

1. **Prequalifications:** Only proposals from Suppliers meeting the minimum prequalification

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requirements listed in the Invitation For Proposals will be considered for award. Proposers shall demonstrate compliance with the prequalification requirements submission of the Prequalification form prior to the deadline listed in the Advertisement For Proposals. The prequalification form is included at the end of this section. The Owner will respond to all prequalification applicants by email of acceptance or rejection of their application. Applicants have a right to a hearing per ORS 279B.425 if they are found not to be qualified, and if they request a hearing with three business days after receipt of the notice.

3.03 Deleted

ARTICLE 4—SITE VISIT; PRE-BID CONFERENCE

4.01 Buyer recommends that Bidder visit the Point of Destination and the site where the Goods are to be installed and Special Services will be provided, taking into account observable local and site conditions that may affect the delivery, cost, progress, and furnishing of the Goods and Special Services. Arrangements for such a visit may be made through Engineer.

4.02 A pre-bid conference will not be held for this procurement.

ARTICLE 5—INTERPRETATIONS AND ADDENDA

5.01 All questions about the meaning or intent of the Procurement Bidding Documents are to be submitted to Engineer in writing by email at:

Westech Engineering, Inc., 3841 Fairview Industrial Dr. SE, Suite 100, Salem, OR, 97302, Phone (503) 585-2474, Project Manager: Christopher J. Brugato, P.E. cbrugato@westech-eng.com

5.02 Interpretations or clarifications considered necessary by Engineer in response to such written questions will be issued by Addenda mailed or delivered to all parties recorded as having received the Procurement Bidding Documents. Questions received less than 10 days prior to the date for opening of Bids will not be answered. Only answers in the Addenda will be binding. Oral statements, interpretations, and clarifications may not be relied upon in the preparation of a Bid, and will not be binding or legally effective.

5.03 Addenda may be issued to clarify, correct, or change the Procurement Bidding Documents as deemed advisable by Buyer or Engineer.

ARTICLE 6—BID SECURITY

6.01 A Bid must be accompanied by Bid security made payable to Buyer in an amount of **10** percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a Bid bond issued by a surety meeting the requirements of Paragraph 5.01 of the General Conditions. Such Bid bond will be issued in the form included in the Procurement Bidding Documents.

6.02 The Bid security of the apparent Successful Bidder will be retained until Buyer (Project Owner) awards the Procurement Contract to such Bidder, and such Bidder has executed the Procurement Contract, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Procurement Contract and furnish the required contract security within 15 days after

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the Notice of Award, Buyer (Project Owner) may consider Bidder to be in default and annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a penal sum bid bond, and to the extent of Buyer's damages in the case of a damages-form bond. Such forfeiture will be Buyer's exclusive remedy if Bidder defaults.

6.03 The Bid security of other Bidders that Buyer believes to have a reasonable chance of receiving the award may be retained by Buyer until the earlier of 7 days after the Effective Date of the Procurement Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

6.04 Bid security of other Bidders that Buyer believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

ARTICLE 7—PROCUREMENT CONTRACT TIMES

7.01 See applicable provisions in the Procurement Agreement to be executed with the successful bidder.

ARTICLE 8—LIQUIDATED DAMAGES

8.01 Any provisions for liquidated damages, such as those for Seller's failure to attain a specified Milestone such as the delivery of the Goods, are set forth in the Procurement Agreement.

ARTICLE 9—RESERVED

ARTICLE 10—"OR-EQUAL" ITEMS

10.01 The Procurement Contract, if awarded, will be based on materials and equipment specified or described in the Procurement Bidding Documents. Bidders may propose "or equal" materials and equipment, which if approved by Engineer will be identified by Addendum. The materials and equipment described in the Procurement Bidding Documents establish a standard of required type, function, and quality to be met by any proposed "or-equal" item. No item of material or equipment will be considered by Engineer as an "or-equal" unless written request for approval has been submitted by Bidder and has been received by Engineer no later than 15 days after the advertisement or invitation to bid is first issued. Each such request shall conform to the requirements of Paragraph 7.04 of the General Conditions. Each such request shall include the Manufacturers' Certification for Compliance with Domestic Preference requirements. Refer to the suggested Manufacturer's Certification provided in these construction Contract Documents. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item as an equal will be final. Bidders shall not rely upon approvals unless set forth in an Addendum. Send requests to the same address listed for receipt of Bids. Substitutes and "or-equal" materials and equipment may be proposed by Contractor in accordance with Paragraphs 7.05 and 7.06 of the General Conditions after the Effective Date of the Contract. Each such request shall include Manufacturer's Certification letter to document

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compliance with Domestic Preference requirements. Refer to Manufacturer's Certification Letter provided in these Contract Documents.

ARTICLE 11—PREPARATION OF BID

11.01 The Bid Form is included with the Procurement Bidding Documents. Additional copies of Procurement Bidding Documents may be obtained from the Issuing Office.

11.02 All blanks on the Bid Form must be completed and the Bid Form must be signed by an individual authorized to act on behalf of the Bidder. Alterations must be initialed by an individual authorized to act on behalf of the Bidder. A Bid price must be indicated for each item in the Bid Form. In the case of optional alternates, the words "No Bid" may be entered.

11.03 Bidder must acknowledge all Addenda by filling in the number and date of each Addendum in the Bid Form and sign where indicated to verify that the Addenda were received. A Bid that does not acknowledge receipt of all Addenda may be considered non-responsive.

11.04 Bidder shall:

A. Sign the Bid Form as indicated in the Bid Form.

B. Include evidence of authority to sign.

C. Provide information on the individual to be contacted for any communications regarding the Bid.

D. Provide evidence of the Bidder's authority and qualification to do business in the locality of the Project, to the extent required, or indicate the ability to obtain such authority and qualification prior to award of the Procurement Contract.

11.05 The responsibilities of each Bidder submitting a Bid are described in the Bidder's representations and certifications set forth in Article 6 of the Bid Form.

ARTICLE 12—BASIS OF BID; COMPARISON OF BIDS

12.01 In accordance with ORS 279.395, the Owner reserves the right to reject any proposal not in compliance with all prescribed public contracting procedures and requirements, including the requirement to demonstrate the Bidder's responsibility under ORS 279B.100, and may reject any and all proposals after finding that doing so is in the best interest of the Owner.

12.02 Proposals for the SBR and DAF equipment will be considered separately and contracts will be awarded to the highest ranked proposer for each equipment system resulting in two separate procurement contracts. While proposed prices will be a consideration, price will not be the sole determining factor in ranking each proposal. The proposal evaluation process implemented by the City will take into consideration the following criteria and associated maximum possible weights:

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Criteria	Points Available
Proposal responsiveness, completeness, organization and Clarity	10 pts
Completeness of the proposed equipment package and expected performance of the proposed equipment	15 pts
Experience of the supplier including number of similar installations	15 pts
Expected responsiveness and service of the supplier considering location of service representatives, track record for other Northwest systems, and ongoing operator training and user-group opportunities.	15 pts
Expected ease and cost of operation and maintenance.	15 pts
Cost	30 pts
Total	100 pts

12.03 *Buyer's Contingency Allowance*

A. If Buyer has stipulated a Buyer's Contingency Allowance in the Bid Form, such Buyer's Contingency Allowance is the same for all Bidders and is not a factor in determining the apparent low Bid.

ARTICLE 13—SUBMITTAL OF BID

13.01 Bidder shall refer to the **Invitation for Proposals** for specific identification of the date, time, and place where Bids are to be submitted.

13.02 Bidder must submit one separate unbound copy of the completed Bid Form, and, if required, the Bid Security and the other documents required to be submitted under the terms of Article 4 of the Bid Form.

13.03 A Bid must be submitted no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid. Submit the Bid in an envelope plainly marked **"Proposal for SBR System Supplier" or "Proposal for DAF System Supplier"** and the name and address of Bidder. Enclose the Bid security and other documents required to be submitted with the Bid as listed in the Bid Form. If a Bid is sent by mail or other delivery system, the sealed envelope

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containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED."

13.04 Faxed or electronically mailed (email) proposals will not be accepted.

13.05 Proposers may submit a proposal for either the Sequencing Batch Reactor (SBR) System or the Dissolved Air Floatation (DAF) system or both. Proposers submitting proposals for both systems shall submit separate sealed proposals/bids for each system.

ARTICLE 14—MODIFICATION OR WITHDRAWAL OF BID

14.01 A Bid may be modified or withdrawn by a document duly signed in the same manner that a Bid must be signed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.

14.02 If, within 24 hours after Bids are opened, any Bidder files a duly signed written notice with Buyer and promptly thereafter demonstrates to the reasonable satisfaction of Buyer that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned.

ARTICLE 15—OPENING OF BIDS

15.01 Bids will be publicly opened at the time and place indicated in the advertisement or invitation for proposals.

ARTICLE 16—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

16.01 All Bids will remain subject to acceptance for the period stated in the Bid Form, but Buyer may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 17—EVALUATION OF BIDS AND AWARD OF PROCUREMENT CONTRACT

17.01 Buyer reserves the right to reject any and all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Buyer also reserves the right to waive all informalities not involving price, time, or changes in the Goods and Special Services.

17.02 Buyer will reject the Bid of any Bidder that Buyer finds, after reasonable inquiry and evaluation, to not be responsible.

17.03 In evaluating Bids, Buyer will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data as may be requested in the Bid Form or may be requested from Bidders prior to a Notice of Award.

17.04 The criteria described in Article 12.02 will be used to score each proposal. Total scores will be tabulated and a recommendation to award the contract to the highest scoring proposer will be presented to the Aumsville City Council for approval. Following selection of a supplier for the SBR and DAF equipment, Agreements of the form included in this RFP will be prepared and executed for each system. The City reserves the right to reject any and all proposals and terminate the

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selection process at any time if, at its sole discretion, it determines such action would be in the best interest of the City.

ARTICLE 18—BONDS AND INSURANCE

18.01 Article 5 of the General Conditions and Article 5 of the Supplementary Conditions set forth Buyer's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the signed Procurement Agreement to Buyer, it must be accompanied by such bonds and acceptable evidence of insurance.

ARTICLE 19—SIGNING OF PROCUREMENT AGREEMENT

19.01 When Buyer issues a Notice of Award to the Successful Bidder, it will be accompanied by the unsigned counterparts of the Procurement Agreement along with the other Procurement Contract Documents identified in the Procurement Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Procurement Agreement and any bonds and insurance documentation required to be delivered by the Procurement Contract Documents to Buyer. Within 10 days thereafter, Buyer will deliver one fully executed counterpart of the Procurement Agreement to Successful Bidder, together with printed and electronic copies of the Procurement Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 20—RESERVED

ARTICLE 21—PROCUREMENT CONTRACT TO BE ASSIGNED

21.01 Bidder's attention is directed to the provisions of Article 5 of the Procurement Agreement which provide for the assignment of the Procurement Contract to a construction contractor designated by the Buyer to construct the **Aumsville Wastewater Treatment Plant Improvements**. Successful Bidder (Seller) will be required to perform the Procurement Contract after it has been assigned to the construction contractor (Contractor Assignee) in accordance with the provisions in the Procurement Contract. Timing of the assignment is addressed in the Procurement Agreement. Forms documenting the assignment of the Procurement Contract and for the agreement of the Seller's surety to such assignment are included as attachments to the Procurement Agreement.

ARTICLE 22—FEDERAL REQUIREMENTS CONTRACT

22.01 Federal requirements at Article 16 of the Supplementary Conditions apply to this project.

22.02 Domestic Preference requirements apply to this project.

ARTICLE 23—AVAILABILITY OF PROPOSALS

23.01 After opening, the Contracting Agency will make Proposals available for public inspection pursuant with timeframes under OAR 137-047-0630 (i.e., proposals are not required to be

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available for public inspection until after the "notice of intent to award" a contract is issued by or on behalf of the contracting agency).

ARTICLE 24—NOTICE OF INTENT TO AWARD, PROTESTS

24.01 As provided by OAR 137-047-0610, notice of intent to award will be issued to all proposer, and any award protests must be submitted in writing and received no later than 4:00 p.m. seven (7) calendar days after the date of issuance of the notice of intent to award (ie. if the Notice of Intent to Award is dated and issued on a Friday, the protest period ends at 4:00 p.m. on the following Friday). Award will not become final until the latter of the seven (7) calendar days following the issuance of the notice of intent to award, or until the Owner provides written response to all timely filed protests that denies the protest and affirms the award. Solicitation protests must be submitted not less than ten (10) days prior to the proposal closing date as specified in (and will be processed in accordance with) OAR 137-047-0730. Award protests must be submitted (and will be processed) in accordance with OAR 137-047-0740.

ARTICLE 25—APPLICATION FOR PAYMENT & CERTIFICATION

25.01 With each application for payment, the Seller will be required to complete and EJCDC form C-620.

ARTICLE 26—INCURRING COSTS

26.01 Neither the Owner nor the Engineer are liable for any costs incurred by the Proposer in the preparation or presentation of the Proposal.

ARTICLE 27—DOMESTIC PREFERENCE REQUIREMENTS

27.01 The project is being funded with assistance from the USDA Rural Development Department. All equipment furnished under this procurement shall comply with the Build America, Buy America Act (BABA) requirements mandated by Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953. All proposers shall complete and submit the "Manufacturer's Certification of Compliance" form included at the end of this section. The "Manufacturer's Certification of Compliance shall be included as an attachment to the Bid Form.

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PREQUALIFICATION FORM

Prequalification Form for the (check only one box)

☐ Sequencing Batch Reactor Equipment for the Aumsville Wastewater Treatment Plant

☒ Dissolved Air Floatation Equipment for the Aumsville Wastewater Treatment Plant

Mail or hand-deliver completed form prior to Bid opening, by 2:00 p.m., local time, by the deadline indicated in the Advertisement for Proposals, to the Engineer (Christopher J. Brugato, P.E., Westech Engineering, Inc., 3841 Fairview Industrial Drive, SE Suite 100, Salem, Oregon 97333, cbrugato@westech-eng.com PH 503.585.2474). This form may be emailed to the Engineer, instead of mailed or hand-delivered, although it is the responsibility of the Proposer emailing the form to confirm its receipt by phone. Email completed form to: cbrugato@westech-eng.com

KROFTA Technologies, LLC

Name of Proposer: 401 South Street Dalton, MA 01227

Phone: 1-413-236-5634 EXT 20

Email: Brian.Trombley@Krofta.com

1. SBR Equipment Supplier: List at least five locations in Oregon or Washington where proposer's equipment is installed and operating. Provide contact name, email, and telephone.

2. DAF Equipment Supplier: List at least five locations in the United States where proposer's equipment is installed and operating. Provide contact name, email, and telephone.

3. Indicate production capacity for each. Each installation must have a treatment capacity of at least 0.5 million gallons per day (mgd) on an average dry weather basis for the Sequencing Batch Reactor supplier and 200 gallons per minute for the Dissolved Air Floatation System supplier.

4. Indicate startup date for each. Each installation must have been operating for a minimum of 2 years since the equipment was placed into service.

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1. Leprino Foods - Greeley, CO - Start-up: 2011 Capacity:1700 GPM

   Kelly Hawkins, khawkins@leprinofoods.com, 1-720-891-5472

2. Pratt Paper - Valparaiso,IN - Start-up: 2018 Capacity: 556 GPM

   Chris Haskell, chaskell@prattindustries.com 1-219-307-4567

3. MARS Petcare - Fort Smith, AR - Start-up: 2015 Capacity: 200 GPM

   Dee Chang, dee.chang@effem.com, 1-479-222-9109

4. BYK USA, Inc. - Gonzales, TX - Start-up: 2018 Capacity: 450 GPM

   Juan de Dios Castaneda, BYK.com, 1-830-263-0181

5. B&B Poultry - Vineland, NJ - Start-up: 2022 Capacity: 425 GPM

   Vincent Marino, vincent.marino@bbpoultry.com, 1-856-692-8893

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MANUFACTURER'S CERTIFICATION OF COMPLIANCE

Date: ~~12/09/24~~ REVISED 12/18/24

Company Name: KROFTA TECHNOLOGIES, LLC

Company Address: 401 South Street, Dalton, MA 01227

Subject: Domestic Preference Requirements Certification for:

City of Aumsville, Oregon Wastewater Treatment Plant Improvement Project

I hereby certify that the following product(s) and/or material(s) shipped or provided for the subject project are in full compliance with the Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58 ,§§ 70901-70953.

Common Name of Items, Products and/or Materials:

1.) DAF Equipment - Metal Fabrications

2.) Skids and other metal Fabrications

3.) Chemical Feed Pumps

4.) Control Panels

5.)

6.)

7.)

8.)

9.)

These products and/or materials were manufactured in the following location(s):

Specifics to be provided during the submittal phase

City, State

Authorized Company Representative (Signature and Printed Name)

Richard Ziomek

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BID FORM FOR PROCUREMENT CONTRACT

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BID FORM FOR PROCUREMENT CONTRACT

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 1—BUYER AND BIDDER

1.01 This Bid is submitted to:

The City of Aumsville
595 Main Street
Aumsville, OR 97325

Note: Proposals shall be submitted to Westech Engineering, Inc. as noted in the Invitation for Proposals.

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Procurement Contract with Buyer in the form included in the Procurement Bidding Documents, and to furnish the following Goods and Special Services as specified or indicated in the Procurement Bidding Documents, for the prices and within the times indicated in this Bid, and in accordance with the other terms and conditions of the Procurement Bidding Documents.

(Check only one box)

☐ Sequencing Batch Reactor and Digester Equipment for the Aumsville Wastewater Treatment Plant

☒ Dissolved Air Floatation Equipment for the Aumsville Wastewater Treatment Plant

Proposers submitting proposals for both the Sequencing Batch Reactor (SBR) and the Dissolved Air Floatation (DAF) system shall submit separate sealed proposals for each system.

ARTICLE 2—BASIS OF BID

2.01 *Lump Sum Bids*

A. Bidder will furnish the Goods and Special Services in accordance with the Procurement Contract Documents for the following Procurement Contract Price(s):

1. Lump Sum Bid Price

Lump Sum Bid Price	$697,485.00

2.02 *Buyer's Contingency Allowance*

A. The Bid Price is supplemented by the following Buyer's Contingency Allowance, as described in the General Conditions, Paragraph 11.06:

Buyer's Contingency Allowance	$75,000

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2.03 *Total Bid Price*

A. The following Total Bid Price is the sum of the Lump Sum Bid Price from Paragraph 2.01and the Buyer's Contingency Allowance. The Total Bid Price, if accepted and incorporated in the Procurement Contract to be awarded, will be subject to any Buyer-accepted Alternates and to final Unit Price and Buyer's Contingency Allowance adjustments.

Total Bid Price	$ 772,485.00

ARTICLE 3—TIME OF COMPLETION

3.01 Bidder agrees that the furnishing of Goods and Special Services will conform to the schedule of Procurement Contract Times set forth in Article 2 of the Procurement Agreement.

3.02 Bidder accepts the provisions of the Procurement Agreement as to liquidated damages.

ARTICLE 4—ATTACHMENTS TO THIS BID

4.01 The following documents are attached to and made a condition of this Bid:

A. Required Bid security in the form prescribed in the Instructions to Bidders.

B. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such authority within the time for acceptance of Bids.

C. Information to document compliance with prequalification requirements listed in the Invitation for Proposals.

D. Manufacturer's Certification of Compliance form (see Instructions To Bidders) to demonstrate compliance with the Build American Buy American Act requirements of this contract.

E. If Bid amount exceeds $10,000, signed Compliance Statement (RD-400-6) Refer to specific equal opportunity requirements set forth in the Supplementary Conditions of the Construction Contract (EJCDC P-800).

F. If bid amount exceeds $25,000, signed Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions (AD-1048).

G. If Bid amount exceeds $100,000, signed RD Instruction 1940-Q Exhibit A-1, Certification for Contracts, Grants, and Loans.

H. Sworn Statement of Good Faith Effort with Small, Women, or Minority Business Utilization Requirements.

I. ARPA/SLFRF Required Contract Clauses.

J. Certification Regarding Lobbying

K. Submittals required with the Proposal as described in Section 11300 Packaged SBR and Digester Equipment and Section 11400 Packaged DAF Equipment.

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ARTICLE 5—BIDDER'S ACKNOWLEDGMENTS

5.01 Bidder accepts all terms and conditions of the Instructions to Bidders. This Bid will remain subject to acceptance for 90 days after the Bid opening, or for such longer period that Bidder may agree to in writing upon request of Buyer.

5.02 Bidder has examined and carefully studied the Procurement Bidding Documents, the related data identified in the Procurement Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

Addendum No.	Addendum Date
1	11/14/24
2	11/19/24

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Bidder's Representations*

A. In submitting this Bid, Bidder represents that:

1. Bidder has examined and carefully studied the Procurement Contract Documents.
2. If required by the Instructions to Bidders to visit the Point of Destination and the site where the Goods are to be installed or Special Services will be provided, or if, in Bidder's judgment, any observable local or site conditions may affect the delivery, cost, progress, or furnishing of the Goods and Special Services, then Bidder has visited the Point of Destination and site where the Goods are to be installed or Special Services will be provided (as applicable) and become familiar with and is satisfied as to the observable local and site conditions that may affect delivery, cost, progress, and furnishing of the Goods and Special Services.
3. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect the cost, progress, and performance of Seller's obligations under the Procurement Contract, including all Domestic Preference requirements.
4. Bidder has carefully studied, considered, and correlated the information known to Bidder with respect to the effect of such information on the cost, progress, and performance of Seller's obligations under the Procurement Contract.
5. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Procurement Contract Documents, and the written resolution (if any) thereof by Engineer is acceptable to Bidder.
6. The Procurement Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance of Seller's obligations under the Procurement Contract.

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7. The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of the Bidding Requirements, that without exception the Bid (including all Bid prices) is premised upon furnishing the Goods and Special Services as required by the Procurement Contract Documents.

6.02 *Bidder's Certifications*

A. Bidder certifies that:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;

2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

3. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Procurement Contract. For the purposes of this Paragraph 6.02.A.4:

   a. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;

   b. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Buyer, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Buyer of the benefits of free and open competition;

   c. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Buyer, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

   d. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process.

5. The Bidder understands the manner of payment for the cost of the Goods and Special Services;

6. The undersigned Bidder certifies their bidder status as follows (as defined in ORS 279A.120):

   Oregon Resident Bidder: YES ☐ NO ☒

   If the bidder is a nonresident bidder, indicate the percent of preference given to resident bidders in the state in which you reside. _____%

7. The undersigned Bidder certifies that it has not discriminated and will not discriminate against minority, women or emerging small business enterprises in obtaining any required subcontracts.

8. The undersigned Bidder certifies that the surety issuing all required bonds is duly authorized and licensed to transact surety business in the state of Oregon.

9. The provisions of ORS 305.385, relating to Oregon tax laws will be complied with.

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10. Bidder acknowledges that in the event the any or all bids are rejected or deemed non-responsive, that Bidder, sub-bidders or suppliers shall have no claim for recovery of bidding costs, or loss of anticipated profits or revenue or other economic loss arising out of or resulting from such rejection, including lost opportunity costs.

11. The undersigned Bidder agrees & certifies that any Performance Bond provided will also remain in full force and effect as a maintenance/warranty bond during the entire guaranty/warranty period, unless a separate warranty/maintenance bond acceptable to the Owner is provided by the Contractor as applicable.

12. Bidder accepts the provisions of the Agreement as to liquidated damages, and agrees that liquidated damages in the amounts listed in the Agreement, accruing on a daily basis, are part of the consideration for the bid and that this amount is a reasonable sum for such damages.

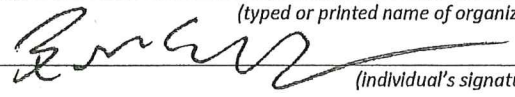
13. Bidder agrees to be responsible for all patent and/or royalty payments associated with completion of the work, as applicable.

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This Bid is offered by:

Bidder:

KROFTA TECHNOLOGIES, LLC
(typed or printed name of organization)

By: 
(individual's signature)

Date: 12/09/24
(date signed)

Name: Brian Trombley
(typed or printed)

Title: Project Manager
(typed or printed)

(If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: Richard Ziomek 
(individual's signature)

Title: Engineering Manager / Chief Operating Officer
(typed or printed)

Address for giving notices:

KROFTA TECHNOLOGIES, LLC

PO Box 7

Dalton, MA 01027

Designated Representative:

Name: BRIAN TROMBLEY
(typed or printed)

Title: PROJECT MANAGER
(typed or printed)

Address:

KROFTA TECHNOLOGIES, LLC

401 South Street

Dalton, MA 01226

Phone: 1-413-236-5634 EXT 20

Email: brian.trombley@krofta.com

License No.:

Classification:

Limitation:

EJCDC® P-400, Bid Form for Procurement Contract.
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APPENDIX D: SIGNED FORMS

a) Required Bid security in the form prescribed in the Instructions to Bidders.

b) Evidence of authority to do business in the state of the Project; or a written covenant to obtain such authority within the time for acceptance of Bids.

c) Information to document compliance with prequalification requirements listed in the Invitation for Proposals.

d) Manufacturer's Certification of Compliance form (see Instructions To Bidders) to demonstrate compliance with the Build American Buy American Act requirements of this contract.

e) If Bid amount exceeds $10,000, signed Compliance Statement (RD-400-6) Refer to specific equal opportunity requirements set forth in the Supplementary Conditions of the Construction Contract (EJCDC P-800).

f) If bid amount exceeds $25,000, signed Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions (AD-1048).

g) If Bid amount exceeds $100,000, signed RD Instruction 1940-Q Exhibit A-1, Certification for Contracts, Grants, and Loans.

h) Sworn Statement of Good Faith Effort with Small, Women, or Minority Business Utilization Requirements.

i) ARPA/SLFRF Required Contract Clauses.

j) Certification Regarding Lobbying

Krofta Technologies 401 South Street PO Box 7 Dalton, Massachusetts USA 01227
Phone: 413-236-5634 Fax: 413-236-6917 www.krofta.com

KROFTA Technologies, LLC Sealed Bid

SUPPLIER FOR DAF SYSTEM SUPPLIER

Proposal for DAF System for the City of Aumsville

c/o

Attn: Christopher J. Brugato, P.E.
Westech Engineering, Inc. at
3841 Fairview Industrial Drive SE, Suite 100
Salem, Oregon 97302-1192

Due 2:00 p.m. local time on December 12, 2024

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PENAL SUM FORM

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*: Krofta, 401 South Street, P.O. Box 7, Dalton, MA 02117

SURETY *(Name, and Address of Principal Place of Business)*: Liberty Mutual Insurance Company, 175 Berkeley Street, Boston, MA 02166

OWNER *(Name and Address)*: The City of Aumsville, 595 Main Street, Aumsville, OR 97325

BID

Bid Due Date: December 12, 2024

Description (check only one box):

☐ Sequencing Batch Reactor and Digester Equipment for the Aumsville Wastewater Treatment Plant, Aumsville, Oregon

☒ Dissolved Air Floatation Equipment for the Aumsville Wastewater Treatment Plant, Aumsville, Oregon

BOND (amount not to be less than 10% of the bid total)

Bond Number: 12122024

Date: December 12, 2024

Penal sum Ten Percent of Bidder's Maximum Bid Price (Words) $ -----10%----- (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER	**SURETY**
Krofta (Seal)	Liberty Mutual Insurance Company (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By:	By:
Signature	Signature (Attach Power of Attorney)
Rick Ziomek	Kevin M. Burruss, Jr.
Print Name	Print Name
Director	Attorney-in-Fact
Title	Title
Attest:	Witness:
Signature	Attest: Signature
Title ENG. GROUP LEADER	Title Witness

Note: Addresses are to be used for giving any required notice.
Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

Certificate No: 8208837-000010

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, Anne Baker, Ashley Wallin, Dana Butler, Jacquelyn DiAddezio, Jeffrey S. Dougherty, Jerome T. Hanuscin, Kathleen McWilliams, Kayla McAneney, Kevin M. Burruss, Jr., Lauren Ickes, Mark A. Farley, Megan Brooks, Neha Gehlot, Oskar Gerhardson, Robert M. DeRaffelo, Thomas Whelan, Vanessa Veal, Wayne D. Weaver

all of the city of Plymouth Meeting state of PA each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 12th day of October, 2022.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

By: _____
David M. Carey, Assistant Secretary

State of PENNSYLVANIA
County of MONTGOMERY ss

On this 12th day of October, 2022 before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Plymouth Meeting, Pennsylvania, on the day and year first above written.

Commonwealth of Pennsylvania - Notary Seal
Teresa Pastella, Notary Public
Montgomery County
My commission expires March 20, 2025
Commission number 1126044
Member, Pennsylvania Association of Notaries

By: _____
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS: Section 12. Power of Attorney.
Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts: Section 5. Surety Bonds and Undertakings.
Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 12th day of December, 2024.

By: _____
Renee C. Llewellyn, Assistant Secretary

LMS-12873 LMIC OCIC WAIC Multi Co 02/21

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

For bond and/or Power of Attorney (POA) verification inquiries, please call 610-832-8240 or email HOSUR@libertymutual.com.

Secretary of State
Corporation Division
255 Capitol Street NE, Suite 151
Salem, OR 97310-1327

Phone: (503) 986-2200
FAX: (503) 378-4381
sos.oregon.gov/business

REGISTRY NUMBER: 233587591
TYPE: FOREIGN LIMITED LIABILITY COMPANY

Next Renewal Date: 11/26/2025

KROFTA TECHNOLOGIES, LLC
401 SOUTH ST
DALTON MA 01226

Acknowledgment Letter

The document you submitted was recorded as shown below. Please review and verify the information listed for accuracy.

DOCUMENT	FILED ON	STATUS
APPLICATION FOR AUTHORITY	11/26/2024	ACTIVE

NAME
KROFTA TECHNOLOGIES, LLC

JURISDICTION
DELAWARE

PRINCIPAL PLACE OF BUSINESS
401 SOUTH ST
DALTON, MA 01226

REGISTERED AGENT
C T CORPORATION SYSTEM
780 COMMERCIAL ST SE STE 100
SALEM, OR 97301

MAILING ADDRESS
401 SOUTH ST
DALTON, MA 01226

Corporate Transparency Act is effective January 1,2024. Failure to report is punishable with a civil penalty of up to $500 a day.

File your **Beneficial Ownership Report** with the U.S. Treasury's Financial Crimes Enforcement Network (FinCEN) within 90 days of forming or registering your business. Go to: **FinCEN.gov/BOI** for helpful information and to submit an electronic report. (Future updates or corrections to your reports must be submitted within 30 days of the change.)

ANNKOV
ACK
11/26/2024

Delaware

The First State

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY "KROFTA TECHNOLOGIES, LLC" IS DULY FORMED UNDER THE LAWS OF THE STATE OF DELAWARE AND IS IN GOOD STANDING AND HAS A LEGAL EXISTENCE SO FAR AS THE RECORDS OF THIS OFFICE SHOW, AS OF THE TWENTY-SECOND DAY OF NOVEMBER, A.D. 2024.

AND I DO HEREBY FURTHER CERTIFY THAT THE ANNUAL TAXES HAVE BEEN PAID TO DATE.





3973125 8300

SR# 20244289083

You may verify this certificate online at corp.delaware.gov/authver.shtml

Authentication: 204944202

Date: 11-22-24

USDA
Form RD 400-6
(Rev.12-09)

Form Approved
OMB No. 0575-0018

COMPLIANCE STATEMENT

This statement relates to a proposed contract with The City of Aumsville, Oregon

(Name of borrower or grantee)

who expects to finance the contract with assistance from either the Rural Housing Service (RHS), Rural Business-Cooperative Service (RBS), or the Rural Utilities Service (RUS) or their successor agencies, United States Department of Agriculture (whether by a loan, grant, loan insurance, guarantee, or other form of financial assistance). I am the undersigned bidder or prospective contractor, I represent that:

1. I ☐ have, ☒ have not, participated in a previous contract or subcontract subject to Executive Order 11246 (regarding equal employment opportunity) or a preceding similar Executive Order.

2. If I have participated in such a contract or subcontract, I ☐ have, ☐ have not, filed all compliance reports that have been required to file in connection with the contract or subcontract.

☐ If the proposed contract is for $50,000 or more; or ☐ If the proposed nonconstruction contract is for $50,000 or more and I have 50 or more employees, I also represent that:

3. I ☐ have, ☐ have not previously had contracts subject to the written affirmative action programs requirements of the Secretary of Labor.

4. If I have participated in such a contract or subcontract, ☐ I have, ☐ have not developed and placed on file at each establishment affirmative action programs as required by the rules and regulations of the Secretary of Labor.

I understand that if I have failed to file any compliance reports that have been required of me, I am not eligible and will not be eligible to have my bid considered or to enter into the proposed contract unless and until I make an arrangement regarding such reports that is satisfactory to either the RHS, RBS or RUS, or to the office where the reports are required to be filed.

I also certify that I do not maintain or provide for my employees any segregated facilities at any of my establishments, and that I do not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I certify further that I will not maintain or provide for my employees any segregated facilities at any of my establishments, and that I will not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I agree that a breach of this certification is a violation of the Equal Opportunity clause in my contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and wash rooms, restaurants and other eating areas time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. I further agree that (except where I have obtained identical certifications for proposed subcontractors for specific time periods) I will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause; that I will retain such certifications in my files; and that I will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays the valid OMB control number. The valid OMB control number for this information collection is 0575-0018. The time required to complete this information collection is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS FOR CERTIFICATIONS OF NON-SEGREGATED FACILITIES

A certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32F.R. 7439, may 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding $ 10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

DATE 12/02/2024

(Signature of Bidder or Prospective Contractor)

401 South St., Dalton, MA 01226

Address (including Zip Code)

This form is available electronically.

OMB Control No. 0505-0027
Expiration Date: 04/30/2022

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion Lower Tier Covered Transactions

AD-1048

The following statement is made in accordance with the Privacy Act of 1974 (5 U.S.C. § 552a, as amended). This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, and 2 C.F.R. §§ 180.300, 180.335, Participants' responsibilities. The regulations were amended and published on August 31, 2005, in 70 Fed. Reg. 61865-61880. Copies of the regulations may be obtained by contacting the Department of Agriculture agency offering the proposed covered transaction.

According to the Paperwork Reduction Act of 1995 an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0505-0027. The time required to complete this information collection is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. The provisions of appropriate criminal, civil, fraud, privacy, and other statutes may be applicable to the information provided.

(Read instructions on page two before completing certification.)

A. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency;

B. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

ORGANIZATION NAME	PR/AWARD NUMBER OR PROJECT NAME
Krofta Technologies, LLC	DAF System - City of Aumsville, OR

NAME(S) AND TITLE(S) OF AUTHORIZED REPRESENTATIVE(S)

Richard Zlomek, Director of Eng.

SIGNATURE(S)	DATE
	12-02-2024

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at How to File a Program Discrimination Complaint (https://www.ascr.usda.gov/filing-program-discrimination-complaint-usda-customer) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442.

Instructions for Certification

(1) By signing and submitting this form, the prospective lower tier participant is providing the certification set out on page 1 in accordance with these instructions.

(2) The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension or debarment.

(3) The prospective lower tier participant shall provide immediate written notice to the person(s) to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(4) The terms "covered transaction," "debarred," "suspended," "ineligible," "lower tier covered transaction," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of the rules implementing Executive Order 12549, at 2 C.F.R. Parts 180 and 417. You may contact the department or agency to which this proposal is being submitted for assistance in obtaining a copy of those regulations.

(5) The prospective lower tier participant agrees by submitting this form that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

(6) The prospective lower tier participant further agrees by submitting this form that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

(7) A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the System for Award Management (SAM) database.

(8) Nothing contained in the foregoing shall be construed to require establishment of a system of records to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(9) Except for transactions authorized under paragraph (5) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

CERTIFICATION FOR CONTRACTS, GRANTS AND LOANS

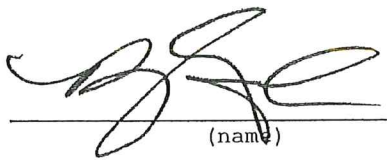
The undersigned certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant or Federal loan, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant or loan.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant or loan, the undersigned shall complete and submit Standard Form - LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including contracts, subcontracts, and subgrants under grants and loans) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.



(name)

12/9/24

(date)

Director

(title)

oOo

SWORN STATEMENT OF GOOD FAITH EFFORT WITH SMALL, WOMEN, OR MINORITY BUSINESS UTILIZATION REQUIREMENTS

Although this project does not have specific MBE/WBE/SBRA participation requirements, the funding agency requires that the prime contractor must engage in outreach, recruitment or other race/gender-neutral activities as a part of their good faith efforts to achieve a fair share of contracts by minority and women owned businesses as well as small businesses in rural areas. The prime contractor may select various outreach, recruitment or other race/gender neutral activities for a particular contract, but at a minimum, the prime contractor must take six steps:

1. Include qualified MBEs, WBEs and SBRAs on solicitation list;

2. Assure that MBEs, WBEs and SBRAs are solicited whenever they are potential sources;

3. Divide total requirements, when economically feasible, into small tasks or quantities to permit maximum participation of MBEs, WBEs and SBRAs;

4. Establish delivery schedules, where the requirements of the work permit, which will encourage participation by MBEs, WBEs and SBRAs;

5. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency, U.S. Department of Commerce, as appropriate; and

6. If the prime contractor awards subcontracts/procurement, require the subcontractor to take the affirmative steps in numbers 1 through 5 above.

* *

A list of contacted Minority, Women and Small Businesses must be attached to this form indicating which minority, women and small businesses were contacted by the bidder, a phone number, the name of a contact person, , whether or not they are being utilized, along with their reasons for non-participation.

By signing this form, the contractor swears that she or he has taken all the steps listed above to obtain participation by minority, women and small business enterprises.

Dorene Vadnais
Signature

11/27/24
Date

Printed name and title of signer

Dorene Vadnais

List of Minority, Women and Small Businesses Contacted and/or Utilized

Name of Business	Contact Person	Phone Number	Date of Contact	Utilized or Not? (Yes/No) Reason for Non-participation if No (ie. not low bid, did not submit bid, etc.)
Gagne Mechanical	Kurt Gagne	413-662-2225	11/12/24	Yes
N.E. Fabricators	Pam Jakubiec	413-442-6475 x10	11/15/24	Yes

ARPA/SLFRF Required Contract Clauses

Purpose: The purpose of this reference is to assist ARPA grant award recipients by summarizing required contract clauses consistent with the federal Uniform Guidance requirements that are applicable to the State and Local Fiscal Recovery Funds (SLFRF) program as part of the American Rescue Plan Act (ARPA).
As described in this document a "recipient" is a recipient of an APRA funded grant award from Business Oregon.

The SLFRF awards are generally subject to the requirements set forth in the **The Office of Management and Budget's (OMB) Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards** (commonly called "Uniform Guidance"). The "Uniform Guidance" is the set of federal rules (administrative requirements, cost principles, and audit guidelines) that apply to federal money. This includes requirements such as the treatment of eligible uses of funds, procurement, and reporting requirements. Please see the SLFRF Compliance and Reporting Guidance page 12 for full Award terms and conditions.

It is the recipient's responsibility to ensure all SLFRF award funds are used in compliance with these requirements. In addition, recipients should be mindful of any additional compliance obligations that may apply – for example, additional restrictions imposed upon other sources of funds used in conjunction with SLFRF award funds, or statutes and regulations that may independently apply to water and sewer infrastructure projects.

Contract Clause Checklist

Directions:
Appendix II of 2 CFR 200 (The Uniform Guidance) outlines the contract provisions that you must place in contracts with your contractors, and in contracts with subrecipients (if any). The checklist below contains these standard clauses for inclusion in contracts needed to utilize ARPA funds.

Clauses for All Contracts:

Creating a contract that complies with ARPA requirements must include the below sections as verbatim:

☐ **Contractor must be registered in SAM.gov. -** The Contractor shall register in the System for Award Management (SAM), which is the primary registrant database for the U.S. Federal Government and shall update the information at least annually after the initial registration and maintain its status in the SAM through the Term of this

Agreement. Information regarding the process to register in the SAM can be obtained at Sam.gov

☐ **Whistleblower -** Contractor receiving ARPA funds shall under or through this contract post notice of the rights and remedies provided to whistleblowers under No Fear Act Pub. L. 107-174. 29 CFR § 1614.703 (d).

☐ **Inspections; Information** - Contractor shall permit, and cause its subcontractors to allow the State of Oregon, the federal government and any party designated by them to:

- Examine, visit and inspect, at any and all reasonable times, the property, if any, constituting the Project.
- Inspect and make copies of any accounts, books and records, including, without limitation, its records regarding receipts, disbursement, contracts, and any other matters relating to the Project, and to its financial standing, and shall supply such reports and information as reasonably requested.
- Interview any officer or employee of the Contractor, or its subcontractors, regarding the Project.

☐ **Equal Opportunity -** Contractor shall comply with Executive Order 11246 of September 24, 1965, entitled ''Equal Employment Opportunity,'' as amended by Executive Order 11375 of October 13, 1967, and as supplemented in Department of Labor regulations (41 CFR chapter 60).

☐ **Copeland "Anti-Kickback" Act -** Contractor shall comply with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

☐ **Debarment and Suspension (Executive Orders 12549 and 12689)** - A contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

☐ **Prohibition on purchasing telecommunications or surveillance equipment, services, or systems.** As required by 2 CFR 200.216, federal grant or loan recipients and subrecipients

are prohibited from obligating or expending loan or grant funds to procure or obtain; extend or renew a contract to procure or obtain; or enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that use covered telecommunications equipment, video surveillance services or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115-232, section 889, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities). Prohibitions extend to the use of Federal funds by recipients and subrecipients to enter into a contract with an entity that "uses any equipment, system, or service that uses covered telecommunications equipment or services" as a substantial or essential component of any system, or as critical technology as part of any system. Certain equipment, systems, or services, including equipment, systems, or services produced or provided by entities subject to the prohibition are recorded in the System for Award Management exclusion list.

☐ **Preference to United States made goods.** - As appropriate and to the extent consistent with law, the contractor should, to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all subawards including all contracts and purchase orders for work or products under this award. For purposes of this section:
(1) "Produced in the United States" means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.
(2) "Manufactured products" means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

Additional Clauses for Contracts Over $10,000:

Creating a contract over $10,000 that complies with ARPA requirements must include the additional below sections as verbatim:

☐ **Procurement of recovered materials over $10,000. -** The Contractor must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds $10,000 or the value of the quantity acquired during the preceding fiscal year exceeded $10,000; procuring solid waste management services in a manner that

maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

☐ **Termination for cause and for convenience** - Contractor shall address termination for cause and for convenience, including the manner by which it will be affected and the basis for settlement.
The Contract Owner shall have the option, in its sole discretion, to terminate this Agreement, at any time during the term hereof, for convenience and without cause. The Contract Owner shall exercise this option by giving Contractor written notice of termination. The notice shall specify the date on which termination shall become effective.

Additional Clauses for Contracts Over $100,000:

Creating a contract over $100,000 that complies with ARPA requirements must include the additional below section(s) as verbatim:

☐ **Certification form located in Appendix I. Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)** - Contractors that apply or bid for an award exceeding $100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

☐ **Note: Only include for contracts that involve the employment of mechanics or laborers.** The Contract Work Hours and Safety Standards Act requires all contractors—prime and sub—to pay laborers and mechanics performing on a federal service contract and federal and federally assisted construction contract over $100,000, 1.5 times their basic rate of pay for all hours worked over 40 in a workweek. Employers are liable to employees for these unpaid wages. The failure of a contractor to comply with this Act may also result in liability under the False Claims Act. Employees who are due unpaid wages under the Contract Work Hours and Safety Standards Act may file a complaint with the Wage and Hour Division within the U.S. Department of Labor. The DOL may then enforce the provisions of the Act against violators.

Additional Clauses for Contracts Over $150,000:

Creating a contract over $150,000 that complies with ARPA requirements must include the additional below section(s) as verbatim:

☐ Contractor shall comply with all applicable standards, orders, or requirements issued under section 306 of the Clean Air Act (42 U.S.C. 1857(h)), section 508 of the Clean Water Act (33 U.S.C. 1368), Executive Order 11738, and Environmental Protection Agency regulations (40 CFR part 15).

Additional Clauses for Contracts Over $250,000 (the simplified acquisition threshold as of 2022):

Creating a contract over $250,000 that complies with ARPA requirements must include the additional below section(s) as verbatim:

☐ Contracts for more than the simplified acquisition threshold, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate. Upon any breach of this Agreement by Contractor, the Contract Owner shall have all remedies available to it both in equity and/or at law.

Appendix I

Certification Regarding Lobbying
(Awards to Contractors and Subcontractors in Excess of $100,000)

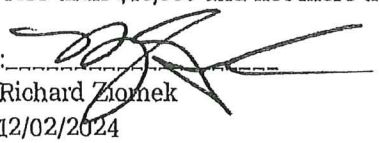
The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Signed: 

Title: Richard Ziomek

Date: 12/02/2024

MA SOC Filing Number: 202380497900 Date: 3/3/2023 9:20:00 AM

The Commonwealth of Massachusetts
William Francis Galvin

Minimum Fee: $500.00

Secretary of the Commonwealth, Corporations Division
One Ashburton Place, 17th floor
Boston, MA 02108-1512
Telephone: (617) 727-9640

Annual Report
(General Laws, Chapter)

Identification Number: 202916531

Annual Report Filing Year: 2023

1.a. Exact name of the limited liability company: KROFTA TECHNOLOGIES, LLC

1.b. If different, the name under which it does business in the Commonwealth:

2. The Limited Liability Company is organized under the laws of: State: DE Country: USA
The date of its organization is: 05/19/2005

3. The general character of business, and if the limited liability company is organized to render professional service, the service to be rendered:
MANUFACTURE AND DISTRIBUTION OF WATER TREATMENT SYSTEMS.

4. Location of its principal office:
No. and Street: 401 SOUTH STREET
City or Town: DALTON State: MA Zip: 01226 Country: USA

5. The business address of its principal office in the Commonwealth, if any:
No. and Street: 401 SOUTH ST.
City or Town: DALTON State: MA Zip: 01226 Country: USA

6. The name and business address of each manager, if any:

Title	Individual Name First, Middle, Last, Suffix	Address (no PO Box) Address, City or Town, State, Zip Code
MANAGER	RICHARD ZIOMEK	401 SOUTH ST. DALTON, MA 01227 USA
MANAGER	BART GOEDSEELS	DE DRIJ DREVEN 30 3550 HEUSDEN-SOLDER, BEL

7. The name and business address of the person(s) authorized to execute, acknowledge, deliver and record any recordable instrument purporting to affect an interest in real property:

Title	Individual Name First, Middle, Last, Suffix	Address (no PO Box) Address, City or Town, State, Zip Code
REAL PROPERTY	BART GOEDSEELS	DE DRIJ DREVEN 30 3550 HEUSDEN-ZOLDER BEL
REAL PROPERTY	RICHARD ZIOMEK	401 SOUTH ST. DALTON, MA 01227 USA

8. Name and address of the Resident Agent:

Name: C T CORPORATION SYSTEM

No. and Street: 155 FEDERAL ST., SUITE 700

City or Town: BOSTON State: MA Zip: 02110 Country: USA

9. If the foreign limited liability company has a specific date of dissolution, the latest date on which the limited liability company is to dissolve:

10. Additional matters:

SIGNED UNDER THE PENALTIES OF PERJURY, this 3 Day of March, 2023,
DORENE M VADNAIS **, Signature of Authorized Signatory.**

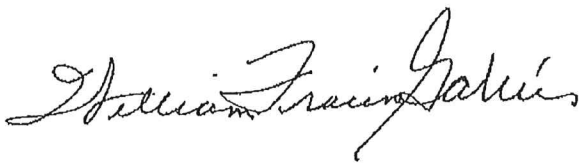
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MA SOC Filing Number: 202380497900 Date: 3/3/2023 9:20:00 AM

THE COMMONWEALTH OF MASSACHUSETTS

I hereby certify that, upon examination of this document, duly submitted to me, it appears that the provisions of the General Laws relative to corporations have been complied with, and I hereby approve said articles; and the filing fee having been paid, said articles are deemed to have been filed with me on:

March 03, 2023 09:20 AM



WILLIAM FRANCIS GALVIN

Secretary of the Commonwealth

Delaware

The First State

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY "KROFTA TECHNOLOGIES, LLC" IS DULY FORMED UNDER THE LAWS OF THE STATE OF DELAWARE AND IS IN GOOD STANDING AND HAS A LEGAL EXISTENCE SO FAR AS THE RECORDS OF THIS OFFICE SHOW, AS OF THE TWENTY-SECOND DAY OF NOVEMBER, A.D. 2024.

AND I DO HEREBY FURTHER CERTIFY THAT THE ANNUAL TAXES HAVE BEEN PAID TO DATE.





3973125 8300

SR# 20244289083

You may verify this certificate online at corp.delaware.gov/authver.shtml

Authentication: 204944202

Date: 11-22-24

PART 2:

CONTRACT FORMS

AGREEMENT BETWEEN BUYER AND SELLER FOR PROCUREMENT CONTRACT

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AGREEMENT BETWEEN BUYER AND SELLER FOR PROCUREMENT CONTRACT

This Procurement Agreement is by and between **The City of Aumsville, Oregon** ("Buyer") **Krofta Technologies, LLC** ("Seller").

Terms used in this Procurement Agreement have the meanings stated in the General Conditions of the Procurement Contract and the Supplementary Conditions of the Procurement Contract.

Buyer and Seller hereby agree as follows:

ARTICLE 1—PROCUREMENT CONTRACT

1.01 *Goods and Special Services*

A. Seller shall furnish the Goods and Special Services as specified or indicated in the Procurement Contract Documents. The Goods and Special Services are generally described as follows (check only one box and delete the other):

☒ **Dissolved Air Floatation Equipment for the Aumsville Wastewater Treatment Plant**

1.02 *The Project*

A. The Project, of which the Goods and Special Services are a part, is generally described as follows: **The Aumsville Wastewater Treatment Plant Improvements.**

1.03 *Engineer*

A. Buyer has retained **Westech Engineering, Inc.** ("Engineer"), to prepare Procurement Contract Documents and act as Buyer's representative. Engineer assumes all duties and responsibilities and has the rights and authority assigned to Engineer in the Procurement Contract Documents in connection with Seller's furnishing of Goods and Special Services.

1.04 *Point of Destination*

A. The Point of Destination is designated as: **The Aumsville Wastewater Treatment Plant, 955 Olney Street SE, Aumsville, Oregon 97325.**

ARTICLE 2—PROCUREMENT CONTRACT TIMES

2.01 *Time of the Essence*

A. All time limits for Milestones, including the submittal of Shop Drawings and Samples, the delivery of Goods, and the furnishing of Special Services as stated in the Procurement Contract Documents, are of the essence of the Procurement Contract.

2.02 *Schedule of Procurement Contract Times*

A. The following schedule sets forth the Procurement Contract Times:

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Milestone	Date or Days	Notes
Provide submittal information as specified under the heading "Submittals Required After Notice of Award" in the relevant equipment specification sections.	45 days after notice to proceed	
Deliver acceptable Goods to Point of Destination	August 27, 2026	The actual delivery date shall be coordinated with the General Contractor for the construction and installation of the treatment plant.

2.03 *Shop Drawings and Samples*

A. *Submittal of Shop Drawings and Samples*: Seller shall submit all Shop Drawings and Samples required by the Procurement Contract Documents to Engineer for its review and approval. A manufacturer's Certification letter must be included in the submittal for each item subject to Domestic Preference requirements. Refer to the Manufacturer's certification form is included in the Instructions to Bidders.

B. *Engineer's Review*: It is the intent of the parties that Engineer will conduct its review of Shop Drawings and Samples and issue its approval, or a denial accompanied by substantive comments regarding information needed to gain approval, within **20** days after Seller's submittal of such Shop Drawings and Samples, or within such longer period that is needed because of the quantity and quality of such submittals. Resubmittals will be limited whenever possible. Engineer's review and approval of a Shop Drawing or Sample shall include review of Manufacturer's Certifications in order to document compliance with Domestic Preference requirements, as applicable.

2.04 *Liquidated Damages*

A. Buyer and Seller recognize that time is of the essence as stated in Paragraph 2.01, and that Buyer will suffer financial and other losses if the Goods are not delivered to the Point of Destination and ready for receipt of delivery by Buyer within the time specified in Paragraph 2.02, plus any extensions thereof allowed in accordance with this Procurement Contract. The parties also recognize that the timely performance of services by others involved in the Project is materially dependent upon Seller's specific compliance with the delivery requirements of Paragraph 2.02. Further, the parties recognize the time, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the loss (whether direct, consequential, or otherwise) suffered by Buyer if complete, acceptable Goods are not delivered on time. Accordingly, instead of requiring any such proof, Buyer and Seller agree that as liquidated damages for delay (but not as a penalty) Seller shall pay Buyer $**1,500** for each day that expires after the time specified in Paragraph 2.02 for delivery of acceptable Goods.

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ARTICLE 3—PROCUREMENT CONTRACT PRICE

3.01 *Procurement Contract Price and Total Price*

A. The Procurement Contract Price is comprised of the Lump Sum and Unit Price amounts set forth in the following paragraphs.

B. Buyer shall pay Seller a Lump Sum of **$697,485** for furnishing the Goods and Special Services (other than any Unit Price Goods and Special Services) in accordance with the Procurement Contract Documents. Such Lump Sum amount accounts for the following Buyer-accepted alternates: **None.**

C. Buyer's Contingency Allowance is stipulated as $**75,000**. Buyer's use of such allowance, including resulting compensation of Buyer, is governed by Paragraph 11.06 of the General Conditions.

D. The Total Price is **$772,485** Such Total Price is comprised of the Lump Sum amount (taking into account any accepted alternates), Unit Price Goods and Special Services amount (if any) (subject to final adjustment), and Buyer's Contingency Allowance (if any) (subject to final adjustment).

ARTICLE 4—PAYMENT PROCEDURES

4.01 *Submittal and Processing of Applications for Payment*

A. Seller shall submit Applications for Payment in accordance with Article 13 of the General Conditions, the Information for Proposers, and the following paragraphs. Engineer and Buyer will process such Applications for Payment in accordance with said Article 13.

4.02 *Progress Payments; Final Payment*

A. Seller may submit an Application for Payment requesting the stated percentage of Procurement Contract Price upon attainment of each of the following Payment Line Items:

Payment Line Item (Lump Sum)	Percentage of Lump Sum
1. Receipt of Approval of Shop Drawings and Samples	10
2. Delivery of Goods to Point of Destination in accordance with the Procurement Contract Documents	80
3. Completion of Startup and Commissioning Services in accordance with the Procurement Contract Documents	5
4. Final Payment: Correction of non-conformities, provision of final Operations and Maintenance manuals, submittal of warranties and other final documentation required by the Procurement Contract Documents.	5
Total Procurement Contract Price (Lump Sum)	100

B. For Unit Price Goods and Special Services, if any, or for payments owed to Seller as a result of authorizations by Buyer under the Buyer's Contingency Allowance (if any), Seller shall submit a separate Application for Payment, no more frequently than monthly, that states (1) the actual quantities of such Unit Price Goods and Special Services that have been furnished, and the applicable unit prices; and (2) the services or items performed or

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furnished under the Buyer's Contingency Allowance, and the amounts owed. If practical, and at Seller's option, Seller may apply for such unit price and Buyer's Contingency Allowance payments in a separate section of an Application for Payment submitted under Paragraph 4.02.A for lump sum items.

C. Buyer shall pay Seller the amount owed under an Application for Payment within 45 days after Engineer's presentation to Buyer of the Application for Payment and Engineer's recommendation.

ARTICLE 5—ASSIGNMENT OF PROCUREMENT CONTRACT

5.01 *Assignment of Contract*

A. Buyer has the right to assign this Procurement Contract for furnishing Goods and Special Services, but only to a person or entity with sufficient apparent ability to satisfy all of Buyer's obligations under this Procurement Contract, and Seller hereby consents to such assignment. Forms documenting the assignment of the Procurement Contract, and consent of Seller's surety to the assignment, have been executed by Buyer, Seller, and Seller's surety, and are attached as exhibits to this Procurement Agreement. If so assigned, the following provisions apply:

1. The Procurement Contract is initially executed in the name of the entity identified herein as Buyer, and will be assigned by such Buyer (as assignor) to a construction contractor (Contractor/Assignee) designated by such Buyer. The assignment will occur on the effective date of the construction contract between such Buyer (Project Owner) and the Contractor/Assignee, which is expected to occur on or about **January 15, 2026**. Commencing on the date of acceptance of assignment by the Contractor/Assignee, all references in the Procurement Contract to "Buyer" shall mean the designated Contractor/Assignee.

2. The assignment of this Procurement Contract relieves the assignor from all further obligations and liabilities under this Procurement Contract. After assignment, Seller shall become a subcontractor or supplier to the Contractor/Assignee and, except as noted herein, all rights, duties, and obligations of Buyer under the Procurement Contract become the rights, duties, and obligations of the Contractor/Assignee.

3. After assignment:

   a. The Procurement Drawings and Procurement Specifications, and any modifying Addenda will become "Contract Documents" under the construction contract.

   b. If the Procurement Drawings or Procurement Specifications, as "Contract Documents" under the construction contract, are duly modified under such construction contract, then Seller and Contractor/Assignee shall enter into a corresponding Change Order under the applicable provisions of this Procurement Contract.

   c. The Procurement Drawings and Procurement Specifications may not be modified by Seller or Contractor/Assignee, singly or in tandem, except as such Procurement Drawings or Procurement Specifications, as "Contract Documents" under the construction contract, have been duly modified under such construction contract.

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d. All performance warranties, guarantees, and indemnifications required by the Procurement Contract will continue to run for the benefit of assignor (Project Owner) and, in addition, for the benefit of the Contractor/Assignee. However, if assignor (Project Owner) and Contractor/Assignee make the same warranty or guarantee claim, then Seller shall only be liable once for such claim. Other than its remedies under such warranties, guarantees, and indemnifications, assignor will not retain direct rights under this Procurement Contract, but will have rights and remedies as a party to the construction contract, whose scope of work will encompass the Procurement Drawings, Procurement Specifications, and modifying Addenda; provided, however, that any limitations on Seller's liability in this Procurement Contract will continue to bind the original Buyer (assignor) after assignment.

e. The Contractor/Assignee shall have all the rights of the Buyer under the Performance Bond and Payment Bond.

f. Seller shall submit all Applications for Payment directly to Contractor/Assignee.

   1) Contractor/Assignee shall review each Application for Payment promptly, determine the amount that Contractor/Assignee approves for payment, and then include the amount approved in the next application for payment submitted to Project Owner (or Engineer) under the construction contract.

   2) Contractor/Assignee shall pay Seller within **30** days of receipt of payment from the Project Owner under the construction contract.

   3) After assignment Engineer will review, approve, or deny the content of Applications for Payment under the Procurement Contract only to the extent that Contractor/Assignee, as construction contractor, has incorporated such content into payment applications that Engineer reviews under the construction contract.

g. The Contractor/Assignee shall have all the rights of the Buyer under any pending Claim by Buyer.

h. All Claims and supporting documentation will be submitted directly by the claimant party (either Buyer **Krofta Technologies, LLC** or Seller), to the other party, without submittal to Engineer.

   1) The other party will render a response in writing within 30 days of receipt of the last submittal of claimant.

   2) If the other party does not render a written response to a Claim within 30 days after receipt of the last submittal of the claimant, the other party shall be deemed to have approved the Claim in its entirety.

   3) The other party's written response to a Claim, or the approval of the Claim in its entirety as a function of failure to respond within 30 days, will be final and binding upon Buyer and Seller 30 days after it is issued, unless within such 30 days of issuance either Buyer or Seller appeals the result by initiating the mediation of the Claim in accordance with the dispute resolution procedures set forth in Paragraph 12.02 of the General Conditions.

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4) Any Claim by Seller that Contractor/Assignee may choose to submit, present, or forward to Project Owner must be submitted to Buyer within sufficient time for Contractor/Assignee to preserve its rights under the construction contract, notwithstanding any procedures or time limits in this Procurement Contract.

i. Seller's recovery of additional cost, time, or both cost and time for any Claim attributable to the Project Owner will be limited to the proportionate recovery by Contractor/Assignee against Project Owner for such Claim. Seller will cooperate and assist Contractor/Assignee in pursuing any Claim by Contractor/Assignee against Project Owner on behalf of Seller, including the timely preparation and delivery of supporting documentation.

j. If the pursuit of any claim by Contractor/Assignee against Project Owner on Seller's behalf requires the expenditure by Contractor/Assignee of legal or consulting fees, or results in litigation, arbitration, or any dispute resolution procedures, Seller agrees to pay for a proportionate share of attorneys' fees, consultant fees, and litigation, arbitration, and other resolution costs incurred by Contractor/Assignee in pursuing the claim on behalf of Seller, based upon the amount claimed by Seller as compared to the total value of the claim pursued by the Contractor/Assignee.

k. All rights, duties, and obligations of Engineer to Contractor/Assignee and Seller under this Procurement Contract will cease.

l. Subject to the foregoing provisions, all references in the Procurement Contract to submitting items to Engineer, or to Engineer having tasks or obligations, will be read after such an assignment as requiring submittal to Contractor/Assignee, or as Contractor/Assignee having such tasks or obligations (which Contractor/Assignee may delegate when appropriate).

m. If the Procurement Contract includes a Buyer's Contingency Allowance, upon assignment such allowance will be automatically reduced to the amount previously authorized by Buyer (Project Owner), and cease to be operational.

B. No other assignment by a party hereto of any rights under or interests in the Procurement Contract will be binding on another party hereto without the written consent of the party sought to be bound. Specifically, but without limitation, Procurement Contract payments or other money that may become due, and Procurement Contract payments or other money that are due, may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by Laws and Regulations). Unless specifically stated to the contrary in any written consent to such an assignment, such an assignment will not release or discharge the assignor from any duty or responsibility under the Procurement Contract Documents.

ARTICLE 6—PROCUREMENT CONTRACT DOCUMENTS

6.01 *List of Procurement Contract Documents*

A. The Procurement Contract Documents consist of the following:

1. Invitation for Proposals.
2. Information for Proposers.

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3. Instructions to Proposers.
4. Proposals (Bid) Form including all attachments.
5. This Procurement Agreement.
6. General Conditions of the Procurement Contract.
7. Supplementary Conditions of the Procurement Contract.
8. Procurement Specifications as listed in the Procurement Specifications table of contents.
9. Addenda Numbers **1 – 2**
10. Bonds:
    a. Performance bond (together with power of attorney).
    b. Payment bond (together with power of attorney).
11. Exhibits to this Procurement Agreement (enumerated as follows):
    a. Exhibit A, Assignment of Contract, Consent to Assignment, and Acceptance of Assignment.
    b. Exhibit B, Surety's Consent to Assignment.
    c. Documentation submitted by Seller **Krofta Technologies, LLC** and
    d. Manufacturer's Certification of Compliance Form (see Information for Proposers) to demonstrate compliance with the Build American Buy American requirements of this contract.
    e. Submittals required with the Proposal as described in Exhibit C, Section 11400 Packaged DAF Equipment.
12. The following which may be delivered or issued on or after the Effective Date of the Procurement Contract and are not attached hereto:
    a. Change Orders;
    b. Change Directives; and
    c. Field Orders.

B. The documents listed in Paragraph 6.01.A are attached to this Procurement Agreement (except as expressly noted otherwise above).

C. There are no Procurement Contract Documents other than those listed above.

D. The Procurement Contract Documents may only be amended or supplemented as provided in Paragraph 11.01 of the Procurement General Conditions.

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ARTICLE 7—SELLER'S REPRESENTATIONS AND CERTIFICATIONS

7.01 *Seller's Representations*

A. In order to induce Buyer to enter into this Procurement Agreement, Seller makes the following representations:

1. Seller has examined and carefully studied the Procurement Contract Documents.

2. If required by the Instructions to Bidders to visit the Point of Destination and the site where the Goods are to be installed or Special Services will be provided, or if, in Seller's judgment, any observable local or site conditions may affect the delivery, cost, progress, or furnishing of the Goods and Special Services, then Seller has visited the Point of Destination and site where the Goods are to be installed or Special Services will be provided (as applicable) and become familiar with and is satisfied as to the observable local and site conditions that may affect delivery, cost, progress, and furnishing of the Goods and Special Services.

3. Seller is familiar with and is satisfied as to all Laws and Regulations that may affect the cost, progress, and performance of Seller's obligations under the Procurement Contract.

4. Seller has carefully studied, considered, and correlated the information known to Seller with respect to the effect of such information on the cost, progress, and performance of Seller's obligations under the Procurement Contract.

5. Seller has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Seller has discovered in the Procurement Contract Documents, and the written resolution (if any) thereof by Engineer is acceptable to Seller.

6. The Procurement Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance of Seller's obligations under the Procurement Contract.

7. Seller's entry into this Procurement Contract constitutes an incontrovertible representation by Seller that without exception all prices in the Procurement Agreement are premised upon furnishing the Goods and Special Services as required by the Procurement Contract Documents.

8. All other representations listed in the Proposal Form.

7.02 *Seller's Certifications*

A. Seller certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Procurement Contract. For the purposes of this Paragraph 7.02:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Procurement Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Procurement Contract to the detriment of Buyer, (b) to establish bid or contract prices at artificial non-competitive levels, or (c) to deprive Buyer of the benefits of free and open competition;

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3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Buyer, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Procurement Contract.

B. Seller's Certifications shall include also include all Certifications listed in the Proposal Form.

ARTICLE 8—RESERVED

ARTICLE 9—MUTUAL WAIVER

9.01 *Mutual Waiver of Consequential Damages*

A. Buyer and Seller waive against each other, and against the other's officers, directors, members, partners, employees, agents, consultants, and subcontractors, any and all claims for or entitlement to incidental, indirect, or consequential damages arising out of, resulting from, or related to the Procurement Contract. If Buyer (Project Owner) assigns this Procurement Contract to a construction contractor (Contractor/Assignee), then the terms of this Paragraph 9.01.A will be binding upon the Contractor/Assignee with respect to Seller and assignor. The terms of this mutual waiver do not apply to or limit any claim by either Buyer or Seller against the other based on any of the following: (a) contribution or indemnification, (b) liquidated damages, (c) costs, losses, or damages attributable to personal or bodily injury, sickness, disease, or death, or to injury to or destruction of the tangible property of others, (d) intentional or reckless wrongful conduct, or (e) rights conferred by any bond provided by Seller under this Procurement Contract.

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IN WITNESS WHEREOF, Buyer and Seller have signed this Procurement Agreement. Counterparts have been delivered to Buyer and Seller.

The Effective Date of the Procurement Contract is December 31, 2024.

Buyer	Seller
The City of Aumsville, Oregon	Krofta Technologies, LLC
(typed or printed name of organization)	*(typed or printed name of organization)*
By: *(individual's signature)*	By: *(individual's signature)*
Date: 12/31/24 *(date signed)*	Date: 12/30/24 *(date signed)*
Name: Ron Harding *(typed or printed)*	Name: Rick Ziomek *(typed or printed)*
Title: City Administrator *(typed or printed)*	Title: Director *(typed or printed)*
	(If Seller is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)
Attest: *(individual's signature)*	Attest: *(individual's signature)*
Title: Oregon Notary (Marion County) *(typed or printed)*	Title: Notary *(typed or printed)*
Address for giving notices: 595 Main Street Aumsville, OR 97325	Address for giving notices: PO Box 7 401 South St. Dalton MASS 01227
Designated Representative:	Designated Representative:
Name: Ron Harding *(typed or printed)*	Name: Brian Trombley *(typed or printed)*
Title: City Administrator *(typed or printed)*	Title: Project Manager *(typed or printed)*
Address: 595 Main Street Aumsville, OR 97325	Address: PO Box 7 401 South Street Dalton, MA 01227
Phone: (503) 749-2030	Phone: 413-236-5634
Email: RHarding@aumsville.us	Email: Brian.Trombley@krofta.com
(If Buyer is a corporation, attach evidence of authority to sign. If Buyer is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)	

OFFICIAL STAMP
KIRSTI LOUISE PIZZUTO
NOTARY PUBLIC-OREGON
COMMISSION NO. 1028064
MY COMMISSION EXPIRES SEPTEMBER 28, 2026

PAMELA K. JAKUBIEC
Notary Public, Commonwealth of Massachusetts
My Commission Expires May 31, 2030

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OFFICIAL STAMP
KIRSTI LOUISE PIZZUTO

Witnessing or Attesting a Signature

State of OREGON

County of Marion

~~Signed (or~~ attested) before me on (date) February 3, 2025

by (name(s) of individual(s)) Ron Harding.

Notary Public - State of Oregon

Official Stamp

OFFICIAL STAMP
KIRSTI LOUISE PIZZUTO
NOTARY PUBLIC-OREGON
COMMISSION NO. 1028064
MY COMMISSION EXPIRES SEPTEMBER 28, 2026

Document Description

This certificate is attached to page 10 of an Agreement section of procurement contract (title or type of document), dated December 31, 2024, consisting of 10 pages in the specified section.

NOTARY PUBLIC-OREGON
COMMISSION NO. 1028064
MY COMMISSION EXPIRES SEPTEMBER 28, 2026

EXHIBIT A—ASSIGNMENT OF PROCUREMENT CONTRACT, CONSENT TO ASSIGNMENT, AND ACCEPTANCE OF ASSIGNMENT

This assignment will be effective on the effective date of the construction contract between Buyer (as "Owner") and Contractor/Assignee (as "Contractor").

The Procurement Contract between **The City of Aumsville, Oregon ("Buyer")** and **Krofta Technologies, LLC ("Seller")** for furnishing Goods and Special Services entitled (check only one box and delete the other):

☒ **Dissolved Air Floatation Equipment for the Aumsville Wastewater Treatment Plant**

(Procurement Contract) is hereby assigned, transferred, and set over to Contractor/Assignee, as assignee, by Buyer, as assignor. Upon assignment the Contractor/Assignee shall have the duties, rights, and obligations of Buyer under the terms of the Procurement Contract, and will be responsible to Owner under the construction contract for the performance of obligations by Seller, which will become a Subcontractor or Supplier to Contractor/Assignee. Buyer, Seller, and Contractor/Assignee hereby acknowledge and agree to be bound by the terms and conditions of assignment set forth in Article 5 of the Agreement Between Buyer and Seller for Procurement Contract.

Assignment Made by Buyer

The City of Aumsville, Oregon
(typed or printed name of organization)

By: _____ Date: 12/31/24
(individual's signature) *(date signed)*

Name: Ron Harding Title: City Administrator
(typed or printed) *(typed or printed)*

If Buyer is a corporation, attach evidence of authority to sign. If Buyer is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Buyer-Seller Agreement.

Assignment Acknowledged and Accepted by Seller

Krofta Technologies, LLC
(typed or printed name of organization)

By: _____ Date: 12/30/24
(individual's signature) *(date signed)*

Name: Rick Ziomek Title: Director
(typed or printed) *(typed or printed)*

If Seller is a corporation, attach evidence of authority to sign.

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Assignment Accepted by Contractor/Assignee

(typed or printed name of organization)

By: _____ Date: _____

(individual's signature) *(date signed)*

Name: _____ Title: _____

(typed or printed) *(typed or printed)*

If Contractor/Assignee is a corporation, attach evidence of authority to sign.

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Docusign Envelope ID: 3D47BF8A-BE75-4E2B-ADCD-C30787BF2DED

Liberty Mutual

Liberty Mutual **Surety**

January 14, 2025

Attn: The City of Aumsville, Oregon,

In relation to Performance and Payment Bond #025001342 ("The Bond") in the amount of $772,485.00 with Krofta Technologies, LLC ("Krofta") as Principal and The City of Aumsville, Oregon as Obligee where Liberty Mutual Insurance Company ("We") is guaranteeing Krofta's responsibilities under the Dissolved Air Floatation Equipment for the Aumsville Wastewater Treatment Plant Contract ("The Contract"), if The Contract is assigned to a third party by the The City of Aumsville, We will be amenable to executing Exhibit B of The Contract as long as appropriate evidence of the Contract Assignment is provided and We can approve the identity of the Assignee. We would expect that after Contract Assignment and providing our approval of the identity of the Assignee, an endorsement would be issued by the surety where it is stated that the Assignee is the new Obligee of The Bond and The City of Aumsville, Oregon is no longer the Obligee of the bond.

Sincerely,

Chase Hobert

Chase Hobert
Senior Executive Underwriter – Manager
Liberty Mutual Insurance Company

EXHIBIT B—SURETY'S CONSENT TO ASSIGNMENT

Surety hereby acknowledges, agrees, and consents that the Procurement Contract for furnishing Goods and Special Services entitled (check only one box and delete the other):

☐ Sequencing Batch Reactor and Digester Equipment for the Aumsville Wastewater Treatment Plant

☐ Dissolved Air Floatation Equipment for the Aumsville Wastewater Treatment Plant

by and between **The City of Aumsville, Oregon** ("Buyer") and **[Name of Seller]** ("Seller") may be assigned, transferred, and set over to **[Name of Contractor/Assignee]** ("Contractor/Assignee"), in accordance with Article 5 and Exhibit A of the Agreement between Buyer and Seller for Procurement Contract.

Surety further agrees that, upon assignment of the Procurement Contract, the Contractor/Assignee shall have all the rights of the Buyer under the Procurement Performance Bond and Procurement Payment Bond.

Agreement to Assignment Acknowledged and Accepted by Surety

_____
(typed or printed name of organization)

By: _____ Date: _____
(individual's signature) *(date signed)*

Name: _____ Title: _____
(typed or printed) *(typed or printed)*

Attach Power of Attorney.

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AGREEMENT EXHIBIT C

Krofta Technologies 401 South Street PO Box 7 Dalton, Massachusetts USA 01227
Phone: 413-236-5634 Fax: 413-236-6917 www.krofta.com

KROFTA Technologies, LLC Sealed Bid

SUPPLIER FOR DAF SYSTEM SUPPLIER

Proposal for DAF System for the City of Aumsville

c/o

Attn: Christopher J. Brugato, P.E.
Westech Engineering, Inc. at
3841 Fairview Industrial Drive SE, Suite 100
Salem, Oregon 97302-1192

Due 2:00 p.m. local time on December 12, 2024

KROFTA FIRM PROPOSAL

FOR:

CITY OF AUMSVILLE

c/o: Westech Eng.

Ref:

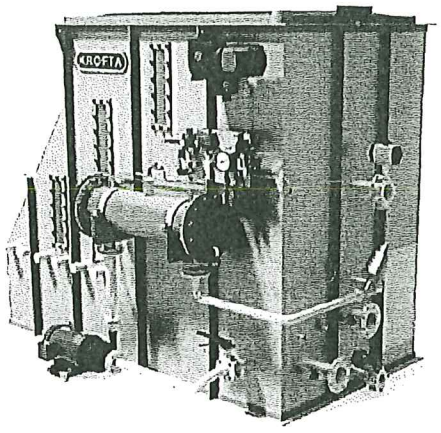
City of Aumsville DAF System Bid

City of Aumsville, OR - USA

KROFTA Multifloat DAF Model: MFH-500

Proposal No.: KEP-24-165

Date of Proposal: 12 December 2024



KROFTA MULTIFLOAT (MFH) DAF

Krofta Technologies 401 South Street PO Box 7 Dalton, Massachusetts USA 01227
Phone: 413-236-5634 Fax: 413-236-6917 www.krofta.com

Proprietary Notice

This proposal includes confidential information of Krofta Technologies which is provided for the sole purpose of permitting the recipient to evaluate the proposal submitted herewith. In consideration of receipt of this document, the recipient agrees to maintain such information in confidence and not reproduce or otherwise disclose the information to any person outside the group directly responsible for evaluation of its contents, except that there is no obligation to maintain the confidentiality of any information that becomes publicly known through no fault of recipient. By receiving and accepting this proposal, recipient agrees to the stated terms.

Overview

Krofta Technologies will provide a Dissolved Air Flotation wastewater treatment unit that is easy to install, operate and maintain. Our equipment has been used in thousands of installations worldwide. Specifically, our mission is to provide a system that offers the following advantages:

- **A comprehensive total solution** – our proposed system provides a reliable method for separating and removing Suspended Solids and Oil & Grease from your Process Wastewater either prior to discharge to the city/municipality or prior to other Wastewater Treatment Phase.
- **Ease of Installation** – we will provide the delivery of a Dissolved Air Flotation (DAF) system in stainless steel wetted construction. This unit is easily set in place minimizing installation costs. No field welding is required. Once final mechanical and electrical tie-ins are completed, the system will be commissioned by our experienced staff and turned over to trained client personnel.
- **Ease of Operation** - the process selected was driven by our extensive treatment experience and with ease of operation and maintenance for the plant operator in mind. Our proposed system can be operated with minimal manpower, requires low electrical demand and is easy to maintain.
- **Startup / Commissioning** – Optional Adder Supplied in Pricing Section for DAF System to be commissioned by our experienced staff and turned over to trained client personnel.
- **Environmental sustainability** – The Krofta proprietary DAF treatment technology provides the following environmentally sustainable benefits:
  - Smaller footprint compared to other competing technologies
  - Low energy usage
  - Ease of installation and operation
  - Robust treatment process
  - Stainless steel equipment minimizes maintenance and up-keep

The following is the Information as requested in the City of Aumsville, Aumsville, OR Request for Proposal described in Section 11400 Packaged DAF Equipment.

1. Manufacturer Information:

Krofta Technologies, LLC of Dalton, Massachusetts is a worldwide water and wastewater equipment solution provider and supplier of Dissolved Air Flotation (DAF) Equipment. Originally founded in the early 1950s by Dr. Milos Krofta, it is currently a subsidiary of Waterleau NV and Group Machiels, global operators in Renewable Energy and Environmental Solutions.

Krofta currently operates out of (2) offices. The Headquarters in Massachusetts houses all engineering, laboratory, marketing, production, rental, aftermarket, and finance responsibilities for the North American Market. In Europe and the rest of the world, these services are handled through the office in Wespelaar, Belgium.

Dr. Milos Krofta has long been recognized as a pioneer in the field of Dissolved Air Flotation and whose innovative designs have advanced DAF technology throughout the years. Krofta initially found success in the Pulp & Paper markets with fiber recovery and effluent pretreatment applications and quickly moved into virtually every other water and wastewater industry where DAF was needed, including municipal water and wastewater treatment.

Today, Krofta DAFs are regularly installed on a wide variety of applications within the Municipal Markets as well as in the Food & Beverage, Oil & Gas, Industrial, Pulp & Paper, and Automotive Industries. In addition, Krofta through its Sandfloat Technology, also supplies DAF equipment to municipalities for Drinking Water applications and is credited with the 1st DAF plant for such an application in the United Sates in 1981 and the then largest plants in the USA with the City of Pittsfield, Massachusetts in 1986. These plants are still in operation today.

Krofta's capabilities today include a large DAF Rental Fleet of 15-20 systems, as well as in-house laboratory services, chemical supply and selection expertise, a dedicated team for after-market services and support as well as Regional Managers throughout the country. Krofta also offers remote assistance/monitoring and a phone/tablet application to assist operators when needed. The nearest Regional Manager for Oregon is currently located in Northern California, near San Francisco.

For this project, Krofta will utilize Brian Trombley as the Primary Project Manager and Point of Contact for the design and delivery of the equipment, although several other team members will also be involved. Brian has been with Krofta since 1997 after graduating from Lafayette College in Pennsylvania with a Mechanical Engineering Degree. He has managed hundreds of DAF Rentals, Equipment Supply, and Equipment Installation projects for Krofta since that time.

Brian and Krofta can be reached at:

Krofta Technologies, LLC
PO Box 7
401 South Street
Dalton, Massachusetts USA 01227
413-236-5634
info@krofta.com
www.krofta.com
brian.trombley@krofta.com

2. Manufacturer Experience:

Since its inception, Krofta has delivered thousands of systems worldwide. We know of numerous systems that were installed in the 1970s that are still in use in 2024. In the last ten years, Krofta has delivered nearly 200 permanent systems in North America and another 65 systems worldwide. In addition, Krofta has delivered over 90 DAF Rental Systems to customers in North America, many of which have been operated continuously for years as Rentals, being serviced regularly by Krofta directly from its Massachusetts office.

Krofta values our clients and customers privacy. In a few instances, we are bound by the Confidentiality and Non-Disclosure agreements which may be in place. However, we would be happy to discuss any of our experiences or installations in general terms upon request.

Please reference Prequalification Form attached in Appendix D.

KROFTA ALGAE APPLICATIONS

Project/Client	City	State	Project Type	Capacity (GPM)	Contact
Calaveras County Water District	Calaveras	California	SPC-8 X2	100	Ron Rose 209-728-2460
City of Junction	Junction City	Texas	SPC-12	300	Patrick Kelly 325-446-6554
Cyanotech	Kailua-Kona	Hawaii	SPC-15	400	Larry Evans 808-334-9413
Del Monte Foods	Sleepy Eye	Minnesota	SPC-15	400	Dale Bailey 507-794-2151

KROFTA CASE HISTORY #05-105

Algae Reduction – Private Community Wastewater

Application: TSS/Algae Reduction After Dual Aerobic Lagoons And Prior to Sandfilter Filtration

Customer: Community of Forest Meadows

Location: Calaveras County – Northern California

Equipment: 2 x Supracell SPC-8 Skid DAF & ADT300

Start-Up: Summer 2006

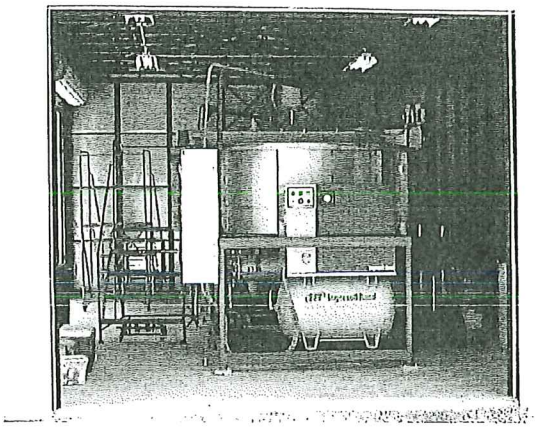
Details: The Supracell SPC-8 DAF is installed after an Aerobic Lagoon Process. Wastewater arrives at the private facility and is fed through a screen separator into an aerated lagoon. Septage trucks also direct discharge to the lagoon. Overflow from the lagoon moves by gravity to a 2nd aerated lagoon. Overflow from this lagoon is pumped to one of 2 SPC8 skids. The 2nd unit is on standby for redundancy. Coagulant is added at 5-20 ppm, depending upon the time of year, prior to the unit and the aerated water release from the air dissolving system. Clarified water is sent by gravity to an upflow sandfilter system and then pumped to a pond to be use for irrigation on the private golf course. Floated sludge is returned to an adjacent underground tank where it is removed by a tanker truck and hauled from the site.

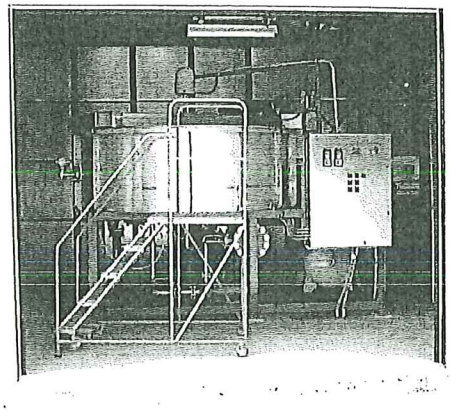
Performance: Influent TSS ranges from 20-500 mg/l depending upon the time of year. Effluent requirement (by permit) is 45 mg/l or less (avg) of TSS with a peak instantaneous limit of 65 mg/l. On average, the SPC-8 produces less than 25 mg/l of TSS.

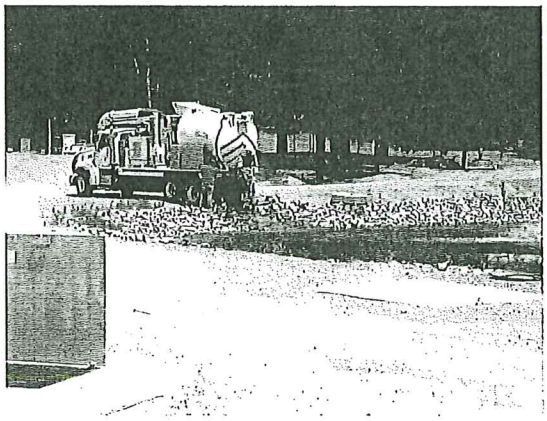
Features: Unit Fabricated in 304L SS, Auto-Level Control System, Modicon PLC Based Control System

KROFTA

INSTALLATION PHOTOS – 2 x SUPRACELL SPC-8 SKID DAF









3. Exceptions:

Exceptions / Clarifications to Bid Documents:

Control Valves to be Pneumatically Actuated and Not Electrically Actuated - Please refer to descriptions in Equipment List.
DAF Access Platform / Ships Stairs has been proposed as KROFTA Standard in 304L Stainless Steel
Our DAF Design does not include a Launder or Weir Section. - Our DAF Level is controlled via PID Loop w/ DAF Level Transmitter and Pneumatically Actuated Butterfly Control Valve with I/P (4-20mA).
We have not included anything in terms of supplying or installing any conduit / wire on Skids Supplied. - We can supply as an adder if required following further discussion of how this would be best done to assist with Owner's Electrical Contractor's Field Wiring.
Skid / DAF Inlet & Outlet Connections to be Flanged as described below in Equipment List
Chemical Skid being supplied as described below in Equipment List
Electrical Control Panels being supplied loose, to be mounted by Owner's Electrical Contractor
We have done our best to ensure Vendors meet the BABAA requirements. Waivers may be required for some Electrical / Instrumentation Components.
Virtual Support Services to be capped as follows (Based on Running 6 months of the year): - Maximum 4 hrs per day - Maximum 8 hrs per week - Maximum 32 hrs per month - Maximum 125 hrs for the year *Note: We are willing to negotiate but feel there should be some caps in place.*
Equipment Supplied as Describe Below.

4. Missing Items:

We understand that if it is deemed necessary that the OWNER would be responsible for the pH Adjustment of the Wastewater Influent to the DAF prior to the Coagulant.

5. Recommendations:

Changing the Sludge Transfer Pump from a Progressive Cavity Pump to an Air Diaphragm Pump. It seems that this would be a better fit with this application since you are going to be taking the system down for several months and you don't have to worry about the Stator in the Progressive Cavity Pump just sitting idle for 6 months. Note: This would require the Air Compressor to get a little larger.

KROFTA Sludge Blanket Controller – Proprietary Sensor / Controls which works with our Sludge Scraper System to maintain an optimum Sludge Blanket.

6. Process Description:

Influent WW Flow Control & Chemical Conditioning

The Krofta DAF feed is provided with a chemical conditioning system to maximize the efficiency and effectiveness of the treatment chemistry. Wastewater is transferred out of the Lagoon by Owner's Pumping System to the KROFTA designed Chemical Conditioning/Flocculation skid.

This flocculation skid will condition mix the incoming Raw Water with the addition of a coagulant. Mixing of added coagulant is achieved by an in-line static mixer providing a flash mix followed with further reaction time provided by the pipe reactor. Then as the water enters the DAF Unit a flocculant will be added.

The Coagulant Metering Pump and Polymer Make-Up System will be dosed at a PPM Setpoint and be automatically controlled based on flow input received from the in-line magnetic flow meter.

Primary Clarification by Krofta Dissolved Air Flotation (DAF)

Krofta proposes to provide one of its rectangular Multifloat high rate DAF Units. The Krofta Technologies MULTIFLOAT (MF) is a rectangular dissolved air flotation (DAF) unit, equipped with its internal Flow Enhancement Cells (FEC's) offering the advantage of a smaller footprint clarifier and compact skid design capable of treating the equalized and chemically conditioned process wastewater feed.

A mix of raw wastewater and aerated recycle flow are introduced at the bottom side of the unit. A header pipe runs down the center of the Multifloat Unit that will distribute the flow to the individual FECs within the flotation tank. FEC design allows for even distribution of the flow across the unit. Retention time within the unit will vary with the amount of raw water being processed but it is generally a minimum of 3-4 minutes. Flocculated particles attach to the aerated water and rise to the surface close to the plate inside the FEC. The plates assist in the rise rate by reducing the hydraulic head over the particle allowing it to rise at an increased rate. Clarified water is drawn back down between the FECs to a collection area below the bottom of the FECs. The clarified water flows into the Clarified Extraction Headers that run along either side of the DAF Unit and discharge into a clearwell reservoir and is then discharged by gravity out of the unit.

The Krofta automatic level control system maintains a constant water level. The automatic level control system consists of a flange mounted transmitter located on the outer tank wall, a
control unit to process the transmitter signal, and an actuated butterfly valve located on the effluent line. The actuated butterfly valve opens or closes in order to maintain a constant water level, required to hold a constant level with a changing feed flow rate. This is a more efficient way of maintaining an accurate level in the DAF Tank

and ensuring an even and more consistent floated sludge blanket forming and being scraped off with the DAF Top Scraper System.

A portion of the clarified water is "recycled" (typically between 15-30%) through the Air Dissolving System through a separate connection to the clearwell reservoir. Should flow be shut-off to the unit, this ensures the flow to the recycle pump will not stop and cause damage to the pump. Dissolved Air is produced by Krofta's proprietary Air Dissolving System which utilizes a standard centrifugal pressure pump along with its Air Dissolving Tube (ADT) System. The KROFTA Air Dissolving System aerates and pressurizes the flow at ~78 psi required to provide flotation. The Air Dissolving System consists of the Air Dissolving Tube (ADT), an air flowmeter, pressure gauges, a sample valve, a pressure release valve, and an ADT flow pump. KROFTA's Air Dissolving System is a more efficient and flexible design and allows for the use of a Standard Centrifugal Pump making it more O&M friendly.

The KROFTA ADT eliminates the need for large volumes of air and water by using air dispersion technology and centrifugal force in place of sheer volume and gravity. Compressed air is pumped into the ADT across the surface of a porous air panel(s) that disperses the air across the entire surface of the panel, which creates faster dissolution of air into the water and retention time of only 7-12 seconds. The flow pattern is a cyclone or vortex, which produces a centrifugal force that helps to eliminate the undesirable entrained air. A specially designed inlet nozzle is sized specifically for each application and can be easily changed out if the recycle flow rate requirements of future waste streams change dramatically. A bleed-off outlet also assists in eliminating coarse entrained air from the ADT to ensure that the tube does not become air-bound or obstructed by a plugged flow around the air panel. The ADT has a Low Compressed Air Consumption: The ADT consumes less than 1 SCFM @ 90psi per 500 liters (132 gallons) of ADT capacity. It provides Maximized Flotation: When the ADT is matched with a properly sized globe valve for pressure release, the ADT will produce a 30-70 micron air bubble, which is well suited for dissolved air flotation.

Microscopic air bubbles in the aerated water attach to the suspended solids in the influent in order to float the solids to the surface. The Floated Materials / Suspended Solids are collected at the top of the FECs and directed towards the sludge collection rake assembly. The Sludge Scraper Assembly pushes the floated material over a simple beach design and deposits the material into a small sludge collection tank built into the MF Unit. The Scraper can be run continuously or via a timer depending on the sludge thickness desired. The floated sludge is then transferred by the floated sludge transfer pump to the sludge tank. The sludge transfer pump is started / stopped based on a set of Conductance Probes & Relay that senses the build-up of floated sludge in the DAF Sludge Well.

Grit or other settleable solids / debris that do not float is collected in the v-bottom of the unit. Because of the small footprint of the unit, a scraping mechanism is not required. The bottom sediment sump is intermittently purged automatically. One or more (depending on the size of the unit) butterfly valves for the purge are controlled by a simple timing mechanism in the control panel or PLC. This settled sludge will also be evacuated from the DAF through the sludge transfer pump and pumped to the sludge tank based on the operator selected time interval.

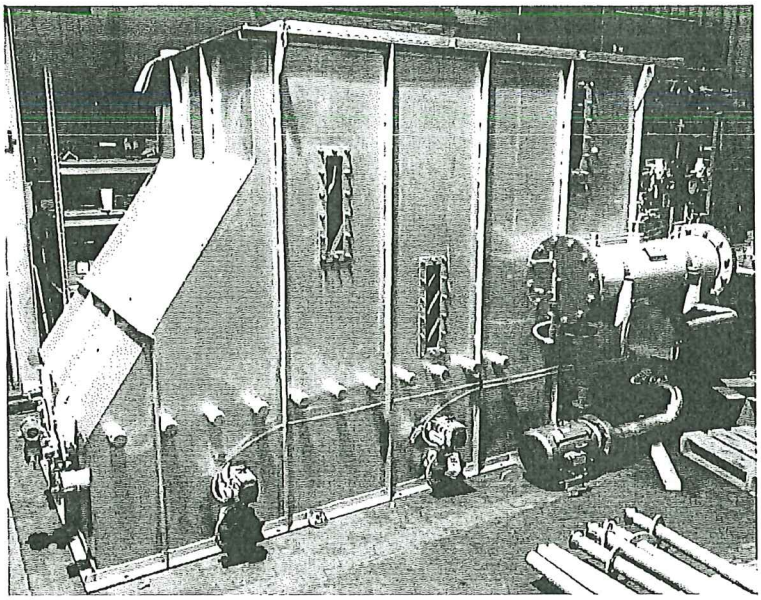
7. Design Calculations:

KROFTA has selected its KROFT Multifloat Model MFH-500 Unit for this application based on the Hydraulic Requirements provided in this RFP as stated below in the Design Criteria Section.

Loading is minimal as listed in the RFP so the Typical ADT-500 Dissolved Air Recycle System has been selected based on a 25% Recycle Rate.

This Unit will be able to handle additional capacity if required in the future.

KROFTA MULTIFLOAT MFH DAF



STANDARD SPECIFICATIONS - MODEL MFH-500:

Materials of Construction	304L Stainless Steel
Materials of Construction – ADT (Wetted)	304L Stainless Steel
Scraper Drive	1.5 HP SEW-Eurodrive
Design Hydraulic Capacity at ≤2,000 mg/L TSS *(Based on 25% Recycle)*	400 GPM (90.8 m3/h) Max. Net
Projected Flotation Area	150.3 Ft2 (14 m2)
Estimated Empty Weight	6,800 Lbs. (3,084 kg)
Estimated Flooded Weight	37,000 Lbs. (16,783 kg)
Power Requirements	460V / 3 PH / 60 HZ

Floated Sludge Projections
Projected Floated Sludge Production from DAF Uni – Note: Projections based on Desing Criteria listed below: 684 GPD @ 3% Consistency; 513 GPD @ 4% Consistency. *Note: Values are Based on Treating 432,000 GPD of Process Wastewater at 50 mg/L TSS and ~95% Capture Efficiency.*

8. Design Criteria:

Application: - Algae Removal from Lagoon		
Design Parameters (Influent)	**Design Values**	**Clarified Effluent Projections**
Flow (DAF Influent), *gpm*	300	*N/A*
pH, S.U.	7 - 8	6.5 – 8.9 **
Alkalinity, *mg/l as CaCO3*	> 100	*N/A*
Temp, *°C*	5 - 20	*N/A*
TSS, *mg/l*	3 to 50	< 10
O&G, *mg/l*	*N/A*	*N/A*

** *Note: pH Adjustment in scope of Owner.*

Floated Sludge Projections
Projected Floated Sludge Production from DAF Unit: 684 GPD @ 3% Consistency; 513 GPD @ 4% Consistency. *Note: Values are Based on Treating 432,000 GPD of Process Wastewater at 50 mg/L TSS and ~95% Capture Efficiency.*

Utility Item	Description
Potable Water Requirements	Polymer Dilution Water – 1-2 GPM @ 60 psi *Typically, customer should also account for Eyewash / Shower requirements; wash down requirements; etc.*
Air Requirements	ADT Air – 1 SCFM @ 90 psig Pneumatic Valves (DAF Influent FCV; DAF Effluent FCV; 2 x Sediment Purge Valves; & Floated Sludge Valve) – estimate 5-8 SCFM @ 80 psig
Projected Power Requirements	Power Consumption – Based on 300 GPM over 24 hours for 30 days as stated in the bid request. Running hours = 720 hours • DAF Scraper Motor – 1.5HP (max) – 1kW = 720 kWh • Recycle Pump – 10HP (max) – 7.5kW = 5,400 kWh • Air Compressor Motor – 5HP (max) – 3.7kW = 2,664 kWh • Sludge Pump Motor – 5HP (max) – 3.7kW = 2,664 kWh • Misc 120V/1PH/60HZ - Solenoids / Chemical Pumps / Etc.– 15 amps (estimated)
Projected Chemical Requirements	Based on 300 GPM over 24 hours for 30 days as stated in the bid request. Coagulant K-AL100 (Alum) provided in 275-gallon totes – assuming 50 ppm: 0.015 GPM / 21.6 GPD / 648 gallons per 30-day period. Polymer K-F1066 (30% anionic emulsion) provided in 55-gallon drums – assuming 2 ppm @ 0.2% solution feed: 0.0006 GPM / 0.864 GPD / 25.92 gallons per 30-day period.

Based upon the Design Criteria above the following Equipment has been selected (shown below in the Equipment List). Please find below Materials of Construction along with general specs of equipment components.

9. Equipment List:

SCOPE OF SUPPLY – KROFTA MULTIFLOAT DAF, MODEL MFH-500:

Item	Description
KROFTA Multifloat DAF Model MFH-500	Wetted construction in 304L SS: Tank Walls, Internal Wetted Parts & Piping. Non-Wetted Structure & Brackets construction in 304L SS: Tank Rim, DAF Support Ribs, Floor Support Grid. Pipe Connection nozzles in 304L SS Pipe w/ SS AFR and Galvanized Back-Up Flanges (ANSI-Style w/ 150 Lbs. Drillings). (For additional info please refer to DAF General Outline Drawing)
Access Platform w/ Ships Stairs *(detached for shipping)*	304L SS Access Platform with diamond plate. Includes Ships Stairs. (Please refer to DAF DUC Drawing for configuration of Platform / Ships Stairs) *Note: Pre-Mounted to DAF Unit and then shipped loose for shipping. To be bolted on in filed by Installation Contractor.*
Isolation Butterfly Valves – DAF Inlet & Recycle Outlet	Bray Butterfly Valve w/ Manual Lever Actuator. Materials: Ductile Iron Lug Body, 316 SS Disc, 416 SS Stem, EPDM Seat. *Note: Mounted to DAF Unit on corresponding nozzles.*
Influent Flow Control Valve	Bray Pneumatic Butterfly Flow Control Valve w/ Spring Return (F/C) Actuator w/ Electro-Pneumatic Positioner. 24VDC Loop Powered (4-20mA) Materials: Ductile Iron Lug Body, 316 SS Disc, 416 SS Stem, EPDM Seat. Aluminum Body Actuator. Plastic Body Positioner *Note: Valve ships loose to be installed in DAF Influent Piping.*
MFH Solids Removal	Components Included as Follows:
Floated Sludge Removal System	Floated Sludge Removal System consists of: Top Scraper System w/ SEW Eurodrive Gearbox/motor Drive Unit, 460V/3PH/60HZ. Scraper Blade Material: BUNA Integral Floated Sludge Hopper
Floated Solids Level Switch	Includes: Conductance Level Probes; 1 x High (pump start) Probe, 1 x Low (pump stop) Probe, & 1 x Reference Probe. Warrick Conductance Level System also contains Relay which is mounted in PLC Panel (24VDC) *Note: Mounted to DAF Unit on corresponding nozzle.*
DAF Floated Sludge Valve	Bray Pneumatic Butterfly Flow Valve w/ Spring Return (F/O) Actuator & 3-Way Solenoid Valve (24VDC) Materials: Ductile Iron Lug Body, 316 SS Disc, 416 SS Stem, EPDM Seat. Aluminum Body Actuator. *Note: Mounted to DAF Unit on corresponding nozzle.*
DAF Sediment Purge Valve Qty (2)	Bray Pneumatic Butterfly Flow Valve w/ Spring Return (F/C) Actuator & 3-Way Solenoid Valve (24VDC) Materials: Ductile Iron Lug Body, 316 SS Disc, 416 SS Stem, EPDM Seat. Aluminum Body Actuator. *Note: Mounted to DAF Unit on corresponding nozzles.*
KROFTA Air Dissolving System	Components Included as Follows – Sized for 25% Recycle Flow:
KROFTA Air Dissolving System Model ADT-500	304L SS Wetted Parts w/ Inlet / Outlet connections have SS AFR w/ Galv Back-up Flanges. Blind Flanges are Painted Mild Steel w/ 304LSS Internal Cladding. (Flanges are ANSI-Style w/ 150 Lbs. Drillings). Gaskets: Neoprene *Note: Mounted to DAF Unit.*
Air Dissolving Pneumatic Panel and System Components	Air Regulator, Pressure Gauge, Rotometer, Pressure Relief Valve, ADT Air Inlet Brass Solenoid Valve (ASCO 24VDC), Low Air Pressure Switch (ASHCROFT 24VDC), w/ Poly Pneumatic Air Tubing. Also includes: KROFTA Coarse Air Bleed-Off Tube, ADT Air Feed Isolation Valve, ADT Air Feed Check Valve, and ADT Sample Isolation Valve. *Note: Mounted to DAF Unit.*

ADT / DAF Recycle Pump Qty (2)	Goulds Model 3656, End Suction Centrifugal Pump, Close Coupled, Cast Iron / Bronze Fitted Construction, single std. mech. seal w/ 10HP, 3500RPM, 460V/3PH/60HZ, TEFC, Premium Efficient Motor. (*Sized for 80 GPM @ 180' TDH*) *Note: One pump Mounted to DAF Unit. The other supplied as loose spare.*
DAF Recycle Flowmeter & Transmitter	Endress & Hauser Magnetic Flow Tube w/ Remote Mounted Transmitter Promag W 400, 4" AA - Approval: Non-hazardous area D - Design: Lap joint flange L - Power Supply: 100-240VAC/24VAC/DC H - Output; Input: 4-20mA HART, pulse/freq., switch output P - Housing: Remote, alu, coated 2 - Cable, Remote Version: 10m/30ft coil and signal cable D - Electrical Connection: Thread NPT1/2 *Note: Instrument ships loose to be installed in DAF Influent piping.*
ADT Pressure Release Valve	KROFTA SS Auto-Purging Pneumatic Angle Seat Globe Valve 316 SS w/ NPT Connections & 3-Way Brass Solenold Valve (24VDC) *Note: Mounted in Skid Piping described below.*

Skid Piping	Includes:
	• 304 SS Mounting Supports for ADT; mounting of ADT & ADT Pneumatic Control Panel to Unit
	• Includes 304L SS Pipe w/ SS AFR and Galvanized Back-Up Flanges (ANSI-Style w/ 150 Lbs. Drillings) for following Piping:
	  ◦ *Piping between DAF Recycle Outlet and Recycle Pump Inlet.*
	  ◦ *Piping between DAF Recycle Pump Outlet and ADT Inlet.*
	  ◦ *Piping w/ Globe Valve Mounted between ADT Outlet and DAF Recycle Inlet*
	• Includes Poly Pneumatic Tubing for ADT Air Control Panel Components; Air Inlet to ADT; Pneumatic Valves mounted on DAF Skid.

Clarified Water System Components:	Components Included as Follows:
DAF Level Transmitter	ABB Differential Pressure Transmitter w/ 3" Flanged Mounted Diaphragm Seal. 24VDC Loop Powered (4-20mA) *Note: Mounted to DAF Unit on corresponding nozzle.*
Effluent Flow Control Valve	Bray Pneumatic Butterfly Flow Control Valve w/ Spring Return (F/C) Actuator w/ Electro-Pneumatic Positioner. 24VDC Loop Powered (4-20mA) Materials: Ductile Iron Lug Body, 316 SS Disc, 416 SS Stem, EPDM Seat. Aluminum Body Actuator. Plastic Body Positioner *Note: Mounted to DAF Unit on corresponding nozzle. Functions to Maintain DAF Level and allows for consistent Floated Sludge removal.*
O&M Manual	Electronic / Digital Copy

SCOPE OF SUPPLY – ADDITIONAL SUPPORT EQUIPMENT:

Item	Description
Influent Flow Equipment	
DAF Influent Flow Control Valve	Bray Pneumatic Butterfly Flow Control Valve w/ Spring Return (F/C) Actuator w/ Electro-Pneumatic Positioner. Materials: Ductile Iron Lug Body, 316 SS Disc, 416 SS Stem, EPDM Seat. Aluminum Body Actuator. Plastic Body Positioner *Note: Valve ships loose to be installed in DAF Influent piping.*
DAF Influent Flowmeter & Transmitter	Endress & Hauser Magnetic Flow Tube w/ Remote Mounted Transmitter Promag W 400, 4" AA - Approval: Non-hazardous area

	D - Design: Lap joint flange L - Power Supply: 100-240VAC/24VAC/DC H - Output; Input: 4-20mA HART, pulse/freq., switch output P - Housing: Remote, alu, coated 2 - Cable, Remote Version: 10m/30ft coil and signal cable D - Electrical Connection: Thread NPT1/2 *Note: Instrument ships loose to be installed in DAF Influent piping.*
Chemical Conditioning / Metering Equipment	
Chemical Conditioning / Floc Tube Pipe Reactor w/ Inline Wafer Style Static Mixer	KROFTA DESIGN - 6" PVC SCH80 Piping mounted on 304L SS Stand, 60 sec. Coag Mix Stage. Also, includes: 1 x Westfall Wafer-Style Static Mixer w/ Injection Quill for Coagulant. Materials: PVC Mounting Ring w/ PVC Mixing Plate; EPDM Gaskets; PVC Injection Quill. *Note: Ships installed in Floc Tube Skid.*
Coagulant Metering Pump Skid	Grundfos DDA Series Diaphragm Metering Pump mounted in Enclosure on a 304L SS Frame, Including Draw Down Cylinder, Isolation Valves, Back Pressure & Pressure Relief Valves. (120V/1PH/60HZ). Sized for Max Coag Flow of 8 GPH. Piped Using PVC SCH80 & Polyethylene Tubing w/ Polypropylene Chemical Tubing Fittings.
Polymer Make-Up System	Prominent Pro-Mix-S – Model: ProMix S SG 60X2-0.60TA Liquid Make-down System skid mounted, including Mechanical Mixing System, Dilution Water Addition, Draw Down Cylinder, and Isolation Valves. (120V/1PH/60HZ) Piped Using PVC SCH80 & Polyethylene Tubing w/ Polypropylene Chemical Tubing Fittings. Sized for Max Neat Polymer Flow of 1 GPH. System Connections: Water Inlet: 3/4" FNPT Pump Inlet: 1/2" FNPT Solution Discharge: 3/4" FNPT Primary Dilution: 60 gph Post Dilution: 60 gph Pump Capacity: 0.72 gph
Sludge Transfer Equipment	
DAF Sludge Transfer Pump Skid:	304 SS Support with following Components mounted & piped w/ PVC SCH80 Piping:
DAF Sludge Transfer Pump	Progressive Cavity Pump – Roto Pump Model: RLCB591 Tag.No RLCB591R1CD1L 20(250X30) Sized for 15 to 60 GPM @ 30 PSI Pump Speed 76-274 RPM Material of Construction Pump Housing - Cast Iron, as per ASTM A 48M Cl. 225 (IS 210 FG 220) Rotor - Alloy Steel AISI C1140 (EN-8: BS970)-Hard Chrome Plated Shaft Alloy Steel AISI C1140(EN-8: BS970)-Un Plated Stator - Nitrile Black Type of Joint - Universal Cardan Joint Paint Specification - R A L 6 0 2 9 Shaft Sealing Arrangement Type Of Mechanical Seal - Single acting,unbalanced bi-directional elastomer bellow Hi-Fab type H -502 face G60, Face Comb.Sic vs Sic, Viton elastomer, SS 316 seal moc, DIN Make Of Mechanical Seal - Hifab or EQUIVALENT

	Nord Gearbox/Motor Unit – 4HP, 460V/3PH/60HZ, TEFC PE Motor. IP55 Protection. Run Dry Protection Sensor & Controller (24VDC) Discharge 2.5" SS Liquid Filled Gauge, 0-60psi Range, Includes: 316SS Isolation ball valve.
Final Effluent Monitoring Skid Equipment	
Final Effluent Monitoring Skid	304 SS Support with following Components mounted & piped w/ SS SCH10 Piping
DAF Effluent Turbidimeter & Transmitter	E&H Turbidity Transmitter, Probe, Probe Cable, & Insertion Assembly (24VDC) *Note: This Instrument will most likely require a waiver from BABAA.*
Compressed Air System Components	
Air Compressor	Atlas Copco Product No. 8152103841 Model: G4FF-145 TRI-V/60 TM MEAF DOL Oil Injected Screw Compressor - Air Cooled -Capacity: 18 CFM @ 138 PSI - Motor: 5HP, IE3 TEFC Motor -Voltage: 208-230/460V/3ph/60Hz -145 PSI Maximum Operating Pressure -Microprocessor Control: Electronikon Basic -Remote control/monitoring via AIRKeeper -Long Life RDX (Roto Duty Extend) Synthetic Oil -Full Feature Model: Integrated refrigerant dryer -Footprint: 57"L x 24"W x 50"H
Air Compressor Condensate Drain	Atlas Copco Product No. 8102048012 Model: IWD 105 115V Intelligent Water Drain with Electronic Zero Loss Collects and removes liquid moisture effectively, reliably, and efficiently Zero-loss drain only releases moisture content when it reaches a pre-set level, leaving a minimal amount of condensate Special housing so the IWD can be used in oil-lubricated and oil-free installs
Coalescing Filter	Atlas Copco Product No. 8102372404 Model: UD15+ (NPT1/2) UD+ two-in-one oil coalescing filter High-efficiency glass fiber Nautilus technology ensures a low pressure drop. Coarse 3D-structured layer/barrier provides efficient oil drainage and prevents re-entry of oil droplets into the air stream
Pressure Regulator / Filter	SMC Pneumatics – Filter Regulator Combination Unit
Electrical Controls	
Main PLC Control Panel	Nema 12 Painted Steel Enclosure, UL Listed Main Rotary Disconnect – Designed for 120V/1PH/60HZ incoming power from Breaker in Owner's Low Voltage Power Distribution Panel. PLC / IO: Allen Bradley PLC; Allen Bradley Panelview Plus Touch Screen HMI; Allen Bradley I/O for associated support / ancillary equipment described above. Includes: Alarm Light w/ annunciator, E-Stop, Reset Button, and Graceport for Laptop/Programmer Connection. Allows for Ethernet Communications *Typical KROFTA Control Functionality. Assumes KROFTA Standard Programming and HMI Operation Screens.*
Motor Control Panel	Nema 12 Painted Steel Enclosure, UL Listed

	Main Rotary Disconnect – Designed for 460V/3PH/60HZ incoming power from Breaker in Owner's Power Distribution Panel. Complete with: Allen Bradley FVNR Starter Controls for: - DAF Recycle/ADT Pump – 10 HP Allen Bradley Powerflex Drives for: - DAF Scraper Drive – 1.5 HP - Sludge Transfer Pump – 5 HP *Note: It is intended that the Air Compressor would be powered off of a separate 460/3PH/60HZ Breaker from Owner's Distribution Panel.*
Description / Features	• PLC Programming Provides Automatic Operation of DAF System with Interlocks. Interlocks Screen shows Active Interlocks for assisting Operator in trouble shooting issues. • Panelview provides Simple Data logging to csv file. – csv files can be downloaded to USB thumb drive. Data logs start to get written over after 30 days. • Alarming – o Red Light and Annunciator for Active Alarms o Amber Light for Active Alarms that have been Acknowledged but not cleared. o Typical Alarming – Low Flow / Low Air Pressure / High and Low Levels / Motor Tripping / VFD Faults • Includes: Remote Access Device for providing online remote troubleshooting (providing there is adequate Cellular Signal or Customer Network Access) during the Warranty Period. • Control Panel Design Notes • Control Panels will be Painted Steel and UL508A Listed • 120V Panel will have side mounted load disconnect switch and UPS for 15 minutes of power • 480V Panel will have Fused Disconnect Rotary thru the front door disconnect & Panduit Voltage Presence Monitor • PLC Panel will house either the ControlLogix Architecture or CompactLogix Architecture, Panelview+ 7 Performance 9" or 10" Operator Interface depending on (whether waiver is acceptable), Stratix 5200 8 Port Switch, UPS, DC Power Supply, Red Beacon Fault Light with Horn, Yellow Alarm Light, E-Stop Pushbutton and Control Reset Pushbutton mounted on PLC door. • Both Systems will follow standard Krofta Standard Software Solution with PLC Logic and modified operator screens for the 9" wide display if waiver is not accepted for 10" Operator Interface. • AutoCAD Electrical Drawings in Krofta's standard configurations will be supplied. Standard RSLogix Studio PLC programs with software protection will be supplied as will be standard FactoryTalk ME application file for the Panelview+ 7 Operator interface. • The specification 17090 will be followed but will require waivers to support BABA requirements.
Buy American Compliance Notes	• To meet the BABA requirement Hoffman Enclosures specified the CDS Family of enclosures and thus will not meet the 3 Point latching specification. These enclosures have screw latching mechanisms and the panels are rated NEMA 4. • To meet the majority of the control components the following will be certified by Rockwell Automation: • ControlLogix 10 Slot Chassis, L81E Processor, 2-16 Point DC Input Modules, 1-8 Pt Analog Input Module, 1-8 Point Analog Output Module, and 1-16 Point Individual Isolated Relay Output module.

	• The Panelview + 7 Performance 9" Wide Display Operator Interface • PowerFlex 750TS 1.5HP & 5 HP VFD for the Scraper and Sludge Transfer Pump • 10 Hp Eco Starter for the recycle pump • 800H Pushbuttons • Other miscellaneous components including fuse blocks, fuses, DC Power Supply, Ethernet Switch, UPS, terminal blocks and relays, etc. could not be found to be BABA compliant and would fall under the 16.14.B waiver.

SCOPE OF SUPPLY – EXTRA MATERIALS:

Item	Description
On-Site Services	
Extra Materials per 1.8.a. 1 thru 6	1) Expendable material such as gaskets, seals, and packing: One complete set. 2) Special tools required to maintain or dismantle, if any required: One complete set. (*Note: No Special Tools Required.*) 3) Spare recycle pump: One uninstalled spare. 4) Spare sludge pump: One uninstalled spare. 5) Mixer motor, rake drive motor, scum skimming drive motor: One uninstalled spare. 6) Solenoid Valves: One uninstalled spare for each type and size.

SCOPE OF SUPPLY – SITE SERVICES:

Item	Description
On-Site Services	
Site Services – KROFTA Technician	7) 5 days for installation assistance, include travel expenses for two separate trips to break the 5 days into two separate trips. 8) 3 days for pre-startup inspection and testing and completion of Manufacturer's Certificate of Proper Installation. 9) 5 days for facility startup. 10) 2 days for post-startup training of Owner's personnel. 11) 1 day for follow up training within 1 year of initial startup.
Site Services – PLC Programmer	1) 3 days for pre-startup inspection and testing and completion of Manufacturer's Certificate of Proper Installation. 2) 5 days for facility startup. Note: Trips for Programmer to coincide with those of KROFTA Technician.
Virtual Support Services	
	Virtual support during first year of operation. The supplier shall provide operational support for City Staff during the first year of operations without additional charge. This support shall consist of telephone discussions, email exchanges, online meetings, and the in-person follow-up training specified above. Note: KROFTA has added some limits in the Exceptions Section.

10. Excluded Items:

Exclusions / Clarifications:

Geotechnical Study / Engineering	By Owner / Owner's Engineer
Licensed Professional (PE) Engineering	By Owner / Owner's Engineer
Any Permitting Work or Permit Fees	By Owner / Owner's Engineer
Building / Architectural Work – includes canopies, sheds, etc.	By Owner / Owner's Engineer
Tanks – EQ, Effluent, Sludge Holding, Bulk Chemical, etc.	By Owner / General Contractor If required
Pre-Screening of Influent Wastewater	By Owner / General Contractor If required
Pumps – DAF Influent, DAF Effluent, etc.	By Owner / General Contractor If required
Chemical Metering – Pre or Post Acid and Caustic Metering Pumps	By Owner / General Contractor If required
Chemical Containment Units for any / all chemicals required	By Owner / General Contractor If required
Safety Shower / Eyewash Station(s)	By Owner / General Contractor If required
All Equipment not specifically called out in above Scope of Supply	By Owner / General Contractor If required
Civil / Site / Earthwork / Concrete and Structural Work	By Owner / General Contractor If required
Equipment Mounting / Installation	By Owner / General Contractor If required
Equipment Anchoring / Anchor Bolts	By Owner / General Contractor If required
Piping / Plumbing *(other than what is explicitly stated in proposal description)*	By Owner / General Contractor
Electrical Work – *i.e. conduit, wiring, electrical disconnects, terminations, etc.*	By Owner / General Contractor
Electrical Work – *i.e. building grounding, grounding of equipment, etc.*	By Owner / General Contractor
Freeze Protection - Heat Tracing / Insulation, etc.	By Owner / General Contractor If required
Wastewater System Treatment Chemicals – along with Chemical Totes, Drums, etc.	By Owner
Sludge Thickening / Hauling / Removal	By Owner
Potable Water Usage for Testing / Operation / Etc.	By Owner
Lab Testing / Fees	By Owner
Offloading & Storage	By Owner / General Contractor If required

11. Drawings:

Refer to Drawings attached in Appendix A.

12. Building Dimensions:

Refer to Drawings attached in Appendix A.

13. Process and Instrumentation Diagram:

Refer to Drawings attached in Appendix A.

14. Instrumentation:

- Specific Instrumentation called out in Equipment List Above.
- Specific software, hardware, control features, monitoring, data storage, and alarms called out in Electrical Controls above in Equipment List.

15. Operation Description:

INITIAL START-UP PROCEDURES

1. Close all drain, sampling, purge and air inlet isolation valves to the MULTIFLOAT and Air Dissolving System.
2. Open DAF Influent, Effluent, and Recycle Outlet Isolation Valves
3. Initially Open Pressure Release Globe Valve to ~50% Open
4. Open Inlet / Outlet Isolation Valves to Air Diaphragm Sludge Transfer Pump
5. Open Air Inlet Isolation Valve and initially set Needle Valve to Air Diaphragm Sludge Transfer Pump to 50% open.
6. Startup Compressed Air System and ensure there is adequate pressure to:
    a. ADT – 90 psig minimum
    b. Pneumatic Valves – 80 psig minimum
    c. Air Diaphragm Pump – 50 psig minimum
7. Check Chemical Systems to make sure they are all primed with Chemical, and that necessary Isolation Valves are open for Inlet to Chemical Pumps as well as valves leading to Injection Points.
8. Enter the following Setpoints on PLC Panel HMI Display
    a. Set Influent Flow Setpoint.
    b. Set DAF Level Setpoint
    c. Set Scraper Speed Setpoint
    d. Set Sediment Purge Valve Open/Close Interval Timers – Typical Interval Open 5-7 secs / Closed 45 mins.
    e. Set Pressure Release Globe Valve Open/Close Interval Timer – Typical Interval Open 10-12 secs / Closed 60 mins.
    f. Set Coagulant Pump PPM Setpoint
    g. Set Polymer System PPM Setpoint
9. Set all Devices to Automatic on PLC Panel HMI Display
    a. DAF Influent FCV
    b. DAF Scraper
    c. DAF Sediment Purge Valve(s)
    d. DAF Floated Sludge Valve
    e. DAF Sludge Transfer Pump Solenoid Valve
    f. ADT Solenoid Valve
    g. DAF Recycle Pump

h. DAF Effluent FCV
i. Coagulant Metering Pump(s)
j. Polymer Make-Up System(s)

10. Start sending DAF Influent Flow to the DAF Unit
11. As Flow begins flow to the DAF the following will happen when Controls are set in Automatic
    a. Influent FCV will Control Flow to the DAF Unit
    b. Recycle Pump / Dissolved Air System will turn on when Start Level is reached
    c. DAF Sludge Scraper will turn on when Level Setpoint is reached
    d. Effluent FCV will Control Level Setpoint in the DAF Unit
    e. Coagulant Meter Pump(s) will pump to satisfy the PPM Setpoint based on Influent Flow
    f. Polymer Makeup System will pump to satisfy the PPM Setpoint based on Influent Flow
    g. Sludge Transfer Pump will start pumping when the Sludge Level reaches the High Conductance Probe in the Sludge Well. It will stop when Sludge Level drops below the Low Conductance Probe.
12. On Initial start / when DAF Unit is empty
    a. Let the DAF fill up water to just below the DAF Level Setpoint and make the following adjustments to the Air Dissolving System:
        i. Adjust the Pressure Release Globe Valve so that you achieve a 8-10 psi pressure drop across the Air Dissolving Tube (ADT) with the Recycle Pump running
            1. Typically the Inlet Pressure is ~76 to 80 psi and the Internal Pressure is ~68 to 72 psi.
        ii. Once the Pressure Release Globe Valve is set:
            1. Open the Air Inlet Isolation Valve to the ADT and set the Air Rotometer to ~10 – 15 SCFH
            2. Open the Course Air Bleed Off Isolation Valve so that it is ~ 1/3 Open and that there is an Air/Water mixture leaving the ADT. This keeps Coarse Air from building up inside the ADT.
            3. Note: After these steps are completed you should start seeing a Floated Sludge Mat forming on the Top of the DAF Unit.
        iii. Next, resume sending Wastewater Flow to the DAF Unit
13. Observe the Sludge Layer forming and make necessary adjustment to the Scraper Speed /Scraper Interval Timere until you achieve the desired Sludge Blanket Thickness on the surface of the DAF. Typically we recommend a 3 to 6" thick Sludge Blanket.
14. Note: With flow going to the DAF Unit during the Initial Startup you will need to tune the PID Loop Settings for the DAF Influent Flow and DAF Level Control.
15. Also Note: The Operator will have to make necessary Chemical Adjustments based on desired Effluent Water Quality.

DAILY START-UP AND OPERATION PROCEDURES

1. Typically, with KROFTA PLC Operated Systems when Devices are Left In Automatic – stopping the flow to the DAF will initiate a Delay Timer so that the DAF Continues running for a period of time before shutting itself down.
2. In order to Wake-Up the DAF System to start processing Wastewater you will just need to re-start sending Wastewater Flow to the DAF Unit.

KROFTA MULTIFLOAT DAF SHUTDOWN & CLEANING FOR LONGER DURATION SHUTDOWN

➢ Cleaning procedures outlined below are recommended at a scheduled shutdown period as depicted in maintenance schedule or after long periods where the DAF unit has not or will not be operated for a period of time. This timing will deviate based on a given application.

1. Manually turn off the chemicals. Allow clean water to continue to flow into polymer unit in order to flush system. It may be a good idea to run one quart of mineral oil through polymer system to help remove unwanted build up in tubing, chamber and site glass (See Polymer Make-up System O&M for detail).
2. Raise the water level high enough to scrape off any sludge layer that may be present. Allow enough time to pass so that the residual chemistry has had time to dissipate.
3. Shut off feed/Influent source
4. Drain the contents of the DAF by opening the Purge valve and running the sludge pump (if tied into purge line) and opening the effluent valve and/or effluent pump (if equipped).
5. Once the unit has been drained:

6. Follow appropriate Lock-Out Tag-Out procedures for isolating the DAF Unit from the process, as well as shutting down any live electrical/mechanical devices; i.e. Top Scraper Gearbox/motor and paddle mechanism, ADT/Recycle Pump, and any other equipment that could cause potential harm when cleaning the DAF Unit.
7. The Sediment Purge Valve(s) should be left open in manual. Leave purge valve in this position until the unit has been cleaned thoroughly.
8. Remove access hatch and clean out any collected sludge within chamber.
9. Open U element clean outs.
10. Open flange on inlet side of DAF to enable inlet header to be flushed.
    i. Horizontal Units also have a cleanout at the end of the Inlet Header that should also be opened.
11. Open extraction tube cleanout (this applies to the Horizontal configuration).
12. Drain ADT and then open ADT for cleaning.
13. Thoroughly spray DAF Unit down to remove any sludge build-up on and within the unit. Note: you may want to use hot water or steam if available, and/or power washer if available. A dilute bleach solution may be used on wetted parts as a means of bacteria and odor control after the unit has been cleaned and rinsed. This should be followed by a final rinse. Perform on the following:
    i. The U elements and plates – please make sure to clean these thoroughly from the top as well as inside the laterals after the clean-out caps are taken off. These elements have slotted distribution holes on the top of each lateral that should be cleaned from any build-up.
    ii. Inlet Header Pipe
    iii. Air Dissolving Tube and Piping – please note to follow cleaning of Air Dissolving Tube by spraying a soapy water solution onto the Air Dissolving Tube Air Panel(s). Slowly turn the air supply to ADT panels and watch for an even distribution of bubbles. If there is not an even distribution of bubbles and/or it takes more than ~10 psi with rotameter @ 10-15 SCFH to see these bubbles form, it may be time to change the ADT Air Panel. For ADT Air Panel replacement instructions, please refer to the Maintenance and Troubleshooting section in O&M.
    iv. Viewing windows
    v. Scraper assembly
    vi. Sludge hopper and Conductance Probes (if equipped)
    vii. Clearwell vents (this applies to the Horizontal Configuration)
    viii. Floated Sludge and Purge valve piping
    ix. Note: Please use caution near the level sensor as a strong blast of water from a power sprayer can and will damage the sensor.
14. When unit is drained and empty of all water & debris, re-install:
    i. Clean-out hatch
    ii. U-Element clean-out caps
    iii. ADT End Flanges
    iv. DAF Inlet Flange
    v. Any other items that were opened/disconnected for cleaning
15. Once the DAF System has been cleaned, return all settings back their original Automatic settings and start up unit.
16. It may be a good idea to take advantage of the unit being down to attend to other system cleaning tasks or PM as required depending on condition and interval of unit being down.



16. Annual O&M cost estimate along with a 20-year life-cycle cost analysis for the proposed equipment:

This shall include an itemized cost for all materials and equipment reasonably expected to require replacement during a 20-year period. Provide projected monthly electrical cost for supplied equipment assuming the electrical cost to be $0.10 per kW-hour. Use current market rates for coagulant and polymer costs. Calculations shall be based on the equipment operating at a flow of 300 gpm on a 24-hour basis for 30 days.

Utility Item	Description
Potable Water Requirements	Polymer Dilution Water – 1-2 GPM @ 60 psi *Typically, customer should also account for Eyewash / Shower requirements; wash down requirements; etc.*
Air Requirements	ADT Air – 1 SCFM @ 90 psig Pneumatic Valves (DAF Influent FCV; DAF Effluent FCV; 2 x Sediment Purge Valves; & Floated Sludge Valve) – estimate 5-8 SCFM @ 80 psig
Projected Power Requirements	Power Consumption – Based on 300 GPM over 24 hours for 30 days as stated in the bid request. Running hours = 720 hours • DAF Scraper Motor – 1.5HP (max) – 1kW = 720 kWh • Recycle Pump – 10HP (max) – 7.5kW = 5,400 kWh • Air Compressor Motor – 5HP (max) – 3.7kW = 2,664 kWh • Sludge Pump Motor – 5HP (max) – 3.7kW = 2,664 kWh • Misc 120V/1PH/60HZ - Solenoids / Chemical Pumps / Etc.– 15 amps (estimated) – 1.8 kW = 1,296 kWh *Electrical Cost = $0.10 per kW-hour x 12,744 kWh = $1,274.40*
Projected Chemical Requirements	Based on 300 GPM over 24 hours for 30 days as stated in the bid request. Coagulant K-AL100 (Alum) provided in 275-gallon totes – assuming 50 ppm: $0.55 per pound / $1,650 per tote. 0.015 GPM / 21.6 GPD / 648 gallons per 30-day period. $129.85 per day / $3,895.50 per 30-day period. Polymer K-F1066 (30% anionic emulsion) provided in 55-gallon drums – assuming 2 ppm @ 0.2% solution feed: $1.57 per pound / $706.50 per drum 0.0006 GPM / 0.864 GPD / 25.92 gallons per 30-day period. $11.76 per day / $352.80 per 30-day period. *Chemical Cost = $4,248.30*



MULTIFLOAT (MF) MAINTENANCE SCHEDULE*								
No.	ITEM	SHIFTLY	WEEKLY	MONTHLY	3-MOS	6-MOS	YEARLY	5-YEAR
1	Inspect Sludge Scraper to Ensure Float Layer is Being Removed	X						
2	Check Scraper Speed and Timer Setting	X						
3	Inspect Rubber Scraper Blades		X					
4	Replace Rubber Scraper Blades (If Needed)					X		
5	Inspect Replace Scraper Guide Blocks (If Needed)							X
6	Inspect Scraper chain assembly (adjust if needed)		X					
7	Replace Scraper Sprockets (If Needed)							X
8	Replace Scraper Chain Links (If Needed)							X
9	Replace Scraper Drive and Driven Shafts (If Needed)							X
10	Replace Scraper Drive and Driven Shaft Bearing (If Needed)							X
11	Inspect Scraper Gear motor (grease as necessary)				X			
12	Replace Gear Motor Gear Oil							X
13	Check Auto-Level Control System & Water Height	X						
14	Check/Clean Sludge Conductivity Probes	X						
15	Test Purge Valve		X					
16	Inspect Clearwell vent for debris (Clean as necessary)	X						
17	Check Compressed Air Pressure to ADT (Min. of 90psi)	X						
18	Check Differential Pressure Across ADT (5-10 # Differential)	X						
19	Check ADT Discharge Pressure (Min. 65 psi)	X						
20	Check Rotometer Flow (Max. 30 SCFH)	X						
21	Check ADT Bleed-Off Valve (~1/3 Open)	X						
22	Inspect/Clean ADT Panel(s)					X		
23	Replace ADT Bleed-Off Tube						X	
24	Replace ADT Panel(s)						X	
25	Replace ADT End Cap Gaskets						X	

26	Check/Flush (purge) Globe Valve	X						
27	Check Replace ADT Recycle Pump Seal Kit						X	
28	Replace ADT Recycle Pump (If Needed)							X
29	Drain and Clean Unit			X				
30	Check All Bolts and Flanges for Tightness			X				
31	Replace DAF Access Hatch Gaskets (If Needed)						X	
32	Replace DAF Viewing Window						X	
33	Check air pressure & needle valve setting to AOD pumps	X						
34	Inspect/Replace AOD Pump Wet End – Balls, Seats, Diaphragm (If Needed)						X	
35	Inspect Influent & Effluent FCV's for Function and Moisture in Positioner	X						
36	Replace Influent/Effluent FCV's VRC Positioner (If Needed)						X	
37	Inspect/Replace Solenoid Valves – ADT, APGV, Purge/Sludge Valve (If Needed)							X

20-YEAR LIFECYCLE COSTS - (Based on DAF System Running 24/7 6 Months/Year)

Power Costs = $152,928.00
Chemical Costs = $509,796.00
Parts (reference info in Spare Parts List Below in #18) – $65,382.67

TOTAL = $728,106.67

17. Equipment and personnel available for pilot testing:

Please Reference Appendix B.



18. Spare Parts: List of recommended spare parts and costs.

ITEM	SYSTEM QTY	RECOM'D QTY	PART#	DESCRIPTION	UNIT PRICE	RECOM'D NET PRICE	REPLACE 20 YR	20 YR LIFE PRICE	NOTES:
				KROFTA MF DAF UNIT PARTS					
1	11	11	SB-500	Scraper Blades - Rubber Only (Punched)	$ 92.00	$ 1,012.00	10.00	$ 10,120.00	
2	4	4	SS-500	Sludge Scraper Sprockets	$ 85.00	$ 340.00	2.00	$ 680.00	
3	22	6	SBGB-500	Scraper Blade Guide Blocks	$ 6.00	$ 36.00	5.00	$ 660.00	
4	42	12	SCL-500	Scraper Chain Links	$ 16.47	$ 197.64	2.00	$ 1,383.48	
5	22	6	SCAL-500	Scraper Attachment Links	$ 23.12	$ 138.72	5.00	$ 2,543.20	
6	1	0	SSDriven-500	Scraper Shaft-Driven	$ 938.00	$ -	1.00	$ 938.00	
7	1	0	SSDrive-500	Scraper Shaft-Drive	$1,050.00	$ -	1.00	$ 1,050.00	
8	4	2	SSC-500	Scraper Shaft Collar	$ 50.16	$ 100.32	2.00	$ 401.28	
9	4	2	SDRIVESB-500	Scraper Shaft Bearing	$ 35.00	$ 70.00	2.00	$ 280.00	
10	1	1	SDGM-500	Scraper Drive Gearbox/Motor Assy					*This has been included in Equipment Price per Bid Spec.*
11	2	2	VW-500	DAF Viewing Window	$ 148.00	$ 296.00	5.00	$ 1,480.00	
12	2	2	AHG-500	Access Door Gasket	$ 70.00	$ 140.00	20.00	$ 2,800.00	
13	2	1		Flow Control Valve Bray Positioner (Pneum Positioner w/ I/P Transducer)	$1,853.00	$ 1,853.00	1.00	$ 3,706.00	
14	3	1		Sediment Purge/ Sludge Valve Solenoid	$ 295.00	$ 295.00	1.00	$ 885.00	*One has also been included in Equipment Price per Bid Spec.*
15	3	1		Pneumatic Valve Position Indicator Switch	$ 165.00	$ 165.00	2.00	$ 990.00	

				KROFTA ADT AIR DISSOLVING SYSTEM PARTS					
1	1	1	NEF-ADT-SP	ADT Air Panel	$ 860.00	$ 860.00	1.00	$ 860.00	
1a	1	1	NEP-ADT-RPK	ADT Panel Rebuild Kit Includes Panel Insert, Sealant, and Hardware.	$ 232.00	$ 232.00	9.00	$ 2,088.00	
2	2	2	ADT-ECG-750	ADT End Cap Gasket	$ 42.00	$ 84.00	20.00	$ 1,680.00	
3	1	1	ADT-ST-750	ADT Bleed Off Tube	$ 45.00	$ 45.00	2.00	$ 90.00	
4	1	1	NEF-ADT-RM	Rotameter	$ 156.00	$ 156.00	2.00	$ 312.00	
5	2	1		Pressure Regulator / Filter	$ 77.90	$ 77.90	2.00	$ 311.60	
5a	2	2		Pressure Regulator / Filter - Filters	$ 6.54	$ 13.08	20.00	$ 261.60	
6	1	1		ADT Solenoid	$ 278.00	$ 278.00	1.00	$ 278.00	*One has also been included in Equipment Price per Bid Spec.*
7	1	1		APGV Valve Solenoid	$ 295.00	$ 295.00	1.00	$ 295.00	*One has also been included in Equipment Price per Bid Spec.*
8	1	1		Recycle Pump					*This has been included in Equipment Price per Bid Spec.*
8a	1	1		Recycle Pump Seal Kit	$ 284.63	$ 284.63	5.00	$ 1,423.15	
9	1	0	APS-750	Air Pressure Switch (ADT Low Air Press)	$ 323.94	$ -	1.00	$ 323.94	
				CHEMICAL SYSTEMS PARTS					
1	1	1		Coagulant Metering Pump					*This has been included in Equipment Price per Bid Spec.*
1a	1	1		Coagulant Pump Service Kit (Valves and Diaphragm) DDA-30	$ 567.90	$ 567.90	5.00	$ 2,839.50	

2	1	1		Polymer Metering Pump					*This has been included In Equipment Price per Bid Spec.*
2a	1	1		Polymer Make-Up System Kit – Includes: - Valve, Injection, V2 , Promix M, S - SEAL, MECH, SHAFT, 304SS, 1/2", PROMIX-U - O-RING,VITON, 1", AS568A-120 - O-RING, CHAMBER, VITON, PROMIX-S - Spare part set DFXa 0530 VPT	$ 635.00	$ 635.00	5.00	$ 3,175.00	
				PUMPS (NOT INCLUDING DAF)					
1	1	1		Sludge – PC Pump					*This has been included in Equipment Price per Bid Spec.*
1a	1	1		Sludge – PC Pump – Rotor (ALLOY STEEL)	$ 920.40	$ 920.40	2.00	$ 1,840.80	
1b	1	1		Sludge – PC Pump – Stator (NITRILE BLACK)	$ 748.80	$ 748.80	4.00	$ 2,995.20	
1c	1	1		Sludge – PC Pump – Mech Seal	$1,532.70	$ 1,532.70	4.00	$ 6,130.80	
1d	1	1		Sludge – PC Pump – Run Dry Sensor	$ 594.10	$ 594.10	1.00	$ 594.10	
				AIR COMPRESSOR / COMPRESSED AIR SYSTEM COMPONENTS					
1	1	1		Pressure Regulator / Filter -3/4"	$ 105.56	$ 105.56	2.00	$ 211.12	
1a	1	1		Pressure Regulator / Filter - Filter	$ 12.30	$ 12.30	20.00	$ 246.00	
2	1	1		Coalescing Filter					*This has been included in Equipment Price per Bid Spec.*
2a	1	1		Coalescing Filter – Filter Element	$ 371.85	$ 371.85	5.00	$ 1,859.25	

3	1	1		Air Compressor – Motor					*This has been included in Equipment Price per Bid Spec.*
4	1	1		Air Compressor – Lubricant / Oil	$ 257.35	$ 257.35	20.00	$ 5,147.00	
5	1	1		Air Compressor – Spare Belts	$ 65.00	$ 65.00	10.00	$ 650.00	
6	1	1		Air Compressor – Spare Oil Filter	$ 85.00	$ 85.00	10.00	$ 850.00	
7	1	1		Air Compressor – Spare Oil Separator	$ 244.85	$ 244.85	10.00	$ 2,448.50	
8	1	1		Air Dryer – Fan Motor	$ 372.25	$ 372.25	1.00	$ 372.25	
9	1	1		Air Dryer – Drain Kit	$ 91.45	$ 91.45	2.00	$ 182.90	
				TOTALS		$13,573.80		$65,382.67	

19. FIRM Pricing, Payment Terms, & Delivery:

REFERENCE PRICING, PAYMENT TERMS, ON ATTACHED BID FORM	REFERENCE APPENIX C.

Delivery:

Submittal Package – Typical Submission is 4-5 weeks for DAF Equipment; & 5-6 weeks for Controls Equipment.
Normal fabrication time is ~14 to 16 weeks for DAF and Associated Equipment after receipt of written order, down payment and approved submittal package. **NOTE:** Faster fabrication time may be available depending on shop schedule or for an additional charge. *We are currently doing our best to meet our Normal Delivery times but please note that this schedule may be impacted by current global supply chain issues with raw material shortages, parts availability, and delivery/trucking delays that many OEMs are currently experiencing.*

20. Warranty / Mechanical Guarantee:

Krofta will guarantee the mechanical components and fabricated parts of the equipment supplied by them for a period of 24 months from the date after the date that the goods are delivered to the point of destination and the Buyer has deemed the goods to be received for the purposes of Paragraph 9.02.B.2 of the General Conditions. The entire equipment package shall be warranted to meet all functional and performance requirements., provided that the following has occurred:

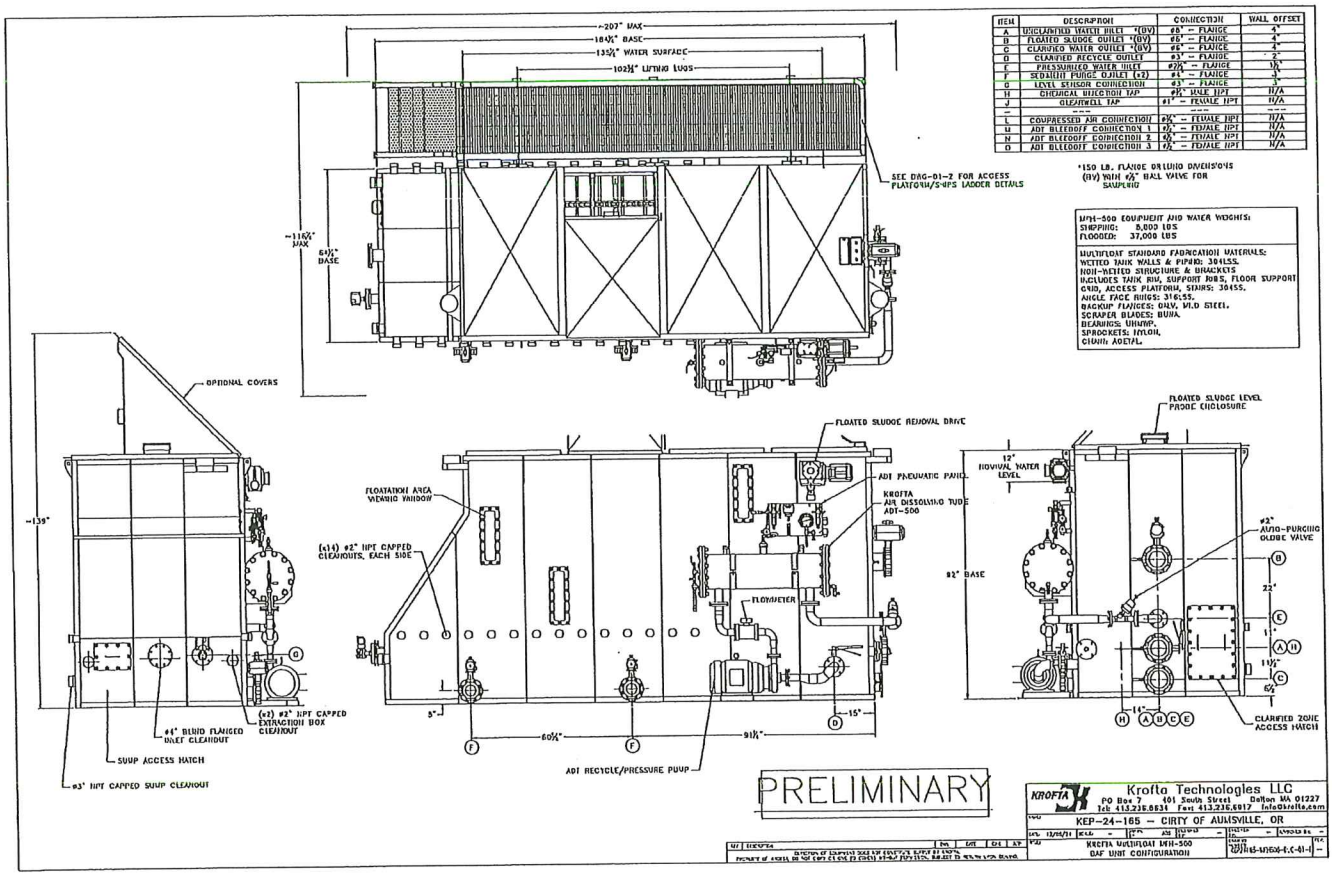
- The unit was operated and maintained as instructed by Krofta
- The failure cannot be attributed to abuse or misuse.
- Krofta was present for start-up activities and has provided its oversight and training services to the designated owner operators.
- Treatment plant operations maintain proper dosing of coagulant, including any which may be of a corrosive nature, such that the DAF is not subject to concentrations of coagulant in excess of the dosage required for proper DAF performance, in accordance with Krofta guidelines and instructions. Wastewater Chloride concentration shall not exceed 200 mg/L.
- Treatment plant operations maintain control of pH, as required for compatibility of materials of construction, and in accordance with Krofta instructions and written Operations and Maintenance manuals.
- Normal Wear Items such as ADT Inserts, Scrapers, Wipers, Seals, Mechanical Seals and Air or Oil Filters are not covered under any such warranty.

APPENDIX A: DRAWINGS

- **Equipment Drawings**
  - **KROFTA** MFH-500 Skid Drawing (*2 Pages*)
  - Chemical Conditioning / Floc Tube Skid Drawing (1 *Page*)
  - Sludge Transfer Pump Skid Drawing (*1 Page*)
  - Effluent Turbidity Monitoring Skid Drawing (*1 Page*)
  - Duplex Coagulant Metering Skid Drawing (*1 Page*)
  - Polymer Make-Up System Drawing (2 *Pages*)

- **General Arrangement Drawing**
  - **KROFTA** MFH-500 DAF System General Arrangement Drawing (*5 Pages*)

- **Process & Instrumentation Drawing (*3 Pages*)**



ITEM	DESCRIPTION	CONNECTION	WALL OFFSET
A	UNCLARIFIED WATER INLET *(DV)	#8" – FLANGE	4"
B	FLOATED SLUDGE OUTLET *(DV)	#6" – FLANGE	4"
C	CLARIFIED WATER OUTLET *(DV)	#6" – FLANGE	4"
D	CLARIFIED RECYCLE OUTLET	#3" – FLANGE	2"
E	PRESSURIZED WATER INLET	#2½" – FLANGE	1½"
F	SEDIMENT PURGE OUTLET (x2)	#4" – FLANGE	3"
G	LEVEL SENSOR CONNECTION	#3" – FLANGE	3"
H	CHEMICAL INJECTION TAP	#¾" MALE NPT	N/A
J	GLEANWELL TAP	#1" – FEMALE NPT	N/A
–	---	---	---
L	COMPRESSED AIR CONNECTION	#¾" – FEMALE NPT	N/A
M	ADT BLEEDOFF CONNECTION 1	#½" – FEMALE NPT	N/A
N	ADT BLEEDOFF CONNECTION 2	#½" – FEMALE NPT	N/A
O	ADT BLEEDOFF CONNECTION 3	#½" – FEMALE NPT	N/A

*150 LB. FLANGE DRILLING DIMENSIONS
(DV) WITH ¾" BALL VALVE FOR SAMPLING

MH-500 EQUIPMENT AND WATER WEIGHTS:
SHIPPING: 8,000 LBS
FLOODED: 37,000 LBS

MULTIFLOAT STANDARD FABRICATION MATERIALS:
WETTED TANK WALLS & PIPING: 304SS.
NON-WETTED STRUCTURE & BRACKETS INCLUDES TANK RIM, SUPPORT RIBS, FLOOR SUPPORT GRID, ACCESS PLATFORM, STAIRS: 304SS.
ANGLE FACE RINGS: 316SS.
BACKUP FLANGES: ONLY, MILD STEEL.
SCRAPER BLADES: BUNA.
BEARINGS: UHMWP.
SPROCKETS: NYLON.
CHAIN: ACETAL.

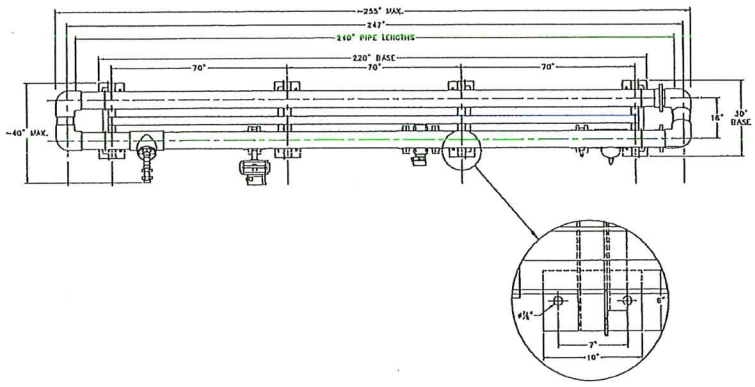
PRELIMINARY

KROFTA Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.0834 Fax: 413.236.6917 info@krofta.com

KEP-24-165 – CITY OF AULISVILLE, OR

KROFTA MULTIFLOAT MH-500 DAF UNIT CONFIGURATION

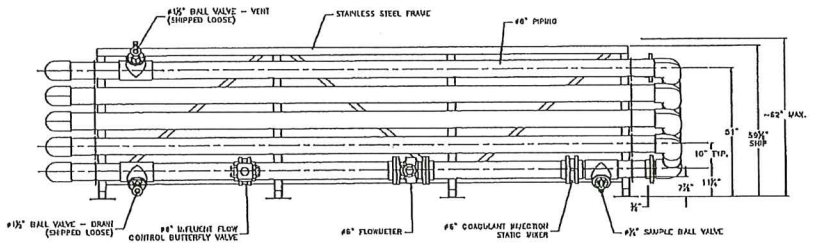
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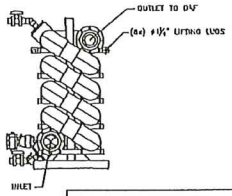


MATERIALS OF CONSTRUCTION:
PIPING: PVC SCH80
FRAME: STAINLESS STEEL
HARDWARE: ZINC PLATED
BALL VALVES: PVC80 VENT/DRAIN/SAMPLE
GASKETS: NEOPRENE

ESTIMATED WEIGHTS:
DRY= 3,400 LBS.
OPERATING= 9,000 LBS.

DESIGN:
200FT OF 6" PVC SCH80 PIPE @ 300GPM = 60 SECONDS MIN. COAGULANT CHEMICAL CONTACT TIME.





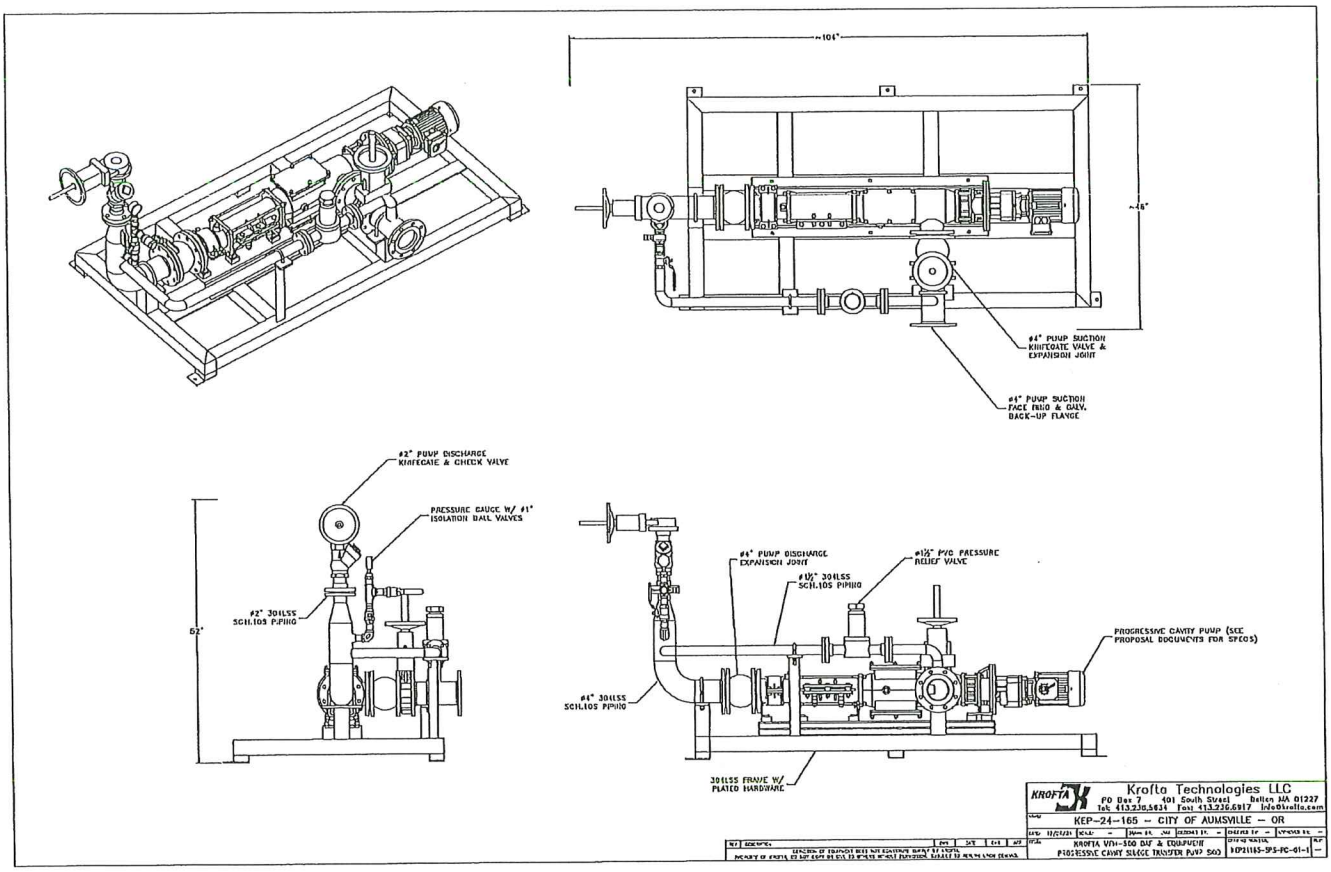
PRELIMINARY

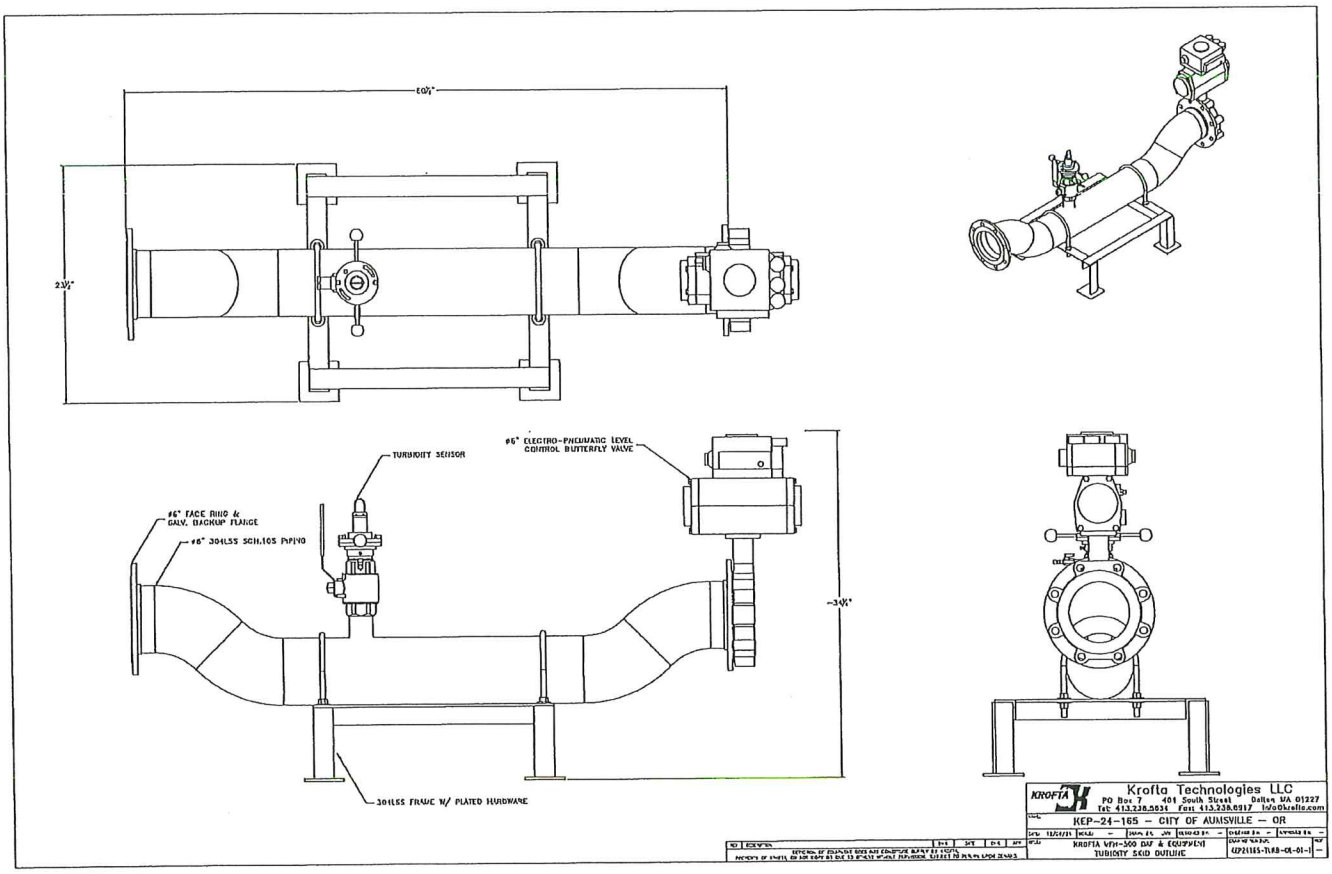
Krofta Technologies LLC
PO Box 7 101 South Street Dalton MA 01227
Tel. 413.236.5634 Fax. 413.236.6917 info@krofta.com

KEP-24-165 – CITY OF AUBURNVILLE, OR

KROFTA DAF VIH-500 DAF & EQUIPMENT
6" FLOCTUBE OUTLINE

NPA1165-FTC6-01-1


~104"
~48"
#4" PUMP SUCTION KNIFEGATE VALVE & EXPANSION JOINT
#4" PUMP SUCTION FACE PATD & GALV. BACK-UP FLANGE
#2" PUMP DISCHARGE KNIFEGATE & CHECK VALVE
PRESSURE GAUGE W/ #1" ISOLATION BALL VALVES
#2" 304LSS SCH.10S PIPING
62"
#4" PUMP DISCHARGE EXPANSION JOINT
#1½" PVC PRESSURE RELIEF VALVE
#1½" 304LSS SCH.10S PIPING
PROGRESSIVE CAVITY PUMP (SEE PROPOSAL DOCUMENTS FOR SPECS)
#4" 304LSS SCH.10S PIPING
304LSS FRAME W/ PLATED HARDWARE
KROFTA
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel. 413.236.6824 Fax 413.236.6917 info@krofta.com
KEP-24-165 -- CITY OF ALBANY -- OR
11/15/24
KROFTA VSH-550 DAF & EQUIPMENT
PROGRESSIVE CAVITY SLUDGE TRANSFER PUMP SKID
KDP1165-PS-PC-01-1

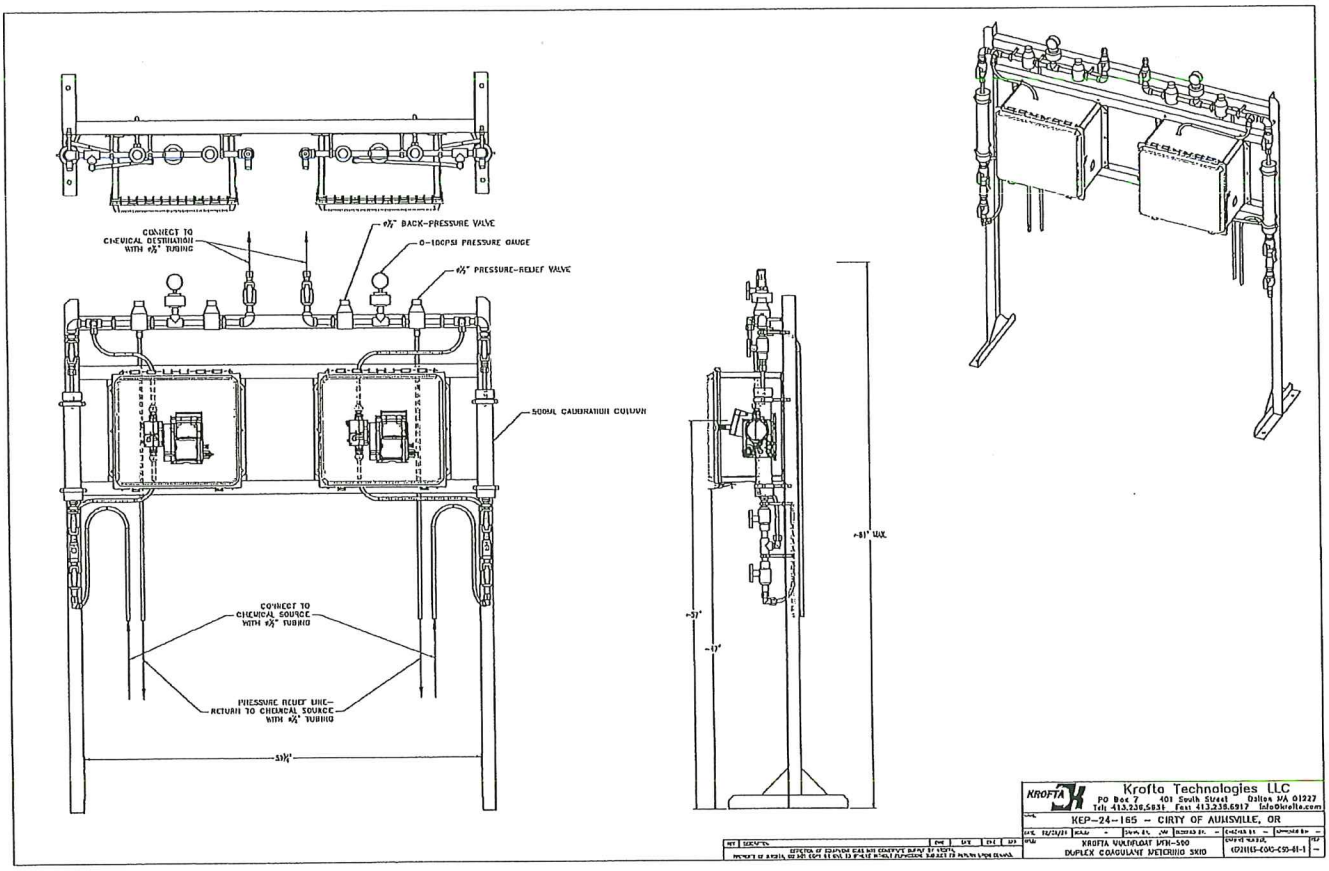


Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel 413.320.5034 Fax 413.320.6917 info@krofta.com

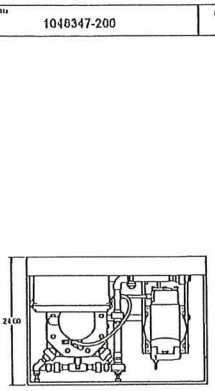
KEP-24-165 – CITY OF AURISVILLE – OR

KROFTA WTP-500 DAF & EQUIPMENT
TURBIDITY SKID OUTLINE

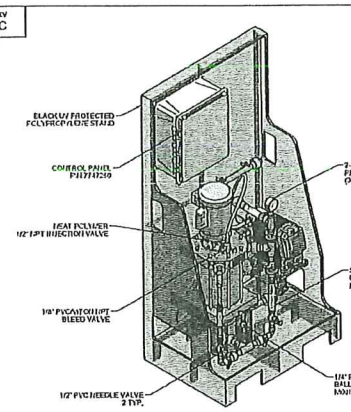
KDP21165-TURB-OL-01-1


CONNECT TO CHEMICAL DESTINATION WITH ⅜" TUBING
⅜" BACK-PRESSURE VALVE
0-100PSI PRESSURE GAUGE
½" PRESSURE-RELIEF VALVE
500ML CALIBRATION COLUMN
CONNECT TO CHEMICAL SOURCE WITH ⅜" TUBING
PRESSURE RELIEF LINE— RETURN TO CHEMICAL SOURCE WITH ⅜" TUBING
33½"
81" MAX
37"
17"
KROFTA
Krofta Technologies LLC
PO Box 2 101 South Street Dalton MA 01227
Tel: 413.236.5831 Fax: 413.236.6917 Info@krofta.com
KEP-24-165 – CITY OF AUMSVILLE, OR
KROFTA VORTIFLOAT MTH-500
DUPLEX COAGULANT METERING SKID

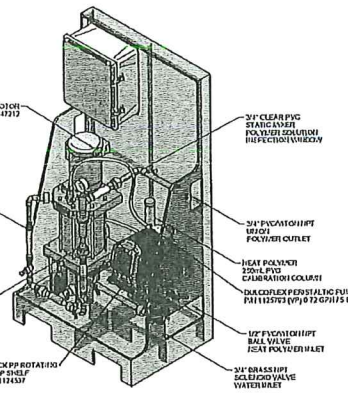
DRAWING	REV
1040347-200	C



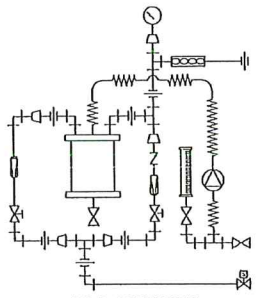
PLAN VIEW



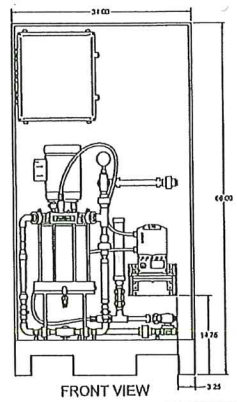
LEFT ISOMETRIC VIEW



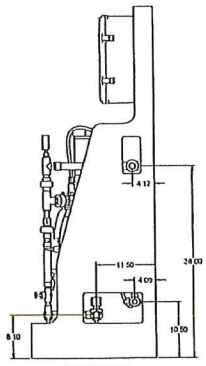
RIGHT ISOMETRIC VIEW



PIPING SCHEMATIC



FRONT VIEW



SIDE VIEW

NOTES:

1. ALL PIPING AND FITTINGS SHALL BE 1/2" AND 3/4" SCH. 80 PVC SOCKET WELD WITH VITON SEALS UNLESS OTHERWISE NOTED.
2. PUMP MAXIMUM CAPACITY RATES BASED UPON PUMPING WATER.
3. POLYMER BLENDING SYSTEM WITH THREE ZONE PVC MIXING CHAMBER.
4. REQUIRED INCOMING POWER:

   120VAC, 1 PHASE, 60Hz, 15 AMP CURRENT RATING AT 120 VAC
5. ALL DIMENSIONS ARE IN INCHES AND ARE SHOWN FOR REFERENCE ONLY.

REV	DATE	DESCRIPTION	BY	APPD
C	10/07/22	CR 00182 & CR 000183	REH	
B	02/11/21	TESTING PRESSURE	ALB	
A	04/15/15	ADDED REINFORCED TEE & REDUCER	ALS	
0	02/07/13	FIRST ISSUE	GJS	

REVISIONS

CUSTOMER: PROMINENT FLUID CONTROLS INC. (PROMIX S SYSTEM)

JOB#: 101317 PURCHASE ORDER#: N/A

TITLE: PROMIX S_60X2-0.60TA SYSTEM SKID GENERAL ARRANGEMENT

ENGINEER'S SEAL

ProMinent

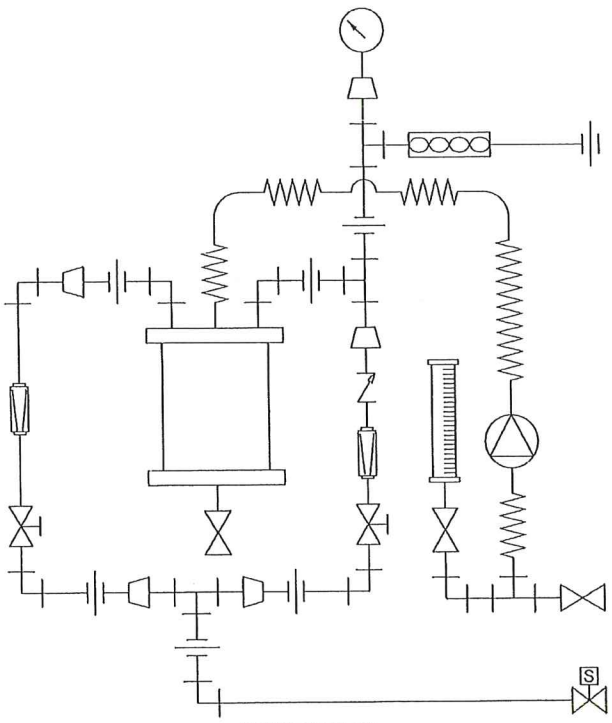
PITTSBURGH PA USA WWW.PROMINENT.US

DESIGNED	GJS
DRAWN	GJS
CHECKED	MARLIN
APPROVED	MARLIN
SCALE	N.T.S.
DATE	02/07/13

MAXIMUM TESTING PRESSURE =	100 PSI
MAXIMUM OPERATING PRESSURE =	100 PSI
MAXIMUM SEAT POLYMER PUMP DISCHARGE PRESSURE =	65 PSI
CHEMICAL SERVICE =	WATER SOLUBLE POLYMER

DRAWING: 1040347-200 REV: C PAGE: 1/2

DWG No	REV
1048347-200	C



PIPING SCHEMATIC

REV	DATE	DESCRIPTION	BY	APPD	REVD
C	10/07/22	CR 00182 & CR 000183	REH		
B	02/11/21	TESTING PRESSURE	ALS		
A	04/15/15	ADDED REINFORCED TEE & REDUCER	ALS		
0	02/07/13	FIRST ISSUE	GJS		

REVISIONS

CUSTOMER: PROMINENT FLUID CONTROLS INC. (PROMIX S SYSTEM)

JOB No: 101317 PURCHASE ORDER No: IIA

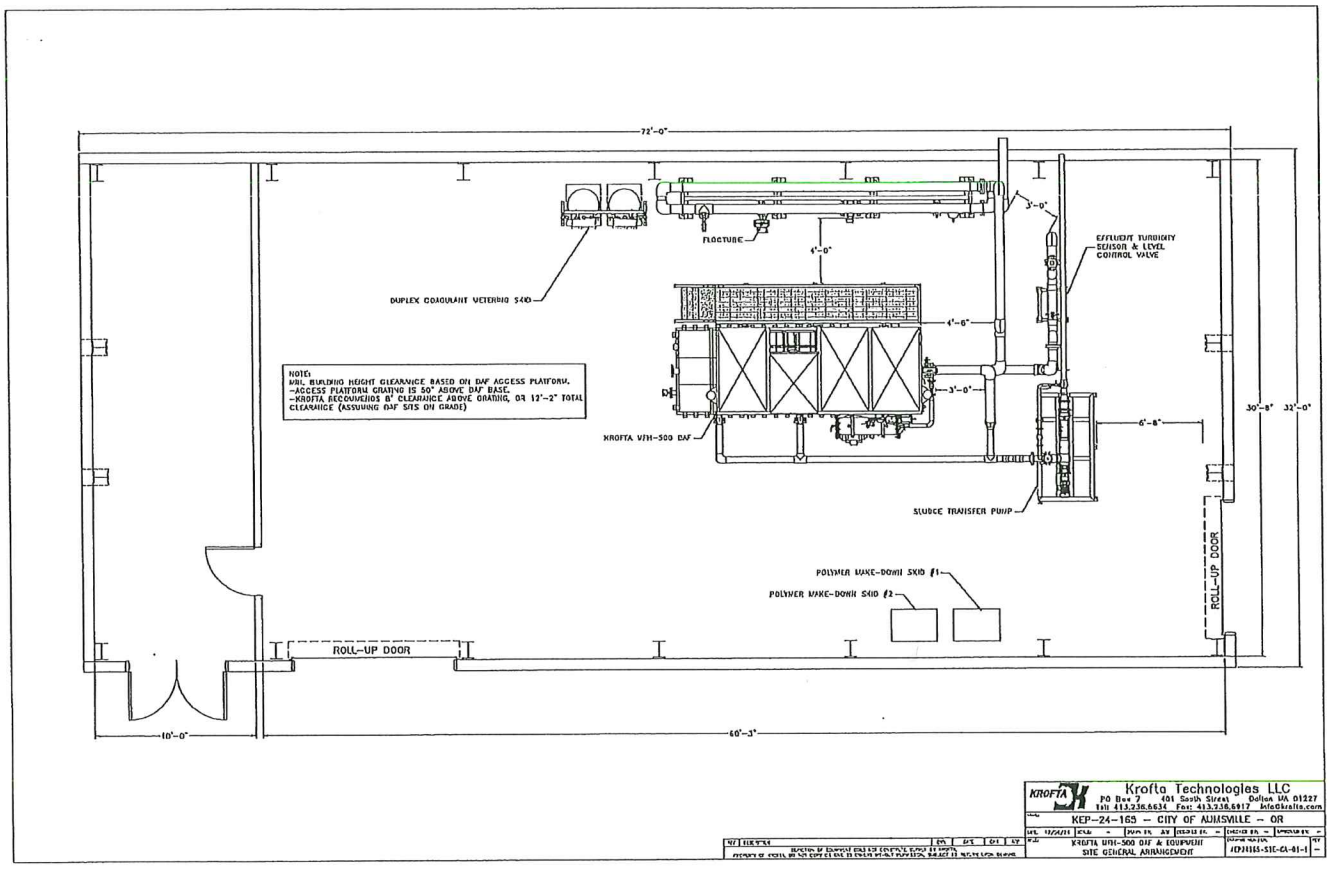
TITLE: PROMIX S_60X2-0.60TA SYSTEM SKID GENERAL ARRANGEMENT

DISTRICT/SEAL

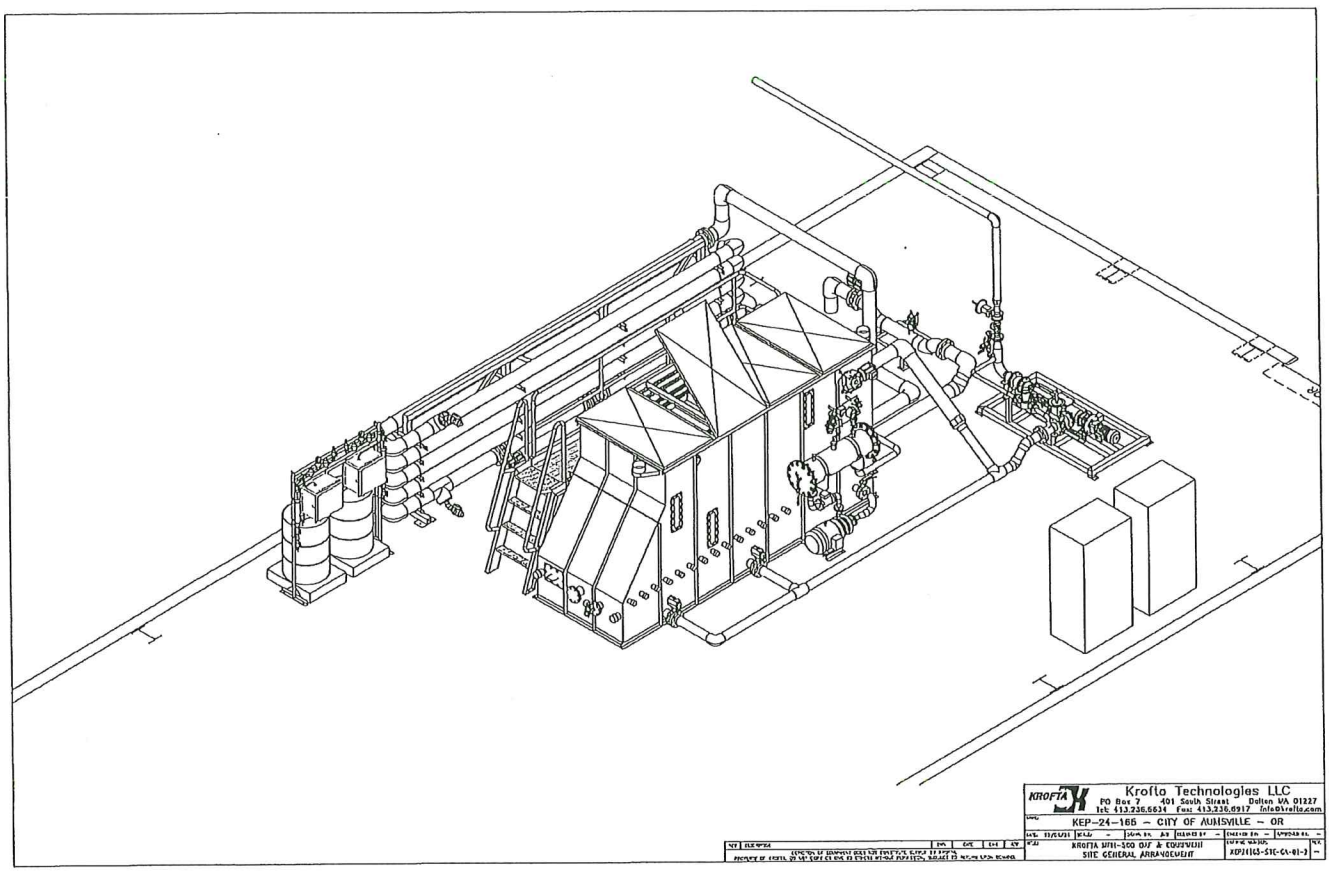
ProMinent

DESIGNED	GJS
DRAWN	GJS
CHECKED	KHURUI
APPROVED	KHURUI
SCALE	N.T.S.
DATE	02/07/13

DWG No	REV	PAGE
1048347-200	C	2/2



KROFTA	Krofta Technologies LLC PO Box 2 401 South Street Dalton MA 01227 tel: 413.236.6634 fax: 413.236.6817 info@krofta.com				
	KEP-24-165 – CITY OF ADAMSVILLE – OR				
WE 12/22/25	SCALE: -	DRAWN BY: AB	DESIGNED BY: -	CHECKED BY: -	
W/I KROFTA	KROFTA WH-300 DAF & EQUIPMENT SITE GENERAL ARRANGEMENT			DRAWING NUMBER: 20241165-SIT-GA-01-1	REV: -

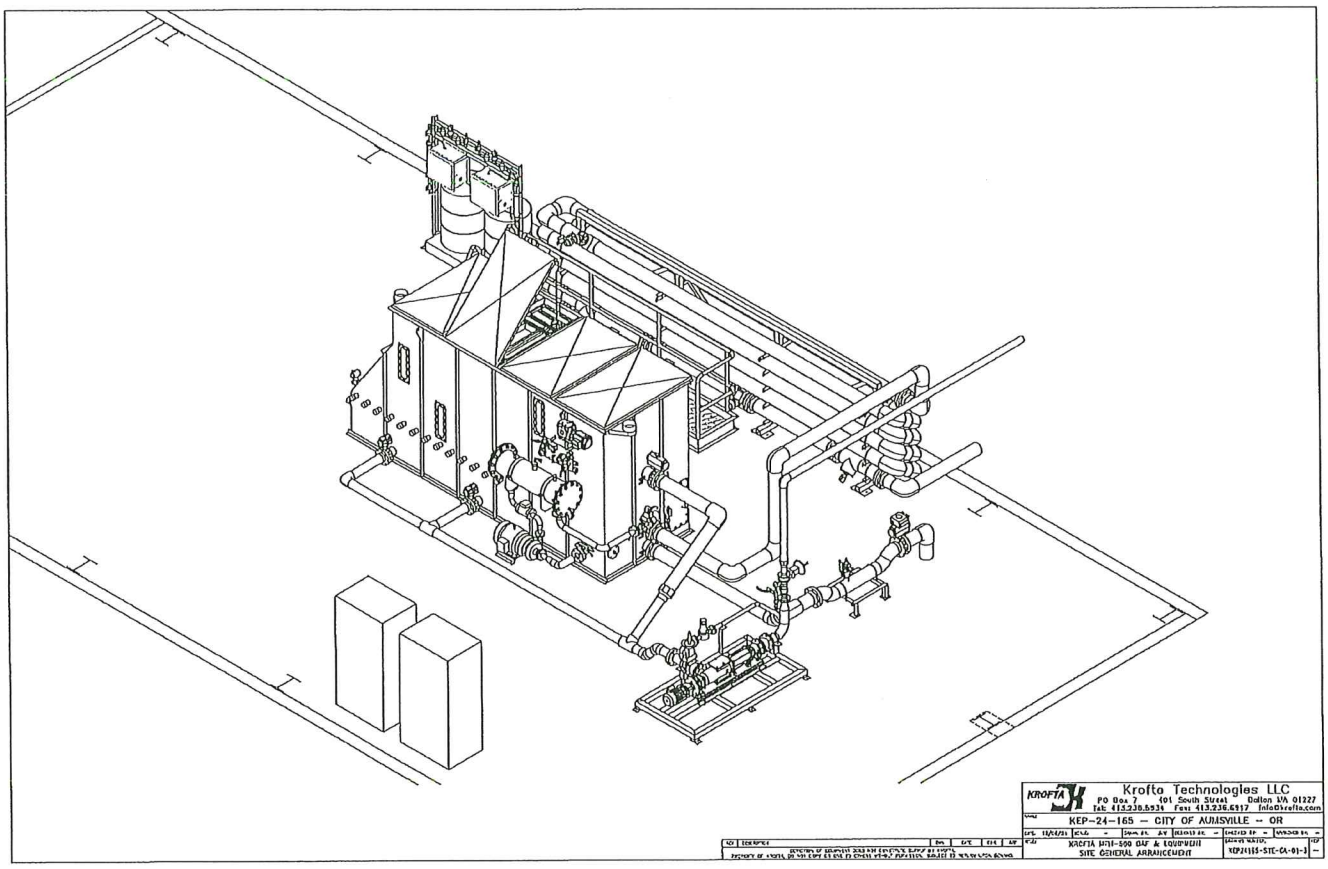


Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel. 413.236.6631 Fax. 413.236.0917 Info@krofta.com

KEP-24-165 – CITY OF AUMSVILLE – OR

KROFTA MPH-300 DAF & EQUIPMENT
SITE GENERAL ARRANGEMENT

XDM165-SIC-GA-01-1

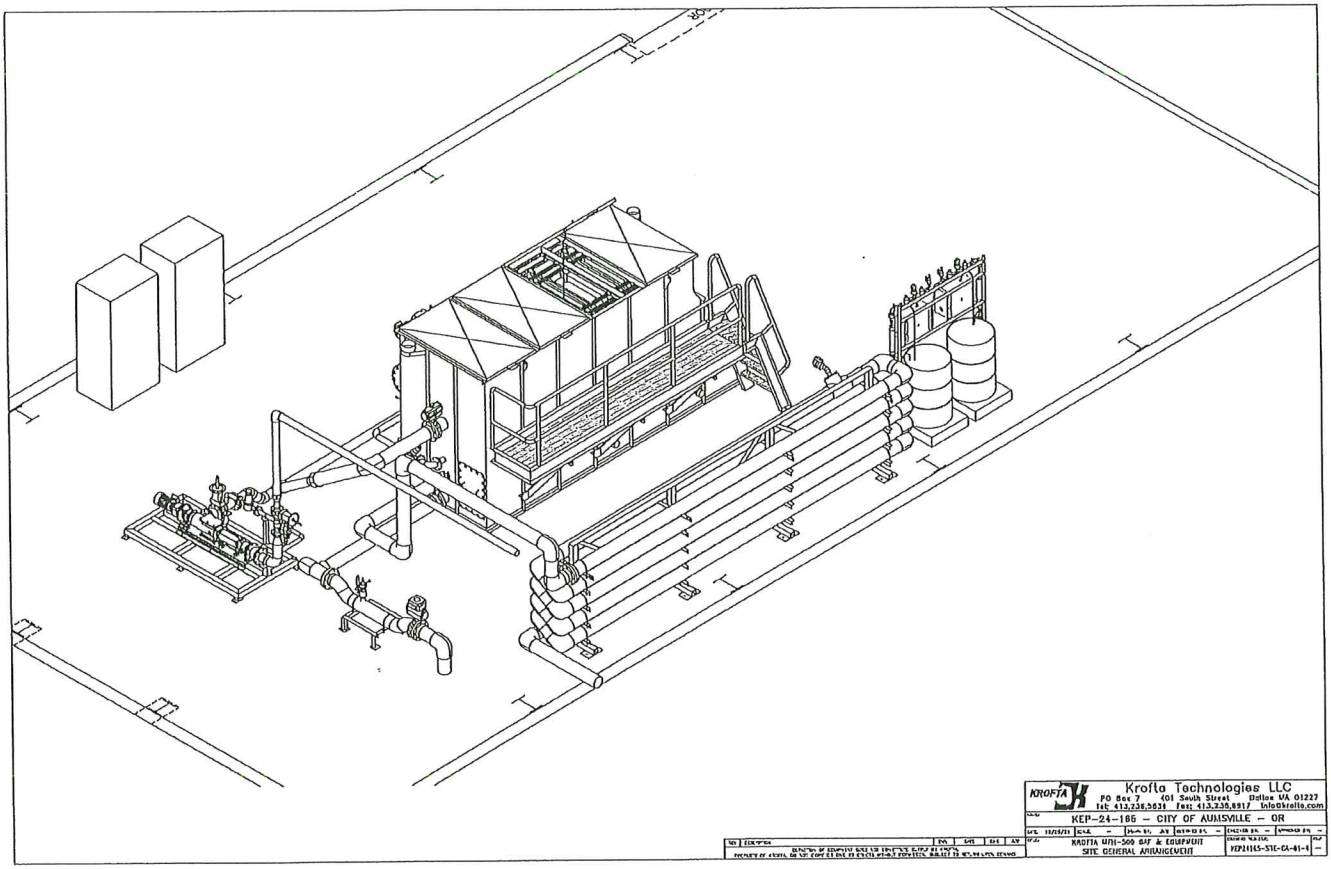


Krofta Technologies LLC
PO Box 1 101 South Street Dalton MA 01227
Tel. 413.236.6534 Fax 413.236.6917 InfoKrofta.com

KEP-24-165 – CITY OF ADAMSVILLE -- OR

KROFTA MSF-500 GAF & EQUIPMENT
SITE GENERAL ARRANGEMENT

KEP24165-SITE-GA-01-1

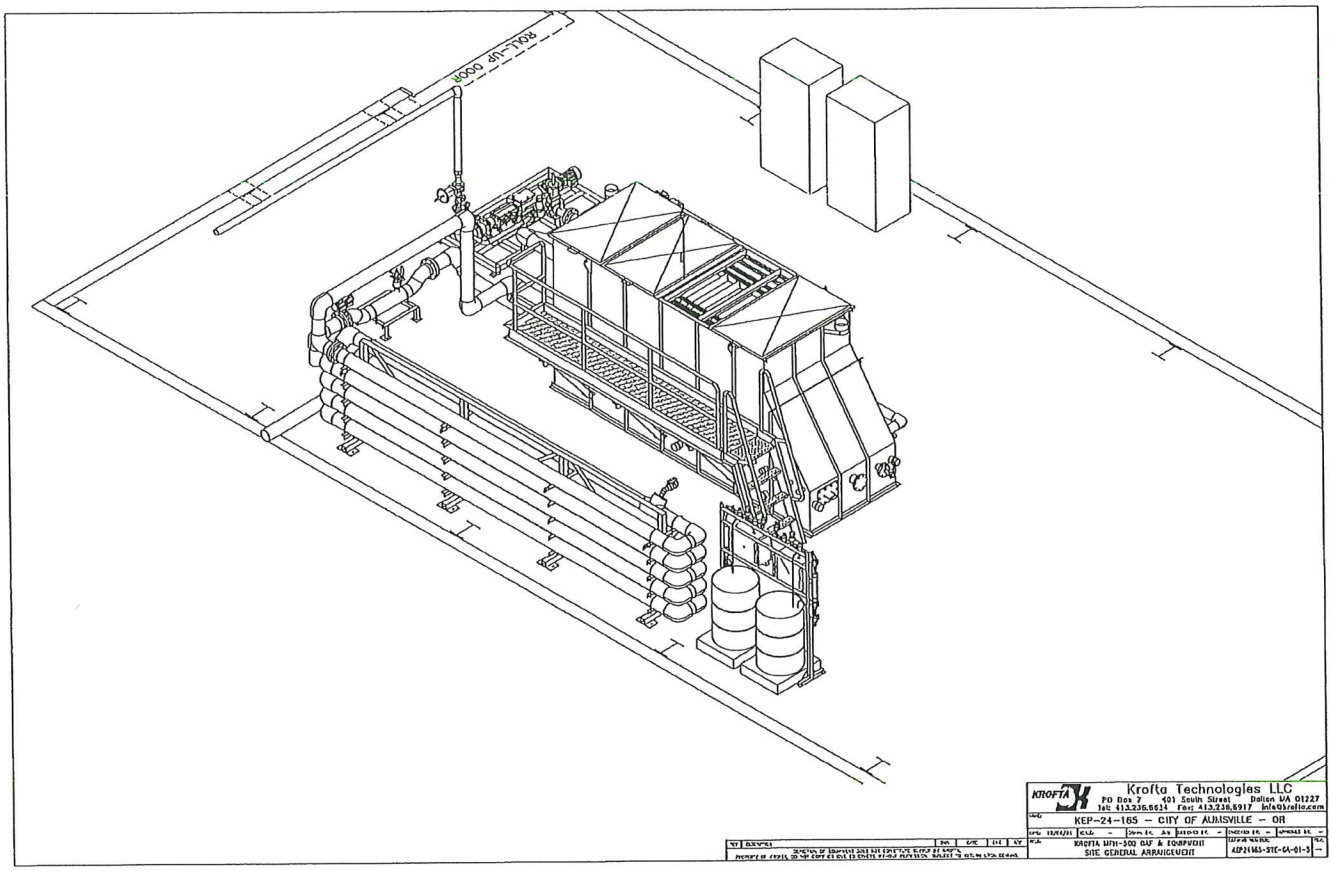


Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
tel: 413.736.5031 fax: 413.320.8817 info@krofta.com

KEP-24-186 – CITY OF AUBURNVILLE – OR

KROFTA MPE-300 GAF & EQUIPMENT
SITE GENERAL ARRANGEMENT

KEP24186-STC-GA-01-1

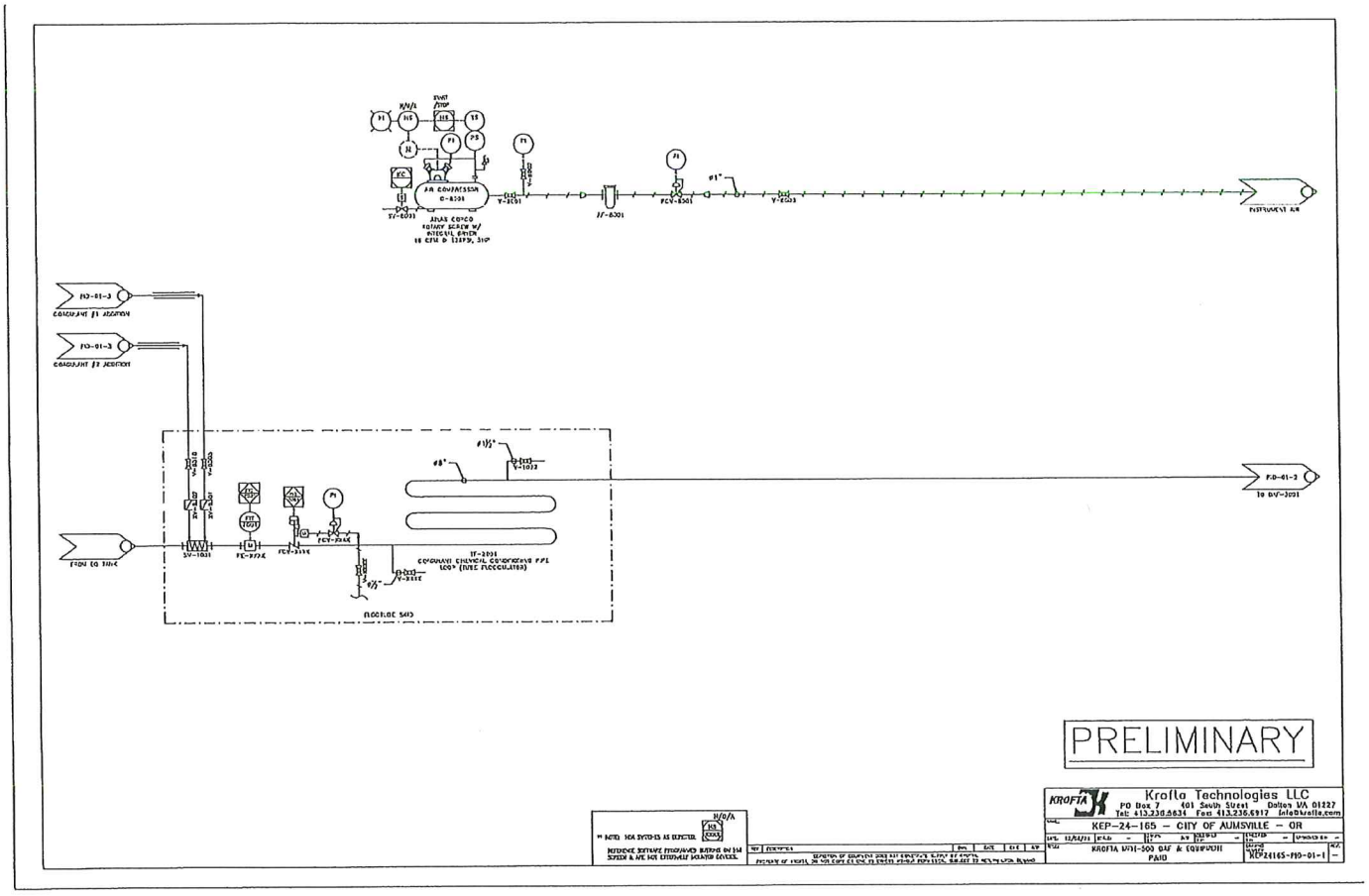


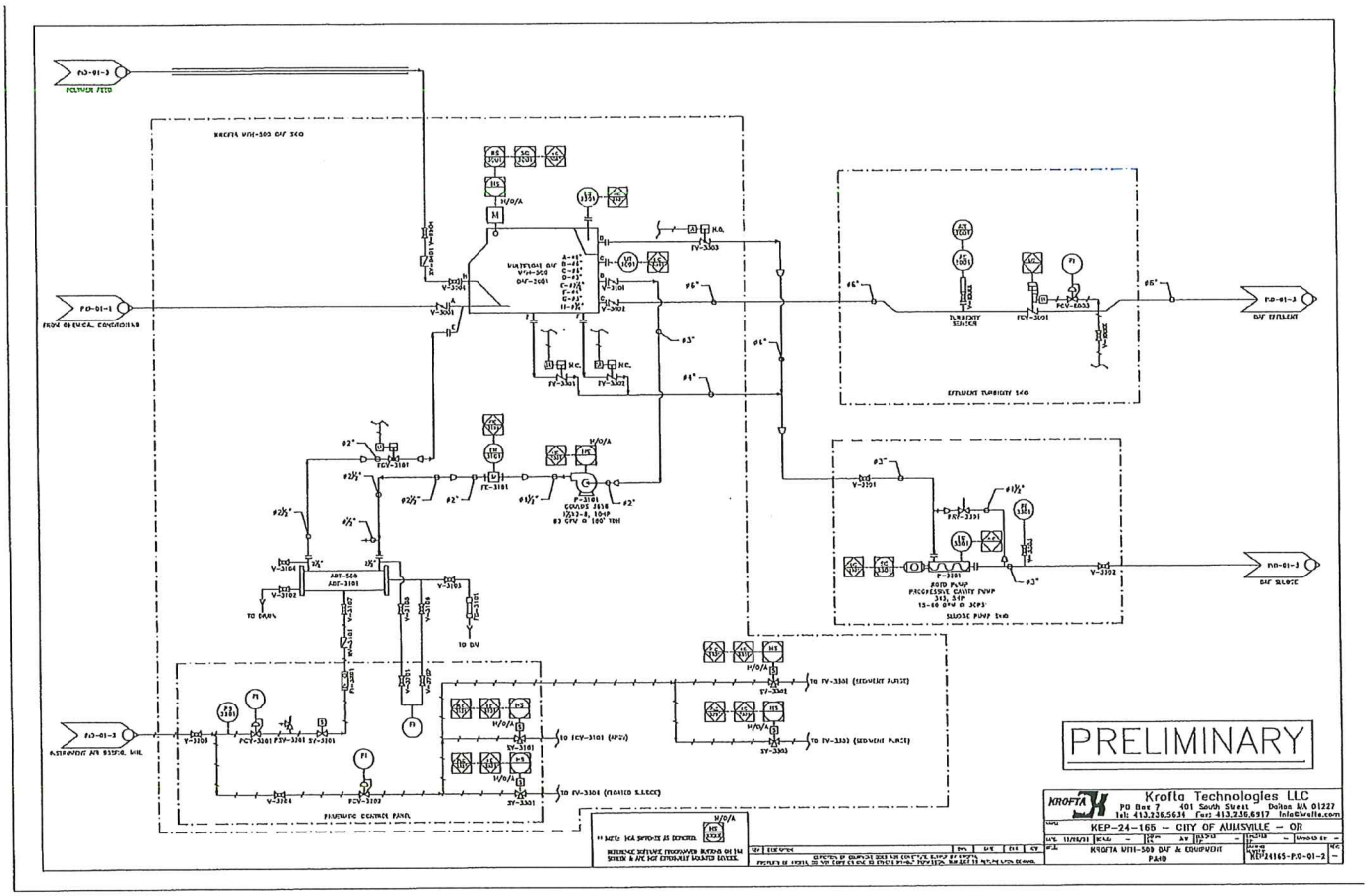
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.6614 Fax: 413.236.6917 info@krofta.com

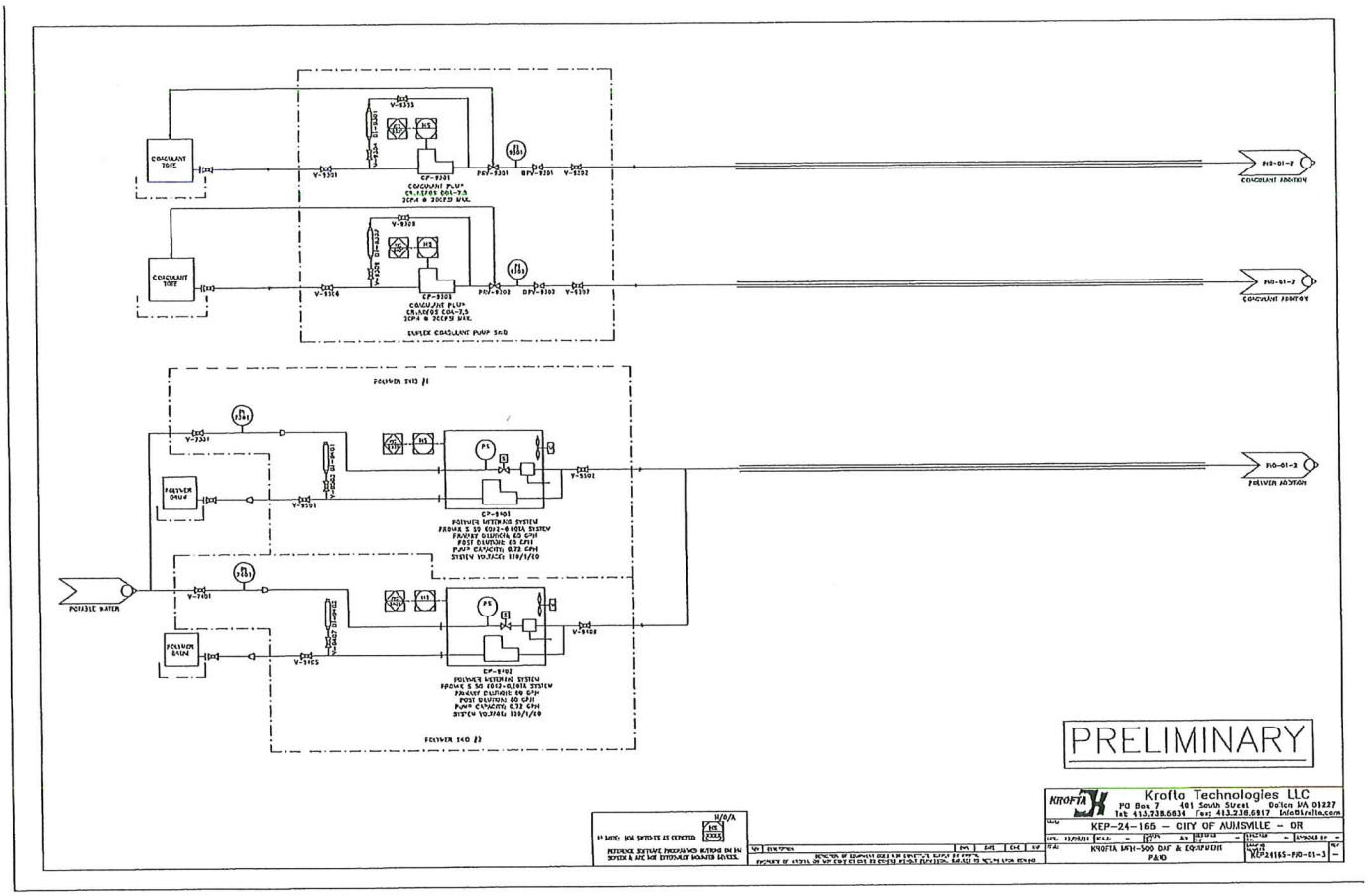
KEP-24-165 – CITY OF ADAMSVILLE – OR

KROFTA WTH-300 GAS & EQUIPMENT
SITE GENERAL ARRANGEMENT

KEP24165-STE-GA-01-3


PRELIMINARY
Krofta Technologies LLC
PO Box 7 101 South Street Dallas VA 01222
Tel: 413.236.5634 Fax 413.236.6912 info@krofta.com
KEP-24-165 - CITY OF AUMSVILLE - OR
KROFTA WTP-500 GAS & EQUIPMENT PAID
KEP24165-PID-01-1


PRELIMINARY
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
tel. 413.236.5631 fax. 413.236.6317 info@krofta.com
KEP-24-165 -- CITY OF AUMSVILLE -- OR
KROFTA WTF-500 DAF & EQUIPMENT
P&ID
KEP-24165-P&ID-01-2


COAGULANT TOTE
V-9331
CP-9201
COAGULANT PUMP
CHEMFEED QDL-2.5
2GPM @ 20PSI MAX.
PRV-9201
BPV-9201
V-9332
P10-01-2
COAGULANT ADDITION
V-9308
CP-9202
COAGULANT PUMP
CHEMFEED QDL-2.5
2GPM @ 20PSI MAX.
PRV-9202
BPV-9202
V-9309
P10-01-1
COAGULANT ADDITION
DUPLEX COAGULANT PUMP SKID
POLYMER SKID #1
V-9301
POLYMER DRUM
V-9302
CP-9401
POLYMER INTERFACE SYSTEM
PROMINENT DULCO FLEX DF4A-0402A SYSTEM
FRONT DILUTION 60 GPH
POST DILUTION 60 GPH
PUMP CAPACITY: 0.72 GPH
SYSTEM VOLTAGE: 120/1/60
V-9101
P10-01-3
POLYMER ADDITION
POTABLE WATER
V-9303
POLYMER DRUM
V-9305
CP-9102
POLYMER METERING SYSTEM
PROMINENT DULCO FLEX DF3A-0402A SYSTEM
FRONT DILUTION 60 GPH
POST DILUTION 60 GPH
PUMP CAPACITY: 0.72 GPH
SYSTEM VOLTAGE: 120/1/60
V-9102
POLYMER SKID #2
PRELIMINARY
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel 413.238.6034 Fax 413.238.6817 info@krofta.com
KEP-24-165 - CITY OF ADAMSVILLE - OR
KROFTA WTP-500 DAF & EQUIPMENT P&ID
KEP24165-P10-01-3

APPENDIX B: PILOT TESTING

Please see attached KROFTA DAF Rental Proposal # KPR-24-119 (6 Pages).

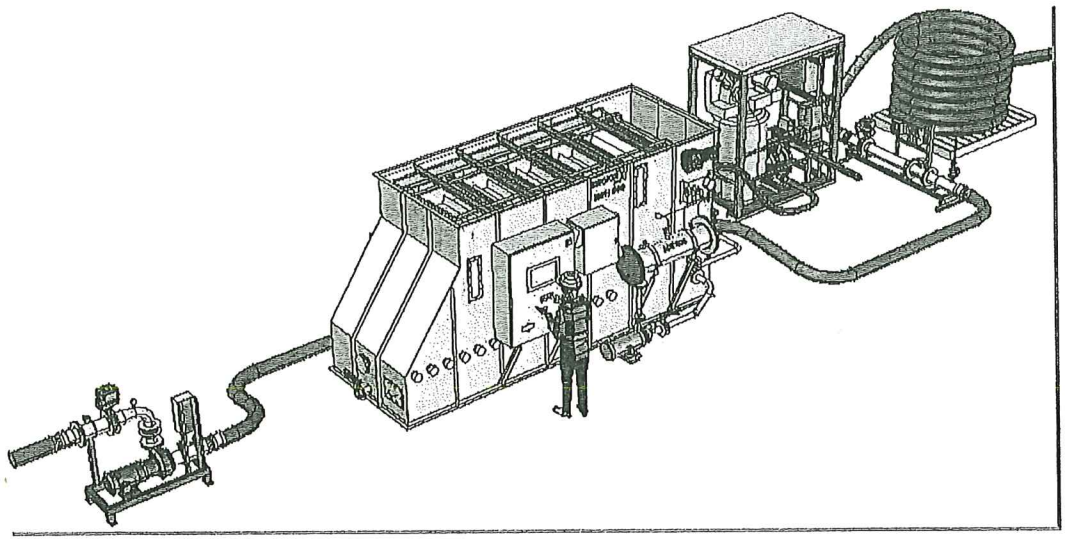
DAF RENTAL PROPOSAL # KPR-24-119

Portable Wastewater Treatment Plant

Multifloat MFH400#3 Trial

City of Aumsville, Oregon

December 12, 2024



Krofta Technologies 401 South Street PO Box 7 Dalton, Massachusetts USA 01227
Phone: 413-236-5634 Fax: 413-236-6917 Email: Info@krofta.com

DAF Rental System Supply: City of Aumsville, Oregon

Standard Supply: Proposal # KPR-24-119

Included	Item
Krofta	Krofta Multifloat DAF MFH400 for up to ~300 gpm* with Built-In Sludge Hopper and Sludge Level Sensor
Krofta	Air Dissolving System – Air Dissolving Tube (ADT) & Pneumatic Control Components
Krofta	Pre-Wired PLC Based Control System with Alarms
Krofta	Air Compressor Skid – Including Air Diaphragm Pump for Sludge, 10 HP Air Compressor, Liquid Polymer Blending System, Grundfos Coagulant Metering Pump
Krofta	Influent Feed Pump/Skid (If Necessary)
Krofta	Basket Strainer
Krofta	Effluent Discharge Pump Skid (If Necessary)
Krofta	Flow Control Skid with pH Transmitter & Probe along with Flow Transmitter (If Required)
Krofta	Acid Metering Pump (If Required)
Krofta	Caustic Metering Pump (If Required)
Krofta	Interconnecting Wiring for Skids and DAF Components
Krofta	~350' of Temporary SCH40 PVC Pipe with Fittings and/or Flanges
Krofta	Krofta Technician for Installation and Set-Up (Including Hose & Fittings), Process Optimization, Start-up Assistance and Training – up to 2 Weeks/1 Trip
Krofta	Sampling & Testing – Upon System Commissioning, Some Limited Sampling and Analytical Testing for Process Evaluation

* Maximum Flow Rate dependent upon TSS mg/l load. Loadings in excess of 2500 mg/l may reduce maximum achievable process rate.

Optional Supply or By Customer:

Included	Item	Approximate Adder $
N/A	18,100 Gallon EQ Tank w/ 460V Mixers (Includes subcontractor delivery, pick-up, and fuel surcharges. Will require an additional 60-100 amps of power)	
N/A	18,100 Gallon EQ Tank – No Mixers	
N/A	18,100 Gallon Sludge Holding Tank	
N/A	EQ, Tank or Sump Level Control(s)	
N/A	Containment – Site, Chemicals, or Tanks (Call to discuss if necessary)	
N/A	Heat Tracing and/or Pipe or Hose Insulation	
TBD	Chemical Supply – Flocculation & Coagulation	
TBD	Chemical Supply – pH Controls, Acid and or Caustic	
N/A	Full System Installation Including any Site Preparation, Offloading, Placement, Piping and Other Mechanical or Civil Work	
N/A	Other – System Operation beyond start-up commitment	
N/A	Other – Additional Week of Krofta Technician 1 Trip/5 Days	$4,950.00
N/A	Other	

Not Included or By Customer:

Not Included	Item
Customer	Freight to Site – FOB Dalton, Massachusetts USA (See Pricing Section)
Customer	Reloading of Equipment & Return Freight to Dalton, Massachusetts USA (See Pricing Section)
Customer	Equipment Offloading, Storage and Positioning at site – Flat Stable Location Required, Heaviest Piece is ~5300 lbs.
Customer	Electrical Supply Required - 100 Amps/460V/3PH/60Hz (DAF Equipment Only – Not including optional mix tank)
Customer	Fresh Water Supply for Chemical Make-Down and/or Equipment Wash Down (40 psi/100 gph)
Customer	Mechanical and/or Civil Work
Customer	Permits, Any or All Taxes, GST/HST, Duties, or Fees – Local, City, State, Provincial, National or Federal
Customer	DAF Float/Sludge Thickening, Handling or Disposal and Odor or H2S Control (Call to Discuss if Necessary)
Customer	System Operation, Day to Day Maintenance, & Good General Housekeeping Practices (Beyond start-up period)
Customer	Decommissioning and System Cleanup along with Waste and/or Chemical Disposal
Customer	On-Going Sampling, Testing and Analysis
Customer	Site Security and Trash Removal
Customer	Heat Tracing and/or Insulation of pipes, lines and equipment
Customer	Building, Tent, or Temporary Structure for Protection from the Elements or Freezing if Applicable

Krofta Technologies, LLC
401 South Street PO Box 7 Dalton, Massachusetts USA 01227
Phone: 413-236-5634 Fax: 413-236-6917 Email: Info@Krofta.com

DAF Rental System Supply: City of Aumsville, Oregon

Customer Also Agrees:

- That Krofta is not responsible for any wastewater violations, fees, fines or other associated costs related to permit compliance
- That system performance is subject to loadings, flow rates, effective chemical pre-treatment regimes and that overall system performance may diminish with excessive loadings or higher than specified flow rates
- That all data generated during the rental period will be shared with Krofta to demonstrate system performance
- To lease the equipment for the entire designated minimum period defined in this proposal. Should the customer wish to cancel the lease prior to the end of the agreed upon minimum term, all outstanding monthly costs and freight charges associated with the lease and the return of the equipment will be invoiced in full and paid in full by the customer.
- To surrender the equipment upon request of Krofta.
- That Krofta reserves the right to modify the terms and costs of the rental agreement after the initial rental period has expired.
- To notify Krofta in writing of intentions to extend the rental of the equipment beyond the initial minimum agreed upon period and adjust any purchase order, issue a new purchase order or change order to reflect the extension as required
- That initial commitment charges may reflect 1-Time set-up equipment fees and/or Technician Charges
- That Krofta has been notified of expected contaminant concentrations (including chlorides) prior to delivery of the equipment
- That all of the Krofta supplied equipment will be returned to Krofta or its sub-contracted Vendors in clean, good working order and that all wastewater, sediments, sludge, and organisms will be removed from the equipment and tanks before it is returned or an additional cleaning and/or waste disposal fee (amount TBD) will be applied.
- That the costs associated with any equipment that needs to be replaced or repaired due to damage caused by the customer or attributed to improper pH control, excessive chlorides, freezing, H2S, vandalism, theft, misuse or neglect by the customer (outside of normal wear and tear) will be the responsibility of the customer.
- That equipment that needs replacement or repair due to failure attributed to normal or intended use, will be supplied by Krofta at no charge to the customer. It is assumed the customer will handle simple unbolt/bolt in-type installations of the supplied components. In circumstances where that is not practical, Krofta may at its discretion subcontract the work to a 3rd party or provide its own technicians to complete the work. It is also assumed that the customer will provide access to Krofta and/or the 3rd party contractor and provide any necessary support services possible to facilitate a timely repair.
- That Krofta will provide at its own cost, a Preventative Maintenance Service Trip at ~(6) Month intervals after start-up. The trip will be coordinated in advance for an agreed upon date to minimize down time and disruption. It is assumed the customer will advise of expected needs or issues of concern regarding the equipment in advance of the arrival of Krofta and provide access and support services as needed.
- That unless specified as "Included" on the previous page of this document – Chemical supply and any costs associated with them are additional to the pricing detailed below. At no time shall any chemicals be returned with the equipment to Krofta. Disposal costs will apply.
- That the prices and scope of supply from Krofta for the rental are subject to change should an onsite visit and survey prior to the rental period by Krofta reveal the existing site conditions vary from what has been disclosed by the customer for the preparation of this proposal.

Pricing & Terms:

Date of Proposal	12/12/24
Minimum Rental Term	1 Month
DAF Equipment Freight to Site (Estimated - Paid by Customer, Charge Billed at Actual Cost)	$9,250.00
DAF Equipment Return Freight (Estimated - Paid by Customer, Charge Billed at Actual Cost)	$9,250.00

Pricing Summary:	Proposal # KPR-24-119
Monthly Trial Invoice Amount for MINIMUM Stated Term of (1) Month – Not Including Freight, Taxes, Permits or Fees	$17,500.00/mo USD
Additional Month(s) Beyond Stated Term of (1) Month Invoiced at – Not Including Freight, Taxes, Permits, Fees or Additional Technician Time if Required	$9,745.00/mo USD
Total Rental Program Amount Including Freight for Stated Term of (1) Month – Not Including Taxes, Permits or Fees	$36,000.00 USD

The pricing noted above is valid for 30 days from date listed and is subject to the terms and conditions outlined in this proposal as well as the Standard Terms and Conditions attached to this proposal. All Freight pricing is quoted as "Estimated" on a dedicated truck and will be invoiced at cost once ordered – subject to current market fuel pricing and delivery timeline requirement. Final invoices will reflect actual freight costs. Invoices are sent monthly on the anniversary date of start-up and are due upon receipt.

Agreement Acceptance & Purchase Order Number/Reference: _____

Customer:	KROFTA:
By: _____	By: Rick Ziomek
Title: _____	Title: Director of Engineering – Krofta Technologies
Signature: _____	Signature: _____
Date: _____	Date: _____

Krofta Technologies, LLC
401 South Street PO Box 7 Dalton, Massachusetts USA 01227
Phone: 413-236-5634 Fax: 413-236-6917 Email: Info@Krofta.com

KROFTA TECHNOLOGIES LLC EQUIPMENT PROGRAM

STANDARD TERMS & CONDITIONS

1. GENERAL: Krofta Technologies, LLC ("Krofta"), has submitted to Customer its proposal for a DAF System (the "System") (the "Proposal") (which Proposal and these Terms and Conditions are collectively referred to as the "Contract"). Services provided by Krofta in connection with its System and the lease and/or use of the System, both for the term and as specified in the Proposal, are made solely under the conditions expressly set forth herein. Any proposed changes or exceptions to these conditions, or additional terms and conditions, included or referenced in Customer's order or acceptance of this offer, are hereby rejected by Krofta, and shall be of no force or effect upon Krofta unless expressly accepted in writing by Krofta.

   This Contract shall bind and inure to the benefit of Customer and Krofta, as well as their respective successors and assigns; however, Customer may not assign this Contract without the prior written consent of Krofta.

   The System is and will remain personal property of Krofta and will not be deemed to be affixed or attached to real estate. As security for the performance of its obligations under the Contract, Customer creates and grants to Krofta a continuing lien on and security interest in the System and authorizes Krofta to execute and file appropriate financing statements evidencing the security interest.

   Neither party shall be deemed to have waived its rights by failing to enforce any particular provision of this Contract.

   If a court invalidates any portion of this Contract the rest of this Contract shall remain valid and be construed as if not containing the invalidated provision.

   Massachusetts law shall govern the rights and obligations of the parties.

2. CREDIT APPROVAL: If at any time information available on Customer's financial condition or credit history, in Krofta's sole judgment, does not justify the terms of payment specified in the Proposal, Krofta may require full or partial payment in advance. Or an acceptable form of payment guarantee such as a bank letter of credit, or other modifications to the terms of payment.

3. PROPRIETARY INFORMATION: All information, data, drawings, instruction and operation manuals furnished by Krofta with this Contract are proprietary to Krofta, submitted in strict confidence, and are to be used by Customer solely for the purposes of this Contract, and shall not be reproduced, transmitted, disclosed or used in any other manner without Krofta's prior written authorization.

4. DELIVERY AND INSTALLATION OF SYSTEM: Krofta will cause the System to be delivered to Customer at the location specified in the Proposal. All responsibility and costs relating to deliver and installation of the System will be incurred and paid as set forth in the Proposal. Customer grants Krofta a license to enter Customer's property for purposes of performing Krofta's responsibilities with respect to the System pursuant to the terms of the Contract.

5. EXCUSABLE INACTION AND/OR DELAY: Krofta shall not be liable for failure to perform or for delay in performance due to fire, flood or any other act of God, strike or other labor difficulty, act of any civil or military authority or of Customer, riot, embargo, terrorism, delay in or shortage of transportation facilities, or any other delay beyond Krofta's reasonable control. In the event Krofta's performance is prohibited and/or delayed by any such cause, Krofta's schedule for performance shall be excused or extended accordingly. If Customer's actions delay Krofta's performance, Customer shall pay KROFTA any additional costs incurred by KROFTA resulting from such delay.

6. TAXES: The dollar amounts set forth in the Proposal do not include any Federal, State or local taxes of any kind applicable to the lease, use or delivery of the System or services covered under this Contract. Customer shall pay direct or reimburse KROFTA for any such taxes that Krofta or Krofta's subcontractors or suppliers are required to pay.

7. WARRANTY DISCLAIMER: KROFTA HAS NOT MADE, AND DOES NOT HEREBY MAKE, ANY REPRESENTATION, WARRANTY, OR COVENANT EXPRESS OR IMPLIED, WITH RESPECT TO THE MERCHANTABILITY, CONDITION, QUALITY, DURABILITY, DESIGN, OPERATION, FITNESS FOR USE OR SUITABILITY OF THE SYSTEM IN ANY RESPECT WHATSOEVER.

8. LIMITATION OF LIABILITY: KROFTA SHALL NOT BE LIABLE TO CUSTOMER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM KROFTA'S OBLIGATIONS UNDER THIS CONTRACT, WHETHER SUCH DAMAGES ARE BASED UPON BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, STRICT LIABILITY OF OTHERWISE, IN ANY EVENT, NOTHEWITHSTANDING ANY LANGUAGE TO THE CONTRARY, KROFTA'S LIABILITY WHATSOEVER TO CUSTOMER SHALL NOT EXCEE THE AMOUNT TO BE PAID BY CUSTOMER FOR THE LEASE AND SERVICES OF THE SYSTEM AS SET FORTH IN THE PROPOSAL. NOTWITHSTANDING THE FOREGOING, UNDER NO CIRCUMSTANCES SHALL KROFTA BE RESPONSIBLE FOR ANY WASTEWATER SYSTEM FAILURES ARISING OUT OF CUSTOMER'S FAILURE TO COMPLY WITH KROFTA'S SPECIFICATIONS FOR THE SYSTEM, OR FOR ANY VIOLATIONS, FEES, FINES OR OTHER ASSOCIATED COSTS.

9. MAINTENANCE: ALTERATIONS TO SYSTEM: Customer shall maintain and return the System clean and in good repair and operating condition, allowing for reasonable wear and tear. Any cost incurred by Krofta for cleaning and waste disposal will be billed to the Customer. Customer shall not make any replacements and/or alterations to the System without Krofta's prior written authorization. Krofta shall not be liable for any costs incurred by Customer for repairs, replacements and/or alterations to the System, without Krofta's prior written authorization, and any adverse consequences resulting from such unauthorized work shall be Customer's full responsibility.

10. USE; IDEMNITY: Customer shall use the System in a manner contemplated by the Proposal and this Contract, and shall comply with all applicable laws, ordinances and regulations, To the extent permitted by law, Customer shall indemnify Krofta against, and hold Krofta harmless from, any and all claims, actions, proceedings, expenses, damages or liabilities, including attorney's fees and court costs, arising in connection with System, including but not limited to claims asserted by Krofta's employees as a result of Customer's negligence or willful misconduct.

11. INSURANCE: While the System is on Customer's premises and/or during the lease term, Customer will assume all risk of loss of or damage to the System from any cause whatsoever. Customer will, at its expense, obtain and maintain fire, general liability and property damages insurance of at least $1,000,000 (one million US dollars) on the System during the entire time period that the System shall be on the Customer's premises. Customer will name Krofta as an additional insured on its insurance policies with regard to the System, and will deliver a certificate of insurance to Krofta prior to delivery of the System. No such policy of insurance shall be subject to reduction or cancellation without 30 days prior written notice to Krofta.

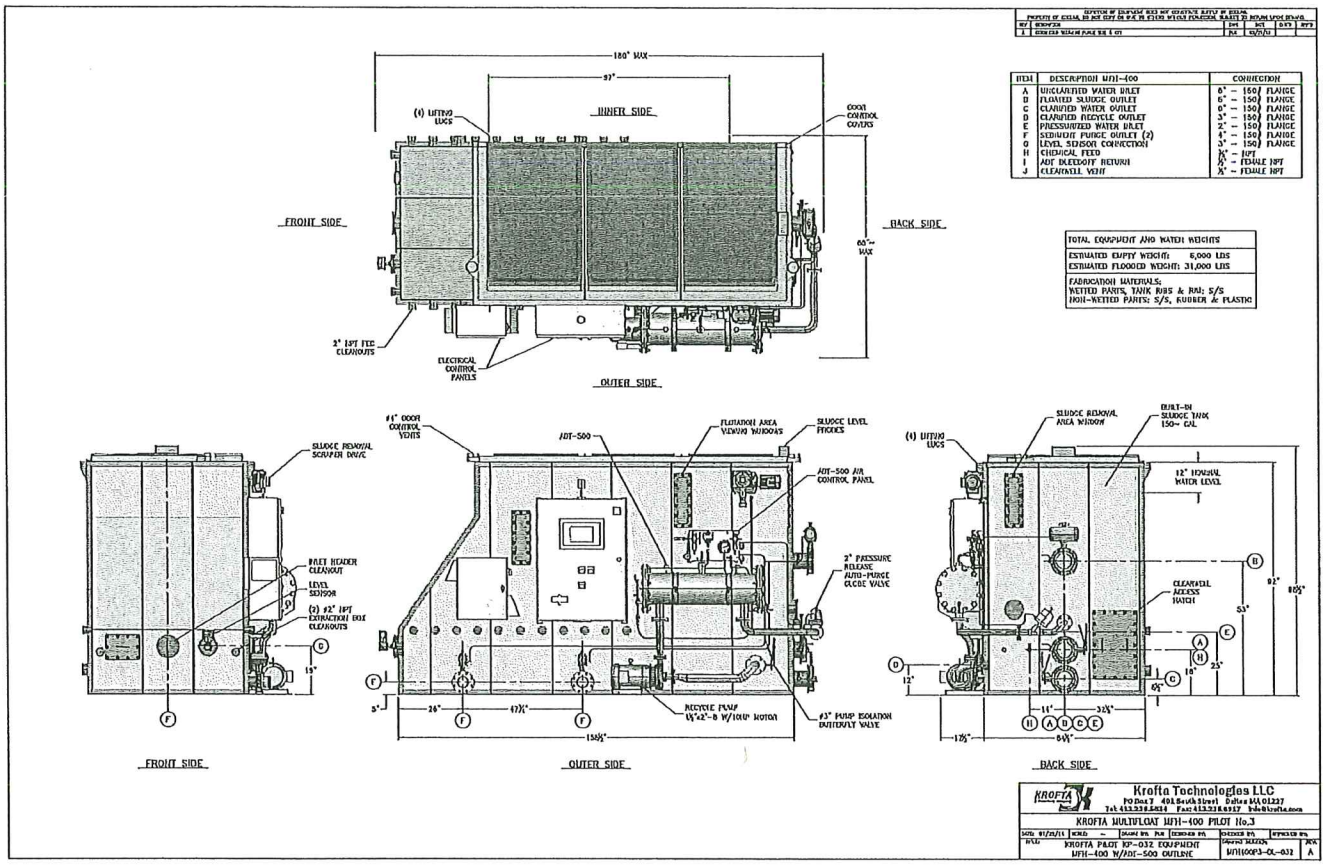
12. CANCELLATION BY CUSTOMER: If Customer cancels this Contract either before or after delivery of the System or refuses to accept delivery of the System, Customer shall be liable to Krofta for all reasonable cancellation charges, including loss of anticipated profits, administrative costs, commissions to sales representatives, costs incurred by Krofta for all work performed or in process up to the time of cancellation or refusal to accept delivery, cancellation charges from Krofta's suppliers or subcontractors, and any other expenses, incurred by Krofta in connection with Customer's cancellation or refusal to accept delivery.

13. EXTENSION OF TERM: The Contract shall not be extended without the express written consent of Krofta. If the Contract is extended, it shall be upon new payment terms and conditions mutually acceptable to Krofta and Customer.

14. DEFAULT BY CUSTOMER: Without incurring any liability or waiving any claim for damages Krofta may have against Customer, or the ability to exercise any other right, remedy or privilege in law or equity that Krofta may have, Krofta, may refuse to make or delay making delivery, withhold any service and/or immediately reclaim possession of the System if (a) Customer threatens to breach and/or breaches the terms contained in the Proposal, this Contract or any contract with Krofta; (b) Krofta becomes aware of facts which, in its judgment, render Customer's financial condition unsatisfactory or cast doubt on Customer's willingness or ability to pay for the System and/or services; or (c) Customer engages in or consents to liquidation, commission of any act of insolvency, appointment of a receiver of asets or assignment for the benefit of creditors. Or if Customer becomes the subject of any bankruptcy or insolvency proceeding. Customer will remain liable for all covenants and indemnities under the Proposal and this Contract and for all legal fees and other costs and expenses, including court costs, incurred by Krofta with respect to the enforcement of any of the remedies listed above or any other remedies available to Krofta.

    If Customer is late in paying the amounts set forth in the Proposal or any partial payment due under this Contract, or otherwise breaches this Contract, Krofta shall be entitled to interest at the legal rate on the overdue amount, and on its damages calculated from the date of default in payment or other breach, plus court costs, reasonable attorneys' fees and other expenses incurred in any effort to collect.

15. ENTIRE AGREEMENT: The Proposal and this Contract, and other documents or instruments executed by Krofta and Customer in connection herewith, shall constitute the entire agreement between the parties with respect to the System, and these documents shall not be modified, amended altered or changed except with the written consent of both parties.



ITEM	DESCRIPTION MFH-400	CONNECTION
A	UNCLARIFIED WATER INLET	6" – 150# FLANGE
B	FLOATED SLUDGE OUTLET	6" – 150# FLANGE
C	CLARIFIED WATER OUTLET	6" – 150# FLANGE
D	CLARIFIED RECYCLE OUTLET	3" – 150# FLANGE
E	PRESSURIZED WATER INLET	2" – 150# FLANGE
F	SEDIMENT PURGE OUTLET (2)	4" – 150# FLANGE
G	LEVEL SENSOR CONNECTION	3" – 150# FLANGE
H	CHEMICAL FEED	¾" – IPT
I	ADT BLEEDOFF RETURN	¾" – FEMALE NPT
J	CLEANOUT VENT	¾" – FEMALE NPT

TOTAL EQUIPMENT AND WATER WEIGHTS
ESTIMATED EMPTY WEIGHT: 8,000 LBS ESTIMATED FLOODED WEIGHT: 31,000 LBS
FABRICATION MATERIALS: WETTED PARTS, TANK RIBS & RAIL: S/S NON-WETTED PARTS: S/S, RUBBER & PLASTIC

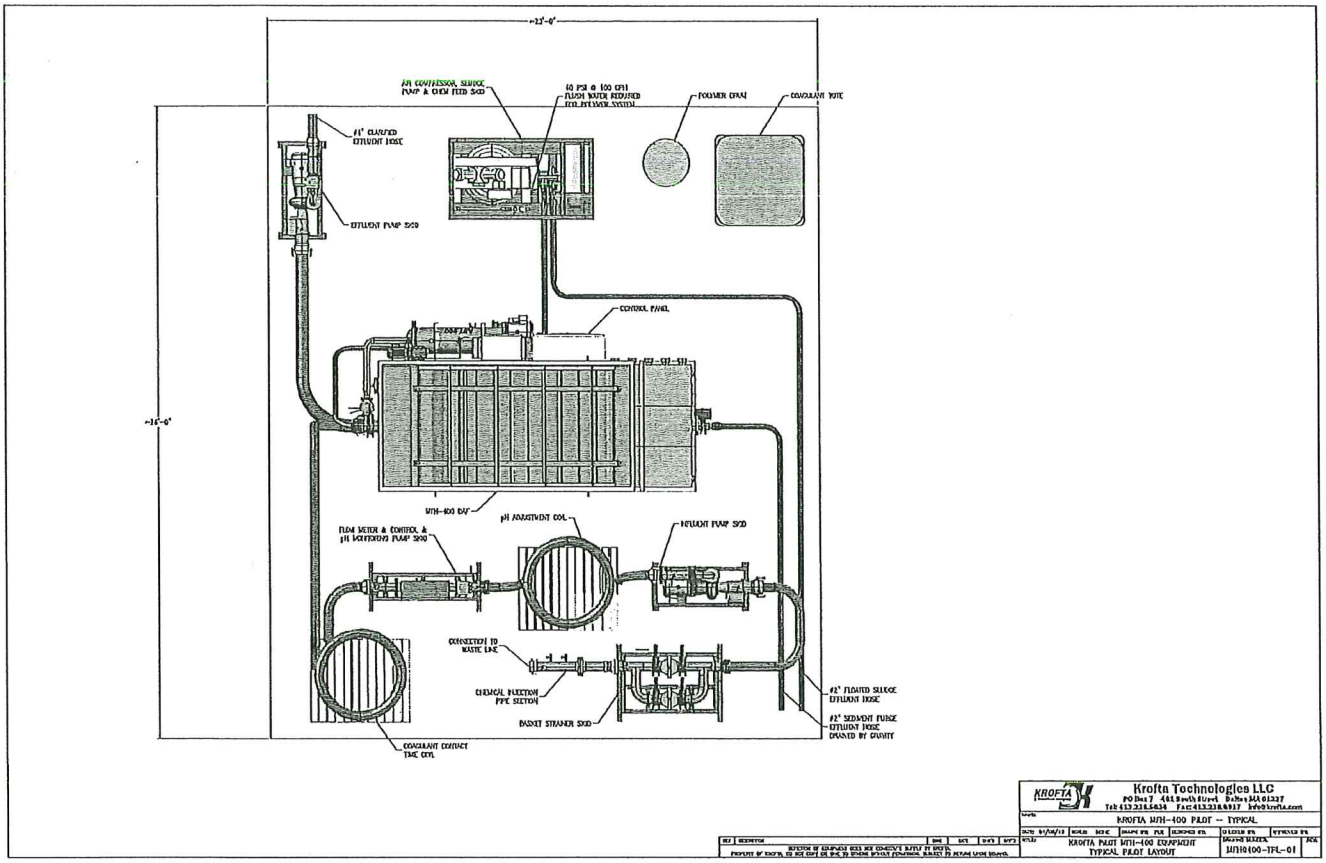
Krofta Technologies LLC
PO Box 7 401 South Street Dallas WI 01227
Tel 413.528.5434 Fax 413.528.5517 info@krofta.com

KROFTA MULTIFLOAT MFH-400 PILOT No.3

DATE	01/21/14	SCALE	–	DRAWN BY	PJR	DESIGNED BY		CHECKED BY		APPROVED BY	

TITLE: KROFTA PILOT KP-032 EQUIPMENT MFH-400 W/ADT-500 OUTLINE

DRAWING NUMBER: MFH400P3-OL-032 REV: A



REV	DESCRIPTION	DWN	CHK	APP	DATE
	REVISION OF EQUIPMENT DOES NOT CONSTITUTE ACCEPTANCE OF IT UNTIL PROPERTY OF KROFTA, IS NOT COPIED OR USED IN ANY MANNER WITHOUT PERMISSION. SUBJECT TO RETURN UPON DEMAND.				

Krofta Technologies LLC
PO Box 7 4419 South Street Bethel VT 05032
Tel: 413.218.6834 Fax: 413.218.6817 info@krofta.com

KROFTA MTH-400 PILOT -- TYPICAL

DATE	BY/APP'D	SCALE	DRAWN BY	CHK	APP	ISSUED BY	CLOSED BY	APP'D
9/24/13		NTS						

KROFTA PILOT MTH-400 EQUIPMENT
TYPICAL PILOT LAYOUT

DRAWING NUMBER: MTH0400-TPL-01
REV:



APPENDIX C: BID FORM

PAYMENT BOND FOR PROCUREMENT CONTRACT

Seller Name: **Krofta Technologies, LLC** Address *(principal place of business)*: **401 South Street** **PO Box 7** **Dalton, MA 01227**	**Surety** Name: Liberty Mutual Insurance Company Address *(principal place of business)*: 175 Berkeley Street, Boston, MA 02116
Buyer Name: **The City of Aumsville, Oregon** Mailing address *(principal place of business)*: **595 Main Street** **Aumsville, Oregon 97325**	**Procurement Contract** Description *(name and location)*: (check only one box and delete the other): ☒ **Dissolved Air Floatation Equipment for the** Aumsville Wastewater Treatment Plant Procurement Contract Price: **$772,485.00** Effective Date of Procurement Contract: December 23, 2024

Bond

Bond Amount: Seven Hundred Seventy Two Thousand, Four Hundred Eighty Five and No/00ths ($772,485.00)

Date of Bond: December 23, 2024

(Date of Bond cannot be earlier than Effective Date of Procurement Contract)

Modifications to this Bond form:

☒ None ☐ See Paragraph 17

Surety and Seller, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

Seller as Principal	Surety
Krofta Technologies, LLC	Liberty Mutual Insurance Company
(Full formal name of Seller)	*(Full formal name of Surety) (corporate seal)*
By: [signature]	By: [signature]
(Signature)	*(Signature)(Attach Power of Attorney)*
Name: Rick Ziomek	Name: Kevin M. Burruss, Jr.
(Printed or typed)	*(Printed or typed)*
Title: Director	Title: Attorney-in-Fact
Attest: [signature]	Attest: [signature]
(Signature)	*(Signature)*
Name: BRIAN TROMBLEY	Name: Paula Darowitz
(Printed or typed)	*(Printed or typed)*
Title: WITNESS	Title: Witness

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Seller, Surety, Buyer, or other party is considered plural where applicable.

EJCDC® P-615, Payment Bond for Procurement Contract.
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1. The Seller and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Buyer to pay for labor, materials, and equipment furnished for use in the performance of the Procurement Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Seller promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Buyer from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Procurement Contract, then the Surety and the Seller shall have no obligation under this Bond.

3. If there is no Buyer Default under the Procurement Contract, the Surety's obligation to the Buyer under this Bond will arise after the Buyer has promptly notified the Seller and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Buyer or the Buyer's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Procurement Contract, and tendered defense of such claims, demands, liens, or suits to the Seller and the Surety.

4. When the Buyer has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Buyer against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond will arise after the following:

   5.1. Claimants who do not have a direct contract with the Seller

      5.1.1. have furnished a written notice of non-payment to the Seller, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

      5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).

   5.2. Claimants who are employed by or have a direct contract with the Seller have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Buyer to the Seller, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

   7.1. Send an answer to the Claimant, with a copy to the Buyer, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

   7.2. Pay or arrange for payment of any undisputed amounts.

   7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Seller may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

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8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Buyer to the Seller under the Procurement Contract will be used for the performance of the Procurement Contract and to satisfy claims, if any, under any procurement performance bond. By the Seller furnishing and the Buyer accepting this Bond, they agree that all funds earned by the Seller in the performance of the Procurement Contract are dedicated to satisfying obligations of the Seller and Surety under this Bond, subject to the Buyer's priority to use the funds for the completion of the Goods and Special Services.

10. The Surety shall not be liable to the Buyer, Claimants, or others for obligations of the Seller that are unrelated to the Procurement Contract. The Buyer shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Procurement Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the Point of Destination is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Procurement Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

13. Notice and Claims to the Surety, the Buyer, or the Seller must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement where the Point of Destination is located, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Seller and Buyer shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

    16.1. *Buyer Default*—Failure of the Buyer, which has not been remedied or waived, to pay the Seller as required under the Procurement Contract or to perform and complete or comply with the other material terms of the Procurement Contract.

    16.2. *Claim*—A written statement by the Claimant including at a minimum:

        16.2.1. The name of the Claimant;

        16.2.2. The name of the person for whom the labor was done, or materials or equipment furnished;

        16.2.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Procurement Contract;

        16.2.4. A brief description of the labor, materials, or equipment furnished;

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16.2.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Procurement Contract;

16.2.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.2.7. The total amount of previous payments received by the Claimant; and

16.2.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.3. *Claimant*—An individual or entity having a direct contract with the Seller or with a subcontractor of the Seller to furnish labor, materials, or equipment for use in the performance of the Procurement Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Point of Destination is located or where the Goods and Special Services are to be installed or furnished. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Procurement Contract, architectural and engineering services required for performance of the work of the Seller and the Seller's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.4. *Goods and Special Services*—The full scope of materials, equipment, other items, and services to be furnished by Seller, as defined in the Procurement Contract.

16.5. *Point of Destination*—The location where delivery of the Goods shall be made, as stated in the Procurement Contract.

16.6. *Procurement Contract*—The contractual agreement between the Buyer and Seller identified on the cover page, including all Procurement Contract Documents and all changes made to the Procurement Contract.

16.7. *Procurement Contract Documents*—All the documents that comprise the contractual agreement between the Buyer and Seller.

17. Modifications to this Bond are as follows: **[Describe modification or enter "None"]**

NONE

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This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

Certificate No: **8208837-000010**

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, Anne Baker, Ashley Wallin, Dana Butler, Jacquelyn DiAddezio, Jeffrey S. Dougherty, Jerome T. Hanuscin, Kathleen McWilliams, Kayla McAneney, Kevin M. Burruss, Jr., Lauren Ickes, Mark A. Farley, Megan Brooks, Neha Gehlot, Oskar Gerhardson, Robert M. DeRafelo, Thomas Whelan, Vanessa Veal, Wayne D. Weaver

all of the city of Plymouth Meeting state of PA each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 12th day of October, 2022.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

By: _____
David M. Carey, Assistant Secretary

State of PENNSYLVANIA
County of MONTGOMERY ss

On this 12th day of October, 2022 before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Plymouth Meeting, Pennsylvania, on the day and year first above written.

Commonwealth of Pennsylvania - Notary Seal
Teresa Pastella, Notary Public
Montgomery County
My commission expires March 28, 2025
Commission number 1126044
Member, Pennsylvania Association of Notaries

By: _____
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS: Section 12. Power of Attorney.
Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts: Section 5. Surety Bonds and Undertakings.
Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 23rd day of December, 2024.

By: _____
Renee C. Llewellyn, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

For bond and/or Power of Attorney (POA) verification inquiries, please call 610-832-8240 or email HOSUR@libertymutual.com.

Bond #025001342

PERFORMANCE BOND FOR PROCUREMENT CONTRACT

Seller	**Surety**
Name: **Krofta Technologies, LLC**	Name: Liberty Mutual Insurance Company
Address *(principal place of business)*: **401 South Street PO Box 7 Dalton, MA 1227**	Address *(principal place of business)*: 175 Berkeley Street, Boston, MA 02116
Buyer	**Procurement Contract**
Name: **The City of Aumsville, Oregon**	Description *(name and location)*: (check only one box and delete the other): ☒ **DISSOLVED AIR FLOATATION EQUIPMENT FOR THE AUMSVILLE WASTEWATER TREATMENT PLANT**
Mailing address *(principal place of business)*: **595 Main Street Aumsville, Oregon 97325**	Procurement Contract Price: **$772,485.00**
	Effective Date of Procurement Contract: December 23, 2024

Bond

Bond Amount: Seven Hundred Seventy Two Thousand, Four Hundred Eighty Five and No/00ths ($772,485.00)

Date of Bond: December 23, 2024

(Date of Bond cannot be earlier than Effective Date of Procurement Contract)

Modifications to this Bond form:

☒ None ☐ See Paragraph 15

Surety and Seller, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

Seller as Principal	Surety
Krofta Technologies, LLC *(Full formal name of Seller)*	Liberty Mutual Insurance Company *(Full formal name of Surety) (corporate seal)*
By: *(Signature)*	By: *(Signature)(Attach Power of Attorney)*
Name: Rick Ziomek *(Printed or typed)*	Name: Kevin M. Burruss, Jr. *(Printed or typed)*
Title: Director	Title: Attorney-in-Fact
Attest: *(Signature)*	Attest: *(Signature)*
Name: Brian Trombley *(Printed or typed)*	Name: Paula Dinowitz *(Printed or typed)*
Title: Witness	Title: Witness

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Seller, Surety, Buyer, or other party is considered plural where applicable.

EJCDC® P-610, Performance Bond for Procurement Contract.
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1. The Seller and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Buyer for the performance of the Procurement Contract, which is incorporated herein by reference.

2. If the Seller performs the Procurement Contract, the Surety and the Seller shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Buyer Default under the Procurement Contract, the Surety's obligation under this Bond will arise after:

    3.1. The Buyer first provides notice to the Seller and the Surety that the Buyer is considering declaring a Seller Default. Such notice may indicate whether the Buyer is requesting a conference among the Buyer, Seller, and Surety to discuss the Seller's performance. If the Buyer does not request a conference, the Surety may, within five (5) business days after receipt of the Buyer's notice, request such a conference. If the Surety timely requests a conference, the Buyer shall attend. Unless the Buyer agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Buyer's notice. If the Buyer, the Seller, and the Surety agree, the Seller shall be allowed a reasonable time to perform the Procurement Contract, but such an agreement does not waive the Buyer's right, if any, subsequently to declare a Seller Default;

    3.2. The Buyer declares a Seller Default, terminates the Procurement Contract, and notifies the Surety; and

    3.3. The Buyer has agreed to pay the Balance of the Procurement Contract Price in accordance with the terms of the Procurement Contract to the Surety or to a seller selected to perform the Procurement Contract.

4. Failure on the part of the Buyer to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Buyer has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

    5.1. Arrange for the Seller, with the consent of the Buyer, to perform and complete the Procurement Contract;

    5.2. Undertake to perform and complete the Procurement Contract itself, through its agents or independent contractors;

    5.3. Obtain bids or negotiated proposals from qualified sellers acceptable to the Buyer for a contract for performance and completion of the Procurement Contract, arrange for a contract to be prepared for execution by the Buyer and a seller selected with the Buyer's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Procurement Contract, and pay to the Buyer the amount of damages as described in Paragraph 7 in excess of the Balance of the Procurement Contract Price incurred by the Buyer as a result of the Seller Default; or

    5.4. Waive its right to perform and complete, arrange for completion, or obtain a new seller, and with reasonable promptness under the circumstances:

        5.4.1. After investigation, determine the amount for which Surety may be liable to the Buyer and, as soon as practicable after the amount is determined, make payment to the Buyer; or

        5.4.2. Deny liability in whole or in part and notify the Buyer, citing the reasons for denial.

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6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven (7) days after receipt of an additional written notice from the Buyer to the Surety demanding that the Surety perform its obligations under this Bond, and the Buyer shall be entitled to enforce any remedy available to the Buyer. If the Surety proceeds as provided in Paragraph 5.4, and the Buyer refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Buyer shall be entitled to enforce any remedy available to the Buyer.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Buyer will not be greater than those of the Seller under the Procurement Contract, and the responsibilities of the Buyer to the Surety will not be greater than those of the Buyer under the Procurement Contract. Subject to the commitment by the Buyer to pay the Balance of the Procurement Contract Price, the Surety is obligated, without duplication for:

    7.1. the responsibilities of the Seller for correction of defective or non-conforming Goods and Special Services, and completion of the Procurement Contract;

    7.2. additional legal, design professional, and delay costs resulting from the Seller's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

    7.3. liquidated damages, or if no liquidated damages are specified in the Procurement Contract, actual damages caused by delayed performance or non-performance of the Seller.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Buyer or others for obligations of the Seller that are unrelated to the Procurement Contract, and the Balance of the Procurement Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Buyer or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Procurement Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction where the Point of Destination is located and must be instituted within two years after a declaration of Seller Default, or within two years after the Seller ceased working, or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

12. Notice to the Surety, the Buyer, or the Seller must be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Point of Destination, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

    14.1. *Balance of the Procurement Contract Price*—The total amount payable by the Buyer to the Seller under the Procurement Contract after all proper adjustments have been made including allowance for the Seller for any amounts received or to be received by the Buyer in settlement of insurance or other claims for damages to which the Seller is entitled, reduced by all valid and proper payments made to or on behalf of the Seller under the Procurement Contract.

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14.2. *Buyer Default*—Failure of the Buyer, which has not been remedied or waived, to pay the Seller as required under the Procurement Contract or to perform and complete or comply with the other material terms of the Procurement Contract.

14.3. *Goods and Special Services*—The full scope of materials, equipment, other items, and services to be furnished by Seller, as defined in the Procurement Contract.

14.4. *Point of Destination*—The location where delivery of the Goods shall be made, as stated in the Procurement Contract.

14.5. *Procurement Contract*—The contractual agreement between the Buyer and Seller identified on the cover page, including all Procurement Contract Documents and changes made to the Procurement Contract.

14.6. *Seller Default*—Failure of the Seller, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Procurement Contract.

14.7. *Procurement Contract Documents*—All the documents that comprise the contractual agreement between the Buyer and Seller.

15. Modifications to this Bond are as follows: **[Describe modification or enter "None"]**

NONE

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This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

Certificate No: **8208837-000010**

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, Anne Baker, Ashley Wallin, Dana Butler, Jacquelyn DiAddezio, Jeffrey S. Dougherty, Jerome T. Hanuscin, Kathleen McWilliams, Kayla McAneney, Kevin M. Burruss, Jr., Lauren Ickes, Mark A. Farley, Megan Brooks, Neha Gehlot, Oskar Gerhardson, Robert M. DeRafelo, Thomas Whelan, Vanessa Veal, Wayne D. Weaver

all of the city of Plymouth Meeting state of PA each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 12th day of October, 2022.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

By: _____
David M. Carey, Assistant Secretary

State of PENNSYLVANIA
County of MONTGOMERY ss

On this 12th day of October, 2022 before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Plymouth Meeting, Pennsylvania, on the day and year first above written.

Commonwealth of Pennsylvania - Notary Seal
Teresa Pastella, Notary Public
Montgomery County
My commission expires March 28, 2025
Commission number 1126044
Member, Pennsylvania Association of Notaries

By: _____
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS: Section 12. Power of Attorney.
Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts: Section 5. Surety Bonds and Undertakings.
Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 23rd day of December, 2024.

By: _____
Renee C. Llewellyn, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

For bond and/or Power of Attorney (POA) verification inquiries, please call 610-832-8240 or email HOSUR@libertymutual.com.

PART 3:

CONDITIONS OF THE CONTRACT

STANDARD GENERAL CONDITIONS OF THE PROCUREMENT CONTRACT

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ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Whenever used in the Procurement Bidding Requirements or Procurement Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated, which are applicable to the singular or plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Procurement Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Procurement Contract Documents.

2. *Application for Payment*—The document prepared by Seller, in a form acceptable to Buyer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Procurement Contract Documents.

3. *Bid*—An offer or proposal of a prospective Seller submitted on the prescribed form setting forth the prices for the Goods and Special Services to be provided.

4. *Bidder*—An individual or entity that, as a prospective Seller, submits a Bid to Buyer.

5. *Buyer*—The individual or entity purchasing the Goods and Special Services.

6. *Change Directive*—A written directive from Buyer to Seller issued on or after the Effective Date of the Procurement Contract, ordering an addition, deletion, or revision in the Goods and Special Services.

7. *Change Order*—A document which is signed by Seller and Buyer and authorizes an addition, deletion, or revision to the Procurement Contract Documents or an adjustment in the Procurement Contract Price or the Procurement Contract Times, issued on or after the Effective Date of the Procurement Contract. Change Orders may be the result of mutual agreement by Buyer and Seller, or of resolution of a Claim.

8. *Claim*—A demand or assertion by Buyer or Seller seeking an adjustment of Procurement Contract Price or Procurement Contract Times, or both, or other relief with respect to the terms of the Procurement Contract. A demand for money or services by a third party is not a Claim.

9. *Contractor/Assignee*—A construction contractor with which Project Owner enters into a construction contract, and to which Project Owner, as initial Buyer, assigns this Procurement Contract.

10. *Effective Date of the Procurement Contract*—The date indicated in the Procurement Agreement on which the Procurement Contract becomes effective.

11. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

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12. *Electronic Means*—Electronic mail (e-mail), upload/download from a secure Project website, or other communications methods that allow: the transmission or communication of Electronic Documents; the documentation of transmissions, including sending and receipt; printing of the transmitted Electronic Document by the recipient; the storage and archiving of the Electronic Document by sender and recipient; and the use by recipient of the Electronic Document for purposes permitted by this Procurement Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

13. *Engineer*—The individual or entity designated as such in the Procurement Agreement.

14. *Field Order*—A written order issued by Engineer which requires minor changes in the Goods or Special Services, but which does not involve a change in the Procurement Contract Price or Procurement Contract Times.

15. *Goods*—The tangible and movable personal property that is described in the Procurement Contract Documents, regardless of whether the property is to be later attached to realty.

16. *Goods and Special Services*—The full scope of materials, equipment, other items, and services to be furnished by Seller, including Goods, as defined herein, and Special Services, if any, as defined herein. This term refers to both the Goods and the Special Services, or to either the Goods or the Special Services, and to any portion of the Goods or the Special Services, as the context requires.

17. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

18. *Milestone*—A principal event specified in the Procurement Contract that Seller must attain by the date or within the number of days indicated, including but not limited to the delivery of the Goods and the furnishing of Special Services.

19. *Notice of Award*—The written notice, by Buyer to a Bidder, of Buyer's acceptance of the Bid.

20. *Point of Destination*—The specific address of the location where delivery of the Goods will be made, as stated in the Procurement Agreement.

21. *Procurement Agreement*—The written instrument, executed by Buyer and Seller, that sets forth the Procurement Contract Price and Procurement Contract Times, identifies the parties and the Engineer, and designates the specific items that are Procurement Contract Documents.

22. *Procurement Bidding Documents*—The Procurement Bidding Requirements and the proposed Procurement Contract Documents (including all Addenda).

23. *Procurement Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and Bid Form with any supplements.

24. *Procurement Contract*—The entire and integrated written agreement between Buyer and Seller concerning the Goods and Special Services.

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25. *Procurement Contract Documents*—Those items so designated in the Procurement Agreement, and which together comprise the Procurement Contract. Shop Drawings and other Seller submittals are not Procurement Contract Documents, even if accepted, reviewed, or approved by Engineer or Buyer.

26. *Procurement Contract Price*—The money that Buyer has agreed to pay Seller for furnishing the Goods and Special Services in accordance with the Procurement Contract Documents.

27. *Procurement Contract Times*—The times stated in the Procurement Agreement by which the Goods must be delivered, Special Services must be furnished, and other Milestones must be attained.

28. *Procurement Drawings*—That part of the Procurement Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Goods and Special Services to be furnished by Seller. Shop Drawings and other Seller submittals are not Procurement Drawings as so defined.

29. *Procurement Specifications*—That part of the Procurement Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the furnishing of the Goods and Special Services, and certain administrative requirements and procedural matters applicable thereto.

30. *Project*—The total undertaking to be accomplished for Project Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Goods and Special Services are a part.

31. *Project Owner*—The entity that has retained (or will retain) engineers, contractors, and others for the planning, study, design, construction, testing, commissioning, and start-up of facilities and improvements. As of the Effective Date of the Procurement Contract, the Project Owner is the Buyer.

32. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Goods and Special Services and which establish the standards by which such portion of the Goods and Special Services will be judged.

33. *Schedule of Submittals*—A schedule, prepared and maintained by Seller, of required Submittals and the time requirements for Engineer's review of the Submittals.

34. *Seller*—The individual or entity furnishing the Goods and Special Services.

35. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Seller and submitted by Seller to illustrate some portion of the Goods and Special Services. Shop Drawings, whether approved or not, are not Procurement Drawings and are not Procurement Contract Documents.

36. *Special Services*—Services to be performed by Seller (or its agents or subcontractors) in association with the Goods to be furnished by Seller, as required by the Procurement Contract Documents.

37. *Submittal*—A written or graphic document, prepared by or for Seller, which the Procurement Contract Documents require Seller to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals

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may include Shop Drawings and Samples; schedules; product data; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or site quality-control testing and inspections; warranties and certifications; suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; record documents; and other such documents required by the Procurement Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Procurement Contract Documents. Change proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

38. *Successful Bidder*—The Bidder whose Bid the Buyer accepts, and to which Buyer makes an award of the Procurement Contract.

39. *Supplementary Conditions*—The part of the Procurement Contract that amends or supplements these General Conditions.

40. *Unit Price Goods and Special Services*—Goods and Special Services to be paid for on the basis of unit prices (if any).

1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B and 1.02.C are not defined, but have the indicated meanings when used in the Bidding Requirements or Procurement Contract Documents.

B. *Intent of Certain Terms or Adjectives*

1. The Procurement Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Goods and Special Services. It is intended that such exercise of professional judgment, action, or determination will be commercially reasonable and will be solely to evaluate, in general, the Goods and Special Services for compliance with the requirements of and information in the Procurement Contract Documents and conformance with the design concept of the completed Project as a functioning whole, as shown or indicated in the Procurement Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective will not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing of Goods or Special Services or any duty or authority to undertake responsibility contrary to any other provision of the Procurement Contract Documents.

2. The word "non-conforming" when modifying the words "Goods and Special Services," "Goods," or "Special Services," refers to Goods and Special Services that are unsatisfactory, faulty, or deficient in that they:

a. do not conform to or comply with the requirements of the Procurement Contract Documents;

b. do not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Procurement Contract Documents; or

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c. in the case of Special Services, have not been completed.

3. The word “receipt” when referring to the Goods, means the physical taking and possession by the Buyer under the conditions specified in Paragraph 9.02.B.2.

4. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.

5. The word "furnish," when used in connection with the Goods and Special Services means to supply and deliver said Goods to the Point of Destination (or some other specified location) and to perform said Special Services fully, all in accordance with the Procurement Contract Documents.

C. *Procurement Contract Price or Procurement Contract Times*: References to a change in “Procurement Contract Price or Procurement Contract Times” or “Procurement Contract Times or Procurement Contract Price” or similar, indicate that such change applies to (1) Procurement Contract Price, (2) Procurement Contract Times, or (3) both Procurement Contract Price and Procurement Contract Times, as warranted, even if the term “or both” is not expressed.

D. Unless stated otherwise in the Procurement Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Procurement Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Seller delivers the executed counterparts of the Procurement Agreement to Buyer, the Seller also shall deliver to Buyer the performance bond and payment bond (if the Procurement Contract requires Seller to furnish such bonds).

B. *Evidence of Seller’s Insurance*: When Seller delivers the signed counterparts of the Procurement Agreement to Buyer, the Seller also shall deliver to Buyer, with copies to each additional insured (as identified in the Procurement Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Seller in accordance with Article 5. Evidence of insurance to be obtained at a later date, such as insurance relating to transit or storage of the Goods, will be provided to Buyer at the time of such insurance is obtained.

C. *Evidence of Buyer’s Insurance*: After receipt of the signed counterparts of the Procurement Agreement and all required bonds and insurance documentation, Buyer shall promptly deliver to Seller, with copies to each additional insured (as identified in the Procurement Contract), certificates and other evidence of insurance (if any) required to be provided by Buyer.

2.02 *Copies of Documents*

A. Buyer shall furnish to Seller four printed copies of the Procurement Contract (including one fully executed counterpart of the Procurement Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

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2.03 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Procurement Contract, the Buyer, Seller, and Engineer may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Procurement Contract does not establish protocols for Electronic Means, then Buyer, Seller, and Engineer shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

2.04 *Preliminary Schedules*

A. Within 15 days after the Effective Date of the Procurement Contract, Seller shall submit to Buyer and Engineer for timely review:

1. a progress schedule of activities, consistent with the Procurement Contract Times, including at a minimum, Shop Drawing and Sample submittals, tests, and deliveries as required by the Procurement Contract Documents.

a. The progress schedule will be acceptable to Buyer and Engineer if it provides an orderly progression of the Submittals, tests, and deliveries to completion within the specified Milestones of the Procurement Contract Times.

b. Such acceptance will not impose on Buyer or Engineer responsibility for the progress schedule, for sequencing, scheduling, or progress of Seller's performance of its obligations under the Procurement Contract, nor interfere with or relieve Seller from Seller's full responsibility therefor.

c. Such acceptance will not be deemed as an acknowledgment of the reasonableness and attainability of the schedule.

2. a preliminary schedule of Submittals.

B. No progress payment will be made to Seller until an acceptable progress schedule and acceptable schedule of Submittals are submitted to Buyer and Engineer (and other conditions applicable to progress payments are met).

2.05 *Preliminary Conference*

A. Within 20 days after the Procurement Contract Times start to run, a conference attended by Seller, Buyer, Engineer and others as appropriate will be held to establish a working understanding among the parties as to the Goods and Special Services and to discuss the schedules referred to in Paragraph 2.04.A, procedures for handling Shop Drawings and other Submittals, processing Applications for Payment, and maintaining required records.

2.06 *Safety*

A. Buyer and Seller shall comply with all applicable Laws and Regulations relating to the safety of persons or property, and to the protection of persons or property from damage, injury, or loss.

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B. When Seller's personnel, or the personnel of any subcontractor to Seller, are present at the Point of Destination or any work area or site controlled by Buyer, the Seller shall be responsible for the compliance by such personnel with any applicable requirements of Buyer's safety programs that are made known to Seller.

C. If Buyer or its representatives visit the Seller's manufacturing or storage facilities, for testing, inspection, or other purposes, Seller shall inform Buyer in advance of any safety preparations, standards, or programs with which Buyer and its representatives must comply.

ARTICLE 3—PROCUREMENT CONTRACT DOCUMENTS

3.01 *Intent*

A. The Procurement Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Procurement Contract Documents or from prevailing custom or trade usage as being required to produce or furnish the indicated Goods and Special Services will be provided, whether or not specifically called for, at no additional cost to Buyer.

C. Unless otherwise stated in the Procurement Contract Documents, if there is a discrepancy between the electronic or digital versions of the Procurement Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version will govern.

D. The Procurement Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Procurement Contract Documents, as provided in Paragraph 3.04.

F. Any provision or part of the Procurement Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Buyer and Seller.

3.02 *Reference Standards*

A. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws and Regulations, whether such reference be specific or by implication, means the standard, specification, manual, code, or Laws and Regulations in effect at the time of opening of Bids (or on the Effective Date of the Procurement Agreement if there were no Bids), except as may be otherwise specifically stated in the Procurement Contract Documents.

B. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a supplier, will be effective to change the duties or responsibilities of Buyer, Seller, or Engineer from those set forth in the part of the Procurement Contract Documents prepared by or for Engineer. No such provision or instruction will be effective to assign to Buyer or Engineer any duty or authority to supervise or direct the performance of Seller's obligations, or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Procurement Contract Documents prepared by or for Engineer.

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3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Seller's Review of Procurement Contract Documents*: If, before or during the performance of Seller's obligations, Seller discovers any conflict, error, ambiguity, or discrepancy within the Procurement Contract Documents, or between the Procurement Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any supplier to Seller, then Seller shall promptly report it to Engineer (or if the Procurement Contract is assigned, then directly to Contractor/Assignee) in writing. Seller shall not proceed with the Goods and Special Services affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer (or if the Procurement Contract is assigned, then by Contractor/Assignee) or by an amendment or supplement to the Procurement Contract Documents issued pursuant to Article 11.

2. Seller shall not be liable to Buyer or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Procurement Contract Documents unless Seller had actual knowledge thereof.

B. *Resolving Discrepancies*: Except as may be otherwise specifically stated in the Procurement Contract Documents, the provisions of the Procurement Contract Documents will take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Procurement Contract Documents and:

1. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Procurement Contract Documents); or

2. the provisions of any Laws or Regulations applicable to the furnishing of the Goods and Special Services (unless such an interpretation of the provisions of the Procurement Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Procurement Drawings and Procurement Specifications*

A. During the performance of Seller's obligations and until final payment, Seller and Buyer shall submit to the Engineer all matters in question concerning the requirements of the Procurement Drawings and Procurement Specifications (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Goods and Special Services, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Procurement Drawings and Procurement Specifications, and judge of the acceptability of the Goods and Special Services thereunder.

1. After assignment (if any) Seller shall submit such matters directly to Contractor/Assignee for response or administration, and the Procurement Contract provisions in Paragraphs 3.04.B and C will not apply.

B. Engineer will issue with reasonable promptness a written clarification, interpretation, or decision on the issue submitted, and if necessary, initiate an amendment or supplement to the Procurement Drawings or Procurement Specifications. Engineer's written clarification, interpretation, or decision will be consistent with the overall intent of the Procurement Contract Documents, and will be final and binding on Seller and Buyer. If either Buyer or Seller believes that a written clarification or interpretation justifies an adjustment in the

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Procurement Contract Price or Procurement Contract Times, either may make a Claim for such adjustment as provided in Article 12.

C. If a submitted matter in question concerns terms and conditions of the Procurement Contract Documents that do not involve (1) the performance or acceptability of the Goods and Services, (2) the design (as set forth in the Procurement Drawings, Procurement Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Buyer and Seller that Engineer is unable to provide a decision or interpretation.

3.05 *Reuse of Documents*

A. Seller and its subcontractors and suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Procurement Drawings, Procurement Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Procurement Drawings, Procurement Specifications, other documents, or copies thereof, on extensions of the Project or any other project, without written consent of Buyer and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Procurement Contract Documents, reuse any such Procurement Contract Documents for any purpose without Buyer's express written consent, or violate any copyrights pertaining to such Procurement Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Procurement Contract. Nothing herein precludes Seller from retaining copies of the Procurement Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND SCHEDULE

4.01 *Commencement of Procurement Contract Times*

A. The Procurement Contract Times will commence to run on the Effective Date of the Procurement Contract.

4.02 *Continuing Performance*

A. Seller shall adhere to the progress schedule established in accordance with Paragraph 2.04.A., as duly adjusted, and the Goods will be delivered and the Special Services furnished within the Procurement Contract Times.

B. Seller shall carry on furnishing of the Goods and Special Services and adhere to the progress schedule during all disputes or disagreements with Buyer. No furnishing of Goods and Special Services will be delayed or postponed pending resolution of any disputes or disagreements, except as expressly permitted herein, or as Buyer and Seller may otherwise agree in writing.

4.03 *Adjustments to Progress Schedule*

A. The progress schedule established in accordance with Paragraph 2.04 may be adjusted from time to time as provided below.

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1. Seller shall submit to Buyer for acceptance (to the extent indicated in Paragraph 2.04) proposed adjustments in the progress schedule that will not result in changing the Procurement Contract Times. Such adjustments will comply with any applicable provisions of the Procurement Specifications.

2. Proposed adjustments in the progress schedule that will change the Procurement Contract Times must be submitted in accordance with the requirements of Article 11. Adjustments in Procurement Contract Times may only be made by a Change Order.

4.04 *Delays*

A. If Buyer, Engineer, or anyone for whom Buyer is responsible, delays, disrupts, or interferes with Seller's performance or progress, then Seller shall be entitled to an equitable adjustment in Procurement Contract Price or Procurement Contract Times.

B. Seller shall not be entitled to an adjustment in Procurement Contract Price or Procurement Contract Times for delay, disruption, or interference caused by or within the control of Seller or anyone for whom Seller is responsible.

C. If Seller's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Buyer, Seller, and those for which they are responsible, then Seller shall be entitled to an equitable adjustment in Procurement Contract Times. Such an adjustment will be Seller's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Procurement Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. abnormal weather conditions;

3. inspection delays by governmental authorities, and custom delays;

4. international shipping delays;

5. acts or failures to act of third-party entities; and

6. acts of war or terrorism.

D. *Adjustments of Procurement Contract Times or Procurement Contract Price—General Provisions*: Seller's entitlement to an adjustment of Procurement Contract Times or Procurement Contract Price is limited as follows:

1. Seller's entitlement to an adjustment of the Procurement Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of Seller's obligations, as of the time of the delay, disruption, or interference.

2. Seller shall not be entitled to an adjustment in Procurement Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Seller. Such a concurrent delay by Seller does not preclude an adjustment of Procurement Contract Times to which Seller is otherwise entitled.

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3. Adjustments of Procurement Contract Times or Procurement Contract Price are subject to the provisions of Articles 11 and 12.

E. Each Seller request seeking a delay-related increase in Procurement Contract Times or Procurement Contract Price must be supplemented by supporting data that sets forth in detail the following: (1) the circumstances that form the basis for the requested adjustment; (2) the date upon which each cause of delay, disruption, or interference began to affect Seller's progress; (3) the date upon which each cause of delay, disruption, or interference ceased to affect Seller's progress; (4) the number of days' increase in Procurement Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and (5) the impact on Procurement Contract Price. Seller shall also furnish such additional supporting documentation as Buyer or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion.

ARTICLE 5—BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Seller shall furnish a performance bond and a payment bond, each in an amount at least equal to the Procurement Contract Price, as security for the faithful performance and payment of Seller's obligations under the Procurement Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 9.04, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Procurement Contract.

B. Seller shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Procurement Contract.

C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Buyer prior to execution of the Procurement Contract, except as provided otherwise by Laws or Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Seller shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Seller is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Seller shall promptly notify Buyer and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements of this Procurement Contract.

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F. If Seller has failed to obtain a required bond, Buyer may exercise Buyer's termination rights under Article 14.

G. Upon request to Buyer from any subcontractor, supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of Seller's obligations, Buyer shall provide a copy of the payment bond to such person or entity.

H. Upon request to Seller from any subcontractor, supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of Seller's obligations, Seller shall provide a copy of the payment bond to such person or entity.

5.02 *Insurance*

A. Seller shall provide insurance of the types and coverages and in the amounts stipulated in the Supplementary Conditions.

B. Failure of Buyer to demand certificates of insurance or other evidence of Seller's full compliance with these insurance requirements or failure of Buyer to identify a deficiency in compliance from the evidence provided will not be construed as a waiver of Seller's obligation to maintain such insurance.

C. Upon assignment of this Procurement Contract, Seller shall name the Contractor/Assignee as an additional insured and comply with the written request of Contractor/Assignee to provide evidence of insurance.

D. Buyer does not represent that insurance coverage and limits established in this Procurement Contract necessarily will be adequate to protect Seller.

E. The insurance and insurance limits required herein will not be deemed as a limitation on Seller's liability under the indemnities and other rights granted to Buyer in the Procurement Contract.

5.03 *Surety or Insurance Companies*

A. All bonds and insurance required by the Procurement Contract Documents to be purchased and maintained by Buyer or Seller shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies must also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

ARTICLE 6—LICENSES AND FEES

6.01 *Intellectual Property and License Fees*

A. Except to the extent stated elsewhere in the Procurement Contract Documents, Seller is not transferring any patent rights, copyrights, or other intellectual property rights for the Goods delivered.

B. To the extent Seller is manufacturing to Buyer's design, Buyer retains all patent rights, copyrights, and other intellectual property rights in such design.

C. If an invention, design, process, product, or device is specified in the Procurement Contract Documents for incorporation in the Goods or for the performance of Special Services, and if, to the actual knowledge of Buyer or Engineer, its use is subject to patent rights, copyrights,

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or other intellectual property rights calling for the payment of a license fee or royalty to others, then the existence of such rights and payment obligations will be disclosed to Seller in the Procurement Contract Documents.

D. Seller shall pay all license fees and royalties and assume all costs incident to the use or the furnishing of the Goods, unless specified otherwise by the Procurement Contract Documents.

6.02 *Seller's Infringement*

A. Subject to Paragraph 6.01, to the fullest extent permitted by Laws and Regulations, Seller shall indemnify and hold harmless Buyer, Engineer, and their officers, directors, members, partners, employees, agents, consultants, contractors, and subcontractors, from and against all claims, costs, losses, damages, and judgments (including but not limited to all reasonable fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement or alleged infringement of any patent, copyright, or other intellectual property right by any of the Goods as delivered or Special Services as performed.

B. Buyer will promptly notify Seller in writing of any claim, suit, or threat of suit by a third party for any infringement or alleged infringement of any patent, copyright, or other intellectual property right with respect to the Goods as delivered or Special Services as performed.

C. Seller shall promptly defend or settle the claim or suit. Seller shall have control over such claim or suit, bear all expenses, and satisfy any adverse judgment.

1. If Seller fails to defend such suit or claim after written notice by Buyer, Seller will be bound, in any subsequent suit or claim against Seller by Buyer, by any factual determination in the prior suit or claim.

2. If Buyer fails to provide Seller the opportunity to defend such suit or claim, Buyer shall be barred from any remedy against Seller for such suit or claim.

D. If a determination is made that Seller has infringed upon the intellectual property rights of another, Seller may, at Seller's own expense, obtain the necessary licenses for Buyer's benefit, or replace the Goods and provide related design and construction, consistent with the requirements of the Procurement Contract Documents, to avoid the infringement.

6.03 *Buyer's Infringement*

A. Subject to Paragraph 6.01, and to the fullest extent permitted by Laws and Regulations, Buyer shall be responsible to Seller for any infringement or alleged infringement of any patent, copyright, or other intellectual property right caused by Seller's compliance with the Procurement Drawings or Procurement Specifications, and will reimburse Seller for any license fee or royalties paid by Seller to others if such payment resulted from any invention, design, process, product, or device specified to be furnished or performed in the Procurement Drawings or Procurement Specifications, but not identified as being subject to payment of such license fee or royalty.

B. Seller will promptly notify Buyer in writing of any claim, suit, or threat of suit by a third party for intellectual property infringement arising from Seller's compliance with the Procurement Drawings or Procurement Specifications.

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C. Buyer shall defend or settle the claim or suit. Buyer shall have control over such claim or suit, bear all expenses, and satisfy any adverse judgment.

1. If Buyer fails to defend such suit or claim after written notice by Seller, Buyer will be bound, in any subsequent suit or claim against Buyer by Seller, by any factual determination in the prior suit or claim.

2. If Seller fails to provide Buyer the opportunity to defend such suit or claim, Seller shall be barred from any remedy against Buyer for such suit or claim.

ARTICLE 7—SELLER'S RESPONSIBILITIES

7.01 *Performance of Obligations*

A. Seller shall be solely responsible for the means, methods, techniques, sequences, and procedures necessary to perform its obligations in accordance with the Procurement Contract Documents.

B. Seller shall supervise, inspect, and direct the furnishing of the Goods and Special Services competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform its obligations in accordance with the Procurement Contract Documents.

C. Seller shall coordinate the provision of Special Services to avoid or limit interference or disruption of other activities at the location where the Special Services are to occur, including but not limited to ongoing facility operations and construction activities.

7.02 *Labor, Materials and Equipment*

A. Seller shall provide competent, qualified and trained personnel in all aspects of its performance of the Procurement Contract.

B. All Goods, and all equipment and material incorporated into the Goods, must be as specified, and unless specified otherwise in the Procurement Contract Documents, must be:

1. new, and of good quality;

2. protected, assembled, connected, cleaned, and conditioned in accordance with the original manufacturer's instructions; and

3. shop-assembled to the greatest extent practicable.

7.03 *Laws and Regulations*

A. Seller shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of its obligations in accordance with the Procurement Contract Documents. Except where otherwise expressly required by such Laws and Regulations, neither Buyer nor Engineer shall be responsible for monitoring Seller's compliance with any Laws or Regulations.

B. If Seller furnishes Goods and Special Services knowing or having reason to know that such furnishing is contrary to Laws or Regulations, Seller shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such performance. It will not be Seller's responsibility to make certain

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that the Procurement Specifications and Procurement Drawings are in accordance with Laws and Regulations, but this provision will not relieve Seller of Seller's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Procurement Contract if there were no Bids) that have a direct effect on the cost or time of Seller's performance will be the subject of an adjustment in Procurement Contract Price or Procurement Contract Times. If Buyer and Seller are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Article 12.

7.04 *"Or Equals"*

A. Whenever an item of material or equipment to be incorporated into the Goods is specified or described in the Procurement Contract Documents by using the names of one or more proprietary items or specific suppliers or manufacturers, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, other items of material or equipment or material or equipment of other suppliers or manufacturers may be submitted to Buyer for Engineer's review.

1. If in Engineer's sole discretion, such an item of material or equipment proposed by Seller is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Engineer as an "or equal" item.

2. For the purposes of this paragraph, a proposed item of material or equipment may be considered functionally equal to an item so named only if in the exercise of reasonable judgment, Engineer determines that: 1) it is at least equal in quality, durability, appearance, strength, and design characteristics; 2) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole; 3) it has an acceptable record of performance and availability of responsive service; and (4) Seller certifies that if approved: a) there will be no increase in any cost, including capital, installation or operating costs, to Buyer; and b) the proposed item will conform substantially to the detailed requirements of the item named in the Procurement Contract Documents.

B. *Engineer's Evaluation*: Engineer will be allowed a reasonable time within which to evaluate each proposal or Submittal made pursuant to Paragraph 7.04.A. Engineer will be the sole judge of whether to accept or reject such a proposal or Submittal. No "or equal" will be ordered, manufactured or utilized until Engineer's review is complete, which will be evidenced by an approved Shop Drawing. Engineer will advise Buyer and Seller in writing of any negative determination. Notwithstanding Engineer's approval of an "or-equal" item, Seller shall remain obligated to comply with the requirements of the Procurement Contract Documents.

C. *Special Guarantee*: Buyer may require Seller to furnish at Seller's expense a special performance guarantee or other surety with respect to any such proposed "or-equal."

D. *Data*: Seller shall provide all data in support of any such proposed "or equal" at Seller's expense.

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7.05 *Taxes*

A. Seller shall pay all taxes and duties arising out of the sale of the Goods and the performance of Special Services. All taxes and duties are included in the Procurement Contract Price, except as noted in the Supplementary Conditions.

7.06 *Submittals*

A. *Shop Drawing and Sample Requirements*

1. Before submitting a Shop Drawing or Sample, Seller shall:

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Procurement Contract Documents;

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal; and

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of Seller's obligations.

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Seller has satisfied its obligations under the Procurement Contract Documents with respect to Seller's review of that Submittal, and that Seller approves the Submittal.

3. With each Shop Drawing or Sample, Seller shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Procurement Contract Documents. This notice will be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. *Submittal Procedures for Shop Drawings and Samples*: Seller shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. *Shop Drawings*

a. Seller shall submit the number of copies required in the Procurement Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Seller proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.06.C.

2. *Samples*

a. Seller shall submit the number of Samples required in the Procurement Specifications.

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b. Seller shall clearly identify each Sample as to material, supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.06.C.

3. Where a Shop Drawing or Sample is required by the Procurement Contract Documents or the Schedule of Submittals, any related work performed by Seller prior to Engineer's review and approval of the pertinent Submittal will be at the sole expense and responsibility of Seller.

C. *Engineer's Review of Shop Drawings and Samples*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Goods, comply with the requirements of the Procurement Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Procurement Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, manufacturing, fabrication, installation, or shipping, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Seller from responsibility for any variation from the requirements of the Procurement Contract Documents unless Seller has complied with the requirements of Paragraph 7.06.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Procurement Contract Documents in a Field Order or other appropriate Procurement Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Seller from responsibility for complying with the requirements of Paragraphs 7.06.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Procurement Contract Documents, will not, under any circumstances, change the Procurement Contract Times or Procurement Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing or Sample will result in such item becoming a Procurement Contract Document.

8. Seller shall furnish Goods that comply with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.06.C.4.

D. *Resubmittal Procedures for Shop Drawings and Samples*

1. Seller shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review

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and approval. Seller shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.

2. Seller shall furnish required Shop Drawing and Sample Submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Seller shall be responsible for Engineer's charges to Buyer for such time. Buyer may impose a set-off against payments due Seller to secure reimbursement for such charges.

3. If Seller requests a change of a previously approved Shop Drawing or Sample, Seller shall be responsible for Engineer's charges to Buyer for its review time, and Buyer may impose a set-off against payments due Seller to secure reimbursement for such charges, unless the need for such change is beyond the control of Seller.

E. *Submittals Other than Shop Drawings and Samples*

1. The following provisions apply to all Submittals other than Shop Drawings and Samples:

a. Seller shall submit all such Submittals to the Engineer in accordance with the schedule of Submittals and pursuant to the applicable terms of the Procurement Contract Documents.

b. Engineer will provide timely review of all such Submittals in accordance with the schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the schedule of Submittals will be deemed accepted.

c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Procurement Contract Documents as to general form and content of the Submittal.

d. If any such Submittal is not accepted, Seller shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.04 and 2.05.

7.07 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Seller shall indemnify and hold harmless Buyer, Engineer, Project Owner, and any assignee of Buyer, including Contractor/Assignee, and their officers, directors, members, partners, employees, agents, consultants, contractors, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of Seller's obligations under the Procurement Contract, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Goods themselves), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Seller, or any individual or entity directly or indirectly employed by Seller or anyone for whose acts Seller may be liable.

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B. In any and all claims against Buyer, Engineer, Project Owner, or any assignee of Buyer, including Contractor/Assignee, or their officers, directors, members, partners, employees, agents, consultants, contractors, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Seller, any subcontractor, any supplier, or any individual or entity directly or indirectly employed by any of them to furnish any of the Goods and Special Services, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.07.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Seller or any such subcontractor, supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.08 *Concerning Subcontractors and Suppliers*

A. Seller may retain subcontractors and suppliers for the performance of parts of the furnishing of the Goods and Special Services. The Seller's retention of a subcontractor or supplier will not relieve Seller's obligation to Buyer to perform and complete the furnishing the Goods and Special Services in accordance with the Procurement Contract Documents.

ARTICLE 8—SHIPPING AND DELIVERY

8.01 *Shipping*

A. Seller shall select the carrier and bear all costs of packaging, transportation, insurance, special handling, and all other costs associated with shipment and delivery.

8.02 *Delivery*

A. Seller shall deliver the Goods free on board (FOB) to the Point of Destination, freight prepaid, in accordance with the Procurement Contract Times set forth in the Procurement Agreement, or other date agreed to by Buyer and Seller.

B. At least 10 days before shipment, Seller shall provide written notice to Buyer of the manner of shipment and the anticipated delivery date. The notice must also include any instructions concerning special equipment or services required at the Point of Destination to unload and care for the Goods. Seller shall also require the carrier to give Buyer at least 24 hours' notice by telephone prior to the anticipated time of delivery.

C. Buyer will be responsible and bear all costs for unloading the Goods from carrier.

D. Buyer will assure that adequate facilities are available to receive delivery of the Goods at the time established for delivery, or on another date agreed to by Buyer and Seller.

E. No partial deliveries will be allowed, unless permitted or required by the Procurement Contract Documents or agreed to in writing by Buyer.

F. Provisions governing inspection on delivery are set forth in Paragraph 9.02.

8.03 *Risk of Loss*

A. Risk of loss and insurable interests transfer from Seller to Buyer upon Buyer's receipt of the Goods.

B. Notwithstanding the provisions of Paragraph 8.03.A, if Buyer rejects the Goods as non-conforming, the risk of loss on such Goods will remain with Seller until Seller corrects the non-conformity or Buyer accepts the Goods. If rejected Goods remain at the Point of

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Destination pending modification and acceptance, then Seller shall be responsible for arranging adequate protection and maintenance of the Goods at Seller's expense.

ARTICLE 9—BUYER'S RIGHTS

9.01 *Seller's Warranties and Guarantees*

A. Seller warrants and guarantees to Buyer that the title to the Goods conveyed will be proper, its transfer rightful, and free from any security interest, lien, or other encumbrance. Seller shall defend, indemnify, and hold Buyer harmless against any liens, claims, or demands contesting or affecting title of the Goods conveyed.

B. Seller warrants and guarantees to Buyer that all Goods and Special Services will conform with the Procurement Contract Documents, and with the standards established by any Samples approved by Engineer. Engineer shall be entitled to rely on Seller's warranty and guarantee. If the Procurement Contract Documents do not otherwise specify the characteristics or the quality of the Goods, the Goods must comply with the requirements of Paragraph 7.02.B.

C. Seller's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, improper modification, improper maintenance, or improper operation by persons other than Seller;

2. excessive corrosion or chemical attack, unless corrosive or chemically-damaging conditions were disclosed by Buyer in the Procurement Contract Documents and the Procurement Contract Documents required the Goods to withstand such conditions;

3. use in a manner contrary to Seller's written instructions for installation, operation, and maintenance; or

4. normal wear and tear under normal usage.

D. Seller's obligation to furnish the Goods and Special Services in accordance with the Procurement Contract Documents will be absolute. None of the following will constitute an acceptance of Goods and Special Services that are non-conforming, or a release of Seller's obligation to furnish the Goods and Special Services in accordance with the Procurement Contract Documents:

1. observations by Buyer, Engineer, or Project Owner;

2. recommendation by Engineer or payment by Buyer of any progress or final payment;

3. use of the Goods by Buyer or Project Owner;

4. any acceptance by Buyer, Engineer, or Project Owner, or any failure to do so;

5. the end of the correction period established in Paragraph 9.04;

6. the issuance of a notice of acceptance;

7. any inspection, test or approval by others; or

8. any correction of non-conforming Goods and Special Services by Buyer or Project Owner.

E. Buyer shall promptly notify Seller of any breach of Seller's warranties or guarantees.

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9.02 *Inspections and Testing*

A. *General Provisions*

1. The Procurement Contract Documents specify required inspections and tests. Buyer shall have the right to perform, or cause to be performed, reasonable inspections and require reasonable tests of the Goods at Seller's facility, and at the Point of Destination. Seller shall allow Buyer a reasonable time to perform such inspections or tests.

2. Seller shall reimburse Buyer for all expenses, except for travel, lodging, and subsistence expenses of Buyer's and Engineer's representatives, for inspections and tests specified in the Procurement Contract Documents. If as the result of any such specified testing the Goods are determined to be non-conforming, then Seller shall also bear the travel, lodging, and subsistence expenses of Buyer's and Engineer's representatives, and all expenses of re-inspection or retesting.

3. Buyer shall bear all expenses of inspections and tests that are not specified in the Procurement Contract Documents (other than any re-inspection or retesting resulting from a determination of non-conformity, as set forth in Paragraph 9.03); provided, however, that if as the result of any such non-specified inspections or testing the Goods are determined to be non-conforming, then Seller shall bear all expenses of such inspections and testing, and of any necessary re-inspection and retesting.

4. Seller shall provide Buyer timely written notice of the readiness of the Goods for all inspections, tests, or approvals which the Procurement Contract Documents specify are to be observed by Buyer prior to shipment.

5. Buyer will give Seller timely notice of all specified tests, inspections, and approvals of the Goods which are to be conducted at the Point of Destination, and a representative of Seller will attend such tests, inspections, and approvals.

6. If, on the basis of inspections or testing, the Goods appear to be conforming, Buyer will give Seller prompt notice thereof. If on the basis of inspections or testing, the Goods appear to be non-conforming, Buyer will give Seller prompt notice thereof and will advise Seller of the remedy Buyer elects under the provisions of Paragraph 9.03.

7. Neither payments made by Buyer to Seller prior to any tests or inspections, nor any tests or inspections, will constitute acceptance of non-conforming Goods, or prejudice Buyer's rights under the Procurement Contract.

B. *Visual Inspection on Delivery*

1. Buyer will visually inspect the Goods upon delivery solely for purposes of identifying the Goods, general verification of quantities, and observation of apparent condition. Such visual inspection will not be construed as final or as receipt of any Goods and Special Services that, as a result of subsequent inspections and tests, are determined to be non-conforming.

2. If, on the basis of the visual inspection specified in Paragraph 9.02.B.1, the Goods appear to comply with the requirements of the Procurement Contract Documents as to quantities and condition, then within 10 days of delivery Buyer shall issue to Seller Buyer's acknowledgment of the receipt of Goods.

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C. *Final Inspection*

1. After all of the Goods have been incorporated into the Project, tested in accordance with such testing requirements as are specified, and are functioning as required, and Seller has performed and completed all Special Services, Buyer will make a final inspection.

2. If, on the basis of the final inspection, Buyer determines that the Goods and Special Services are conforming, Buyer's notice thereof will constitute Buyer's acceptance of the Goods and Special Services, subject to any limitations stated in the notice.

3. If, on the basis of the final inspection, the Goods and Special Services are non-conforming, Buyer will identify the non-conformity in writing.

9.03 *Non-Conforming Goods and Special Services*

A. If, on the basis of inspections and testing prior to delivery, the Goods and Special Services are found to be non-conforming, or if at any time after Buyer has acknowledged receipt of delivery and before the expiration of the correction period described in Paragraph 9.04, Buyer determines that the Goods and Special Services are non-conforming, then Seller shall promptly, without cost to Buyer and in response to written instructions from Buyer, either correct such non-conforming Goods and Special Services, or, if Goods are rejected by Buyer, remove and replace the non-conforming Goods with conforming Goods, including all work required for reinstallation.

B. *Buyer's Rejection of Non-Conforming Goods*

1. If Buyer elects to reject the Goods in whole or in part, Buyer's notice to Seller will describe in sufficient detail the non-conforming aspect of the Goods. If Goods have been delivered to Buyer, Seller shall promptly, and within the Procurement Contract Times, remove and replace the rejected Goods.

2. Seller shall bear all costs, losses and damages attributable to the removal, replacement, reinspection, and retesting of the non-conforming Goods.

3. Upon rejection of the Goods, Buyer retains a security interest in the Goods to the extent of any payments made and expenses incurred in their testing and inspection.

C. *Buyer's Rejection of Non-Conforming Special Services*

1. If at any time Buyer elects to reject the Special Services in whole or in part, Buyer's notice to Seller will describe in sufficient detail the non-conforming aspect of the Special Services.

2. Seller shall promptly provide conforming Special Services acceptable to Buyer.

3. If Seller fails to provide conforming Special Services, Buyer may remove the Special Services from the scope of the Procurement Contract, and equitably reduce the Procurement Contract Price.

D. *Remedying Non-Conforming Goods*: If Buyer elects to permit the Seller to modify the Goods to correct the non-conformance, then Seller shall promptly provide a schedule for such modifications and shall make the Goods conforming within a reasonable time.

E. *Buyer's Acceptance of Non-Conforming Goods*: Instead of requiring correction or removal and replacement of non-conforming Goods discovered either before or after final payment,

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Buyer may accept the non-conforming Goods. Seller shall bear all reasonable costs, losses, and damages attributable to Buyer's evaluation of and determination to accept such non-conforming Goods.

F. *Seller Obligations*: Seller shall pay all claims, costs, losses, and damages, including but not limited to all fees and charges for re-inspection, retesting and for any engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs arising out of or relating to the non-conforming Goods and Special Services. Seller's obligations will include the costs of the correction or removal and replacement of the non-conforming Goods and the replacement of property of Buyer and others destroyed by the correction or removal and replacement of the non-conforming Goods, and obtaining conforming Special Services from others.

G. *Buyer's Rejection of Conforming Goods*: If Buyer asserts that Goods and Special Services are non-conforming and such Goods and Special Services are determined to be conforming, or if Buyer rejects as non-conforming Goods and Special Services that are later determined to be conforming, then Seller shall be entitled to reimbursement from Buyer of costs incurred by Seller in inspecting, testing, correcting, removing, or replacing the conforming Goods and Special Services, including but not limited to fees and charges of engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs associated with the incorrect assertion of non-conformance or rejection of conforming Goods and Special Services.

9.04 *Correction Period*

A. Seller's responsibility for correcting all non-conformities in the Goods and Special Services will extend for a period of one year after the acceptance of the Goods and Special Services in accordance with Paragraph 9.02.C.2.

B. Where non-conforming Goods and Services (and damage to other work resulting therefrom) have been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Goods and Services will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

C. Seller's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph may not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 10—ENGINEER'S STATUS

10.01 *Engineer's Role Defined*

A. Engineer will be Buyer's representative until assignment (if any) of the Procurement Contract.

B. The duties and responsibilities and the limitations of authority of Engineer prior to assignment, if any, of the Procurement Contract, are set forth in the Procurement Contract Documents.

C. Engineer's responsibilities, if any, after an assignment (if any) of the Procurement Contract, are set forth in the Procurement Agreement.

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10.02 *Duties and Responsibilities; Authority; Limitations*

A. As set forth in Article 3, Engineer will be the initial interpreter of the Procurement Contract Documents and judge of the acceptability of the Goods and Special Services, and will issue clarifications, interpretations, and decisions regarding such issues.

B. Acting on behalf of Buyer under the provisions of Article 9, Engineer has the authority to disapprove or reject Goods and Special Services that Engineer believes to be non-conforming. Engineer also has the authority to require special inspection or testing of the Goods or Special Services as provided in Paragraph 9.02, whether or not the Goods are fabricated or installed, or the Special Services are completed.

C. Engineer may authorize minor deviations or variations in the Procurement Contract Documents by: 1) written approval of specific variations set forth in Shop Drawings when Seller has duly noted such variations as required in Paragraph 7.06.A.3, or 2) a Field Order.

D. As set forth in Article 12, Engineer will review Claims, and render decisions on Claims.

E. In rendering any interpretations, clarifications, reviews, decisions, disapprovals, acceptances, rejections, authorizations, and judgments, Engineer will not show partiality to Buyer or Seller. Engineer will not be liable to Buyer, Seller, or others in connection with any interpretations, clarifications, reviews, decisions, disapprovals, acceptances, rejections, authorizations, or judgments conducted or rendered by Engineer in good faith.

F. Engineer will not supervise, direct, control, or have authority over or be responsible for the means, methods, techniques, sequences, or procedures used by Seller to perform its obligations under this Procurement Contract, or the safety precautions and programs incident thereto, or for any failure of Seller to comply with Laws and Regulations applicable to the performance of its obligations. Engineer will not be responsible for Seller's failure to furnish the Goods and Special Services in accordance with the Procurement Contract Documents.

ARTICLE 11—CHANGES

11.01 *Amending and Supplementing the Procurement Contract*

A. The Procurement Contract may be amended or supplemented by a Change Order, a Change Directive, or a Field Order.

B. If an amendment or supplement to the Procurement Contract includes a change in the Procurement Contract Price or the Procurement Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Procurement Contract that involve (1) the conformance or acceptability of the Goods and Special Services, (2) the design (as set forth in the Procurement Drawings, Procurement Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Buyer and Seller may amend other terms and conditions of the Procurement Contract without the recommendation of the Engineer.

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11.02 *Change Orders*

A. Buyer and Seller shall execute appropriate Change Orders covering:

1. Changes in Procurement Contract Price or Procurement Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Goods and Special Services furnished in accordance with a Change Directive;

2. Changes in Procurement Contract Price resulting from a Buyer set-off, unless Seller has duly contested such set-off;

3. Changes in the Goods and Special Services which are: (a) ordered by Buyer pursuant to Paragraph 11.05, (b) required because of Buyer's acceptance of non-conforming Goods and Services under Paragraph 9.03 or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Goods and Special Services involves the design (as set forth in the Procurement Drawings, Procurement Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Change Directive; Article 12, Claims; and similar provisions.

B. If Buyer or Seller refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Change Directives*

A. A Change Directive will not change the Procurement Contract Price or the Procurement Contract Times but is evidence that the parties expect that the modification ordered or documented by a Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Change Directive's effect, if any, on the Procurement Contract Price and Procurement Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Procurement Contract Documents governing adjustments, expressly including Paragraph 11.08 regarding change of Procurement Contract Price.

B. If Buyer has issued a Change Directive and Buyer or Seller believes that an adjustment in Procurement Contract Times or Procurement Contract Price is necessary, then such party shall submit a Claim seeking such an adjustment no later than 30 days after the completion of the Goods and Services set out in the Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Goods and Services if the changes do not involve an adjustment in the Procurement Contract Price or the Procurement Contract Times and are compatible with the design concept as indicated by the Procurement Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Buyer and also on Seller, which shall perform the Goods and Special Services involved promptly.

B. If Seller believes that a Field Order justifies an adjustment in the Procurement Contract Price or Procurement Contract Times, then before proceeding with the Goods and Special Services at issue, Seller shall submit a Claim as provided herein.

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11.05 *Buyer-Authorized Changes in the Goods and Special Services*

A. Without invalidating the Procurement Contract and without notice to any surety, Buyer may, at any time or from time to time, order additions, deletions, or revisions in the Goods and Special Services. Changes involving the design (as set forth in the Procurement Drawings, Procurement Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Goods and Special Services may be accomplished by a Change Order, if Buyer and Seller have agreed as to the effect, if any, of the changes on Procurement Contract Times or Procurement Contract Price; or by a Change Directive. Upon receipt of any such document, Seller shall promptly proceed with the Goods and Special Services involved; or, in the case of a deletion in the Goods and Special Services, promptly cease activities with respect to such deletion. Added or revised Goods and Special Services must be performed under the applicable conditions of the Procurement Contract Documents.

11.06 *Buyer's Contingency Allowance*

A. The Buyer's Contingency Allowance, if any such is set forth in the Procurement Agreement, is for the sole use of Buyer to cover unanticipated costs.

B. If Buyer exercises its unilateral right to use all or a portion of the Buyer's Contingency Allowance, Buyer will issue a written directive that documents the costs to which the allowance is applied, Seller's entitlement to compensation, and the consequent reduction in such allowance.

C. Prior to final payment, the Total Price, as set forth in the Procurement Agreement, will be duly adjusted to account for any unused portion of the Buyer's Contingency Allowance.

D. The Procurement Agreement, Article 5, addresses the impact on Buyer's Contingency Allowance of an assignment of the Procurement Contract.

11.07 *Unauthorized Changes in the Goods and Special Services*

A. Seller shall not be entitled to an increase in the Procurement Contract Price or an extension of the Procurement Contract Times with respect to any work performed that is not required by the Procurement Contract Documents, as amended, modified, or supplemented.

11.08 *Change of Procurement Contract Price*

A. The Procurement Contract Price may only be changed by a Change Order. Any Claim for an adjustment of Procurement Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Procurement Contract Price will be determined as follows:

1. For changes in Unit Price Goods and Special Services, by application of the unit prices to the quantities of the items involved;

2. To the extent the cost of the change is not covered by unit prices, then by a mutually agreed lump sum; or

3. To the extent the cost of the change is not covered by unit prices and the parties do not reach mutual agreement to a lump sum, then on the basis of documented costs plus a Seller's fee for overhead and profit of 15%.

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11.09 *Change of Procurement Contract Times*

A. The Procurement Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Procurement Contract Times must comply with the provisions of Article 12.

11.10 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Goods and Special Services or the provisions of the Procurement Contract (including, but not limited to, Procurement Contract Price or Procurement Contract Times), the giving of any such notice will be Seller's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS, DISPUTES, AND DISPUTE RESOLUTION

12.01 *Claims*

A. The parties agree to endeavor to avoid or resolve Claims through direct, good faith discussions and negotiations whenever practicable. Such discussions and negotiations should at the outset address whether the parties mutually agree to suspend the Claims process, including the time periods established in this Paragraph 12.01; if so, a written record of such mutual agreement should be made and jointly executed.

B. Claimant shall deliver to Engineer and the other party to the Procurement Contract written notice of each Claim within 15 days after the occurrence of the event giving rise to the Claim.

C. Claimant shall deliver written supporting data to Engineer and the other party within 45 days after such occurrence unless Engineer allows an additional period of time.

D. Engineer will review each such Claim and render a decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

E. If Engineer does not render a formal written decision on a Claim within the time stated in Paragraph 12.01.D., Engineer shall be deemed to have issued a decision denying the Claim in its entirety 31 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

F. The rendering of a decision by Engineer pursuant to this Paragraph 12.01 with respect to any such Claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment) will be a condition precedent to any exercise by Buyer or Seller of such rights or remedies as either may otherwise have under the Procurement Contract Documents or by Laws or Regulations in respect of any such Claim, dispute, or other matter. If the exercise of such rights or remedies will imminently be time-barred, a party may take actions necessary to preserve such rights and remedies notwithstanding the lack of the condition precedent referred to in this paragraph.

G. If a submitted matter in question concerns terms and conditions of the Procurement Contract Documents that do not involve (1) the performance or acceptability of Goods and Special Services under the Procurement Contract Documents, (2) the design (as set forth in the Procurement Drawings, Procurement Specifications, Addenda, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Buyer and Seller that Engineer is unable to provide a decision or interpretation. If Buyer and Seller

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are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Paragraph 12.02.

H. Engineer's written decision on such Claim or a decision denying the Claim in its entirety that is deemed to have been issued pursuant to Paragraph 12.01, will be final and binding upon Buyer and Seller 30 days after it is issued unless within 30 days of issuance Buyer or Seller appeals Engineer's decision by initiating the mediation of such Claim in accordance with the dispute resolution procedures set forth in Paragraph 12.02.

I. If Article 12 has been amended to delete the mediation requirement, then Buyer or Seller may appeal Engineer's decision within 30 days of issuance by following the alternative dispute resolution process set forth in Article 12, as amended; or if no such alternative dispute resolution process has been set forth, Buyer or Seller may appeal Engineer's decision by 1) delivering to the other party within 30 days of the date of such decision a written notice of intent to submit the Claim to a court of competent jurisdiction, and 2) within 60 days after the date of such decision instituting a formal proceeding in a court of competent jurisdiction.

J. No Claim for an adjustment in Procurement Contract Price or Procurement Contract Times will be valid if not submitted in accordance with Article 12.

K. The effect on Claims of an assignment of the Procurement Contract by Buyer to a Contractor/Assignee is addressed in the Procurement Agreement, Article 5.

12.02 *Dispute Resolution Method*

A. Either Buyer or Seller may initiate the mediation of (1) any Claim decided in writing by Engineer under Paragraph 12.01 before such decision becomes final and binding, or (2) any other dispute between the parties, including but not limited to any dispute arising after final inspection of the Goods and Services. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Procurement Contract. The request for mediation must be submitted in writing to the American Arbitration Association and the other party to the Procurement Contract. Timely submission of the request will stay Engineer's decision from becoming final and binding.

B. Mediation is a condition precedent to seeking final dispute resolution under Paragraph 12.02.C. Buyer and Seller shall participate in the mediation process in good faith. The process must be concluded within 60 days of filing of the request. The date of termination of the mediation will be determined by application of the mediation rules referenced above.

C. If the mediation process does not result in resolution of the dispute, then Engineer's written Claim decision under Paragraph 12.01.D or a Claim denial pursuant to Paragraph 12.01.E becomes final and binding, or if applicable such other dispute is deemed resolved in favor of respondent, unless, within 30 days after termination of the mediation, Buyer or Seller:

1. elects in writing to invoke any final dispute resolution process provided for in the Supplementary Conditions, or

2. agrees with the other party to submit the Claim or dispute to another final dispute resolution process, or

3. if no final dispute resolution process has been provided for in the Supplementary Conditions, delivers to the other party written notice of the intent to submit the Claim

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or dispute to a court of competent jurisdiction, and within 60 days of the termination of the mediation institutes such formal proceeding.

ARTICLE 13—PAYMENT

13.01 *Applications for Progress Payments*

A. Seller shall submit to Buyer for Engineer's review Applications for Payment filled out and signed by Seller and accompanied by such supporting documentation as is required by the Procurement Contract Documents and also as Buyer or Engineer may reasonably require.

B. The timing and amounts of progress payments will be as stipulated in the Procurement Agreement.

C. Any Application for Payment that is based in whole or in part on the delivery of Goods must be accompanied by a bill of sale, invoice, or other documentation reasonably satisfactory to Buyer warranting that Buyer has rightfully received good title to the Goods from Seller and that, upon payment, the Goods will be free and clear of all liens. Such documentation will include releases and waivers from all parties with viable lien rights.

D. Buyer shall notify Seller promptly of any deficiency in the required documentation.

13.02 *Review of Applications for Progress Payments*

A. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Buyer, or return the Application to Seller indicating in writing Engineer's reasons for refusing to recommend payment.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Buyer, based on Engineer's observations of Seller's progress, as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Goods and Special Services or other obligations of Seller have progressed to the point indicated;

b. the quality of the Goods and Special Services or other obligations of Seller are generally in accordance with the Procurement Contract Documents; and

c. the conditions precedent to Seller being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Seller's progress.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Goods and Special Services or other obligations of Seller have been exhaustive, extended to every aspect of the Goods and Special Services or other obligations of Seller in progress, or involved detailed inspections of the Goods and Special Services or other

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obligations of Seller beyond the responsibilities specifically assigned to Engineer in the Procurement Contract; or

b. there may not be other matters or issues between the parties that might entitle Seller to be paid additionally by Buyer, or entitle Buyer to withhold payment to Seller.

4. Neither Engineer's review of Seller's progress for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Seller's performance or furnishing of Goods and Special Services or other obligations of Seller; or

b. for the means, methods, techniques, sequences, or procedures of construction, manufacturing, fabrication, installation, or shipping, or the safety precautions and programs incident thereto; or

c. for Seller's failure to comply with Laws and Regulations applicable to Seller's performance under the Procurement Contract; or

d. to make any examination to ascertain how or for what purposes Seller has used the money paid for the Procurement Contract Price; or

e. to determine that title to any of the Goods or component parts have passed to Buyer free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Buyer stated in Paragraph 13.02.A.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Buyer from loss because:

a. the Goods and Services are non-conforming, requiring correction or replacement;

b. the Procurement Contract Price has been reduced by Change Orders;

c. Buyer has been required to correct non-conforming Goods and Special Services in accordance with Paragraph 9.03.C, or has accepted non-conforming Goods and Special Services pursuant to Paragraph 9.03.E; or

d. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Seller and therefore justify termination for cause under the Procurement Contract Documents.

13.03 *Basis and Amount of Progress Payments*

A. The basis and amounts of the progress payments will be as provided in the Procurement Agreement, subject to the provisions of this Article 13 regarding reductions in payment.

13.04 *Suspension of or Reduction in Payment*

A. Buyer may temporarily cease making progress payments, or reduce the amount of a progress payment, even though recommended for payment by Engineer, under the following circumstances:

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1. Buyer has reasonable grounds to conclude that Seller will not furnish the Goods or the Special Services in accordance with the Procurement Contract Documents, and

2. Buyer has requested in writing assurances from Seller that the Goods and Special Services will be delivered or furnished in accordance with the Procurement Contract Documents, and Seller has failed to provide adequate assurances within ten days of Buyer's written request.

3. In addition to any reductions in payment (set-offs) recommended by Engineer, Buyer is entitled to impose a set-off against payment based on any of the following:

    a. claims have been made against Buyer based on Seller's conduct in the performance or furnishing of the Goods and Special Services, or buyer has incurred costs, losses, or damages resulting from Seller's conduct in the performance or furnishing of the Goods and Special Services, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

    b. Seller has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Point of Destination or the worksite;

    c. Seller has failed to provide and maintain required bonds or insurance;

    d. Buyer has incurred extra charges or engineering costs related to Submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

    e. the Goods and Special Services are non-conforming, requiring correction or replacement;

    f. Buyer has been required to correct non-conforming Goods and Special Services, in accordance with Paragraph 9.03.C, or has accepted non-conforming Goods and Special Services pursuant to Paragraph 9.03.E;

    g. the Procurement Contract Price has been reduced by Change Orders;

    h. an event that would constitute a default by Seller and therefore justify a termination for cause has occurred;

    i. liquidated or other damages have accrued as a result of Seller's failure to achieve Milestones, Substantial Completion, or final completion of the Goods and Special Services; or

    j. liens have been filed in connection with the Procurement Contract, except where Seller has delivered a specific bond satisfactory to Buyer to secure the satisfaction and discharge of such liens.

B. If Buyer refuses to make payment of the full amount recommended by Engineer, Buyer will provide Seller and Engineer immediate written notice stating the reason for such action and promptly pay Seller any amount remaining after deduction of the amount withheld. Buyer shall promptly pay Seller the amount withheld when Seller corrects the reason for such action to Buyer's satisfaction.

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13.05 *Final Payment*

A. After Seller has corrected all non-conformities to the reasonable satisfaction of Buyer and Engineer and furnished all Special Services, Seller may submit its final Application for Payment following the procedures for progress payments.

B. The final Application for Payment will be accompanied by all documentation called for in the Procurement Contract Documents (including but not limited to all final operations and maintenance manuals, and any special warranties), a list of all unsettled Claims, and the written consent of surety to the making of final payment.

C. If, on the basis of final inspection and the review of the final Application for Payment and accompanying documentation, Engineer is reasonably satisfied that Seller has furnished the Goods and Special Services in accordance with the Procurement Contract Documents, and that Seller has fulfilled all other obligations under the Procurement Contract Documents, then Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment subject to the provisions of Paragraph 13.02, and present the final Application for Payment to Buyer. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Buyer from loss for the reasons stated in Paragraph 13.02.

D. If Engineer does not recommend final payment, Engineer will return the final Application for Payment to Seller, indicating the reasons for refusing to recommend final payment, in which case Seller shall make the necessary corrections and resubmit the final Application for Payment.

E. In support of its recommendation of final payment Engineer will also give written notice to Buyer and Seller that the Goods and Special Services are acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 13.06.

F. If the final Application for Payment and accompanying documentation are appropriate as to form and substance, Buyer shall, within 30 days after receipt thereof, pay Seller the amount recommended by Engineer, less any sum Buyer is entitled to set off against Engineer's recommendation, pursuant to the provisions of Paragraph 13.04.

G. Buyer will not make final payment, or return or release included retainage (if any) at any time, unless Seller submits written consent of the surety to such payment, return, or release.

13.06 *Waiver of Claims*

A. By making final payment, Buyer waives its claim or right to liquidated damages or other damages for late completion by Seller, except as set forth in an outstanding Claim, appeal, set-off, or express reservation of rights by Buyer. Buyer reserves all other claims or rights after final payment.

B. The acceptance of final payment by Seller will constitute a waiver by Seller of all claims and rights against Buyer other than those pending matters that have been duly submitted or appealed under the provisions of Article 12.

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ARTICLE 14—CANCELLATION, SUSPENSION, AND TERMINATION

14.01 *Cancellation*

A. Buyer has the right to cancel the Procurement Contract, without cause, at any time prior to delivery of the Goods by written notice. Cancellation pursuant to the terms of this paragraph will not constitute a breach of contract by Buyer. Upon cancellation:

1. Buyer shall pay Seller for the direct costs incurred in producing any Goods that Seller has specially manufactured for the Project, plus a fair and reasonable amount for overhead and profit.

2. For Goods that are not specially manufactured for the Project, Seller shall be entitled to a restocking charge of 10 percent of the unpaid Procurement Contract Price of such Goods.

14.02 *Suspension of Performance by Buyer*

A. Buyer has the right to suspend performance of the Procurement Contract for up to 90 days, without cause, by written notice. Upon suspension under this paragraph, Seller shall be entitled to an increase in the Procurement Contract Times and Procurement Contract Price caused by the suspension, provided that performance would not have been suspended or delayed for causes attributable to Seller.

14.03 *Suspension of Performance by Seller*

A. Seller may suspend the furnishing of the Goods and Special Services only under the following circumstance:

1. Seller has reasonable grounds to conclude that Buyer will not perform its future payment obligations under the Procurement Contract; and

2. Seller has requested in writing assurances from Buyer that future payments will be made in accordance with the Procurement Contract, and Buyer has failed to provide such assurances within ten days of Seller's written request.

14.04 *Breach and Termination*

A. *Buyer's Breach*

1. Seller shall have the right to terminate the Procurement Contract for cause by declaring a breach if Buyer fails to comply with any material provision of the Procurement Contract. Upon termination, Seller shall be entitled to all remedies provided by Laws and Regulations.

2. If Seller believes Buyer is in breach of its obligations under the Procurement Contract, Seller shall provide Buyer with reasonably prompt written notice setting forth in sufficient detail the reasons for declaring that it believes a breach has occurred. Buyer shall have 7 days from receipt of the written notice declaring the breach (or such longer period of time as Seller may grant in writing) within which to cure or to proceed diligently to cure such alleged breach.

B. *Seller's Breach*

1. Buyer may terminate Seller's right to perform the Procurement Contract for cause by declaring a breach should Seller fail to comply with any material provision of the

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Procurement Contract Documents. Upon termination, Buyer shall be entitled to all remedies provided by Laws and Regulations.

2. In the event Buyer believes Seller is in breach of its obligations under the Procurement Contract, Buyer shall provide Seller with reasonably prompt written notice setting forth in sufficient detail the reasons for declaring that it believes a breach has occurred. Seller shall have 7 days from receipt of the written notice declaring the breach (or such longer period of time as Buyer may grant in writing) within which to cure or to proceed diligently to cure such alleged breach.

3. If and to the extent that Seller has provided a performance bond under the provisions of Paragraph 5.01, the notice and cure procedures of that bond, if any, will supersede the notice and cure procedures of Paragraph 14.04.B.2.

ARTICLE 15—MISCELLANEOUS

15.01 *Giving Notice*

A. Whenever any provision of the Procurement Contract requires the giving of written notice to Buyer, Seller, or Engineer, it will be deemed to have been validly given if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;

2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

15.02 *Controlling Law*

A. This Procurement Contract is to be governed by the law of the state in which the Goods are to be installed.

B. In the case of any conflict between the express terms of this Procurement Contract and the Uniform Commercial Code, as adopted in the state whose law governs, it is the intent of the parties that the express terms of this Procurement Contract will apply.

15.03 *Computation of Time*

A. When any period of time is referred to in the Procurement Contract by number of days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

15.04 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Procurement Contract, and the provisions of this paragraph will be as effective as if repeated specifically in the Procurement Contract in connection with each particular duty, obligation, right, and remedy to which they apply.

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15.05 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Procurement Contract, as well as all continuing obligations indicated in the Procurement Contract, will survive final payment, completion, and acceptance of the Goods and Special Services or termination or completion of the Procurement Contract or of the services of Seller.

15.06 *Entire Agreement*

A. Buyer and Seller agree that this Procurement Contract is the complete and final agreement between them, and supersedes all prior negotiations, representations, or agreements, either written or oral. This Procurement Contract may not be altered, modified, or amended except in writing signed by an authorized representative of both parties.

15.07 *No Waiver*

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Procurement Contract.

15.08 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

15.09 *Successors and Assigns*

A. Buyer and Seller each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Procurement Contract.

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SUPPLEMENTARY CONDITIONS OF THE PROCUREMENT CONTRACT

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SUPPLEMENTARY CONDITIONS OF THE PROCUREMENT CONTRACT

These Supplementary Conditions amend or supplement EJCDC® P-700, Standard General Conditions of the Procurement Contract (2019). The General Conditions remain in full force and effect except as amended.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, “Paragraph SC-4.05.”

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

SC-1.01.A.5 Add the following at the end of the Paragraph:

For the purposes of Rural Development, this term is synonymous with the term “applicant” as defined in 7 CFR 1780.7 (a) (1), (2) and (3) and is an entity receiving financial assistance from the federal programs.

SC-1.01.A.7 Add the following at the end of the Paragraph:

The Change Order form to be used on this Project is EJCDC C-941 (2018). Agency approval is required before Change Orders are effective.

SC-1.01.A.41 Add the following new paragraph immediately after Paragraph 1.01.A.40:

41. Agency - The Project is financed in whole or in part by USDA Rural Utilities Service pursuant to the Consolidated Farm and Rural Development Act (7 USC Section 1921 et seq.). The Rural Utilities Service programs are administered through the USDA Rural Development offices; therefore, the Agency for these documents is USDA Rural Development.

SC-1.01.A.42 Add the following new paragraph immediately after Paragraph 1.01.A.41:

42. Domestic Preference Definitions:

42.a - Build America, Buy America Act (BABAA) – Requirements mandated by Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§

70901-70953-58 mandating domestic preference that all iron and steel, manufactured products, and construction materials are produced in the United States, in accordance with 2 CFR part 184.

42.b - Construction Materials – Those articles, materials, or supplies — other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives— that are or consist primarily of: non-ferrous metals, plastic and polymer- based products, glass, lumber or drywall.

42.c - Contractor’s Certification – A certification submitted by Contractor that, to the best of the Contractor’s knowledge and belief, all Work complies with Domestic Preference requirements.

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42.d - De Minimis – Materials and products that represent a small portion of an infrastructure project, specifically no more than 5% of the project costs up to a maximum of $1,000,000.

42.e - Domestic Preference – The Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953.

42.f - Engineer's Certification – Documentation submitted by the Engineer that Drawings, Specifications, and Bidding Documents comply with Domestic Preference requirements.

42.g - Manufactured Product – Items assembled out of components, or otherwise made or processed from raw materials into finished products. Manufactured products must be manufactured (assembled) in the United States, and the cost of components that were mined, produced, or manufactured in the United States must be greater than 55 percent of the total cost of all components of the product.

42.h - Manufacturer's Certification – Documentation provided by the Manufacturer stating that Domestic Preference requirements have been satisfied for all provided items. Manufacturers' Certifications must include (at a minimum): specific list of products (using common names) associated with the certificate, location of the final manufacturing, signature of the manufacturer's representative, and a reference to the Domestic Preference statute. If items are purchased via a Supplier, distributor, vendor, etc. from the Manufacturer directly, then the Supplier, distributor, vendor, etc. will be responsible for obtaining and providing these certifications to the parties purchasing the products.

42.i - Minor Components - Components within an iron and/or steel product otherwise compliant with the Domestic Preference requirements. This waiver, typically used by Manufacturers, allows use of non-domestically produced miscellaneous Minor Components comprising up to five percent of the total material cost of an otherwise domestically produced iron and steel product. However, unless a separate waiver for a product has been approved, all other iron and steel components in said product must still meet the Domestic Preference requirements. This waiver does not exempt the whole product from the Domestic Preference requirements only Minor Components within said product and the iron or steel components of the product must be produced domestically.

42.j - Primarily Iron or Steel - A product is made of greater than 50 percent iron or Steel on a materials cost basis. Construction Materials - Those articles, materials, or supplies made primarily of iron and/or steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered "structural steel". Note: Mechanical and electrical components, equipment and systems are not considered Construction Materials. See definitions of Mechanical Equipment and Electrical Equipment.

ARTICLE 2—PRELIMINARY MATTERS

SC-2.02.A – Delete "four" and insert in its place "five."

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ARTICLE 3—PROCUREMENT CONTRACT DOCUMENTS

No Supplementary Conditions in this Article.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF WORK

No Supplementary Conditions in this Article.

ARTICLE 5—BONDS AND INSURANCE

SC-5.02 Add the following new paragraphs immediately after Paragraph 5.02.E:

F. Seller shall purchase and maintain such liability and other insurance as is appropriate for the furnishing of Goods and Special Services and as will provide protection from claims set forth below which may arise out of or result from Seller's furnishing of the Goods or Special Services and Seller's other obligations under the Procurement Contract Documents, whether the furnishing of Goods and Special Services or other obligations are to be performed by Seller, any subcontractor or supplier, or by anyone directly or indirectly employed by any of them to furnish the Goods and Special Services, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Seller's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Seller's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained: (a) by any person as a result of an offense directly or indirectly related to the employment of such person by Seller, or (b) by any other person for any other reason;

5. claims for damages, other than to the Goods, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

G. The policies of insurance so required by this Paragraph 5.02 to be purchased and maintained must:

1. with respect to insurance required by Paragraphs SC-5.02.F.3 through SC-5.02.F.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability):

a. The City of Aumsville, Oregon.

b. Westech Engineering, Inc.

c. all of whom must be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the

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insurance afforded to these additional insureds must provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided below or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Seller's indemnity obligations under Paragraph 7.07;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused, until at least 30 days prior written notice has been given to the purchasing policyholder and to each other additional insured identified in these Supplementary Conditions.

6. remain in effect at least until final payment and at all times thereafter when Seller may be correcting, removing, or replacing non-conforming Goods in accordance with Paragraph 9.03 and 9.04; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and Seller shall furnish Buyer and each other additional insured identified in these Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Buyer and any such additional insured of continuation of such insurance at final payment and one year thereafter).

H. The limits of liability for the insurance required by Paragraph SC-5.02.F must provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs SC-5.02.F.1 and F.2:

a.	State:	Statutory
b.	Applicable Federal (e.g., Longshoremen's)	Statutory
c.	Employer's Liability	$500,000

d. In accordance with ORS 279B.230, Contractor shall promptly, as due, make payment to any entity furnishing care incident to sickness or injury, to employees of Contractor, of all sums which Contractor agrees to pay for such care and all moneys which Contractor deducted from the wages of employees pursuant to any law, contract, or agreement for the purpose of providing or paying for such service.

e. Contractor and Subcontractors that employ workers who work under this Contract in the State of Oregon shall comply with ORS 656.017 and provide required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. Contractor shall ensure that each of its Subcontractors complies with these requirements.

2. Seller's General Liability under Paragraphs SC-5.02.F.3 through F.6 which must include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Seller:

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a. Each Occurrence (Bodily Injury and Property Damage) $1,000,000

b. Medical Expense (any one person) $10,000

c. Personal and Advertising Injury $1,000,000

d. General Aggregate $2,000,000

e. Products & Completed Operations Aggregate $2,000,000

f. Property Damage liability insurance shall NOT exclude Explosion, Collapse, and Underground (XCU) coverages (no XCU exclusion), with the exception that exclusions for blasting operations are acceptable for insurance covering projects which do not include or allow blasting.

g. Excess or Umbrella Liability

1) General Aggregate $2,000,000

2) Each Occurrence $2,000,000

3. Automobile Liability under Paragraph SC-5.02.F.6:

a. Bodily Injury

1) Each Person $1,000,000

2) Each Accident $1,000,000

b. Property Damage

1) Each Accident $1,000,000

2) Combined Single Limit of $1,000,000

c. If each of the categories listed above does not include the full listed limits, the umbrella coverage shall be increased to $8,000,000 and include coverage for all auto categories.

I. Seller shall deliver to Buyer, with copies to each additional insured identified in these Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Buyer or any other additional insured) which Seller is required to purchase and maintain. Certificates of insurance shall be delivered to the City within 10 days after the award of the Procurement Agreement.

ARTICLE 6—LICENSES AND FEES

SC-6.02.A Delete this paragraph and replace with the following paragraph.

A. Subject to Paragraph 6.01, to the fullest extent permitted by Laws and Regulations, Seller shall indemnify, defend, and hold harmless Buyer, Engineer, and their officers, directors, members, partners, employees, agents, consultants, contractors, and subcontractors, from and against all claims, costs, losses, damages, and judgments (including but not limited to all reasonable fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement or alleged infringement of any patent, copyright, or other intellectual property

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right by any of the Goods, including materials or any part thereof, as delivered or Special Services as performed.

ARTICLE 7—SELLER'S RESPONSIBILITIES

SC-7.03.A.1 Add the following paragraph after Paragraph 7.03A

1) While not intended to be inclusive of all Laws and Regulations for which Seller may be responsible under paragraph 7.03, the following Laws or Regulations are included as mandated: Oregon Revised Statutes 279.

2) Seller shall comply with the public contracting requirements set forth in Exhibit A to the Supplementary Conditions of the Contract.

SC-7.02.C Add the following new paragraph immediately after Paragraph 7.02.B:

All Materials and products incorporated into the Work shall meet the Domestic Preference requirements.

SC-7.04.A Amend the second sentence of paragraph by striking out the following words

Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item is permitted,

SC-7.04.A.2 Amend the first sentence of Paragraph by deleting the following:

"it has an acceptable record of performance and availability of responsive service; 4)"

SC-7.04.D Add the following at the end of paragraph:

"Seller shall include a Manufacturer's Certification letter for compliance with Domestic Preference requirements, if applicable. Refer to Manufacturer's Certification Letter provided in these Contract Documents."

SC-7.06.A.1.c Amend paragraph by deleting the last period and adding:

", including Manufacturer's Certification letter for any item in the submittal subject to Domestic Preference requirements. Refer to Manufacturer's Certification Letter provided in these Contract Documents."

SC-7.06.C.9 Add new paragraph immediately after Paragraph 7.06.C.8:

9.Engineer's review and approval of a Shop Drawing or Sample shall include review of Manufacturers' Certifications in order to document compliance with Domestic Preference requirements, as applicable.

SC-7.07.A Delete this paragraph and replace with the following paragraph.

A. To the fullest extent permitted by Laws and Regulations, Seller shall indemnify, defend, and hold harmless Buyer, Engineer, Project Owner, and any assignee of Buyer, including Contractor/Assignee, and their officers, directors, members, partners, employees, agents, consultants, contractors, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of Seller's obligations under the Procurement Contract, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness,

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disease, or death, or to injury to or destruction of property, including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Seller, or any individual or entity directly or indirectly employed by Seller or anyone for whose acts Seller may be liable.

SC-7.08.A Amend by adding the following to the end of the paragraph:

The total amount of work subcontracted by the Seller shall not exceed fifty percent of the Procurement Contract price without prior approval from the Owner, Engineer and Agency.

ARTICLE 8—SHIPPING AND DELIVERY

SC-8.02.A Delete this paragraph and replace with the following paragraph

A. Seller shall deliver the Goods free on board (FOB) to the Point of Destination, freight and insurance prepaid, in accordance with the Procurement Contract Times set forth in the Procurement Agreement, or other date agreed to by Buyer and Seller.

ARTICLE 9—BUYER'S RIGHTS

SC-9.01.F Add new paragraph immediately after Paragraph 9.01.E:

F. Seller shall certify prior to final payment that all Work and Materials have complied with Domestic Preference requirements. Seller shall provide Certification to Owner and Engineer. Refer to the Sample Language for Contractor's Certification provided in these Contract Documents.

SC-9.01.G Add new paragraph immediately after Paragraph 9.01F:

G. Seller warrants the Goods to be free from defects in materials and workmanship under normal use and service for a period of one year from the date that Substantial Completion is issued to the General Construction Contractor. The Goods shall be warranted to meet all functional and performance requirements. The above provisions do not in any way limit the guarantees on any items for which a longer guarantee is specified or on any items for which a manufacturer gives a guarantee for a longer period. Seller shall furnish to Buyer all appropriate guarantee or warranty certificates as indicated in the Procurement Specifications or upon request by Buyer.

SC-9.01.H Add new paragraph immediately after Paragraph 9.01G:

H. Notwithstanding any express warranties provided elsewhere, the implied warranties of merchantability and of fitness for a particular purpose are applicable and shall not be deemed to be excluded or modified, and Seller may not exclude or modify them. Goods provided shall also be covered by any additional warranty customarily provided by Seller or by the manufacturer of the Goods.

SC-9.03.A.1 Add new Paragraph 9.03.A.1 immediately after Paragraph 9.03.A:

1. Goods that are non-compliant with Domestic Preference requirements are considered non-conforming.

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ARTICLE 10—ENGINEER'S STATUS

No Supplementary Conditions in this Article.

ARTICLE 11—CHANGES

SC-11.02.C Add new paragraph immediately after Paragraph 11.02.B:

C. The Buyer shall contact the Agency for concurrence on each Change Order prior to issuance. All Contract Change Orders must be concurred on (signed) by Agency before they are effective.

ARTICLE 12—CLAIMS, DISPUTES, AND DISPUTE RESOLUTION

No Supplementary Conditions in this Article.

ARTICLE 13—PAYMENT

SC-13.01.E Add new paragraph immediately after Paragraph 13.01.D:

E. The Application for Payment form to be used on this Project is EJCDC® C-620. The Agency must approve all Applications for Payment before payment is made.

SC-13.01.F Add new paragraph immediately after Paragraph 13.01.E:

F. By submitting an Application for Payment based in whole or in part on furnishing equipment or materials, Seller certifies that such equipment and materials are compliant with Domestic Preference requirements. Manufacturer's Certification letter for materials satisfy this requirement. Refer to Manufacturer's Certification Letter provided in these Contract Documents.

SC-13.02.A.2.d Add the following new paragraph immediately after Paragraph 13.02.A.2.c:

d. The materials presented for payment in an Application for Payment comply with Domestic Preference requirements.

SC-13.05.G Add the following language at the end of paragraph:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage or invest the retainage for the benefit of the Contractor.

ARTICLE 14—CANCELLATION, SUSPENSION, AND TERMINATION

No suggested Supplementary Conditions in this Article.

ARTICLE 15—MISCELLANEOUS

SC-15.10 Add new paragraph immediately after Paragraph 15.09:

15.10 Tribal Sovereignty

A. No provision of this Agreement will be construed by any of the signatories as abridging or debilitating any sovereign powers of the [insert name of Tribe] Tribe; affecting the trust-beneficiary relationship between the Secretary of the Interior, Tribe, and Indian

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landowner(s); or interfering with the government- to-government relationship between the United States and the Tribe.

SC-16 – Add the following new Article 16 immediately after Article 15:

ARTICLE 16—FEDERAL REQUIREMENTS

16.01 Agency Not a Party

A. This Contract is expected to be funded in part with funds provided by Agency. Neither Agency, nor any of its departments, entities, or employees, is a party to this Contract.

16.02 Procurement Contract Approval

A. Buyer and Seller will furnish Buyer's attorney such evidence as required so that Buyer's attorney can complete and execute the "Certificate of Owner's Attorney and Agency Concurrence" (Exhibit A, Attachment 1 of RUS Bulletin 1780-26) before Buyer submits the executed Procurement Contract Documents to Agency for approval.

B. Agency concurrence is required on both the Bid and the Procurement Contract before the Procurement Contract is effective.

16.03 Conflict of Interest

A. Seller may not knowingly Procurement Contract with a Supplier or Manufacturer if the individual or entity who prepared the Drawings and Specifications has a corporate or financial affiliation with the Supplier or Manufacturer. Buyer's officers, employees, or agents shall not engage in the award or administration of this Procurement Contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest or other interest in or a tangible personal benefit from the Seller. Buyer's officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from Seller or subcontractors.

16.04 Gratuities

A. If Buyer finds after a notice and hearing that Seller, or any of Seller's agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of Buyer or Agency in an attempt to secure this Procurement Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Procurement Contract, Buyer may, by written notice to Seller, terminate this Procurement Contract. Buyer may also pursue other rights and remedies that the law or this Procurement Contract provides. However, the existence of the facts on which Buyer bases such findings shall be an issue and may be reviewed in proceedings under the dispute resolution provisions of this Contract.

B. In the event this Procurement Contract is terminated as provided in paragraph 16.04.A, Buyer may pursue the same remedies against Seller as it could pursue in the event of a breach of this Procurement Contract by Seller. As a penalty, in addition to any other damages to which it may be entitled by law, Buyer may pursue exemplary damages in an amount (as determined by Buyer) which shall not be less than three nor more than ten

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times the cost Seller incurs in providing any such gratuities to any such officer or employee.

16.05 Small, Minority and Women's Businesses

A. If Seller intends to let any subcontracts for a portion of the work, Seller will take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible. Affirmative steps will include:

1. Placing qualified small and minority businesses and women's business enterprises on solicitation lists;

2. Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;

3. Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises;

4. Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises;

5. Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.

16.06 Anti-Kickback

A. Seller shall comply with the Copeland Anti-Kickback Act (40 USC 3145) as supplemented by Department of Labor regulations (29 CFR Part 3,

"Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans or Grants of the United States"). The Act provides that Seller or subcontractor shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public facilities, to give up any part of the compensation to which they are otherwise entitled. Buyer shall report all suspected or reported violations to Agency.

16.07 Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended

A. Seller to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

16.08 Equal Employment Opportunity

A. The Procurement Contract is considered a federally assisted construction contract. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 FR 12319, 12935, 3 CFR Part, 1964-1965

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Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Procurement Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."

16.09 Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)

A. Seller that applies or bid for an award exceeding $100,000 must file the required certification (RD Instruction 1940-Q Exhibit A-1). The Seller certifies to the Buyer and every subcontractor certifies to the Seller that it will not and has not used federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining the Procurement Contract if it is covered by 31 U.S.C. 1352. The Seller and every subcontractor must also disclose any lobbying with non-federal funds that takes place in connection with obtaining any federal award. Such disclosures are forwarded from tier to tier up to the Buyer. Necessary certification and disclosure forms shall be provided by Buyer.

16.10 Environmental Requirements

A. When constructing a Project involving trenching and/or other related earth excavations, Seller shall comply with the following environmental conditions:

1. Wetlands – When disposing of excess, spoil, or other Construction Materials on public or private property, Seller or subcontractor shall not fill in or otherwise convert wetlands.

2. Floodplains – When disposing of excess, spoil, or other Construction Materials on public or private property, Seller or subcontractor shall not fill in or otherwise convert 100-year floodplain areas (Standard Flood Hazard Area) delineated on the latest Federal Emergency Management Agency Floodplain Maps, or other appropriate maps, e.g., alluvial soils on NRCS Soil Survey Maps.

3. Historic Preservation – Buyer shall ensure that the seller and/or subcontractor maintains a copy of the following inadvertent discovery plan onsite for review:

4. Endangered Species – Seller or subcontractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of Seller or subcontractor, Seller or subcontractor will immediately report this evidence to Buyer and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the U.S. Fish and Wildlife Service.

B. Mitigation Measures – The following environmental mitigation measures are required on this Project:

1. Buyer shall obtain and comply with all required County, State, and federal permits, including mitigations measures.

2. An Inadvertent Discovery Plan (IDP) must be "in place" before construction begins. If earth disturbing activities during project construction uncover cultural

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materials (i.e. Structural remains, historic artifacts, or prehistoric artifacts), the area around the discovery shall be secured, all work shall cease, and the appropriate authorities shall be contacted to discuss appropriate protocol for removal, inventory, and proper preservation of the resource(s). These authorities are: 1) RD State Environmental Coordinator (SEC) Brian Daily, at (503) 801-2689; 2) the Oregon State Historic Preservation Office Archaeologist, Jamie French, at (503) 979-7580. The RD SEC will notify any applicable tribal contacts.

3. If earth disturbing activities in any portion of the project area uncover human remains, all work shall cease immediately in accordance with Treatment of Native American Human Remains Discovered Inadvertently or through Criminal Investigations on Private and Public, State-Owned Lands in Oregon and ORS 97.740-.994 and 358.905-961. The area around the discovery shall be secured and the Morrow County Coroner and RD SEC shall be notified immediately. The RD SEC shall notify the State Archaeologist at SHPO and the appropriate tribes without delay.

4. Wetland areas, if identified, will be avoided during construction as much as possible. Best management practices (BMPs), such as the placement of silt fencing and appropriate buffering, will be used in proposed project areas located near wetland areas, and disturbed areas will be restored following construction. If any staging or additional grading is required for the wastewater improvements, within the inventoried wetlands areas along Johnson Road the DSL shall be notified for comments. An Oregon Removal-Fill Law (ORS 196.795-990) may be required.

5. In order to alleviate the health risk to the community in event of a flood, the design of the system shall provide that in event of a flood the system remain operable in order to process wastewater and alleviate a health risk.

6. If trees or shrubs are removed during the migratory bird breeding season (April 15 through August 10), a nest survey should be completed prior to vegetation disturbance.

7. Project equipment will be cleaned prior to arriving on site and before leaving the work site, with routine monitoring and control of weeds.

8. Fugitive dust control measures shall be applied as needed.

9. Construction activities shall be limited to daylight hours to reduce noise impacts.

16.11 Procurement Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708)

A. Where applicable, for contracts awarded by the Buyer in excess of $100,000 that involve the employment of mechanics or laborers, the Seller will comply with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, the Seller will compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic will be required to work in surroundings or under

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working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

16.12 Debarment and Suspension (Executive Orders 12549 and 12689)

A. A Procurement Contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

16.13 Procurement of recovered materials

A. The Seller will comply with 2 CFR Part 200.322, "Procurement of recovered materials."

16.14 Domestic Preference

A. Build America, Buy America Act (BABAA). All Iron and Steel Products, Manufactured Products, and Construction Materials used in this project must comply with the Build America, Buy America Act (BABAA) requirements mandated by Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953. Aggregates such as stone, sand, or gravel do not apply to BABAA

B. The following waivers apply to this Contract:

1. BABAA De Minimis, Small Grants and Minor Components

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EXHIIBIT A
TO
SUPPLEMENTARY CONDITIONS OF THE PROCUREMENT CONTRACT

Oregon Public Contracting Requirements

A. **Conditions Concerning Payment**. Seller agrees to (1) make payment promptly, as due, to all persons supplying to Seller labor or material for the performance of the work provided for in the Procurement Agreement; (2) pay all contributions or amounts due the Industrial Accident Fund from Seller or subcontractor incurred in the performance of the Procurement Agreement; (3) not permit any lien or claim to be filed or prosecuted against the state or a county, school district, municipality, municipal corporation or subdivision thereof, on account of any labor or material furnished; and (4) pay to the Department of Revenue all sums withheld from employees under ORS 316.167.

B. **Medical Care and Workers' Compensation.** Seller shall promptly, as due, make payment to any person, copartnership, association or corporation furnishing medical, surgical and hospital care services or other needed care and attention, incident to sickness or injury, to the employees of Seller, of all sums that Seller agrees to pay in connection with the Goods and all moneys and sums that Seller collected or deducted from the wages of employees under any law, contract or agreement for the purpose of providing or paying for the Goods.

C. **Nondiscrimination**. During the term of the Procurement Agreement, Seller shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, age, sexual orientation, disability or national origin.

D. **Hours of Labor**. Pursuant to ORS 279B.020, ORS 279B.235, and ORS 279C.520 Seller shall pay employees for overtime work performed under this Agreement in accordance with ORS 653.010 to 653.261 and the Fair Labor Standards Act of 1938 (29 U.S.C. 201 et seq.).

E. **Compliance with Laws and Regulations**. Seller shall adhere to all applicable federal, state, and local laws, regulations, executive orders and ordinances applicable to the work under this Agreement. Seller shall comply with the clauses required in every public Agreement entered into in the State of Oregon as set forth in ORS 279B.220, 279B.225, 279B.230, 279B.235, 279C.505, 279C.510, 279C.515, 279C.520, and 279C.530, which are hereby incorporated by reference.

F. **Audit and Inspection of Records**

i. Seller shall maintain a complete set of records relating to this Procurement Agreement in accordance with generally accepted accounting procedures. Seller shall permit the authorized representatives of Buyer, to inspect and audit all work, materials, payrolls, books, accounts, and other data and records of Seller relating to its performance under this Procurement Agreement until the expiration of three (3) years after final payment under this Procurement Agreement.

ii. Seller further agrees to include in all of its subcontracts under this Procurement Agreement a provision to the effect that the subcontractor agrees that Buyer, or any of their duly authorized representatives shall, until the expiration of three (3) years after final payment under the subcontract, have access to and the right to examine any directly pertinent books, documents, papers, and other records of the subcontractor.

iii. The periods of access and examination described in subparagraphs i and ii of this Section

for records that relate to (1) disputes between Buyer and Seller, (2) litigation or settlement of claims arising out of the performance of the Procurement Agreement, or (3) costs and expenses of the Procurement Agreement as to which exception has been taken by the Comptroller General or any of his or her duly authorized representatives, shall continue until all disputes, claims, litigation, appeals, and exceptions have been resolved.

G. **Certificate of Oregon Tax Law Compliance**. By signature hereto, both Parties agree to this Agreement as written. Seller affirms, under penalty of perjury as provided in ORS 305.385(6), that to the best of its knowledge it is not in violation of any Oregon Tax Laws set forth at ORS Chapters 118, 314, 316-18, 321 and 323 and the elderly rental assistance program under ORS 310.630-310.706; under ORS 320.005-320.150; under ORS 403.200–403.250 and any local tax laws administered by the Oregon Department of Revenue under ORS 305.620.

BUYER'S ACKNOWLEDGMENT OF RECEIPT OF GOODS

Buyer:	The City of Aumsville	Buyer's Project No.:
Engineer:	Westech Engineering, Inc.	Engineer's Project No.:
Seller:		Seller's Project No.:
Project:		
Contract Name:		

This Buyer's Acknowledgment of Receipt of Goods (Acknowledgment) applies to:

☐ All Goods ☐ The following specified portions of the Goods: **[Specify]**

Date of delivery of the Goods to the Point of Destination: **[Date]**

Date of Buyer's visual inspection of the Goods: **[Date]**

Date of this Acknowledgment: **[Date]**

Buyer acknowledges:

1. The Goods to which this notice applies have been delivered to the Point of Destination.
2. Buyer has visually inspected such Goods pursuant to Paragraph 9.02.B.1 of the General Conditions of the Procurement Contract.
3. Based on the visual inspection, such Goods appear to comply with the requirements of the Procurement Contract Documents as to quantities and condition, subject to any exceptions and limitations in this Acknowledgment.
4. Such Goods are deemed received for purposes of Paragraph 9.02.B.2 of the General Conditions of the Procurement Contract.
5. Seller may submit its Application for Payment for the delivered Goods, subject to the terms of the Procurement Agreement.

Exceptions (if any) to this Acknowledgment: ☐ None ☐ As follows:

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The responsibilities between Buyer and Seller for securing and storing the Goods, maintaining the Goods during storage, and for furnishing the Special Services, shall be as provided in the Procurement Contract.

The following documents are attached to and made a part of this Acknowledgement:

[List, if any, or indicate None]

This Acknowledgment does not constitute an acceptance of any Goods not in conformance with the Procurement Contract Documents, nor is it a release of Seller's obligation to furnish all Goods and Special Services in accordance with the Procurement Contract.

Buyer

By (signature): _____

Name (Printed): _____

Title: _____

Date: _____

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BUYER'S NOTICE REGARDING CONFORMITY OF GOODS AND SPECIAL SERVICES

Buyer:	The City of Aumsville	Buyer's Project No.:
Engineer:	Westech Engineering, Inc.	Engineer's Project No.:
Seller:		Seller's Project No.:
Project:		
Contract Name:		
Notice Date:	Effective Date of the Procurement Contract:	

Buyer hereby gives notice to Seller that, to the best of Buyer's knowledge, information, and belief, the Goods and Special Services:

☐ Are in conformance with the Procurement Contract Documents. Upon Seller's submittal of its final Application for Payment in accordance with the Procurement Contract Documents, Seller will be eligible for final payment, except as expressly indicated in the Procurement Contract.

☐ Are nonconforming with the Procurement Contract Documents for the following reason(s):

1. **[List reason(s) and clearly cite contractual provisions and factual circumstances of each]**

Seller's Special Services were completed on: **[fill in date]**

Notes to User—Where the Procurement Contract has not been assigned by initial Buyer, use the following paragraph. If the Procurement Contract has been assigned, delete the following paragraph.

Buyer has consulted with and received Engineer's recommendation on conformity of the Goods and Special Services.

This Buyer's Notice Regarding Conformity of Goods and Special Services (Notice) is made expressly subject to the following terms and conditions to which all who receive and rely on said Notice agree: **[Edit the following to suit the specific procurement]**

1. This Notice is expressly subject to the terms and conditions set forth in the Procurement Contract.
2. This Notice is not a guarantee or warranty of Seller's performance under the Procurement Contract, an acceptance of Goods and Special Services that are not in accordance with the related Procurement Contract Documents, including but not limited to nonconforming Goods and Special Services discovered after final inspection, nor an assumption of responsibility for any failure of Seller to furnish the Goods and Special Services thereunder in accordance with the Procurement Contract, or to otherwise comply with the Procurement Contract Documents or the terms of any special guarantees specified therein.
3. This Notice does not relieve Seller of any surviving obligations under the Procurement Contract and is subject to Buyer's reservations of rights with respect to completion and final payment.

Buyer

By (signature): _____ Name (Printed): _____

Date: _____ Title: _____

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PART 4:

SPECIFICATIONS

SECTION 11400
PACKAGED DAF EQUIPMENT

PART 1: GENERAL

1.1 SUMMARY

a. This section covers the Work necessary for a packaged dissolved air floatation clarifier (DAF) system supplier to furnish a pre-engineered, factory preassembled and wired, skid-mounted, DAF equipment package, complete and operable with all ancillary equipment including a packaged control system. The packaged unit shall be prewired with single power, control, and single piping connections for the inlet, outlet, and float/sludge pump discharge.

b. At a minimum, the equipment package shall include the items listed below.
   1) A flocculation tank or tube flocculator including all mechanical equipment.
   2) DAF clarifier including all mechanical equipment.
   3) Sludge/Float collection and pump.
   4) Recycle pump and all air saturation equipment including air compressor.
   5) Stairs and walkways.
   6) Coagulant Feed Equipment.
   7) Polymer Feed Equipment.
   8) Instrumentation.
   9) A packaged control panel to control the DAF equipment.
   10) Operations and maintenance manual.
   11) Warranty as specified.
   12) Startup assistance and training.

1.2 RELATED SECTIONS

a. This section is supplemented by the following sections.
   1) Section 16090, Packaged Electrical System Requirements
   2) Section 17090, Packaged Control System Requirements

1.3 DOMESTIC PREFERENCE REQUIREMENTS.

a. The project is being funded with assistance from the USDA Rural Development Department. All equipment furnished under this procurement shall comply with the Build America, Buy America Act (BABA) under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953. Absent an approved waiver, all iron, steel, manufactured products, and construction materials used in this project must be produced in the United States. All proposers shall complete and submit the "Manufacturer's Certification of Compliance" form included in the Information for Bidders with their proposal as described in the Information for Bidders.

1.4 BACKGROUND INFORMATION

a. Design Conditions. The City's existing treatment plant is unable to consistently produce effluent meeting the effluent limits in the City's NPDES permit. The City plans to construct a new sequencing batch reactor (SBR) treatment plant to treat the wastewater. Beginning May 1 of each year and continuing through October, treated effluent from the SBR process will be stored in existing effluent storage lagoons onsite. From May through October, no treated effluent from the SBR process will be discharged to the receiving stream. From November through April, the effluent stored in the lagoons will be polished using a dissolved air floatation (DAF) clarifier and blended with effluent from the SBR process, disinfected, and discharged to the receiving stream. The primary treatment goal of the DAF equipment it to remove algae and solids in the effluent stored in the storage lagoons. The DAF equipment will be operated seasonally from November through April. From May through October, the DAF equipment will not be used. Therefore, the DAF equipment shall be designed to be easily taken out of service. Effluent stored in the lagoons will be pumped from the lagoons to the package DAF clarifier. The pump station will be designed and furnished by the Owner. The DAF supplier shall provide a packaged DAF clarifier that includes aluminum or stainless-steel tankage, inlet flow meter, chemical injection points, flocculation equipment, air saturation equipment, recycle pumps, float and sludge skimming and collection equipment, effluent launders, a pump to convey float and sludge to the sludge storage lagoon, all internal process piping, chemical storage and dosing systems for coagulant and polymer, instruments, and controls. The DAF system shall be suitable for mounting on a concrete pad inside a metal treatment plant building. The DAF system supplier scope of supply is described in greater detail below.

b. Preliminary Drawings. Preliminary drawings for the treatment system improvements are included in Appendix A. The drawings are based on a DAF process manufactured by AWC Solutions. If this procurement results in the selection of a different DAF supplier, the drawings will be revised accordingly. The drawings in Appendix A are preliminary in nature, not ready for construction purposes, and are for informational purposes only. The information presented in these bidding documents and this specification take precedence over any conflicting information shown on the drawings included in Appendix A.

1.5 DESIGN CRITERIA

a.	DAF treatment capacity:	300 gpm
b.	Raw Water TSS:	3-50 mg/L
c.	Raw Water Alkalinity:	> 100 mg/L as CaCO3
d.	Raw Water pH:	7 – 8
e.	Raw Water Temperature:	5 – 20 °C
f.	Treated Water TSS	< 10 mg/L
g.	Treated Water pH	6.5 – 8.9

h. Owner will furnish additional equipment as needed to adjust pH and/or alkalinity of the raw water. Supplier does not need to include this equipment in their scope of supply. The inlet piping shall include at least two spare chemical injection points in addition to the chemical injection points required for the coagulant and polymer.

1.6 SUBMITTALS

a. Required with Proposal: Provide submittal information in accordance with the following outline.

1) Manufacturer Information:
   a) A brief history of the manufacturing company
   b) Manufacturer location information and contact information.
   c) Duration manufacturer has been in business
   d) Duration manufacturer has been manufacturing dissolved air floatation equipment systems.
   e) Project Manager name and qualifications proposed for this project. The proposed project manager shall be Owner's primary point of contact throughout this project.
   f) Location and qualifications of the nearest qualified service representative.

2) Manufacturer Experience:
   a) Total number of DAF facilities installed in the last 10 years including location and capacity.
   b) Total number of DAF facilities designed to primarily remove algae. Include location, capacity, and owner contact information.
   c) Provide owner name, location, contact name, contact telephone number, capacity, date of installation, and model name and/or number for at least two similar facilities with a minimum treatment capacity of 300 gpm in Oregon, Washington, or Idaho.

3) Exceptions: Identify any exceptions to these Contract Documents.

4) Missing Items: Identify components that are not specified, but are necessary to provide a fully operational system that provides the required treatment including any pH or alkalinity adjustment needs.

5) Recommendations: Provide recommendations to make DAF system more cost-effective or to improve operation and maintenance. For each recommendation, identify any advantages and disadvantages in terms of operational flexibility, system performance, or operations and maintenance requirements.

6) Process Description: Provide technical information describing the proposed treatment process.

7) Design Calculations: Provide design calculations supporting the proposed design including basin sizing calculations, recycle pump and air saturation equipment sizing calculations, and estimates of float/solids production rates at a minimum.

8) Design Criteria: Provide a listing of design criteria for the DAF equipment including raw water flows and quality, anticipated effluent quality, tank sizes, tank and piping materials, skid materials, operating water levels, pumping rates, coagulant, and polymer type and consumption rates, etc. Provide horsepower,

voltage, and NEMA rating for all motors and approximate run time in hours per day, etc.

9) Equipment List: Provide a complete listing of all proposed equipment including manufacturer and model, capacity, horsepower, constant speed versus adjustable speed drives, voltage, and other similar information.

10) Excluded Items: Provide a list of all materials and equipment that must be furnished and installed by the Construction General Contractor to complete the system such as anchor bolts, piping, valves, field wiring, etc.

11) Drawings: Show plan layout and cross sections and dimensions of the required tanks and all equipment and instrumentation.

12) Building Dimensions: Provide recommended ceiling height and clearances around the equipment.

13) Process and Instrumentation Diagram.

14) Instrumentation: Describe software, hardware, control features, monitoring, data storage, and alarms.

15) Operation Description: Provide operations guide including procedures for system initial startup, annual startup at the beginning of the winter discharge season (November 1-April 30), normal operating procedures, and procedures for taking the equipment out of service for the summer storage period (May 1 – October 31).

16) Annual O&M cost estimate along with a 20-year life-cycle cost analysis for the proposed equipment. This shall include an itemized cost for all materials and equipment reasonably expected to require replacement during a 20-year period. Provide projected monthly electrical cost for supplied equipment assuming the electrical cost to be $0.10 per kW-hour. Use current market rates for coagulant and polymer costs. Calculations shall be based on the equipment operating at a flow of 300 gpm on a 24-hour basis for 30 days.

17) Equipment and personnel available for pilot testing: Describe the manufacturer's equipment personnel available for pilot testing. Include the estimated cost for a two-week pilot study at the treatment plant site in Aumsville, Oregon. The cost estimate for pilot testing is understood to be an estimate only rather than a firm price. If authorized by the Owner, the final scope, duration, objectives, details, and costs of any pilot testing will be negotiated after project award and funds from the Buyer's Contingency Allowance (See general condition 11.6) will be used to compensate the supplier for the pilot testing.

18) Spare Parts: List of recommended spare parts and costs.

b. Required after Notice of Award:
   1) Provide initial action submittal 60 calendar days after Notice to Proceed.
   2) Provide resubmittal 21 days after receipt of Engineer's review comments.
   3) Action Submittals:
      a) Detailed drawings, with mechanical, electrical, and instrumentation connection types and sizes shown and dimensioned for each component including manufacturer, materials of construction, and spare parts provided.
      b) Location and layout of all anchor bolts for mounting equipment skids and panels.
      c) Plan, section, and detail drawings in PDF and CAD format for all equipment including chemical feed pump panels.
      d) List of all original equipment by model and part number (detailed bill-of-materials). List manufacturer names, addresses, and phone numbers.
      e) Pumps, Actuators, Valves, Compressors, etc.:
         (1) Make, model, weight, and horsepower of each equipment assembly.
         (2) Complete catalog information, descriptive literature, specifications, and identification of materials of construction. seal, coupling, and bearing literature shall be included with pump information.
         (3) Performance curves.
         (4) Data and diagrams per Section 16070, Packaged Electrical System Requirements, including:
            (a) Power and control wiring diagrams, including terminals and numbers.
            (b) Complete motor nameplate data, as defined by NEMA, motor manufacturer, and motor modifications.
      f) Sample of proposed warranty.
      g) Electrical:
         (1) Shop drawings for the control panel including control panel construction drawings, enclosure sizes, exterior panel elevations, panel interior elevations, schematic and ladder logic drawings with field wiring terminations clearly identified.
         (2) Complete composite diagram showing wiring of power and control interconnections between each component of the packaged system
         (3) List number and capacity of transformer(s), if any. List any components that will run off power supply other than 480V, three-phase.
         (4) For Each Motor: Frequency of operation and percent of full load operation for power demand analysis.
      h) Instrumentation and Control:
         (1) P&IDs, in PDF and CAD format.
         (2) Process and instrumentation diagrams and description of functions monitored, controlled, and alarmed.
         (3) Submittals required per Section 17090, Packaged Control System Requirements.

c. Informational Submittals

1) Installation guide for use by the Construction General Contractor. Installation information shall, at a minimum, include assembly instructions, mounting requirements, and recommended startup and commissioning sequence.
2) Shipping information including size and type of vehicles used for shipping, number of shipments, number and weight of each component of each shipment.
3) Unloading requirements for each component of each shipment.
4) Recommended handling method, and requirements for storage and protection of all components prior to installation and following installation but prior to startup.
5) Assembly instructions for any components that are shipped unassembled.
6) Operation and Maintenance Manual for all equipment. The manuals shall be written specifically for this project and shall include detailed process operation instructions, start-up, and shutdown procedures, process control and troubleshooting procedures, emergency procedures, and all necessary safety precautions. The O&M manual shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances supplied under this Section. Manuals shall be supplied in three ring binders with a labelled cover sheet and spine.
7) Data summary from testing and startup period.

1.7 WARRANTY

a. Supplier shall warrant all equipment furnished to be free from defects in materials and workmanship under normal use and service for a period of one year from the date that Substantial Completion is issued to the General Construction Contractor. The entire equipment package shall be warranted to meet all functional and performance requirements.

1.8 EXTRA MATERIALS

a. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:

1) Expendable material such as gaskets, seals, and packing: One complete set.
2) Special tools required to maintain or dismantle, if any required: One complete set.
3) Spare recycle pump: One uninstalled spare.
4) Spare sludge pump: One uninstalled spare.
5) Mixer motor, rake drive motor, scum skimming drive motor: One uninstalled spare.
6) Solenoid Valves: One uninstalled spare for each type and size.
7) Any other items listed below.

PART 2: PRODUCTS

2.1 GENERAL

a. The packaged DAF treatment unit shall be a single-train. Redundancy of mechanical equipment shall be provided by supplying uninstalled spare equipment as noted below.

b. All metallic components including the tanks, skid, support structure, and miscellaneous metal components shall be exclusively either Type 304 stainless steel, Type 316 stainless steel or marine grade aluminum to avoid contact between dissimilar metals. Painted, mild-steel components shall not be used.

c. Equipment shall fully comply with OSHA standards.

d. Terminal piping connections shall be ANSI standard flanges.

e. Provide skid complete with fasteners, supports, wiring, and other components to constitute a complete and operable system including interconnecting piping for all skid-mounted components. For systems that include more than one equipment skid where interconnect piping between the two skids will not be furnished by the Supplier, the Supplier shall clearly identify the interconnection requirements that must be completed in the field.

f. Provide labels on all piping to indicate service and direction of flow.

g. Provide true union fittings for piping where future disconnection may be needed at valves, pumps, etc.

h. Provide single connection points for the raw water inlet, treated water outlet, spray wash water, float/sludge pump discharge pipe, drain pipe, chemical injection points for all manufacturer-supplied chemical systems including the polymer and coagulant feed systems and two spare chemical injection points.

i. All valve actuators shall be electric and shall include position indicators and outputs for valve position feedback monitored by the DAF control system.

j. Provide manual drain valves on all tankage to facilitate seasonal decommissioning. Plumb all drain valves on each package skid to a single discharge point.

k. Provide packaged DAF tankage with a stairway and walkway along the length of the tank including all handrails in accordance with OSHA requirements. The stairs and walkway shall be marine grade aluminum.

2.2 FLOCCULATION SYSTEM

a. Provide flocculation tank or tube flocculators including all motors, valves, chemical injection points, chemical mixing equipment, and mechanical flocculators (for systems that utilize flocculation tanks) for a complete system.

b. Provide an uninstalled spare motor for systems that utilize a motorized mixer.

2.3 DAF SYSTEM

a. Provide DAF tank including all air-saturated water distribution piping, wash water piping and valves, baffles, motors, valves, sludge and scum skimming equipment for a complete system.

b. Provide an uninstalled spare motor for each size and type of motor installed.

2.4 AIR SATURATION SYSTEM

a. Provide all air saturation equipment including a recycle pump, isolation valves, check valves, air saturation tank, and air compressor. Air saturation equipment shall be skid-mounted. Air compressor may be omitted for systems that utilize an air saturation pump with an air eductor loop specifically designed for DAF systems.

b. Provide electronic flow meter on recycle pump discharge pipe wired for monitoring by the DAF control system.

c. Provide oil-filled pressure gauges on the intake and discharge sides of the recycle pump.

d. Provide un-installed spare recycle pump

2.5 FLOAT/SLUDGE PUMPING SYSTEM

a. Provide integral skid-mounted, float/sludge collection and pumping system to pump float/sludge to the sludge storage lagoon. The pump shall be a progressive cavity pump or similar pump specifically designed to pump sludge. The pump shall be capable of pumping the design float/sludge flowrate at a TDH of 50 feet. The final pump duty point will be confirmed with the manufacturer during the final design phase of the project.

b. Provide un-installed spare float/sludge pump.

2.6 CHEMICAL FEED SYSTEMS

a. Provide coagulant and polymer chemical feed systems consisting of all day tanks, metering pumps, and pump panels.

a. Pumps shall be panel-mounted at the factory. Each panel shall be specifically designed for feeding the specified chemical solution. Provide panels with two chemical feed pumps for each chemical for 100% redundancy.

b. Pump panels and chemical feed equipment shall be shipped separately for mounting to the DAF building wall.

c. All piping mounted on the panel shall be Schedule 80 PVC. No metallic connectors shall be used for equipment or pipe mounting on the panel. All transitions from PVC pipe to solution tubing shall be made by threaded tubing connectors that can be screwed or unscrewed by hand. PVC unions shall be placed strategically to facilitate equipment removal.

d. Metering pumps shall be mounted on a black, grey, or blue, UV-protected polypropylene or polyethylene support panel suitable for wall mounting. The pump panel shall include the following accessories, pre-piped, where applicable:

1) An adjustable-pressure, diaphragm-type back pressure/anti-siphon valve, constructed of materials compatible with chemical to be used. The back pressure valve shall be of in line construction with a manual bypass valve to allow manual routing of the chemical to waste.

2) An in-line, adjustable-pressure, diaphragm-type pressure relief valve, constructed of materials compatible with chemical to be used.

3) A calibration chamber shall be of PVC & acrylic construction with 1/2" pipe thread connections at the top and bottom. The column shall be sized to provide at least a 30 second draw down at maximum pump capacity.

4) A pressure gauge and compatible isolator shall be provided to aid in setting backpressure and pressure relief valves and to continuously indicate system backpressure.

5) True-union ball valves shall be utilized with isolation valves provided at all equipment connections. Seals shall be compatible with the chemical being pumped.

2.7 INSTRUMENTS

a. In addition to the instruments noted above, the supplier shall furnish a skid-mounted turbidimeter for monitoring the finish water quality. The turbidimeter shall be mounted to the DAF skid, prewired at the factory, and integrated with the DAF control system. The sample and discharge piping shall be mounted to the skid and the drainage shall be plumbed to the tank drainage piping.

2.8 DAF CONTROL PANEL

a. Provide a control panel shipped loose for mounting in the electrical room adjacent to the DAF room as shown on the drawings in Appendix A.

b. The control panel shall be designed to automatically control and monitor all of the DAF equipment while minimizing operator attention. The control software program shall be factory tested prior to delivery to the jobsite.

c. The control panel enclosure shall be a heavy duty, free standing, NEMA 12, enclosure. The panel shall be made of 10-gauge steel and fully braced. The doors shall be heavy duty 3-point latching doors with a padlocking handle. The master circuit breaker disconnect shall be on the far right, and be interlocked with the doors. The panel shall include an internal light, service outlet, and be UL approved and labelled.

d. Motor starters and drives may be either incorporated into the DAF control panel or a separate MCC may be provided. If a separate MCC is provided it shall conform to the requirements of Section 16447, Low Voltage Motor Control Centers. If incorporated into the DAF control panel, line voltage wiring for starters and drives shall be physically separated from low voltage control wiring. Install the line voltage wiring and starters within a physically separated compartment from low voltage wiring. Provide code required separation, metal barriers, and dead front covers to allow an operator to work on the low voltage compartment within the control panel without being exposed to line voltage live parts.

e. Refer to Section 16070, Packaged Electrical System Requirements and Section 17090, Packaged Control System Requirements for additional requirements.

PART 3: EXECUTION

3.1 DESIGN SUPPORT

a. The suppliers project manager shall provide design support for the design team consisting of telephone discussions, email exchanges, and online meetings. No in-person meetings are anticipated to be required for this project (other than any pilot testing authorized by the Owner).

b. Pilot Testing. The supplier shall coordinate with the design team to formulate a pilot testing program suitable for this project at the treatment plant site in Aumsville, Oregon. Manufacturer shall provide and operate all equipment during the pilot testing. Manufacturer shall provide a lump sum price for the pilot testing for review and approval by the Owner and the Engineer. If authorized by the Owner, the Buyer's Contingency Allowance (See general condition 11.6) will be used to compensate the supplier for the pilot testing. Suppliers shall not include the price for pilot testing in the lump sum bid price provided under Article 2.01 of the bid form.

3.2 INSPECTION, START-UP AND FIELD TESTING

a. The DAF Manufacturer/Supplier shall furnish the services of a qualified representative to supervise the installation, start-up and field testing of the equipment. A qualified manufacturer's representative shall be one who has had at least five years experience in the installation of the types of equipment specified for this project.

b. At the completion of the installation, the manufacturer's representative shall prepare a signed certification letter stating the following at a minimum.

1) The installation is as specified and is acceptable to the manufacturer.

2) The warranty and/or guarantee will be in full effect during the warranty period with no qualifications or reservations.

c. The Supplier shall furnish the services of the manufacturer's field representative to advise on the field installation of all equipment.

d. The representative shall inspect the installation prior to startup and commissioning. The representative shall conduct performance testing and prepare written documentation describing the results. They shall certify that the installation is correct and that the equipment is ready for startup and commissioning. After the representative has certified that the installation is ready for operation, they shall supervise startup of the facility and certify that the system has operated as designed.

e. After the installation and operation of the equipment has been certified, the manufacturer's representatives shall train the City's personnel in the proper operation and maintenance of the equipment.

f. During the first year of operation, the representative shall perform follow-up training for one 8 hour period at a time requested by the Owner. The costs for this training including travel expenses shall be included in the Supplier's bid price. No additional compensation will be made.

g. The manufacturer's field representative shall be present at the project site for the minimum days listed below, travel time excluded.
1) 5 days for installation assistance, include travel expenses for two separate trips to break the 5 days into two separate trips.
2) 3 days for pre-startup inspection and testing and completion of Manufacturer's Certificate of Proper Installation.
3) 5 days for facility startup.
4) 2 days for post-startup training of Owner's personnel.
5) 1 day for follow up training within 1 year of initial startup.

h. Virtual support during first year of operation. The supplier shall provide operational support for City Staff during the first year of operations without additional charge. This support shall consist of telephone discussions, email exchanges, online meetings, and the in-person follow-up training specified above.

SECTION 16090

PACKAGED ELECTRICAL SYSTEM REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. The Section includes the requirements pertaining to conduits and fittings used to contain electrical conductors and cables.
   2. All conductors and cables shall be installed in conduit or approved raceways regardless of which Division the conductors or cables are specified.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this Section.
   1. American National Standards Institute (ANSI).
      a. C80.1, Rigid Steel Conduit-Zinc Coated.
   2. American Society for Testing Materials (ASTM).
      a. A123 E1, Standard Specification for Zinc-Coated (Galvanized) Coatings on Iron and Steel Products.
      b. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
   3. National Electrical Contractors Association (NECA).
      a. National Electrical Installation Standards (NEIS).
   4. National Electrical Manufacturers Association (NEMA).
      a. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Coated and Intermediate Metal Conduit.
      b. TC 3, PVC Fittings for use with Rigid PVC Conduit and Tubing.
      c. TC 6, PVC and ABS plastic Utilities Duct for Underground Installation.
      d. WC 3, Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
      e. WC 5, Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
      f. WC 7, Cross Linked-Thermostetting Polyethylene Wire and Cable for the Transmission and Distribution of Electrical Energy.
      g. WC 55, Instrumentation Cables and Thermocouple Wire.
   5. Nation Fire Protection Association (NFPA).
      a. 70, National Electrical Code (NEC).
   6. Underwriters Laboratories, Inc. (UL).
      a. 6, Standard for Safety Rigid Metal Conduit.
      b. 13, Standard for Power-Limited Circuit Cables.
      c. 44. Standard for Safety Rubber-Insulated Wires and Cables.
      d. 50 Enclosures for Electrical Equipment.
      e. 360, Standard for Safety Liquid-Tight Flexible Metallic Conduit.

f. 510, Standard for Safety Insulating Tape.
g. 514B, Standards for Safety Fittings for Conduit and Outlet Boxes.
h. 514C Standard for Safety Non-Metallic Outlet Boxes, Flush Device Boxes and Covers.
i. 651, Standard for Safety Schedule 40 and 80 PVC Conduit.
j. 651A, Standard for Safety Type EB and Rigid PVC Conduit and HDPE Conduit.
k. 797, Standard for Safety Electrical Metallic Conduit.
l. 1581, Standard for Safety References for Electrical Wires, Cables and Flexible Cords.
m. 1660, Standard for Safety Liquid-Tight Flexible Nonmetallic Conduit.

1.3 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:
1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

1.4 PACKAGED ELECTRICAL SYSTEM REQUIREMENTS

A. All electrical connections and circuits for packaged system motors, valves, instruments, sensors, switches, and all other electrical devices and appurtenances shall be furnished and installed by the manufacturer as a packaged system. The system shall comply with the following requirement:
1. UL Listed
2. All electrical components shall be installed in a Neat and Workmanlike manner as

defined by the National Electrical Contractor's Association (NECA) and a Professional and Skillful Manner as defined by the National Electrical Code.

3. All components shall be corrosion resistant utilizing products specified within this document.
4. Separation of Class 1 wiring from Class 2 wiring shall be provided.
5. All Class 1 power wiring associated with packaged equipment that is pre-wired by the supplier shall be terminated within an enclosure that has been provided by the manufacturer. The enclosure shall be furnished with labeled terminal blocks. The enclosure shall be the point of connection for "field connections" to the pre-wired conductors and cables. The "field wiring" shall be provided by Others. .
6. Similar to the Class 1 power enclosure, dedicated enclosures shall be provided for both analog and digital Class 2 low voltage pre-wired conductors and cables.
7. All wiring shall be tested at the factory by the manufacturer for continuity and resistance.
8. All equipment, enclosures, terminal blocks, and conductors shall be individually labeled.

B. Connections requiring "Field" wiring
   1. All electrical and low voltage conduit and wiring connections that must be constructed in the field (and not at the factory) for motors, equipment, instruments, transmitters, enclosures, etc shall be clearly identified on shop drawings. The drawings shall include scaled plan views, scaled elevation views, and electrical wiring schematics. The information provided shall include, at minimum:
      a. Voltage, phase, amps.
         1) AC vs DC circuits.
      b. Motor nameplate information
      c. Instrument nameplate information
      d. Line voltage, neutral, and grounding requirements, including wire count and minimum wire size.
      e. Instrumentation and control digital and analog wiring requirements.
      f. All interlock wiring
      g. Network connectivity (i.e. CAT6)
      h. Termination locations to transition between factory and "field" wiring.
   2. The schematics shall clearly delineate between "field" and manufacturer provided conduit and wiring.

PART 2 PRODUCTS

2.1 HARDWARE

A. **Stainless Steel Hardware (260533.H01)**
   1. All hardware shall be 316 or 304 stainless steel and sized for the load served.
      a. Strut channel, nuts, hex heads, washers, threaded rods, bolts, anchors, clamps, and all other hardware.

2.2 CONDUCTORS

A. **1,000 Volt Conductors (260533.C80)**
   1. Stranded copper, XHHW/XHHW-2 insulation.

B. **Twisted Shielded Pairs (260533.C70)**
   1. Stranded copper, 18 AWG.
   2. Outer PVC jacket, overall aluminum shield, drain wire, indoor/outdoor rated, and sunlight resistant.

2.3 CONDUITS AND BOXES

A. **Galvanized Rigid Steel Conduit (GRC) (260533.C01)**.
   1. Shall be mild steel, hot dipped galvanized inside and out.
   2. Shall be manufactured in accordance with ANSI C80.1 – Rigid Steel Conduit, Zinc Coated, and UL-6.
   3. Conduit fittings shall be hot dipped galvanized malleable iron.
   4. Condulets shall form 7 type.
   5. The use of three-piece couplings shall be incorporated only when unavoidable and not simply due to poor planning and layout.
   6. The use of compression, setscrew and split conduit fittings is unacceptable.
   7. Gaskets shall be installed on all condulet covers regardless of the environment they are installed in.
   8. Conduit straps shall be hot dipped galvanized malleable iron and incorporate matching conduit spacers when attached directly to walls, ceilings and floors.

B. **Liquid-Tight Flexible Aluminum Conduit (LFAC) (260533.C20)**.
   1. Shall be constructed of a flexible aluminum core with a sunlight resistant thermoplastic outer jacket.
   2. Conduit fittings shall be manufactured to the PVC-GRC fitting specifications. Galvanized or non-metallic conduit fittings are unacceptable unless written approval is obtained from the ENGINEER for specific locations before installation.
   3. No couplings shall be installed.
   4. Sealing rings shall be installed where conduit terminates at an enclosure.

C. **Cast Iron Boxes (260533.B01)**
   1. Shall be cast iron galvanized boxes, have tapered threaded hubs and be the deep FD type in all cases.
   2. Boxes shall have internal grounding screw.
   3. Shall have external mounting tabs.
   4. Whichever manufacturer is submitted and approved, all like boxes on Project shall be of the same manufacturer.

D. **Power and Instrumentation Junction Boxes (260533.B99)**
   1. UL Listed, 304 or 316 stainless steel, NEMA 4X, IP 66.
   2. Size as selected by the Manufacturer.

3. Gasketed door with quick release latches and padlock hasp and staple.
4. Stainless steel continuous hinges.
5. Manufacturer supplied aluminum backpanel.

2.4 CONDUIT ACCESSORIES

A. **Cord Grip (CGB) (260533.C89)**.
1. Provide stainless steel bodied cord grips with NPT mounted in conduit couplings as identified on the Drawings.

B. **Cord Connector (260533.C90)**.
1. Provide stainless steel cord grip with integrated stainless steel mesh.
2. Provide cord grip with stainless steel integrated mesh for any unsupported cord longer than 59 inches to provide adequate support of the cord.

2.5 IDENTIFICATION

A. **Colored Tape (260533.I01)**
1. Colored tape shall be used to identify individual conductors larger than # 6 AWG.

B. **Conductor and Cable Sleeves (260533.I02)**
1. The identification sleeves shall be properly sized for the cable or conductor.
2. Sleeves shall be white with black machine generated characters.

C. **Plastic Nameplates (260533.I03)**
1. Shall have a black background with white engraved letters. Nameplates for emergency functions shall be red background with white engraved letters. The nameplates shall have self adhesive rated for the environment which they are installed. The font type shall be consistent on all nameplates.

D. **Color Coding (260533.I04)**
1. Conductors shall be colored as specified in the table below.

System	Conductor	Color
All Systems	Equipment Grounding	Green
IT / Data	Data Cable Sheath (outer cover)	Blue
24 Volt DC	Positive	Blue
	Negative	White w/ Blue Stripe
	Discrete Input Line (hot leg) Side	Blue
	Discrete Input Switch Leg	Blue w/ White Stripe
	Discrete Output Line (hot leg) Side	Blue
	Discrete Output Switch Leg	Blue w/ Orange Stripe
120/208 Volt Three Phase	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral	White

System	Conductor	Color
120, 208, 277 Volt	Switch Legs	Pink
480 Volt Three Phase	Phase A	Brown
Wye or Delta Corner Tap	Phase B	Purple
	Phase C	Yellow
	Neutral	Gray

PART 3 EXECUTION

3.1 CONDUCTOR INSTALLATION

A. General Requirements
1. Conductor and cable installations shall meet or exceed the NECA National Electrical Installation Standards.
2. CONTRACTOR shall not exceed the manufacturer's recommendations for maximum pulling tensions or minimum bending radii for respective conductors or cables.
3. Pulling compound is recommended for all conductor or cable installations and shall be used on all installations requiring a mechanical pulling device.
4. CONTRACTOR shall furnish and use a dynamometer on all conductor or cable installations requiring the use of a mechanical pulling device. The dynamometer shall be used to verify the maximum pulling tensions are not exceeded. Should the pulling tensions be exceeded, the conductor or cable shall be removed from the raceway and discarded. It shall not be reused under any circumstance on the project. The CONTRACTOR shall be responsible to make the alterations necessary before attempting to re-pull new conductors or cables.
5. Immediately after pulling in conductors or cables, the pulling compound shall be completely removed from the conductors or cables, from boxes, enclosures, floors, walls, etc.
6. Conductor and cable installations shall be continuous without splices or intermediate terminations unless specifically identified on the Drawings or prior written approval from the ENGINEER.
7. Where conductors or cables are routed in boxes enclosures or cable tray they shall be neatly bundled with cable ties at intervals not to exceed 12 inches on center. The tension for the cable ties shall be set with a tool specifically manufactured for that purpose and of the same manufacturer as the cable tie. Side cutters, linemen pliers and similar tools shall not be used to cut the tail end of the cable tie. The CONTRACTOR shall only use the tool specifically manufactured for this purpose and of the same manufacturer as the cable tie.
8. Conductors and cables shall not be installed until the raceway, boxes, enclosures, conduit bushings, etc. have all been installed. Where conductors or cables have been installed prior to meeting this requirement, the ENGINEER shall at their discretion elect to have the conductors or cables removed, disposed of and replaced with new product.

9. Should the outer jacket of any conductor or cable be damaged in any way, they shall be removed, disposed of and replaced with new product.

B. Grounding
   1. An equipment grounding conductor shall be installed in all raceways. Size shall be as identified on the Drawings or the NEC, whichever is greater, but in no case shall it be less than # 16 AWG for under 50 volts and no less than # 14 for 50 volts or above.
   2. Provide ground bushings for all conduits that do not terminate in a hub type fitting and install at the source of power with a bonding conductor fastened to the ground bushing.
   3. Provide grounding type bushings with lug for a connection to a grounding conductor for all conduits which terminate at a cable tray.
   4. Provide grounding type bushings with lugs for connection of grounding conductor at both ends of metallic conduit runs. Bond ground bushings to the grounding system.
   5. Provide a green insulated wire-grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

3.2 HARDWARE INSTALLATION

A. General Requirements
   1. Hardware shall be set to a torque as recommended by the manufacturer.
   2. Washers and split lock washers shall be installed on all bolts, threaded rods and anchors.
   3. Lead or plastic type anchors are prohibited from use on the project.
   4. When threaded rods are installed in drop-in type anchors, a washer, split lock washer and a jamb nut shall be installed at the anchor to ensure stability.
   5. When channel (strut) is installed as a hanger or support from threaded rod, washers, split lock washers and jamb nuts shall be installed on both sides of the strut to lock it in place.
   6. Cut ends of channel, strut, threaded rods or other cut fittings shall be filed smooth before installation.
   7. Threaded rod shall not extend more than one (1) inch beyond the channel, strut or other material it is supporting.
   8. Hangers and supports shall be installed level and plumb.
   9. Provide strut plastic end caps at the ends of all struts that are exposed to unintentional contact by personnel. Plastic end caps shall be safety yellow finish or color as directed by the OWNER.
   10. Hangers and supports shall be installed per the National Electrical Code, Building Code and Structural Code and shall be designed to safely support the load. The ENGINEER may request the CONTRACTOR provide a copy of their design calculations for the seismic requirements and the load served

3.3 CONDUIT INSTALLATION

A. General Requirements
   1. Raceways shall be electrically and mechanically complete before the conductors are installed.
   2. Conduit joints shall be wrench tight, thoroughly grounded, secure and free of obstructions.
   3. Conduits shall be reamed.
   4. Metallic threads shall all be coated with conduit thread lubricant before assembly. Failure to install the lubricant will result in removal of all conduit and reassembly with the conduit lubricant.
   5. Exposed conduits shall be installed parallel or perpendicular to the structural members and surfaces and shall be level and or plumb.
   6. When two or more conduits are routed in the same general direction their routing shall be parallel with symmetrical bends.
   7. Conduits shall be bent with equipment specifically designed for this purpose and for the specific size and type of conduit.
   8. Conduits that are creased or crushed shall be replaced.
   9. Install conduits such that they do not interfere with the proper and safe operation of equipment and do not block or otherwise interfere with the ingress and egress and installation of removable hatches and covers.
   10. Conduits that terminate at an enclosure that does not have a threaded hub shall be installed with a Myers type hub and ground ring. No exceptions shall be permitted without prior written approval for specific locations issued by the ENGINEER. Conduits that are permitted to terminate without a Myers type hub or a threaded hub shall have a ground bushing installed. A separate bonding conductor shall be routed to all ground bushings within an enclosure and be bonded to the enclosure and grounding conductor if present.
   11. Final connections to dry type transformers, motors, instruments, and other equipment requiring a flexible connection shall be made with LFAC conduit. Lengths shall not exceed three (3) feet.
   12. Spare conduits shall be provided with a coupling and threaded male plug that matches the makeup of the conduit for the area they are installed in. The conduit shall terminate at an enclosure when one is called out and exists as part of the Work. Where the spare conduit is stubbed up in a concrete slab for future equipment, it shall be installed flush with the finished floor. Where spare conduits are routed to other areas such as outside a building envelope, in an attic, to a vault, etc., the conduit shall have a female conduit cap installed.
   13. All conduits shall be individually identified at every point they terminate. The conduit identification shall be the same as that which is used on the conduit /conductor schedule in the Drawings. Should conduits be installed that are not listed on the conduit schedules, the CONTRACTOR shall add conduit callouts to the as-built conduit schedules and label the conduits accordingly.

B. Miscellaneous
   1. Provide cord grip for any unsupported cord.

3.4 BOX INSTALLATION

A. General.
   1. Boxes and enclosures shall be mounted level and plumb.
   2. Boxes and enclosures shall not be altered, holes drilled, etc. in any way that may compromise the NEMA rating of the enclosure or box.
   3. Boxes and enclosures shall be mounted with stainless steel hardware.
   4. Boxes and enclosures shall be bonded to the equipment grounding conductor.
   5. Surface mounted enclosures and boxes shall be spaced off the surface at least ¼ inch in damp or wet locations.
   6. Boxes and enclosures with threaded hubs or punched holes shall have the opening match the conduit size. The use of reducing bushings or reducing washers is unacceptable.
   7. Galvanized cast iron boxes are permitted only where GRC conduit is permitted.
   8. Enclosures shall be provided whenever a junction or pull box larger than 4 inches square is required.
   9. Provide a divider whenever a box contains conductors of different potentials that the code requires separation.

3.5 IDENTIFICATION

A. Plastic Nameplates
   1. Provide plastic nameplates for motor control centers, control panels, enclosures, junction boxes, and similar equipment. The verbiage on the nameplate shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available on the Contract Drawings.
   2. Typically the nameplates shall be centered and installed near the top of the equipment.
   3. Nameplates shall be black with white characters unless specified otherwise.

B. Conductor and Cable Identification Sleeves
   1. Provide heat shrink, machine generated, white labels with black characters for all cables and conductors. Identify the source and load served by the conductors and cables, including the terminal identification upon which the respective conductor originates and terminates.
   2. The labels shall be installed between 6 to 8 inches from the end and shrunk. Conductors shall be labeled at all splices and points of termination.

END OF SECTION

SECTION 16447

LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. This section includes requirements for Low voltage (600 VAC or less) Motor Control Centers (MCC).

1.2 REFERENCES

A. The following is a list of Standards that may be referenced in the Section.
   1. NEMA Standard ICS-2 Industrial Control and System Controllers, Contactors, and Overload Relays Rated 600 Volts.
   2. Underwriters Laboratories (UL) Standard No. UL-508C Power Conversion Equipment.
   3. Underwriters Laboratories (UL) Standard No. UL-845 Motor Control Centers.
   4. American National Standards Institute ANSI C19.3 Compressors for Process Industries.
   5. National Electric Code (NEC).

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.3 SUBMITTALS

A. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:
   1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
   2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
   3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not

clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Shop Drawings

1. Dimensional drawings showing the overall length, width and height of the assembled MCC. Included on these drawings shall be individual bucket locations and conduit entry areas and wiring diagrams.
2. Physical properties, handling, mounting and, if applicable, shipping break point locations shall be shown in the drawings. This shall include total weight, lifting instructions, height and floor space required.
3. Provide control systems engineering to produce custom unit elementary drawings showing interwiring and interlocking between units and to remotely mounted devices. Show all field devices, switches, lights, wire and terminal numbers, and grounding requirements. Indicate special identifications for electrical devices per the Contract Documents including internal and external interlocking, all components, overload settings, ratings, wire tags, terminal blocks, and devices for each load. Each drawing shall be circuit specific for the load submitted on. No typical schematic drawings shall be approved.
4. All drawings shall list the equipment number of the connected motor(s) for each MCC submitted on.
5. Component designations, e.g., relays, fuses, etc. shall match those shown in the Contract Documents.
6. Complete Bills of Materials shall be included with and shown on the Schematic or panel construction drawings for each MCC. Include list of spare parts provided.
7. The equipment drawings, summary tables, elementary drawings/diagrams, spare parts list and bill of materials list shall be computer generated. Hand drawings, sketches, or lists are not acceptable.

1.4 QUALITY ASSURANCE

A. Qualifications

1. The motor control center shall be the product of a manufacturer who shall also be the manufacturer of all the circuit breakers, fused switches and motor starters included in the motor control center and who has produced the same type of equipment for a period of at least 15 consecutive years.
2. Motor control center[s] shall be designed, assembled and tested by the manufacturer of the motor control equipment included in the control center assembly.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Equipment Handling

1. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.6 SYSTEM SUPPLIER

A. The SYSTEM SUPPLIER shall be the vendor that supplies the motor control center.

1.7 OWNER'S SCADA SYSTEM AND SYSTEM INTEGRATOR (SI)

A. The OWNER has pre-selected a SYSTEM INTEGRATOR (SI) to provide a SCADA system to monitor the entire wastewater treatment system, including but not limited to the new SBR and DAF systems.
   1. The SCADA system will be Rockwell Automation FactoryTalk SE.

B. The MCC shall be Ethernet/IP compatible so that it is compatible with the SCADA system.
   1. The SYSTEM SUPPLIER shall provide all programming of protocol converters used as gateway devices between their protocol and Ethernet/IP.

C. The control panel SYSTEM SUPPLIER shall coordinate with the SI, ENGINEER, and OWNER to ensure a fully coordinated control system that integrates with the OWNER'S SCADA system.
   1. Provide for continued and ongoing coordination with plant-wide SCADA developers to ensure uniform integration of SCADA operator screens and functions where they are determined to be appropriate and useful.
   2. ENGINEER has final authority in determining the extent and degree of integration between the plant-wide SCADA and the SYSTEM SUPPLIER'S motor control center.

D. Provide a data map of all points on packaged control system PLC to the SI

1.8 MOTOR CONTROL CENTER REQUREMENTS AND STANDARDS

A. The motor control center (MCC) shall be designed by the SYSTEM SUPPLIER. The design responsibilities of the SYSTEM SUPPLIER shall include, but not be limited to, the following.
   1. Shall meet the design requirements as described in the following Specifications below. The MCCs shall be capable of controlling all of the motors and pumps associated with the packaged systems.
      a. Section 11300 SBR Equipment.
      b. Section 11400 DAF Equipment.
   2. Select the appropriate motor starter type for the respective motor loads of the packaged system (across-the-line motor starters, full voltage reversing motor starters, variable frequency drives (VFDs)).
   3. Size the motor starter (including VFDs) and size the overcurrent protection devices per the NEC.

4. Design the motor starting schematics and wiring diagrams for each motor starter, including but not limited to pushbuttons, emergency stops, indicator lights, control power transformers, control relays, etc.
5. Design motor protection relays associated with submersible pumps or motors that are located in NEC Class 1 Division 1 and Class 1 Division 2 locations. Install the relays on the door of the respective motor starter bucket within the MCC. Facilitate coordinate of the motor protection relay with the pump manufacturer and MCC manufacturer.

B. The MCC shall have the minimum characteristics.
1. UL Listed
2. Short circuit rating = 65,000 AIC.
3. Integral surge protection device.
4. Minimum of 25% spare load capacity
5. Minimum of 25% spare "bucket" space for future motor staters.
6. The MCC shall be Ethernet/IP compatible so that it may communicate with the plant's SCADA system.

C. The SYSTEM SUPPLIER shall provide a fully engineered, factory-tested, and completely functional MCC that is capable of controlling the packaged system.

1.9 COMMISSIONING
1. Provide commissioning in accordance with Section 11300 and 11400.

1.10 MAINTENANCE

A. Maintenance Manuals
1. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

B. Extra Materials
1. Provide as recommended by the manufacturer.

C. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturers name, description and part number on the exterior of the package.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

A. Low Voltage Motor Control Centers.
1. Ratings
a. The motor control center shall be rated as shown on the Drawings.
b. All units and sections shall be UL labeled.

2. Enclosure
    a. The enclosure shall be rated NEMA Type 1A with gasketed doors. Structures shall be totally enclosed, dead-front, free-standing assemblies. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.
    b. Compartments for mounting control units shall be incrementally arranged such that not more than six (6) Size 1 or Size 2 starters can be mounted within each vertical structure. Guide rails shall be provided.
3. Vertical Sections
    a. Each vertical section shall be 90 inches high and up to 21 inches deep maximum.
    b. Vertical sections shall have internal base mounting angles at the bottom and external lifting angles at the top running continuous within each shipping block.
    c. Each vertical section shall have side sheets extending the full height and depth of the section to minimize the chance of fault propagation to adjacent sections.
4. Wireways
    a. Structures shall contain a horizontal wireways of standard sections, at both the top and bottom of the structure. Horizontal wireways shall be not less than 9 inches high. The horizontal wireways shall be isolated from the horizontal bus via metal barriers and be readily accessible through hinged covers. To prevent damage to cable insulation, the wireway opening between sections shall have rounded corners and the edges shall be rolled back. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.
    b. A full height vertical wireway with minimum of 35 square inches of cross-sectional area and hinged door shall be provided in each standard vertical section. Wireways shall contain steel rod cable supports. A permanent vertical wireway wall shall separate the buckets from the vertical wireway, and remain intact even when the buckets are removed.
5. Horizontal and Vertical Power Bus Bars
    a. Bus material shall be tin-plated copper or silver-plated copper. Vertical bus shall have a minimum rating of 300 amps and in no case shall it be rated less than the load served within the vertical bus's respective vertical section. The bus bracing shall be fully rated to withstand the fault current specified.
    b. The power bus system shall be supported, braced, and isolated by a bus support molded of a high strength, non-tracking glass-reinforced polyester material.
    c. The horizontal bus shall be rated at 65 degrees C temperature rise over a 40 degrees C ambient in compliance with UL standards.
    d. The horizontal bus shall be connected to the vertical bus with a minimum of two (2) bolts and each bolt shall be capable of handling the load.
    e. Vertical bus safety protection shall consist of shutters that automatically open when buckets are inserted and automatically close when buckets are

removed. Shutters shall prevent personnel exposure to live vertical bus bars. Shutters shall isolate the bus from arcing faults.

6. Grounding and Ground Bus
   a. A tin-plated copper or silver-plated copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the motor control center. The ground bus shall be located in the horizontal wireway.
   b. The size of the horizontal ground bus shall be sized for the load served.
   c. Each structure shall contain a tin-plated vertical ground bus rated 300 amperes. The vertical ground bus shall be directly connected to the horizontal ground bus via a tin-plated copper connector.
   d. A grounding stab shall be provided on each plug-in unit, such that the stab engages onto a copper vertical ground bus prior to the power stabs engaging.
   e. A grounding point shall be provided at each starter unit for purposes of landing the ground wire coming from the motor. This grounding point shall be directly tied to the horizontal ground bus.
7. Bucket (Unit) Construction
   a. Bucket Mounting
      1) After insertion, each plug-in unit shall be held in place by a latch that is located at the front of the unit.
      2) Multi-turn latches requiring more than 1/4 turn per latch shall not be acceptable.
      3) Plug-in stabs shall be mounted in a glass reinforced plastic insulation block at the rear of the unit.
      4) Wiring from the unit disconnecting means to the plug-in stabs shall be routed into this insulation block such that the wiring is not exposed at the rear of the unit.
      5) Size 1 through Size 5 non-reversing starters (FVNR) shall be plug-in buckets.
      6) Where shown in the Contract Documents, provide buckets configured to accommodate the variable frequency drives (VFD). VFDs mounted in motor control centers shall be factory integrated and shipped fully configured and fabricated to the job site. Site installation of the VFDs within the motor control centers is not acceptable.
      7) The unit door shall be fastened to the stationary structure (not the unit itself), so that the door can be closed when the unit has been removed.
      8) The door shall be hinged on the left-hand side so that it opens away from the vertical wireway.
      9) Minimum bucket height shall be 12 inches nominal.
   b. The operator handle of all buckets shall be interlocked with the MCC frame, so that a unit insert cannot be withdrawn or inserted when the operator is in the ON position.
   c. The operating handle of all buckets shall be capable of being pad locked in the open (off) position.
8. Control Power

a. Control Potential Transformers (CPT) shall be mounted in each unit containing motor starters and motor contactors.
b. CPT's shall have primary and secondary fuses and provide the following excess capacity in addition to that required by the starter coil:
    1) Size 1 - extra 40VA
    2) Size 2 - extra 40VA
    3) Size 3 - extra 125VA
    4) Size 4 - extra 180VA
    5) Size 5 - extra 200VA
c. Primary and secondary fuses shall have a clearly visible integral blown fuse indicator.

9. Overcurrent Devices
    a. Main Circuit Protective Device
        1) Circuit breakers shall be molded case with inverse time and instantaneous tripping characteristics.
        2) Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver allow and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
        3) Circuits shall have a minimum symmetrical interrupting capacity as indicated on the Drawings.
        4) Main breaker shall be molded case with electronic trip units.
    b. Electronic Trip Units
        1) Each molded case circuit breaker microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.
        2) An adjustable trip setting dial mounted on the front of the trip unit shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be adjustable and settings shall be adjusted by the CONTRACTOR as indicated on the Drawings. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.
        3) System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
            a) Adjustable long-time setting (set by adjusting the trip setting dial).
            b) Adjustable short-time setting and delay with selective curve shaping.
            c) Adjustable instantaneous setting.
            d) Adjustable ground fault setting and delay (where required by Code).

e) The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.
f) When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override.
g) Where internal ground fault protection is specified, adjustable settings shall not exceed 1200 amperes. Provide neutral ground fault sensor for four-wire loads.
h) Where continuous current rating of the protective device is rated or can be adjusted to 1200 amperes or higher, the electronic trip unit shall be provided with a arc flash energy-reducing maintenance mode capability.
i) Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set.

c. Starter buckets shall have full-voltage, non-reversing, motor circuit protectors (HMCP) with magnetic trip only, and a 65,000 short circuit rating, unless otherwise noted. The HMCP shall provide adjustable magnetic protection and be adjustable up to 1700% of motor nameplate full load current to comply with NEC requirements. All HMCP combination starter units shall have a 'tripped' position on the unit disconnect and a push-to-test button on the HMCP. Type HMCP motor circuit protectors through size 4 shall include transient override feature for motor inrush current.

10. Motor Starters
    a. Magnetic starters through NEMA Size 9 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring. Each starter shall have a minimum of one (1) normally open auxiliary contact.
    b. Coils shall be of molded construction through NEMA Size 9. All coils to be color-coded through size 5 and permanently marked with voltage, frequency and part number.
11. Solid State Overload Relays
    a. Provide a solid-state overload relay for protection of the motors.
    b. The overload relay shall provide high accuracy through the use of state-of-the-art microelectronic packaging technology. The relay shall be suitable for application with NEMA Size 1 through Size 7 motor starters.
    c. The overload relay shall be modular in design, be an integral part of a family of relays to provide a choice of levels of protection, be designed to directly replace existing electromechanical overload relays, and be listed under UL Standard 508.
    d. The overload relay shall have the following features:
        1) Self-powered
        2) Class 10A, 10, 20, or 30 selectable tripping characteristics
        3) Manual or automatic reset
        4) Supply with electronic reset
        5) Reset capabilities through onboard fieldbus

6) Selectable (On/Off) Phase loss protection. The relay shall trip in 10 seconds or less under phase loss condition
7) Selectable (On/Off) Phase Imbalance protection. The relay shall trip in 10 seconds or less under phase imbalance condition.
8) Visible trip indication
9) One normally open and one normally closed isolated auxiliary contact
10) Test button that operates the normally closed contact
11) Test trip function that trips both the normally and normally closed contacts
12) A current adjustment range of 5:1 or greater
13) Embedded, selectable (On/Off) ground fault protection shall be an available option. Relay shall trip when ground fault is detected at 50% of full load ampere setting.
14) An LED that provides self-diagnostic information
15) An LED that aids in commissioning by indicating running current is too high compared to the FLA dial.
16) Ethernet/IP with I/O and webserver communication shall be provided.
17) Additional digital inputs and outputs (4 in and 2 out additional) shall be an available option. Inputs shall be both 24 VDC and 120 VAC, and outputs shall be discrete relay outputs
18) Diagnostic Trip Information indicating a specific trip on either ground fault, phase loss, phase imbalance, or thermal.
19) When using any of the available fieldbus the relay shall be capable of providing the following data monitoring:
    a) Individual Phase Currents
    b) Average RMS Current
    c) Thermal Capacity
    d) % Phase unbalance
    e) GF Current
    f) Line Frequency
    g) Relay settings
    h) Contactor Status

12. Variable Frequency Drives
    a. The VFDs shall be installed within the MCC.
    b. The final VFD size shall be based on the full load current of the approved submittals of the driven load.
    c. Any modifications to a standard product necessary to meet this Section shall be made only by the VFD manufacturer.
        1) Each VFD shall be completely factory pre-wired, assembled, and then tested as a complete system by the VFD manufacturer to ensure a properly coordinated, fully integrated drive system.
    d. It is the responsibility of the VFD manufacturer to ensure that the drive will not damage motor insulation due to high carrier frequency, reflected wave, dv/dt or other drive electrical characteristics based upon the installed conditions.

1) Provide equipment necessary to mitigate potential damage to motor insulation.

e. Minimum efficiency = 96%.
f. Sinusoidal pulse width modulated (PWM) type drive.
   1) Six-pulse insulated gate bipolar transistor (IGBT) power section.
   2) Microprocessor based controls.
   3) 5% Line reactors and 3% dv/dt load filters.
g. Minimum protective features:
   1) Motor overload protection.
   2) Instantaneous overcurrent.
   3) Instantaneous overvoltage.
   4) Undervoltage.
   5) Power unit overtemperature.
   6) Phase loss.
   7) VFD output short circuit.
h. Operation in either a constant volts/hertz or sensorless vector mode:
   1) Control mode selectable via programming keypad.
i. Frequency control
   1) Minimum of 3 selectable skip frequencies with adjustable bandwidths.
   2) Programmable minimum frequency.
   3) Programmable maximum frequency.
j. Separately adjustable acceleration and deceleration rates:
   1) Each rate adjustable from 0.01 to 3,600 seconds.
k. The VFD shall be capable of determining the speed and direction of a spinning load, “catch” the load and accelerate or decelerate it without damage to the load
l. Upon loss of speed reference, the VFD shall be programmable to either:
   1) Stop
   2) Maintain current speed
   3) Default to pre-selected speed
m. The VFD shall be capable of continuous operation in the event of a power loss of 5 cycles or less.
n. Inputs/Outputs
   1) Analog inputs:
      a) Configurable as either 0-10 volts or 4-20mA.
   2) Analog outputs:
      a) Programmable 4-20mA isolated
   3) Discrete inputs:
      a) Programmable
   4) Discrete outputs:
      a) Programmable
      b) Form C relay contacts
o. Potentiometer 3-wire input
p. Ethernet/IP communications.
q. Stop on a communication loss to PLC.
r. Diagnostics

1) Store a minimum of 4 fault conditions in non-volatile memory on a first in- first out basis.
    a) Operating frequency.
    b) Drive status.
    c) Power mode

s. User selectable automatic restart feature allowing the VFD to restart following a momentary power failure or other VFD fault.
    1) Programmable for up to 9 restart attempts
    2) Adjustable time delay between restart attempts.

t. The VFD shall be capable of being programmed while energized. Provide an accessible port to connect a laptop from outside of the enclosure with the enclosure door closed and the VFD energized.

u. Provide cabinet cooling devices required to maintain the VFD within the Manufacturer's specified temperature limits for the project conditions.
    1) Controlled by control power on.
    2) Long-life low noise cooling fans, sized for 150 percent capacity cooling.
    3) Provide power and fuse protection for the cooling fans.

v. Power disconnect:
    1) Thermal magnetic circuit breaker.
    2) Lockable in the off position

w. Line reactors:
    1) 5 percent input

x. Load DV/DT filters:
    1) 3 percent.

y. Metal oxide varistors to provide protection against:
    1) Line transients: 5,000 volts peak min
    2) Line to ground transients: 7,000 peak min

z. Provide each VFD with a keypad
    1) Password protected
    2) Mounted on door of MCC.
    3) Back-lit LCD
        a) Minimum of 2 lines with 16 characters per line.
    4) Display following parameters:
        a) Speed
        b) Output current
        c) Output frequency
        d) Input voltage
        e) Output voltage
        f) Total 3-phase kilowatts
        g) Kilowatt-hour meter
        h) Elapsed run time meter
        i) Revolutions per minute
        j) DC bus voltage

aa. Pilot devices, including but not limited to, selector switches, pushbuttons, and indicator lights. Refer to Section 17090,

13. Terminal Blocks

a. Terminal blocks shall be mounted within the unit and located near the front for accessibility. They shall not be located at the rear of the vertical wireway.
b. Power terminal blocks shall be provided.
c. On plug-in units, control terminal blocks shall be pull-apart style.

14. Internal Wiring shall be NEMA Class IIS, Type B. All internal wires shall be clearly labeled at each termination and the label identification shall be clearly present on the record drawings submitted. Manufacture installed wires shall be green for grounds, white for neutrals, and red for control power. All terminal blocks shall be identified with labels showing the terminal block identification and individual terminal numbers. Control wiring shall be 600V, 90 °C, 16 AWG minimum machine tool wire (MTW). Power wiring shall be 600V, 90 °C, 10 AWG minimum.
15. Operator Control Stations
    a. Each starter shall be equipped with a fused control power transformer, minimum of two (2) indicating lights, Hand-Off-Auto (HOA) selector switch, and two (2) normally open contacts, unless otherwise scheduled on the drawings. A unit-mounted device panel shall have space to accommodate six (6) 30 mm oil-tight pilot-control devices or indicating ammeters, voltmeters, or elapsed time meters. In order to improve maintenance capabilities, the device panel shall withdraw with the unit. Door-mounted pilot devices are not acceptable.
    b. Indicator lights: LED type full size, full voltage, with push-to-test feature. Colors and quantities shall be as shown in the Contract Documents.
16. Finishes
    a. Surfaces shall be painted according to the manufacturers standard color scheme. All unpainted parts shall be plated for resistance to corrosion.
17. Identification Requirements
    a. Equipment and internal and external components shall be identified pursuant to Section 16090.
18. Control Devices: Relays, timers, surge monitors, and other control components shall be in accordance with Section 17090.
19. Digital Metering Module (DMM)
    a. Ethernet/IP communications.
    b. Provide a digital metering module (DMM) for each MCC as shown in the Contract Documents.
    c. The DMM shall be a microprocessor based, solid state unit suitable for door mounting on the electrical equipment enclosure and for providing monitoring for the 3 phase electrical circuits detailed in the Contract Documents. The DMM shall be UL-listed and comply with applicable portions of ANSI C37.90.
    d. The DMM shall provide direct reading of metered or calculated values for the items listed below and shall automatically range between Units, Kilo-units, and Mega-units for all displayed values. Accuracy's indicated shall be of read or calculated values.
        1) AC amperes in each phase: 1 percent accuracy.
        2) AC voltage, phase-to-phase and phase-to-neutral: 1 percent accuracy.

3) Kilowatts: 2 percent accuracy.
4) Kilovars: 2 percent accuracy.
5) Power factor: 4 percent accuracy.
6) Frequency: 0.5 percent accuracy.
7) Kilowatt demand (5, 10, 15, 30 minutes interval programmable): 2 percent accuracy.
8) Kilowatt hours: 2 percent accuracy.
9) Kilovar hours: 2 percent accuracy.
10) KVA: 2 percent accuracy.
11) KVAH: 2 percent accuracy.
12) Percent TDD.
13) Percent THD.
14) K factor.

e. External current transformers with ratios as indicated on the drawing or as required shall be provided integrated into the equipment lineup.
f. The DMM shall not utilize voltages greater than 120 VAC on the equipment enclosure door. This may be accomplished by back pan mounting of the voltage input sensors and door mounting the display portion of the DMM or with the use of separate (and fused) potential transformers. Integral potential transformers shall be fused.
g. The DMM shall have a dedicated communication port configured for Ethernet/IP protocol.
h. The DMM display face shall be membrane type and rated suitable for NEMA 12 mounting and integrated into the motor control center enclosure. The device shall have a durable, LED display screen accessible to the user without requiring opening a switchboard door.
i. The DMM shall have an operating temperature range of 0 degrees C to 70 degrees C, and 0 to 95 percent relative humidity non-condensing.
j. The DMM shall allow the user to disable undesired values/functions and to later reactivate them if required.
k. Control power shall be drawn from the monitored incoming AC line terminal connections. No separate AC supply input shall be required.
l. The device shall have non-volatile memory and not require battery backup; in the event of a power failure, the device shall retain all pre-set parameters, accumulated watt-hours, watt demand. Data at time of power loss shall be stored.

20. Surge Protection Devices (SPDs)
    a. Provide a surge suppression device (SPD) as shown on the Drawings.
    b. The SPDs shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
    c. The Maximum Continuous Operating Voltage (MCOV) of the SPDs shall not be less than 115% of the nominal system operating voltage.
    d. The SPDs shall provide line-to-line and line-to-ground protection.

e. The Nominal Discharge Current rating of the SPDs shall be 20kA.
f. The maximum Voltage Protection Rating of the SPDs shall not exceed 2,000.
g. The SPDs shall be provided with the following integral mounting options:
h. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
i. The indicator lights shall report the status of all protection elements and circuitry in the L-G and L-L modes.
j. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators shall indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights shall continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted
k. The SPD shall include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
l. The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
m. The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
n. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
o. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
p. All of the SPD's components and diagnostics shall be contained within one discrete assembly.
q. The minimum surge current withstand capacity of the SPD shall be as follows:
r. 250kA per phase.
s. 125kA per mode.

t. The SPDs shall be mounted within the switchboard enclosure. Externally mounted SPDs shall not be acceptable.
u. The SPDs shall be provided with a circuit breaker disconnect.

21. Ethernet/IP Devices
    a. Motor Control Center assemblies shall be provided with a factory assembled EtherNet/IP field bus communications network providing direct connectivity between MCC devices and the system controller and/or HMI.
    b. Ethernet 10/100 auto negotiate layer 2 managed industrial switches shall be provided as required in the MCC lineup. The Ethernet switch shall have sufficient ports available to connect to each EtherNet/IP device and have at least 2 open ports for a customer connection and a PC connection for maintenance. The Ethernet switch shall be mounted in the top removable unit of each vertical section or shipping split and not in the vertical wireway. If required by the application, the switch shall be capable of connecting to multiple sections.
    c. The EtherNet/IP system installed in the MCC shall include a complete and tested cabling system. The cabling system shall be shielded 600V CAT 6 and consist of home run connections from the device to a switch located in the MCC and in accordance with the ODVA specification. Non-standard, non-shielded cable will not be accepted.
    d. It shall be permissible to daisy chain Ethernet/IP devices using a 2-port switch configuration in each device unit or bucket and not use the home run topology.
    e. All cabling shall be securely supported and attached to the MCC structure in accordance with the contract drawings and the manufacturer's recommendations.
    f. EtherNet/IP communications modules shall be provided at each device interfacing to the EtherNet/IP field bus. The communications modules shall be installed in the unit device compartment or bucket, and shall be direct-connected to the EtherNet/IP Ethernet cable. Each device shall be provided with the appropriate factory fabricated cable for interfacing the communications module with the associated EtherNet/IP device.
    g. Industrial Ethernet Switch
        1) The MCC shall have a managed industrial Ethernet switches mounted in fixed mounted units within the lineup. Reference the Drawings for locations.
        2) The managed industrial Ethernet switch shall deliver optimal network security, network resiliency (if needed), and flexibility. The functionality should include port based control/prioritization, switch-level ring support, VLAN segmentation, and other Layer-2 switch features.
        3) The switch shall be suitable for use in a switch-level ring network topology.
        4) The switch shall be provided with a minimum of two (2) spare Ethernet ports.
        5) The spare Ethernet ports shall be wired to spare Industrial Ethernet RJ45 connectors within the vertical wireways of the motor control center,

located as shown on the Drawings. The spare Ethernet ports shall be located in vertical wireways that are adjacent to SPACE compartments.

6) The switch shall be located in the top horizontal wireway or within it's own bucket, as shown on the Drawings.
7) The switch shall accept redundant fiber optic cable connectors. The redundant fiber optic cable shall be used to network the switch to the Plant's PLC control panels.
8) The switch shall be provided with single mode LC type fiber optic connectors.
9) The size and quantities of switches shall be determined by the Manufacturer.

h. Industrial Ethernet Cable
   1) Shall be rated 600 volt UL Category 6 PLTC.

2.2 SEISMIC

A. Provide manufacturer's seismic certificate.

PART 3 EXECUTION

3.1 SOURCE QUALITY CONTROL

A. Tests and Inspections
   1. Provide factory testing of the control panels to ensure correct operation.
      a. Correct all errors prior to shipping
   2. Provide copy of the test results in electronic (PDF) format to the OWNER and ENGINEER.
   3. OWNER has the option to perform a virtual "witness testing" of the factory testing. Coordinate scheduling with the OWNER if desired.

3.2 DEMONSTRATION, TRAINING, START-UP, AND COMMISSIONING

A. Refer to the following Specifications for requirements.
   1. Section 11300 SBR Equipment
   2. Section 11400 DAF Equipment

3.3 AS-BUILT DATA

A. Provide a final as-built drawing in electronic format (PDF) as part of the O&Ms
   1. MCC drawings, elevations, and wiring diagrams
   2. All product data
   3. Recommended maintenance procedures
   4. Training materials
   5. Test results
   6. Warranty information

END OF SECTION

SECTION 17090

PACKAGED CONTROL SYSTEM REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
   1. This section contains the requirements pertaining to the construction and installation of the control panels.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. National Electrical Contractors Association (NECA)
   2. National Electrical Installation Standard (NEIS)
      a. 5055, Standard of Installation
   3. National Fire Protection Association (NFPA)
      a. 70, National Electrical Code (NEC)
      b. 79, Electrical Standard for Industrial Machinery
   4. Underwriters Laboratories, Inc. (UL)
      a. 3121-1, Standard for Safety for Process Control Equipment
      b. 508, Industrial Control Equipment
      c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations
   5. National Electrical Manufacturer's Association (NEMA)
      a. 250, Enclosures for Electrical Equipment
      b. ICS 1-2000, Industrial Control and Systems General Requirements

1.3 SUBMITTALS

A. Contractor shall submit all the product data in Division 40 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:
   1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
   2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Shop Drawings
1. Dimensional drawings showing the overall length, width, and height of the assembled control panel. Included on these drawings shall be the back panel layout of installed control devices showing part numbers, dimensions, nameplate text, and other details required for a complete assembly. Provide elevation drawings of the interior and exterior of the control panel.
2. For large control panel, physical properties, handling, mounting, shipping break point locations shall be shown in submittal drawings. This shall include total weight, lifting instructions, height, and floor space required.
3. Provide electrical schematic drawings that include: wiring details such as internal and field connection terminal block numbers; shielded wire termination requirements; grounding requirements; and wire colors. Show all required internal and external interlocking. Each drawing shall be circuit specific for the system submitted. No typical schematic drawings shall be submitted.
    a. Include all “field” connections (i.e. wiring that is external to the panel but terminates on the panel).
    b. Include all 120-volt and 24-volt circuits, including power to devices and instruments which are external to the control panel.
    c. Include all auxiliary contacts for alarms, status monitoring, and control.
4. Provide enlarged details of all of the electrical components on each DIN rail within the control panel.
5. Provide loop drawings of all digital and analog inputs and outputs (I/O).
    a. Indicate if instruments and devices are loop or self-powered.
6. Drawings shall list the equipment number of the box, control panel, or center submitted.
7. Component designations shall match those shown on the Drawings.
8. Complete bills of materials shall be included with submittal.

D. Operator Interface Terminal (OIT) Screen Submittals
1. Provide one (1) submittal in PDF format, showing all proposed OIT screens. Include the following:
    a. Actual colors used
    b. User interface buttons and interfaces
    c. Alarms and data monitoring
    d. Description of hierarchy of screens

2. Assume a minimum of three (3) rounds of submittals with the OWNER and ENGINEER.

1.4 SYSTEM SUPPLIER

A. The SYSTEM SUPPLIER shall be the vendor that supplies a programmable logic controller (PLC) PLC control panel for either the SBR or DAS packaged systems.

1.5 OWNER'S SCADA SYSTEM AND SYSTEM INTEGRATOR (SI)

A. The OWNER has pre-selected a SYSTEM INTEGRATOR (SI) to provide a SCADA system to monitor the entire wastewater treatment system, including but not limited to the new SBR and DAF systems.
   1. The SCADA system will be Rockwell Automation FactoryTalk SE.

B. The packaged control systems shall be Ethernet/IP compatible so that they are compatible with the SCADA system.
   1. The SYSTEM SUPPLIER shall provide all programming of protocol converters used as gateway devices between their protocol and Ethernet/IP.

C. The control panel SYSTEM SUPPLIER shall coordinate with the SI, ENGINEER, and OWNER to ensure a fully coordinated control system that integrates with the OWNER'S SCADA system.
   1. Provide for continued and ongoing coordination with plant-wide SCADA developers to ensure uniform integration of SCADA operator screens and functions where they are determined to be appropriate and useful.
   2. ENGINEER has final authority in determining the extent and degree of integration between the plant-wide SCADA and the SYSTEM SUPPLIER'S packaged control system.

D. Provide a data map of all points on packaged control system PLC to the SI.

1.6 CONTROL PANEL REQUIREMENTS AND STANDARDS

A. The SYSTEM SUPPLIER shall provide all components for a complete and functional PLC control panel, regardless of whether the components are specifically identified within this Specification or not. Generally, the control panel shall consist of the following:
   1. Programmable Logic Controller (PLC)
   2. Operator Interface Terminal (OIT)
   3. Network switch and Ethernet/IP protocol converter (if required)
   4. Uninterruptible power supply (UPS), battery backup for the UPS, and low voltage power supplies.
   5. Indicator lights, pushbuttons, selector switches.
   6. Surge protection device
   7. Overcurrent protective devices, terminal blocks, and terminal strips.

B. The overall size of the control panel, backpanel, and spacing of the internal components on the backpanel shall provide reasonable access for maintenance and troubleshooting. A design which does not permit reasonable use of typical hand tools (screw driver) by an average person to access and troubleshoot components shall not be acceptable.

C. An uninterruptible power supply (UPS) capable of supply the PLC, OIT, network switch, protocol converter, power supplies, and all I/O for a minimum of fifteen (15) minutes.

D. The exact design and layout of the control panel shall be the responsibility of the SYSTEM SUPPLIER due to its custom and unique nature. However, the control panel shall comply with the requirements and standards:
   1. All electrical components, devices, and wiring shall be installed in a Neat and Workmanlike manner as defined by the National Electrical Contractor's Association (NECA) and a Professional and Skillful Manner as defined by the National Electrical Code
   2. 18-month warranty minimum.
   3. UL 508A label.
   4. The control panel shall be capable of communicating with the Owner's SCADA system via Ethernet/IP. The Owner's SCADA system will be a Rockwell FactoryTalk View.
   5. Minimum short circuit rating = 42,000 AIC.
      a. The control panel nameplate shall include the AIC rating.
   6. Seismic certificate.
   7. Single enclosure.
   8. Separation of voltages for Class 1, Class 2, and Class 3 wiring as required by Code.
   9. Provide Code-required intrinsically safe relays and barriers as required. Provide Code-required separation of intrinsically safe wiring within the panel as required.
   10. Cooled and ventilated, engineered by the SYSTEM SUPPLIER.
      a. Provide intake and exhaust shrouds as needed.
      b. Provide exhaust fans with thermostats as needed.
   11. Shall monitor for loss of input power and shall generator an alarm to the SCADA system if power is lost.
   12. Surge protection on the incoming power circuit.
   13. Install wiring to maintain Code required separation of Class 1 and Class 2 wiring.
   14. Utilize wire duct management with covers, cable ties, and Velcro straps for all wiring.
   15. Control outputs shall be individually fused.
   16. 24-VDC digital input and output circuits.
      a. Provide MOV-type surge arresters on relay outputs where required.
   17. 24-VDC analog input and output circuits.
   18. 120-VAC digital output circuits.
   19. Provide uninterruptible power supplies to maintain constant power to the control panel.
   20. All control circuits protected by circuit breakers or fuses.

21. Provide 24 VDC power supplies for both internal and external loads.
    a. Size the power supplies so that all instrumentation associated with the packaged system may be powered by the power supply.
    b. 25% spare (volt-amps) minimum.
22. 120-VAC, 15-amp GFCI protected receptacle for troubleshooting and connecting a laptop.
23. Indicator lights for each alarm and status recommended by the Manufacturer.
24. Hand-Off-Auto for each motor or valve as recommended by the Manufacturer.
25. LED strip lights above every enclosure door, activated by motion sensors.
26. Grounding bus bar.
27. Data packet on door to hold as-built drawings.
28. All power distribution blocks, terminal blocks, conductors, relays, pilot devices, and all other components within the control panel shall be individually and distinctly labeled. The labels shall match the shop drawings.
29. Leave space at the bottom and top of the control panel enclosure for the installation of "field" conduits and wiring.
30. Fully tested and commissioned by the System Supplier at the factory prior to shipping.
    a. Provide written certification of testing to the OWNER.

E. Coordinate with the OWNER and ENGINEER through the submittals and coordination meetings to ensure the control panel, PLC, OIT, and networking system applications conform to the requirements of the Owner's project requirements and standards.

1.7 QUALITY ASSURANCE

A. Qualifications
    1. Equipment provided as part of this section shall be manufactured by a single licensed firm, regularly engaged in the design and manufacture of such equipment for a minimum of five years. The control panels shall have a UL508A listing. Components within control panels shall be listed in a manner consistent with UL508A requirements.

1.8 MAINTENANCE

A. Manufacturer shall provide and list in the bill of materials the following spare parts.
    1. One each of all power and control fuses provided in the assembled control panel/ center.

B. Provide Operation and Maintenance Data and Manuals Pursuant to the Contract Documents.

1.9 WARRANTY

A. Refer to the following sections for requirements
    1. Section 11300 SBR Equipment
    2. Section 11400 DAF Equipment

PART 2 PRODUCTS

2.1 PLC COMPONENTS, HARDWARE, AND SOFTWARE

A. Programmable Logic Controller (PLC)
   1. Shall consist of power supply, processor, 24-VDC digital inputs, 24-VDC digital outputs, 120-VAC digital outputs, 4-20mA analog inputs, and 4-20mA analog outputs, and all other modules for a complete PLC capable of controlling and monitoring the packaged control system.
   2. The Programmable Logic Controller (PLC) shall provide program memory, processing speed, I/O capacity, and Ethernet/IP node capacity as needed for optimal operation of the packaged control system without delays or lag caused by scanning time, lack of processing or memory resources, or inefficient PLC code. RAM memory shall be protected by a backup battery with further memory protection from a flash card. The processor shall have LED Indicators showing Run, Fault, and Battery Low status. Typical Scan Time is 1ms/1k ladder logic. The processor shall have one dedicated serial port, which supports RS232 communications. The processor shall have a built in Ethernet port for Ethernet/IP network communications and a minimum of one USB port.
      a. Memory, speed, and I/O capacity shall be sized for a minimum of 25% spare capacity and expansion.
      b. Shall include non-volatile memory storage.
   3. PLC shall support programming via relay ladder, structured text, function block, and sequential function chart.
   4. DIN rail mounted.
   5. Rated for the temperature and environment in which the PLC is installed.
   6. UL Listed.

B. Operator Interface Terminal
   1. UL listed and rated for the environment in which it is installed.
   2. OITs shall be capable of displaying operating data, alarms, set points, etc. by a color display screen and shall have the following characteristics:
      a. Capable of generating graphics to display trends and access PLC data.
      b. OIT shall have a touch-screen with wide aspect ratio color.
   3. Touch screen shall allow the following gestures:
      a. Tap
      b. Double-tap
      c. Drag
      d. Long press
   4. OITs shall be capable of applying user defined graphic symbols including push buttons, selector switches, numeric and ASCII entry devices, diagnostic indicators, message displays, embedded numbers, ASCII variable displays and other devices.
   5. Shall support up to 100 screens and up to 500 alarms minimum.
   6. OITs shall have an alarm capability that utilizes an alarm list to record and display important data on triggered alarms with buttons for printing or clearing the list.

7. An alarm banner may be used to notify an operator when an alarm occurs by displaying a message and providing buttons for alarm response.
8. OIT power supplies shall be 24V DC and rated for operation from 18 to 32V DC absolute.
9. Display size for OIT shall be 12 inches nominal.
10. Conformal coated.
11. Installed on the control panel door. OIT shall be provided with mounting levers.
12. SD card (1GB) with protective cover, hot swappable, for external storage.
13. Lithium ion battery with cover.
14. Status indicators on back of terminal, including fault conditions.
15. Ethernet/IP compatible with Ethernet port.
16. USB host and device ports.
17. Provide with all software and firmware, including license, for screen development and packaged control system operation.

C. Managed Network Switches
1. Switch shall be UL Listed, EtherNet/IP, and rated for the environment in which it is installed.
2. Compatible with the OWNER's SCADA system.
3. Port count for number of devices served with 25% spare minimum.
4. Copper Ethernet connectors shall be RJ45.
5. DIN Rail Mounted.
6. 24 VDC powered.
7. Security
   a. STP, RSTP, MSTP resiliency protocols.
   b. EtherChannel (link aggregation)
   c. MAC ID port security
   d. Port thresholds and mirroring
   e. CIP Interface
   f. VLANs

D. Protocol Converters
1. If required, shall be used to convert the PLC, OIT, and network switch communication protocol to Ethernet/IP.
2. The control panel equipment shall be capable of communicating over Ethernet/IP with the OWNER'S SCADA system.
3. Switch shall be UL Listed, EtherNet/IP Certified and rated for the environment in which it is installed.
4. 24 VDC powered.

E. PLC and OIT Software
1. Provide software, firmware, and licenses for the PLC and OIT,
2. Provide a licensed copy of the PLC and OIT software to the OWNER.

2.2 CONTROL PANEL ENCLOSURE AND COMPONENTS

A. Control Panel Enclosure (407800.E20).

1. Control panel enclosure shall be provided as shown on the Drawings.
2. Control Panel enclosure shall be painted steel, NEMA 12.
3. Control Panel enclosure shall be continuous hinged with gasketed doors.
4. Control Panel enclosure shall include a lockable hasp.
5. Control Panel enclosure back-panel shall be painted steel.
6. Control Panel enclosure shall be supported on 12-inch legs.

B. Panel Vents (407800.V01).
   1. Panel Vents shall be provided as shown on the Drawings.

C. Enclosure Cooling Fan (407800.T01).
   1. Enclosure cooling fans shall be provided as shown on the Drawings.
   2. Enclosure cooling fans shall operate on 115 VAC.
   3. Enclosure cooling thermostats shall be provided for each fan.
   4. Enclosure cooling fans shall be provided with air filter, air plenum, finger guard, and inlet grille.
   5. Enclosure cooling exhaust vents shall be provided for each fan.
   6. Enclosure cooling exhaust vents shall be provided with air filter, filter retainer with integral finger guard, and exhaust grille.

D. Enclosure Lighting (407800.L01).
   1. Enclosure lighting shall be provided as shown on the Drawings.
   2. Enclosure lighting shall be LED.
      a. Lamp shall be provided by CONTRACTOR.
   3. Enclosure lighting shall be operated via a remote door switch.
   4. Enclosure lighting shall be 115 VAC powered.

E. Enclosure Corrosion Inhibitor (407800.I06).
   1. Enclosure corrosion inhibitors shall be provided as shown on the Drawings.

F. General Purpose Control Relays (407800.R01).
   1. General purpose control relays shall be provided as shown on the Drawings.
   2. General purpose control relays shall be industrial plug-in blade style.
   3. General purpose control relays shall indicate the on/off status by either a neon indicating light, LED indicating light, or by mechanical means.
   4. General purpose control relays shall be provided with a “push-to-test” function.
   5. General purpose control relays shall be provided with a minimum of three Form C contacts, and 10 Amp contact rating.
   6. General purpose control relay coil voltage shall be either 120 VAC or 24 VDC as indicated on the Drawings.
   7. General purpose control relays shall be provided with DIN rail mounting bases and hold down clips.
      1) Relay bases shall be of the same manufacturer as the relay.

G. Time Delay Relays (407800.R12).
   1. Time delay relays shall be provided as shown on the Drawings.

2. Time delay relays shall be either time delay on energize (TDOE), or time delay on de-energize (TDODE) as indicated on the Drawings.
3. Time delay relays shall be provided with a timing range as indicated on the Drawings.
4. Time delay relays shall be industrial plug-in blade style.
5. Time delay relays shall indicate the timed out status by either a neon indicating light, LED indicating light, or by mechanical means.
6. Time delay relays shall be provided with a minimum of three Form C contacts, and 10 Amp contact rating.
7. Time delay relay coil voltage shall be either 120 VAC or 24 VDC as indicated on the Drawings.
8. Time delay relays shall be provided with DIN rail mounting bases and hold down clips.
    1) Relay bases shall be of the same manufacturer as the relay.

H. Low Voltage Monitoring Relay (407800.R50).
1. Low voltage monitoring relays shall be provided as shown on the Drawings.
2. Low voltage monitoring relays shall have a fixed pick up at 22 VDC.
3. Low voltage monitoring relays shall have an adjustable dropout from 16 to 21 VDC.
4. Low voltage monitoring relays shall plug into an eight-pin octal relay base.
    a. Relay base shall be of the same manufacturer as the relay.

I. Power Circuit Breaker (407800.C02).
1. Power circuit breakers shall be provided as shown on the Drawings.
2. Power circuit breakers shall be current-limiting and designed to interrupt and isolate electrical power to individual power circuits and components deriving power from the enclosure.
3. Power circuit breakers shall be UL489 listed.
4. Power circuit breakers shall have the number of poles as indicated on the Drawings.
5. Power circuit breakers shall have current interruption ratings of 10K RMS symmetrical amperes, minimum, with voltage ratings and current trip ratings as shown on the Drawings.
6. Power circuit breakers shall have fast acting (type “B” trip curve), normal (type “C” trip curve) and high inrush (type “D” trip curve) trip characteristics as dictated by the connected load.
7. Power circuit breakers shall be panel mounted on DIN rail.
8. Power circuit breakers shall include a positively trip-free mechanism that cannot be defeated by holding the handle in the ON position.
9. Power circuit breakers shall be wire connected and include terminal lugs.

J. Power Circuit Breaker Accessories (407800.C04).
1. Provide busbar for one-pole, two-pole or three-pole circuits when shown on the Drawings. The busbar shall be the same manufacturer as the power circuit breaker.

2. Provide busbar shroud on all unused terminals. The shroud shall be the same manufacturer as the busbar.
3. Provide a bus connector to supply the power feed to the bus bar as shown on the Drawings. The bus connector shall be the same manufacturer as the busbar.

K. Control Fuses (407800.F01).
1. Control Fuses shall be provided as shown on the Drawings.
2. Control Fuses shall interrupt and isolate electrical power to individual control circuits and components within each enclosure and for circuits and components located outside each enclosure but deriving power from the enclosure.
3. Control Fuses shall be rated at 250 VAC minimum and with current ratings as shown on the Drawings.
4. Control Fuses shall have fast acting and time delay characteristics as dictated by the connected load.
5. Provide five (5) spare fuses of each type and size provided for each control panel.

L. Transient Voltage Surge Suppressors (407800.V10).
1. Transient voltage surge suppressors shall be provided as shown on the Drawings.
2. Transient voltage surge suppressors shall be capable of continuously sustaining a minimum of 20 amp for connected loads, operating from 120 VAC power with a line frequency between 47-63 Hz.
3. Transient voltage surge suppressors shall have a UL 1449 Suppressor Classification of 400 VAC for normal/common mode noise suppression.
4. Transient voltage surge suppressors shall include L-N, L-L, L-G and N-G modes of suppression, with noise attenuation of 50dB minimum for normal mode and 40dB minimum for common mode and a peak surge capability of 25kA.
5. Transient voltage surge suppressors shall have a green status LED as well as form C contacts for operating status indication and alarming.
6. Transient voltage surge suppressors shall mount on DIN rail.

M. Selector Switches (407800.S01).
1. Selector switches shall be provided as shown on the drawings.
2. Selector switches shall be of round construction with rotary operators.
3. Selector switches operation shall be to maintain the position turned to unless shown otherwise on the Drawings.
4. Selector switches shall be provided with the number of contacts, switch positions, and other details as shown on the Drawings.
5. Selector switches shall be rated NEMA 13 for indoor applications and NEMA 4 for outdoor applications.
6. Selector switch contacts shall be rated at 10 Amps.

N. Pushbutton Switch (407800.S02).
1. Pushbutton switches shall be provided as shown on the drawings.
2. Pushbutton switches shall be of round construction with push or push-pull operators.
3. Pushbutton switch operation shall be momentary or maintained as shown on the Drawings.

4. Pushbutton switches shall be provided with the number of contacts, switch positions, and other details as shown on the Drawings.
5. Pushbutton switches shall be rated NEMA 13 for indoor applications and NEMA 4 for outdoor applications.
6. Pushbutton switch contacts shall be rated at 10 Amps.
7. Pushbutton switches for Emergency Stop and other emergency switches (e.g., Help Me switches) shall be: provided with a red mushroom head; pull to reset; provided with N/C (failsafe) contacts; and shall be non-illuminated.

O. Indicator Lights (407800.L20).
1. Indicator lights shall be provided as shown on the drawings.
2. Indicator lights shall be of round construction.
3. Indicator lights shall have a built in push-to-test function.
4. Indicator light operation shall be as shown on the Drawings.
5. Indicator light lens colors shall be as shown on the Drawings.
6. Indicator lights shall be provided with high visibility LED lamps with transformers for circuit voltages over 24 VAC/DC, and high visibility LED lamps without transformers for circuits 24 VAC/DC and below.
7. Indicating lights shall be rated as NEMA 13 for indoor applications and NEMA 4 for outdoor applications.
8. Indicator light contacts shall be rated at 10 Amps.

P. Terminal Strip Identification Block (407800.T15).
1. Provide a terminal strip identification block with a machine generated label to match those shown on the Drawings.

Q. Low Current Terminal Blocks (407800.T10).
1. Low current terminal blocks shall be provided as shown on the Drawings and in all panels requiring low current field terminations. Provide accessories as required and as shown including, but not limited to end anchors, end barriers, bridge jumpers, terminal strip pre-printed markers and snap-in pre-printed terminal block markers.
2. Low current terminal blocks shall be used for electrical circuits rated at or less than 30 amps.
3. Low current terminal blocks shall mount on DIN rail.
4. Low current terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
5. Low current terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
6. Low current terminal blocks shall be grey in color.
7. Low current terminal blocks shall be UL rated for up to 30 amps at 600 VAC.
8. Low current terminal blocks shall accept wires from 24 to 10 AWG for single conductor per termination.

R. Grounding Terminal Blocks (407800.T60).

1. Grounding terminal blocks shall be provided as shown on the Drawings and in all panels requiring field terminations.
2. Grounding terminal blocks shall be used for electrical circuits rated at or less than 30 amps.
3. Grounding terminal blocks shall mount on DIN rail.
4. Grounding terminal blocks shall be UL rated for a maximum of 30 amps and 600 VAC and to accept wires from 26 to 10 AWG for single conductor per termination.
5. Grounding terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
6. Low current terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
7. Grounding terminal blocks shall be green / yellow in color.

S. Knife Disconnect Terminal Blocks (407800.T55).
1. Knife disconnect terminal blocks shall be provided shown on the Drawings, on all non-fused analog loop terminations, and in all panels requiring field analog loop terminations.
2. Knife disconnect terminal blocks shall be used for analog circuits.
3. Knife disconnect terminal blocks shall mount on DIN rail.
4. Knife disconnect terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
5. Knife disconnect terminal blocks shall be gray/orange in color.

T. Fusible DC Terminal Blocks (407800.T30).
1. Fusible DC terminal blocks shall be provided for 24 VDC control circuits as shown on the Drawings.
2. Fusible DC terminal blocks shall be rated for use in electrical control circuits rated 6.3 amps or less and 15-30 VAC/DC.
3. Fusible DC terminal blocks shall mount on DIN rail.
4. Fusible DC terminal blocks shall accept 5 mm by 20, 25 or 30 mm fuses and use LED type blown fuse indicators.
5. Fusible DC terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
6. Fusible DC terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
7. Fusible DC terminal blocks shall be black in color.

U. Fusible AC Terminal Blocks (407800.T35).
1. Fusible AC terminal blocks shall be provided for 120 VAC control circuits as shown on the Drawings.
2. Fusible AC terminal blocks shall be rated for use in electrical control circuits rated 6.3 amps or less and 110-250 VAC/DC.
3. Fusible AC terminal blocks shall mount on DIN rail.
4. Fusible terminal blocks shall accept 5 mm by 20, 25 or 30 mm fuses and use neon blown fuse indicators.

5. Fusible AC terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
6. Fusible AC terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
7. Fusible AC terminal blocks shall be black in color.

V. Relay Terminal Blocks (407800.T50).
1. Relay terminal blocks shall be provided as shown on the Drawings.
2. Relay terminal blocks shall mount on DIN rail.
3. Relay terminal blocks shall include coil voltage present indication.
4. Relay terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
5. Relay terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
6. Relay terminal block coil voltage shall match the coil voltage shown on the Drawings.
7. Relay terminal block contacts shall SPDT, rated for 5A at 24V AC/3A at 120V AC.

W. Single Wire Conductors (407800.C20).
1. Single wire conductors shall be provided as required for wiring within control panels and control centers.
2. Single wire conductors shall be UL listed, standard type MTW.
3. Insulation colors shall comply with Section 16121 600-volt Conductors and Cables.
4. Single wire conductors shall be rated at a minimum of 600 volts.
5. Single wire conductors for 120 VAC circuits shall be 14AWG minimum.
6. Single wire conductors for motor power circuits shall be sized to the larger of; 125% of the attached motor load or 14AWG.
7. Single wire conductors for transformer power circuits shall be sized to the larger of; 125% of the transformer rating or 14AWG.
8. Single wire conductors for all other circuits shall be sized to the larger of; 100% of the attached load or 16AWG.

X. Single Pair Twisted Shielded Cable (407800.C25).
1. Single pair twisted shielded cables shall be provided as required for wiring within control panels and control centers.
2. Single pair twisted shielded cable be twisted, single pair with a drain wire and overall foil shielding, and PVC jacket.
3. Single pair twisted shielded cables shall be UL listed.
4. Single pair twisted shielded cables shall be rated at a minimum of 300 volts.

Y. Insulated Wire Ferrules (407800.F30).
1. Insulated wire ferrules shall be provided for all wiring within boxes, control panels, and control centers.
2. Insulated wire ferrules shall be plastic sleeved and insulated.
3. Insulated wire ferrule color code shall match DIN color code.

4. Insulated wire ferrules shall be installed using a controlled cycle tool from the ferrule manufacturer and specifically intended for use with the ferrules provided.

Z. Wire Identification Labels (407800.L02).
1. Wire identification labels shall be provided for all conductors within control panels and control centers.
2. Wire identification labels shall be machine printed, non-adhesive, wire marker heat shrink sleeves with identification numbers that match the approved submittals.
3. Wire identification labels shall be properly sized for the conductor or cable and shall be white with black characters.

AA. Wide Slot Wire Duct (407800.W20).
1. Wire ducts shall be provided as shown on the Drawings.
2. Wire ducts shall be sized as shown on the Drawings, or larger.
3. Wire ducts shall be no more than 40% filled based on the total cross sectional area of the wire duct.
4. Wire ducts shall be white in color.
5. Wire ducts shall have slotted sides.
6. Wire ducts shall include removable covers
7. Wire ducts shall be attached to the backpanel with screws or plastic fasteners that are approved for the use and provided by the wire duct manufacturer.
8. Wire ducts shall not be attached to backpanel or enclosure side surfaces with glue or other such adhesives.

BB. Narrow Slot Wire Ducts (Narrow Slot) (407800.W21).
1. Wire ducts shall be provided as shown on the Drawings.
2. Wire ducts shall be large enough to provide a wire fill area no more than 40 percent of the total cross sectional area of the wire ducts.
3. Wire ducts shall be attached to the back panel with screws or plastic fasteners that are approved for use with, and provided by the wire duct manufacturer.
4. Wire ducts shall not be attached to back panel or enclosure side surfaces with glue, tape, or other such adhesives.
5. Wire ducts shall be white in color.
6. Wire ducts shall have slotted sides.
7. Wire ducts shall be provided with removable covers.

CC. Noise Shield (407800.N20).
1. Noise shields shall be provided as shown on the Drawings.
2. Noise shields shall be designed to provide up to 20 dB reduction in noise, equivalent to six-inch air spacing.
3. Noise shields shall be provided with bonding clips to allow mounting inside wire ducts.
4. Noise shield height shall match the wire duct height.
5. Noise shields shall be perforated and pre-scored.
6. Noise shields shall include vertical wall slots and horizontal cable tie slots.

7. Noise shields shall be zinc plated on all horizontal (contact) surfaces and black powder coated on all vertical surfaces.
8. Noise shields shall be attached to the backpanel with screws or plastic fasteners that are approved for the use and provided by the wire duct manufacturer.

DD. Spiral Wrap (407800.W30).
1. Spiral wrap shall be provided as shown on the Drawings and for all conductor and cable wire assemblies that cross hinged connections.
2. Spiral wrap shall be sized per the manufacturer's instructions.
3. Spiral wrapped assemblies shall include a strain relieving loop at each hinge crossing, with a minimum 6 inch vertical height, to minimize flexing of the wires in the conductor and cable assemblies.

EE. Cable Ties (407800.W40).
1. Cable Ties shall be provided as required for organizing and arranging conductors within boxes, control panels, and control centers.
2. Cable ties shall be UV resistant.
3. Cable ties shall be black in color.
4. Cable ties shall be installed using a tool from the cable tie manufacturer and specifically intended for use with the cable ties provided.

FF. DIN Mounting Rail (407800.D10).
1. DIN Mounting Rail shall be provided as shown on the Drawings and in all panels requiring DIN mounting rail.
2. DIN mounting rails shall be made of steel, galvanized, and yellow chromated.

GG. Dual Outlet DIN Mounting GFCI Receptacles (407800.R88).
1. Dual outlet DIN mounting GFCI receptacles shall be provided as shown on the Drawings.
2. Dual outlet DIN mounting GFCI receptacles shall be rated for 20A at 120V AC.
3. Dual outlet DIN mounting GFCI receptacles shall be suitable for use with wires up to #10 AWG.
4. Dual outlet DIN mounting GFCI receptacles shall be rated for 25mS response time at 4-6 mA.
5. Dual outlet DIN mounting GFCI receptacles shall comply with UL943.

HH. Ground Bars (407800.G06).
1. Ground bars shall be provided as shown on the Drawings.
2. Ground bars shall be low profile, "bus" type with set screw or pressure type connections and all copper construction.
3. Ground bars shall include sufficient termination points to accommodate all equipment grounding conductors as shown on the Drawings.
4. Ground bars shall include spare termination points to accommodate twenty (20) additional conductors sized, #14 through #8 AWG.

II. Control Power Transformers (407800.T05).
1. Control power transformers shall be provided as shown on the Drawings.

2. Provided with primary and secondary fusing.

JJ. 24 VDC Power Supplies (270800.P96)
1. 24 VDC output, sized by the SYSTEM SUPPLIER.
2. UL Listed.
3. DIN Rail mounted.
4. LED colored indicators:
   a. DC OK output
   b. Floating DC OK output.
   c. Active power boost
5. Form C contacts for output alarm
6. Minimum 25% spare capacity.

KK. Uninterruptible Power Supplies (407800.U06).
1. Uninterruptible power supplies shall be sized by the SYSTEM SUPPLIER and shall provide backup power for the PLC, OIT, network switch, protocol converter, 24vdc power supply, and any other hardware upon which loss of power is unacceptable.
2. The UPS shall be provided with leak proof, maintenance free, lead acid batteries capable of operating at 50 % load for 24 minutes and at 100 % load for 6.5 minutes minimum.
3. Uninterruptible power supplies shall be UL1778 listed.
4. Uninterruptible power supply enclosures shall be zinc plated sheet steel.
5. Uninterruptible power supplies shall be designed for DIN rail mounting and panel mounting.
6. Uninterruptible power supplies shall be provided with three LED indicating lights and audible alarm to indicating the following signals:
   a. Alarm.
   b. Battery Mode.
   c. Power OK.
7. Uninterruptible power supplies shall be provided with an LED graph display that indicates the quantity of battery reserve in percent.
8. Uninterruptible power supplies shall be capable of ‘fast charging.’ The UPS shall be wired to the associated 24VDC power supply for ‘fast charging.’ The ‘fast charging’ feature shall minimize the time required to re-charge the UPS’s power supply units.
9. Uninterruptible power supplies shall include relay contacts to allow monitoring of the following signals:
   a. Alarm.
   b. Battery Mode.
   c. Power OK.
10. The warranty shall be a minimum of 1 year after final competition.
11. Minimum 25% spare capacity.

LL. UPS Power Storage Device (407800.B02)..
1. UPS power storage device shall be provided as shown on the Drawings.

2. UPS power storage devices shall be maintenance-free lead gel, rechargeable batteries.
3. UPS power storage devices shall be suitable for DIN rail mounting.
4. UPS power storage devices shall be rated 24VDC.
5. UPS power storage devices shall be connected in parallel to increase amp-hour buffer capacity..
6. UPS power storage devices shall be provided with an internal output fuse.
7. UPS power storage devices shall be rated for operating temperatures between 0 degrees C and 40 degrees C.
8. UPS power storage devices shall be compatible with the UPS.
9. Minimum 25% spare capacity.

MM. Heavy Duty End Bracket (407800.A61).
1. Provide heavy duty end brackets on DIN rails as indicated on the Drawings.
2. Heavy duty end brackets shall be suitable for 35 mm DIN rails.
3. End brackets shall be screw-on style.
4. Provide Phoenix E/AL-NS 35 series or approved equal.

NN. Intrinsically Safe Relay (407800.R90).
1. Intrinsically safe relay shall be a signal conditioner used for transfer of binary switching signals from a hazardous area.
2. The input circuit shall be monitored for line faults (breakage and short circuit (LFD)).
3. Errors on the intrinsically safe relay shall be indicated by a red flashing LED and the output shall switch to a high-impedance state.
4. Intrinsically safe relay shall be two (2) channel.

OO. Intrinsically Safe HART Barrier (407800.B90).
1. Intrinsically safe HART barrier shall be a repeater power supply and input isolating amplifier. The repeater power supply and input signal conditioner shall be designed for the intrinsically safe and electrically isolated operation of measuring transducers and mA current sources installed in the hazardous areas.
2. Intrinsically safe barrier shall be capable of supplying power to 2-wire transducers.
3. Intrinsically safe barrier shall be capable of operating and measuring 4-wire transducers via a non-powered input.
4. The analog measured value on the intrinsically safe or non-intrinsically safe side shall be capable of overlaying a digital (HART) communication signal and transmit bidirectionally.
5. Intrinsically safe HART Barrier shall be single (1) channel. .

PP. Category 6 Ethernet Patch Cable (407800.C90).
1. Category 6 Ethernet patch cable shall be provided for all Ethernet/IP networked devices.
2. Category 6 Ethernet patch cable shall be suitable for use as Industrial Ethernet Cable, 100BaseTX.

3. Category 6 Ethernet patch cable shall be rated for use in a temperature range between -10 degrees C and 60 degrees C.
4. Category 6 Ethernet patch cable shall be rated for outdoor use.
5. Category 6 Ethernet patch cable shall be rated for 300 volts maximum.
6. Category 6 Ethernet patch cable conductors shall be 4-pair, solid copper, 24 AWG.
7. Category Ethernet patch cable conductor pairs shall be bonded.
8. Category 6 Ethernet patch cable insulation material shall be Polyolefin.
9. Category 6 Ethernet patch cable insulation color shall be blue.
10. Category 6 Ethernet patch cable shall be provided with aluminum foil polyester tape shield with 100% insulation coverage.
11. Category 6 Ethernet patch cable outer jacket material shall be PVC. Jacket material shall be sunlight and oil resistant. Jacket shall have sequential markings at two foot intervals.
12. Category 6 Ethernet patch cable shall be provided with RJ45 plugs, suitable for IP20 applications.

PART 3 EXECUTION

3.1 GENERAL

A. For all conductors terminating on terminal strips, install crimp-on, insulated plastic sleeve ferrules on each wire. Install ferrules with a crimping tool provided by the ferrule manufacturer for that purpose.

B. Individual conductors and cables shall be grouped together and routed through plastic wire ducts mounted on the backpanel surface.

C. Bond each enclosure back-panel to the grounding electrode system with a # 8 AWG copper conductor.

D. Where conductors and cables are routed in boxes or enclosures, they shall be neatly bundled with cable ties at intervals not to exceed 12 inches on center. The tension for the cable ties shall be set with a tool specifically made for this purpose and of the same manufacturer as the cable tie. Side cutters or other type tools shall not be used to cut the tail end of the cable tie. The CONTRACTOR shall only use the tool specifically made for this purpose and designed for use with the cable ties provided.

3.2 PLC AND OIT SOFTWARE DESIGN REQUIREMENTS

A. The PLC shall be used to provide packaged system automatic control, automatic manual control, alarming, and monitoring. The OIT shall be used to allow a user to interface with the packaged system controls and alarms in graphical format.

B. General requirements for PLC software design
   1. Password protected
   2. Subdivide into sections by processes

3. Further subdivide into subsections which contain logic for individual equipment, motors, valves, and instruments.
4. Use comments within the software to note and describe each program section. Briefly describe the control objectives.
5. Utilize a naming convention for points, variables, and tags that is consistent with the actual equipment name and process number used on at the plant. Coordinate with the ENGINEER for the process names and numbers.

C. General requirements for OIT software and screen design
1. Password protected
2. Easily navigated menus
3. Touch screen operation
4. Maintain consistency in graphic display and controls design
5. Maintain consistent and predictable window operations
6. Accurate representation of the packaged system and its operations
7. Allows operators to change set points and control equipment.
8. Include help menus and windows to provide information to help operations staff understand complex control options.
9. Alarm annunciation with dedicated alarm page including acknowledgement of alarms.
10. Include overview displays with a similar physical layout as the actual facility.
11. Display organizational philosophy
    a. Organize into a hierarchy that allows fast, intuitive, and easy navigation between screens.
        1) Data and trends – display alarm history, data monitoring, and set points.
        2) Plant overview – display major and critical processes
        3) Process overviews – display detailed data for each process within the plant
        4) Control displays – display means to monitor and control specific process equipment, motors, valves, and instruments within a process. It shall allow the display of analog data in bar graph or digital form combined with process graphics on multiple screens.
12. Software Documentation and Commenting
13. Use comments within the software to note and describe each program section. Briefly describe the control objectives.

D. Provide a database or map which lists all of the discrete and analog I/O points.

3.3 SOURCE QUALITY CONTROL

A. Tests and Inspections
1. Provide factory testing of the control panels to ensure correct operation.
    a. Correct all errors prior to shipping
2. Provide copy of the test results in electronic (PDF) format to the OWNER and ENGINEER.
3. OWNER has the option to perform a virtual “witness testing” of the factory testing. Coordinate scheduling with the OWNER if desired.

3.4 DEMONSTRATION, TRAINING, START-UP, AND COMMISSIONING

A. Refer to the following Specifications for requirements.
   1. Section 11300 SBR Equipment
   2. Section 11400 DAF Equipment

3.5 AS-BUILT DATA

A. Provide a final as-built drawing in electronic format (PDF) as part of the O&Ms
   1. PLC ladder logic
   2. OIT screens
   3. Control panel drawings, elevations, and wiring diagrams
   4. All product data
   5. Sequence of operations
   6. Recommended maintenance procedures
   7. Training materials
   8. Test results
   9. Warranty information

END OF SECTION

DAF EQUIPMENT PROCUREMENT CONTRACT CHANGE ORDERS

CHANGE ORDER NO.: 1

Owner/Buyer:	City of Aumsville, Oregon	Owner's Project No.:	
Engineer:	Westech Engineering, Inc.	Engineer's Project No.:	2599.3220.0
Seller:	Krofta Technologies, LLC	Contractor's Project No.:	25K01
Project:	Aumsville Wastewater Treatment Plant		
Contract Name:	Dissolved Air Floatation Equipment		
Date Issued:	4/14/25	Effective Date of Change Order:	4/14/25

The Contract is modified as follows upon execution of this Change Order:

Description:

Seller shall perform on-site dissolved air floatation simulations as described in the attached proposal from Krofta Technologies, LLC

Attachments:

Krofta Technologies, Change Order: 25K01-CO#1 – KTS250411-01, dated April 11, 2025

Change in Contract Price		Change in Contract Times
Original Contract Price:		Original Contract Times:
Lump Sum Price	$697,485	Delivery of acceptable goods
Buyers Contingency Allowance	$75,000	to Point of Destination: August 27, 2026
Total Price	$772,485	
Changes from previously approved Change Orders		Changes from previously approved Change Orders:
Lump Sum Price	$0	Delivery of acceptable goods
Buyers Contingency Allowance	$0	to Point of Destination:
Total Price	$0	none
Contract Price prior to this Change Order:		Contract Times prior to this Change Order:
Lump Sum Price	$697,485	Delivery of acceptable goods
Buyers Contingency Allowance	$75,000	to Point of Destination
Total Price	$772,485	August 27, 2026
Changes this Change Order:		Changes this Change Order:
Lump Sum Price	+ $16,790	Delivery of acceptable goods
Buyers Contingency Allowance	- $16,790	to Point of Destination
Total Price	$0	none
Contract Price incorporating this Change Order:		Contract Times with all approved Change Orders:
Lump Sum Price	$714,275	Delivery of acceptable goods
Buyers Contingency Allowance	$58,210	to Point of Destination
Total Price	$772,485	August 27, 2026

	Recommended by Engineer (if required)	Accepted by Seller
By:	Christopher J. Brugato, P.E.	CEO
Title:	Project Manager, Westech Engineering	
Date:	4/14/25	4/18/25

BRIAN DAILY

Digitally signed by BRIAN DAILY
Date: 2025.04.21 08:40:55 -07'00'

Authorized by Owner/Buyer	Approved by Funding Agency (if applicable)
By: Matthew Etcel	
Title: Ass. Stant Public works Director	
Date: 4-18-24	

KROFTA Technical Services

For

City of Aumsville WWTP

955 Olney St SE

Aumsville, OR 97325

Site Coordinates: 44.854427, -122.876365

Ref: The Aumsville Wastewater Treatment Plant Improvements Project

Dissolved Air Flotation Equipment – JO 2599.3220.0

Change Order: 25K01-CO#1 - KTS250411-01

11 APRIL 2025

Krofta Technologies 401 South Street PO Box 7 Dalton, Massachusetts USA 01227
Phone: 413-236-5634 Fax: 413-236-6917 www.krofta.com

Proprietary Notice

This proposal includes confidential information of Krofta Technologies which is provided for the sole purpose of permitting the recipient to evaluate the proposal submitted herewith. In consideration of receipt of this document, the recipient agrees to maintain such information in confidence and not reproduce or otherwise disclose the information to any person outside the group directly responsible for evaluation of its contents, except that there is no obligation to maintain the confidentiality of any information that becomes publicly known through no fault of recipient. By receiving and accepting this proposal, the recipient agrees to the stated terms.

About Krofta Technologies

Krofta Technologies (Krofta), located in Dalton, MA is a provider of Design & Supply solutions for genuine Krofta DAF liquid-solid separation technology along with all relevant upstream and downstream process stages for comprehensive treatment solutions. Krofta offers a complete range of Dissolved Air Flotation Clarifiers, including rentals, with a foundation of more than 50 years of DAF technology pioneering and a portfolio of +3,000 references worldwide. All Krofta DAFs, and many of the ancillary systems, are fabricated in our Massachusetts manufacturing shop.

Technical Services Agreement (TSA)
For
City of Aumsville, OR
Ref: KROFTA Contract with City of Aumsville, OR for Dissolved Air Flotation Equipment for The Aumsville Wastewater Treatment Plant Improvements

Krofta Technologies is pleased to provide this Technical Services Agreement Proposal for the on-site Dissolved Air Flotation Simulations.

Through the proposed Technical Services Agreement, Krofta Technologies will provide:

- **On-Site Dissolved Air Flotation Simulations** of City of Aumsville, OR collected Raw Influent Water necessary to provide maximum of (6) 2-Gallon Samples of simulated DAF Clarified Effluent for lab analysis by 3rd party lab (Waterlab).

SCOPE OF SUPPLY

Krofta Technologies responsibilities include the following scope:

- One (1) Site Visit and Investigation:
  - Krofta Lab Technician: One (1) Trip / 2-3 Full Days on-site.
  - Krofta to Supply DAF Simulation Kit along with necessary chemicals to perform simulations described above.
  - Upon receipt of 3rd party lab results, a report will be issued reviewing the TSA study and lab results.

DISSOLVED AIR FLOTATION SIMULATION GOALS

- Confirm the ability of a DAF process to achieve solids removal to < 10 mg/L.
- Identify best-fit Coagulant and Flocculant products and estimated dosages.
- Determine the estimated minimal chemical treatment and optimal chemical treatment, via on-site turbidity analysis.
- Determine required mix-times for coagulant and flocculant products for optimal floc stability.
- Identify potential need for pH adjustment.
- Analyze raw influent and simulated DAF clarified effluent for TSS, pH, Alkalinity, Turbidity, BOD, TKN, Ammonia, Nitrate & Nitrite Nitrogen.

SAMPLE COLLECTION AND PREPARATION

5-gallon grab samples will need to be collected from EFFLUENT STORAGE LAGOONS (CELLS) at the beginning of each sampling day. The sample location is under the surface of the water, will be drawn using a small submersible sump pump, and collected into 5-gallon carboys. On each sample bottle, note the following information with a black sharpie: Sample identifier/number, Date and time of sample, and Location of sample.

From the collected 5-gallon grab samples, 2 gallons will be bottled in the provided Waterlab analysis containers. There will be duplicate bottles for each sample analysis (TSS, pH, Alkalinity, Turbidity, BOD, TKN, Ammonia and Nitrate & Nitrite Nitrogen). The remaining 3 gallons will be utilized to perform the DAF simulations.

Simulated DAF Clarified Effluent will be collected from the 1-liter simulation columns and combined to fulfill the required 2 gallons for each treatment type (minimal chemical treatment and optimal chemical treatment). There will be duplicate bottles for each sample analysis (TSS, pH, Alkalinity, Turbidity, BOD, TKN, Ammonia and Nitrate & Nitrite Nitrogen).

After all sample bottles have been filled, the Waterlab chain of custody form will be used to note the relevant time of sampling information.

The chain of custody form should remain accessible as additional information will be noted by Krofta during the bench test. Influent grab samples and DAF simulated effluent sample bottles will be placed in a provided cooler with ice packs. Samples will be brought to Waterlab by Krofta at the conclusion of each day.

CLARIFICATIONS

The raw influent water that will be collected for the on-site dissolved air flotation studies will not be truly representative, as part of this project is the Addition of an SBR which will be ahead of the DAF System. SBR will be treating water ahead of EQ BASIN that will then flow through (3) different EFFLUENT STORAGE LAGOONS (CELLS) prior to being pumped to the DAF Treatment System.

SCHEDULE

Week of April 21, 2025	
Monday April 21st	KROFTA Lab Tech to fly out to Oregon.
Tuesday April 22nd	KROFTA Lab Tech to Setup and start working on DAF Simulations with goal of completing first (2) 2-Gallon Samples of Simulated DAF Effluent.
Wednesday April 23rd	KROFTA Lab Tech to complete the remaining (4) 2-Gallon Samples of Simulated DAF Effluent.
Thursday April 24th	Left open as a make-up day in case there is a problem with finishing the DAF Simulations.
Friday April 25th	KROFTA Lab Tech to travel home.

SERVICES AGREEMENT - PRICING SUMMARY

Services Agreement	
Description	**Total**
Technical Services as described above. INCLUDES KROFTA time for onsite sampling work, travel, & final report. This also includes travel expenses.	$9,565.00
3rd Party Lab Analysis of (3) 2-Gallon Samples of Raw Influent and (6) 2-Gallon Samples simulated DAF Clarified Effluent	$7,225.00
TOTAL	**$16,790.00**

PAYMENT TERMS

- 100% Net 30 - Following Completion of Technical Services described above.

Authorization to Proceed:

By: _____

Name: _____

Title: _____

Date: _____

Purchase Order Number:_____

Krofta Technologies, LLC

By: _____

Name:_____

Title: _____

Date: _____

TERMS & CONDITIONS:

1. GENERAL: Products and Services provided by KROFTA as specified in the Proposal are made solely under the conditions expressly set forth herein. Any proposed changes or exceptions to these conditions, or additional terms and conditions, included or referenced in Customer's order or acceptance of this offer, are hereby rejected by KROFTA, and shall be of no force or effect upon KROFTA unless expressly accepted in writing by KROFTA. This Contract shall bind and inure to the benefit of Customer and KROFTA, as well as their respective successors and assigns; however, Customer may not assign this Contract without the prior written consent of KROFTA. Neither party shall be deemed to have waived its rights by failing to enforce any particular provision of this Contract. If a court invalidates any portion of this Contract, the rest of this Contract shall remain valid and be construed as if not containing the invalidated provision. Massachusetts law shall govern the rights and obligations of the parties.

2. CREDIT APPROVAL: If at any time information available on Customer's financial condition or credit history, in KROFTA's sole judgment, does not justify the terms of payment specified in the Proposal, KROFTA may require full or partial payment in advance, or an acceptable form of payment guarantee such as a bank letter of credit, or other modifications to the terms of payment.

3. PROPRIETARY INFORMATION: All information, data, drawings, instruction and operation manuals furnished by KROFTA with this Contract are proprietary to KROFTA, submitted in strict confidence, and are to be used by Customer solely for the purposes of this Contract, and shall not be reproduced, transmitted, disclosed or used in any other manner without KROFTA's prior written authorization.

4. DELIVERY AND INSTALLATION OF PRODUCTS: All responsibility and costs relating to delivery and installation of Products will be incurred and paid as set forth in the Proposal.

5. EXCUSABLE INACTION AND/OR DELAY: KROFTA shall not be liable for failure to perform or for delay in performance due to fire, flood or any other act of God, strike or other labor difficulty, act of any civil or military authority or of Customer, riot, embargo, terrorism, delay in or shortage of transportation facilities, or any other delay beyond KROFTA's reasonable control. In the event KROFTA's performance is prohibited and/or delayed by any such cause, KROFTA's schedule for performance shall be excused or extended accordingly. If Customer's actions delay KROFTA's performance, Customer shall pay KROFTA any additional costs incurred by KROFTA resulting from such delay.

6. TAXES: The dollar amounts set forth in the Proposal do not include any Federal, State or local taxes of any kind applicable to the Products and Services covered under this Contract. Customer shall pay direct or reimburse KROFTA for any such taxes that KROFTA or KROFTA'S subcontractors or suppliers are required to pay.

7. WARRANTY DISCLAIMER: EXCEPT AS SPECIFICALLY SET FORTH IN THE PROPOSAL, KROFTA DOES NOT MAKE ANY REPRESENTATION, WARRANTY OR COVENANT EXPRESS OR IMPLIED, WITH RESPECT TO THE MERCHANTABILITY, CONDITION, QUALITY, DURABILITY, DESIGN, OPERATION, PERFORMANCE, FITNESS FOR USE OR SUITABILITY OF THE PRODUCTS.

8. WARRANTY LIMITATION: Any warranty or guarantee, if any, shall be null and void if: (i) changes in flow, load or composition of the material being treated occur, (ii) the Products are not installed, maintained and operated (including using the correct amounts and types of flocculants, coagulants and pH controls as directed by KROFTA) in accordance with KROFTA's written instructions, or (iii) Customer makes any replacements and/or alterations to the Product without KROFTA's prior written authorization. KROFTA shall not be liable for any damages or costs incurred by Customer as a result of any item listed in the prior sentence. Notwithstanding any language to the contrary contained in any document, (i) no warranty shall survive past 12 months from the date of delivery to customer of the product, and (ii) all performance / process guarantees shall terminate on the earlier to occur of successful completion of performance testing or 12 months from the date of delivery to Customer of the product. Customer shall give KROFTA prompt written notice of a breach of any warranty or guarantee, with specific details and access to relevant records and the product, necessary. If it is determined that KROFTA is responsible for such breach, KROFTA will make every reasonable effort to either repair or replace the defective Product piece at its option and expense. If it is determined that KROFTA is not responsible, customer agrees to reimburse KROFTA for costs incurred in investigating and substantiating such alleged breach.

9. LIMITATION OF LIABILITY: KROFTA SHALL NOT BE LIABLE TO CUSTOMER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM KROFTA'S OBLIGATIONS UNDER THIS CONTRACT, WHETHER SUCH DAMAGES ARE BASED UPON BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, STRICT LIABILITY OR OTHERWISE. IN ANY EVENT, NOTWITHSTANDING ANY LANGUAGE TO THE CONTRARY CONTAINED IN ANY DOCUMENT, KROFTA'S LIABILITY WHATSOEVER TO CUSTOMER (INCLUDING ALL COSTS INCURRED IN ATTEMPTING TO CORRECT ALL BREACHES) SHALL NOT EXCEED IN THE AGGREGATE THE AMOUNT TO BE PAID BY CUSTOMER FOR THE PRODUCT AND SERVICES AS SET FORTH IN THE PROPOSAL, OR IF SUCH BREACH IS ATTRIBUTABLE TO SPECIFIC PARTS OF THE PRODUCT OR SERVICES, THE VALUE OF THE SPECIFIC PRODUCT OR SERVICE THAT IS THE CAUSE OF SUCH BREACH.

10. CANCELLATION BY CUSTOMER: If Customer cancels this Contract before delivery of the Product or refuses to accept delivery of the Product, Customer shall be liable to KROFTA for reasonable cancellation charges, including loss of anticipated profits, administrative costs, commissions to sales representatives, costs incurred by KROFTA for all work performed or in process up to the time of cancellation or refusal to accept delivery, cancellation charges from KROFTA's suppliers or subcontractors, and any other expenses incurred by KROFTA in connection with Customer's cancellation or refusal to accept delivery.

11. DEFAULT BY CUSTOMER: Without incurring any liability or waiving any claim for damages KROFTA may have against Customer, or the ability to exercise any other right, remedy or privilege in law or equity that KROFTA may have, KROFTA may refuse to make or delay making delivery, withhold any service and/or immediately reclaim possession of the Product if (a) Customer threatens to breach and/or breaches the terms contained in the Proposal, this Contract or any contract with KROFTA; (b) KROFTA becomes aware of facts which, in its judgment, render Customer's financial condition unsatisfactory or cast doubt on Customer's willingness or ability to pay for the Product and/or Services; or (c) Customer engages in or consents to liquidation, commission of any act of insolvency, appointment of a receiver of assets or assignment for the benefit of creditors, or if Customer becomes the subject of any bankruptcy or insolvency proceeding. Customer will remain liable for all covenants and indemnities under the Proposal and this Contract and for all legal fees and other costs and expenses, including court costs, incurred by KROFTA with respect to the enforcement of any of the remedies listed above or any other remedies available to KROFTA. If Customer is late in paying the amounts set forth in the Proposal or any partial payment due under this Contract, or otherwise breaches this Contract, KROFTA shall be entitled to interest at the rate of 1.5% per month on the overdue amount, and on its damages, calculated from the date of default in payment or other breach, plus court costs, reasonable attorneys' fees and other expenses incurred in any effort to collect.

12. ENTIRE AGREEMENT: The Proposal and this Contract, and other documents or instruments executed by KROFTA and Customer in connection herewith, shall constitute the entire agreement between the parties with respect to the Product and Services, and these documents shall not be modified, amended, altered or changed except with the written consent of both parties.

CHANGE ORDER NO.: 2

Owner/Buyer:	City of Aumsville, Oregon	Owner's Project No.:	
Engineer:	Westech Engineering, Inc.	Engineer's Project No.:	2599.3220.0
Seller:	Krofta Technologies, LLC	Contractor's Project No.:	25K01
Project:	Aumsville Wastewater Treatment Plant		
Contract Name:	Dissolved Air Floatation Equipment		
Date Issued:	4/16/26	Effective Date of Change Order:	4/16/26

The Contract is modified as follows upon execution of this Change Order:

Description:

During the design process for the treatment plant, several changes to the design for the DAF equipment have been determined to be in the best interest of the City. These include the following items.

1) **Add a second air compressor package to improve redundancy.**
2) **Change the air compressors from reciprocating compressors to screw compressors.**
3) **Delete the progressive cavity sludge pumps and replace with air actuated diaphragm pumps.**
4) **Increase the size of the air compressors to provide the air supply needed for the air actuated diaphragm pumps.**
5) **Prepare seismic calculations for the various equipment skids.**
6) **Miscellaneous changes to the control panel equipment to improve compatibility with the Owner's SCADA system.**
7) **Delete the pneumatic control valve on the tube flocculator. This is not needed for the system to function properly.**

Additional details and costs for these changes are summarized in the attachment.

Attachments:

Krofta Technologies, Change Order: 25K01-CO#0002 – Dated April 16, 2026

Change in Contract Price		Change in Contract Times
Original Contract Price:		Original Contract Times:
Lump Sum Price	$697,485	Delivery of acceptable goods to Point of Destination: August 27, 2026
Buyers Contingency Allowance	$75,000	
Total Price	$772,485	
Changes from previously approved Change Orders		Changes from previously approved Change Orders:
Lump Sum Price	+ $16,790	Delivery of acceptable goods to Point of Destination: none
Buyers Contingency Allowance	- $16,790	
Total Price	$0	
Contract Price prior to this Change Order:		Contract Times prior to this Change Order:
Lump Sum Price	$714,275	Delivery of acceptable goods to Point of Destination August 27, 2026
Buyers Contingency Allowance	$58,210	
Total Price	$772,485	
Changes this Change Order:		Changes this Change Order:
Lump Sum Price	+ $28,127	Delivery of acceptable goods to Point of Destination none
Buyers Contingency Allowance	- $28,127	
Total Price	$0	
Contract Price incorporating this Change Order:		Contract Times with all approved Change Orders:
Lump Sum Price	$742,402	Delivery of acceptable goods to Point of Destination August 27, 2026
Buyers Contingency Allowance	$30,083	
Total Price	$772,485	

	Recommended by Engineer (if required)	Accepted by Seller
By:	Christopher J. Brugato, P.E.	Rick Ziomek
Title:	Project Manager, Westech Engineering	Director KROFTA
Date:	4/16/26	4/17/26

	Authorized by Owner/Buyer	Approved by Funding Agency (if applicable)
By:	Matthew Etzel	EMILY JENNINGS Digitally signed by EMILY JENNINGS Date: 2026.04.22 14:19:44 -07'00'
Title:	Assistant Public Works Director	USDA RD State Engineer
Date:	4/21/26	04/22/2026

KROFTA CHANGE ORDER: 25K01-CO: #0002 ISS: 4/15/2026

ITEM #	DESCRIPTION	QTY	UNIT	NET PRICE
	Air Compressors –			
1	Original Smaller Size Air Compressor & Components: AIR COMPRESSOR: Atlas Copco – MODEL: G4FF-145 TRI-V/60 TM MEAF DOL Oil Injected Screw Compressor Mounted on 60 Gallon tank; Air Cooled -Capacity: 18 CFM @ 138PSI; Motor: 5HP, IE3 TEFC Motor; Voltage: 208-230/460V/3ph/60Hz; 145 PSI Maximum Operating Pressure; Microprocessor Control: Elektronikon Basic; Long Life RDX (Roto Duty Extend) Synthetic Oil; Full Feature Model: Integrated refrigerant dryer; Footprint: 57"L x 24"W x 50"H --- HIGH EFFICIENCY COALESCING FILTER: Atlas Copco – MODEL: UD15+ (NPT1/2) --- CONDENSATE DRAIN: Atlas Copco –MODEL: IWD 105 115V; Zero Loss Drain for tank	1	LOT	*($8,464.00)*
2	~~OPTION 1: Chage to following Air Compressor & Components tot the following to add size for Air Diaphragm Pump and add Redundant Spare:~~ ~~AIR COMPRESSOR: Atlas Copco – MODEL: CR15-CRS2-460/3-120H-IS~~ ~~Oil Injected Cast-Iron Recip Compressor; Air Cooled -Capacity: 51 CFM @ 175 PSI; -Motor: 15HP, ODP motor; Voltage: 460V/3ph/60Hz; 175 PSI Maximum Operating Pressure; Receiver: 120gal, horizontal; Electronic drain; Aftercooler; Low oil level switch~~ ~~---~~ ~~HIGH TEMPERATURE REFRIGERATED AIR DRYER:~~ ~~Atlas Copco – MODEL: FX HT35 ACUL 115V 1PH 60; 74CFM @ 125psi~~ ~~---~~ ~~HIGH EFFICIENCY COALESCING FILTER:~~ ~~Atlas Copco – MODEL: UD25+ (NPT1/2)~~ ~~---~~ ~~CONDENSATE DRAIN: Atlas Copco – MODEL:IWD 105 115V; Zero Loss Drain for tank~~	2	LOT	$33,657.00
3	OPTION 2: Chage to following Air Compressor & Components tot the following to add size for Air Diaphragm Pump and add Redundant Spare: AIR COMPRESSOR: Atlas Copco – MODEL: G7L FF 125 TRI-V/60 TM120 Oil Injected Screw Compressor Mounted on 120 Gallon tank; Air Cooled -Capacity: 39.2 CFM @ 125PSI; Motor: 10HP, IE3 TEFC Motor; Voltage: 208-230/460V/3ph/60Hz; 129 PSI Maximum Operating Pressure; Microprocessor Control: Elektronikon Basic; Long Life RDX (Roto Duty Extend) Synthetic Oil; Full Feature Model: Integrated refrigerant dryer; Footprint: 77"L x 26"W x 58"H --- HIGH EFFICIENCY COALESCING FILTER: Atlas Copco – MODEL: UD25+ (NPT1/2) --- CONDENSATE DRAIN: Atlas Copco – MODEL: IWD 105 115V; Zero Loss Drain for tank	2	LOT	$29,718.00
	Seismic Calculations -			
4	Pricing to provide P.E. Stamped Equipment Skid Seismic design check and Anchorage Detail and Calculations for:	1	LOT	$14,175.00
4a.	6" Chemical Conditioning / Floc Tube Skid as shown on previous submittal dwg.			
4b.	KROFTA MFH-500 DAF Skid as shown on previous submittal dwg. .			
4c.	Turbidity Skid as shown on previous submittal dwg.			
4d.	Air Diaphragm Sludge Transfer Pump Skid as shown on previous submittal dwg.			

	Control Panel Modifications -			
5	Modifications as Detailed on Engineer's Return Comments – Main Items: Changing AB PLC Processor from ControlLogix to CompactLogix Changinge Scraper VFD from Powerflex xxx to Powerflex 525 Drive Changing AB Panelview 9" Screen (BABAA Compliant) to 12" Screen Addiing Line Reactors and Making Misc.changes as described on attached Engineeer Markups	1	EA	($1,474.00)
	Valves -			
6	Removal of DAF Influent Flow Control Valve - 6" Bray Pneumatic Actuated Butterfly Valve with Positioner and I/P.	1	EA	($1,680.00)
	Pumps -			
7	Deleting Progressive Cavity Pumps	2	EA	($15,458.00)
8	Adding Air Diaphragm Pumps (Per Submittal)	2	EA	$11,310.00
	~~TOTAL CHANGE ORDER - W/ AIR COMP OPTION 1 -~~			~~$32,066.00~~
	TOTAL CHANGE ORDER - W/ AIR COMP OPTION 2 -			$28,127.00

DAF EQUIPMENT PROCUREMENT CONTRACT PREVIOUS PAYMENTS

Contractor's Application for Payment

Owner:	The City of Aumsville, Oregon	**Owner's Project No.:**	
Engineer:	Westech Engineering, Inc.	**Engineer's Project No.:**	2599.3220.0
Contractor:	Krofta Technologies, LLC	**Contractor's Project No.:**	25-K01
Project:	Wastewater Treatment Plant Improvements		
Contract:	Dissolved Air Floatation Equipment		
Application No.:	1	**Application Date:**	8/20/2025
Application Period:	From 12/31/2024	to	8/15/2025

1. Original Contract Price		$ 697,485.00
2. Net change by Change Orders		$ 16,790.00
3. Current Contract Price (Line 1 + Line 2)		$ 714,275.00
4. Total Work completed and materials stored to date (Sum of Column G Lump Sum Total and Column J Unit Price Total)		$ 86,538.00
5. Retainage		
a. 5% X $ 86,538.00 Work Completed		$ 4,326.90
b. 5% X $ - Stored Materials		$ -
c. Total Retainage (Line 5.a + Line 5.b)		$ 4,326.90
6. Amount eligible to date (Line 4 - Line 5.c)		$ 82,211.10
7. Less previous payments (Line 6 from prior application)		
8. Amount due this application		$ 82,211.10
9. Balance to finish, including retainage (Line 3 - Line 4 +Line 5.c)		$ 632,063.90

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:

(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;

(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such liens, security interest, or encumbrances); and

(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective; and

(4)In consideration for the payment referenced above, and upon receipt of such payment, Contractor hereby waives and releases its lien and right to claim a lien for labor, services, or materials furnished through the date of this application, with the exception that this release does not cover retainage; and

(5)Contractor represents that receipt of said payment constitutes full and complete payment for all work, and all costs or expenses incurred (including, but not limited to, costs for supervision, field office overhead, interest on capital, profit and conditions costs) relative to the work or improvements as of the date of this application; and

(6)Contractor specifically waives, quitclaims and releases any claim for damages due to delay, hindrances, interference, acceleration, inefficiencies or extra work, or any other claim of any kind it may have as of the date of this application, except as follows (outstanding claims or change order work to be listed by Contractor, attach pages if required):

Contractor: KROFTA Technologies, LLC

Signature: _____ **Date:** 10/1/25

Recommended by Engineer		**Approved by Owner**	
By:		**By:**	
Title:	Project Manager - Westech Engineering, Inc.	**Title:**	CS+I Administrator
Date:	9/30/25	**Date:**	10/8/25
Approved by Funding Agency			
By:		**By:**	
Title:		**Title:**	
Date:		**Date:**	

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Progress Estimate - Lump Sum Work

Contractor's Application for Payment

Owner:	The City of Aumsville, Oregon	**Owner's Project No.:**	
Engineer:	Westech Engineering, Inc.	**Engineer's Project No.:**	2599.3220.0
Contractor:	Krofta Technologies, LLC	**Contractor's Project No.:**	25-K01
Project:	Wastewater Treatment Plant Improvements		
Contract:	Dissolved Air Floatation Equipment		

Application No.: 1 **Application Period:** From 12/31/24 to 08/15/25 **Application Date:** 08/20/25

A	B	C	D	E	F	G	H	I
			Work Completed					
Item No.	Description	Scheduled Value ($)	(D + E) From Previous Application ($)	This Period ($)	Materials Currently Stored (not in D or E) ($)	Work Completed and Materials Stored to Date (D + E + F) ($)	% of Scheduled Value (G / C) (%)	Balance to Finish (C - G) ($)
			Original Contract					
1	Receipt of Approval of Shop Drawings and Samples	69,748.50	69,748.00			69,748.00	100%	0.50
2	Delivery of Goods to Point of Destination	557,988.00				-	0%	557,988.00
3	Completion of Startup and Comissioning Services	34,874.25				-	0%	34,874.25
4	Final Payment	34,874.25				-	0%	34,874.25
						-		-
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	Original Contract Totals	$ 697,485.00	$ 69,748.00	$ -	$ -	$ 69,748.00	10%	$ 627,737.00

EJCDC C-620 Contractor's Application for Payment
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Progress Estimate - Lump Sum Work

Contractor's Application for Payment

Owner:	The City of Aumsville, Oregon	**Owner's Project No.:**	
Engineer:	Westech Engineering, Inc.	**Engineer's Project No.:**	2599.3220.0
Contractor:	Krofta Technologies, LLC	**Contractor's Project No.:**	25-K01
Project:	Wastewater Treatment Plant Improvements		
Contract:	Dissolved Air Floatation Equipment		

Application No.: 1 **Application Period:** From 12/31/24 to 08/15/25 **Application Date:** 08/20/25

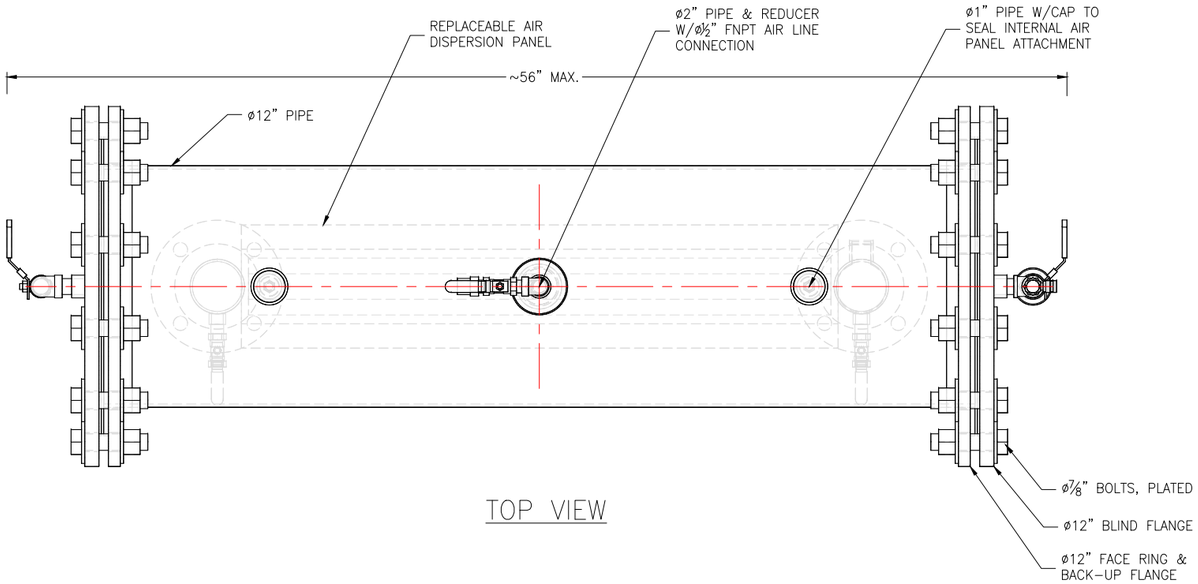
A	B	C	D	E	F	G	H	I
			Work Completed					
Item No.	Description	Scheduled Value ($)	(D + E) From Previous Application ($)	This Period ($)	Materials Currently Stored (not in D or E) ($)	Work Completed and Materials Stored to Date (D + E + F) ($)	% of Scheduled Value (G / C) (%)	Balance to Finish (C - G) ($)
			Change Orders					
1	Perform Onsite DAF Simulations	16,790.00	16,790.00			16,790.00	100%	-
						-		-
						-		-
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						-		-
	Change Order Totals	$ 16,790.00	$ 16,790.00	$ -	$ -	$ 16,790.00	100%	$ -
			Original Contract and Change Orders					
	Project Totals	$ 714,275.00	$ 86,538.00	$ -	$ -	$ 86,538.00	12%	$ 627,737.00

EJCDC C-620 Contractor's Application for Payment
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DAF Equipment Procurement Contract Submittals

Aumsville Wastewater Treatment Plant DAF Equipment Submittal Index

1. Drawings
    a. Equipment Drawings
    b. General Arrangement
    c. P&ID
2. Major Equipment
    a. Krofta DAF Unit
3. Pumps
    a. Air Operated Diaphragm
    b. Centrifugal
4. Instruments
    a. Flow
    b. Level Switch – Conductance
    c. Level Transmitter – Diff Press
    d. Pressure Gauge
    e. Pressure Switch
    f. Turbidity
5. Valves
    a. Ball Valves – PVC
    b. Ball Valves – Stainless Steel
    c. Butterfly Valves
    d. Butterfly Valves – Pneum Oper
    e. Needle Valve
    f. Solenoid Valves
6. Chemical Feed
    a. Coagulant Dosing
    b. Polymer Make-Up System
7. Compressed Air
8. Electrical

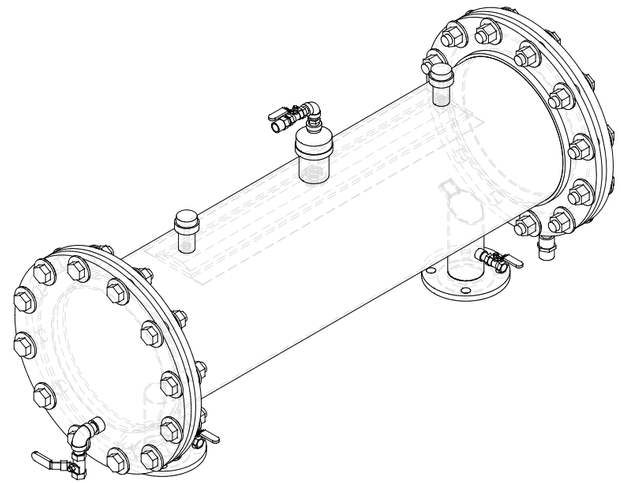


TOP VIEW

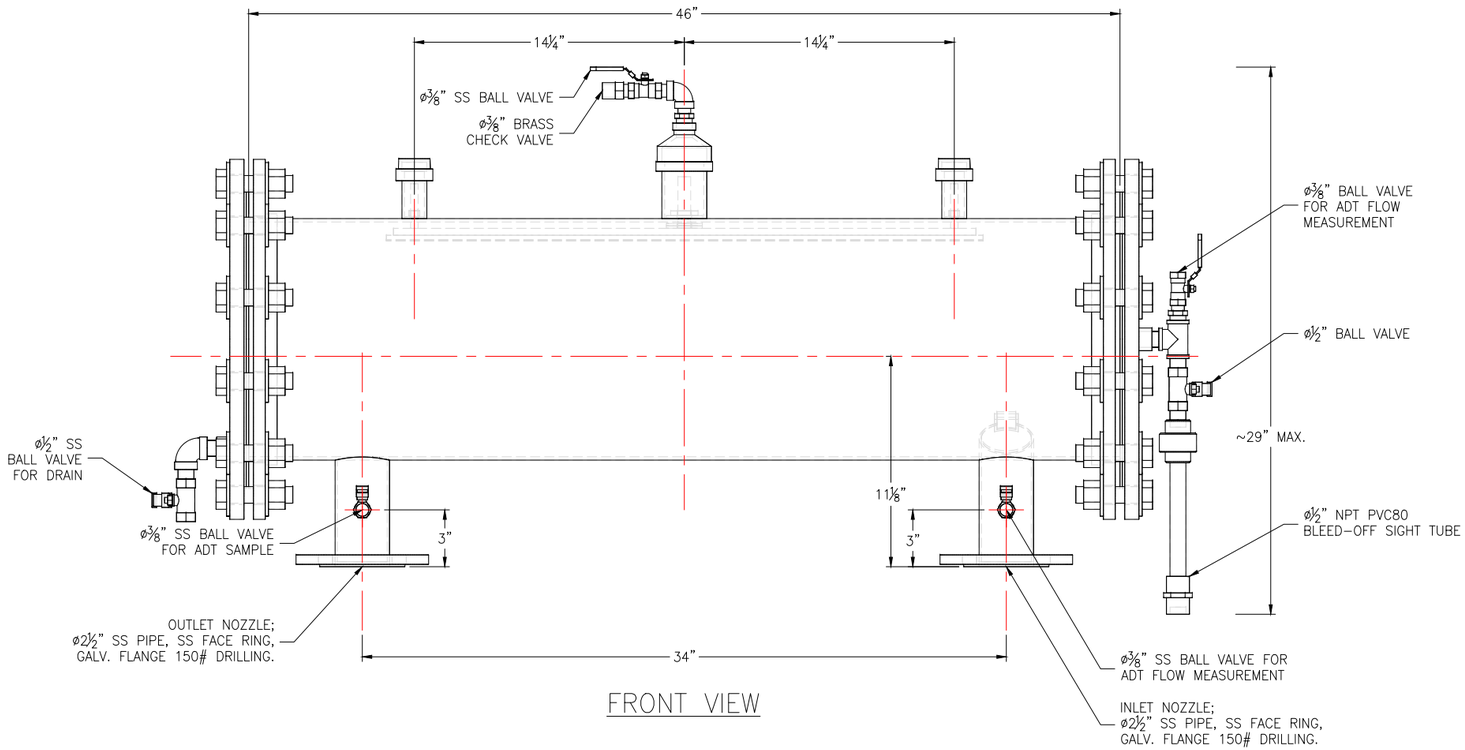
MATERIALS OF CONSTRUCTION:

- ADT PIPING: 304LSS.
- BACK-UP FLANGES: GALV. STEEL.
- BLIND FLANGES: PAINTED MILD STEEL W/304LSS INTERNAL CLADDING.
- FASTENERS: ZINC PLATED.
- GASKETS: NEOPRENE
- REPLACEABLE AIR PANEL: 304LSS

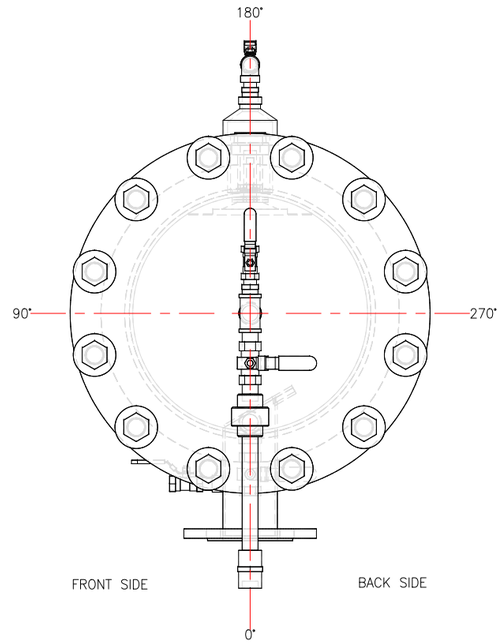
ESTIMATED WEIGHTS:
DRY = 360 LBS. [164 KG]
OPERATING = 550 LBS. [250 KG]



ISO VIEW



FRONT VIEW



INLET END

ADT INLET NOZZLE SIZED FOR FLOW OF _____ GPM.

SUBMITTED FOR APPROVAL
BY: JEFF MILLER MAY 19, 2025
APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP

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ITEM	QTY	MAT'L	DESCRIPTION	REMARKS

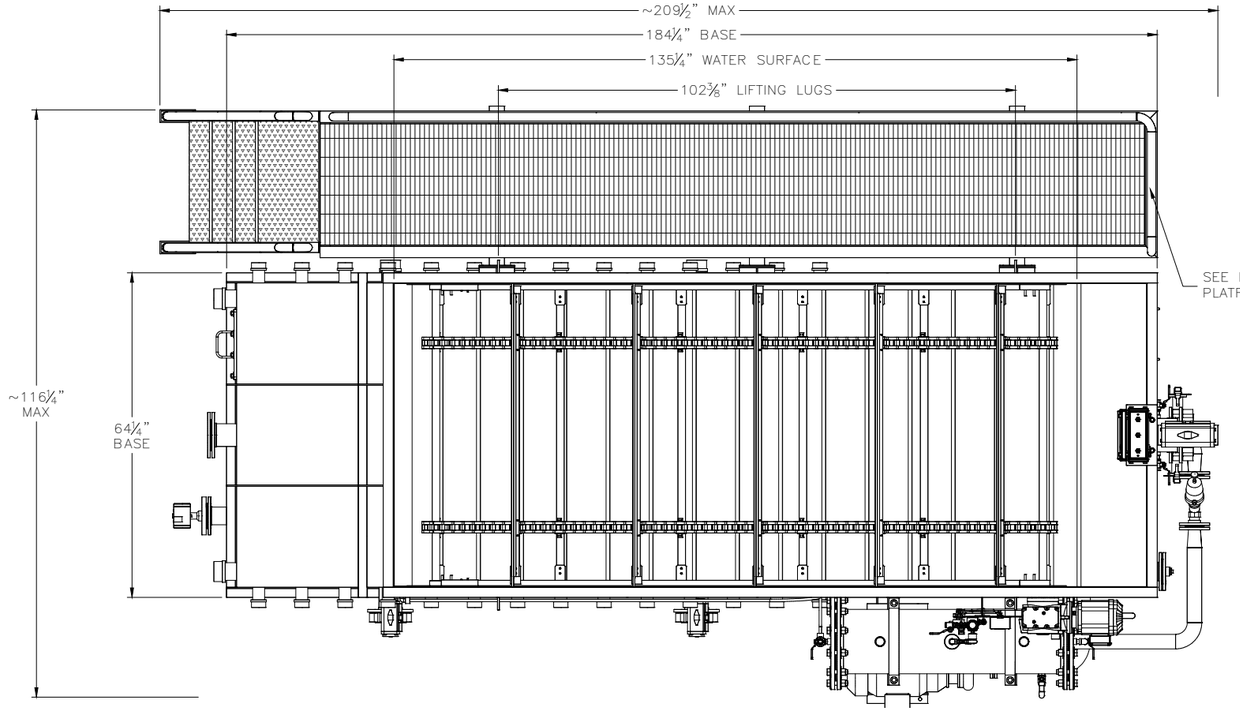
KROFTA a Watertexx company
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME: JOB 25-K01 – CITY OF AUMSVILLE, OR

DATE: 05/19/25	SCALE: –	DRAWN BY: ADG	DESIGNED BY: –	CHECKED BY: –	APPROVED BY: –

TITLE: AIR DISSOLVING TUBE TYPE ADT-500 CONFIGURATION OUTLINE

DRAWING NUMBER: 25K01-ADT500-COL-01-1 REV: –

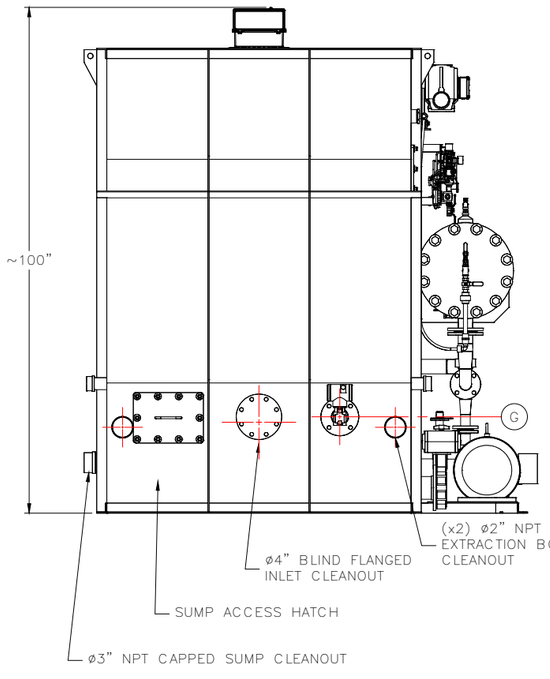


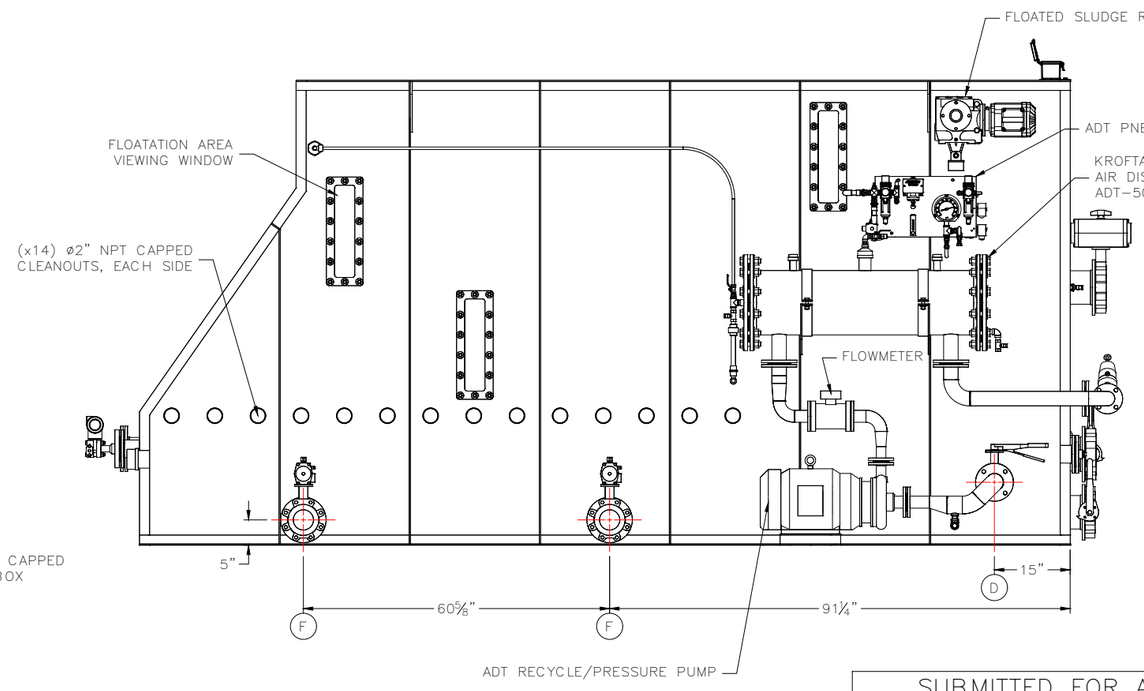
ITEM	DESCRIPTION	CONNECTION	WALL OFFSET
A	UNCLARIFIED WATER INLET *(BV)	ø6" – FLANGE	4"
B	FLOATED SLUDGE OUTLET *(BV)	ø6" – FLANGE	4"
C	CLARIFIED WATER OUTLET *(BV)	ø6" – FLANGE	4"
D	CLARIFIED RECYCLE OUTLET	ø3" – FLANGE	2"
E	PRESSURIZED WATER INLET	ø2½" – FLANGE	1½"
F	SEDIMENT PURGE OUTLET (x2)	ø4" – FLANGE	3"
G	LEVEL SENSOR CONNECTION	ø3" – FLANGE	3"
H	CHEMICAL INJECTION TAP	ø¼" MALE NPT	N/A
J	CLEARWELL TAP	ø1" – FEMALE NPT	N/A
–	---	---	---
L	COMPRESSED AIR CONNECTION	ø⅜" – FEMALE NPT	N/A
M	ADT BLEEDOFF CONNECTION 1	ø½" – FEMALE NPT	N/A
N	ADT BLEEDOFF CONNECTION 2	ø½" – FEMALE NPT	N/A
O	ADT BLEEDOFF CONNECTION 3	ø½" – FEMALE NPT	N/A

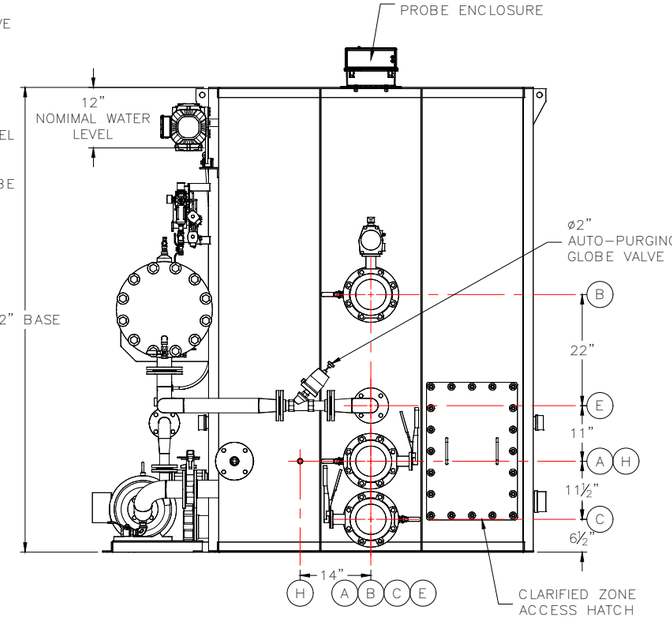
*150 LB. FLANGE DRILLING DIMENSIONS (BV) WITH ø½" BALL VALVE FOR SAMPLING

MFH-500 EQUIPMENT AND WATER WEIGHTS:
SHIPPING: 5,800 LBS
FLOODED: 37,000 LBS

MULTIFLOAT STANDARD FABRICATION MATERIALS:
WETTED TANK WALLS & PIPING: 304LSS.
NON-WETTED STRUCTURE & BRACKETS INCLUDES TANK RIM, SUPPORT RIBS, FLOOR SUPPORT GRID, ACCESS PLATFORM, STAIRS: 304SS.
ANGLE FACE RINGS: 316LSS.
BACKUP FLANGES: GALV. MILD STEEL.
SCRAPER BLADES: BUNA.
BEARINGS: UHMWP.
SPROCKETS: NYLON.
CHAIN: ACETAL.







SUBMITTED FOR APPROVAL
BY: JEFF MILLER DATE: MAY 19, 2025
APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP

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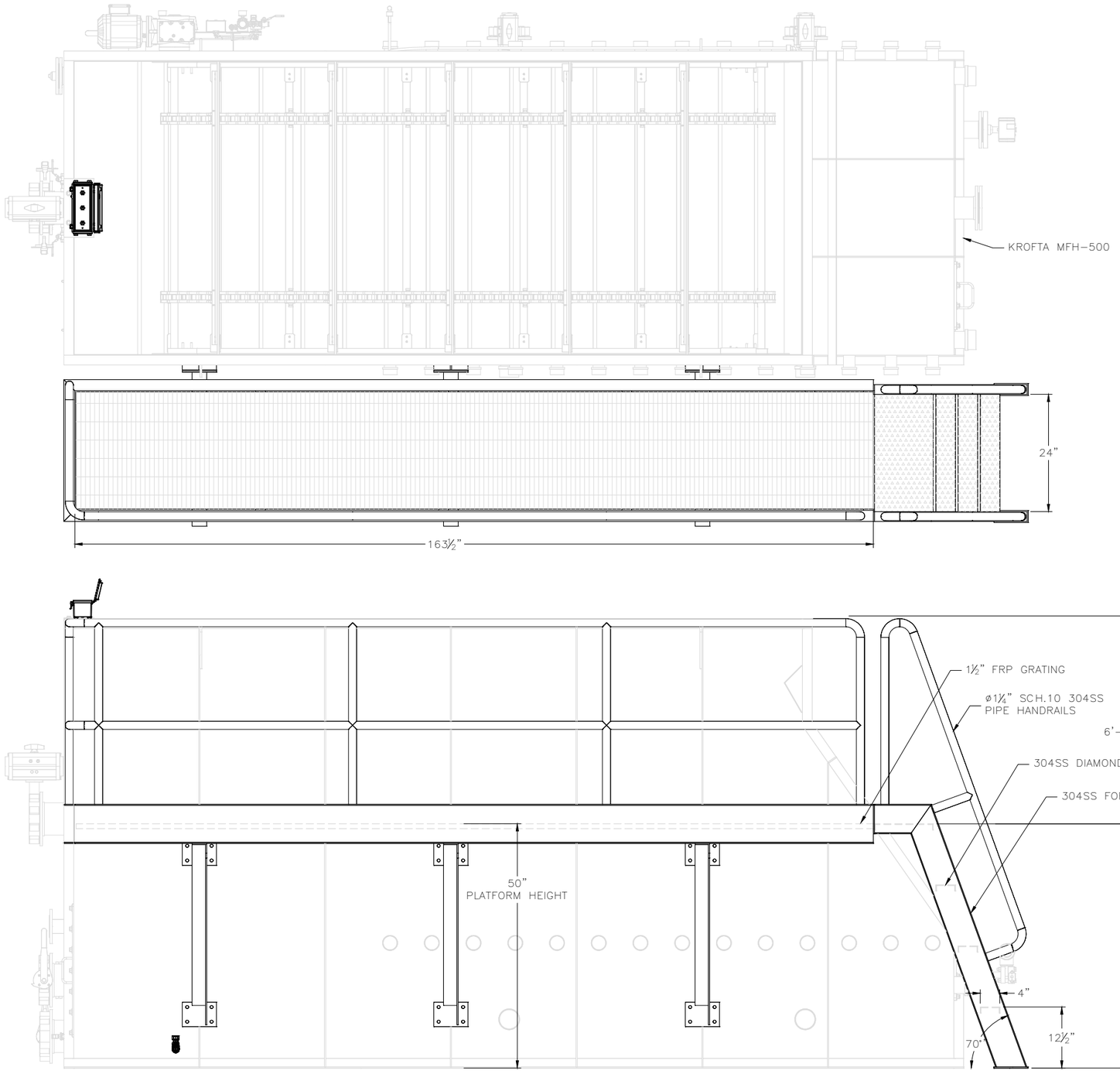
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PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME: JOB 25-K01 – CITY of AUMSVILLE, OR

DATE: 05/19/25	SCALE: –	DRAWN BY: ADC	DESIGNED BY: –	CHECKED BY: –	APPROVED BY: –

TITLE: KROFTA MULTIFLOAT MFH-500 DAF UNIT CONFIGURATION

DRAWING NUMBER: 25K01-MFH500-DUC-01-1 REV: –



SUBMITTED FOR APPROVAL

BY: JEFF MILLER DATE: MAY 9, 2025

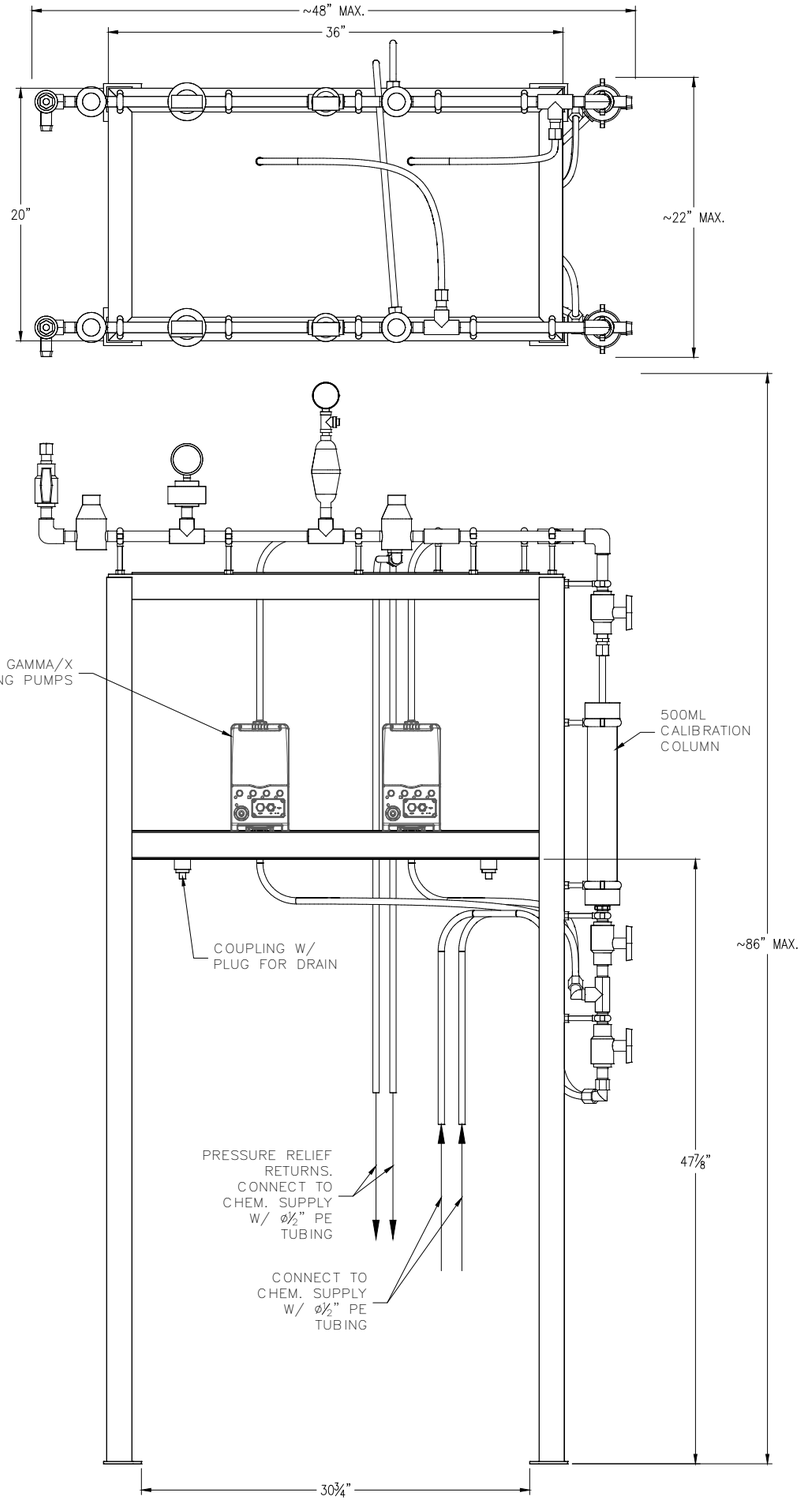
APP'D BY: _____ DATE: _____

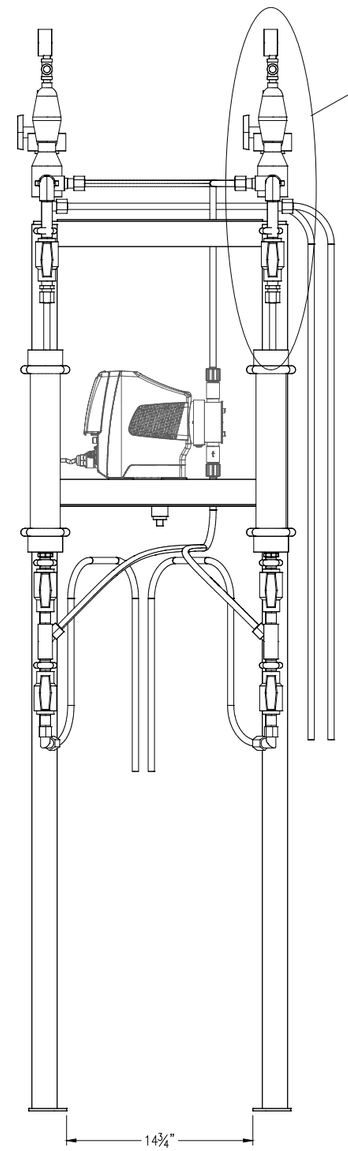
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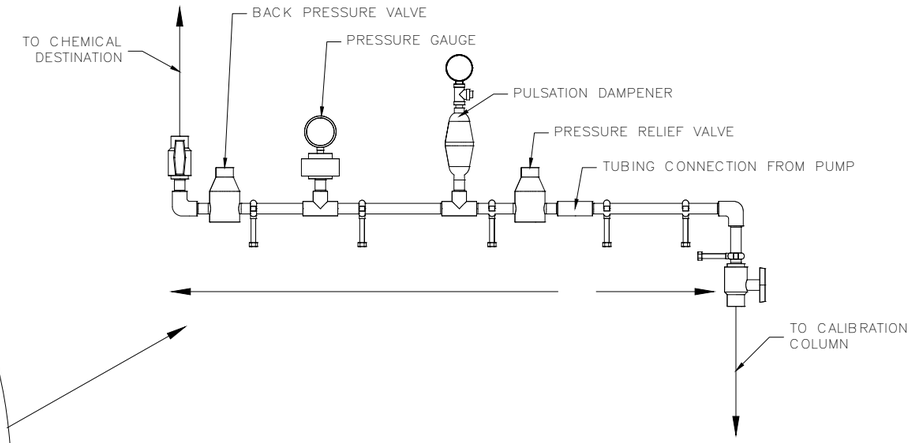
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NAME:	JOB 25–K01 – CITY of AUMSVILLE, OR						
DATE: 05/19/25	SCALE: –	DRAWN BY: ADG	DESIGNED BY: –	CHECKED BY: –	APPROVED BY: –		
TITLE:	KROFTA MULTIFLOAT MFH–500 DAF UNIT CONFIGURATION			DRAWING NUMBER:	25K01-MFH500-DUC-01-2	REV:	–







COAGULANT METERING SYSTEM
MATERIALS OF CONSTRUCTION

FRAME– 304LSS
HARDWARE– 18–8SS
PIPING– PVC80 NPT CONNS
TUBING– POLYETHYLENE
GASKETS/SEALS– VITON

SHIPPING WEIGHT: 180 LBS.

RE–SUBMITTED FOR APPROVAL

BY: JEFF MILLER DATE: MAY 28, 2025

APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP
A	ADDED SHIPPING WEIGHTS	ADG	08/21/25	–	–

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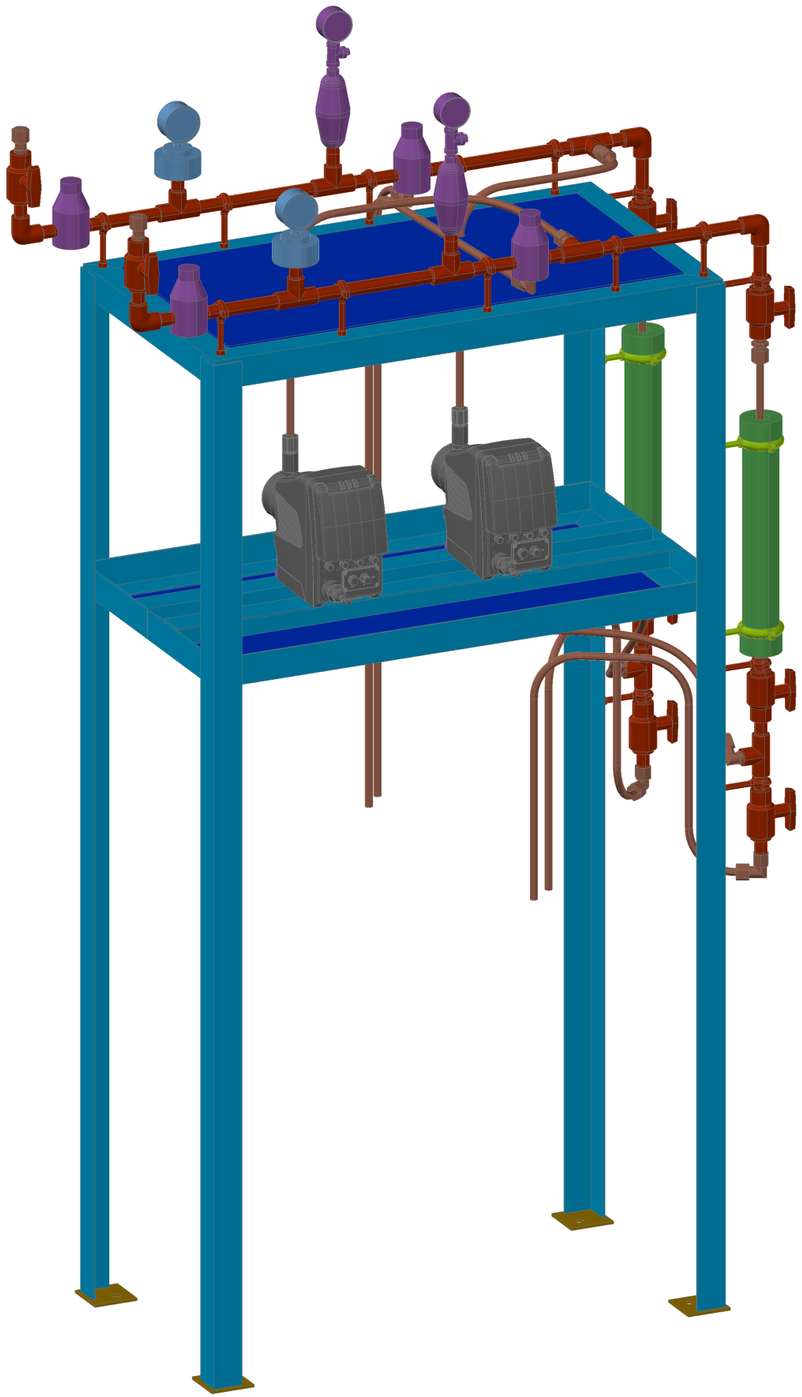
NAME: JOB 25–K01 – CITY OF AUMSVILLE, OR

DATE:	SCALE:	DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
05/28/25	–	ADG	–	–	–

TITLE: KROFTA MULTIFLOAT MFH–500 DAF & EQUIPMENT COAGULANT CHEMICAL STAND OUTLINE

DRAWING NUMBER: 25K01–COAG–CSO–01–1

REV: A



RE–SUBMITTED FOR APPROVAL

BY: JEFF MILLER DATE: MAY 28, 2025

APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP
A	ADDED SHIPPING WEIGHTS	ADG	08/21/25	–	–

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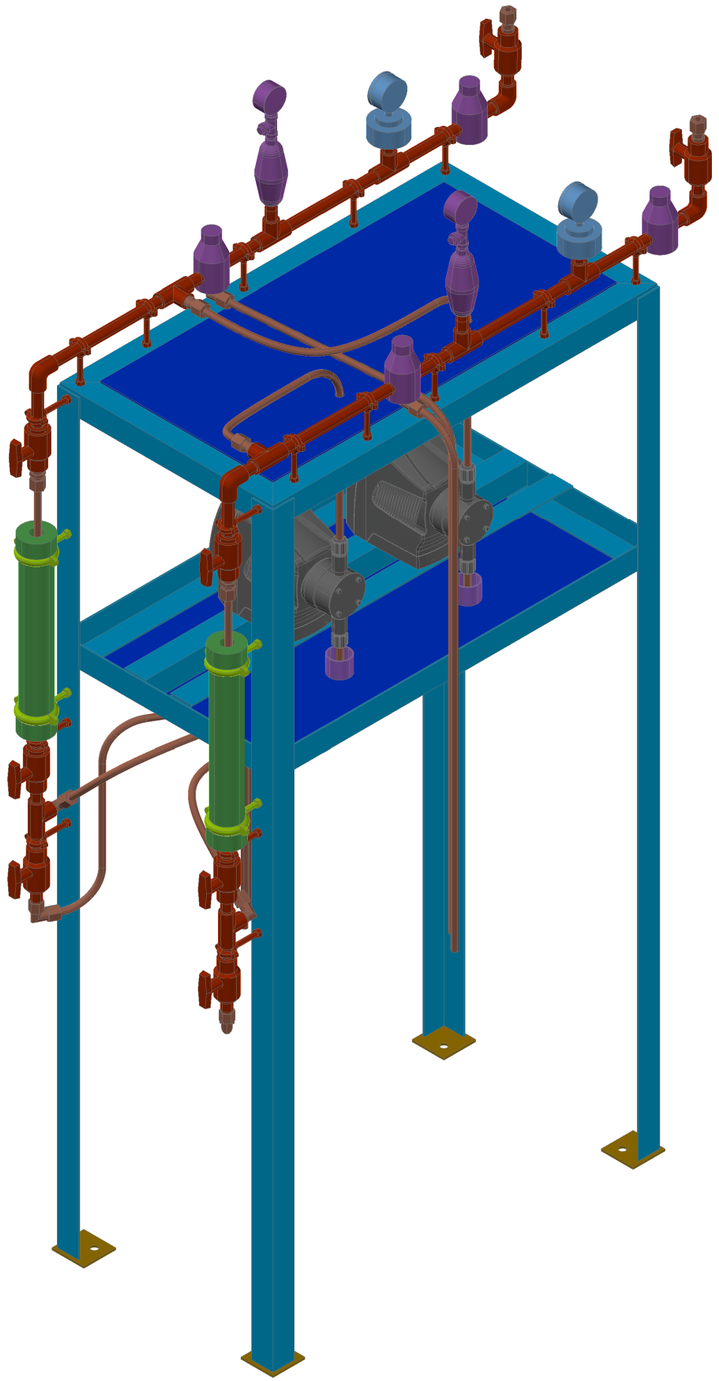
NAME: JOB 25–K01 – CITY OF AUMSVILLE, OR

DATE:	SCALE:	DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
05/28/25	–	ADG	–	–	–

TITLE: KROFTA MULTIFLOAT MFH–500 DAF & EQUIPMENT
COAGULANT CHEMICAL STAND OUTLINE

DRAWING NUMBER: 25K01–COAG–CSO–01–2

REV: A



RE-SUBMITTED FOR APPROVAL

BY: JEFF MILLER DATE: MAY 28, 2025

APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP
A	ADDED SHIPPING WEIGHTS	ADG	08/21/25	–	–

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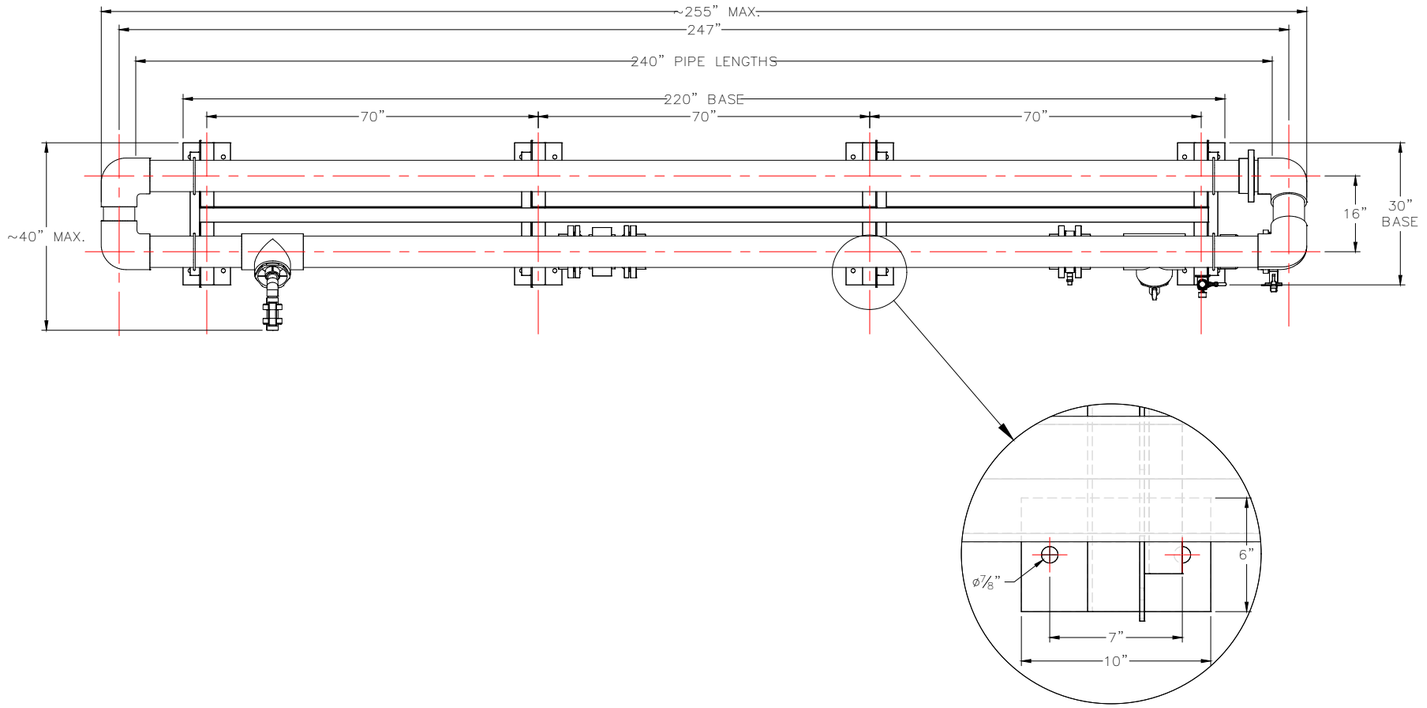
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NAME: JOB 25-K01 – CITY OF AUMSVILLE, OR

DATE:	SCALE:	DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
05/28/25	–	ADG	–	–	–

TITLE: KROFTA MULTIFLOAT MFH-500 DAF & EQUIPMENT
COAGULANT CHEMICAL STAND OUTLINE

DRAWING NUMBER: 25K01-COAG-CSO-01-3 REV: A

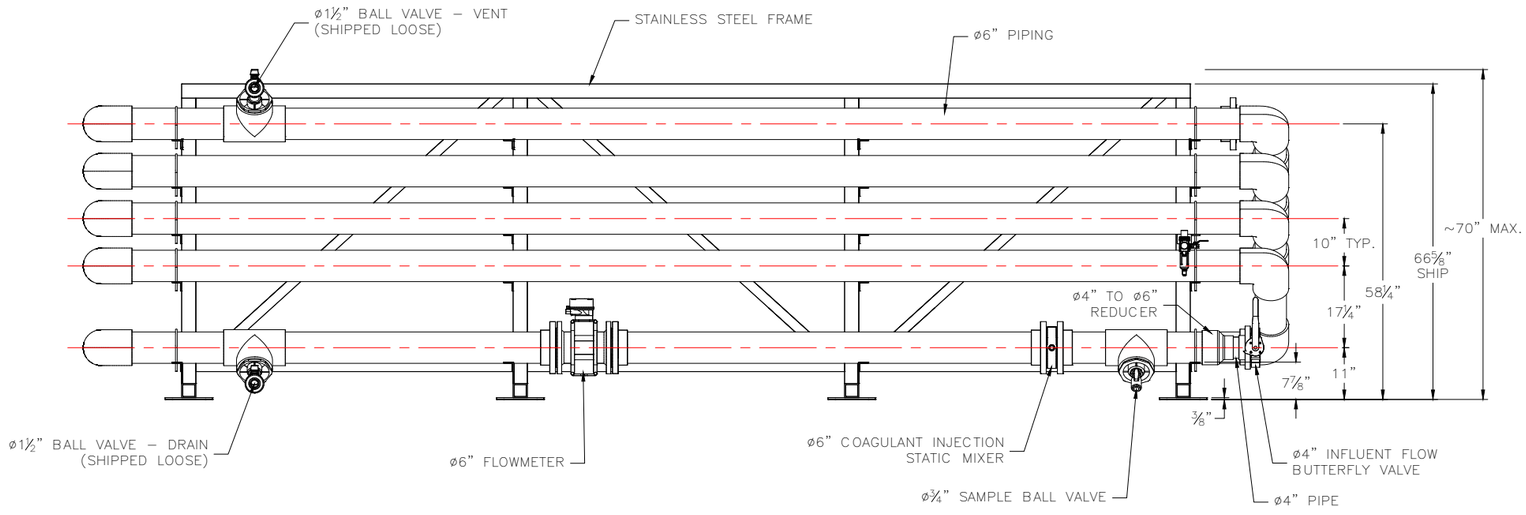


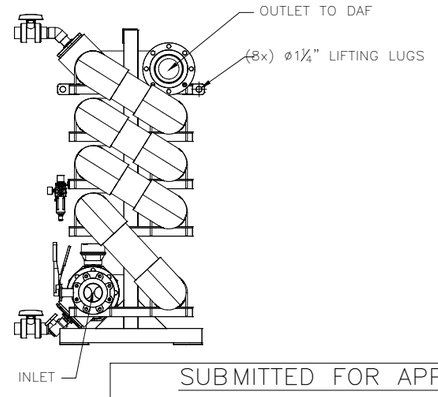
MATERIALS OF CONSTRUCTION:
PIPING: PVC SCH80
FRAME: STAINLESS STEEL
HARDWARE: ZINC PLATED
BALL VALVES: PVC80 VENT/DRAIN/SAMPLE
GASKETS: NEOPRENE

ESTIMATED WEIGHTS:
DRY= 3,400 LBS.
OPERATING= 9,000 LBS.

DESIGN:
200FT OF ø6" PVC SCH.80 PIPE @ 300GPM = 60 SECONDS MIN. COAGULANT CHEMICAL CONTACT TIME.

SHIPPING WEIGHT: 2,200 LBS.





SUBMITTED FOR APPROVAL
BY: JEFF MILLER DATE: JUNE 4, 2025
APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP
A	CHANGED TO A MANUAL FCV, ADDED SHIPPING WEIGHT	ADG	08/21/25	–	–

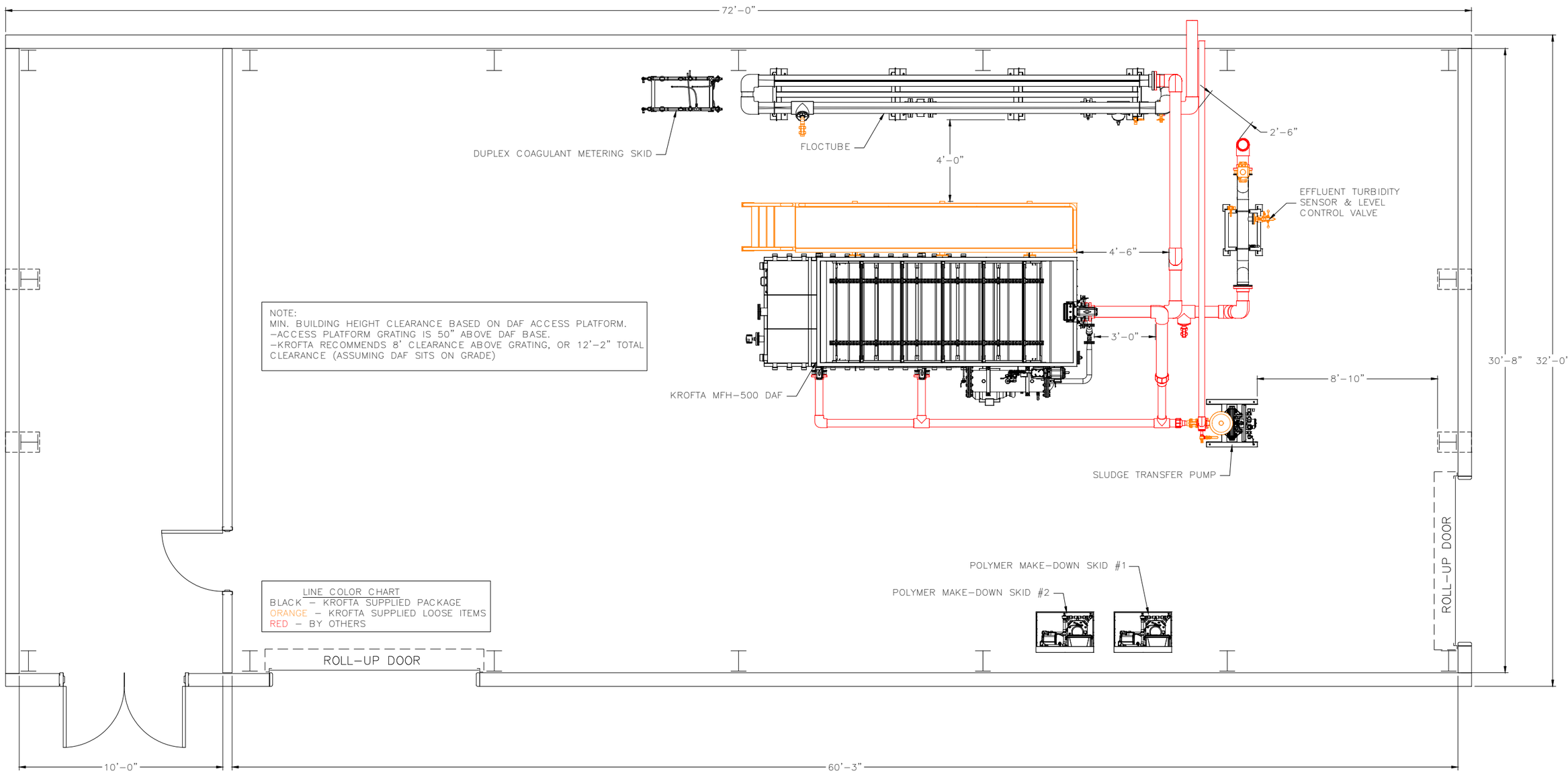
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NAME: JOB 25–K01 – CITY OF AUMSVILLE, OR

DATE	SCALE	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
06/04/2025	–	ADG	–	–	–

TITLE: KROFTA MULTIFLOAT MFH–500 DAF & EQUIPMENT ø6" FLOCTUBE OUTLINE
DRAWING NUMBER: 25K01–FT06–01–1
REV: A



NOTE:
MIN. BUILDING HEIGHT CLEARANCE BASED ON DAF ACCESS PLATFORM.
-ACCESS PLATFORM GRATING IS 50" ABOVE DAF BASE.
-KROFTA RECOMMENDS 8' CLEARANCE ABOVE GRATING, OR 12'-2" TOTAL CLEARANCE (ASSUMING DAF SITS ON GRADE)

LINE COLOR CHART
BLACK - KROFTA SUPPLIED PACKAGE
ORANGE - KROFTA SUPPLIED LOOSE ITEMS
RED - BY OTHERS

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REV	DESCRIPTION	DWN	DATE	CHK	APP

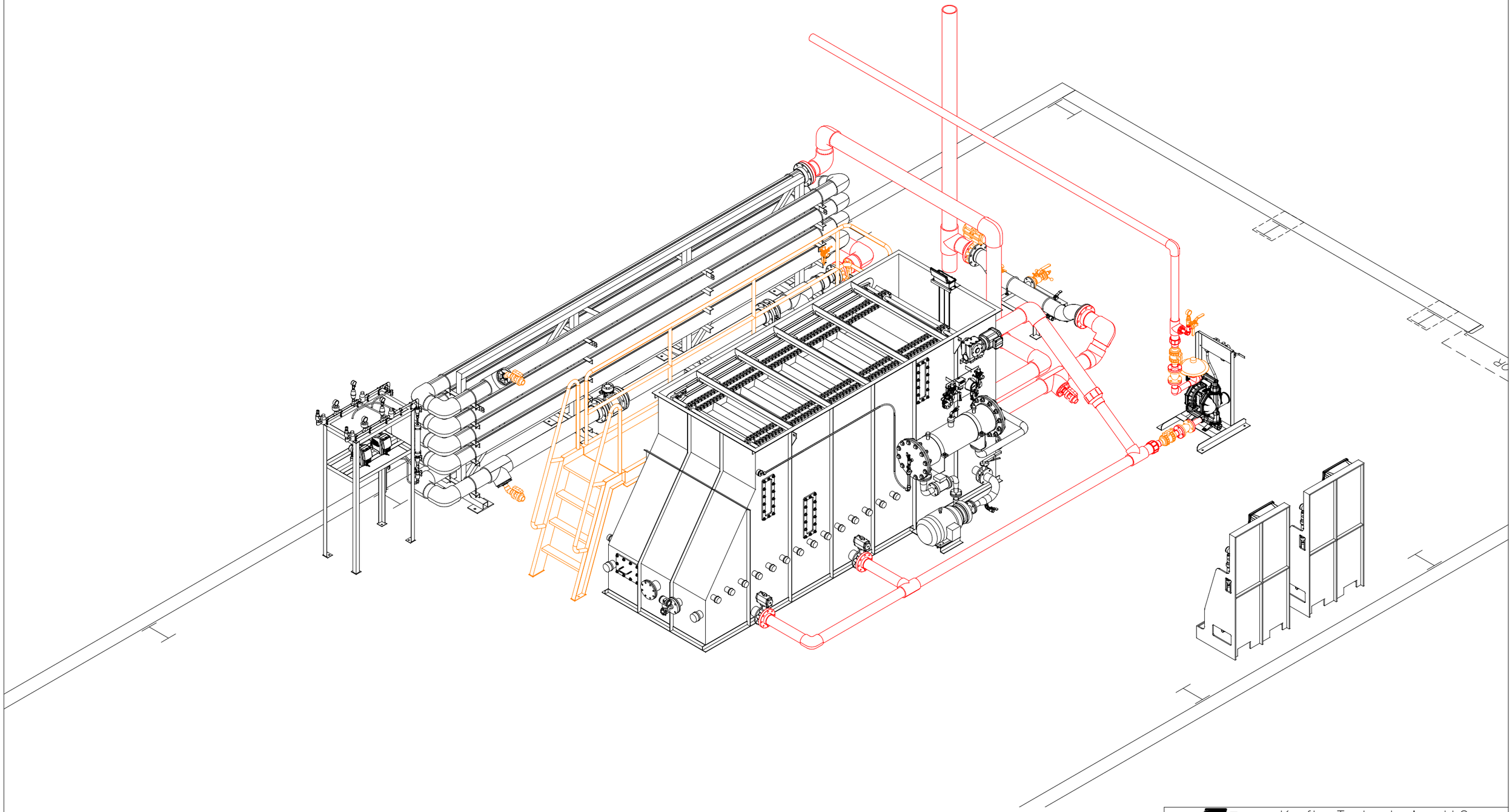
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NAME: JOB 25-K01 - CITY OF AUMSVILLE - OR

DATE:	SCALE:	DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
08/21/25	-	ADG	-	-	-

TITLE: KROFTA MFH-500 DAF & EQUIPMENT SITE GENERAL ARRANGEMENT

DRAWING NUMBER: 25K01-SITE-GA-01-1_CCS REV: -



REV	DESCRIPTION	DWN	DATE	CHK	APP

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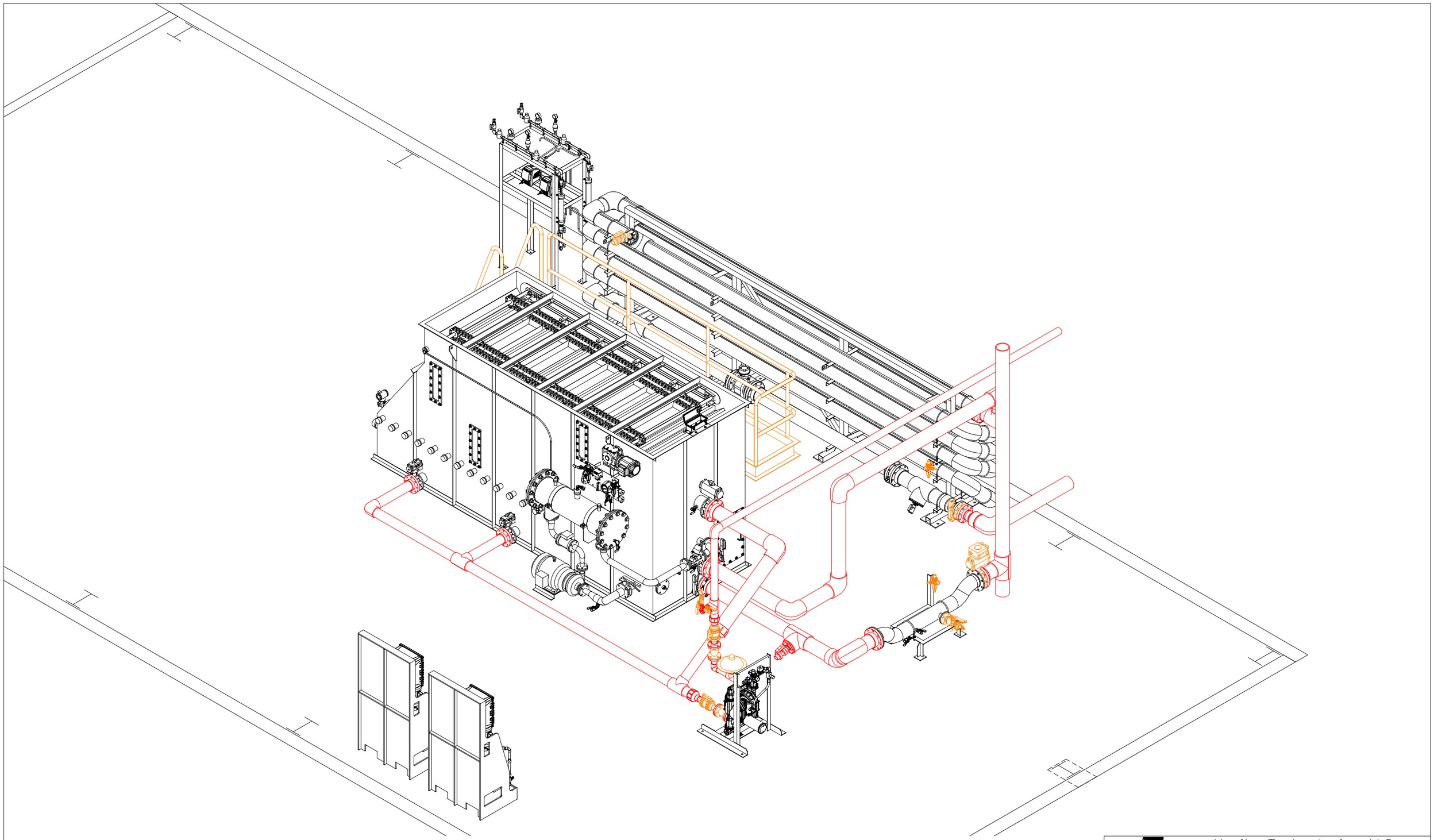
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DATE:	SCALE:	DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
08/21/25	–	ADG	–	–	–

TITLE: KROFTA MFH-500 DAF & EQUIPMENT
SITE GENERAL ARRANGEMENT

DRAWING NUMBER: 25K01-SITE-GA-01-2_CCS

REV: –



REV	DESCRIPTION	DWN	DATE	CHK	APP

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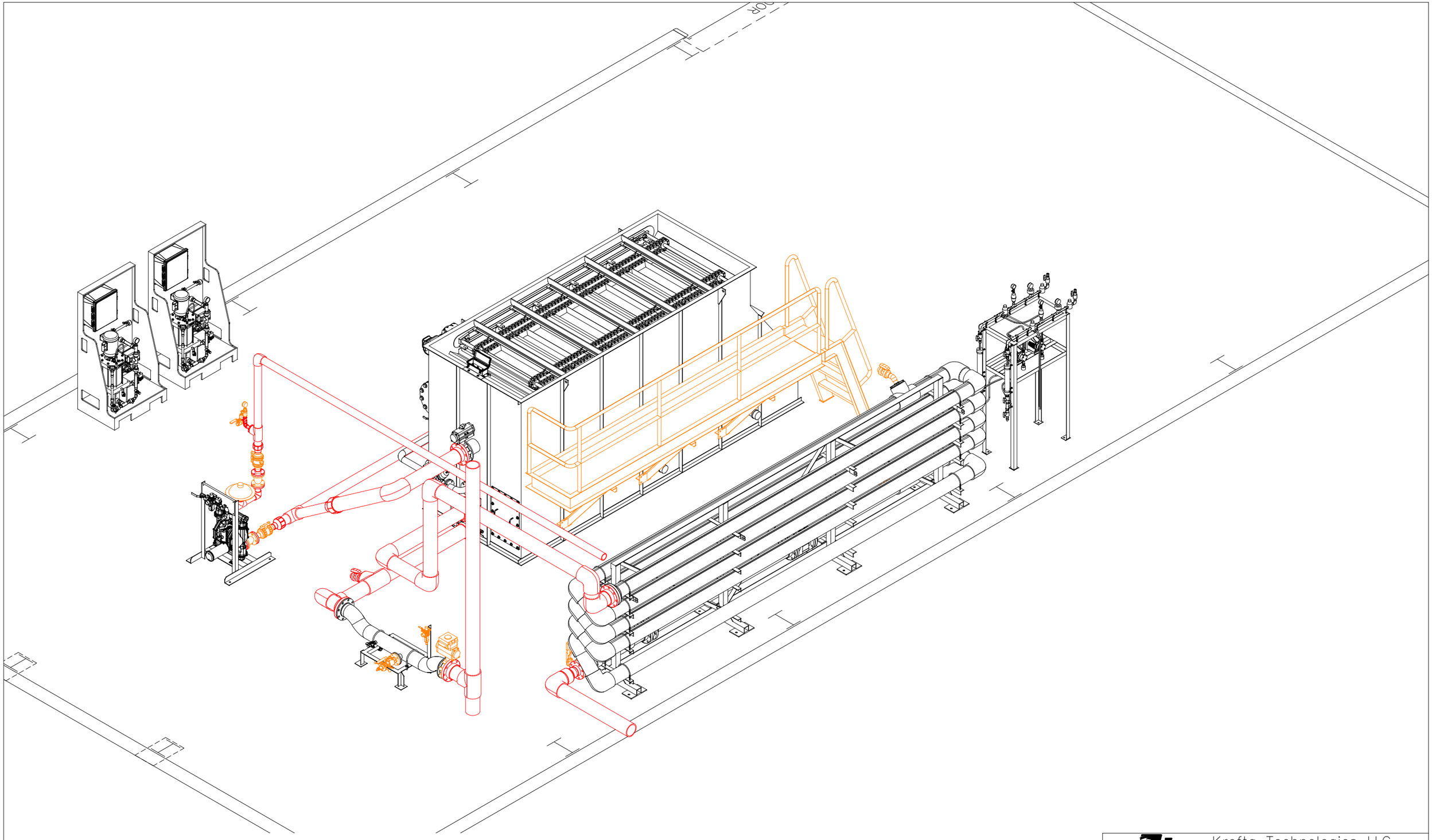
NAME: JOB 25-K01 – CITY OF AUMSVILLE – OR

DATE:	SCALE:	DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
08/21/25	–	ADG	–	–	–

TITLE: KROFTA MFH-500 DAF & EQUIPMENT
SITE GENERAL ARRANGEMENT

DRAWING NUMBER: 25K01-SITE-GA-01-3_CCS

REV: –



REV	DESCRIPTION	DWN	DATE	CHK	APP

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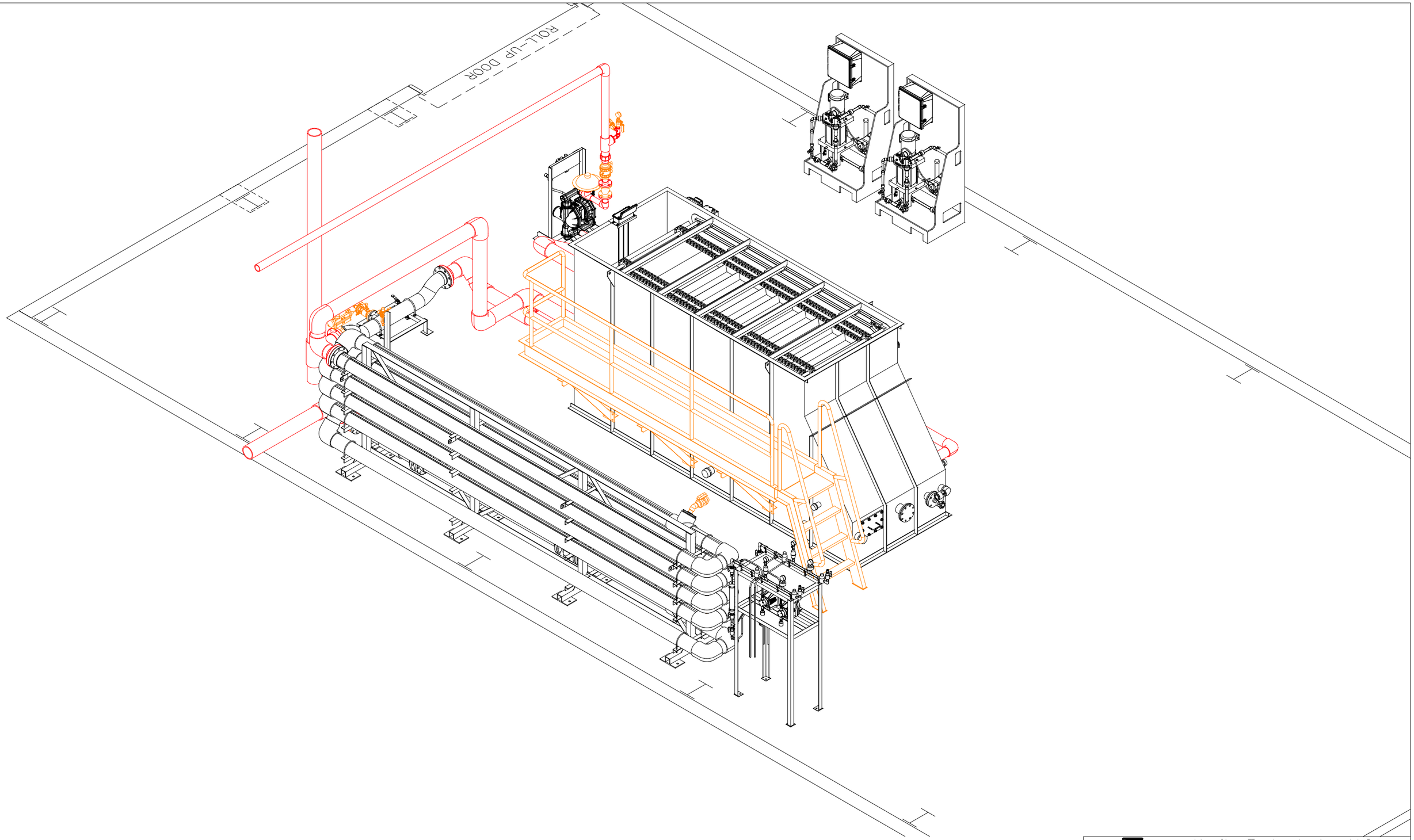
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DATE:	SCALE:	DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
08/21/25	–	ADG	–	–	–

TITLE: KROFTA MFH-500 DAF & EQUIPMENT
SITE GENERAL ARRANGEMENT

DRAWING NUMBER: 25K01-SITE-GA-01-4_CCS

REV: –



REV	DESCRIPTION	DWN	DATE	CHK	APP

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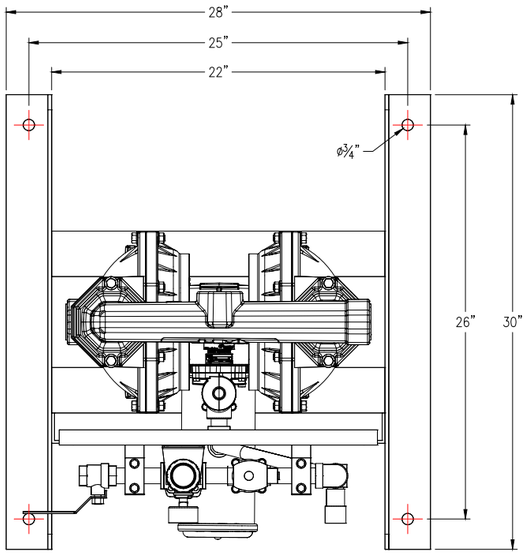
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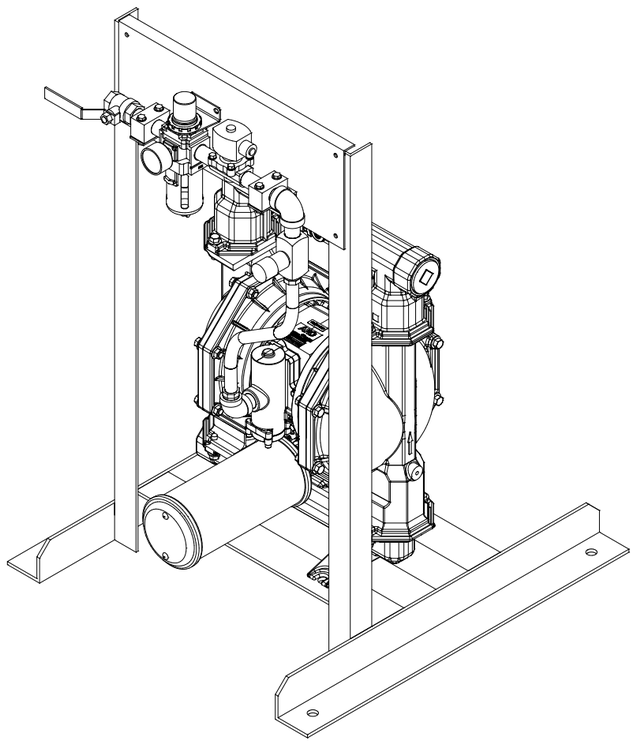
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08/21/25	–	ADG	–	–	–

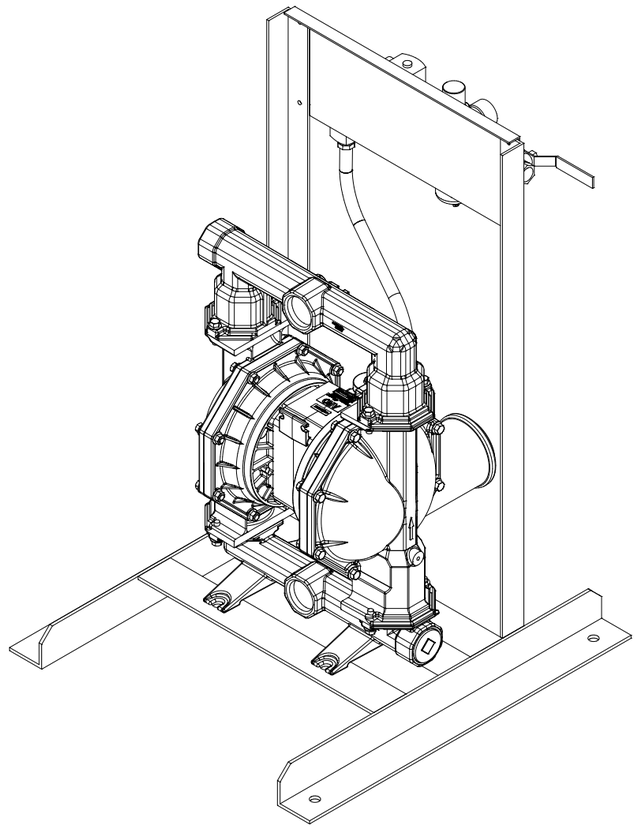
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SITE GENERAL ARRANGEMENT

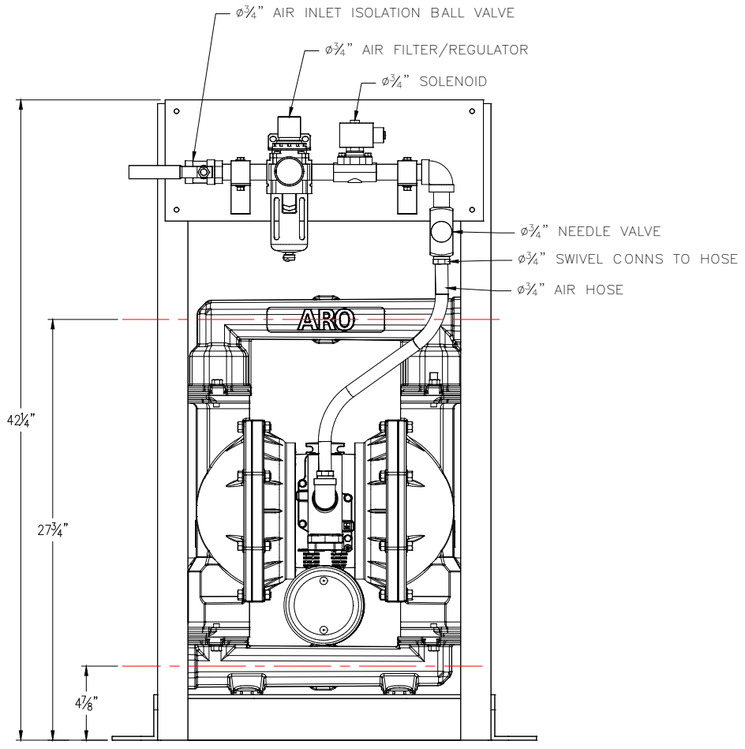
DRAWING NUMBER: 25K01-SITE-GA-01-5_CCS

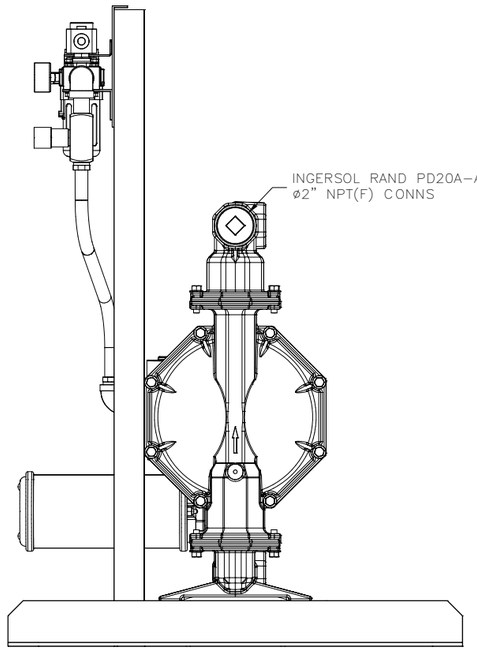
REV: –











MATERIALS OF CONSTRUCTION:
- FRAME: 304LSS
- AIR PIPING: 304LSS
- AIR HOSE: EPDM, 200PSI W/ BRASS NPT(M) X BARB SWIVEL CONNS

SHIPPING WEIGHT: 263 LBS

SUBMITTED FOR APPROVAL

BY: JEFF MILLER DATE: MARCH 13, 2025

APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP
A	ADD SHIPPING WEIGHT	ADG	08/21/25	–	–

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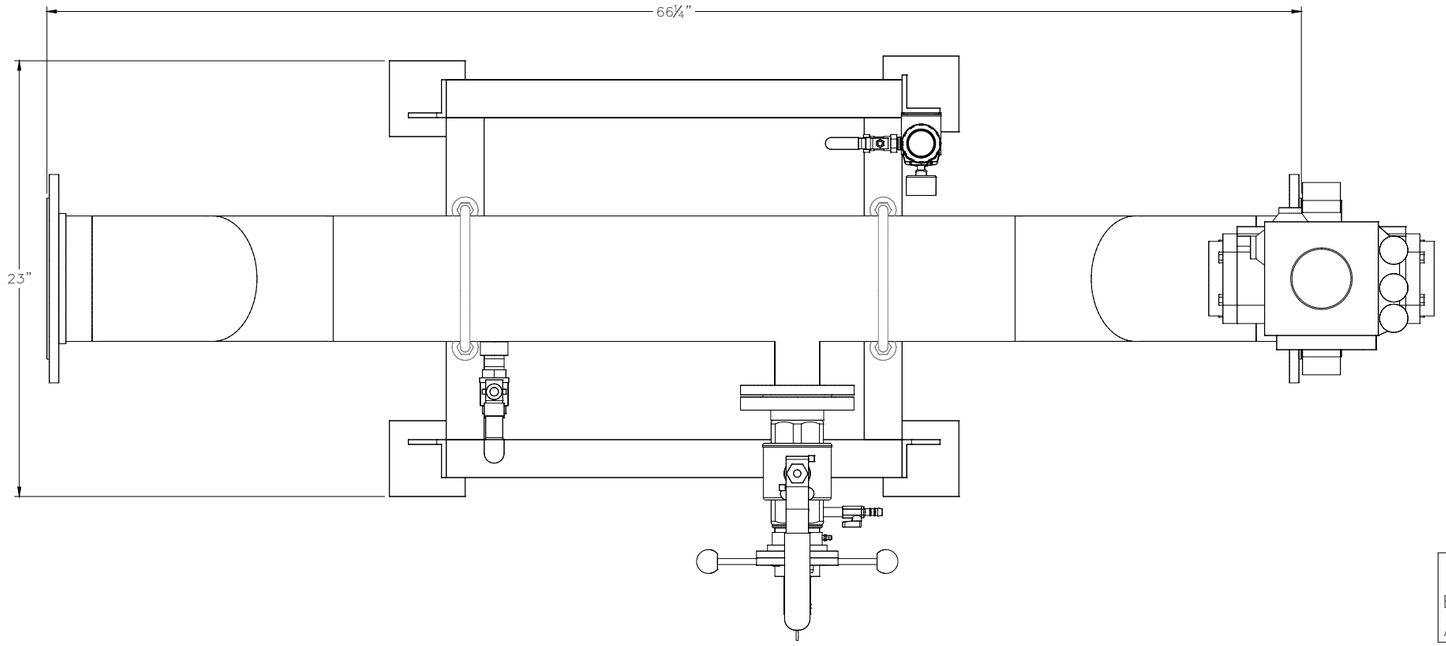
NAME: JOB 25-K01 – CITY of AUMSVILLE, OR

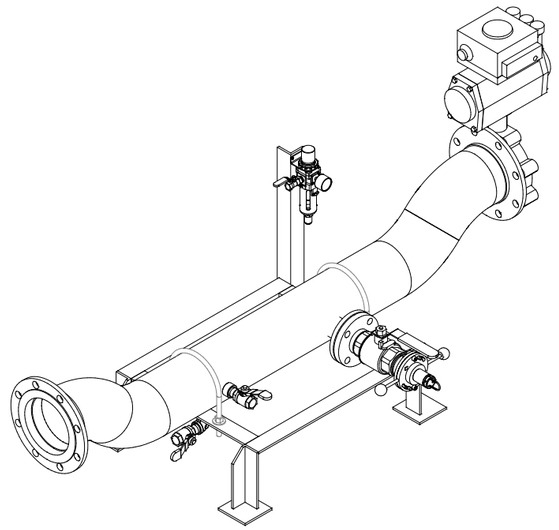
DATE	SCALE	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
03/13/25	–	ADG	–	–	–

TITLE: KROFTA MULTIFLOAT MFH-500 DAF & EQUIPMENT SLUDGE TRANSFER PUMP SKID OUTLINE

DRAWING NUMBER: 25K01-SPS-02-1

REV: A



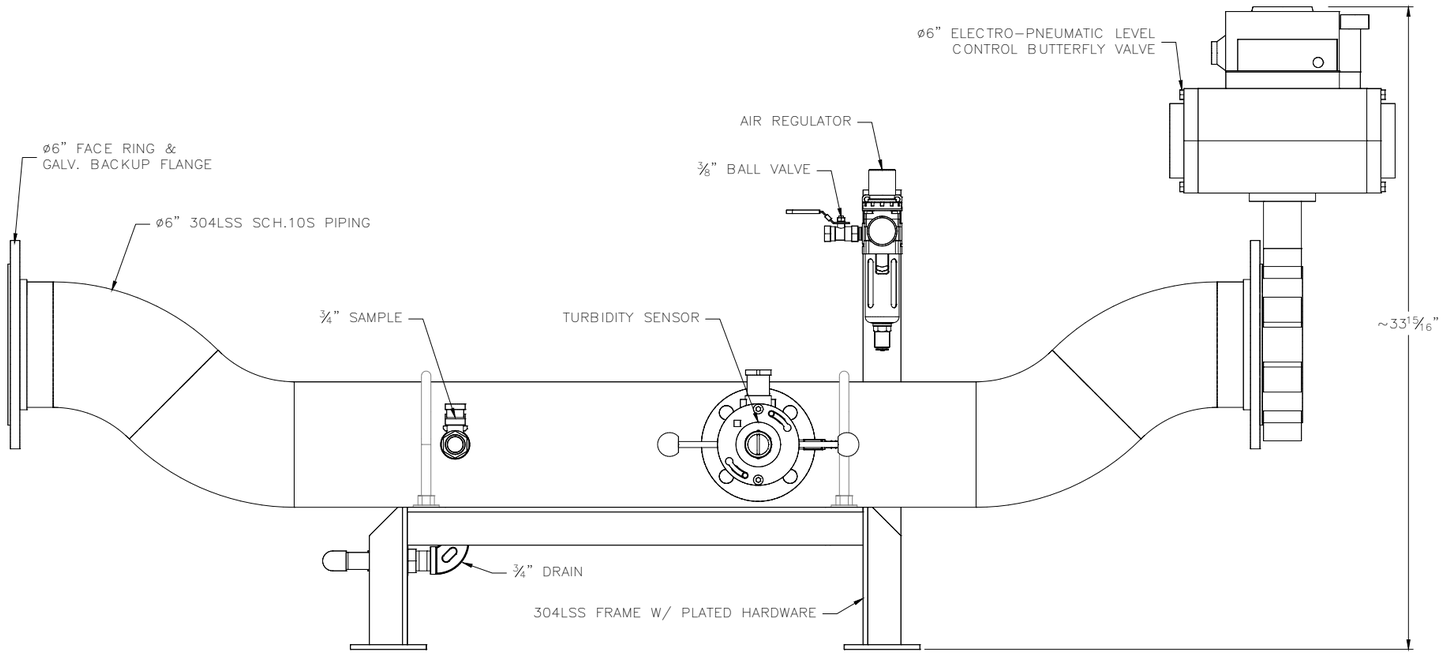


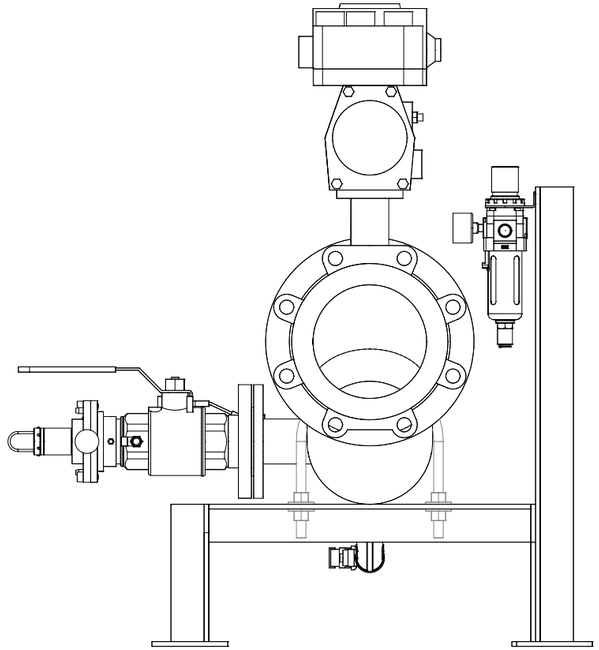
SUBMITTED FOR APPROVAL

BY: JEFF MILLER DATE: JUNE 4, 2025

APP'D BY: _____ DATE: _____

SHIPPING WEIGHT: 300 LBS





REV	DESCRIPTION	DWN	DATE	CHK	APP
A	ADDED SHIPPING WEIGHT	ADG	08/21/25	–	–

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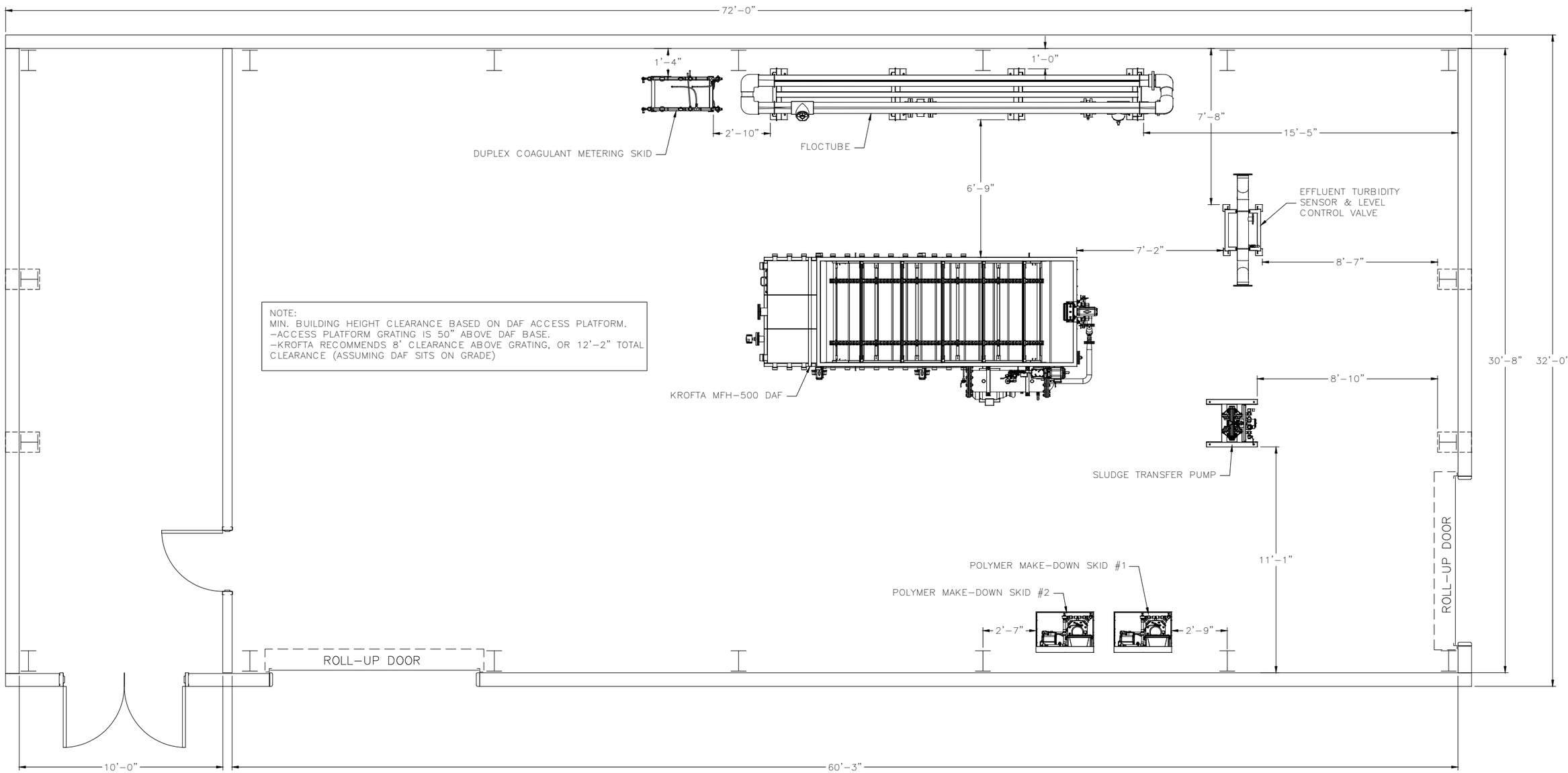
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DATE: 06/04/25	SCALE: –	DRAWN BY: ADG	DESIGNED BY: –	CHECKED BY: –	APPROVED BY: –

TITLE: KROFTA MFH-500 DAF & EQUIPMENT TUBIDITY SKID OUTLINE

DRAWING NUMBER: 25K01-TURB-OL-01-1 REV: A



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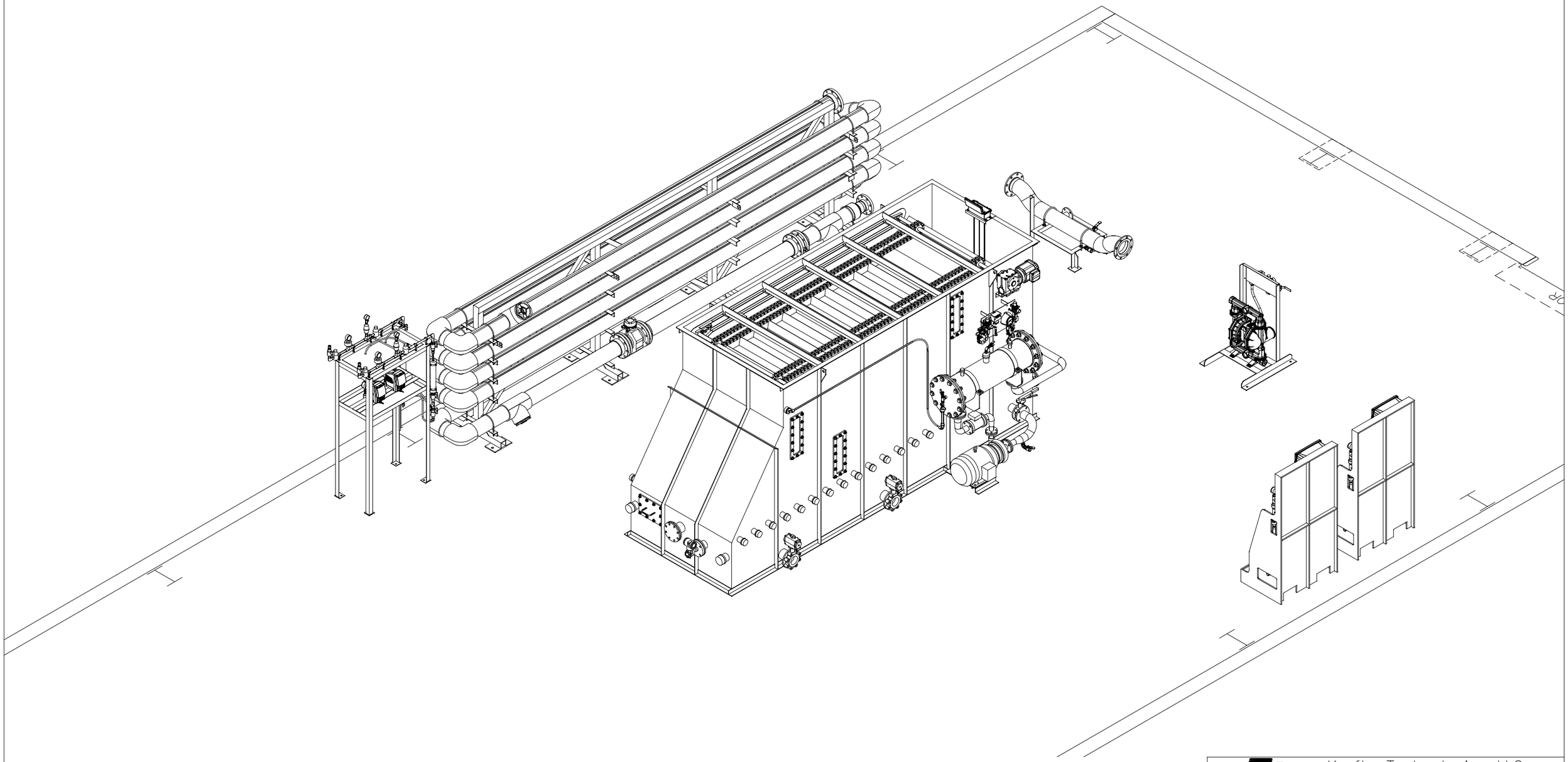
DATE	SCALE	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
08/21/25	–	ADG	–	–	–

TITLE: KROFTA MFH–500 DAF & EQUIPMENT SITE GENERAL ARRANGEMENT

DRAWING NUMBER: 25K01–SITE–GA–01–1_EQUIP REV: –

REV	DESCRIPTION	DWN	DATE	CHK	APP

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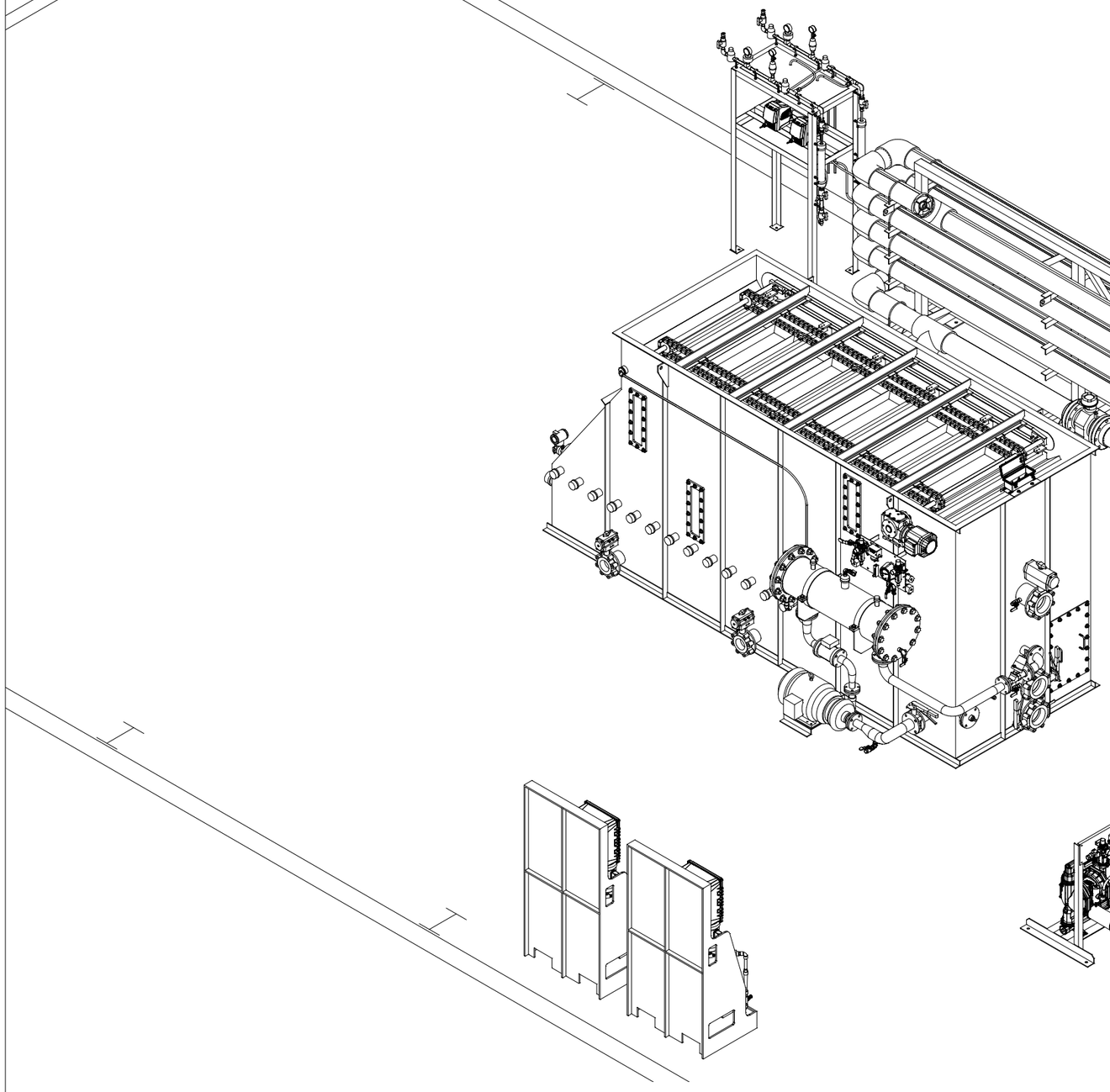
NAME: JOB 25-K01 – CITY OF AUMSVILLE – OR

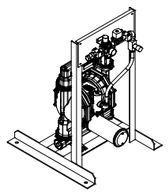
DATE:	SCALE:	DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
08/21/25	–	ADG	–	–	–

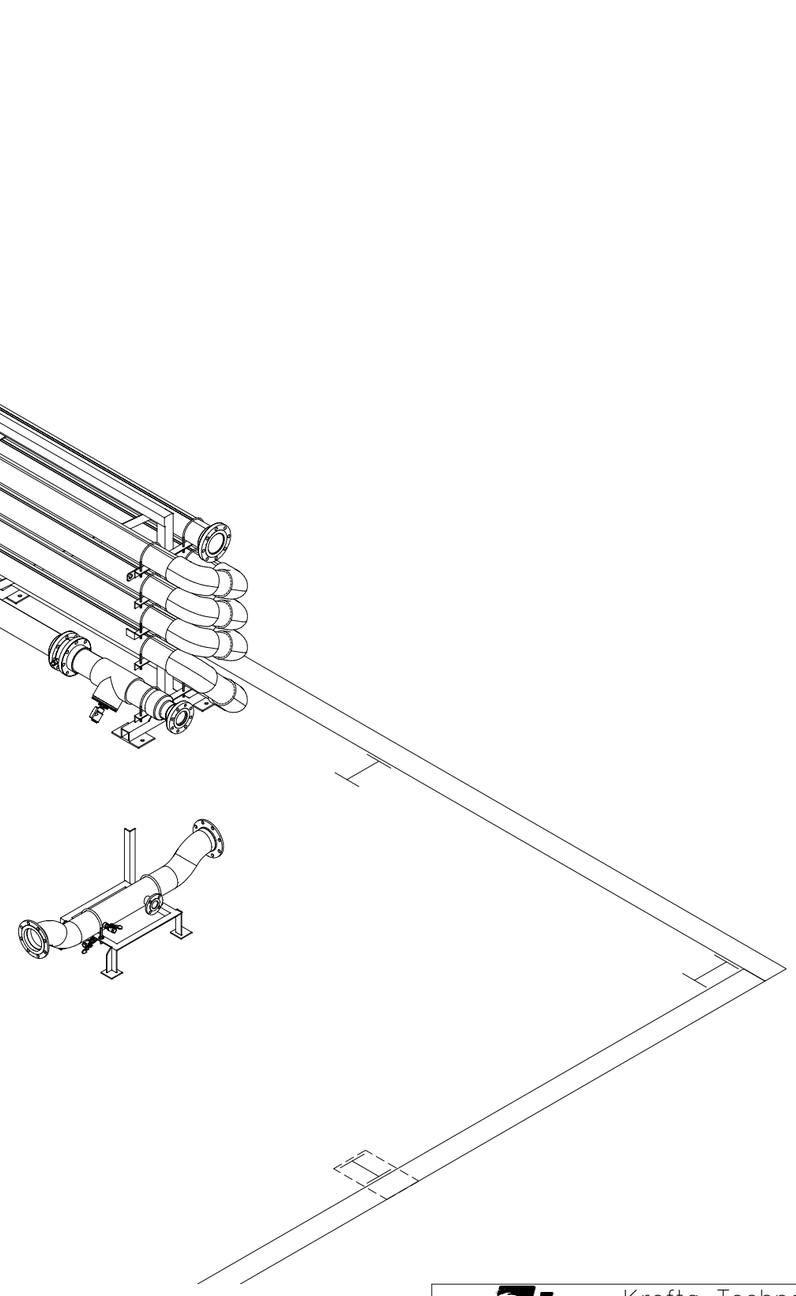
TITLE: KROFTA MFH-500 DAF & EQUIPMENT
SITE GENERAL ARRANGEMENT

DRAWING NUMBER: 25K01-SITE-GA-01-2_EQUIP

REV: –







REV	DESCRIPTION	DWN	DATE	CHK	APP

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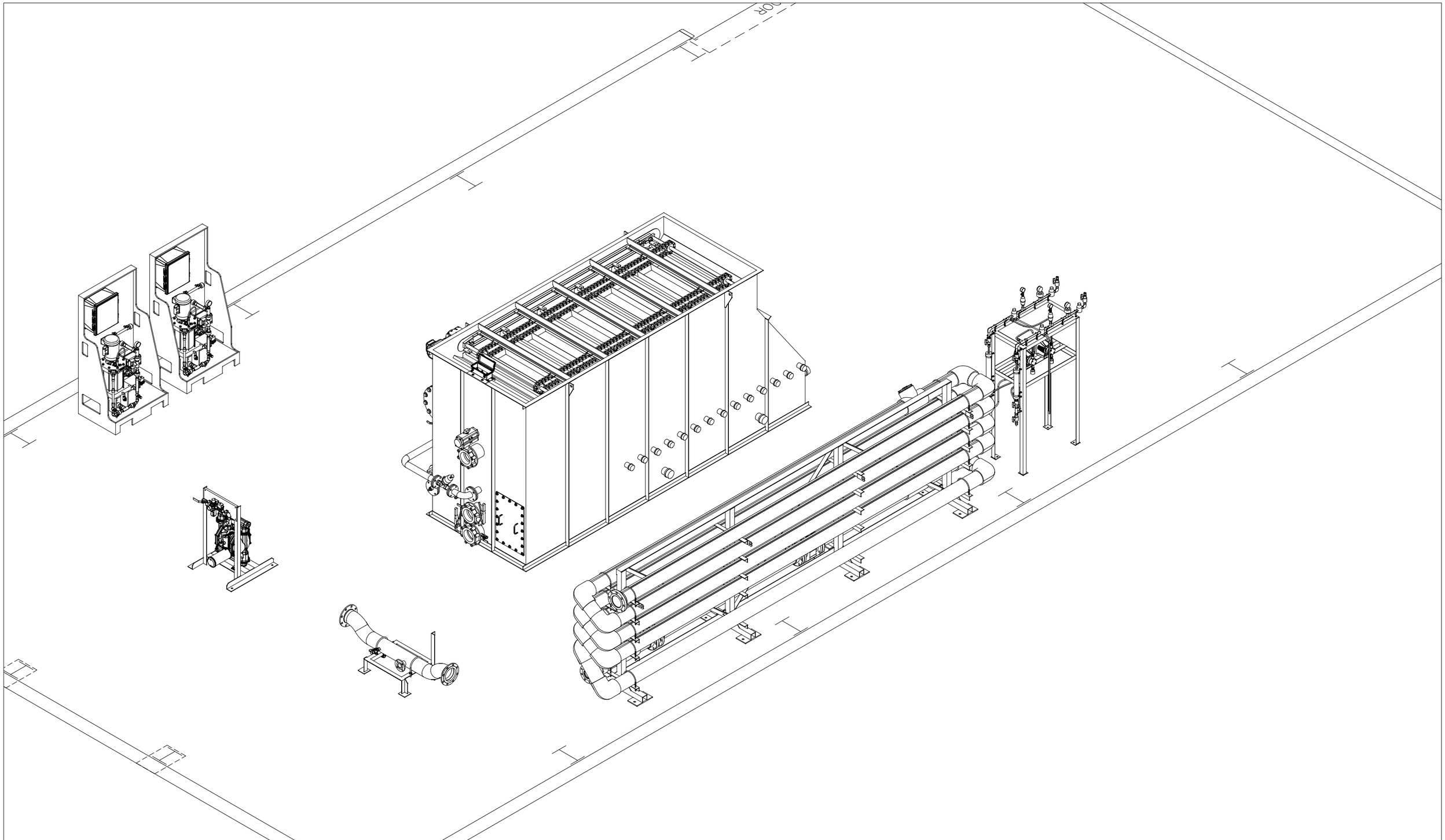
KROFTA
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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DRAWING NUMBER: 25K01-SITE-GA-01-3_EQUIP REV: –



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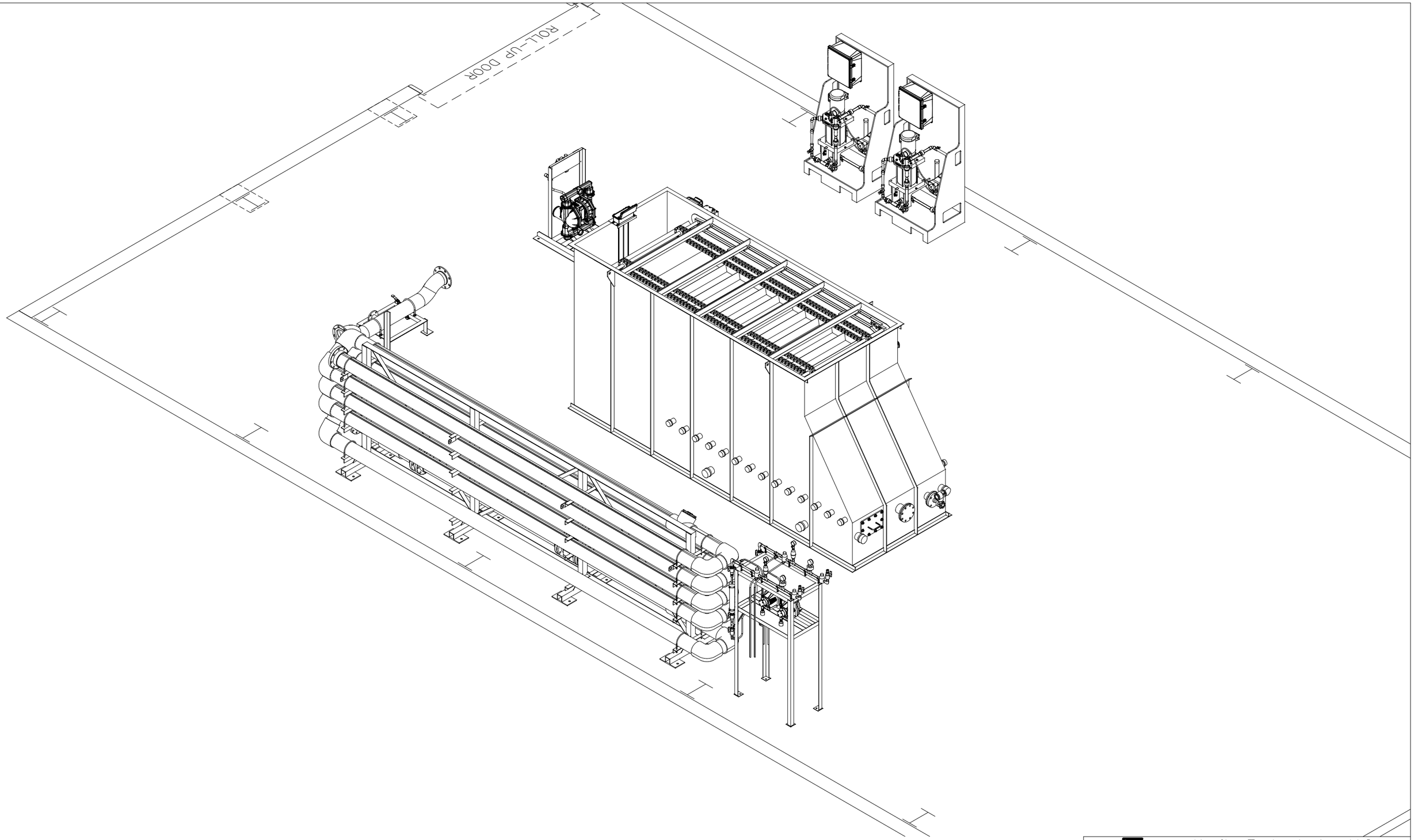
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TITLE: KROFTA MFH-500 DAF & EQUIPMENT
SITE GENERAL ARRANGEMENT

DRAWING NUMBER: 25K01-SITE-GA-01-4_EQUIP

REV: –



REV	DESCRIPTION	DWN	DATE	CHK	APP

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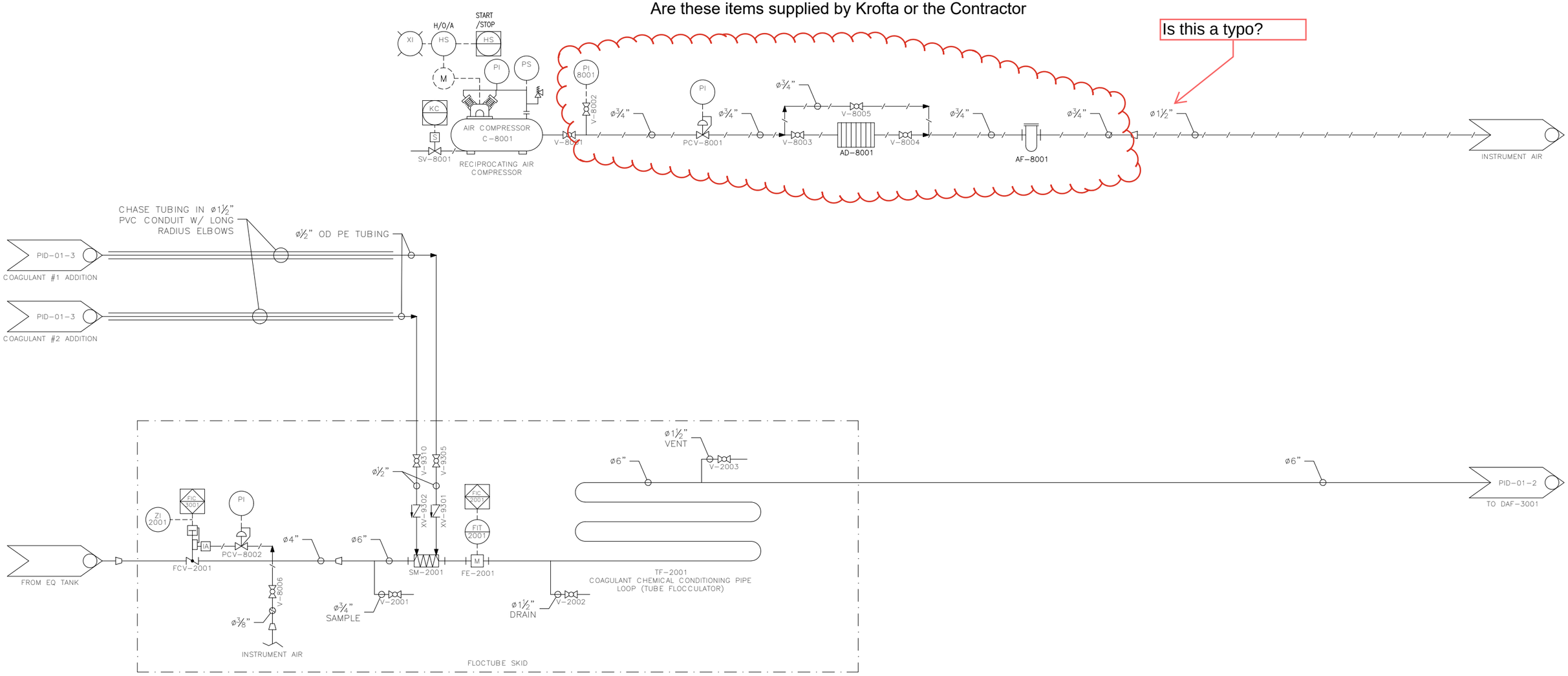
TITLE: KROFTA MFH-500 DAF & EQUIPMENT SITE GENERAL ARRANGEMENT

DRAWING NUMBER: 25K01-SITE-GA-01-5_EQUIP

REV: –

Are these items supplied by Krofta or the Contractor

Is this a typo?



PRELIMINARY

** NOTE: HOA SWITCHES AS DEPICTED: H/O/A HS XXXX

REFERENCE SOFTWARE PROGRAMMED BUTTONS ON HMI SCREEN & ARE NOT EXTERNALLY MOUNTED DEVICES.

REV	DESCRIPTION	DWN	DATE	CHK	APP

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NAME: JOB 25-K01 – CITY OF AUMSVILLE – OR

DATE: 06/02/25 | SCALE: – | DRAWN BY: ADG | DESIGNED BY: – | CHECKED BY: – | APPROVED BY: –

TITLE: KROFTA MFH-500 DAF & EQUIPMENT P&ID

DRAWING NUMBER: 25K01-PID-01-1 | REV: –

PID-01-3
POLYMER FEED

KROFTA MFH-500 DAF SKID

PID-01-1
FROM CHEMICAL CONDITIONING

ø6"

V-3001

RS 3001
SC 3001
KC 3001
HS
H/O/A
M
LS 3301
LIC 3301
ZSL 3301
KC 3301
ZSH 3301
S
IA
N.O.
FV-3301

XV-9401 V-9409
V-9410

MULTIFLOAT DAF
MFH-500
DAF-3001

A-ø6"
B-ø6"
C-ø6"
D-ø3"
E-ø2½"
F-ø4"
G-ø3"
H-ø¾"

LIT 3001
LIC 3001
V-3101
V-3002

ZSL 3302
KC 3302
ZSH 3302
N.C.
FV-3302

ZSL 3303
KC 3303
ZSH 3303
ø3"
ø4"
FV-3303

ø4"

FIC 3101
FIT 3101
FE-3101

ø2"
FCV-3101

ø2½"
ø2"
ø1½"
P-3101
GOULDS 3656
1½X2-8, 10HP
80 GPM @ 180' TDH
ø2"

ø2½"
ø½"
V-3104
2½"
ADT-500
ADT-3101
V-3103
V-3102
TO DRAIN
V-3107
V-3105
V-3106
FG-3101
TO DAF
XV-3101
FI-3201
V-3201
V-3202

PNUEMATIC CONTROL PANEL

PID-01-3
INSTRUMENT AIR 90SPIG. MIN.
ø⅜"
PS 3201
PI
V-3203
PCV-3201
PSV-3201
SV-3201

PI
PCV-3202
V-3204

PLC 3101
KC 3101
HS
H/O/A
S
SV-3101

TO FV-3301 (FLOATED SLUDGE)
TO FV-3302 (SEDIMENT PURGE #1)
TO FV-3303 (SEDIMENT PURGE #2)
TO FCV-3101 (APGV)

ø6"

AIT 3001
AE 3001
V-3005
TURBIDITY SENSOR
V-3006
ø¾"
SAMPLE
V-3004
ø¾"
DRAIN

ZI 3001
LIC 3001
IA
PI
FCV-3001
PCV-8003
V-8007
ø⅜"
INSTRUMENT AIR

EFFLUENT TURBIDITY SKID

ø6"
PID-01-3
DAF EFFLUENT

SLUDGE TRANSFER PUMP SKID

INSTRUMENT AIR
ø¾"
V-3305
PI
PCV-3301
HS
LIC
H/O/A
S
SV-3305
NV-3301

ø2"
V-3301
P-3301

PI 3301
V-3303
V-3304
V-3302
ø3"
PID-01-3
DAF SLUDGE

PRELIMINARY

H/O/A
HS XXXX

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REV	DESCRIPTION	DWN	DATE	CHK	APP

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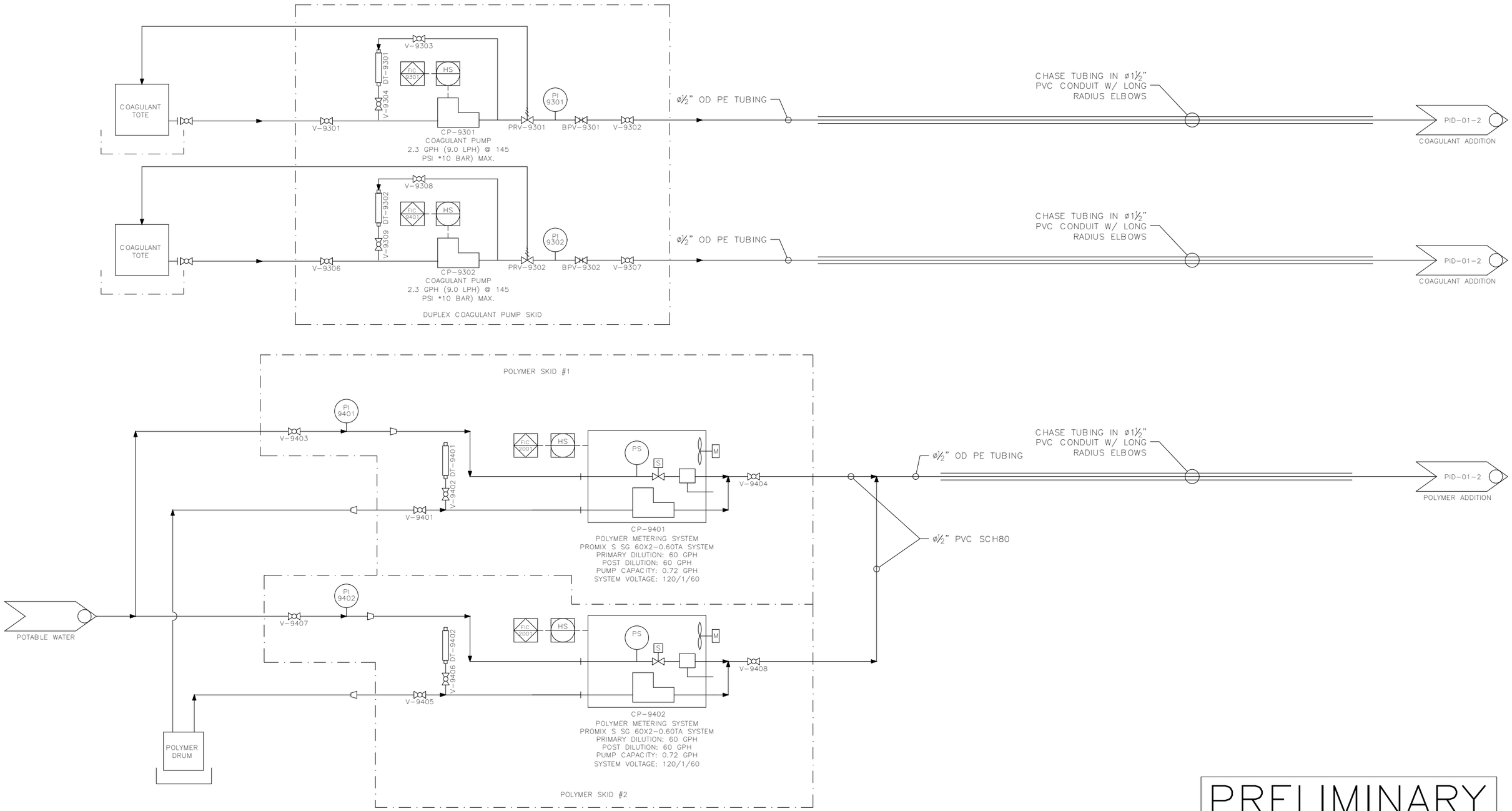
NAME: JOB 25-K01 – CITY OF AUMSVILLE – OR

DATE:	SCALE:	DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
06/02/25	–	ADG	–	–	–

TITLE: KROFTA MFH-500 DAF & EQUIPMENT P&ID

DRAWING NUMBER: 25K01-PID-01-2

REV: –



PRELIMINARY

H/O/A

HS XXXX

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REV	DESCRIPTION	DWN	DATE	CHK	APP

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DATE: 06/02/25	SCALE: –	DRAWN BY: ADC	DESIGNED BY: –	CHECKED BY: –	APPROVED BY: –

TITLE: KROFTA MFH-500 DAF & EQUIPMENT P&ID

DRAWING NUMBER: 25K01-PID-01-3

REV: –

EQUIPMENT TECHNICAL DATA SHEETS

ADT PRESSURE RELEASE VALVE

AUTO PURGING GLOBE VALVE (APGV)

KROFTA APGV:
2" Schubert & Salzer model 7010 Angle Seat Valve with threaded ends (316 SS body, SS stem, SS Linear Control Plug (Cv = 30), PEEK seat and live loaded packing) mounted with Spring Return CLOSE 5” pneumatic actuator with 3 springs and Stroke Limiter in the closed direction. Actuator needs 60 – 80 psi main air supply.

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

AUTO PURGING GLOBE VALVE (APGV)

Angle Seat Valve 7010

1/2" up to 3" up to 428°F

Pneumatically operated angle seat valve for the control of neutral and aggressive gases, liquids and steam.

- Compact design
- For temperatures from -22°F up to +428°F
- Working pressure up to 580 psi
- Versatile actuators
- ANSI Class VI shutoff
- Various end connections, including NPT, ANSI-Flanges, Tri-clamp, tube ends, etc.



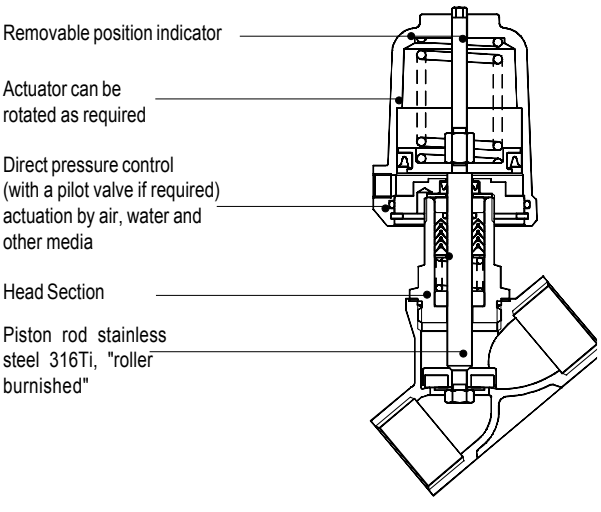
Technical Data

	Body material		
	Brass	Bronze	SST 316
Nominal size	2 1/2" and 3"	1/2" - 2"	1/2" - 2 1/2"
Connections: NPT thread, Tri clamp Welding ends (ISO/SAE), Tube ends ANSI 150, ANSI 300	2 1/2" - 3"	1/2" - 2"	1/2" - 2 1/2"
Nominal pressure	235 psi	235 psi	580 psi
Max. fluid temperat. ***Optional Type 220 HT-Version**	-22°F up to 338°F	-22°F up to 338°F up to +392°F	-22°F up to 338°F **up to +428°F***
Ambient temperature	-22°F up to +140°F		
Viscosity of the fluid	maximum 600 mm²/s (600cSt, 80°E)		
Vacuum	maximum 0.0295 mercury (Hg)		
Working pressure for inverted packing	maximum 175 psi		

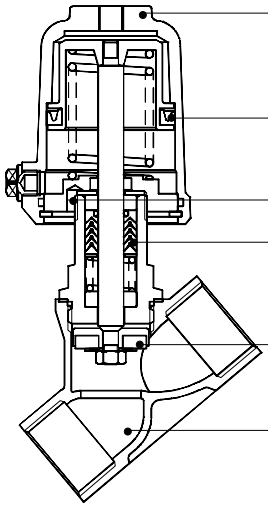
Options

- limit switches
  - inductive proximity switches
  - mechanical limit switches
- solenoid valves
- manual override
- O_2-cleaned version
- PTFE-free version (PEEK)
- ASi-Bus

Normally closed



Normally open



SCHUBERT & SALZER CONTROL® SYSTEMS

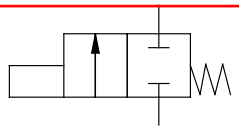
1920 Derita Road, Concord, N. C. 28027
Tel: (704) 789-0169, 1-877-414-9664 Fax: (704)792-9783
Www.schubert-salzer.com, info.us@schubert-salzer.com

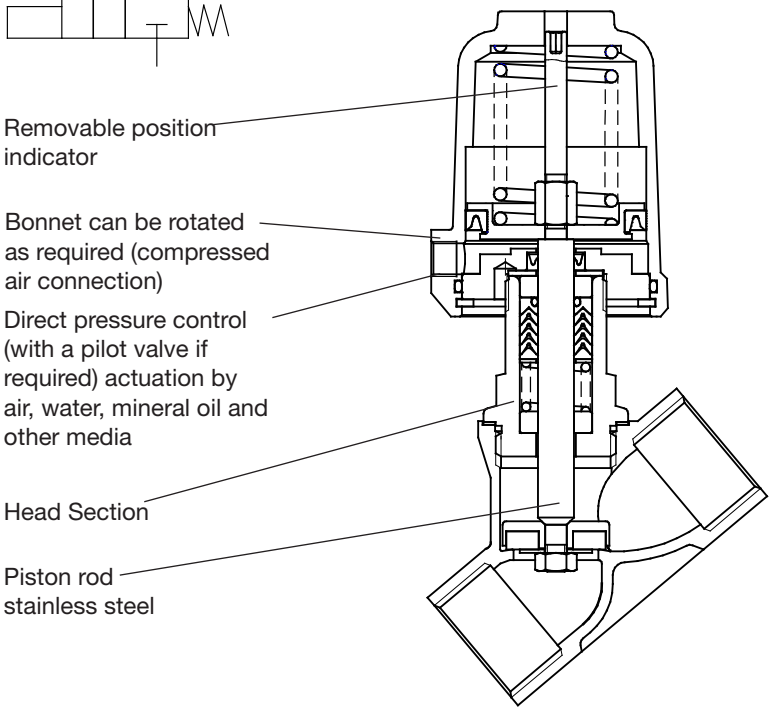
Angle Seat Valve 7010

Build up and function

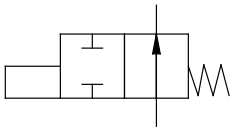
Spring closes

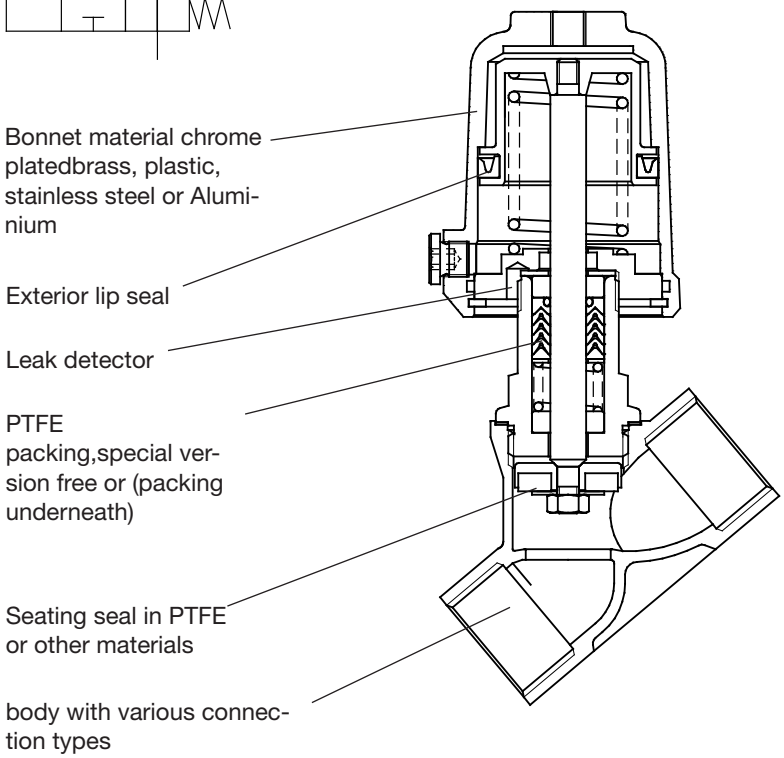
The function „sping closes“ may be applied closing against or closing with the flow. In the configuration closing with the flow the valve should only be used for gaseous fluids. If used for liquids, water hammers may occur.





Spring opens





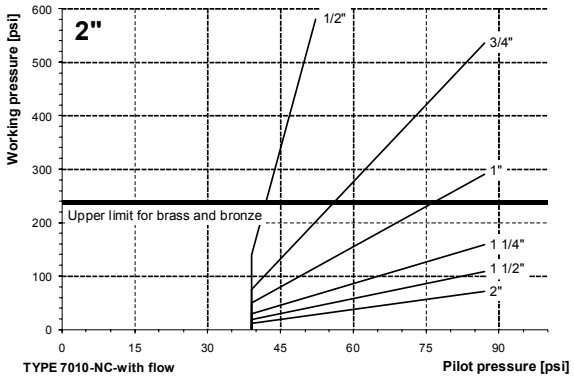
Angle Seat Valve 7010

Metall and stainless steel actuator

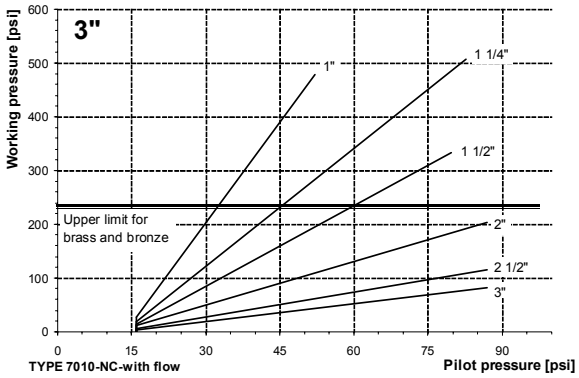
Spring closes NC (closing with flow)

Normally closed angle seat valves, closing with the flow. Operates better with gases, with liquids water hammer is possible.

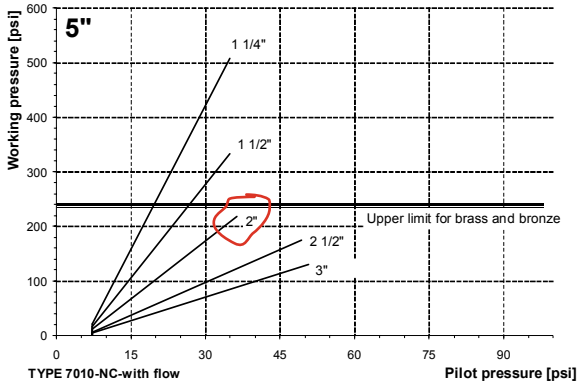
Actuator diameter 2"



Actuator diameter 3"



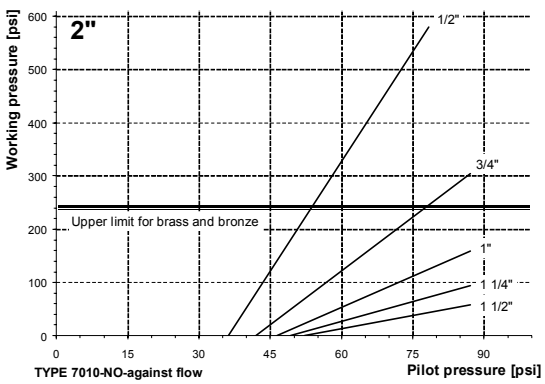
Actuator diameter 5"



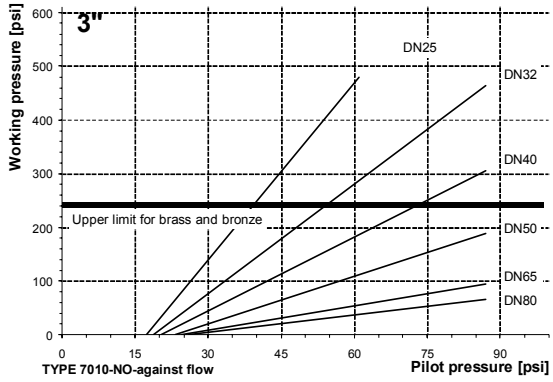
Spring opens NO (closing against flow)

Normally open angle seat valves, closing against the flow.

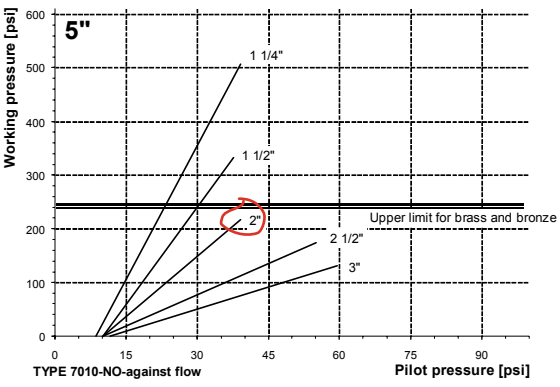
Actuator diameter 2"



Actuator diameter 3"



Actuator diameter 5"



Angle Seat Valve 7010

Normally closed angle seat valves, closing against the flow (operating with fluids).

Metall and stainless steel actuator

Nominal size	Working pressure (i.e. Differential) psi		Pilot pressure psi	Piston Ø inch	Springs
	stainless steel	brass/ bronze			
1/2" (15)	320	230	50 - 145	2"	1
3/4" (20)	100	100	50 - 145	2"	1
3/4" (20)	190	190	65 - 145	2"	2
3/4" (20)	275	230	85 - 145	2"	3
1" (25)	35	35	50 - 145	2"	1
1" (25)	85	85	65 - 145	2"	2
1" (25)	130	130	85 - 145	2"	3
1" (25)	320	230	50 - 145	3"	1
1 1/4" (32)	15	15	50 - 145	2"	1
1 1/4" (32)	45	45	65 - 145	2"	2
1 1/4" (32)	75	75	85 - 145	2"	3
1 1/4" (32)	175	175	50 - 145	3"	1
1 1/4" (32)	245	230	65 - 145	3"	2
1 1/4" (32)	320	230	85 - 145	3"	3
1 1/4" (32)	160	160	20 - 145	5"	1
1 1/4" (32)	335	230	30 - 145	5"	2
1 1/2" (40)	30	30	65 - 145	2"	2

Nominal size	Working pressure (i.e. Differential) psi		Pilot pressure psi	Piston Ø inch	Springs
	stainless steel	brass/ bronze			
1 1/2" (40)	50	50	80 - 145	2"	3
1 1/2" (40)	100	100	50 - 145	3"	1
1 1/2" (40)	145	145	65 - 145	3"	2
1 1/2" (40)	190	190	80 - 145	3"	3
1 1/2" (40)	100	100	20 - 145	5"	1
1 1/2" (40)	220	220	30 - 145	5"	2
1 1/2" (40)	305	230	45 - 145	5"	3
2" (50)	60	60	50 - 145	3"	1
2" (50)	85	85	65 - 145	3"	2
2" (50)	110	110	80 - 145	3"	3
2" (50)	125	125	30 - 145	5"	2
2" (50)	190	190	45 - 145	5"	3
2 1/2" (65)	60	35 *	80 - 145	3"	3
2 1/2" (65)	75	50 *	30 - 145	5"	2
2 1/2" (65)	100	75 *	45 - 145	5"	3
3" (80)		50 *	45 - 145	5"	3

* brass body

Standard

Angle Seat Valve 7010

Ordering Number System

1	2	3	4	5	6	7	8	9	10	11	12
7	0	1	0	/				V			S

Type: 7010 — Size: / — Symbol: "V": Valve; "A": Actuator (valve without body); "R": Repair kit (sealings)

1 - 6 : Please quote all 6 sections.
7 - 12: Quote only if required.

1. Body type	2. Connection	3. Body material	4. Seating seal	5. Pilot function	6. Actuator	7. Springs	8. Head section material
1 Angle body	5 NPT-thread	0 Brass	0 PTFE	0 NC (closing with flow)	7 Piston 2" (NPT)	- Standard	- Standard
2 Flanged body	C ANSI Flanges 150 (type 7031)	1 Bronze	1 Viton	1 NO (closing against flow)	8 Piston 3" (NPT)	1 1 spring	graphite, reinforced
		2 Stainless steel 316L	2 EPDM	2 NC (closing against flow)	9 Piston 5" (NPT)	2 2 springs	
	H Welding ends acc. ISO		3 Buna	3 Universal, double acting	P Plastic bonnet for piston 2" (NPT)	3 3 springs	
	J SAE (1/2")		7 Peek		S Plastic bonnet for piston 3" (NPT)		
	3 Tube ends						
	Z Tri clamp inch (ASME 1998)				For stainless steel actuator choose size 7,8,9		
	Y Tri-Clamp Inch "long"				For metric air-connection please consult factory		
	* other upon request						

9. Packing	10. Temperature version	11. Accessories	12. Special versions	13. Body	14. Head section	15. Piston and seat	16. Bonnet
- Standard PTFE-Carbon filled	- Standard (338°F bronze, stainless steel)	- No accessories	S Special versions	- Standard	- Standard	- Standard	- Standard
		1 Electrical position indicator with single switch	M Position indicator with cable bushing				C Version completely in stainless (bonnet)
A PTFE free	H High temperature (392°F bronze, stainless steel)	2 Electrical position indicator with double switches	N Position indicator with plug connection				
2 inverted, vacuum	B HT 220 Version 430°F, 1/2" - 1 1/4" (stainless steel only)	3 Manual overide normally (N.O.)	X ASI-BUS IP65				
	V Viton exterior lip sealing	4 Manual overide normally (N.C.)					
		5 Stroke limitation (N.C.)					
		6 Pilot valve DN 2, 230 V AC					
		7 Pilot valve DN 2, 24 V DC					
		K Single mechanical switch					
		M Double proximity switch 10 - 36 V DC (PNP)					
		P Single proximity switch 10 - 36 V DC (PNP)					
		T Single proximity switch compact 10 - 30 V DC (PNP)					

Special versions:

...S - - - - - - 3 closing cap for position indicator (actuator 2")
...S - - - - - - 2 closing cap for position indicator (actuator 3", 5")
...S - - - - - - - - 1 silicone free
...S - - - - - - - - 5 oxygen service
...S - - - - - - - - 66 pilot valve 110/120V AC (already assembled)
...S - - - - - - - - 501 pilot valve 110/120V AC (assembled in the USA)

For other versions, please contact factory

Type 7010

Ordering example: 7010/050V152028----5
2" angle seat valve, NPT connection, stainless steel body, PTFE seat, N.C., actuator size 3", stroke limitation.

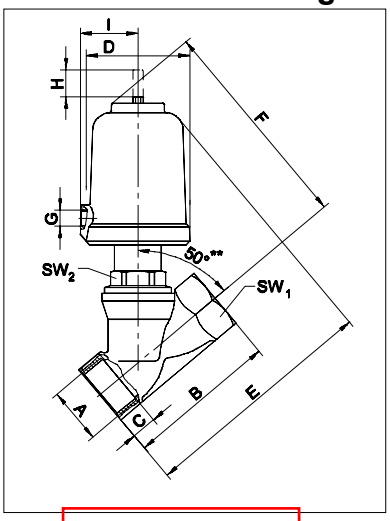
Type 7010 HT 220

Ordering example: 7010/025V152728---B5
1" angle seat valve, NPT connection, stainless steel body, Peek seating seal, N.C., actuator size 3", HT 220 Version, stroke limitation.

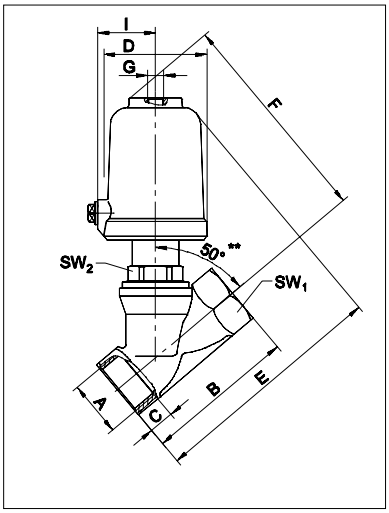
Angle Seat Valve 7010

SCHUBERT SALZER INC.

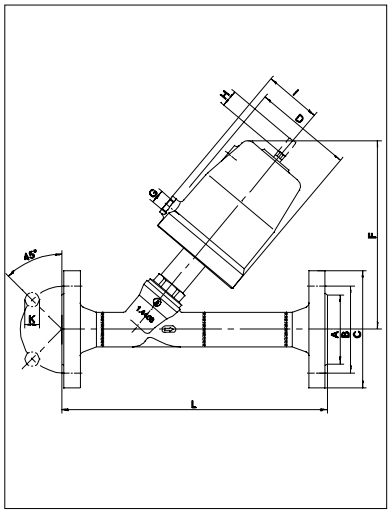
Dimensions and Weights



Normal closed



Normal open



7031

DN	Actuator diameter	A Rp/NPT	B		C	D	E		F	G	H	I	SW1		SW2	Cv-Values		Weight (lbs)	Weight (lbs)
			Bronze SST	Brass			Bronze SST	Brass			(Stroke)		Bronze SST	Brass		Bronze SST	Brass		Model 7012
15	2"	1/2"	2,55	-	0,45	2,45	5,30	-	4,70	G1/8	0,28	1,35	1,00	-	1,20	4	-	2,4	2,2
20	2"	3/4"	2,95	-	0,50	2,45	5,30	-	4,90	G1/8	0,47	1,35	1,20	-	1,20	9	-	2,6	2,4
25	2"	1"	3,55	-	0,60	2,45	5,70	-	5,10	G1/8	0,63	1,35	1,55	-	1,20	17	-	3,1	2,9
25	3"	1"	3,55	-	0,60	3,80	7,30	-	6,70	G1/4	0,63	2,15	1,55	-	1,20	19	-	6,6	3,7
32	2"	1 1/4"	4,35	-	0,65	2,45	6,30	-	5,70	G1/8	0,63	1,35	1,90	-	1,20	24	-	4,0	3,7
32	3"	1 1/4"	4,35	-	0,65	3,80	7,85	-	7,50	G1/4	0,79	2,15	1,90	-	1,20	28	-	7,3	4,6
32	5"	1 1/4"	4,35	-	0,65	5,75	9,05	-	8,45	G1/4	0,79	3,15	1,90	-	1,20	28	-	12,1	-
40	2"	1 1/2"	4,70	-	0,75	2,45	6,50	-	5,90	G1/8	0,63	1,35	2,15	-	1,20	35	-	4,6	4,4
40	3"	1 1/2"	4,70	-	0,75	3,80	8,05	-	7,70	G1/4	0,91	2,15	2,15	-	1,20	41	-	7,9	5,3
40	5"	1 1/2"	4,70	-	0,75	5,75	9,25	-	8,65	G1/4	0,91	3,15	2,15	-	1,20	41	-	12,8	-
50	2"	2"	5,90	-	0,85	2,45	7,30	-	6,30	G1/8	0,63	1,35	2,70	-	1,25	46	-	5,9	5,7
50	3"	2"	5,90	-	0,85	3,80	8,85	-	7,85	G1/4	1,14	2,15	2,70	-	1,25	64	-	9,2	6,6
50	5"	2"	5,90	-	0,85	5,75	9,85	-	8,85	G1/4	1,14	3,15	2,70	-	1,25	64	-	14,1	-
65	3"	2 1/2"	7,10	7,10	1,00	3,80	10,25	10,25	8,25	G1/4	1,14	2,15	3,35	3,35	1,60	93	108	13,6	11,0
65	5"	2 1/2"	7,10	7,10	1,00	5,75	11,20	11,20	9,45	G1/4	1,14	3,15	3,35	3,35	1,60	93	108	18,5	-
80	3"	3"	-	8,25	1,10	3,80	-	11,00	8,85	G1/4	1,14	2,15	-	3,95	1,60	-	133	18,3	-
80	5"	3"	-	8,25	1,10	5,75	-	12,00	9,85	G1/4	1,14	3,15	-	3,95	1,60	-	133	23,1	-

Dimensions in inches

Differing dimensions of model 7031

DN	Piston diam.	A	B	C	D	F	K	L	N No.of drillings	weight (lbs)
1/2"	2"	1,38	2,38	3,50	2,44	4,92	0,62	9,06	4	5,95
3/4"	2"	1,69	2,75	3,88	2,44	4,92	0,62	10,24	4	7,50
1"	2"	2,00	3,12	4,25	2,44	5,12	0,62	10,24	4	9,04
1"	3"	2,00	3,12	4,25	3,78	6,69	0,62	10,24	4	12,57
1 1/4"	2"	2,50	3,50	4,62	2,44	5,71	0,62	11,81	4	12,57
1 1/4"	3"	2,50	3,50	4,62	3,78	7,28	0,62	11,81	4	15,87
1 1/4"	5"	2,50	3,50	4,62	5,75	8,46	0,62	11,81	4	20,72
1 1/2"	2"	2,88	3,88	5,00	2,44	5,91	0,62	11,81	4	14,11
1 1/2"	3"	2,88	3,88	5,00	3,78	7,48	0,62	11,81	4	17,42
1 1/2"	5"	2,88	3,88	5,00	5,75	8,66	0,62	11,81	4	22,05
2"	2"	3,62	4,75	6,00	2,44	6,30	0,75	13,78	4	18,96
2"	3"	3,62	4,75	6,00	3,78	7,68	0,75	13,78	4	22,27
2"	5"	3,62	4,75	6,00	5,75	8,86	0,75	13,78	4	27,56

Dimensions in inches

Text and pictures ate not binding. We reserve the right, to alter the equipment.

D **Betriebsanleitung**

GB USA **Operating Instructions**

F **Manuel d'utilisation**

Typ 7010



SCHUBERT & SALZER CONTROL SYSTEMS

Version: 12/2006

M7010-def.doc
Art.-Nr: 110 7010

Bunsenstrasse
Tel: (0841) 9654-0
www.schubert-salzer.com

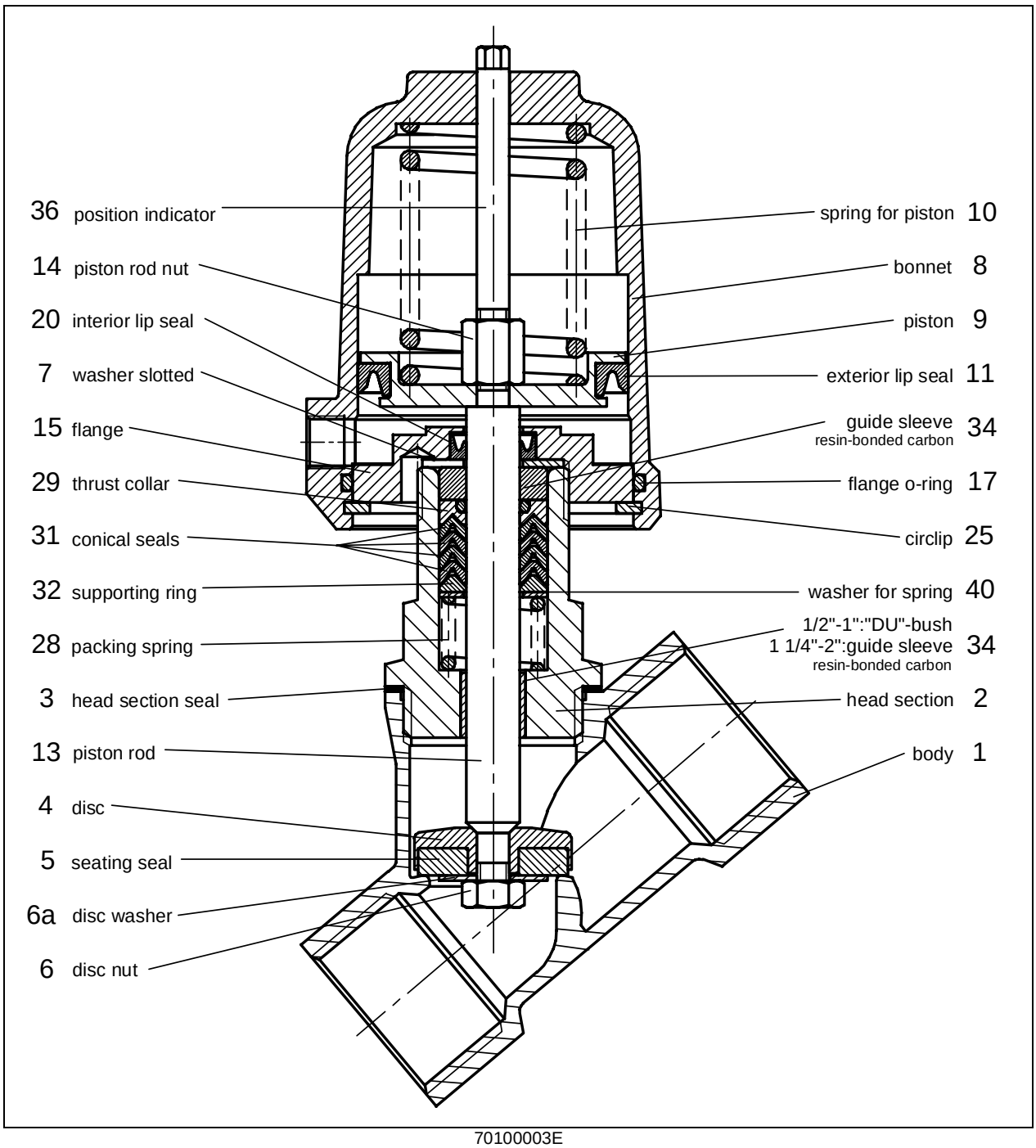
D-85053 Ingolstadt
Fax: (0841) 9654-590

2 GB USA Operating Instructions (English)

2.1 Spare Parts List

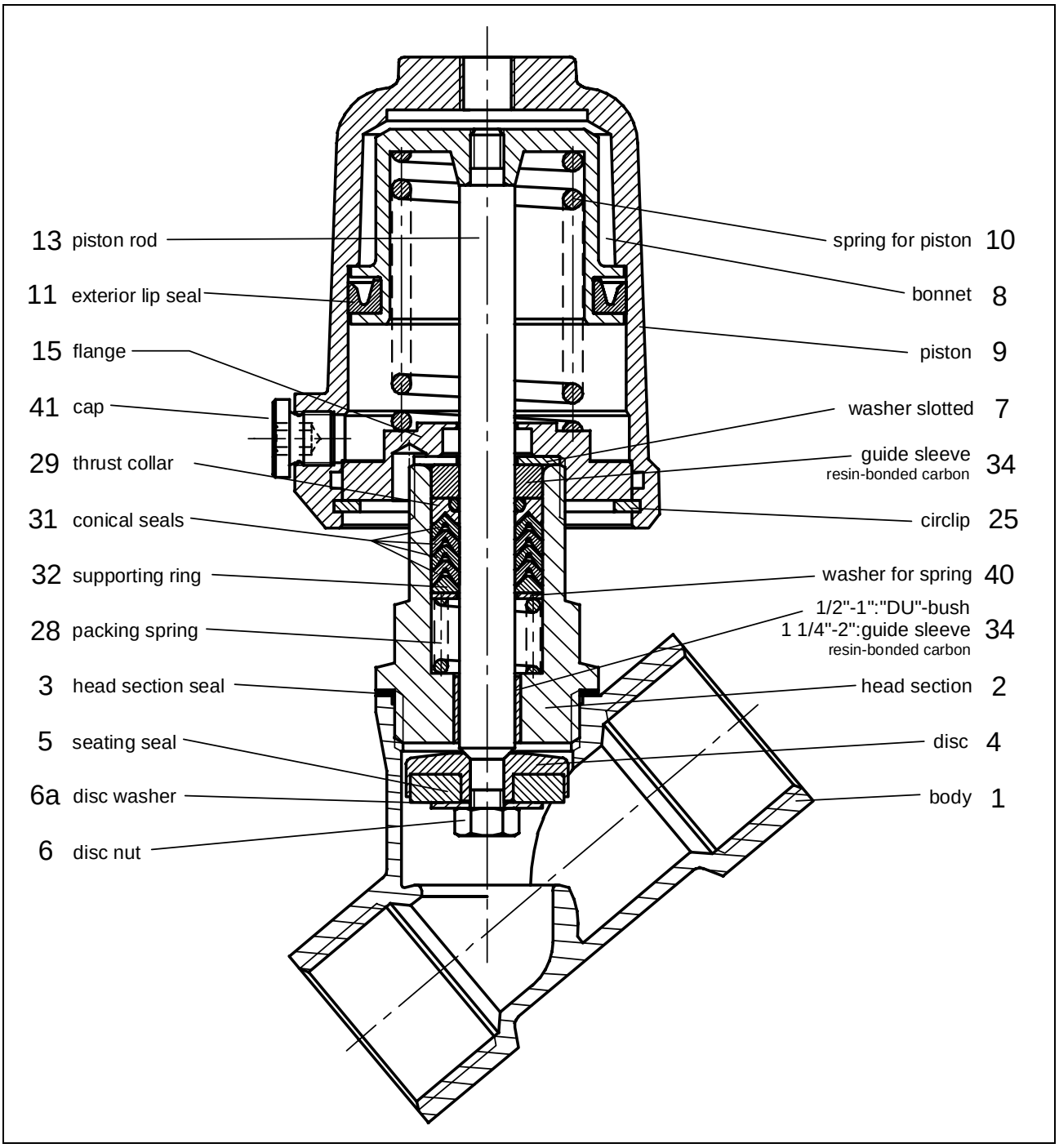
Use original Schubert & Salzer Control Systems spare parts only!

2.1.1 Function Spring Closes



70100003E

2.1.2 Function “Spring Opens”



70100004E

	Depending on size and version number and kind of guiding parts may differ from those shown in the spare parts list. In case of need demand for a detailed spare parts list.

Besides the single spare parts repair kits are available for all valves containing all sealings and parts subject to wear.

2.2 Technical Data

	Body material		
	Brass	Bronze	Stainless steel
Nominal size	DN 65 and DN 80	DN 15 to DN 50	DN 8 to DN 65
Connections:			
Pipe thread acc. DIN 2999	2 1/2" and 3"	1/2" - 2"	1/4" - 2 1/2"
NPT thread	2 1/2" and 3"	1/2" - 2"	1/4" - 2 1/2"
welding ends (DIN/ISO)			1/2" - 2 1/2"
Nominal pressure	PN 16	PN 16	PN 40
Max. fluid temperat.	-30°C up to 170°C	-30°C up to 170°C	-30°C up to 170°C
*optional		Up to +200°C*	Up to +200°C*
Ambient temperature	-30°C up to +60°C		
Viscosity of the fluid	maximum 600 mm²/s (600cSt, 80°E)		
Vacuum	maximum 0,001bar abs		
Working pressure for hollow construction	maximum 12 bar		

2.3 Mounting

This instruction is valid for functions “spring closes” and “spring opens”.



For function „double acting“ proceed according to description of function „spring opens“. For all other versions consult Schubert & Salzer Control Systems if necessary.

Remove all packing material from the valve.

Before mounting check the pipeline for contaminations and foreign bodies and clean if necessary.

The valve has to be mounted to the pipeline according the direction of flow which is indicated by an arrow on the valve body.

The pipelines have to be connected to the valve avoiding stress on it. The pipeline must not be pulled up to the valve in any case.

On bodies with threaded ends the threads have to be sealed using a suitable sealant.

If the valve is welded to the pipeline its ends have to be only tacked first. For accomplishing welding actuator and head section have to be unscrewed from the body to avoid damage on the sealing elements.

Welding on the pipelines requires a distance to the valve of 50 cm min. as there is a risk of damage of the valve seat.

The function of the completely mounted valve has to be checked before putting the installation into service.

Mounting position:

The mounting position of the valve is arbitrary.

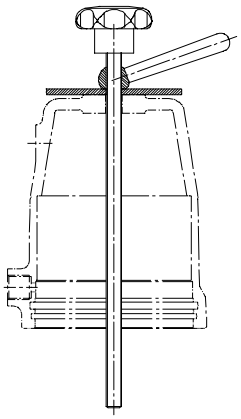
2.4 Dismounting the Valve

2.4.1 Function “Spring Closes“

2.4.1.1 Dismounting the Actuator

1. Unscrew indicator pin (36).
2. Insert mounting tool (4010 408 for actuator D50, 4010 409 for actuator D80/D125) into bonnet and screw to nut (14).
3. Tighten the spring (10) a little bit by turning the mounting tool lever until the sealing lifts off from the valve seat.
4. Unscrew actuator from body (1).
5. Remove circlip (25) using a suitable pair of tongues.
6. Release actuator spring (10) by turning the lever.

   ⚠ Hold mounting screw of mounting tool at the same time.
7. Remove mounting tool.



Mounting tool
D50: Art.-No: 4010 408
D80/D125: Art.-No: 4010 409



Mounting pin
Art.-No: 4010 410

2.4.1.2 Dismounting the Head Section

1 Loosen nut (6) while fixing nut (14).
2 Pull out piston rod (13) from head section.
3 Clamp flange to a (15) to a vice.

⚠ Do not clamp flange at its outer diameter, as this is a sealing surface for the bonnet which might be damaged then.

4 Unscrew head section (2) from flange (15).
5 Press out guiding sleeves (34) and packing with mounting pin (art.-No: 4010410). (Please keep order of parts in mind for later mounting.)

2.4.2 Function “Spring Opens”

1 Unscrew actuator from body (1).
2 Remove circlip (25) using a suitable pair of tongues.
3 Take off bonnet (8).
4 Loosen nut (6) while fixing piston (9).
5 Pull out piston rod (13) from head section.
6 Clamp flange to a (15) to a vice.

 Do not clamp flange at its outer diameter, as this is a sealing surface for the bonnet which might be damaged then.

7 Unscrew head section (2) from flange (15).
8 Press out guiding sleeves (34) and packing with mounting pin (art.-No: 4010410). (Please keep order of parts in mind for later mounting.)

2.5 Mounting the Valve

	Note lubrication and bonding plan! Use original Schubert & Salzer Control Systems spare parts only!

2.5.1 Function „Spring Closes“

1 Clean all parts.
2 Push guide sleeves and packing into the head section (2). Take care for the right order.

 The conical seals (31) have to be greased **individually**.

3 Put interior lip seal (20) and washer (7) into flange.
4 Screw head section (2) to flange (15) firmly.

 Do not clamp flange at its outer diameter, as this is a sealing surface for the bonnet which might be damaged then.

5 Screw piston rod (13) and piston (9) using nut (14).
6 Push piston rod (13) carefully into the head section (from the top).
7 Screw all disc parts to piston rod (13).
8 Insert O-ring into bonnet.
9 Mount exterior lip seal (11) to bonnet (9).
10 Put spring (10) on piston (9).
11 Mount bonnet (8).
12 Tighten spring with mounting tool until the circlip (25) can be mounted.
13 Insert circlip to bonnet (take care that the circlip has properly snapped to its groove).
14 Screw actuator to valve body (1).
15 Remove mounting tools an screw in indicator pin (36).

2.5.2 Function „Spring Opens“

1 Clean all parts.
2 Push guide sleeves and packing into the head section (2). Take care for the right order.


The conical seals (31) have to be greased individually.

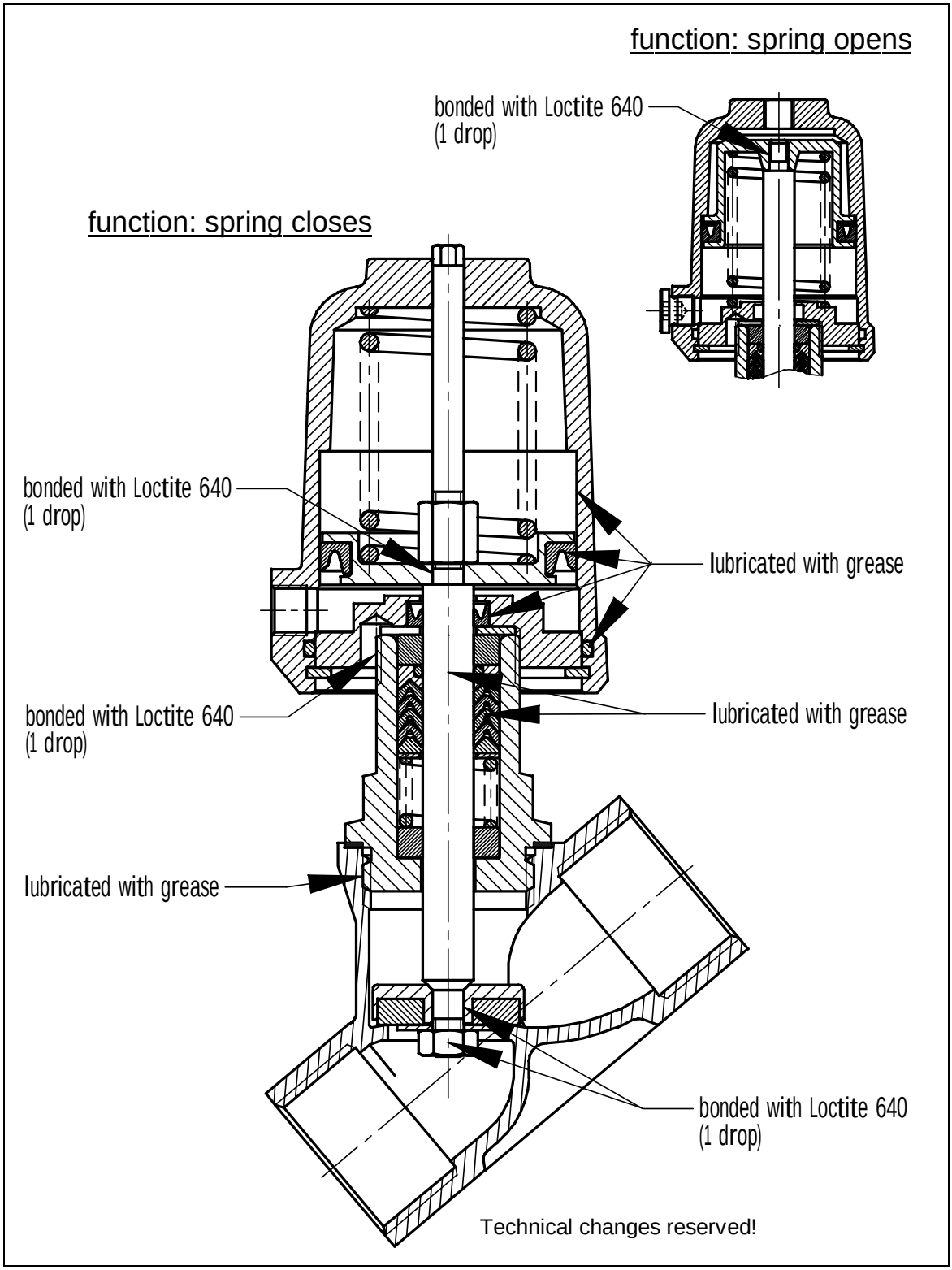
3 Put washer (7) into flange (15).
4 Screw head section (2) to flange (15) firmly.


Do not clamp flange at its outer diameter, as this is a sealing surface for the bonnet which might be damaged then.

5 Screw piston rod (13) and piston (9).
6 Put spring (10) into bonnet.
7 Push piston rod (13) carefully into the head section (from the top).
8 Screw all disc parts to piston rod (13).
9 Mount exterior lip seal (11) to bonnet (9).
10 Put bonnet (8) carefully over piston (9) and flange (15).
11 Press bonnet firmly to head section (2) and flange (15).
12 Insert circlip to bonnet (take care that the circlip has properly snapped to its groove).
13 Screw actuator to valve body (1).

2.6 Lubrication and Bonding Plan

	The lubrication and bonding plan is valid for all standard versions of this valve type. Contact the manufacturer for suitable lubricants. Special versions (e.g. silicon free, oxygen service or food applications) require other lubricate qualities optionally.



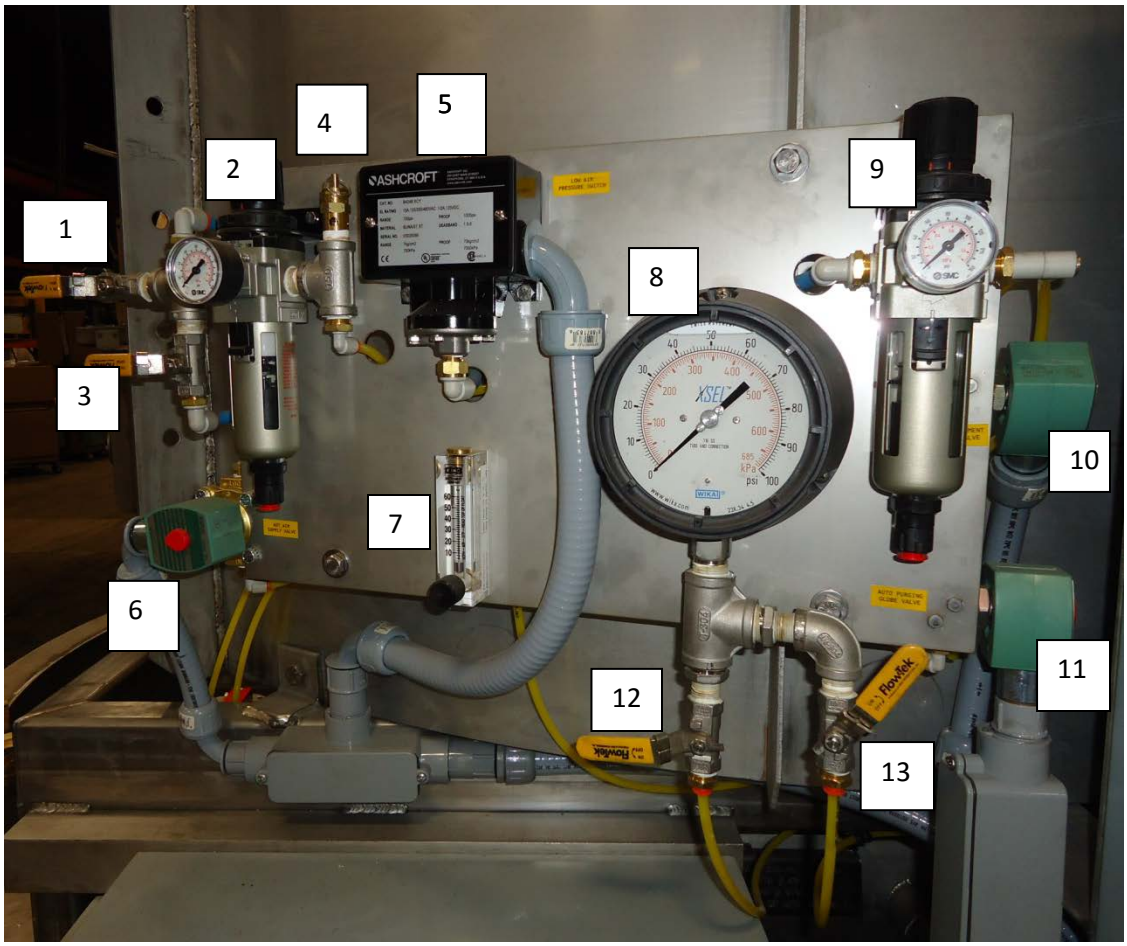
EQUIPMENT TECHNICAL DATA SHEETS

AIR DISSOLVING TUBE

PNEUMATIC CONTROL PANEL W/ COMPONENTS

1. Isolation Valve – SS Ball Valves
2. Air Pressure Filter/Regulator ~ 90psi
    a. ADT Air
    b. Pneumatic Valve Supply Air
3. Pressure Relief Safety Valve
4. Low Air Pressure Switch
5. Rotameter – ADT Air Feed
6. ADT Solenoid Valve
7. ADT Pressure Gauge
8. Pressure Release Globe Valve (APGV) Solenoid Valve
9. ADT Air Inlet Check Valve
10. ADT Course Air Bleed-Off Sight Tube

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917



1- Isolation Valve – Main Feed
2- ADT Air Pressure Filter/Regulator ~ 90psi
3- Isolation Valve - Purge Valve & Pressure Release Valve
4- Safety Relief Valve
5- Low Pressure Switch
6- ADT - Solenoid Valve
7- Rotameter – ADT Air Feed ~ 10 SCFH
8- ADT Pressure Gauge: Inlet ~ 80psi / Outlet ~ 70psi
9- Pneumatic Valves Air Pressure Filter/Regulator ~ 80 psi
10-(NOT APPLICABLE)
11-Pressure Release Valve (APGV) - Solenoid Valve
12-Isolation Valve – ADT Inlet Pressure
13-Isolation Valve – ADT Outlet Pressure

ADT ISOLATION VALVES

76F-100-A SERIES

STAINLESS STEEL FULL PORT BALL VALVE

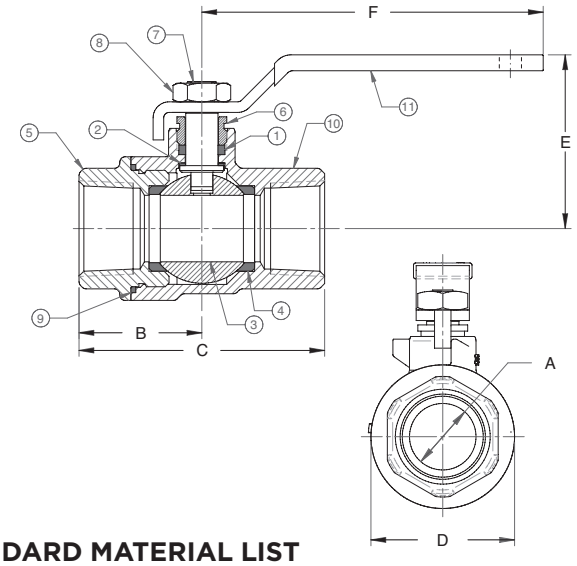
LEADFREE CERTIFIED

5 YEAR WARRANTY MADE IN USA

Female NPT Thread, 1/4"-3" 1000 CWP (psig), Cold Non-Shock. (See referenced P/T chart)
150 psig Saturated Steam.
Vacuum Service to 29 inches Hg.
MSS SP-110 Compliant.
Designed, cast, machined, assembled, and 100% factory tested in USA.

FEATURES

- Investment cast components
- Reinforced seats
- Blowout-proof stem design
- Adjustable packing gland
- Stainless steel lever and nut



STANDARD MATERIAL LIST

	PART	MATERIAL
1	Stem packing	MPTFE
2	Stem bearing	RPTFE
3	Ball	A276-316SS (1/4" to 2", except 1-1/4") A276-316SS or A351-CF8M stainless (1-1/4") A351-CF8M stainless (3")
4	Seat (2)	RPTFE (2" & smaller); RTFM (3")
5	Retainer	ASTM A276-316SS (1/4" & 3/8") ASTM A351-CF8M stainless (1/2" to 3")
6	Gland	A276-316 Stainless Steel
7	Stem	A276-316 Stainless Steel
8	Lever nut	304 Stainless Steel
9	Body Seal	RPTFE (1/2" to 3")
10	Body	A351-CF8M
11	Lever and grip	SS w/vinyl

- Fire safe to API 607 (requires -24 suffix)
- Meets NACE MR0175 (2000) & MR0103 (2012)
- CSA CGA 3.16-M88 (Requires "GS" suffix)
- NSF/ANSI/CAN 61 Section 8, Annex G (1/4" to 2")
- NSF/ANSI 372 - Drinking Water System Components - Lead Content

OPTIONS AVAILABLE

(MORE INFORMATION IN SECTION J)

- Minimum quantities apply
- To specify an option, replace the "01" standard suffix with the suffix of the option.
- To specify multiple options, replace the "01" suffix with the desired suffixes in the numerical order shown below. NOTE: Not all suffixes can be combined together.

(SUFFIX)	OPTION	SIZES
-P -27-	BSPP (Parallel) Thread Connection	1/2" to 2"
-T -27-	BSPT (Tapered) Thread Connection	1/2" to 3"
-02-	Stem Grounded	1/2" to 3"
-08-	90º Reversed Stem	1/2" to 2"
-11-	Therma-Seal™ Insulating Tee Handle	1/4" to 2"
-14-	Side Vented Ball (Uni-Directional)	3/8" to 3"
-24-	Graphite Packing, PTFE Body Seal, RPTFE Bearing (API 607, 6th Edition, ISO 10497:2010)	1/2" to 3"
-27-	Standard Configuration, SS Latch-Lock Lever & Nut	3/8" to 3"
-30-	Cam-Lock and Grounded	1/2" to 2"
-32-	SS Tee Handle & Nut	1/2" to 2"
-35-	PTFE Trim	3"
-39-	SS Hi-Rise Locking Wheel Handle, SS Nut	1/2" to 2"
-40-	Cyl-Loc and Grounded	1/2" to 2"
-44-	Seal Welded	All
-45-	Less Lever & Nut	1/2" to 3"
-46-	Latch Lock Lever - Lock in Closed Position Only	1/2" to 2"
-47-	SS Latch Lock Oval Handle	1/2" to 2"
-48-	SS Oval Handle (No Latch) & Nut	1/4" to 2"
-49-	No Lubrication. Assembled Dry.	1/2" to 3"
-50-	2-1/4" CS Locking Stem Extension	1/2" to 2"
-56-	Multifill Seats & Packing	1/2" to 3"
-57-	Oxygen Cleaned	All
-60-	Static Grounded Ball & Stem	1/2" to 3"
-GS-	CSA CGA 3.16 (RTFE Seat - All sizes)	All
-UA-	AIS (American Iron & Steel) Compliant	1/2" to 3"

Pressure/Temperature Ratings - Page M-12, Graph No. 8

DIMENSIONS

PART NO.	SIZE	A	B	C	D	E	F	WT.
76F-101-27	1/4"	0.37	0.95	1.91	1.12	1.60	3.85	0.47
76F-102-27	3/8"	0.37	0.95	1.91	1.12	1.60	3.85	0.44
76F-103-27A	1/2"	0.50	1.21	2.35	1.27	1.73	3.85	0.57
76F-104-27A	3/4"	0.81	1.39	2.77	1.62	1.96	3.85	0.91
76F-105-27A	1"	1.00	1.67	3.34	2.00	2.27	4.75	1.38
76F-106-27A	1-1/4"	1.25	1.96	3.92	2.73	3.21	7.77	4.17
76F-107-27A	1-1/2"	1.50	2.05	4.10	2.92	3.31	7.77	4.69
76F-108-27A	2"	2.00	2.37	4.74	3.75	3.69	7.77	6.90
76F-100-27A	3"	3.00	3.70	7.40	5.68	5.23	10.00	22.40

*LEAD FREE: The wetted surfaces of this product shall contain no more than 0.25% lead by weighted average. Complies with Federal Public Law 111-380. ANSI 3rd party approved and listed.

REV. 22AUG23

Filter Regulator

AW1000 to 4000

CAD

Standard Specifications

Model		AW1000	AW2000	AW3000	AW4000	AW4000-06
Port size		M5 X 0.8	1/8 1/4	1/4 3/8	1/4 3/8 1/2	3/4
Fluid		Air				
Proof pressure		1.5MPa				
Max. operating pressure		1.0MPa				
Set pressure range		0.05 to 0.7MPa	0.05 to 0.85MPa			
Gauge port size		1/16	1/8	1/8	1/4	1/4
Ambient and fluid temperature		–5 to 60°C (No freezing)				
Filtration		5µm				
Drain capacity (cm^3)		2.5	8	23	45	45
Bowl material		Polycarbonate				
Construction		Relieving style				
Weight (kg)		0.09	0.36	0.53	1.09	1.15
Accessory (Std. equipment)	Bowl guard	—	—	●	●	●

Accessory (option)/Part No.

Description \ Model			Part No. AW1000	AW2000	AW3000	AW4000	AW4000-06
Accessory	Bracket		B120	B220	B320	B420	B420
	Gauge (1)	1.0MPa	G27-10-R1	G36-10-□01	G36-10-□01	G46-10-□02	G46-10-□02
		0.2MPa	(G27-10-R1)(2)	G36-2-□01	G36-2-□01	G46-2-□02	G46-2-□02
	Auto drain float style (3)	N.O.	—	—	AD43	AD44	AD44
		N.C.	—	—	AD53	AD54	AD54
	Auto drain pressure differential		AD61	AD62	—	—	—

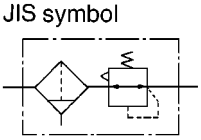
Note 1) □ in the part number for gauge (e.g. G36-10-□01) indicates threading. No symbol for Rc(PT) and "N" for NPT.
Note 2) A gauge for pressure 1.0MPa is used.
Note 3) Minimum operating pressure N.O.: 0.1MPa, N.C.: 0.15MPa
∗ "–01, –02, –03, –04, –06," after the part numbers indicates port size. (01: 1/8, 02: 1/4, 03: 3/8, 04: 1/2, 06: 3/4).
∗ Gauge for "AW1000-M5G-1" is "G27-10-R1" for the pressure at 1.0MPa.

Minimizes space and piping due to the integration of the filter and the regulator.

Direct operated, relieving style

Order Made P.1.8-6

JIS symbol





AW3000



AW2000



AW1000



AW3000-□BG



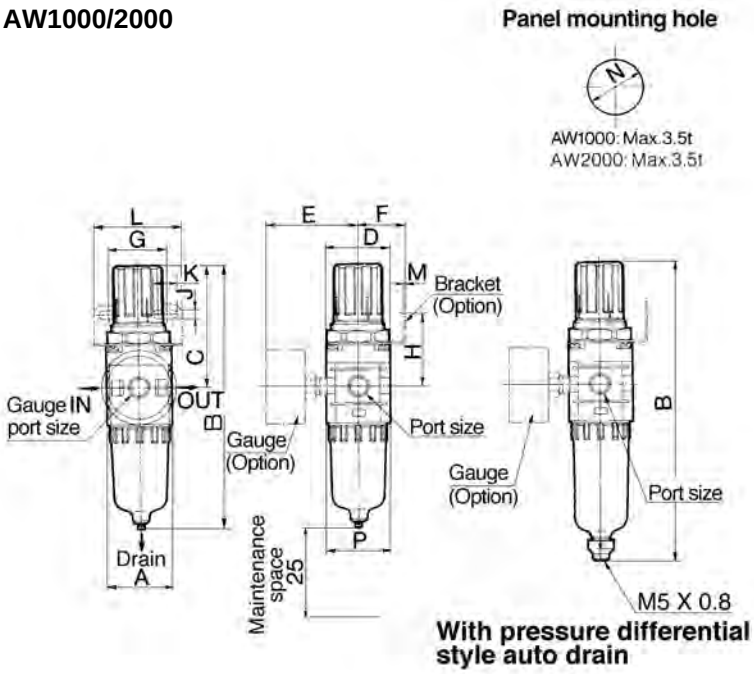
AW2000-□BG



AW1000-□BG

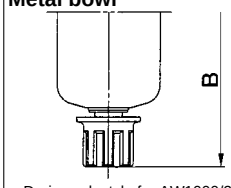
Dimensions CAD

AW1000/2000



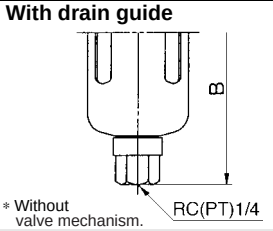
Options (AW3000/4000)

Metal bowl



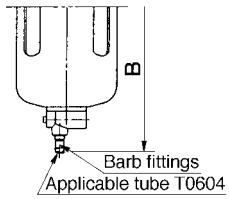
∗ Drain cock style for AW1000/2000 is same as the standard.

With drain guide

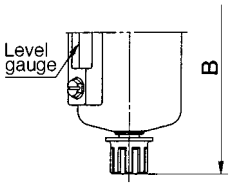


∗ Without valve mechanism.

With drain cock/barb fittings



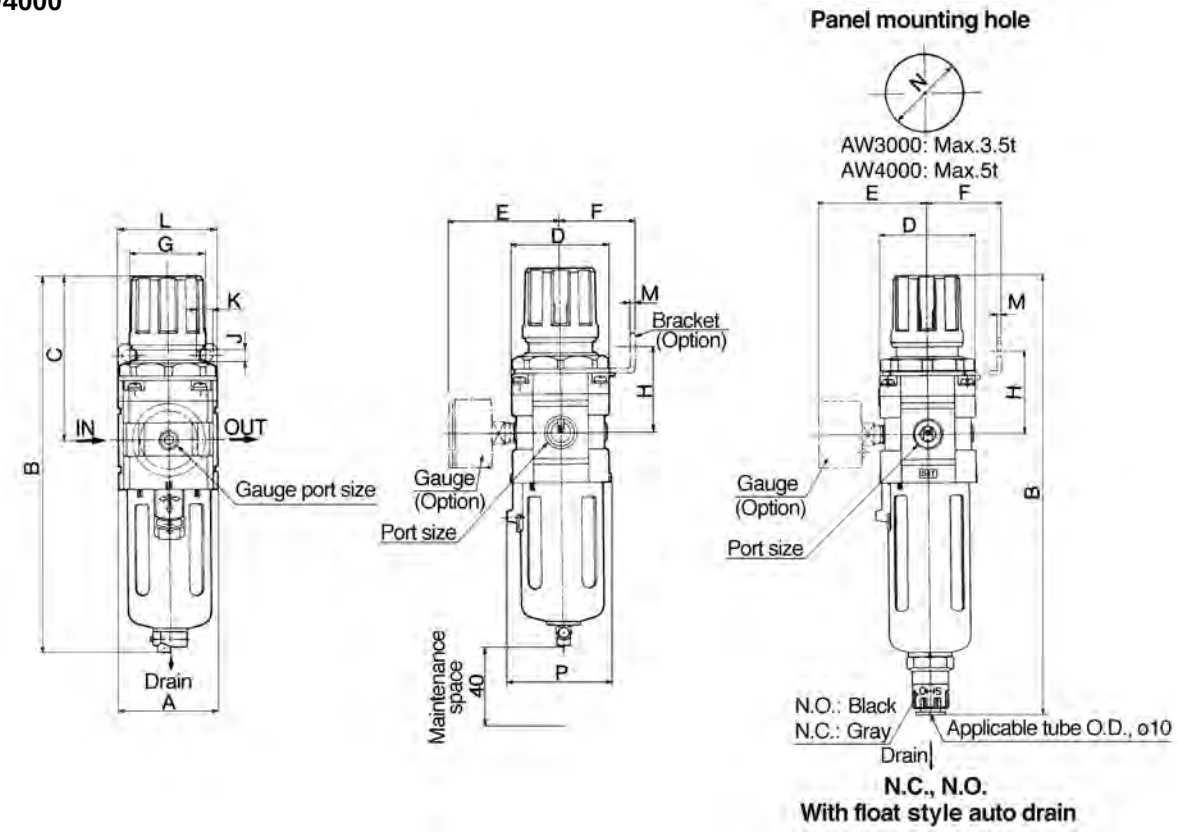
Metal bowl with level gauge



Model	With barb fittings	With drain guide	Metal bowl	Metal bowl with level gauge
	B	B	B	B
AW1000	——	——	109.5	——
AW2000	——	——	164.5	——
AW3000	216	213.5	220.5	240.5
AW4000	267.5	265	272	292
AW4000-06	271.5	269.5	276.5	296.5

∗Dimensions except for B is the same as the shown on the left.

AW3000/4000



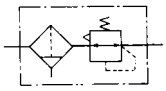
Model	Port size	A	B	C	D	E	Bracket mounting dimensions F	G	H	J	K	L	M	N	P	With auto drain Float B	Press. Diff. B
AW1000	M5 X 0.8	25	109.5	50.5	25	26	25	28	30	4.5	6.5	40	2.0	20.5	28	—	130
AW2000	1/8, 1/4	40	164.5	78	40	56.8	30	34	44	5.4	15.4	55	2.3	33.5	40	—	187.5
AW3000	1/4, 3/8	53	207.5	92.5	53	60.8	41	40	46	6.5	8.0	53	2.3	42.5	56	248.5	—
AW4000	1/4, 3/8, 1/2	70	259	112	70	70.5	50	54	54	8.5	10.5	70	2.3	52.5	73	300	—
AW4000-06	3/4	75	263	114	70	70.5	50	54	56	8.5	10.5	70	2.3	52.5	73	304	—

CAD
AW1000 —— SAC1000, #4
AW2000 —— SAC2000, #4
AW3000 —— SAC2503, #4
AW4000 —— SAC4000, #4
AW4000-06 —— SAC4006, #4

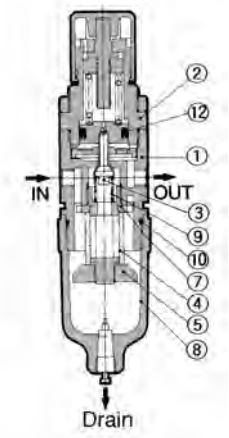
AW1000 to 4000

Construction

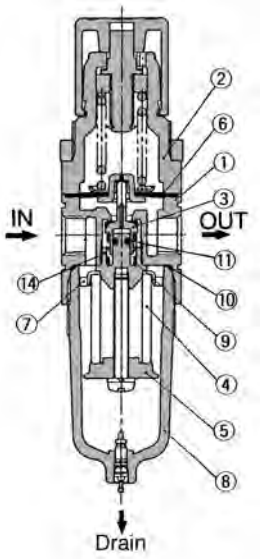
JIS symbol



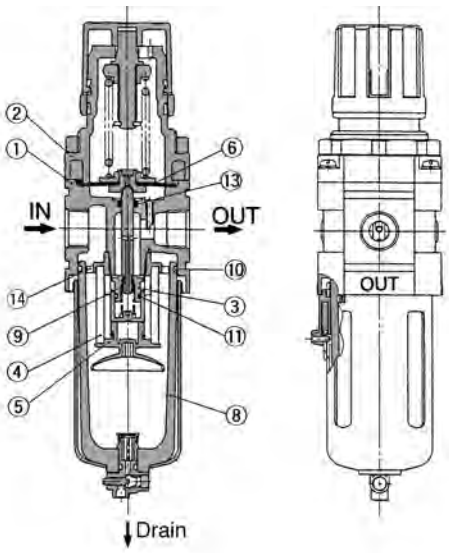
AW1000



AW2000



AW3000/4000



Component Parts

No.	Description	Material			Note
		AW1000, 2000	AW3000	AW4000, 4000-06	
①	Body	Zinc die cast	Aluminum die cast		Painted Silver
②	Bonnet	Polyacetal		Aluminum die cast	Painted Black

Replacement Parts

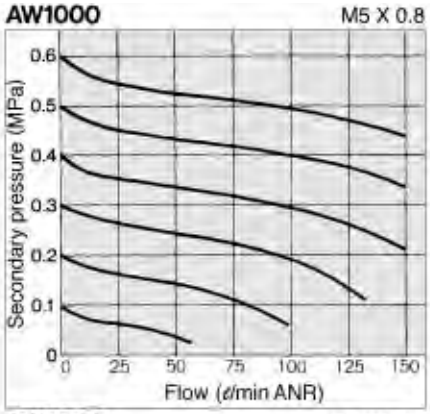
No.	Description	Material	Part No.				
			AW1000	AW2000	AW3000	AW4000	AW4000-06
③	Valve assembly	Brass, NBR	134819	1349160	1315216A	1316212A	1316213A
④	Element	Non-woven material	111344	1129116	111585	1116103	1116103
⑤	Baffle	Indicated in (parentheses).	111312 (POM)	11295 (PBT)	1315541 (POM)	1316276 (POM)	1316276 (POM)
⑥	Diaphragm assembly	NBR	——	131445A	1315215A	1316211A	1316211A
⑦	Deflector	PBT	11133A	1129111	——	——	——
⑧	Bowl assembly(1)	Poly-carbonate	C100F	C200F	C300F	C400F	C400F
⑨	Valve spring	Stainless steel	134824	1349158	131525	131625	131625
⑩	Bowl O ring	NBR	111325	11297	111512	111636	111636
⑪	Valve O ring	NBR	——	1349247	131544	131645	131645
⑫	Mini Y packing	NBR	MYN-10A	——	——	——	——
⑬	O ring	NBR	——	——	JIS B2401P5	JIS B2401P5	JIS B2401P5
⑭	Valve guide	Indicated in (parentheses).	——	134132 (ZDC)	1315540 (POM)	1316275 (POM)	1316275 (POM)

Note 1) Bowl guard (SPC) is attached to the bowl assembly of "AW3000" to "AW4000-06".

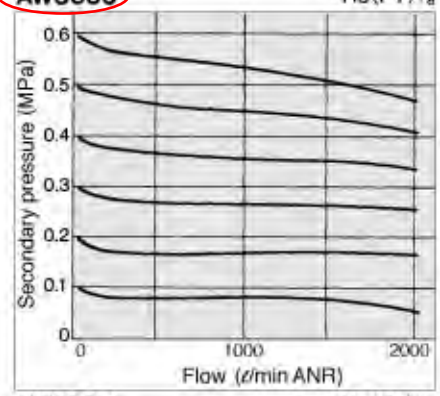
Flow Characteristics

Conditions: Supply pressure 0.7MPa

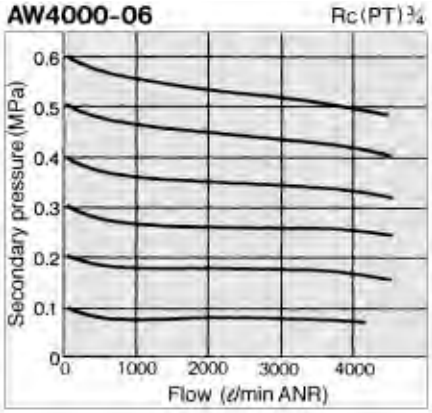
AW1000 M5 X 0.8



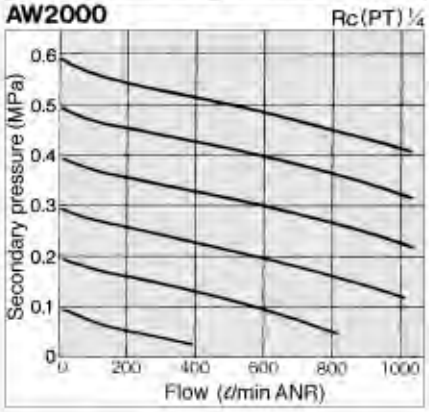
AW3000 Rc(PT) 3/8



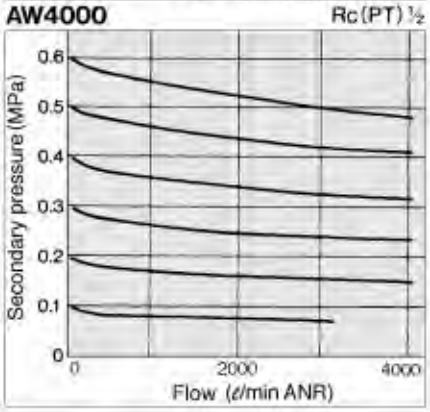
AW4000-06 Rc(PT) 3/4



AW2000 Rc(PT) 1/4



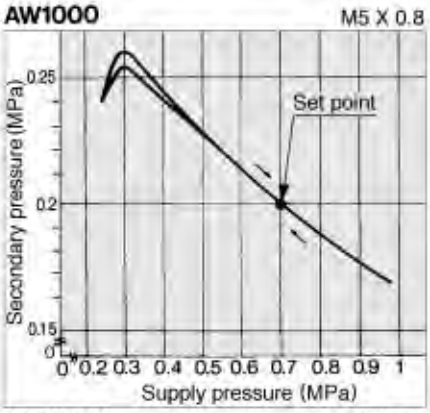
AW4000 Rc(PT) 1/2



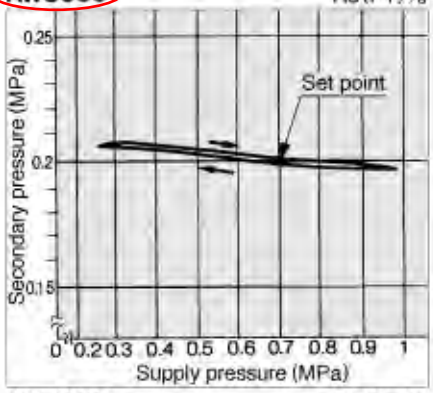
Pressure Chracteristics

Conditions: Supply pressure 0.7MPa, Secondary pressure 0.2MPa, Flow 20 ℓ/min (ANR)

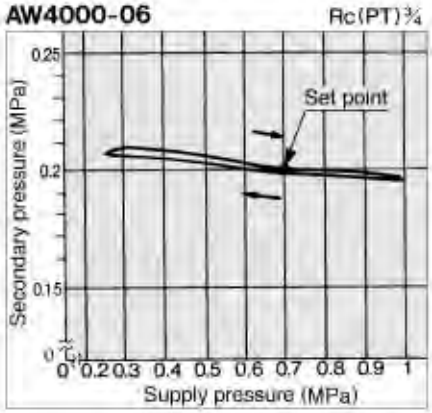
AW1000 M5 X 0.8



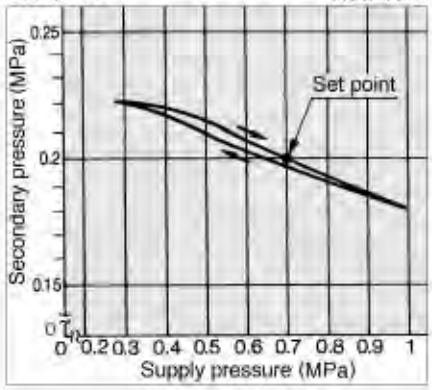
AW3000 Rc(PT) 3/8



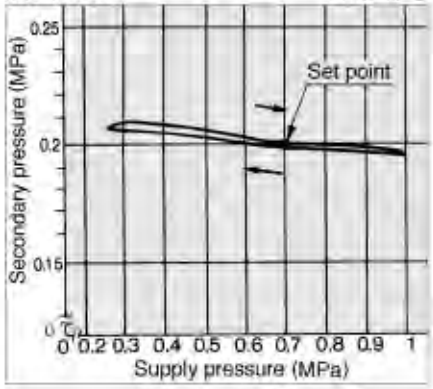
AW4000-06 Rc(PT) 3/4



AW2000 Rc(PT) 1/4



AW4000 Rc(PT) 1/2



AW1000 to 4000

How to Order

AW | **30** | **00** – [ ] | **03** | **BG** – **2N**

Filter Regulator

Body size

10	M5
20	1/8
30	3/8
40	1/2

Thread

—	Metric (M5)
	Rc(PT)
N	NPT
F	G(PF)

Port size

M5	M5 X 0.8
01	1/8
02	1/4
03	3/8
04	1/2
06	3/4

Accessory

Symbol		Description	Applicable model
—		—	—
B		Bracket	AW1000 to AW4000-06
C	Auto drain	Auto drain float style (N.C.)	AW3000 to AW4000-06
D	Auto drain	Auto drain pressure differential	AW1000/2000
	Auto drain	Auto drain float style (N.O.)	AW3000 to AW4000-06
G	Gauge	Without limit indicator	AW1000
	Gauge	With limit indicator	AW2000 to AW4000-06

Option

1(1)	Set at 0.02 to 0.2MPa
2	Metal bowl
6	Nylon bowl
8	Metal bowl with level gauge (AW3000/4000 only)
C	Bowl guard (AW2000 only)
J(2)	Drain guide (AW3000/4000 only)
N	Non relieving
R	Flow direction: Right to left
W	With drain cock and barb fittings (AW 3000/4000 only) (For nylon ø6, ø4)

∗If more than one symbol is required to be listed when ordering, list in the alphabetical order. (Ex. 2NR)

Note 1) Only regulating spring is different from the standard model.
Note 2) Without valve mechanism

Option Combinations

◎Combinable ▭Impossible ●Depends on the model

	Description	Symbol	Auto drain			Option									Applicable Filter Regulator			
			D	D	C	1	2	6	8	C	J	N	R	W	AW1000	AW2000	AW3000	AW4000
Accessory	Auto drain pressure differential style	D				◎	◎	◎		●		◎	◎		◎	◎		
	Auto drain float style (N.O.)	D				◎	◎	◎	◎			◎	◎				◎	◎
	Auto drain float style (N.C.)	C				◎	◎	◎	◎			◎	◎				◎	◎
Option	0.02 to 0.2MPa	–1	◎	◎	◎		◎	◎	●	●	●	◎	◎	●	◎	◎	◎	◎
	Metal bowl	–2	◎	◎	◎	◎					●	◎	◎		◎	◎	◎	◎
	Nylon bowl	–6	◎	◎	◎	◎				●	●	◎	◎	●	◎	◎	◎	◎
	Metal bowl with level gauge	–8		◎	◎	◎					◎	◎	◎				◎	◎
	With bowl guard	–C	◎			◎		◎				◎	◎			◎		
	Drain guide (Bore size: 1/4)	–J				◎	◎	◎	◎			◎	◎				◎	◎
	Non relieving	–N	◎	◎	◎	◎	◎	◎	●	●	●		◎	●	◎	◎	◎	◎
	Flow direction: Right to left	–R	◎	◎	◎	◎	◎	◎	●	●	●	◎		●	◎	◎	◎	◎
	One-touch drain cock with barb fittings	–W				◎		◎				◎	◎				◎	◎

⚠ Precautions

Be sure to read before handling. Refer to p.0-26 and 0-27 for Safety Instructions and common precautions on the products mentioned in this catalog, and refer to p.1.0-1 and 1.0-2 for precautions on every series.

Selection

⚠Warning

①The residual secondary pressure cannot be released by releasing the supply pressure. To release the residual pressure, use a filter regulator designed for such use.

Installation and Adjustment

⚠Warning

①Set up the regulator while verifying the pressure that is indicated on the supply and the secondary pressure gauges. Turning the handle excessively could damage the internal parts.

①The pressure gauge that is provided with the product for setting a pressure between 0.02 to 0.2MPa is the 0.2MPa style. To prevent damage to the pressure gauge, make sure that pressure in excess of 0.2MPa is not applied.

③The adjustment handle must be operated manually. Using a tool to turn the handle could lead to damage.

⚠Caution

①Release the lock to adjust the pressure. After the adjustment, engage the lock.
Failure to observe this procedure could damage the handle or cause the secondary pressure to fluctuate.

1) On the AW1000 and AW2000 styles, pull the adjustment handle to release the lock and push the handle to engage the lock. If it does not lock easily, turn the handle slightly clockwise or counterclockwise before pushing it.

2) On the AW3000 and AW4000 styles, pull the adjustment handle to release the lock. (An orange colored line is provided at the bottom of the adjustment handle for visual checking.) Push the adjustment handle to engage the lock. If it does not lock easily, turn the handle slightly clockwise or counterclockwise; then, push it until the orange colored line is no longer visible.



Maintenance Inspection

⚠Warning

①Replace the filter element within 2 years of operation or before the pressure drop reaches 0.1MPa. Failure to observe this precaution could damage the filter element.

48435K



All brass construction with zinc-plated music wire spring. Stamped with "UV" and "NB" symbols. Available set pressure range 25 PSI to 250 PSI. Set pressure tolerance ±3% of set pressure. 250°F max. temperature.

Flow Capacity Chart

Part Number	Inlet Size	Dimensions (PDF File)	Set Pressure (Range - PSIG)	Approx. Shipping Weight
ST12	1/8" NPT	ST12_Layout.pdf	25 -350	2.0 oz.
ST25	1/4" NPT	ST25_Layout.pdf		
ST38	3/8" NPT	ST38_Layout.pdf		

ADT PRESSURE RELIEF VALVE (PSV-2201)





Model "SA"

Model "SA" ASME safety valves are designed for high temperature applications such as intercoolers and aftercoolers where a compact size is required.

All brass construction with stainless steel spring and stainless steel ball seating on brass seat. Three inlet sizes available: 1/8" NPT, 1/4" NPT, 3/8" NPT.

Stamped with "UV" and "NB" symbols. Available set pressure range 50 PSI to 350 PSI. Set pressure tolerance ±3% of set pressure. 350°F max. temperature.

Flow Capacity Chart

Part Number	Inlet Size	Dimensions (PDF File)	Set Pressure (Range - PSIG)	Approx. Shipping Weight
SA12	1/8" NPT	SA12_Layout.pdf	50 -350	2.5 oz.
SA25	1/4" NPT	SA25_Layout.pdf		
SA38	3/8" NPT	SA38_Layout.pdf		

ADT LOW AIR PRESSURE SWITCH

B-Series Switches – Pressure, Differential Pressure & Hydraulic







FEATURES

B-Series switches have proven reliable in such harsh environments as:

- ***Offshore oil rigs***
- ***Chemical and petrochemical plants***
- ***Pulp and paper mills***
- ***Steel mills***
- ***Power plants***
- ***Water and sewage-treatment plants***
- ***Other corrosive environments***

Ashcroft Inc. supplies highly reliable Ashcroft® switches and controls for industrial and process applications. We begin with rock-solid designs, matching the most appropriate technology with the safety and reliability requirements of the applications. The materials of construction are specified to Ashcroft's exacting standards, and product is built to last in the toughest applications. Our modern, responsive manufacturing facility is supported by an extensive network of stocking distributors and factory sales offices located in virtually every part of the world. Special application assistance is always just a telephone call away.

The Ashcroft B-Series switch line is designed to satisfy most switch requirements. Materials of construction have been selected for long life. A wide variety of precision switch elements are available to meet every application requirement, including hermetically sealed contacts for added reliability and safety. The actuators we use have been proven in more than 20 years of service in the world's plants and mills. Special designs are available for fire safety, NACE, limit control and other more stringent requirements. Simplicity and ease of use are stressed to improve reliability of the installation.

Applications include: pumps, compressors, washers, filters, degreasers, evapora-tors, recovery systems, food processing, ground support equipment, reverse osmosis systems, heat exchangers, hydraulic systems, lubrication systems, marine equipment, textile machinery, heating and air conditioning equipment.

All specifications are subject to change without notice.
All sales subject to standard terms and conditions.
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Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

ASHCROFT®
Trust the shield.™

B-Series Switches – Pressure, Differential Pressure & Hydraulic

Pressure & Differential Pressure Switches

B-Series pressure, differential pressure and vacuum switches use two different actuators depending on setpoint requirements. For setpoints between 2 and 3000 psi, the simple, rugged diaphragm-sealed piston actuator is used. This design features high reliability and choice of actuator seal materials for virtually every application. An optional welded design is also available for setpoints up to 1000 psi for maximum reliability. This design is available in 316 SS or Monel. Differential pressure models use a unique, dual diaphragm-sealed piston design that features very high static operating pressures and small size.

For setpoints between 4.5 and 150 inches of H_2O, a large diaphragm is used for increased sensitivity in both pressure and differential pressure designs with good choice of materials of construction.

All standard models feature ±1 percent of range setpoint repeatability and a minimum of 400 percent of range proof pressures.

These standard designs perform well in applications where shock and vibration could be a problem and may be used in conjunction with Ashcroft diaphragm seals in extreme services such as slurries or abrasive process fluids.

PRESSURE/VACUUM SWITCHES

Nominal Range[1]			Overpressure Ratings		Approximate Deadband[2] Switch Element				
			Proof psi	Burst psi	20, 26, 27	21, 24, 31	50	22	32, 42
Vacuum									
–30″ Hg	–760mm Hg	-100 kPa	250	400	0.3-0.7	1.5-3.0	0.5-2.2	0.4-1.5	2.1-4.2
Compound									
–15″ H_2O/ 15″ H_2O	–375mm H_2O/ 375mm H_2O	–3.7 kPa/ 3.7 kPa	20	35	0.15-.75/ 0.15-.75	1.5-2.5/ 1.5-2.5	0.45-2.0/ 0.45-2.0	0.5-1.2/ 0.5-1.2	2.1-3.5/ 2.1-3.5
–30″ H_2O/ 30″ H_2O	–760mm H_2O/ 760mm H_2O	–7.5 kPa/ 7.5 kPa	20	35	0.30-.60/ 0.30-.60	1.5-2.5/ 1.5-2.5	0.45-2.0/ 0.45-2.0	0.5-1.5/ 0.5-1.5	2.1-3.5/ 2.1-3.5
–30″ Hg/ 15 psi	–760mm Hg/ 1.0 kg/cm²	–100 kPa/ 100 kPa	250	400	0.5-1.0/ 0.3-0.7	2.0-3.0/ 0.5-1.5	0.75-2.5/ 0 .5-1.0	0.7-1.8/ 0.7-1.4	2.8-4.2/ 0.7-2.1
–30″ Hg/ 30 psi	–760mm Hg/ 2.0 kg/cm²	–100 kPa/ 200 kPa	250	400	1.0-1.5/ 0.3-0.8	3.0-6.0/ 1.0-2.0	1.2-4.5/ 0.7-1.5	1.4-2.4 0.4-1.3	4.2-8.4/ 1.4-2.8
–30″ Hg/ 60 psi	–760mm Hg/ 4.0 kg/cm²	–100 kPa/ 400 kPa	250	400	2.0-3.0/ 0.7-1.5	5.0-9.0/ 3.0-5.0	2.5-7.0/ 1.1-4.0	2.8-4.5 1.0-2.3	7.0-12.0/ 4.2-7.0
Pressure									
10″ H_2O	250mm H_2O	2.5 kPa	20	35	0.2-0.5	1.0-2.0	0.35-1.5	0.4-1.0	1.4-2.8
30″ H_2O	750mm H_2O	7.5 kPa	20	35	0.3-0.6	1.5-2.5	0.45-2.0	0.5-2.0	2.1-3.5
60″ H_2O	1500mm H_2O	15 kPa	20	35	0.5-1.3	1.5-3.5	0.9-2.5	0.7-3.0	2.1-5.0
100″ H_2O	2500mm H_2O	25 kPa	20	35	0.6-1.6	2.5-5.5	1.1-4.0	1.0-4.0	3.5-7.7
150″ H_2O	3750mm H_2O	37 kPa	20	35	1.0-2.5	4.5-8.5	1.7-6.5	2.0-6.0	6.0-12.0
15 psi	1.0 kg/cm²	100 kPa	500	1500	0.1-0.35	0.5-1.5	0.2-1.0	0.4-1.0	0.7-2.1
30 psi	2.0 kg/cm²	200 kPa	500	1500	0.1-0.50	0.5-1.5	0.3-1.0	0.4-1.0	0.7-2.1
60 psi	4.0 kg/cm²	400 kPa	500	1500	0.3-1.0	1.0-3.5	0.7-2.5	0.6-2.0	1.4-5.0
100 psi	7.0 kg/cm²	700 kPa	1000	3000	0.5-1.7	1.5-5.0	1.1-3.5	1.0-4.5	2.1-7.0
200 psi	14 kg/cm²	1400 kPa	1000	3000	1-3	5-13	2-9	3.0-7.5	7.0-18.2
400 psi	28 kg/cm²	2800 kPa	2400	3000	4-7.5	5-24	5.5-15	4.0-11.0	7.0-33.6
600 psi	42 kg/cm²	4200 kPa	2400	3000	4-11	9-30	7-20	5.0-23.0	12.6-42
1000 psi	70 kg/cm²	7000 kPa	12000	18000	7-30	30-110	18-70	15-80	42-154
3000 psi	210 kg/cm²	2100 kPa	12000	18000	15-60	80-235	37-160	30.0-230	112-329

DIFFERENTIAL PRESSURE SWITCHES

Nominal Range[1]			Pressure Ratings		Approximate Deadband[2] Switch Element				
			Static Working Pressure	Proof psi	20, 26, 27	21, 24, 31	50	22	32, 42
30″ H_2O	750mm H_2O	7.5 kPa	5.4	21.6	0.3-0.6	1.5-2.5	0.45-2.0	0.5-2.0	2.1-3.5
60″ H_2O	1500mm H_2O	15 kPa	5.4	21.6	0.5-1.3	1.5-3.5	0.9-2.5	0.7-3.0	2.1-5.0
100″ H_2O	2500mm H_2O	25 kPa	5.4	21.6	0.6-1.6	2.5-5.5	1.1-4.0	1.0-4.0	3.5-7.7
150″ H_2O	3750mm H_2O	37 kPa	5.4	21.6	1.0-2.5	4.5-8.5	1.8-6.5	2.0-6.0	6.3-12.0
15 psid	1.0 kg/cm²	100 kPa	500	2000	0.5-1.0	2.0-5.0	0.7-3.5	0.7-1.4	2.8-7.0
30 psid	2.0 kg/cm²	200 kPa	500	2000	1.0-2.0	2.0-5.0	1.5-3.5	1.4-2.8	2.8-7.0
60 psid	4.0 kg/cm²	400 kPa	500	2000	2.0-4.0	3.0-6.0	3.0-4.5	2.8-5.6	4.2-8.5
100 psid	7.0 kg/cm²	700 kPa	1000	4000	4.0-10.0	11.0-20.0	7.0-15.0	6.0-14.0	16.0-28.0
200 psid	14.0 kg/cm²	1400 kPa	1000	4000	5.0-15.0	12.0-40.0	10.0-26.0	7.0-21.0	17.0-56.0
400 psid	28.0 kg/cm²	2800 kPa	1000	8000	10.0-20.0	20.0-60.0	15.0-40.0	14.0-28.0	28.0-84.0
600 psid	42 0 kg/cm²	4200 kPa	1000	8000	20.0-40.0	80.0-150.0	30.0-115.0	30.0-56.0	112.0-210.0

Values shown are for zero static working pressure.

NOTES:

1 Switches may generally be set between 15% and 100% of nominal range on increasing pressure. Consult factory for applications where setpoints must be lower.

2 All deadbands are given in English units as shown in the nominal range column. Deadbands shown are for switches with Buna N diaphragm. Approximate deadbands for optional diaphragms:

Viton:	Multiply Buna N value by 1.4
Teflon:	Multiply Buna N value by 1.2
Stainless Steel:	Multiply Buna N value by 1.7
Monel:	Multiply Buna N value by 1.7
Dual Switch Element:	Multiply single switch element value by 1.6 for approximate deadband.

ASHCROFT®
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B-Series Switches – Pressure, Differential Pressure & Hydraulic

B-SERIES PRESSURE AND DIFFERENTIAL PRESSURE SWITCH MODEL NUMBER:

To specify the exact switch desired, select entries from appropriate tables as shown in example below.

1		2		3	4			5
B	4	2	0	B	X	P	K	600 PSI

1 – ENCLOSURE	
B4	Pressure switch, Type 400, watertight enclosure meets NEMA 3, 4, 4X, 13 and IP66 requirements.
B7(1)	Pressure switch, Type 700, explosion-proof enclosure meets Div. 1 & 2, NEMA 7, 9 and IP66 requirements.
D4	Differential pressure switch, Type 400, water-tight enclosure meets NEMA 3, 4, 4X, 13 and IP66 requirements.
D7(1)	Differential pressure switch, Type 700, explosion-proof enclosure meets Div. 1 & 2, NEMA 7, 9 and IP66 requirements.

3 – ACTUATOR SEAL					
		Range			
Code and Material	**Process Temperature Limits °F**(9)	**Vac. ˝ H_2O**	**0-600 psi**	**1000 psi**	**3000 psi**
B – Buna-N	0 to 150	•	•	•	•
V – Viton	20 to 300	•	•	•	
T – Teflon	0 to 150	•	•	•	•
S – 316L(8)	0 to 300		•	•	
P – Monel(8)	0 to 300		•	•	

4 – OPTIONS	5 – RANGE
Use table from page 5	Select from table on page 2

NOTES:

1 Standard housing epoxy coated aluminum. Use variation code XYW for 316SS housing.
2 Not available with psid ranges.
3 Dual switches are 2 SPDT snap-action switches, not independently adjustable.
4 Wires cannot be terminated inside B400 switch enclosure.
5 Not available with type 700 enclosure.
6 Estimated dc. rating, 2.5A, 28 Vdc (not UL listed).
7 Estimated dc rating, 0.4A, 120 Vdc (not UL listed).
8 Available on pressure only.
9 Ambient operating temperature limits –20 to 150°F, all styles, setpoint shift of ±1% of range per 50°F temperature change is normal. Switches are calibrated at 70°F reference.

2 – SWITCH ELEMENT SELECTION		
Order Code	**Switch Elements UL/CSA Listed SPDT**	
20(7)	Narrow deadband ac	15A, 125/250 Vac
21	Ammonia service	5A, 125/250 Vac
22(6)	Hermetically sealed switch, narrow deadband	5A, 125/250 Vac
23	Heavy duty ac	22A, 125/250 Vac
24(1)	General purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc; 6A, 30 Vdc
25(2)	Heavy duty dc	10A, 125 Vac or dc, ⅛ HP, 125 Vac or dc
26(7)	Sealed environment proof	15A, 125/250 Vac
27	High temperature 300°F	15A, 125/250 Vac
28(5)	Manual reset trip on increasing	15A, 125/250 Vac
29(5)	Manual reset trip on decreasing	15A, 125/250 Vac
31	Low level (gold) contacts	1A, 125 Vac
32	Hermetically sealed switch, general purpose	11A, 125/250 Vac 5A, 30 Vdc
42	Hermetically sealed switch, gold contacts	1A, 125 Vac
50	Variable deadband	15A, 125/250 Vac
	UL/CSA Listed Dual (2 SPDT)	
61(7)	Dual narrow deadband	15A, 125/250 Vac
62(7)	Dual sealed environment proof	15A, 125/250 Vac
63	Dual high temp. 300°F	15A, 125/250 Vac
64	Dual general purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc
65	Dual ammonia service	5A, 125/250 Vac
67(4,6)	Dual hermetically sealed switch, narrow deadband	5A, 125/250 Vac
68(4)	Dual hermetically sealed switch, general purpose	11A, 125/250 Vac 5A, 30 Vdc
70	Dual low level gold contacts	1A, 125 Vac
71(4)	Dual hermetically sealed switch, gold contacts	1A, 125 Vac

B-Series Switches – Pressure, Differential Pressure & Hydraulic

OPTIONAL FEATURES AND ACCESSORIES

B-SERIES SWITCH OPTIONS							
		Appicable Switch Series					
		Pressure		Differential Pressure		H	
Code	Description	(psi)	(in. H_2O)	(psi)	(in. H_2O)		Notes
XBP	Wall Mounting Bracket in. H_2O		•		•		
XBX	½″ Male NPT Bushing					•	
XCH	Chained Cover	•	•	•	•	•	
XC8	CSA Approval	•	•	•	•		10
XCN	ATEX Directive 94/9/EC/IECEx Rating	•	•	•	•		15
XD2	Dual Seal Rating (700 Series only)	•			•		
XFM	FM Approval – Single Element	•	•	•	•		14
	FM Approval – Dual Element	•	•	•	•		14
XFP	Fungus Proofing	•	•	•	•	•	
XFS	Factory Adjusted Setpoint	•	•	•	•	•	2
XG3	Belleville Actuator	•					13,14
XG5	UL Limit Control to 150″ H_2O				•		1, 14
XG6	UL Limit Control to 600 psi	•					1, 14
XG7	Secondary Chamber with Vent	•					11
XG8	Steam Limit Control to 300 psi	•					7
XG9	Fire Safe Welded Actuator	•					7
XHS	High Static Differential Pressure			•			12
XHX	High Pressure, 40 psi, (static) d/p only 160 psi (proof) d/p only 100 psi (proof) pressure only (″ H_2O)		•		•		
XJK	Left Conduit Connection	•	•	•	•	•	8
XJL	¾″ to ½″ Reducing Bushing	•	•	•	•	•	
XJM	Metric Electrical Conduit Connection M20 x 1.5	•	•	•	•	•	
XK3	Terminal Block (700 Series only)	•	•	•	•		6
XLE	6 foot Leads on the Micro Switch	•	•	•	•	•	
XNH	Tagging Stainless Steel	•	•	•	•	•	
XNN	Paper Tag	•	•	•	•	•	
XPK	Pilot Light(s) Top Mounted	•	•	•	•	•	4
XPM	¾″ Sealed Conduit Connection with 16″ Lead Wires	•	•	•	•	•	
XTA	316 Stainless Steel Pressure Connection for in. H_2O Range		•		•		
XTM	2″ Pipe Mounting Bracket	•	•	•	•		
XUD	316 Stainless Steel Pressure Conn.			•			
X06	Pressure Connection: ½ NPT Male, ¼ NPT Female 316 Stainless Steel (Combination)	•	•	•	•		5
X07	½ NPTF Press. Conn., 316 SS	•	•	•	•		9
X6B	Cleaned for Oxygen Service	•	•	•			3
	Diaphragm Seal	•	•	•	•		

NOTES:

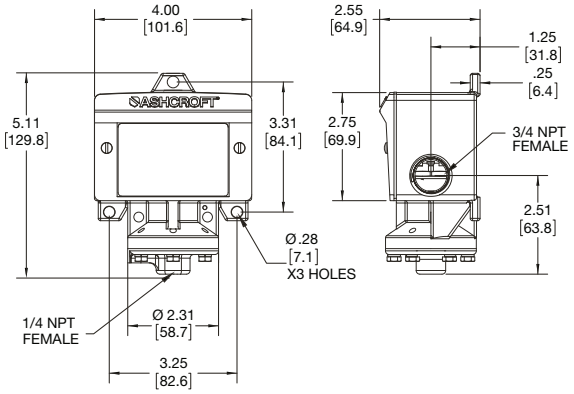
1 Buna N and Viton diaphragm.
2 Advise static or working pressure for differential pressure switches.
3 Buna N cannot be cleaned for oxygen service.
4 N/A on 700 Series.
5 Standard with 1000 and 3000 psi ranges. Bottom connection only on DP in H_2O ranges.
6 Terminal Blocks standard with 700 dual switches.
7 Stainless steel diaphragm only.
8 Standard on 700 Series. N/A with DPDT element on 400 Series.
9 N/A with Monel diaphragm.
10 Standard on 400 Series.
11 SS diaphragm required. Teflon diaphragm is the backup. NEMA 7 only.
12 Buna N and Viton diaphragm – 15#D & 30#D only.
13 24, 32, 64 or 68 element only.
14 N/A on all combinations.
15 700 Series only.

Ex II 2GD
Ex d IIC T6 Gb
Ex t IIIC T85° C Db IP 6X
(Ta = –20°C to +60°C)

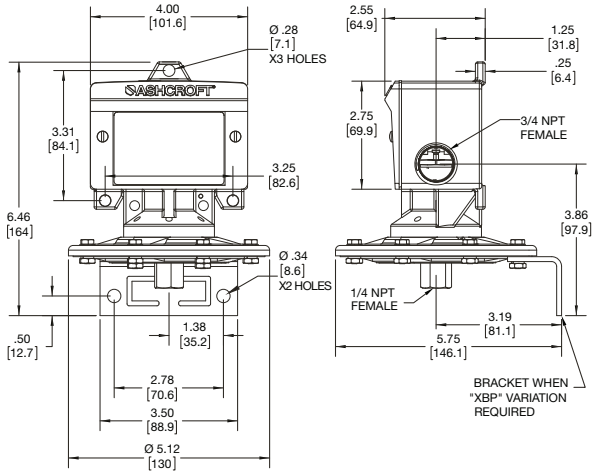
B-Series Switches – Pressure, Differential Pressure & Hydraulic

Dimensions – 400 Series

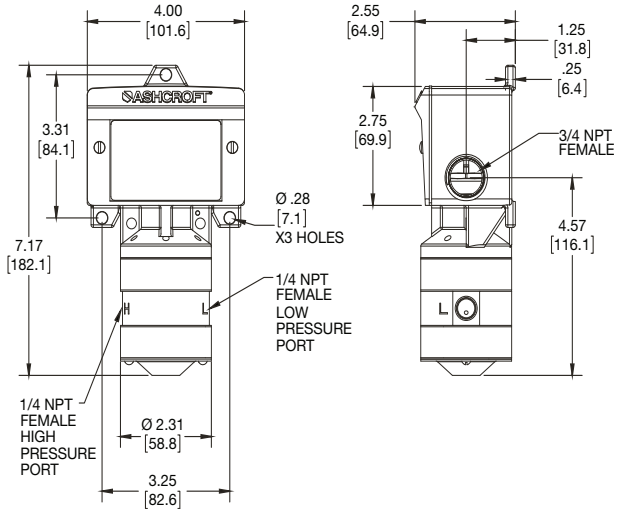
Pressure switch – psi ranges



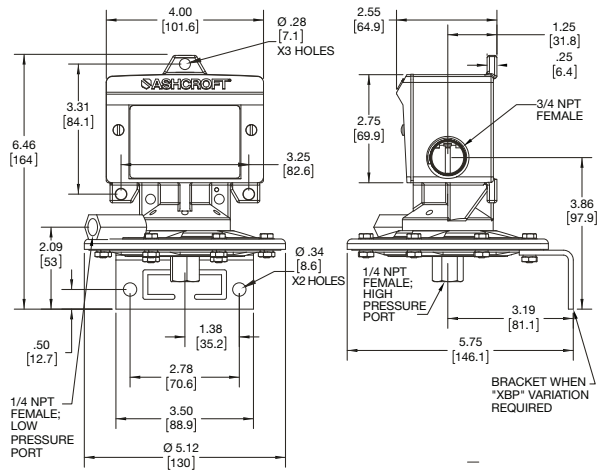
Pressure switch – inches of water ranges



Differential pressure switch – psi differential ranges



Differential pressure switch – inches of water ranges



ASHCROFT®
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World Headquarters

Ashcroft Inc.
250 E. Main Street
Stratford, CT 06614-5145 U.S.A.
Tel: (203) 378-8281
Fax: (203) 385-0408
email: info@ashcroft.com
www.ashcroft.com

International Operations

Brazil
Willy Instrumentos de Medicao e
Controle Ltda.
Rua Joao Pessoa, 620
09520-000
Sao Caetano Do Sul-Sao Paulo-Brazil
Tel: 55-11-4224-7402
Fax: 55-11-4224-7477
email: contato@ashcroft.com
www.ashcroft.com.br

China
Ashcroft Instruments (Suzhou) Co., Ltd.
1508 Lin-hu Avenue
Ascendas Lin-hu Industrial Square
Wujiang Fenhu Economic Zone
Wujiang China, 215211
Tel: 011-86-512-6326-9101
Fax: 011-86-512-6326-9106
www.ashcroft.com

France
Ashcroft Instruments GmbH Sales Office
48, Chemin des Landes
69700 Montagny
France
Tel: 33 (0) 9 65 32 71 31
Fax: 33 (0) 4 72 39 10 57
email: ashcroft.france@wanadoo.fr

Germany
Ashcroft Instruments GmbH
Postfach 11 20, D-52490
Baesweiler, Germany
Max-Planck-Strasse 1, D-52499
Baesweiler, Germany
Tel: 49-2401-8080
Fax: 49-2401-808 125
email: sales@ashcroft.com
www.ashcroft.eu

India
Ashcroft India Pvt. Ltd.,
Plot 2306, G.I.D.C. Chhatral,
Ta. Kalol, Dist. Gandhinagar,
Chhatral 382729, India.
Tel: 91-2764-233681/82/83
Fax: 91-2764-233440
sales@ashcroftindia.com
www.ashcroftindia.com

Mexico
Ashcroft Instruments Mexico, S.A. de C.V.
General Mariano Arista No. 54 Nave 8
Col. Argentina Poniente
Deleg. Miguel Hidelgo
11230 Mexico City, Mexico
Tel: 525-550-82-3030
Fax: 525-550-82-3027
email: jmendieta@ashcroft.com.mx

Saudi Arabia
AARICO
P.O. Box 12031
Jubail Industrial City 31961
Kingdom of Saudi Arabia
Tel: 966-3-341-0278
Fax: 966-3-341-7624
email:anil@aarico.net
www.ashcroft-alrushaid.com

Singapore
Ashcroft Instruments Singapore Pte. Ltd.
Block 1004 Toa Payoh North
#07-15/17
Singapore 318995
Tel: 65-6252-6602
Fax: 65-6252-6603
email: John.Wong@ashcroft.com.sg

United Kingdom
Ashcroft Instruments GmbH Sales Office
Cambridge Office
Unit 17 & 18 William James House
Cowley Road
Cambridge CB4 0WX
Tel: 44-0-1223-395500
Fax: 44-0-1223-395501
email: sales@ashcroftuk.com

Venezuela
Manufacturas Petroleras Venezolanas S.A.
KM7 Carretera A
El Mojan Calle 18
#15B355 Zona
Ind. Norte Sector Canchancha
Maracaibo Edo Zulia Venezuela
Tel: 58-261-757-9070
Tel: 58-261-742-4372
Fax: 58-261-757-9461
email: contactenos@mapvensa.com
www.mapvensa.com

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Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

7520 / 7530 Series

Acrylic Tube

Economical machined cast acrylic block construction makes these meters great for OEM use. Optional inlet metering valve available.

ADT ROTOMETER



DESCRIPTION

Metering Tube	Machined cast acrylic
Internal Components	316L SS
Fitting Material	Standard: PVC (brass for 2C block size) Optional: 316L SS or brass
Inlet/Outlet Fittings	NPT, horizontal Control valve optional
O-Ring	Standard: EPR Optional: Buna N, Viton® , and Kalrez®

PERFORMANCE

Capacities	Water 7 GPH to 20 GPM Air 2.6 SCFH to 60 SCFM
Scale	50mm, 75mm, 100mm, 127mm, 250mm direct reading
Accuracy	± 6% of full scale flow, 50 mm scale ± 4% of full scale flow, 75 mm scale ± 4% of full scale flow, 100 mm scale ± 7% of full scale flow, 6C-04, 6C-06 ± 3% of full scale flow, 127 mm scale ± 2% of full scale flow, 250 mm scale
Turndown	10:1
Repeatability	3%, 50 mm scale 2%, 75 mm scale 2%, 100 mm scale 4%, 6C-04, 6C-06 2%, 127 mm scale 0.5%, 250 mm scale
Maximum Temperature	Liquid 130° F (54° C) Gases 100° F (38° C)
Maximum Pressure	Water 125 psig Air 100 psig
Ambient Temperature	33° F to 125° F (1° C to 52° C)

OPTIONS

Certified Calibrations	Conform to ISA RP 16.6
Scales	Any volumetric unit

7520 / 7530 Series Specifications

Acrylic Tube

Order Number	Flow Water	Order Number	Flow Air	Dimensions (Inches) A	B	C	D	E	F	G	Diameter L	Connection Size
Block #2C, 50mm (2 Inch) Scale												
–	–	2C-01*	2.6 SCFH	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT
–	–	2C-03	5 SCFH	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT
–	–	2C-05*	10 SCFH	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT
–	–	2C-07*	20 SCFH	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT
2C-02	7 GPH	2C-09	30 SCFH	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT
2C-04	12 GPH	2C-11	60 SCFH	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT
2C-06	22 GPH	2C-13	100 SCFH	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT
2C-08	44 GPH	2C-15	180 SCFH	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT
2C-10	60 GPH	2C-17	4 SCFM	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT
2C-12	75 GPH	—	—	4.125	1	1.215	4	.50	1.05	3	.700	1/4" FNPT

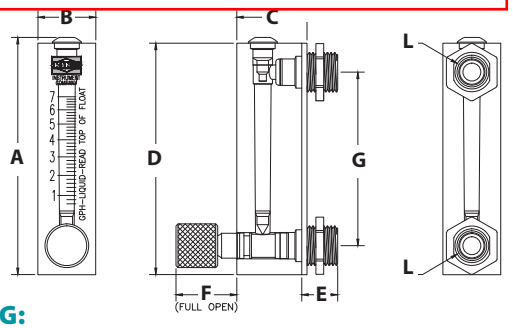
**These meters have glass ball floats*

Order Number	Flow Water	Order Number	Flow Air	Dimensions (Inches) A	B	C	D	E	F	G	Connections & Mounting Connection Size	Centerline H	Thread J	Diameter L
Block #3C, 75mm (3 Inch) Scale														
3C-02	1 GPM	3C-01	4 SCFM	6.875	1.20	1.35	6.625	1	1.37	5		3	.25 - 20	1
3C-04	2 GPM	3C-03	8 SCFM	6.875	1.20	1.35	6.625	1	1.37	5	1/2" MNPT x 1/4"FNPT	3	.25 - 20	1
3C-06	3.5 GPM	3C-05	15 SCFM	6.875	1.20	1.35	6.625	1	1.37	5		3	.25 - 20	1
3C-08	5 GPM	3C-07	23 SCFM	6.875	1.20	1.35	6.625	1	1.37	5		3	.25 - 20	1
Block #5C, 127mm (5 Inch) Scale														
5C-10	10 GPH	5C-11	42 SCFH	8.45	1.20	1.35	8.25	1	1.37	6.437		3.937	.25 - 20	1
5C-12	20 GPH	5C-13	100 SCFH	8.45	1.20	1.35	8.25	1	1.37	6.437		3.937	.25 - 20	1
5C-14	40 GPH	5C-15	175 SCFH	8.45	1.20	1.35	8.25	1	1.37	6.437		3.937	.25 - 20	1
5C-02	1 GPM	5C-01	4 SCFM	8.45	1.20	1.35	8.25	1	1.25	6.437	1/2" MNPT x 1/4 "FNPT	3.937	.25 - 20	1
5C-04	100 GPH	5C-03	6.8 SCFM	8.45	1.20	1.35	8.25	1	1.37	6.437		3.937	.25 - 20	1
5C-06	2 GPM	5C-05	8.2 SCFM	8.45	1.20	1.35	8.25	1	1.37	6.437		3.937	.25 - 20	1
5C-08	5 GPM	5C-07	22 SCFM	8.45	1.20	1.35	8.25	1	1.37	6.437		3.937	.25 - 20	1
Block #6C, 100mm (4 Inch) Scale														
6C-02	10 GPM	6C-01	40 SCFM	9.125	1.78	1.812	8.875	1.25	1.875	6.50		4	.25 - 20	1.375
6C-04	15 GPM	6C-03	60 SCFM	9.125	1.78	1.812	8.875	1.25	1.875	6.50	1" MNPT	4	.25 - 20	1.375
6C-06	20 GPM	—	—	9.125	1.78	1.812	8.875	1.25	1.875	6.50		4	.25 - 20	1.375
Block #7C, 250mm (10 Inch) Scale														
7C-02	2 GPM	7C-01	8 SCFM	14.50	1.78	1.812	14.25	.75	1.75	12.25		8.75	.375 - 24	1.25
7C-04	3.5 GPM	7C-03	14.4 SCFM	14.50	1.78	1.812	14.25	.75	1.75	12.25	1/2" FNPT	8.75	.375 - 24	1.25
7C-06	5 GPM	7C-05	20 SCFM	14.50	1.78	1.812	14.25	.75	1.75	12.25		8.75	.375 - 24	1.25
7C-08	10 GPM	7C-07	42 SCFM	14.50	1.78	1.812	14.25	.75	1.75	12.25		8.75	.375 - 24	1.25

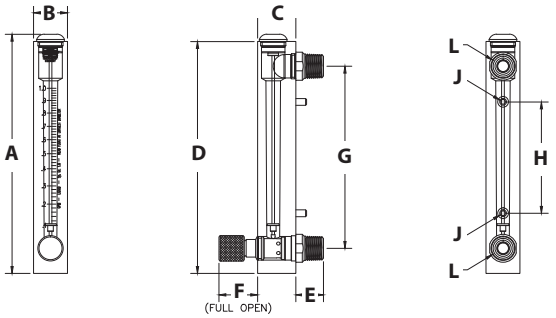
Blocks 3C, 5C, 6C and 7C have mounting studs depicted in dimension "H" and thread "J". (Mounting nuts not supplied)

DIMENSION DIAGRAM

2C blocks



3C, 5C, 6C, 7C blocks



ORDERING:

Use the following guide to determine the specific product number you require.

7	5													

Meter Series
7520 No valve
7530 With valve

Fitting Material
Brass - 1
PVC - 2 (2C not available in PVC)
316L SS - 3

O-Ring Material
EPR - 1
Buna-N - 2
Viton® - 3

Valve Material
Brass - 1
316L SS - 2
Without Valve - 0

Order Number
See Specifications table

ASCO® Red-Hat®

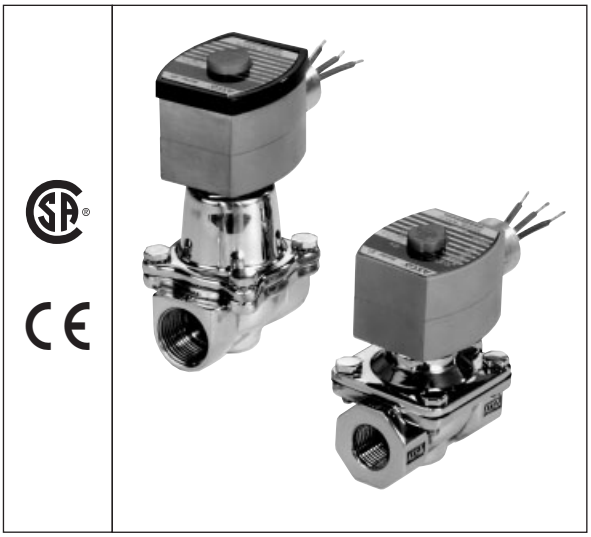
Pilot Operated
General Service Solenoid Valves
Brass or Stainless Steel Bodies
3/8" to 2 1/2" NPT

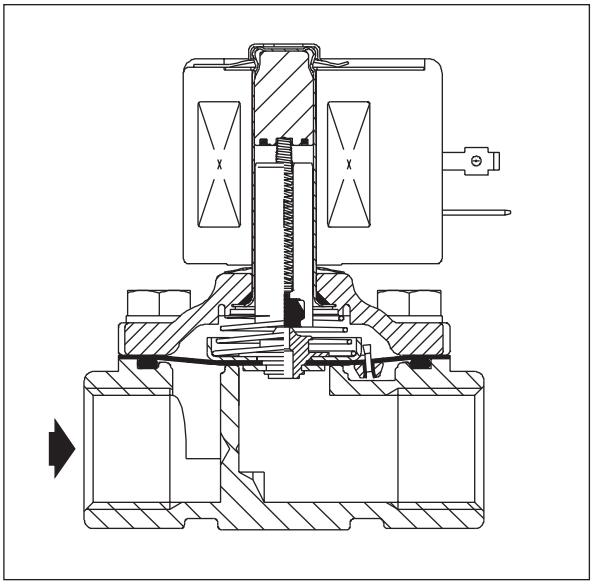
NC
NO

2/2
SERIES
8210

Features

- Wide range of pressure ratings, sizes, and resilient materials provide long service life and low internal leakage.
- High Flow Valves for liquid, corrosive, and air/inert gas service.
- Industrial applications include:
  - Car wash
  - Laundry equipment
  - Air compressors
  - Industrial water control
  - Pumps





Construction

Valve Parts in Contact with Fluids		
Body	Brass	304 Stainless Steel
Seals and Discs	NBR or PTFE	
Disc-Holder	PA	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
F	16.8	16.1	35	180	272610	97617	272614	97617
F	-	17.1	40	93	238610	-	238614	-
F	-	20	43	240	99257	-	99257	-
F	-	20.1	48	240	272610	-	272614	-
H	30.6	-	-	-	-	74073	-	74073
H	40.6	-	-	-	-	238910		238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages available when required.

Solenoid Enclosures

Standard: Red-Hat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; Red-Hat - Type I.
Optional: Red-Hat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; Red-Hat - Explosionproof and Watertight, Types 3, 4, 4X, 7, and 9.
(To order, add prefix "EF" to catalog number, except Catalog Numbers 8210B57, 8210B58, and 8210B59. Valves not available with Explosionproof enclosures.)
See Optional Features Section for other available options.

Nominal Ambient Temperature Ranges:

Red-Hat II/
Red-Hat AC: 32˚F to 125˚F (0˚C to 52˚C)
Red-Hat II DC: 32˚F to 104˚F (0˚C to 40˚C)
Red-Hat DC: 32˚F to 77˚F (0˚C to 25˚C)
(104˚F/40˚C occasionally)
Refer to Engineering Section for details.

Approvals:

CSA certified. Red-Hat II meets applicable CE directives.
Refer to Engineering Section for details.

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)							Max. Fluid Temp. °F		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	3/8	1.5	①	150	125	-	40	40	-	180	150	8210G73 ③	1P	●	8210G36 ③	1P	●	6.1/F	11.6/F
3/8	5/8	3	0	150	150	-	40	40	-	180	150	8210G93	5D	❍	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G1	6D	❍	-	-	-	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	-	-	-	175	-	8210G6	5D	❍	-	-	-	17.1/F	-
1/2	7/16	2.2	①	150	125	-	40	40	-	180	150	8210G15 ③	2P	●	8210G37 ③	2P	●	6.1/F	11.6/F
1/2	5/8	4	0	150	150	-	40	40	-	180	150	8210G94	5D	❍	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	-	175	150	-	-	-	8210G87	7D	●	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G2	6D	❍	-	-	-	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G7	5D	❍	-	-	-	17.1/F	-
1/2	3/4	4	5	-	300	-	-	300	-	180	125	8210G227	5D	❍	-	-	-	17.1/F	40.6/H
3/4	5/8	4.5	0	150	150	125	40	40	-	175	150	-	-	-	8210G88	7D	●	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G9	9D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	5	0	150	150	-	40	40	-	180	150	8210G95	8D	❍	-	-	-	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G3	11D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	6	0	-	-	-	200	180	180	-	77	8210B26 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G26 ② ‡	40P	●	-	-	-	16.1F	-
1	1	13	0	-	-	-	100	100	80	-	77	8210B54 ‡	31D	-	8210D89	15D	-	-	30.6/H
1	1	13	0	150	125	125	-	-	-	180	-	8210G54	41D	●	8210G89	45D	●	16.1/F	-
1	1	13	5	150	150	100	125	125	125	180	150	8210G4	12D	❍	-	-	-	6.1/F	11.6/F
1	1	13.5	0	300	225	115	-	-	-	200	-	8210G27 ‡	42P	●	-	-	-	20.1/F	-
1	1	13.5	10	300	300	300	-	-	-	175	-	8210G78 ②	13P	-	-	-	-	17.1/F	-
1 1/4	1 1/8	15	0	-	-	-	100	100	80	-	77	8210B55 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	1 1/8	15	0	150	125	125	-	-	-	180	-	8210G55	43D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	5	150	150	100	125	125	125	180	150	8210G8	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	1 1/4	22.5	0	-	-	-	100	100	80	-	77	8210B56 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G56 ‡	44D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	5	150	150	100	125	125	125	180	150	8210G22	18D	●	-	-	-	6.1/F	11.6/F
2	1 3/4	43	5	150	125	90	50	50	50	180	150	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	1 3/4	45	5	150	125	90	50	50	50	180	150	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	125	125	80	180	150	8210G33	23D	●	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	250	200	200	250	200	200	180	180	8210G11 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	125	125	80	180	150	8210G34	23D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G30	37D	●	10.1/F	11.6/F
1/2	5/8	4	5	250	200	200	250	200	200	180	180	8210G12 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	3/4	5.5	0	150	150	125	125	125	80	180	150	8210G35	25D	●	-	-	-	10.1/F	11.6/F
3/4	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G38	38D	●	10.1/F	11.6/F
3/4	3/4	6.5	5	-	-	-	250	200	200	-	180	8210C13	24D	●	-	-	-	-	16.8/F
3/4	3/4	6.5	5	250	200	200	-	-	-	180	-	8210G13	46D	●	-	-	-	16.1/F	-
1	1	13	0	125	125	125	-	-	-	180	-	8210B57 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	1	13	5	-	-	-	125	125	125	-	180	8210D14	26D	●	-	-	-	-	16.8/F
1	1	13	5	150	150	125	-	-	-	180	-	8210G14	47D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	0	125	125	125	-	-	-	180	-	8210B58 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	1 1/8	15	5	-	-	-	125	125	125	-	180	8210D18	28D	●	-	-	-	-	16.8/F
1 1/4	1 1/8	15	5	150	150	125	-	-	-	180	-	8210G18	48D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	0	125	125	125	-	-	-	180	-	8210B59 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	1 1/4	22.5	5	-	-	-	125	125	125	-	180	8210D32	29D	●	-	-	-	-	16.8/F
1 1/2	1 1/4	22.5	5	150	150	125	-	-	-	180	-	8210G32	49D	●	-	-	-	16.1/F	-
2	1 3/4	43	5	-	-	-	125	125	125	-	150	8210103	30P	●	-	-	-	-	16.8/F
2	1 3/4	43	5	125	125	125	-	-	-	180	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	1 3/4	45	5	-	-	-	125	125	125	-	150	8210104	27P	●	-	-	-	-	16.8/F
2 1/2	1 3/4	45	5	125	125	125	-	-	-	180	-	8210G104	51P	●	-			16.1/F	-

Notes: ① 5 psi on Air; 1 psi on Water.
② Valve provided with PTFE main disc.
③ Valve includes Ultem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve.
Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless Steel disc-holder.
‡ Must have solenoid mounted vertical and upright.

Specifications (Metric units)

Pipe Size (ins.)	Orifice Size (mm)	Kv Flow Factor (m3/h)	Operating Pressure Differential (bar)							Max.Fluid Temp. °C		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	10	1.29	①	10	9	-	3	3	-	81	65	8210G73 ③	1P	●	8210G36 ③	1P	●	6.1/F	11.6/F
3/8	16	2.57	0	10	10	-	3	3	-	81	65	8210G93	5D	❍	-	-	-	10.1/F	11.6/F
3/8	16	2.57	0.3	14	10	9	9	7	7	81	65	8210G1	6D	❍	-	-	-	6.1/F	11.6/F
3/8	16	2.57	0.3	21	21	21	-	-	-	79	-	8210G6	5D	❍	-	-	-	17.1/F	-
1/2	11	1.89	①	10	9	-	3	3	-	81	65	8210G15 ③	2P	●	8210G37 ③	2P	●	6.1/F	11.6/F
1/2	16	3.43	0	10	10	-	3	3	-	81	65	8210G94	5D	❍	-	-	-	10.1/F	11.6/F
1/2	16	3.43	0	10	10	9	3	3	-	79	65	-	-	-	8210G87	7D	●	17.1/F	11.6/F
1/2	16	3.43	0.3	14	10	9	9	7	7	81	65	8210G2	6D	❍	-	-	-	6.1/F	11.6/F
1/2	16	3.43	0.3	21	21	21	-	-	-	79	-	8210G7	5D	❍	-	-	-	17.1/F	-
1/2	19	3.43	0.3	-	21	-	-	21	-	81	52	8210G227	5D	❍	-	-	-	17.1/F	40.6F
3/4	16	3.86	0	10	10	9	3	3	-	79	65	-	-	-	8210G88	7D	●	17.1/F	11.6/F
3/4	19	4.29	0.3	9	9	9	7	6	5	81	65	8210G9	9D	❍	-	-	-	6.1/F	11.6/F
3/4	19	4.29	0	10	10	-	3	3	-	81	65	8210G95	8D	❍	-	-	-	10.1/F	11.6/F
3/4	19	5.57	0.3	17	10	7	9	9	9	81	65	8210G3	11D	❍	-	-	-	6.1/F	11.6/F
3/4	19	5.14	0	-	-	-	14	12	12	-	25	8210B26 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	19	5.14	0	24	21	14	-	-	-	92	-	8210G26 ② ‡	40P	●	-	-	-	16.1F	-
1	25	11.14	0	-	-	-	7	7	6	-	25	8210B54 ‡	31D	-	8210D89	15D	-	-	30.6/H
1	25	11.14	0	10	9	9	-	-	-	81	-	8210G54	41D	●	8210G89	45D	●	16.1/F	-
1	25	11.14	0.3	10	10	7	9	9	9	81	65	8210G4	12D	❍	-	-	-	6.1/F	11.6/F
1	25	11.57	0	21	16	8	-	-	-	92	-	8210G27 ‡	42P	●	-	-	-	20.1/F	-
1	25	11.57	0.7	21	21	21	-	-	-	79	-	8210G78 ②	13P	-	-	-	-	17.1/F	-
1 1/4	29	12.86	0	-	-	-	7	7	6	-	25	8210B55 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	29	12.86	0	10	9	9	-	-	-	81	-	8210G55	43D	●	-	-	-	16.1/F	-
1 1/4	29	12.86	0.3	10	10	7	9	9	9	81	65	8210G8	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	32	19.29	0	-	-	-	7	7	6	-	25	8210B56 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	32	19.29	0	10	9	9	-	-	-	81	-	8210G56 ‡	44D	●	-	-	-	16.1/F	-
1 1/2	32	19.29	0.3	10	10	7	9	9	9	81	65	8210G22	18D	●	-	-	-	6.1/F	11.6/F
2	44	36.86	0.3	10	9	6	3	3	3	81	65	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	44	38.57	0.3	10	9	6	3	3	3	81	65	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	16	2.57	0.0	10	10	9	9	9	6	81	65	8210G33	23D	●	-	-	-	10.1/F	11.6/F
3/8	16	2.57	0.3	17	14	14	17	14	14	81	81	8210G11 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	16	3.43	0	10	10	9	9	9	6	81	65	8210G34	23D	●	-	-	-	10.1/F	11.6/F
1/2	16	2.57	0	10	10	7	9	9	6	81	65	-	-	-	8210G30	37D	●	10.1/F	11.6/F
1/2	16	3.43	0.3	17	14	14	17	14	14	81	81	8210G12 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	19	4.71	0	10	10	9	9	9	6	81	65	8210G35	25D	●	-	-	-	10.1/F	11.6/F
3/4	16	2.57	0	10	10	7	9	9	6	81	65	-	-	-	8210G38	38D	●	10.1/F	11.6/F
3/4	19	5.57	0.3	-	-	-	17	14	14	-	81	8210C13	24D	●	-	-	-	-	16.8/F
3/4	19	5.57	0.3	17	14	14	-	-	-	81	-	8210G13	46D	●	-	-	-	16.1/F	-
1	25	11.14	0	9	9	9	-	-	-	81	-	8210B57 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	25	11.14	0.3	-	-	-	9	9	9	-	81	8210D14	26D	●	-	-	-	-	16.8/F
1	25	11.14	0.3	10	10	9	-	-	-	81	-	8210G14	47D	●	-	-	-	16.1/F	-
1 1/4	29	12.86	0	9	9	9	-	-	-	81	-	8210B58 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	29	12.86	0.3	-	-	-	9	9	9	-	81	8210D18	28D	●	-	-	-	-	16.8/F
1 1/4	29	12.86	0.3	10	10	9	-	-	-	81	-	8210G18	48D	●	-	-	-	16.1/F	-
1 1/2	32	19.29	0	9	9	9	-	-	-	81	-	8210B59 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	32	19.29	0.3	-	-	-	9	9	9	-	81	8210D32	29D	●	-	-	-	-	16.8/F
1 1/2	32	19.29	0.3	10	10	9	-	-	-	81	-	8210G32	49D	●	-	-	-	16.1/F	-
2	44	36.86	0.3	-	-	-	9	9	9	-	65	8210103	30P	●	-	-	-	-	16.8/F
2	44	36.86	0.3	9	9	9	-	-	-	81	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	44	38.57	0.3	-	-	-	9	9	9	-	65	8210104	27P	●	-	-	-	-	16.8/F
2 1/2	44	38.57	0.3	9	9	9	-	-	-	81	-	8210G104	51P	●	-	-	-	16.1/F	-

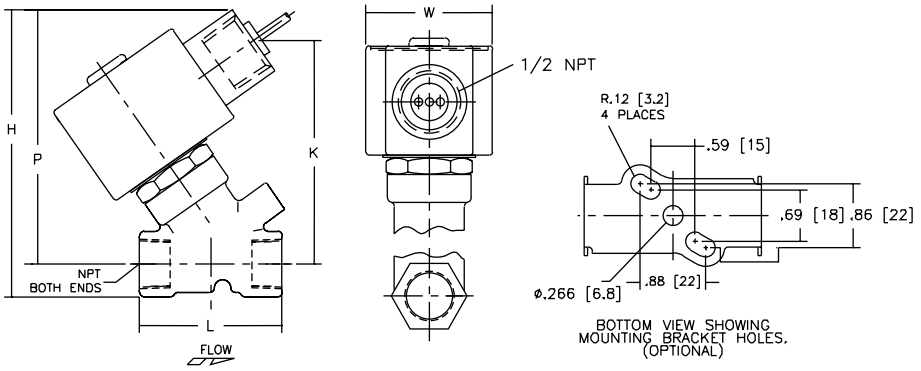
Notes:
① 0.3 bar on Air; 0.0 bar on Water.
② Valve provided with PTFE main disc.
③ Valve includes UItem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve. Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless Steel disc-holder.
‡ Must have solenoid mounted vertical and upright.

Dimensions: inches (mm)

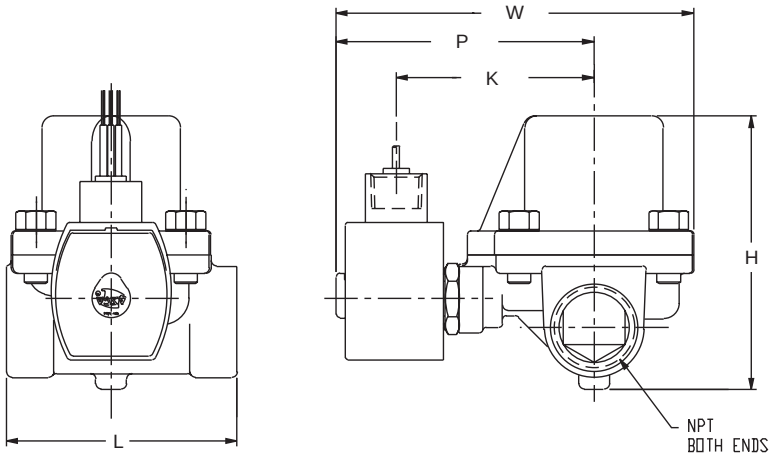
Constr. Ref. No.		H	K	L	P	W
1*	ins.	3.85	3.00	1.91	3.41	1.69
	mm	98	76	49	87	43
2*	ins.	4.17	3.25	2.28	3.63	1.69
	mm	106	83	58	92	43
13	ins.	4.44	3.22	3.75	4.19	5.81
	mm	113	82	95	106	147
5	ins.	3.84	2.31	2.75	3.28	2.28
	mm	98	59	70	83	58
6*	ins.	3.38	1.94	2.75	2.80	2.28
	mm	86	49	70	71	58
7	ins.	4.19	2.50	2.81	3.47	2.39
	mm	106	64	71	88	61
8	ins.	4.13	2.47	2.81	3.44	2.29
	mm	105	63	71	87	58
9*	ins.	3.66	2.10	2.81	2.96	2.28
	mm	93	53	71	75	58
10*①	ins.	5.25	X	2.81	4.59	2.31
	mm	133	X	71	117	59
11*	ins.	4.16	2.66	3.84	3.52	2.75
	mm	106	68	98	89	70
12	ins.	5.64	3.15	3.75	4.01	3.36
	mm	143	80	95	102	85
15*	ins.	5.34	X	3.75	4.47	3.84
	mm	136	X	95	114	98
16	ins.	5.64	3.15	3.66	4.01	3.56
	mm	143	80	93	102	90
18	ins.	6.11	3.30	4.38	4.16	3.92
	mm	155	84	111	106	100
20*	ins.	7.33	3.71	5.06	4.57	4.87
	mm	186	94	129	116	124
21*	ins.	7.33	3.71	5.50	4.57	4.87
	mm	186	94	140	116	124
23	ins.	4.35	2.65	2.75	3.79	2.28
	mm	110	67	70	96	58
24	ins.	5.06	X	3.78	4.44	2.75
	mm	129	X	96	113	70
25	ins.	4.64	2.81	2.81	3.94	2.28
	mm	118	71	71	100	58
26	ins.	6.53	X	3.75	4.91	3.19
	mm	166	X	95	125	81
27	ins.	8.22	X	5.50	5.47	4.87
	mm	209	X	140	139	124
28	ins.	6.53	X	3.66	4.91	3.19
	mm	166	X	93	125	81
29	ins.	7.03	X	4.38	5.06	4.40
	mm	179	X	111	129	112

① Valves must be mounted with solenoid vertical and upright.
* DC dimensions slightly larger.

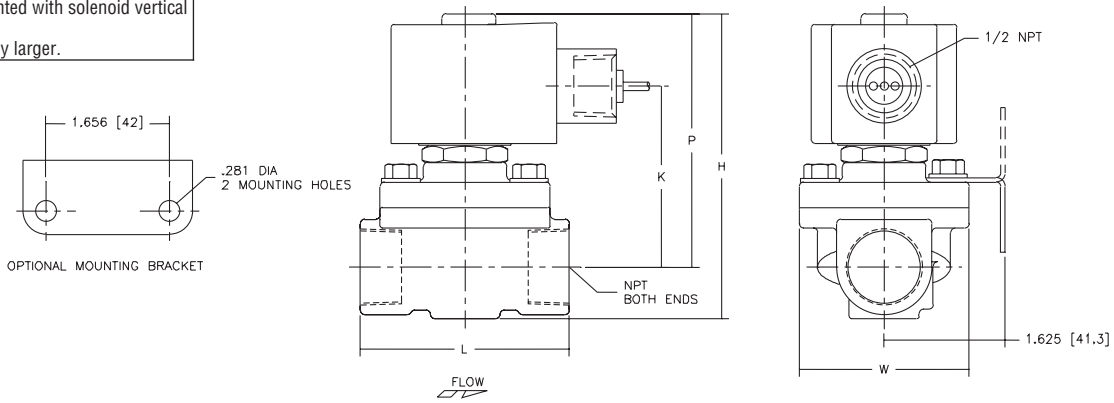
Constr. Refs. 1, 2



Constr. Ref. 13



Constr. Refs. 5-9, 11, 20, 21, 23 , 25, 37,38

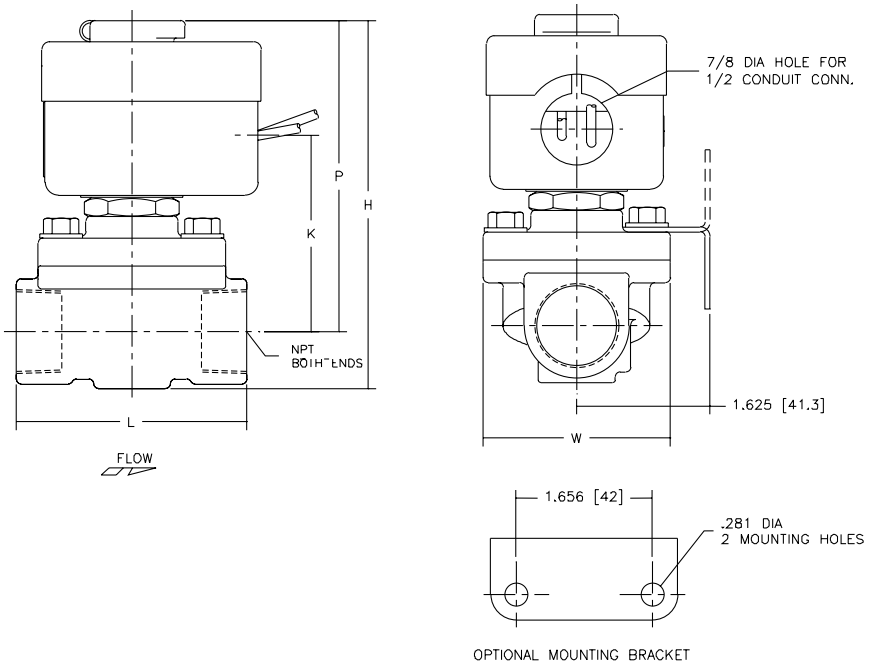


Dimensions: inches (mm)

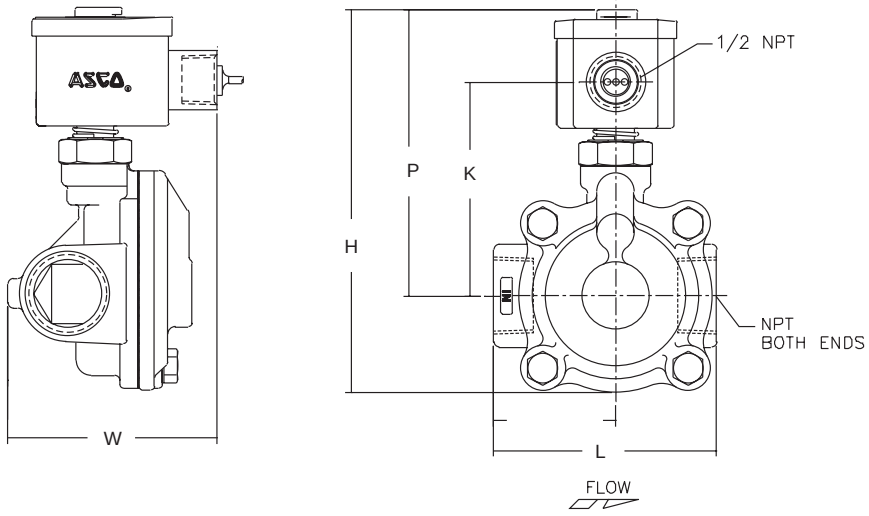
Constr. Ref. No.		H	K	L	P	W
30	ins.	8.22	X	5.06	5.47	4.87
	mm	209	X	129	139	124
31	ins.	5.25	X	3.75	4.44	3.25
	mm	133	X	95	113	83
32	ins.	5.69	X	3.66	4.69	3.25
	mm	145	X	93	119	83
33	ins.	6.06	X	4.38	4.94	3.91
	mm	154	X	111	125	99
34	ins.	6.91	X	3.75	6.09	3.25
	mm	176	X	95	155	83
35	ins.	7.34	X	3.66	6.34	3.25
	mm	186	X	93	161	83
36	ins.	7.66	X	4.38	6.56	3.91
	mm	1.95	X	111	167	99
37	ins.	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
38	ins.	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
39	ins.	5.42	2.31	2.75	4.86	3.80
	mm	138	59	70	123	97
40	ins.	5.20	3.29	2.81	4.50	2.28
	mm	132	83	71	114	58
41	ins.	5.13	3.10	3.75	4.32	3.25
	mm	130	79	95	110	83
42	ins.	6.43	4.40	3.93	5.62	3.25
	mm	163	112	100	143	83
43	ins.	5.57	3.35	3.66	4.57	3.25
	mm	142	85	93	116	83
44	ins.	5.90	3.57	4.38	4.79	3.91
	mm	150	91	111	122	99
45	ins.	5.26	3.17	3.75	4.38	3.84
	mm	134	81	95	111	98
46	ins.	4.95	3.10	3.84	4.31	2.75
	mm	126	79	98	110	70
47	ins.	6.43	3.59	3.75	4.81	3.52
	mm	163	91	95	122	90
48	ins.	6.43	3.59	3.66	4.81	3.73
	mm	163	91	93	122	95
49	ins.	6.91	3.75	4.38	4.96	4.40
	mm	176	95	111	126	112
50	ins.	8.13	4.15	5.06	5.37	4.87
	mm	207	105	129	136	124
51	ins.	8.13	4.15	5.50	5.37	5.18
	mm	207	105	140	136	132

IMPORTANT: Valves may be mounted in any position, except as noted in specifications table.

Constr. Refs. 10, 15, 24, 26-36

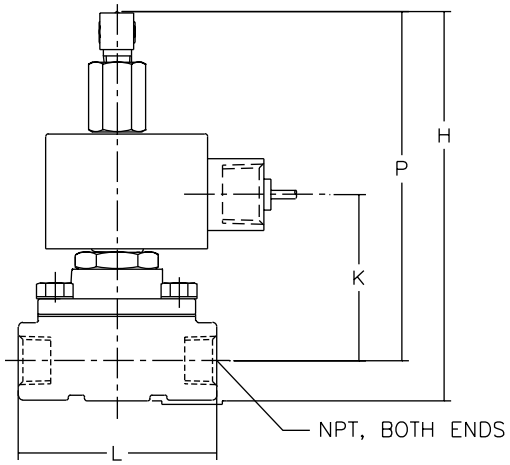


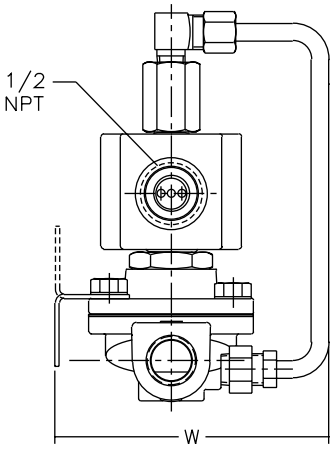
Constr. Refs. 12, 16, 18



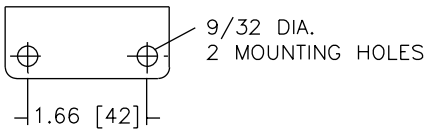
Dimensions: inches (mm)

Constr. Refs. 39



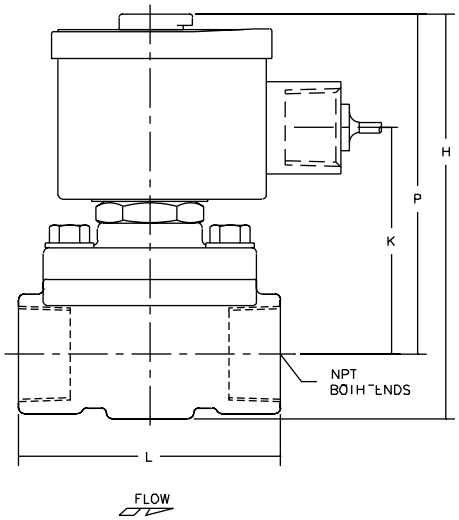


FLOW

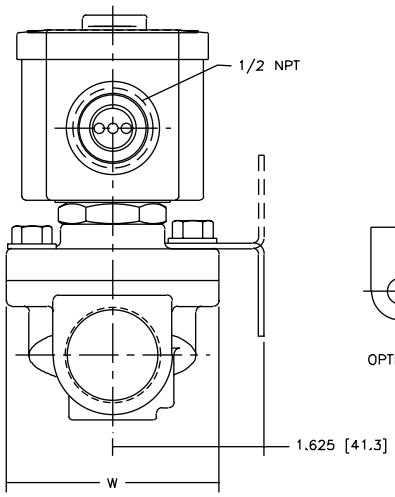


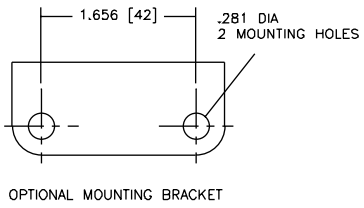
SHOWING MOUNTING
BRACKET ONLY

Constr. Refs. 40-51



FLOW





OPTIONAL MOUNTING BRACKET

Data Sheet

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1279 Duragauge® Pressure Gauge

ADT PRESSURE GAUGE

FEATURES

- Custom dial printing options
- Micrometer adjustable pointer
- ***PLUS!***™ Performance option dampens vibration, shock and pulsation effects
- Pressure range from vacuum to 30,000 psi
- NSF-61 Compliant

TYPICAL USES

- Refineries
- Chemical and petrochemical plants
- Offshore oil rigs
- Water and wastewater pressure control
- Pulp and water
- Mining and metals
- Equipment skids
- Specialized OEM equipment
- Cryogenics



1279
4½″ dial size

Certified to NSF/ANSI/CAN 61

SPECIFICATIONS

Accuracy:	±0.5% of span (ASME B40.100 Grade 2A)		
Size:	4½″		
Range:	Vacuum, compound to 30,000 psi		
Process Connection Location:	Lower, back, side, top		
Process Connection:	¼ NPT, ½ NPT, 9/16-18 UNF-2B Aminco® (high pressure connection)		
Case Style:	Solid front with pressure relief back		
Window:	Glass (STD.), acrylic, shatter proof glass, non-glare glass (OPT.)		
Movement:	Rotary, adjustable, 400 SS, Teflon™ coated		
Movement Materials:	400 SS, Teflon™ coated pinion gear and segment		
Dial:	Aluminum, white background, black scale		
Pointer:	Micrometer, adjustable, aluminum		
Weather Protection:	Case	IP Rating	Ordering Code
	Dry	Case not sealed, recommended for weather protected environment only	S
	Dry, field fillable	IP66	SH
	Liquid filled	IP66	SL
Dampening Options:	Liquid: glycerin, silicone, Halocarbon®, ***PLUS!***™ Performance		
Mounting:	Stem, surface, flush (STD.), pipe, remote (OPT.)		
Approvals:	CE/UKCA, CRN, NSF-61		

WETTED COMPONENTS

Bourdon Tube	Process Connection	Joints
316L Stainless steel	316L Stainless steel	Welded
316L Stainless steel	Steel	Welded
K-Monel® 500	Monel® 400, Steel	Welded
C510 Pho. Bronze	Brass	Silver Brazed

KEY BENEFITS

- **Available with a wide variety of accessory and diaphragm seal assemblies**
- **Available with high process temperature dissipation siphons**

MIN/MAX TEMPERATURE LIMITS

Version	Ambient	Process	Storage
Dry	-20 °F to 200 °F (-29 °C to 93 °C)	-20 °F to 250 °F (-29 °C to 121 °C)	-40 °F to 250 °F (-40 °C to 121 °C)
PLUS!™	-40 °F to 150 °F (-40 °C to 66 °C)	-40 °F to 200 °F (-40 °C to 93 °C)	-40 °F to 150 °F (-40 °C to 66 °C)
Glycerin fill	20 °F to 150 °F (-7 °C to 66 °C)	20 °F to 150 °F (-7 °C to 66 °C)	0 °F to 150 °F (-18 °C to 66 °C)
Silicone fill	-40 °F to 150 °F (-40 °C to 66 °C)	-40 °F to 200 °F (-40 °C to 93 °C)	-40 °F to 150 °F (-40 °C to 66 °C)
Halocarbon® fill	-40 °F to 150 °F (-40 °C to 66°C)	-40 °F to 200 °F (-40 °C to 93 °C)	-40 °F to 150 °F (-40 °C to 66 °C)

NON-WETTED COMPONENTS

Case	Ring	Pressure Relief Back
Phenolic	Threaded, Polycarbonate (meets UL 94 V-0)	Polycarbonate (Meets UL 94 V-0)

Note: Other than discoloration of the dial and hardening of the gasketing that may occur as ambient or process temperatures exceeds 150 °F, non-liquid-filled gauges with standard glass windows, can withstand continuous operating temperatures up to 250 °F (121 °C). Liquid-filled gauges can withstand 200 °F (93 °C) but glycerin fill and acrylic window will tend to yellow. Accuracy at temperatures above or below the reference ambient temperature of 68 °F (20 °C) will be affected by approximately .4% per 25 °F. Gauges with welded joints will withstand 750 °F (400 °C), 450 °F (232 °C) with silver brazed joints for short times without rupture, although other parts of the gauge will be destroyed and calibration will be lost. For continuous use and for process or ambient temperatures above 250 °F (121 °C), a diaphragm seal or capillary or siphon is recommended.

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1279 Duragauge® Pressure Gauge

ORDERING CODE Example:	451279	S	SH	04	L	XLL	15#
Dial Size/Model Code							
451279 - 4½″ solid front	451279						
System (tube and process connection)							
A - Bronze tube, brass process connection, Max. pressure connection 1,000 psi							
P - K-Monel® 500 tube, Monel® 400 process connection, Max. pressure 30,000 psi							
R - 316L SS tube, steel process connection, Max. pressure 20,000 psi							
S - 316 SS tube, 316L SS process connection, Max. pressure 20,000 psi (NSF-61 Compliant)		S					
Case Design							
S - Solid front case, dry							
SH - Solid front case, dry (IP66 NEMA 4X)			SH				
SL - Solid front case, liquid filled (glycerin STD.)							
Process Connection Sizes							
02 - ¼ NPT Male, N/A for ranges over 20,000 psi							
04 - ½ NPT Male, N/A for ranges over 20,000 psi				04			
09 - 9/16 18 UNF-2B, Aminco® high pressure fitting, pressures over 20,000 psi (STD.)							
AM - AND 10050-4 (¼ tubing connection)							
RW - SAE 7/16 & 20 Straight thread							
Process Connection Location							
L - Lower					L		
B - Back							
D - Side (3 o'clock)							
E - Side connection (9 o'clock)							
T - Top connection							
Options (If choosing an option(s) must include a "X") (See Table 1 on page 3 for more options)						–X__	
GV - Silicone case fill							
GX - Halocarbon® case fill							
LL - ***PLUS!***™ Performance						LL	
ND - PLUS! Performance, silicone free (glycerin and silicone filled gauges)							
NZ - ***PLUS!***™ Performance, silicone free dry gauges							
X1P - IP65 dry case (case cannot by liquid filled)							
NH - SS tag wired to case							
PD - Acrylic window (STD. with liquid filled or hermetically sealed cases)							
SG - Safety Glass							
C4 - Traceable calibration certificate							
6B - Cleaned for oxygen service							
5G - Attach one accessory to gauge. Applicable to PL02 pressure limiting valve, V01,V02,V03 valves, 1098, 1100, 1198, 2198 siphons, 7001, 7004 needle valves, 1115 capillary, 1106 pulsation dampner, 1112, PD02 pressure snubbers, MDV swivel adapter, 2265 electric warning contact							
Range (coding examples only, see range table on page 3 for all standard ranges)							
Single Scales							
15# - 15 psi							15#
1BR - 1 bar							
1KSC - 1 kg/cm²							
100KP - 100 kPa							
Dual Scales							
15#/BR - 15 psi inner scale, 1 bar outer scale							
1BR/# - 1 bar inner scale, 15 psi outer scale							

When selecting a diaphragm seal or isolation ring, refer to the Min/Max Guide for compatibility with this gauge or scan the QR code to the right.

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1279 Duragauge® Pressure Gauge

TABLE 1

CODE	OPTION
AB	Gauges calibrated to compensate for absolute pressure
C3	Material Traceability Report per EN 10204 3.1 (S and P wetted parts only)
DA	Dial marking (text marking on the dial)
D3	DuraVis™ retroreflective dial
EP	Maximum pointer (adjustable, N/A with liquid filled or hermetically sealed cases)
HY	Hydrostatic/pneumatic testing. (System with ranges 15 -400 PSI pressurized to 150% of rated system pressure for 5 minutes. Ranges 600 PSI - 10,000 PSI pressurized to 130% system pressure for 5 minutes.)
MQ	Positive Material Identification
NG	Non-glare glass (N/A with liquid fill or hermetically sealed cases)
OS	Overload stop
SG	Safety glass
SH	Red set hand, stationary
TM	2″ Pipe mounting bracket
TS	Throttle screw (STD. with liquid filled, hermetically sealed or ***PLUS!***™ Performance)
VS	Underload stop
56	Flush mounting ring

STANDARD PRESSURE RANGES

	psi	bar	kPa	mPa	KG (kg/cm²)
Vacuum	30IMV	N1BR	N100KP	N1MP	N1KSC
	–	N1/0.6BR	N100/60KP	0.1/0.06MP	N1/0.6KSC
Compound	V/15#	–	–	–	–
	–	N1/1.5BR	N100/150KP	N0.1/0.15MP	N1/1.5KSC
	V/30#	–	–	–	–
	–	N1/3BR	N100/300KP	N0.1/0.3MP	N1/3KSC
	V/60#	–	–	–	–
	–	N1/5BR	N100/500KP	N0.1/0.5MP	N1/5KSC
	V/100#	–	–	–	–
	–	N1/9BR	N100/900KP	N0.1/0.9MP	N1/9KSC
Positive Pressure	15#	1BR	100KP	0.1MP	1KSC
	20#	–	–	–	–
	–	1.6BR	160KP	0.16MP	1.6KSC
	30#	–	–	–	–
	–	2.5BR	250KP	0.25MP	2.5KSC
	60#	4BR	400KP	0.4MP	4KSC
	–	6BR	600KP	0.6MP	6KSC
	100#	–	–	–	–
	120#	–	–	–	–
	–	10BR	1000KP	1MP	10KSC
	160#	–	–	–	–
	200#	–	–	–	–
	–	16BR	1600KP	1.6MP	16KSC
	300#	–	–	–	–
	–	25BR	2500KP	2.5MP	25KG
	400#	–	–	–	–
	500#	–	–	–	–
	600#	40BR	4000KP	4MP	40KSC
	800#	–	–	–	–
	–	60BR	6000KP	6MP	60KSC
	1000#	–	–	–	–
	1500#	100BR	10000KP	10MP	100KG
	2000#	–	–	–	–
	–	160BR	16000KP	16MP	160KSC
	3000#	–	–	–	–
	–	250BR	25000KP	25MP	250KSC
	4000#	–	–	–	–
	5000#	–	–	–	–
	6000#	400BR	40000KP	40MP	400KSC
	8000#	–	–	–	–
	–	600BR	60000KP	60MP	600KSC
	10000#	–	–	–	–
	15000#	1000BR	100000KP	100MP	1000KSC
	20000#	-	-	-	-
	-	1600BR	-	160MP	1600KSC
	30000#	-	-	-	-

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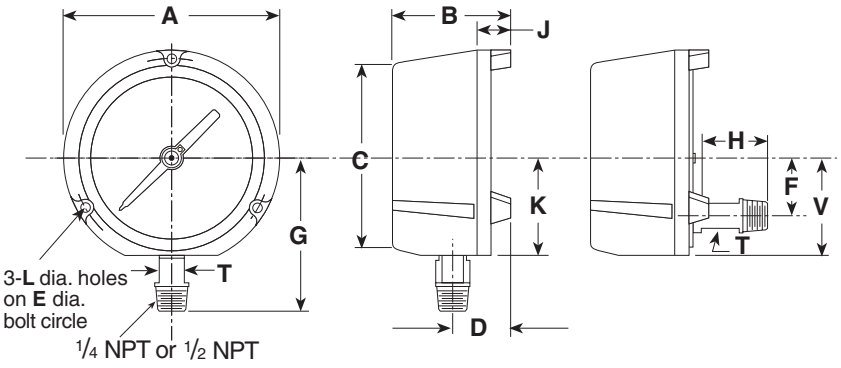
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1279 Duragauge® Pressure Gauge

DIMENSIONS in [ ] are millimeters

For reference only, consult Ashcroft for specific dimensional drawings

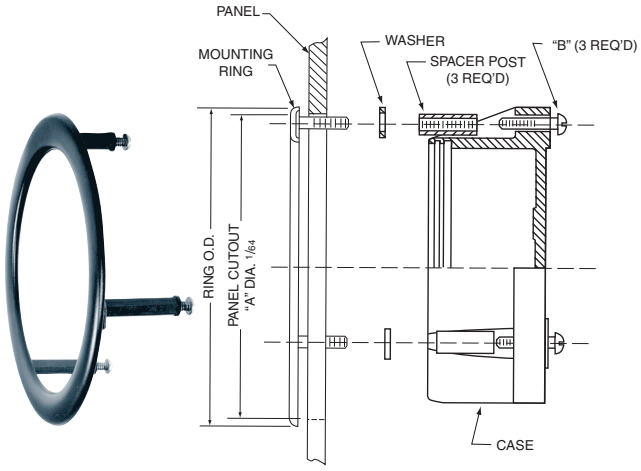
Dial Size Inches	A	B	C	D	E	F	G	H	J	K	L	T	V	Weight oz/kg
4½	5.81 [147.6]	3.36 [85.3]	5.07 [128.7]	1.60 [40.6]	5.375 [137]	1.62 [41.2]	3.92 [99.6]	0.73 [18.4]	0.94 [23.9]	2.62 [66.7]	0.218 [5.5]	0.62 [15.7]	2.62 [66.7]	2.5 (Dry) 3.5 (L.F.)



1278M Series Flush Mounting Ring

1278M Series Flush Mounting Ring. Used to flush mount gauge case 1279(*)S. Black finish (STD.); Polished SS finish (OPT.)

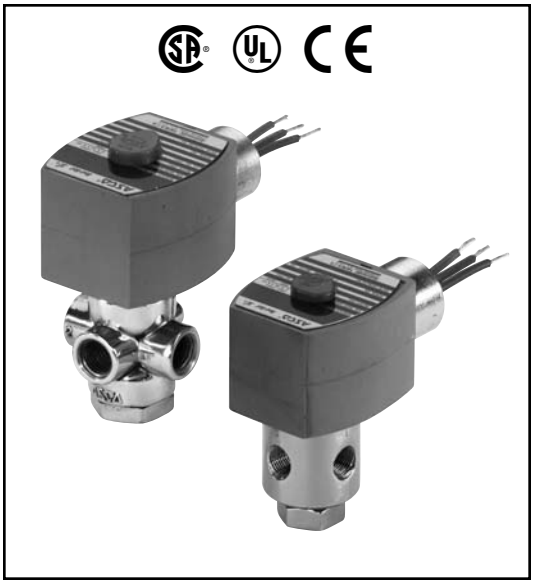
Gauge Size Inches	Ring O.D.	"A" DIA.	"B" Size of 3 Screws	"C" Size of Washers
4½	6 [152]	5.625 [148]	#10-24 x 1⅝	7/16 x 17/64 x 5/8

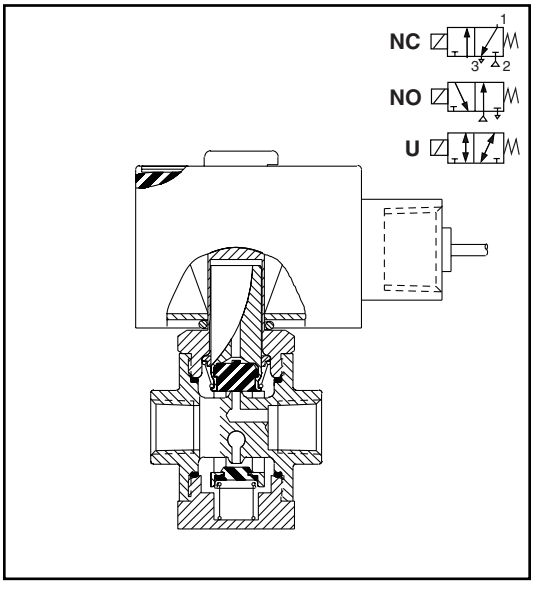


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Features

- All NPT connections are in the valve body to allow in-line piping
- No Minimum Operating Pressure Differential required
- Broadest range of applications
- Mountable in any position





Construction

Valve Parts in Contact with Fluids		
Body	Brass	303 Stainless Steel
Seals and Disc	NBR or Cast UR, as Listed	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Core Springs	302 Stainless Steel	
Shading Coil	Copper	Silver
Disc-Holder	CA	
Core Guide	CA (10.1 and 17.1 Watt only)	

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	10.6	6.1	16	30	238210	238310	238214	238314
F	-	9.1	25	40	238210	-	238214	-
F	11.6	10.1	25	50	238610	238710	238614	238714
F	22.6	17.1	40	70	238610	238710	238614	238714

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages are available when required.

Solenoid Enclosures

Standard: Watertight, Types 1, 2, 3, 3S, 4, and 4X.

Optional: Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9. (To order, add prefix "EF" to the catalog number.)

See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

AC: 32˚F to 125˚F (0˚C to 52˚C)
DC: 32˚F to 104˚F (0˚C to 40˚C)

Note: Some stainless steel constructions are rated -40˚F (-40˚C). See note ④ in specifications table.

Refer to Engineering Section for details.

Approvals

CSA certified. UL listed General Purpose Valves.
Meets applicable CE directives.

SIL 3 capable per IEC 61508 on normally closed const.
Third party certification provided by EXIDA.

Refer to Engineering Section for details.

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi) Max. AC Air-Inert Gas	Max. AC Water	Max. AC Lt. Oil @ 300 SSU	Max. DC Air-Inert Gas	Max. DC Water	Max. DC Lt. Oil @ 300 SSU	Max. Fluid Temp. °F AC	Max. Fluid Temp. °F DC	Brass Body Catalog Number	Brass Body Const. Ref.	Stainless Steel Body Catalog Number	Stainless Steel Body Const. Ref.	Watt Rating/ Class of Coil Insulation ② AC	Watt Rating/ Class of Coil Insulation ② DC
UNIVERSAL OPERATION (Pressure at any port)																
1/8	3/64	0.06	175	175	175	125	125	125	140	120	8320G130 ①	1	8320G140 ①	1	9.1F	10.6F
1/8	1/16	0.09	100	100	100	65	65	65	180	120	8320G001	1	8320G041 ③	1	9.1F	10.6F
1/8	1/16	0.09	175	175	175	125	125	125	200	150	8320G212	4	8320G221 ④	4	17.1/F	22.6/F
1/8	3/32	0.12	50	50	50	50	50	50	180	120	8320G083	1	8320G087 ③	1	6.1/F	10.6/F
1/8	3/32	0.12	100	100	100	60	60	60	200	150	8320G213	4	8320G222 ④	4	17.1/F	11.6/F
1/8	1/8	0.21	30	30	30	20	20	20	180	120	8320G003	1	8320G043 ③	1	9.1/F	10.6/F
1/8	1/8	0.21	50	50	50	25	25	25	200	150	8320G214	4	8320G223 ④	4	17.1/F	11.6/F
1/4	1/16	0.09	125	130	130	75	75	75	200	150	8320G172	2	-	-	10.1/F	11.6/F
1/4	1/16	0.09	175	175	175	125	125	125	200	150	-	-	8320G230 ④	3	17.1/F	22.6/F
1/4	3/32	0.12	100	100	100	60	60	60	200	150	8320G174	2	8320G200 ③④	3	17.1/F	11.6/F
1/4	1/8	0.25	50	50	50	25	25	25	200	150	8320G176	2	8320G201 ③④	3	17.1/F	11.6/F
1/4	11/64	0.35	20	20	20	12	12	12	200	150	8320G178	2	-	-	10.1/F	11.6/F
NORMALLY CLOSED (Closed when de-energized) – $PFD_{AVG} = 6.81 \times 10^{-4}$																
1/8	3/64	0.06	200	200	200	200	200	200	180	120	8320G132	1	8320G142 ③	1	6.1F	10.6/F
1/8	1/16	0.09	150	125	125	125	125	125	180	120	8230G013	1	8320G045 ③	1	6.1F	10.6/F
1/8	1/16	0.09	210	225	225	160	160	160	200	150	8320G215	4	8320G224 ④	4	17.1/F	11.6/F
1/8	3/32	0.12	100	100	100	100	100	100	180	120	8320G015	1	8320G047 ③	1	6.1F	10.6/F
1/8	3/32	0.12	150	150	150	115	115	115	200	150	8320G216	4	8320G225 ④	4	10.1/F	11.6/F
1/8	1/8	0.21	40	40	40	40	40	40	180	120	8320G017	1	8320G049 ③	1	6.1F	10.6/F
1/8	1/8	0.21	85	85	85	60	60	60	200	150	8320G217	4	8320G226 ④	4	10.1/F	11.6/F
1/4	1/16	0.09	210	225	225	160	160	160	200	150	8320G182	2	8320G231 ④	3	17.1/F	11.6/F
1/4	3/32	0.12	150	150	150	115	115	115	200	150	8320G184	2	8320G202 ③④	3	10.1/F	11.6/F
1/4	1/8	0.25	85	85	85	60	60	60	200	150	8320G186	2	8320G203 ③④	3	10.1/F	11.6/F
1/4	11/64	0.35	45	45	45	25	25	25	200	150	8320G188	2	-	-	10.1/F	11.6/F
NORMALLY OPEN (Open when de-energized)																
1/8	3/64	0.06	200	200	200	200	200	200	180	120	8320G136	1	8320G146 ③	1	6.1F	10.6/F
1/8	1/16	0.09	150	125	125	125	125	125	180	120	8320G027	1	8320G051 ③	1	6.1F	10.6/F
1/8	1/16	0.09	235	250	250	160	160	160	200	150	8320G218	4	8320G227 ④	4	17.1/F	11.6/F
1/8	3/32	0.12	100	100	100	100	100	100	180	120	8320G029	1	8320G053 ③	1	6.1F	10.6/F
1/8	3/32	0.12	150	140	140	100	100	100	200	150	8320G219	4	8320G228 ④	4	10.1/F	11.6/F
1/8	1/8	0.21	40	40	40	40	40	40	180	120	8320G031	1	8320G055 ③	1	6.1F	10.6/F
1/8	1/8	0.21	70	70	70	55	55	55	200	150	8320G220	4	8320G229 ④	4	10.1/F	11.6/F
1/4	1/16	0.09	235	250	250	160	160	160	200	150	8320G192	2	8320G232 ④	3	17.1/F	11.6/F
1/4	3/32	0.12	150	140	140	100	100	100	200	150	8320G194	2	8320G204 ③④	3	10.1/F	11.6/F
1/4	1/8	0.25	70	70	70	55	55	55	200	150	8320G196	2	8320G205 ③④	3	10.1/F	11.6/F
1/4	11/64	0.35	40	40	40	30	30	30	200	150	8320G198	2	-	-	10.1/F	11.6/F

① Supplied with cast UR disc.
② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts; the watt rating for the 9.1/F solenoid is 11.1 watts.
③ Can be used for ***dry*** natural gas service with the EF prefix.
④ Constructions standard rated -40˚F (-40˚C) ambient temperature. EFX prefix and TPL # not required.

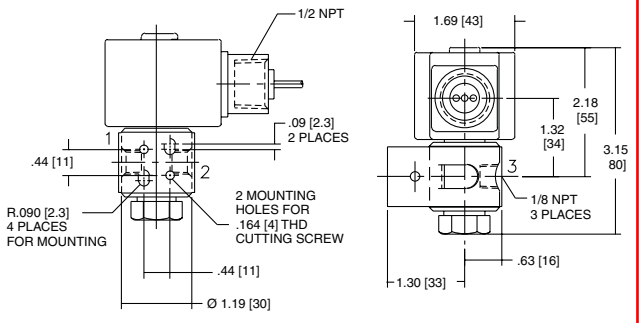
Specifications (Metric units)

Pipe Size (ins.)	Orifice Size (mm)	Kv Flow Factor (m3/h)	Operating Pressure Differential (bar) Max. AC Air-Inert Gas	Max. AC Water	Max. AC Lt. Oil @ 300 SSU	Max. DC Air-Inert Gas	Max. DC Water	Max. DC Lt. Oil @ 300 SSU	Max. Fluid Temp. °C AC	Max. Fluid Temp. °C DC	Brass Body Catalog Number	Brass Body Const. Ref.	Stainless Steel Body Catalog Number	Stainless Steel Body Const. Ref.	Watt Rating/ Class of Coil Insulation② AC	Watt Rating/ Class of Coil Insulation② DC
UNIVERSAL OPERATION (Pressure at any port)																
1/8	1.2	0.05	12	12	12	9	9	9	60	49	8320G130 ①	1	8320G140 ①	1	9.1F	10.6F
1/8	1.6	0.08	7	7	7	4	4	4	82	49	8320G001	1	8320G041 ③	1	9.1F	10.6F
1/8	1.6	0.08	12	12	12	9	9	9	93	66	8320G212	4	8320G221 ④	4	17.1/F	22.6/F
1/8	2.4	0.10	3	3	3	3	3	3	82	49	8320G083	1	8320G087 ③	1	6.1/F	10.6/F
1/8	2.4	0.10	7	7	7	4	4	4	93	66	8320G213	4	8320G222 ④	4	17.1/F	11.6/F
1/8	3.2	0.18	2	2	2	1	1	1	82	49	8320G003	1	8320G043 ③	1	9.1/F	10.6/F
1/8	3.2	0.18	3	3	3	2	2	2	93	66	8320G214	4	8320G223 ④	4	17.1/F	11.6/F
1/4	1.6	0.08	9	9	9	5	5	5	93	66	8320G172	2	-	-	10.1/F	11.6/F
1/4	1.6	0.08	12	12	12	9	9	9	93	66	-	-	8320G230 ④	3	17.1/F	22.6/F
1/4	2.4	0.10	7	7	7	4	4	4	93	66	8320G174	2	8320G200 ③④	3	17.1/F	11.6/F
1/4	3.2	0.21	3	3	3	2	2	2	93	66	8320G176	2	8320G201 ③④	3	17.1/F	11.6/F
1/4	4.4	0.30	1	1	1	1	1	1	93	66	8320G178	2	-	-	10.1/F	11.6/F
NORMALLY CLOSED (Closed when de-energized) – PFD_{AVG} = 6.81 x 10^{-4}																
1/8	1.2	0.05	14	14	14	14	14	14	82	49	8320G132	1	8320G142 ③	1	6.1F	10.6/F
1/8	1.6	0.08	10	9	9	9	9	9	82	49	8230G013	1	8320G045 ③	1	6.1F	10.6/F
1/8	1.6	0.08	14	15	15	11	11	11	93	66	8320G215	4	8320G224 ④	4	17.1/F	11.6/F
1/8	2.4	0.10	7	7	7	7	7	7	82	49	8320G015	1	8320G047 ③	1	6.1F	10.6/F
1/8	2.4	0.10	10	10	10	8	8	8	93	66	8320G216	4	8320G225 ④	4	10.1/F	11.6/F
1/8	3.2	0.18	3	3	3	3	3	3	82	49	8320G017	1	8320G049 ③	1	6.1F	10.6/F
1/8	3.2	0.18	6	6	6	4	4	4	93	66	8320G217	4	8320G226 ④	4	10.1/F	11.6/F
1/4	1.6	0.08	14	15	15	11	11	11	93	66	8320G182	2	8320G231 ④	3	17.1/F	11.6/F
1/4	2.4	0.10	10	10	10	8	8	8	93	66	8320G184	2	8320G202 ③④	3	10.1/F	11.6/F
1/4	3.2	0.21	6	6	6	4	4	4	93	66	8320G186	2	8320G203 ③④	3	10.1/F	11.6/F
1/4	4.4	0.30	3	3	3	2	2	2	93	66	8320G188	2	-	-	10.1/F	11.6/F
NORMALLY OPEN (Open when de-energized)																
1/8	1.2	0.05	14	14	14	14	14	14	82	49	8320G136	1	8320G146 ③	1	6.1F	10.6/F
1/8	1.6	0.08	10	9	9	9	9	9	82	49	8320G027	1	8320G051 ③	1	6.1F	10.6/F
1/8	1.6	0.08	16	17	17	11	11	11	93	66	8320G218	4	8320G227 ④	4	17.1/F	11.6/F
1/8	2.4	0.10	7	7	7	7	7	7	82	49	8320G029	1	8320G053 ③	1	6.1F	10.6/F
1/8	2.4	0.10	10	10	10	7	7	7	93	66	8320G219	4	8320G228 ④	4	10.1/F	11.6/F
1/8	3.2	0.18	3	3	3	3	3	3	82	49	8320G031	1	8320G055 ③	1	6.1F	10.6/F
1/8	3.2	0.18	5	5	5	4	4	4	93	66	8320G220	4	8320G229 ④	4	10.1/F	11.6/F
1/4	1.6	0.08	16	17	17	11	11	11	93	66	8320G192	2	8320G232 ④	3	17.1/F	11.6/F
1/4	2.4	0.10	10	10	10	7	7	7	93	66	8320G194	2	8320G204 ③④	3	10.1/F	11.6/F
1/4	3.2	0.21	5	5	5	4	4	4	93	66	8320G196	2	8320G205 ③④	3	10.1/F	11.6/F
1/4	4.4	0.30	3	3	3	2	2	2	93	66	8320G198	2	-	-	10.1/F	11.6/F

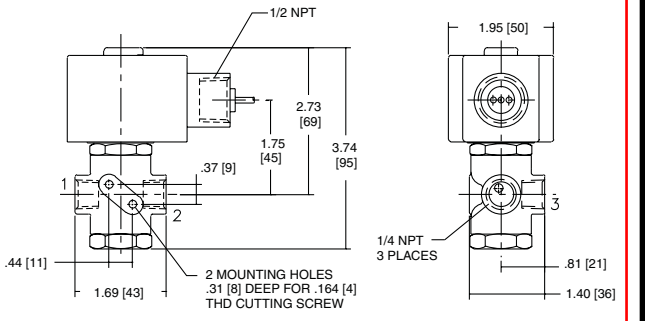
① Supplied with cast UR disc.
② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts; the watt rating for the 9.1/F solenoid is 11.1 watts.
③ Can be used for ***dry*** natural gas service with the EF prefix.
④ Constructions standard rated -40˚F (-40˚C) ambient temperature. EFX prefix and TPL # not required.

Dimensions: inches (mm)

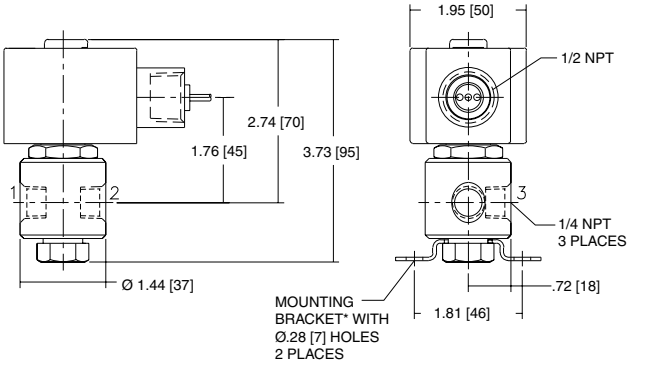
Const. Ref. 1



Const. Ref. 2

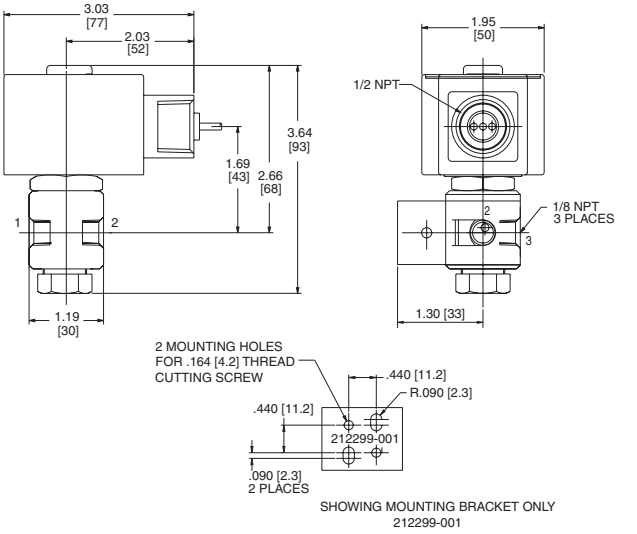


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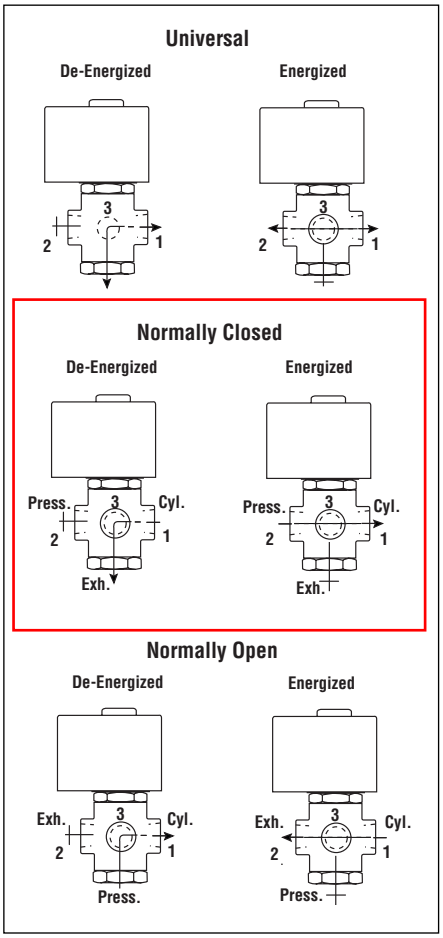
* MOUNTING BRACKET
IS STANDARD ON THIS
CONSTRUCTION

Const. Ref. 4



SHOWING MOUNTING BRACKET ONLY
212299-001

FLOW DIAGRAMS



7768K

▲ BRASS CHECK VALVES - PISTON SERIES

BRASS AND STAINLESS STEEL PISTON CHECK VALVES

Female Pipe x Female Pipe

MODEL	END CONN.	END CONN.	A	MAX PRESSURE	OPEN DIA.	APPROX C.V.	WATER G.P.M. @ 10 PSI
215-2F2F	1/8 F.N.P.T.	1/8 F.N.P.T.	1.38	500	.197	1.4	3.7
415-4F4F	1/4 F.N.P.T.	1/4 F.N.P.T.	1.80	500	.265	2.0	5.6
615-6F6F	3/8 F.N.P.T.	3/8 F.N.P.T.	2.25	500	.375	4.0	12.0
815-8F8F	1/2 F.N.P.T.	1/2 F.N.P.T.	2.55	500	.437	5.3	16.0
1215-12F12F	3/4 F.N.P.T.	3/4 F.N.P.T.	3.00	500	.594	3.5	24.0

ADT AIR INLET CHECK VALVE

Male Pipe x Male Pipe

MODEL	END CONN.	END CONN.	A	MAX PRESSURE	OPEN DIA.	APPROX C.V.	WATER G.P.M. @ 10 PSI
210-2M2M	1/8 M.N.P.T.	1/8 M.N.P.T.	1.19	500	.140	.54	1.7
410-4M4M	1/4 M.N.P.T.	1/4 M.N.P.T.	1.50	500	.203	1.15	3.5
610-6M6M	3/8 M.N.P.T.	3/8 M.N.P.T.	1.70	500	.297	2.5	8.0
810-8M8M	1/2 M.N.P.T.	1/2 M.N.P.T.	2.00	500	.375	4.0	12.0
1210-12M12M	3/4 M.N.P.T.	3/4 M.N.P.T.	2.20	500	.500	7.0	22.0

-K15

Female Pipe x Male Pipe

MODEL	END CONN.	END CONN.	A	MAX PRESSURE	OPEN DIA.	APPROX C.V.	WATER G.P.M. @ 10 PSI
210-2F2M	1/8 F.N.P.T.	1/8 M.N.P.T.	1.06	500	.140	.54	1.7
410-4F4M	1/4 F.N.P.T.	1/4 M.N.P.T.	1.38	500	.203	1.15	3.5
610-6F6M	3/8 F.N.P.T.	3/8 M.N.P.T.	1.69	500	.297	2.5	8.0
810-8F8M	1/2 F.N.P.T.	1/2 M.N.P.T.	1.88	500	..375	4.0	12.0
1210-12F12M	3/4 F.N.P.T.	3/4 M.N.P.T.	2.25	500	.500	7.0	22.0

CODE IDENTIFICATION

(F) F.N.P.T. Female
(M) M.N.P.T. Male

SEAL

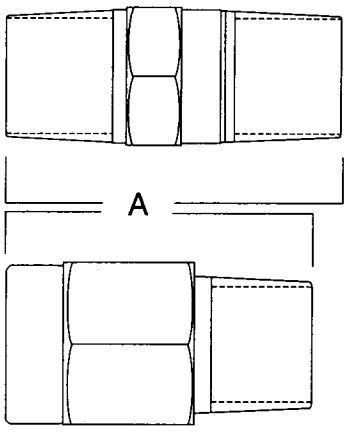
(B) Buna-N
(E) Ethylene Propylene
(F) Fluroelastomer
(N) Neoprene

MATERIALS

(BRS) Brass
(SST) 316 Stainless Steel

BRS 210 - 4 M 4 M - B

- Seal
- End Connector
- Size
- End Connector
- Size
- Model
- Material



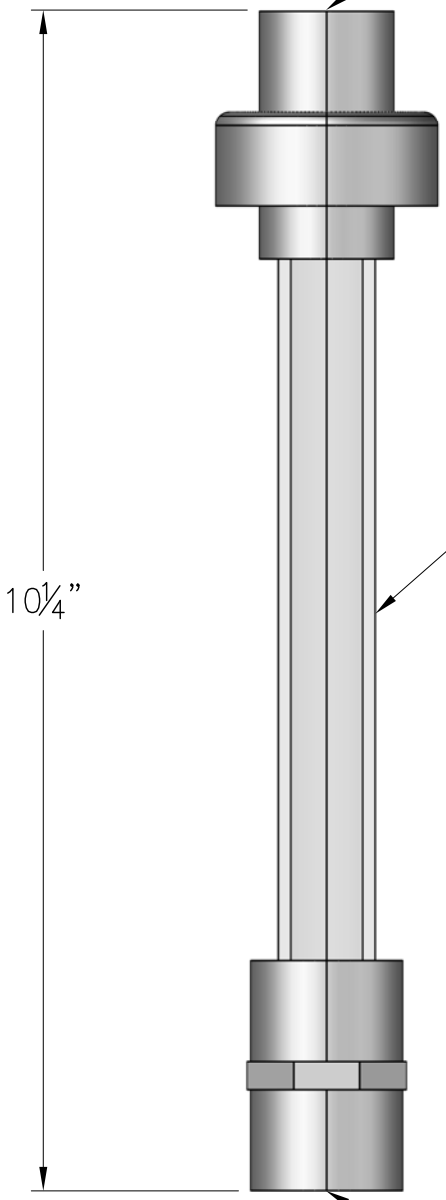
The Brass Piston Series valves will operate in any position, with its compact design and one piece body, making it a superb all purpose valve. Applications include air or liquid for all types as determined by the O-ring seal.

- Standard cracking pressure 1 p.s.i. (optional 1/3, 3 or 7 p.s.i. available) with a maximum operating pressure of 500 p.s.i. and a maximum operating temperature 180° F.
- Buna-N seals standard, ethylene propylene, fluroelastomer and neoprene seals available.
- Body and piston materials are brass or stainless steel.
- Springs are type 302 stainless steel (Hastelloy spring available).
- Retainer is plated steel or stainless steel.
- For Technical Assistance, custom springs, and end combinations, please call or fax our Customer Service Department.
- **UL Listed Component**

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REV	DESCRIPTION	DWN	DATE	CHK'D	APP'D

ADT COURSE AIR BLEED-OFF SITE TUBE



KROFTA
a Watereau company

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME:					
AIR DISSOLVING TUBE					
DATE: 07/27/15	SCALE: –	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:
TITLE: STANDARD BLEED–OFF SIGHT TUBE OUTLINE				DRAWING NUMBER: ADTBO–OL–01	REV:

EQUIPMENT TECHNICAL DATA SHEETS

KROFTA DISSOLVED AIR FLOTATION UNIT (DAF)
&
AIR DISSOLVING TUBE (ADT)

DESCRIPTION

KROFTA MULTIFLOAT Model: MFH-500 DAF Unit

- Materials:
  Wetted construction in 304L SS: Tank Walls, Internal Wetted Parts & Piping.
  Non-Wetted Structure & Brackets construction in 304L SS: Tank Rim, DAF Support Ribs, Floor Support Grid. Pipe Connection nozzles in 304L SS Pipe w/ SS AFR and Galvanized Back-Up Flanges (ANSI-Style w/ 150 Lbs. Drillings).
- Includes:
  - Floated Sludge Removal System –
    - Top Scraper System w/ SEW Eurodrive Gearbox/motor Drive Unit, 1.5HP, 460V/3PH/60HZ.
    - Scraper Blade Material: BUNA
    - Integral Floated Sludge Hopper
    - Floated Sludge Radar Level Sensor (4-20mA)
    - Floated Sludge Valve – Qty (1) – Pneumatic Open/Close Butterfly Valve (NC)
      - Including solenoid valve (24VDC)
  - Sediment Removal –
    - Sediment Purge Valves – Qty (2) – Pneumatic Open/Close Butterfly Valve (NC)
      - Including solenoid valve (24VDC)
  - DAF Level Control –
    - DAF Level Sensor – Differential Pressure Transmitter (4-20mA)
    - DAF Level Control Valve – Pneumatic Modulating Butterfly Valve (NC) (4-20mA)
  - Isolation Butterfly Valves mounted to following nozzles:
    - DAF Influent
    - DAF Effluent
    - DAF Recycle Outlet
  - 304L SS Access Platform w/ Ships Stairs (*Disassembled for shipping*)

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

KROFTA AIR DISSOLVING SYTEM utilizing KROFTA AIR DISSOLVING TUBE Model: ADT-500 Unit

- Materials:
  Wetted construction in 304L SS
  Pipe Connection nozzles in 304L SS Pipe w/ SS AFR and Galvanized Back-Up Flanges. Blind Flanges are Painted Steel w/ 304L SS Internal Cladding. (ANSI-Style w/ 150 Lbs. Drillings).
  Gaskets: Neoprene
- Includes:
  - Air Dissolving Pneumatic Panel and System Components
    - Air Regulator, Pressure Gauge, Rotometer, Pressure Relief Valve, ADT Air Inlet Brass Solenoid Valve (24VDC), Low Air Pressure Switch (24VDC), w/ Poly Pneumatic Air Tubing**.** Also includes: KROFTA Coarse Air Bleed-Off Tube, ADT Air Feed Isolation Valve, ADT Air Feed Check Valve, and ADT Sample Isolation Valve.
  - ADT / DAF Recycle Pump
    - Design Point: 80 GPM @ 180' TDH
    - Pressure Release Globe Valve – Qty (1) – KROFTA APGV – Pneumatic Open/Close (to last position) Angle Seat Globe Valve – (NC to adjusted position)
      - Including solenoid valve (24VDC)

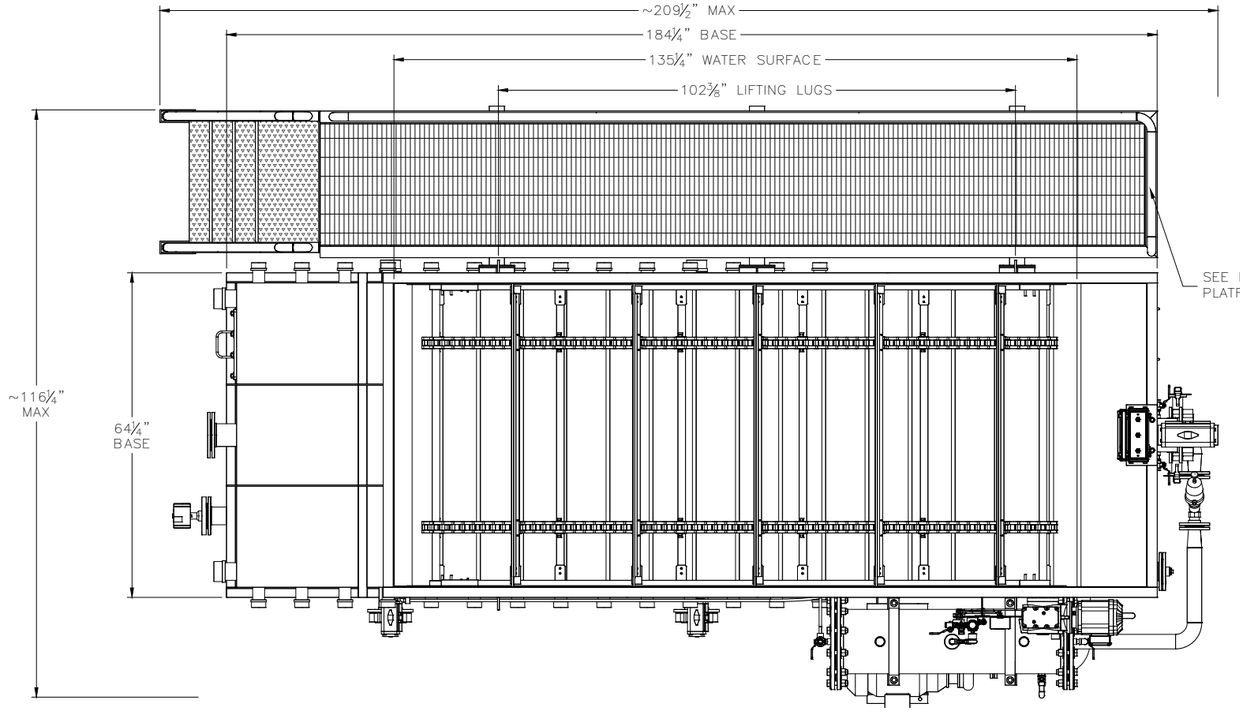
KROFTA DAF SKID PIPING

- Includes: 304 SS Mounting Supports for ADT; mounting of ADT & ADT Pneumatic Control Panel to Unit w/ following 304L SCH 10 Piping w/ 316 SS AFR and Galvanized Back-Up Flanges (ANSI-Style w/ 150 Lbs. Drillings).:
  - *Piping between DAF Recycle Outlet and Recycle Pump Inlet.*
    - *Note: this to be disconnected prior to shipping and to be re-installed onsite by the contractor.*
  - *Piping between DAF Recycle Pump Outlet and ADT Inlet.*
  - *Piping w/ Globe Valve Mounted between ADT Outlet and DAF Recycle Inlet*
- *Includes Pneumatic Poly Tubing from Pneumatic Control Panel to:*
  - *ADT Unit*
  - *Pneumatic Valves*

ADDITIONAL DETAILS:

- Note, for additional info please refer to:
  - KROFTA MFH-500 DAF & ADT-500 Drawings
  - Additional Equipment Submittals for Valves, Instruments, etc.

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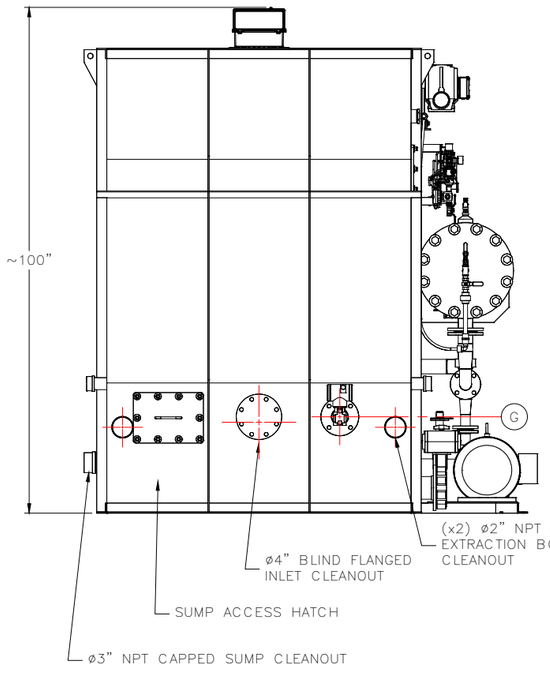


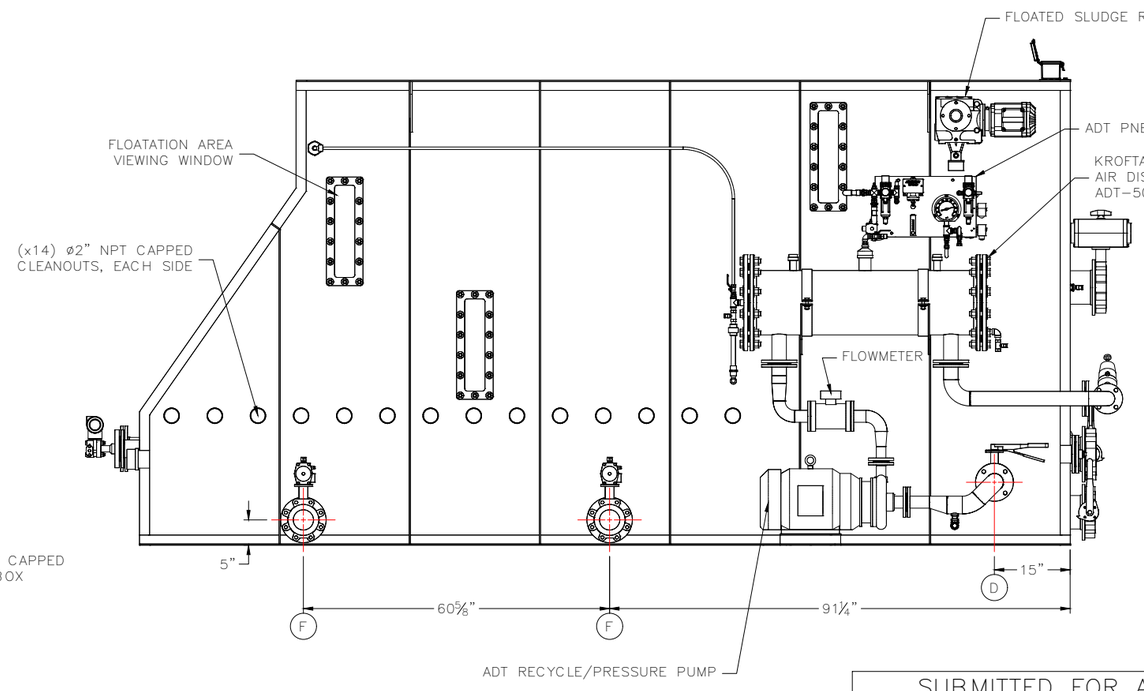
ITEM	DESCRIPTION	CONNECTION	WALL OFFSET
A	UNCLARIFIED WATER INLET *(BV)	ø6" – FLANGE	4"
B	FLOATED SLUDGE OUTLET *(BV)	ø6" – FLANGE	4"
C	CLARIFIED WATER OUTLET *(BV)	ø6" – FLANGE	4"
D	CLARIFIED RECYCLE OUTLET	ø3" – FLANGE	2"
E	PRESSURIZED WATER INLET	ø2½" – FLANGE	1½"
F	SEDIMENT PURGE OUTLET (x2)	ø4" – FLANGE	3"
G	LEVEL SENSOR CONNECTION	ø3" – FLANGE	3"
H	CHEMICAL INJECTION TAP	ø¼" MALE NPT	N/A
J	CLEARWELL TAP	ø1" – FEMALE NPT	N/A
–	---	---	---
L	COMPRESSED AIR CONNECTION	ø⅜" – FEMALE NPT	N/A
M	ADT BLEEDOFF CONNECTION 1	ø½" – FEMALE NPT	N/A
N	ADT BLEEDOFF CONNECTION 2	ø½" – FEMALE NPT	N/A
O	ADT BLEEDOFF CONNECTION 3	ø½" – FEMALE NPT	N/A

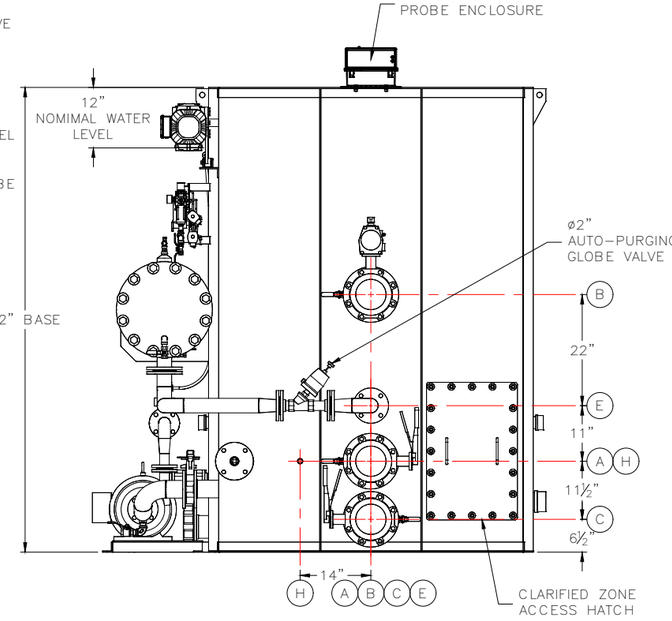
*150 LB. FLANGE DRILLING DIMENSIONS (BV) WITH ø½" BALL VALVE FOR SAMPLING

MFH-500 EQUIPMENT AND WATER WEIGHTS:
SHIPPING: 5,800 LBS
FLOODED: 37,000 LBS

MULTIFLOAT STANDARD FABRICATION MATERIALS:
WETTED TANK WALLS & PIPING: 304LSS.
NON-WETTED STRUCTURE & BRACKETS INCLUDES TANK RIM, SUPPORT RIBS, FLOOR SUPPORT GRID, ACCESS PLATFORM, STAIRS: 304SS.
ANGLE FACE RINGS: 316LSS.
BACKUP FLANGES: GALV. MILD STEEL.
SCRAPER BLADES: BUNA.
BEARINGS: UHMWP.
SPROCKETS: NYLON.
CHAIN: ACETAL.







SUBMITTED FOR APPROVAL
BY: JEFF MILLER DATE: MAY 19, 2025
APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP

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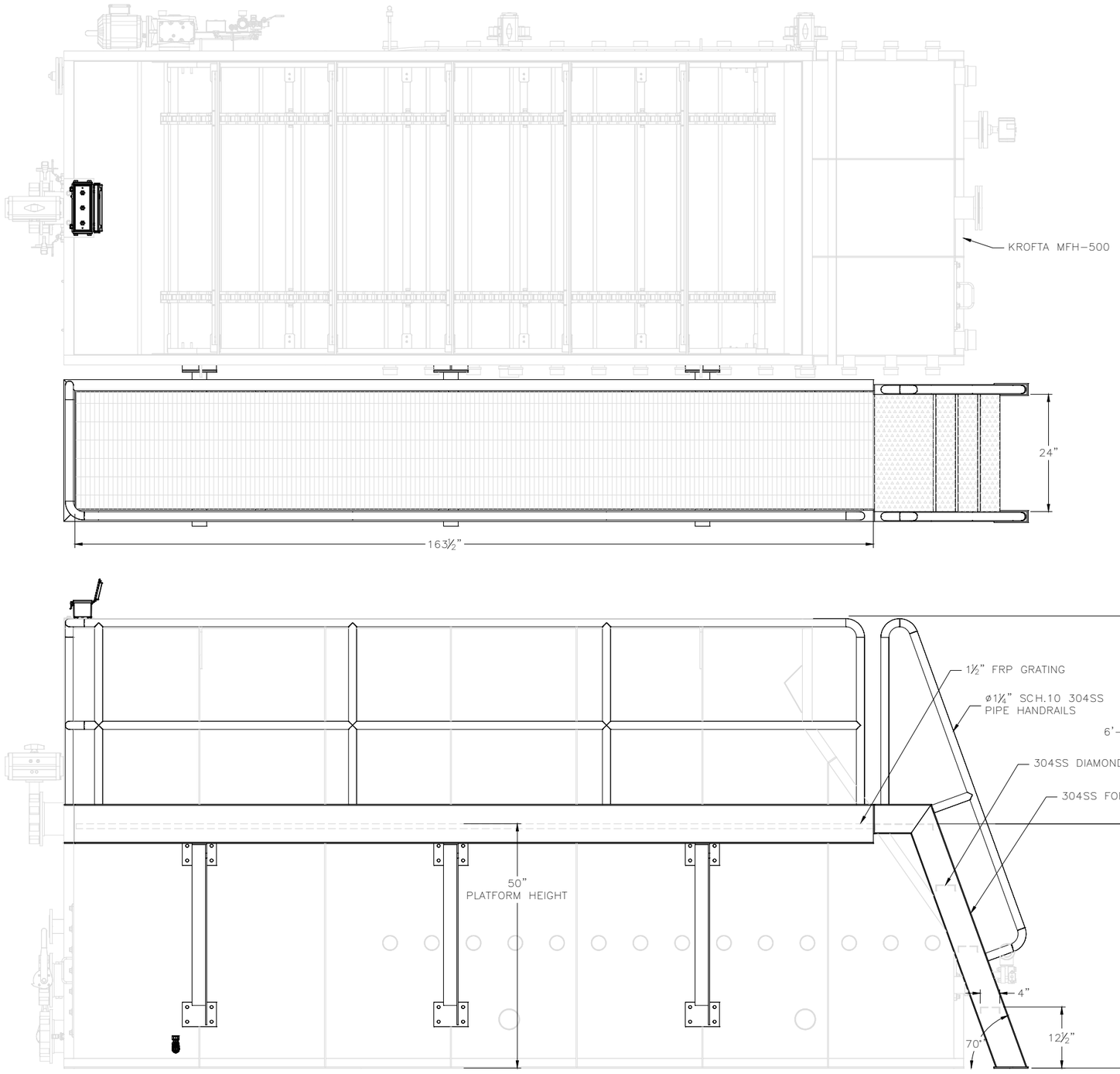
KROFTA
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME: JOB 25-K01 – CITY of AUMSVILLE, OR

DATE: 05/19/25	SCALE: –	DRAWN BY: ADC	DESIGNED BY: –	CHECKED BY: –	APPROVED BY: –

TITLE: KROFTA MULTIFLOAT MFH-500 DAF UNIT CONFIGURATION

DRAWING NUMBER: 25K01-MFH500-DUC-01-1 REV: –



SUBMITTED FOR APPROVAL

BY: JEFF MILLER DATE: MAY 9, 2025

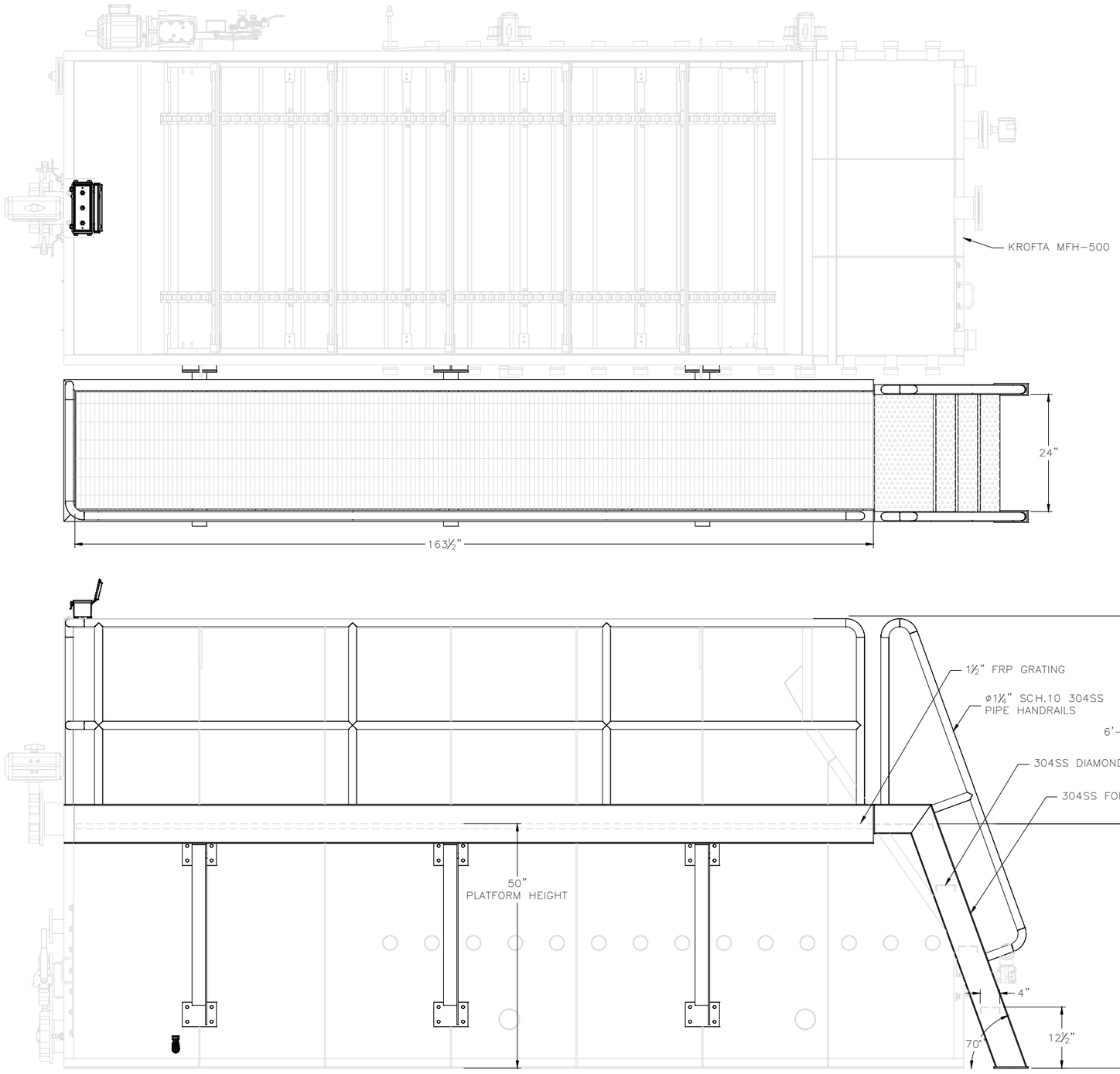
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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME:	JOB 25–K01 – CITY of AUMSVILLE, OR						
DATE: 05/19/25	SCALE: –	DRAWN BY: ADG	DESIGNED BY: –	CHECKED BY: –	APPROVED BY: –		
TITLE:	KROFTA MULTIFLOAT MFH–500 DAF UNIT CONFIGURATION			DRAWING NUMBER:	25K01-MFH500-DUC-01-2	REV:	–



SUBMITTED FOR APPROVAL

BY: JEFF MILLER DATE: MAY 9, 2025

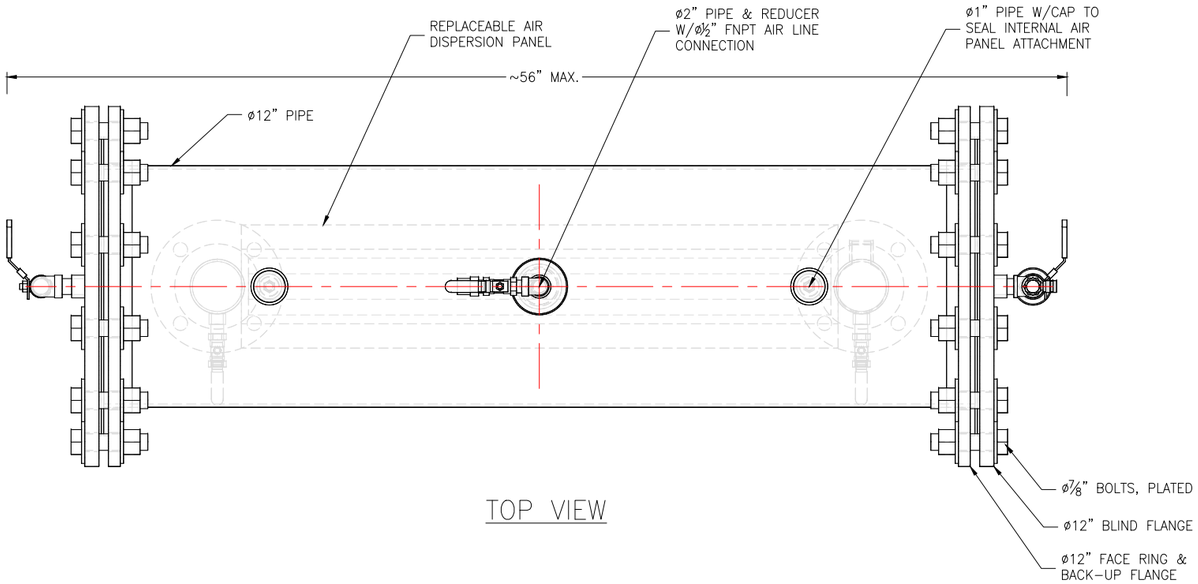
APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP

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NAME:	JOB 25–K01 – CITY of AUMSVILLE, OR						
DATE: 05/19/25	SCALE: –	DRAWN BY: ADG	DESIGNED BY: –	CHECKED BY: –	APPROVED BY: –		
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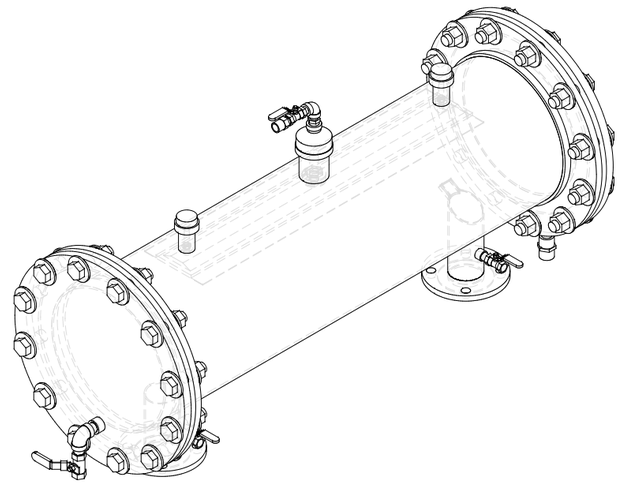


TOP VIEW

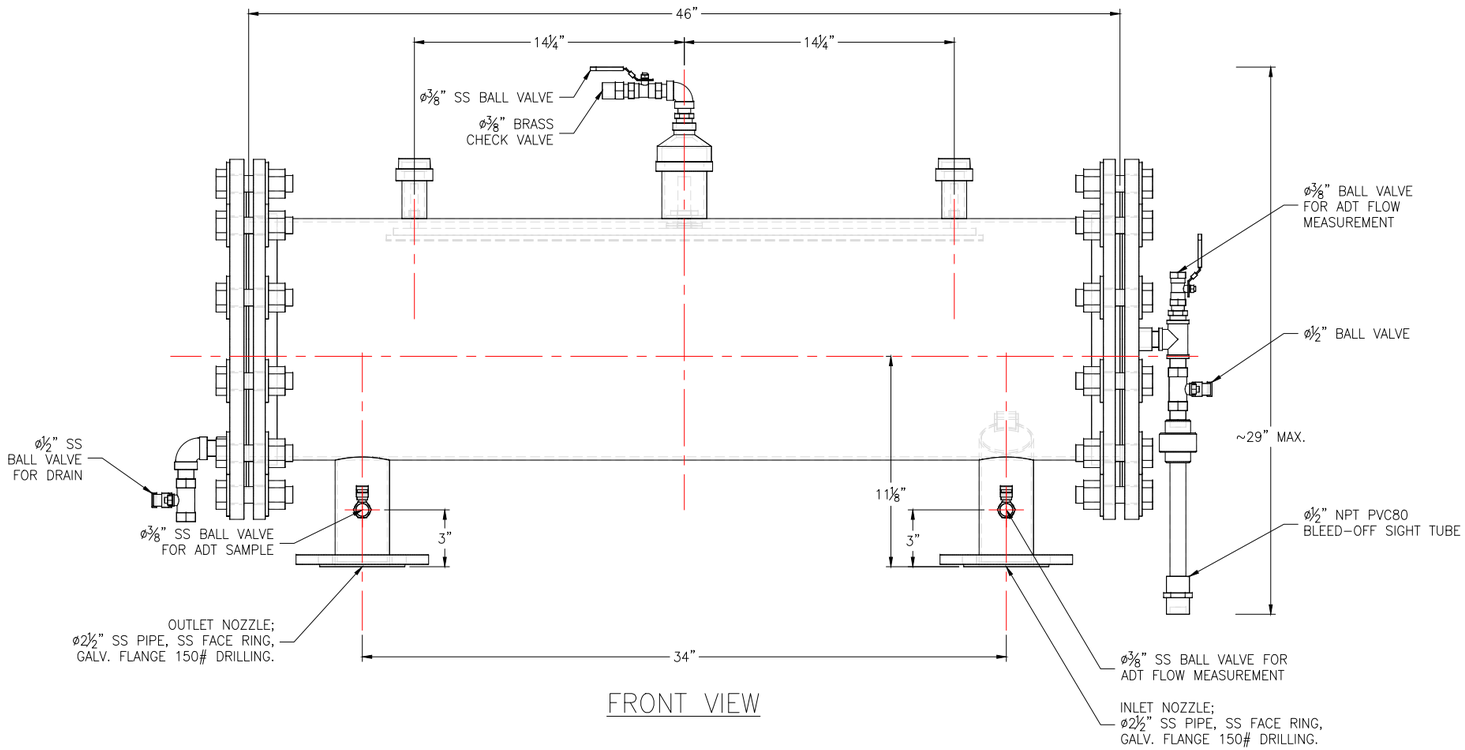
MATERIALS OF CONSTRUCTION:

- ADT PIPING: 304LSS.
- BACK-UP FLANGES: GALV. STEEL.
- BLIND FLANGES: PAINTED MILD STEEL W/304LSS INTERNAL CLADDING.
- FASTENERS: ZINC PLATED.
- GASKETS: NEOPRENE
- REPLACEABLE AIR PANEL: 304LSS

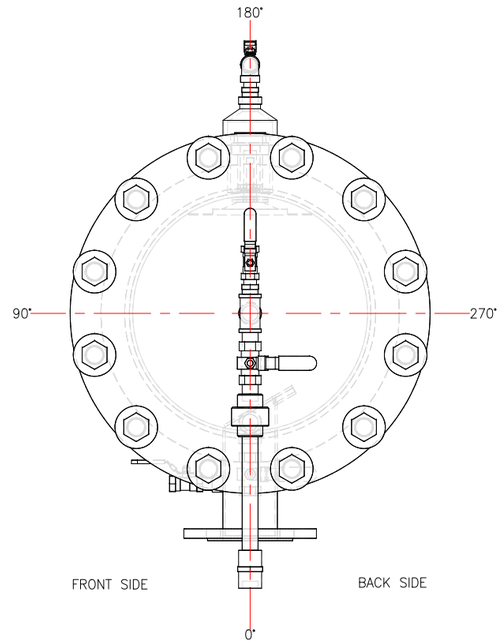
ESTIMATED WEIGHTS:
DRY = 360 LBS. [164 KG]
OPERATING = 550 LBS. [250 KG]



ISO VIEW



FRONT VIEW



INLET END

ADT INLET NOZZLE SIZED FOR FLOW OF _____ GPM.

SUBMITTED FOR APPROVAL
BY: JEFF MILLER MAY 19, 2025
APP'D BY: _____ DATE: _____

REV	DESCRIPTION	DWN	DATE	CHK	APP

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ITEM	QTY	MAT'L	DESCRIPTION	REMARKS

KROFTA a Watertexx company
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME: JOB 25-K01 – CITY OF AUMSVILLE, OR

DATE: 05/19/25	SCALE: –	DRAWN BY: ADG	DESIGNED BY: –	CHECKED BY: –	APPROVED BY: –

TITLE: AIR DISSOLVING TUBE TYPE ADT-500 CONFIGURATION OUTLINE

DRAWING NUMBER: 25K01-ADT500-COL-01-1 REV: –

KROFTA MULTIFLOAT DAF

OPERATION MANUAL

12/17/2018

KROFTA TECHNOLOGIES
PO Box 7, 401 South Street, Dalton, MA 01227, Ph: 413-236-5634 Fax: 413-236-6917
Website: www.kroftatech.com

MULTIFLOAT (MF) GENERAL DESCRIPTION

The Krofta Technologies MULTIFLOAT (MF) is a rectangular dissolved air flotation (DAF) unit, available in vertical (MFV) and horizontal designs. Krofta designs and engineers DAFs for installation in a wide variety of industrial or municipal applications. The design is of a modular configuration, which allows additional Flotation Enhancement Cells (FECs) to be added or subtracted from the flotation cell to accommodate different flow capacities.

PROCESS DESCRIPTION

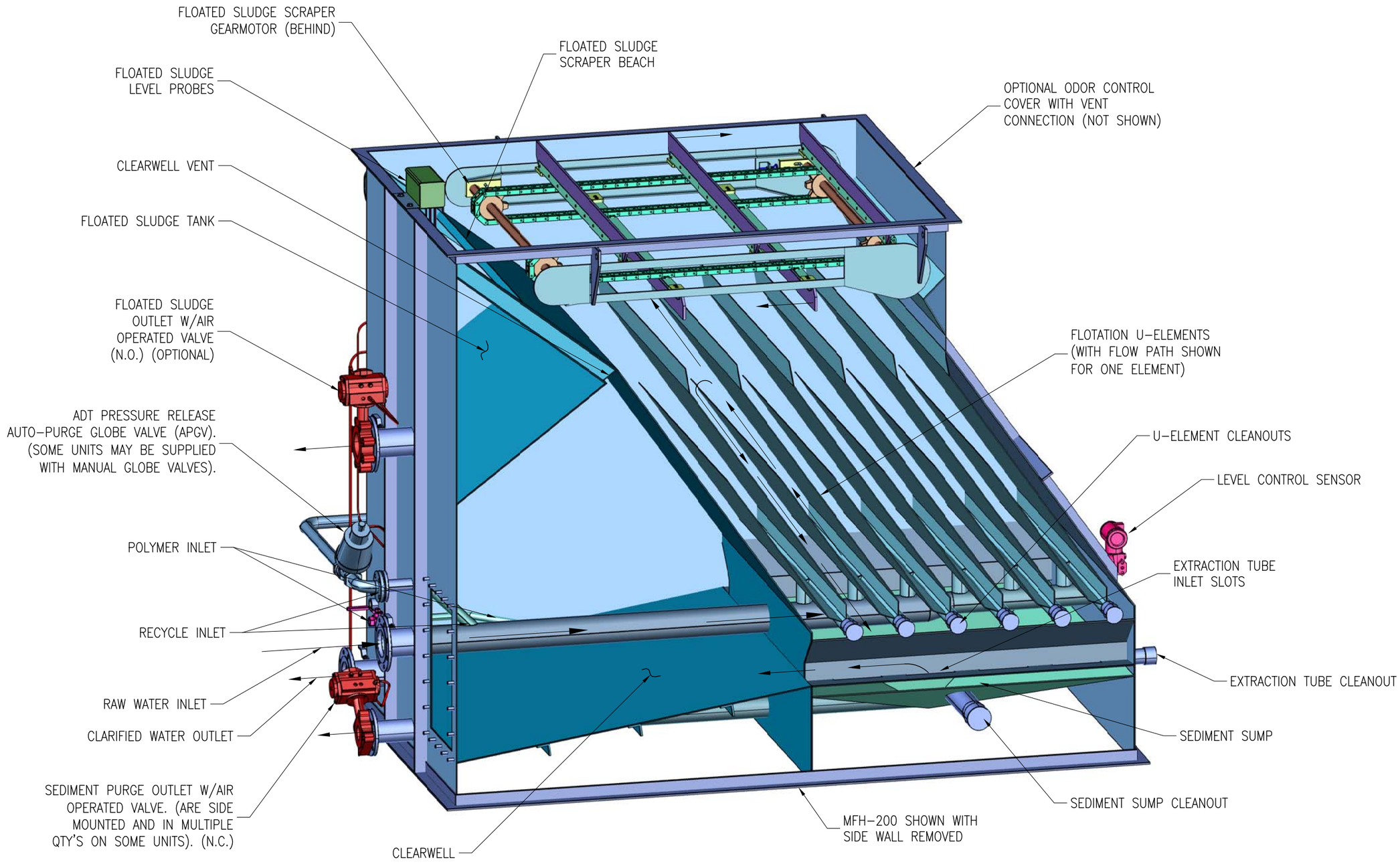
A mix of raw wastewater and aerated recycle flow are introduced at the bottom side of the unit. A header pipe is affixed to the outside of the unit that will distribute the flow to the individual FECs within the flotation tank. This arrangement also allows the unit to be customized so that the unit can be installed tight against a wall on either side of a room by swapping the influent / effluent piping to either side of the unit. FEC design allows for even distribution of the flow across the unit. Retention time within the unit will vary with the amount of raw water being processed but it is generally a minimum of 3-4 minutes. Flocculated particles attach to the aerated water and rise to the surface close to the plate inside the FEC. The plates assist in the rise rate by reducing the hydraulic head over the particle allowing it to rise at an increased rate. Clarified water is drawn back down between the FECs to a collection area below the bottom of the FECs. The clarified water flows up over a divider plate at the top of the tank, into a clearwell reservoir and is then discharged by gravity out of the unit. The Krofta automatic level control system maintains a constant water level.



A portion of the flow is “recycled” back to the Air Dissolving Tube (ADT) through a separate connection below the effluent line. Should flow be shut-off to the unit, this ensures the flow to the recycle pump will not stop and cause damage to the pump. Floated materials are collected at the top of the FECs and directed towards the sludge collection rake assembly. The rake pushes the floated material over a simple beach design and deposits the material into a small sludge collection trough that is discharged by gravity.

Grit or other debris that does not float is collected in the v-bottom of the unit. Because of the small footprint of the unit, a scraping mechanism is not required. The bottom sediment sump is intermittently purged automatically. One or more (depending on the size of the unit) butterfly valves for the purge are controlled by a simple timing mechanism in the control panel or PLC.

AIR DISSOLVING SYSTEM: A portion of the clarified water (typically 15% - 30% depending on the application) is recycled to feed the air dissolving system. The water is drawn from the clarified water source and pumped through a standard centrifugal pump at ~180 ft/hd. The clarified water then enters the ADT where it has an 8-12 second retention time. A globe valve located on the discharge line controls the flow. The pressurized flow is connected to the inlet header where it is mixed with raw water flow prior to entering the unit. A specially designed influent nozzle causes the flow from the recycle pump to enter the ADT in a spiral pattern.



KROFTA MULTIFLOAT INTERNAL VIEW

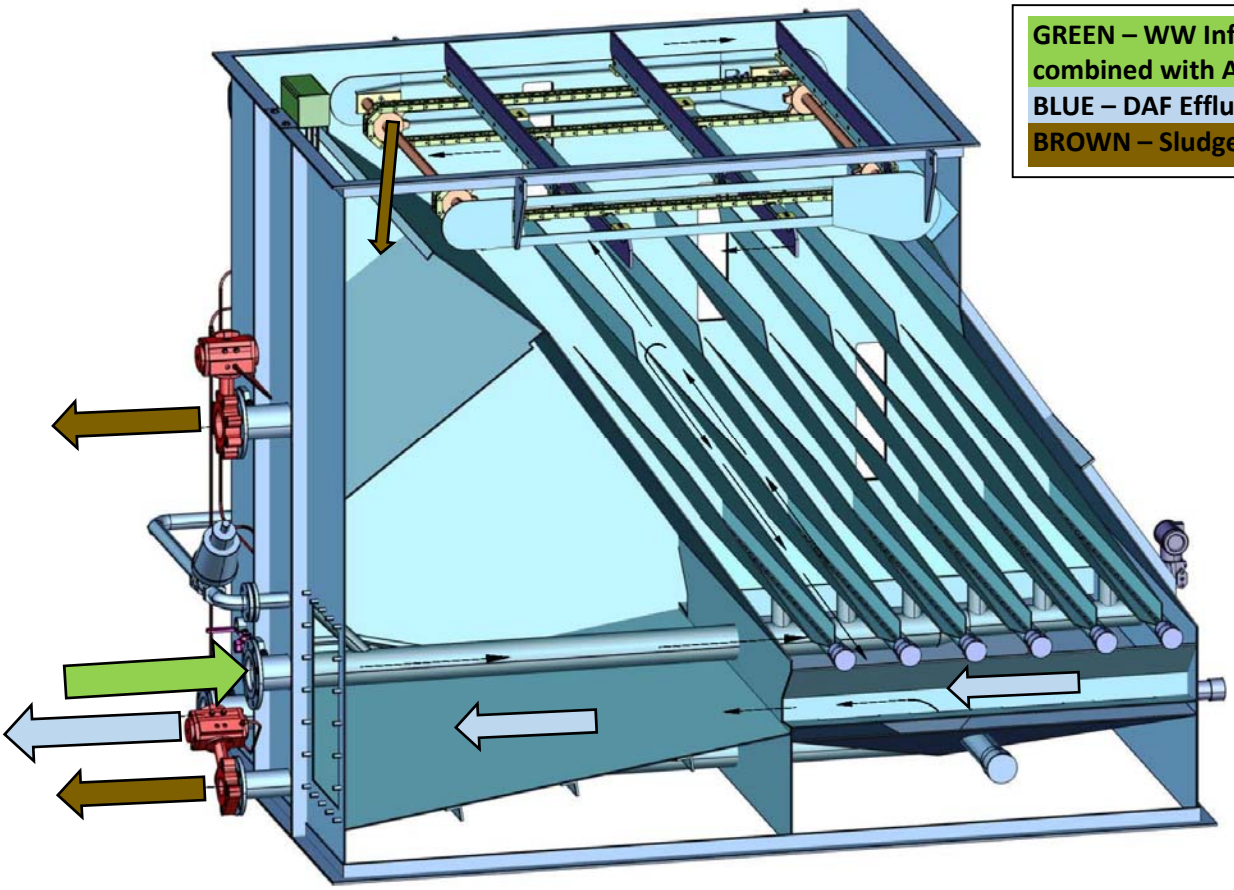
REV	DESCRIPTION	DWN	DATE	CHK'D	APP'D

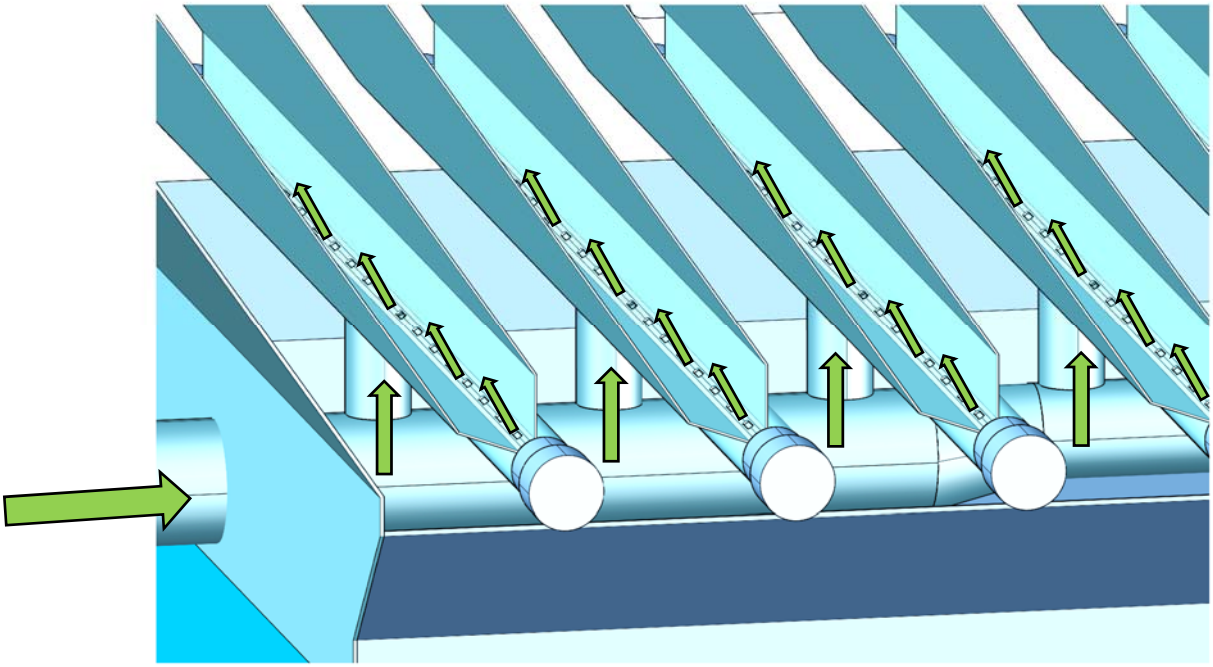
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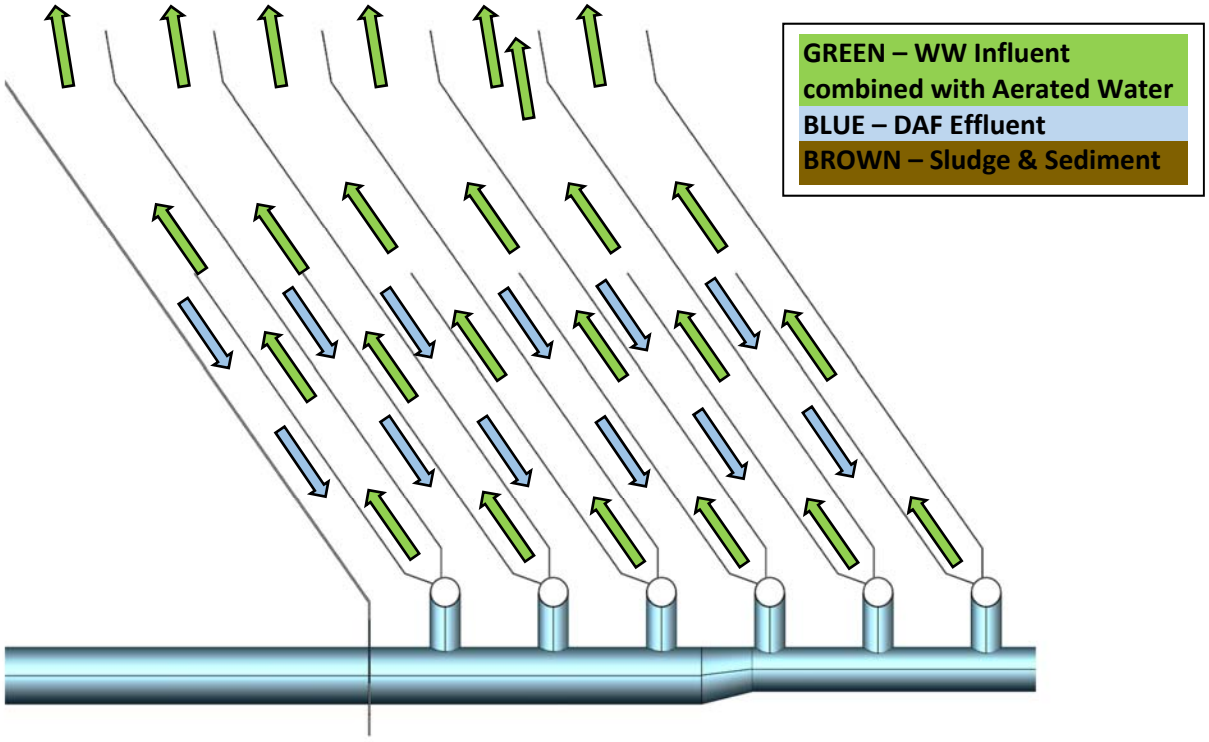
KROFTA a Watereau company
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

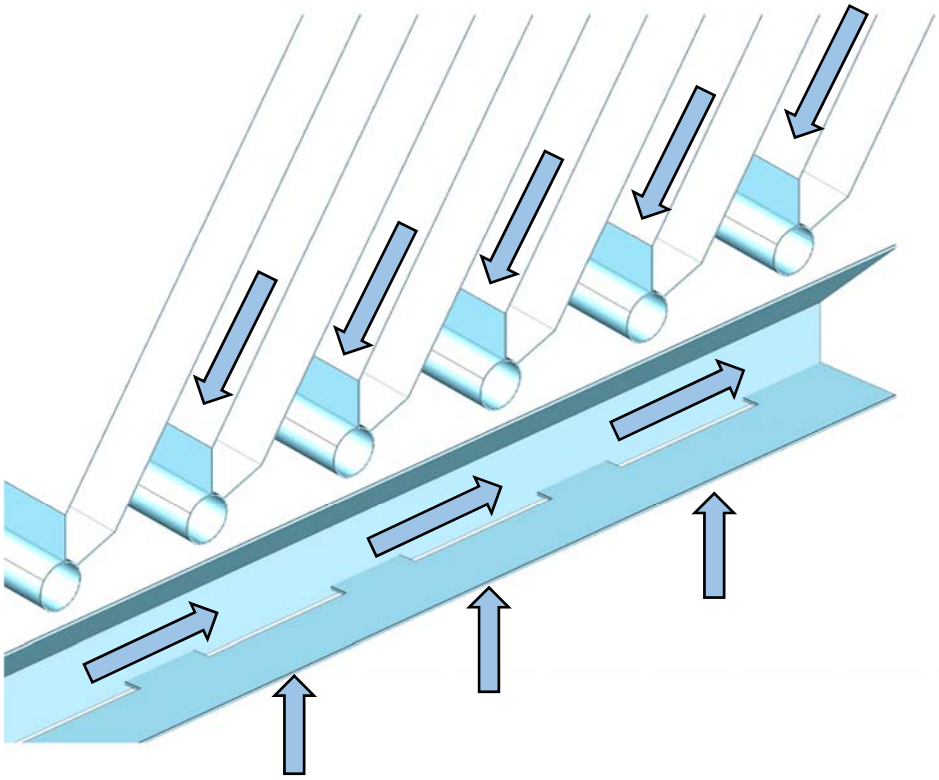
NAME: KROFTA MULTIFLOAT					
DATE: 11/04/14	SCALE: –	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:
TITLE: MFH-200 HORIZONTAL DAF INTERNAL VIEWS & DESCRIPTIONS				DRAWING NUMBER: MFH200-INT-01	REV:

KROFTA MULTIFLOAT HORIZONTAL

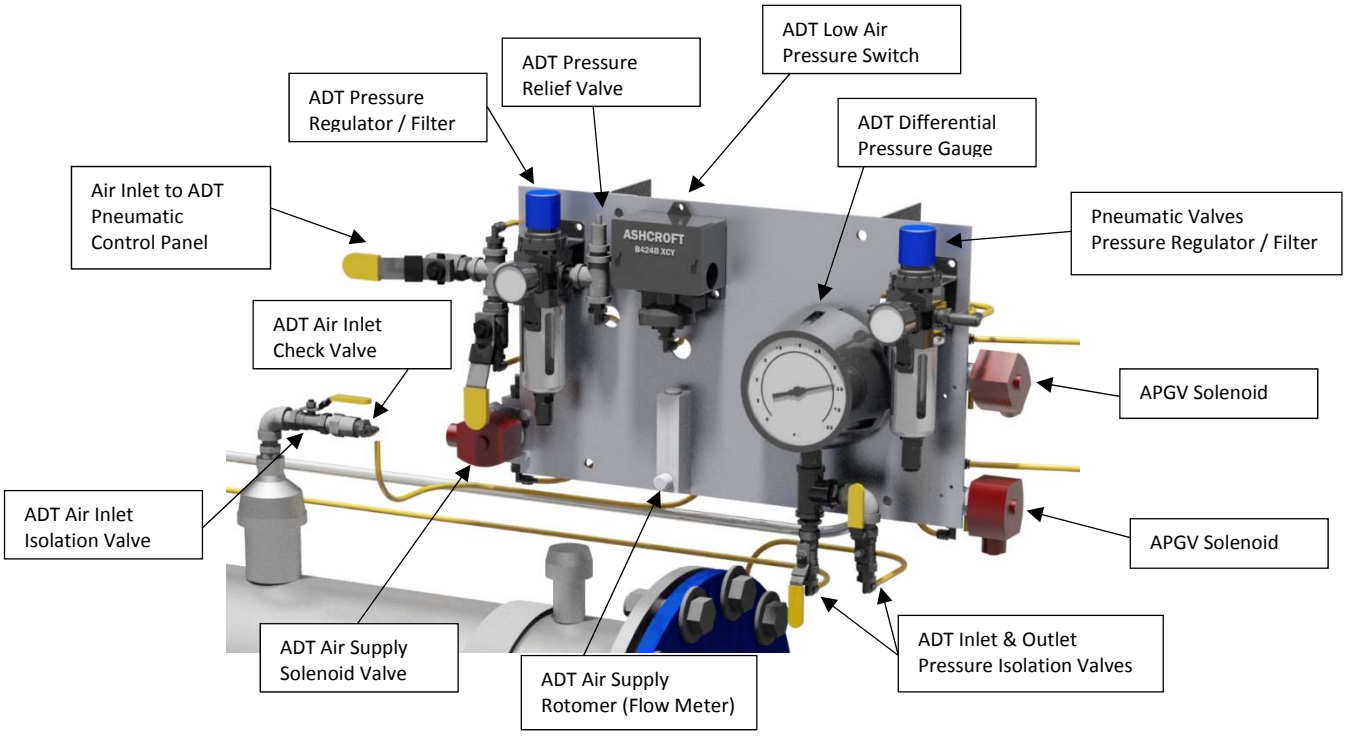


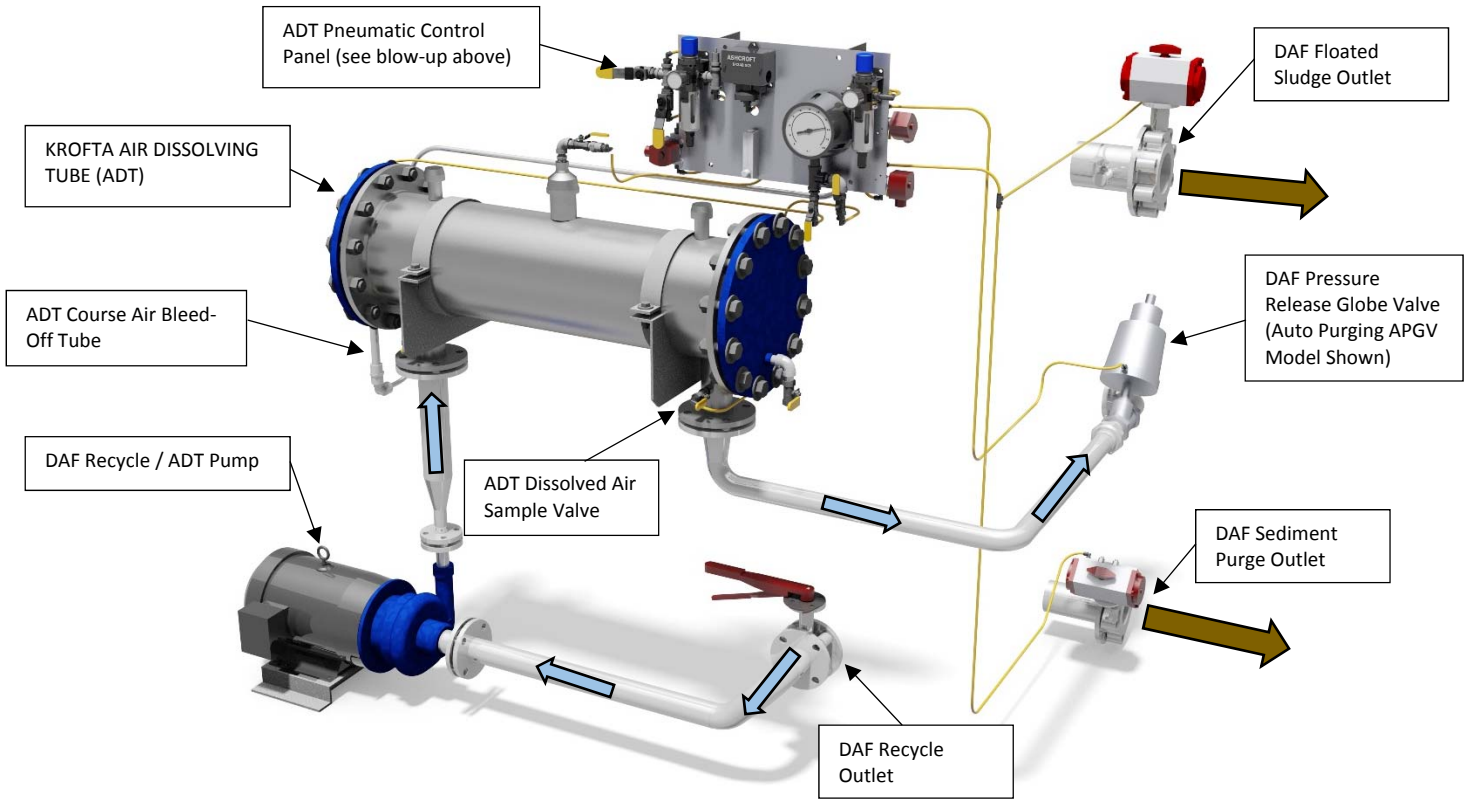



GREEN – WW Influent combined with Aerated Water
BLUE – DAF Effluent
BROWN – Sludge & Sediment



KROFTA AIR DISSOLVING SYSTEM





MULTIFLOAT UNIT DESCRIPTION

TANK COMPONENTS

MULTIFLOAT tank parts are standard in stainless steel. Customer pipe connections are at flanges located under the unit. A sump well in the tank floor is provided to collect sediment. Sediment is released through a purge valve located at the bottom of the sump well. A window located on the tank wall is provided for visual verification of floated sludge thickness and proper flotation of solids.

AIR DISSOLVING SYSTEM

The **KROFTA** Air Dissolving System aerates and pressurizes the flow required to provide flotation. The Air Dissolving System consists of the Air Dissolving Tube (ADT), an air flowmeter, pressure gauges, a sample valve, a pressure release valve, and an ADT flow pump.

The standard ADT material is stainless steel. The ADT is designed to dissolve air into a pressurized water flow. The ADT requires minimum flows and pressures to function properly. Excess air and water is removed through the bleed off located at the centerline of the tube. A pressure gauge is provided with connections to the inlet piping of the ADT and to the ADT itself. Isolation valves allow for a pressure differential between the inlet and the tube to be determined. The pressure gauge at the outlet monitors the system pressure when the pressure release valve is adjusted.

LEVEL CONTROL

The water level in the MULTIFLOAT unit is kept constant with the use of an automatic level control system. The automatic level control system consists of a flange mounted transmitter located on the outer tank wall, a control unit to process the transmitter signal, and an actuated butterfly valve located on the effluent line. The actuated butterfly valve opens or closes in order to maintain a constant water level, required to hold a constant level with a changing feed flow rate.

AIR DISSOLVING TUBE DESCRIPTION

The KROFTA TECHNOLOGIES CORPORATION Air Dissolving Tube (ADT) has been in use on Dissolved Air Flotation (DAF) clarifiers since the 1970s. Since that time, over 2000 ADTs have been put into operation producing dissolved air in a recycle stream on a wide variety of applications and types of equipment.

The typical pressure vessel design has an upper zone containing air in which pressurized water is introduced and sprayed across or mixed in. The air is dissolved into the water in this zone. The water then falls to the bottom of the vessel. The lower zone of the vessel is filled with water and has the purpose of eliminating entrainment of any undissolved air in the discharged water. Entrainment of air in a recycle stream will cause air hammer effects, coarse air bubbles, and turbulence in the flotation clarifier, which will result in decreased efficiency. This type of pressure vessel will require an ASME code and should be tested annually for safety purposes. These pressure vessels often have 1 to 1 ½ minutes of retention time and operate at anywhere from 70 to 150 psi or more. This retention time is 6 to 9 times longer than that required by the ADT.

The KROFTA ADT eliminates the need for large volumes of air and water by using air dispersion technology and centrifugal force in place of sheer volume and gravity. Compressed air is pumped into the ADT across the surface of a porous air panel that disperses the air across the entire surface of the panel, which creates faster dissolution of air into the water and retention time of only 7-12 seconds. The flow pattern is a cyclone or vortex, which produces a centrifugal force that helps to eliminate the undesirable entrained air. A specially designed inlet nozzle is sized specifically for each application and can be easily changed out if the recycle flow rate requirements of future waste streams change dramatically. A bleed-off outlet also assists in eliminating coarse entrained air from the ADT to ensure that the tube does not become air-bound or obstructed by a plugged flow around the air panel.

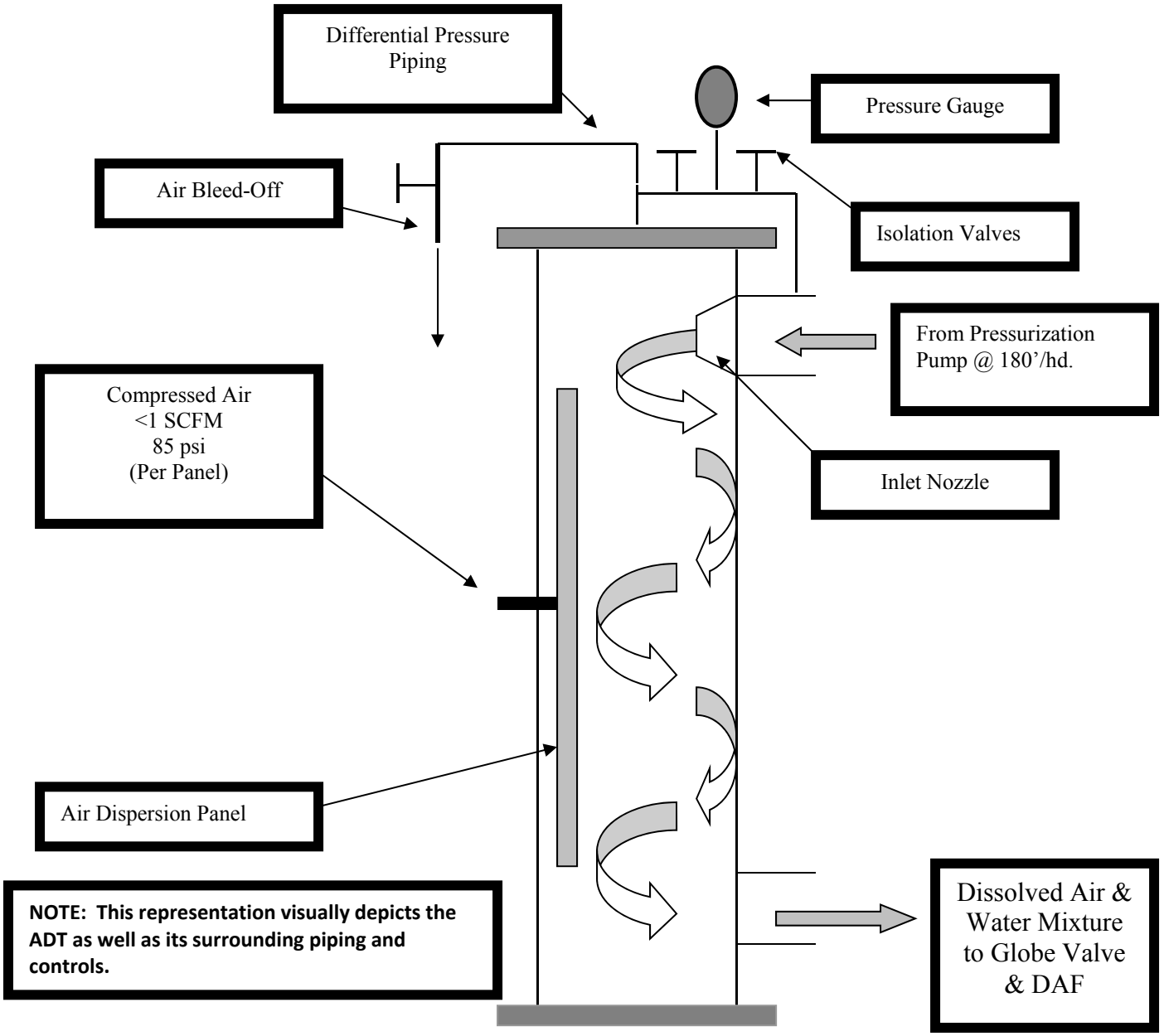
The ADT contains one or more air panel assemblies that disperse the compressed air from the compressor across the surface of a vyon panel. Water from the centrifugal pressure pump is pumped through the ADT at ~180'/hd. A specially designed nozzle on the ADT inlet nozzle directs the flow in a tangential flow pattern so that it encircles the air panel assembly within the tube. As the water enters the ADT, it interfaces with the vyon panel. The air pressure is set higher than the ADT inlet water pressure so that the air is dissolved into the recycle stream. Each air panel assembly has a stainless steel backing assembly and front cover plate. Small holes are cut in the front cover plate exposing surface area of the vyon panel to the spiraling water flow.

Some of the many advantages of the ADT are as follows:

- Small Size: The ADT is 6-9 times smaller than traditional style pressure vessels. This reduces footprint requirements and increase mounting possibilities. The ADT can be installed horizontally or vertically and can be easily retrofitted to any style DAF clarifier.
- Elimination of any entrained air from the outlet by centrifugal separation and "bleed-off" capability.
- Simple construction using standard piping components. Units can be fabricated in either 304 or 316SS.
- Stainless Steel offers superior corrosion resistance over mild steel. It also offers a superior appearance and reduces maintenance since it does not need to be painted.
- The inherently safe design with standard piping components and a moderate operating pressure (65-85 psi) eliminates the need for an ASME certification.
- A customized inlet nozzle designed to meet specific flow requirements that can be easily removed and changed should the requirements change significantly. Adding 1 or more additional ADTs accommodate applications requiring large flows.

- Simple Operation: The ADT requires minimal supervision and attention once it is brought on line. There are no moving parts within the ADT. The ADT also utilizes a standard pump.
- Low Air Consumption: The ADT consumes less than 1 SCFM/500 liters (132 gallons) of ADT capacity.
- Maximized Flotation: When the ADT is matched with a properly sized globe valve for pressure release, the ADT will produce a 30-70 micron air bubble, which is well suited for dissolved air flotation.
- Installation versatility: The ADT can be provided on a wide variety of platforms. In addition to the standard tube, options can be selected which have the ADT mounted on a skid or stand, pre-piped and or wired to a pump or control system.
- 7 Models to choose from with capacities from <80 gpm to 800 gpm

Air Dissolving Tube



OPERATIONAL PARAMETERS

Air Dissolving Tube/System

Recycle Pump – The typical ADT Recycle Pump is a standard centrifugal pump. The ADT Recycle Pump is sized to produce a recycle flow rate of 20-25% of the process flow rate at 180'HD (~78 psi) when operating at 100% speed. Pressure at the ADT inlet should be approximately 75 - 80psi. The suction nozzle of the pump should always be flooded for proper operation and quick re-starts.

Air Pressure- The regulated supply air pressure to the ADT Pneumatic Control Panel must be set 5-10 psi higher than the Recycle Pump discharge pressure at the ADT inlet to ensure that the ADT air pressure overcomes the internal tube pressure to inject air into the recycle stream. Instrument air is not necessary; however, the regulator water trap must be purged regularly if not equipped with an automatic purge. A pressure relief safety valve, preset at 100 psi, on the pneumatic control panel prevents over-pressurization of the tube.

Air Volume – The volumetric airflow rate to each ADT air panel is controlled by an adjustable rotometer, one rotometer per panel. The rotometer should be set for a *maximum* of 60 SCFH or <1 SCFM per air panel. Best results are typically obtained at ~20 SCFH per rotometer. There should be no water visible within the rotometer. If water is present, it likely indicates that the check valve has failed at the ADT injection point. Replace both the rotometer and check valve if necessary.

Air Solenoid & Pressure Switch – In some installations, there may be an automatic solenoid that opens upon initiation of a start sequence. The air solenoid would open at time of the Recycle Pump start to enable the pump to start freely, reducing the chances of air binding or pump cavitations. If the system has a Pressure Switch as well, the system may not start in "Auto" mode if the proper air pressure is not present.

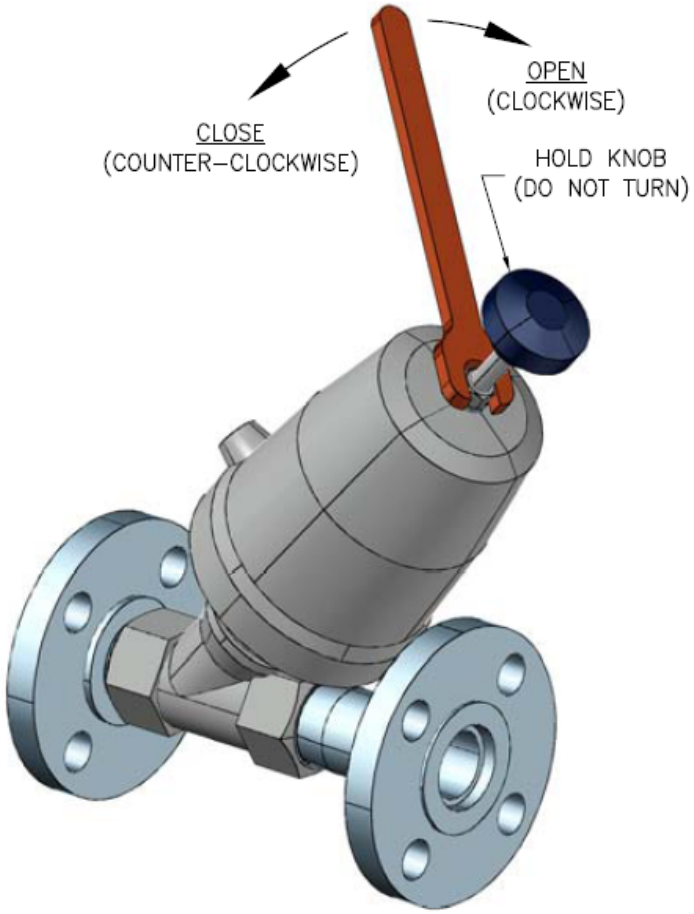
Air Dissolving Tube – The ADT can function in a vertically or horizontally mounted position. ADT inlet and outlet pressure are observable on the 4" pressure gauge mounted on the ADT Pneumatic Control Panel by closing the coarse air bleed-off valve and alternately closing and opening the two isolation ball valves installed on the inlets of the gauge. One gauge port connects to the ADT inlet nozzle to read ADT inlet pressure (Recycle Pump discharge pressure). The second gauge port connects to the center of the ADT tube at a tap located on the ADT blind end-flange to read ADT outlet pressure. The pressure differential between the inlet and outlet pressures is the pressure drop across the ADT notched orifice plate mounted on the internal side of the ADT inlet nozzle. On most KROFTA DAF systems, the Recycle Pump operates at full speed to produce a recycle flow rate of 20-25% of the process design flow rate. The internal orifice plate on the ADT inlet is sized to produce an 8-10psi pressure drop across the ADT. An 8-10 psi pressure drop across the ADT produces optimal dissolved air micro bubble formation. A curve supplied with each system shows flow rates at each differential pressure reading. ADT recycle flow rates higher than 20-25% produce a larger pressure drop across the orifice plate, observable as a larger pressure differential on the pressure gauge, resulting in more aerated water injected into the raw wastewater stream as it enters the DAF. The Pressure Release Valve (see below) controls this recycle flow. Do NOT run the system at less than 60 psi (center of tube pressure) because dissolving efficiency will be diminished and system performance will drop. Too much recycle flow can add excessive turbulence within the DAF. This may be as detrimental and cause poor flotation in the DAF as not enough recycle flow to float the solids load in the DAF. Avoid large pressure drops (>12 psi) as excessive turbulence

will likely result. You will also reduce the contact time for the air and water in the dissolving tube reducing efficiency. You will pump more water but there will be less air in each gallon entering the DAF.

Bleed-Off Valve – The ADT requires that a Bleed-Off Valve be open approximately 1/3 during normal operation. The Bleed-Off valve ensures that air pocket are not formed in the tube causing air binding, coarse air, or plug flow around the air dissolving tube panel. There should be an air/water mixture exiting the tube at all times. The Bleed-Off Valve is normally piped to a floor drain, clear well, sludge well, or back into the raw water stream.

Pressure Reducing Globe Valve –
The volume of dissolved air delivered and mixed with the raw waste stream as it enters the DAF is a function of the recycle flow rate, which is controlled by the Pressure Reducing Globe Valve. Since the recycle pump runs at full speed, the ADT recycle flow rate is adjusted by way of the adjustable globe valve. Opening the globe valve increases the recycle flow rate, resulting in a larger pressure drop across the ADT internal orifice plate. The larger pressure differential registers on the 4" pressure gauge on the ADT Pneumatic Control Panel. Closing the globe valve reduces the recycle flow rate, reducing the ADT pressure differential. The globe valve is typically adjusted to achieve the 8 psi pressure differential across ADT Inlet Nozzle (corresponding to typical DAF Recycle / Aerated Water design flow). The globe valve should not be adjusted too far open such that the pressure at the center of the ADT tube (the ADT outlet pressure) is less than 60 psi. ADT outlet pressure below 60 psi causes diminished air dissolving efficiency and system performance. Setting the globe valve too far open results in too much recycle flow, which may cause excessive turbulence in the DAF. As a result this may cause poor flotation in the in the DAF. As a general guideline, avoid pressure differentials greater than 12 psi across the ADT. Higher recycle flow rates reduce the contact time of the air and water in the dissolving tube. More recycle water flows to the DAF but with less air per gallon of water. Conversely, operating the system with the globe valve too far closed may produce too little recycle flow resulting in not enough micro bubbles being released to float the solids load in the DAF. It may be necessary in some applications to periodically purge the globe valve to maintain to prevent plugging and to maintain the optimum pressure differential across the ADT.

Auto-Purging Globe Valve (APGV) – Some systems may be equipped with auto-purging Pressure Release Globe Valves. Our typical Auto-Purging Globe Valve is an angle-seat, air-actuate to open, spring-loaded to close, globe valve. The valve is set to a % open position by turning a locknut on the threaded valve stem. Turning the locknut clockwise opens the valve. Turning the locknut counter-clockwise closes the valve. The valve is adjusted to the open percentage needed to achieve the 8 psi pressure differential described above. During operation, the APGV is periodically driven to 100% open for a brief period to flush out any accumulated material in the valve to prevent clogging of the valve. The valve is air-actuated to open by way of a solenoid valve. When the solenoid valve is closed and air is removed from the APGV, the valve returns to its set position (position that the locknut on the threaded valve stem was set to, which limits the retracted travel). On PLC-based control systems, the solenoid is commanded to open and close by the PLC. The auto-purge cycle OPEN/CLOSE time intervals are entered on an HMI on the APGV control screen. On non-PLC-based control systems, the auto-purge cycle OPEN/CLOSE time intervals are determined by a timer control module mounted on the control panel door. The standard timer is an Allen-Bradley 700HX Timer. Generally, the APGV purge cycle is configured to open the valve for approximately 5-8 seconds at a frequency of anywhere from once per half-hour to once per 8-hours to adequately clear the valve of accumulated material while limiting the brief induced upset to the ADT operation to a minimum. The frequency of the purge cycle varies with loading conditions, with heavier loading requiring more frequent purge cycles than lighter loading.



HOLD THE BLACK KNOB ON THE APGV THREADED VALVE STEM SO THAT THE VALVE STEM DOESN'T ROTATE. USE A ½" OPEN–ENDED BOX WRENCH TO TURN THE STOP–NUT CLOCKWISE TO OPEN THE APGV AND INCREASE THE ADT FLOW RATE AND PRESSURE DIFFERENTIAL OR COUNTER–CLOCKWISE TO CLOSE THE APGV AND DECREASE THE ADT FLOW RATE AND PRESSURE DIFFERENTIAL.

NOTE: Never inject polymer or other coagulation/flocculation chemicals into the ADT. In general terms, it is recommended that the coagulant be injected as far away as possible, with as much contact or mixing time as possible, and that the polymer (flocculent) be injected downstream of the globe valve to prevent floc shear caused by turbulence through the globe valve.

INITIAL START-UP PROCEDURES

Prior to starting up the DAF System for the first time, the customer must conduct a thorough inspection to ensure that no construction debris, pipe shavings, or other foreign material or contaminants are present in the system. Construction debris, pipe shavings, and foreign material and contaminants can interfere with the proper operation of DAF System components and ancillary equipment including but not limited to valves, check valves, and pumps.

If a chemical metering system is being commissioned for the first time, the fully installed chemical metering system must be pressure and leak tested using clean water before priming and charging the chemical metering system with the chemical to be used. Commissioning, maintenance, and operation of the chemical feed pumps should be attempted only by qualified and properly trained personnel using all necessary personal protective equipment (PPE) recommended for protection from a chemical, which includes eyewear and chemical-specific PPE. A copy of the MSDS for each chemical handled should be reviewed and thoroughly understood prior to working on any chemical feed system utilized for a specific chemical. Appropriate Personal Protection Equipment (PPE), which may include goggles; face shield; and rubberized coat, pants, and gloves must be used when working with chemicals or the chemical storage and metering equipment. When performing maintenance on any chemical system, great care must be taken to prevent accidental contact to the chemicals by those persons performing the maintenance task and any other personnel in the area. Contact with chemicals associated with DAF operations has the potential for severe injury to unprotected personnel.

1. Close all drain, sampling, purge and air inlet valves to the MULTIFLOAT and Air Dissolving System.

2. <u>Start the DAF Sludge Scraper</u>

   a.) Set the Scraper speed setpoint to 25% (15Hz), which is the minimum allowed Scraper gearmotor speed to ensure adequate cooling of the TEFC motor.

   b.) Start the Scraper drive and verify that the Scraper travels in the correct direction. The Scraper blades traveling on the underside flight of the Scraper assembly should be traveling toward the Sludge Hopper and the Scraper blades traveling on the upper flight of the Scraper assembly should be traveling away from the Sludge Hopper.

   c.) Observe the Scraper travel for several complete chain rotations and verify that there is no mechanical binding or other abnormal movement.

   NOTE: It is common for the Scraper chains to stretch during the initial period of operation, typically on the order of 30 days depending on the duty cycle of the Scraper. After an initial period of operation, a chain link may need to be removed from both chains to rectify excessive play in the Scraper assembly due to the chains stretching. For the chain adjustment procedure, refer to MAINTENANCE & TROUBLESHOOTING – MECHANICAL MAINTENANCE – SCRAPER.

3. Check the level control mechanism. Turn on the raw water feed pump or open the inlet valve if the clarifier is gravity fed. Allow the water level in the DAF to stabilize.

4. <u>Start the Air Dissolving System</u>

a) Close the ball valve at the ADT air injection port on the ADT.

b) Open the ADT Pressure Reducing Globe Valve, located on the ADT discharge pipe, prior to starting the ADT Recycle Pump to avoid deadheading the pump when it is started.

c) Ensure that the water level in the DAF is high enough to flood the Recycle Pump suction nozzle to avoid pump cavitation when the pump is running.

d) Start the Recycle Pump.

e) With the Pressure Reducing Globe opened to about 60-70% should allow the Recycle Pump to build up pressure rather quickly at initial startup.

f) Gradually open or close the ADT Pressure Reducing Globe until the ADT inlet pressure reading on the 4" dual-port pressure gauge on the ADT Pneumatic Control Panel is at 78 psi (180' HD).

g) Read the ADT outlet pressure on the 4" pressure gauge. The difference between the ADT inlet pressure and outlet pressure should be approximately 8 psi. The ADT Recycle Pump and the ADT internal orifice plate are sized to produce the optimum 8-psi pressure drop across the ADT at the design recycle flow rate required by the application process

h) If the ADT pressure differential is greater than or less than 8 psi, the recycle flow rate can be determined by looking at the observed pressure differential value on the ADT flow curve and finding the corresponding flow rate for the.

i) Adjust the Air Filter Regulator on the ADT Pneumatic Control Panel to 90 psig. The supply air pressure must be higher than the ADT inlet water pressure for air to enter the ADT and to prevent water backflow into the air lines.

j) Open the ADT Air Supply Isolation Valve(s) to the ADT Air Panel(s).

k) At initial system start-up, set the ADT Air Flow Meter(s) at 5-10 SCFH. The airflow rate may need to be increased after the system has operated for a period of time.

l) Open the ADT Bleed-Off Valve to approximately 1/3 open to bleed off undissolved ecess air from the ADT. Generally, 1 to 3 gpm of water also exists through the bleed-off port. Bleed-off can be observed in the clear tube attached to the bleed-off port..

NOTE: The air supply to the ADT should be off whenever the Recycle Pump is not operating to prevent building an air pocket inside of the ADT.

5. Start the chemical pumps.

6. The water level in the MULTIFLOAT should be adjusted for optimum floated sludge collection by the rake. Typically, a 4" to 6" sludge blanket with the rake operating at 50% of the variable frequency output is the optimum condition. Lowering the water level reduces sludge collection, allowing a thicker, dryer layer of sludge to form on the surface. Raising the level increases collection and thins out the sludge layer. It will take up to an hour after a level change before the sludge thickness reaches equilibrium. The

sludge layer becomes too thick when it begins to break up in pieces and/or settle out. Adjustment of the speed is important for fine tuning the sludge removal rate after the water level is established.

7. The settled sludge purge should be operated depending on the rate of sedimentation in the system. Typical purging of the sump should be 5 to 10 seconds. The interval between valve openings should initially be 30 minutes and then adjusted based on operating experience.

DAILY START-UP AND OPERATION PROCEDURES

1. Follow the same sequence as for initial start-up, except that previously established valve and control settings should be maintained and unchanged.

2. Check that the ADT inlet pressure, outlet pressure, and differential pressure values are as previously set and that the clarified water is clear.

3. If the MULTIFLOAT was not drained, the Air Dissolving System can be started before the influent feed is turned on. This will help prevent solids build-up in the clarified water during start-up.

INITIAL SHUTDOWN PROCEDURES

1. Turn off the chemical pumps and stop influent flow into the unit.

2. Turn off the DAF Recycle/ADT Pump after closing the ADT Air Supply Isolation Valve(s) to the ADT Air Panel(s) and opening the ADT Pressure Reducing Globe Valve.

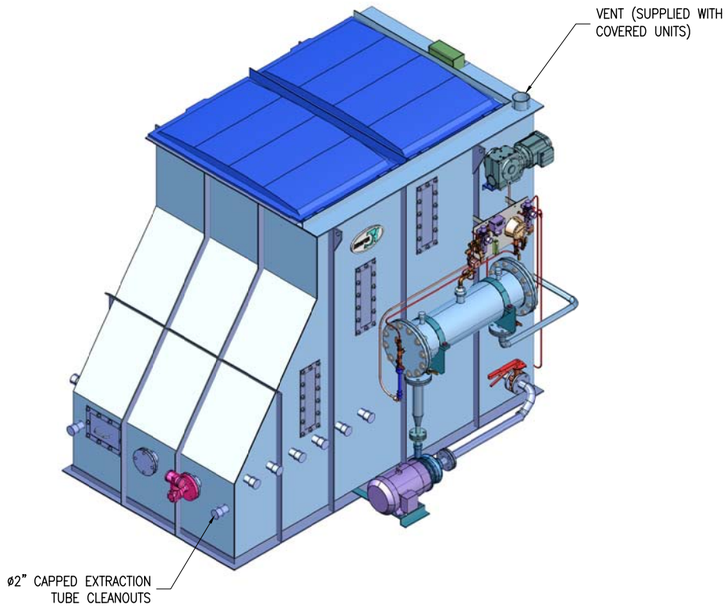
   NOTE: Clean-up is easier if the Air Dissolving System and MULTIFLOAT are allowed to run for a period after the process flow has stopped. Clarified water will recirculate and most of the solids will be flushed from the system.

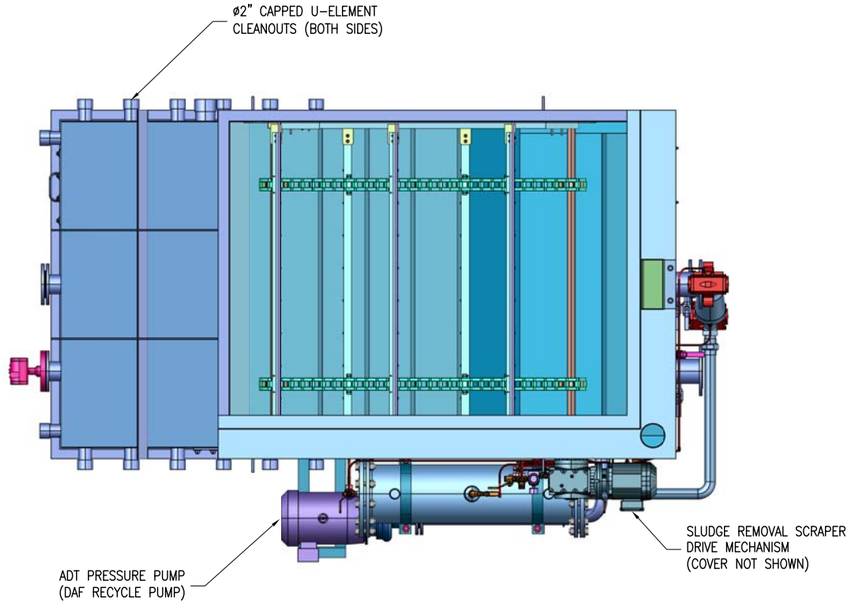
3. Continue to operate the scraper drive until the remaining sludge has been removed.

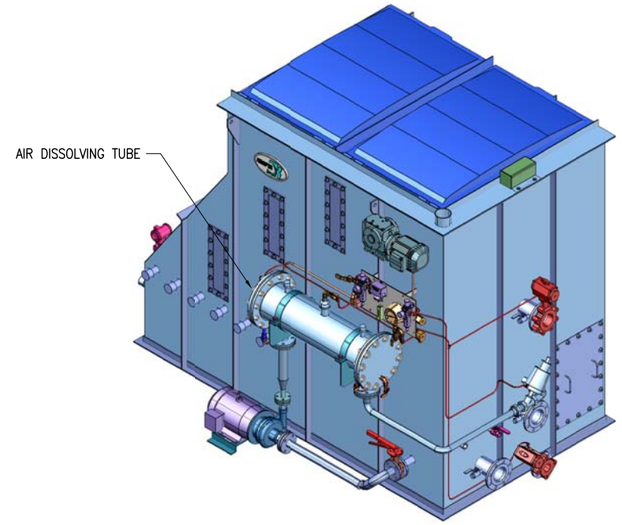
4. Valve and control settings previously established should not be changed.

5. The water does not have to be drained out unless the shut-down is for a period greater than a day or a complete wash-up is necessary.

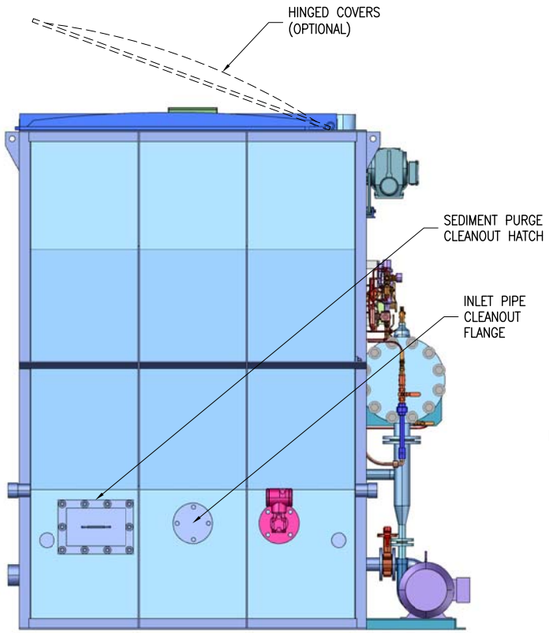
6. If the MULTIFLOAT is drained, hose down all parts thoroughly; dried-on sludge can be difficult to remove.

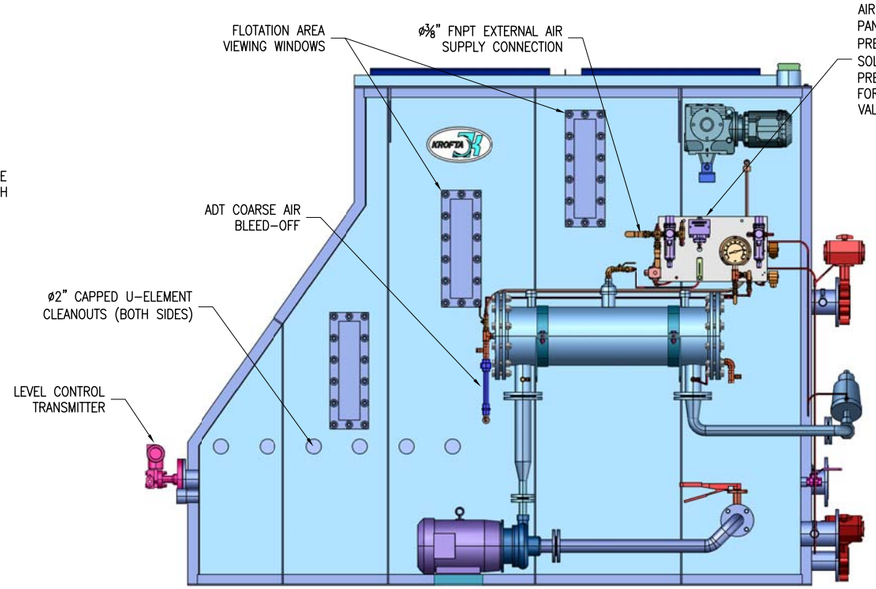


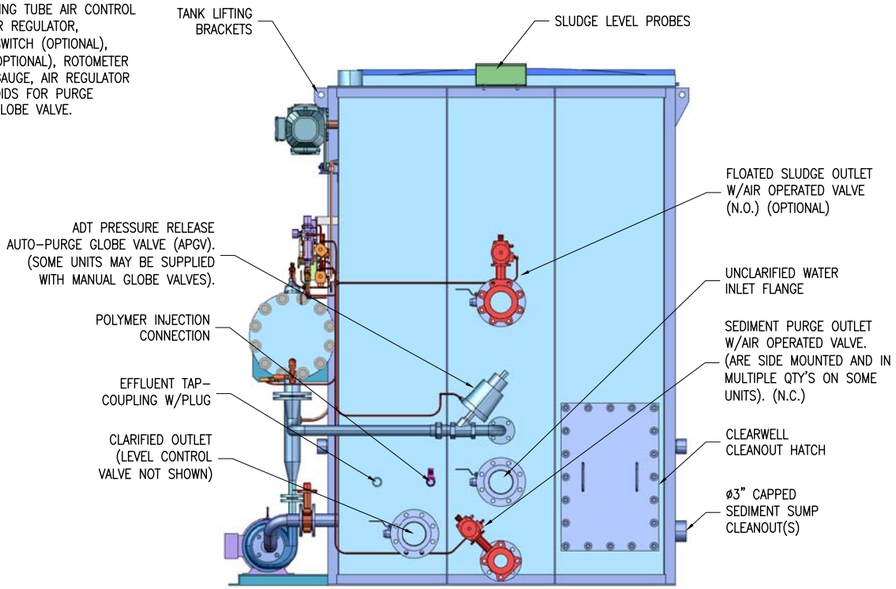




TOP VIEW







FRONT VIEW

SIDE VIEW

BACK VIEW

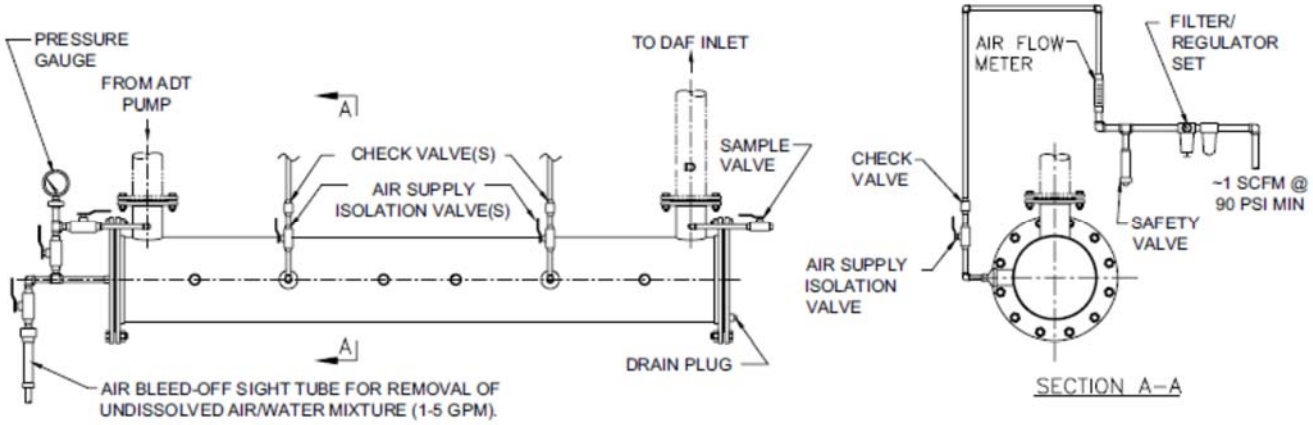
PLEASE NOTE – NOT ALL UNITS WILL INCLUDE ALL OF THE DEPICTED COMPONENTS. DRAWING IS INTENDED TO IDENTIFY COMPONENTS CALLED OUT IN OPERATION AND MAINTENANCE MANUAL.

REV	DESCRIPTION	DWN	DATE	CHK'D	APP'D

DEPICTION OF EQUIPMENT DOES NOT CONSTITUTE SUPPLY BY KROFTA.
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KROFTA a Watereau company
Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME:					
KROFTA MULTIFLOAT HORIZONTAL (MFH) DAF UNIT					
DATE: 03/23/15	SCALE: –	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:
TITLE: KROFTA MULTIFLOAT MFH GENERAL ARRANGEMENT				DRAWING NUMBER: MFH-GA-01	REV:



DAF MULTIFLOAT CLEANING PROCEDURES

Cleaning procedures outlined below are recommended at a scheduled shutdown period as depicted in maintenance schedule (below) or after long periods where the DAF unit has not or will not be operated for a period of time. This timing will deviate based on a given application.

1. Manually turn off the chemicals. Allow clean water to continue to flow into polymer unit in order to flush system. It may be a good idea to run one quart of mineral oil through polymer system to help remove unwanted build up in tubing, chamber and site glass (See Polymer Make-up System O&M for detail).

2 Raise the water level high enough to scrape off any sludge layer that may be present. Allow enough time to pass so that the residual chemistry has had time to dissipate.

3. Shut off feed/influent source

4. Drain the contents of the DAF by opening the Purge valve and running the sludge pump (if tied into purge line) and opening the effluent valve and/or effluent pump (if equipped).

5. Once the unit has been drained:

   a. Follow appropriate Lock-Out Tag-Out procedures for isolating the DAF Unit from the process, as well as shutting down any live electrical/mechanical devices; i.e. Top Scraper Gearbox/motor and paddle mechanism, ADT/Recycle Pump, and any other equipment that could cause potential harm when cleaning the DAF Unit.

   b. The purge valve should be left open in manual. Leave purge valve in this position until the unit has been cleaned thoroughly.

   c. Remove access hatch and clean out any collected sludge within chamber. If Multifloat is a Vertical configuration, make sure to hose down the Extraction Box around the DAF Effluent Outlet.

d. Open U element clean outs.

e. Open up flange on inlet side of DAF to enable inlet header to be flushed. Horizontal Units also have a cleanout at the end of the Inlet Header that should also be opened.

f. Open extraction tube cleanout (this applies to the Horizontal configuration).

g. Drain ADT and then open up ADT for cleaning.

h. Thoroughly spray unit down to remove any sludge build up on and within the unit including:

i. The U elements and plates – please make sure to clean these thoroughly from the top as well as inside the laterals after the clean-out caps are taken off. These elements have slotted distribution holes on the top of each lateral that should be cleaned from any build-up.
ii. Inlet Header Pipe
iii. Air Dissolving Tube and Piping – please note to follow cleaning of Air Dissolving Tube by spraying a soapy water solution onto the Air Dissolving Tube Air Panel(s). Slowly turn air supply to ADT panels and watch for an even distribution of bubbles. If there is not an even distribution of bubbles and/or it takes more than ~10 psi with rotometer @ 10-15 SCFH to see these bubbles form it may be time to change the ADT Air Panel. For ADT Air Panel replacement instructions, please refer to Maintenance and Troubleshooting section.
iv. Viewing windows
v. Scraper assembly
vi. Sludge hopper and Conductance Probes (if equipped)
vii. Clearwell vents (this applies to the Horizontal Configuration)
viii. Purge valve piping
ix. Note: Please use caution near the level sensor as a strong blast of water from a power sprayer can and will damage the sensor.
x. Use hot water or steam if available, and/or power washer if available.

i. A dilute bleach solution may be used on wetted parts as a means of bacteria and odor control after the unit has been cleaned and rinsed. This should be followed by a final rinse.

j. When unit is drained and empty of all water & debris, re-install:

i. Clean-out hatch
ii. U-Element clean-out caps
iii. ADT End Flanges
iv. DAF Inlet Flange
v. Any other items that were opened/disconnected for cleaning

7. Once unit has been cleaned, return all settings back their original CASCADE (Automatic) settings and start up unit.

8. It may be a good idea to take advantage of the unit being down to attend to other system cleaning tasks or PM as required.

MAINTENANCE and TROUBLESHOOTING

GENERAL

KROFTA units should receive a visual inspection at least once weekly, a thorough item-by-item inspection monthly, and lubrication and adjustment on a three-month schedule minimum with continuous operation, or on a six-month schedule maximum with intermittent operation.

MECHANICAL MAINTENANCE

TANK

Only routine cleaning is required for stainless steel.

SCRAPER

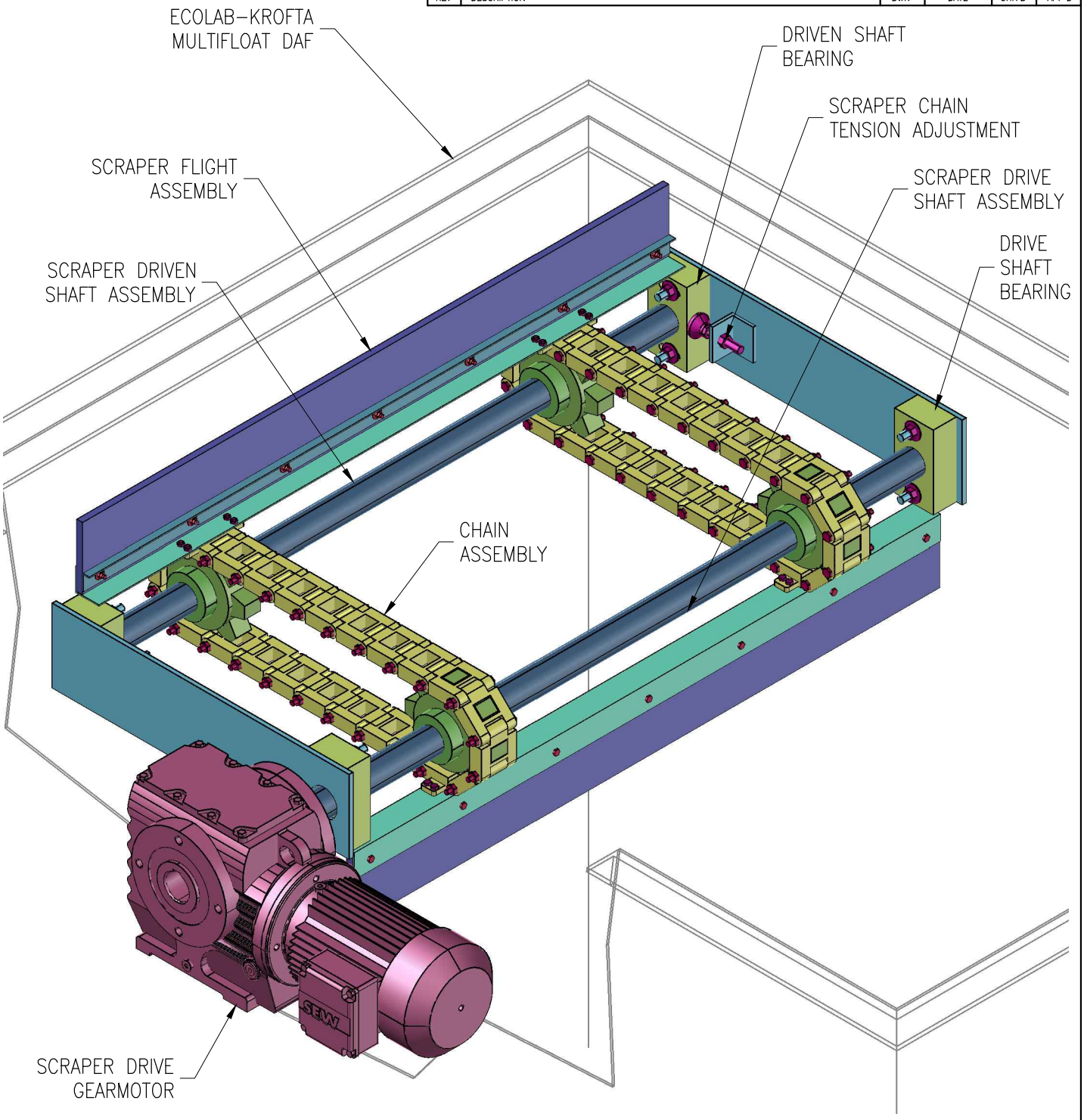
Check support bearing for excessive wear monthly. The gearbox requires periodic oil changes. Note that an initial oil change may be required soon after start of operation. See the gearbox manufacturers' brochure for more detailed instructions.

Chains should be kept just tight enough to prevent excess sag. Over tightening the chains will cause excessive sprocket and link wear. Please see following instructions for Chain Adjustments.

Scrapers Blades will wear over time and will need replacing. Over time they can lose their elasticity and begin to deform in a wavy pattern. Please see following instructions for replacement of Scraper Blades.

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NOTES:

1. CHAINS SHOULD BE KEPT JUST TIGHT ENOUGH TO PREVENT EXCESS SAG. OVERTIGHTENING THE CHAINS WILL CAUSE EXCESSIVE SPROCKET & LINK WEAR.
2. TO ADJUST CHAINS, LOOSEN THE BEARING MOUNTING NUTS & CHAIN TIGHTENER LOCKNUTS. TIGHTEN THE ADJUSTER ONLY ENOUGH TO SET BOTH CHAINS WITH EQUAL TENSION. TIGHTEN BEARING NUTS & ADJUSTER LOCKNUTS WHEN SET.

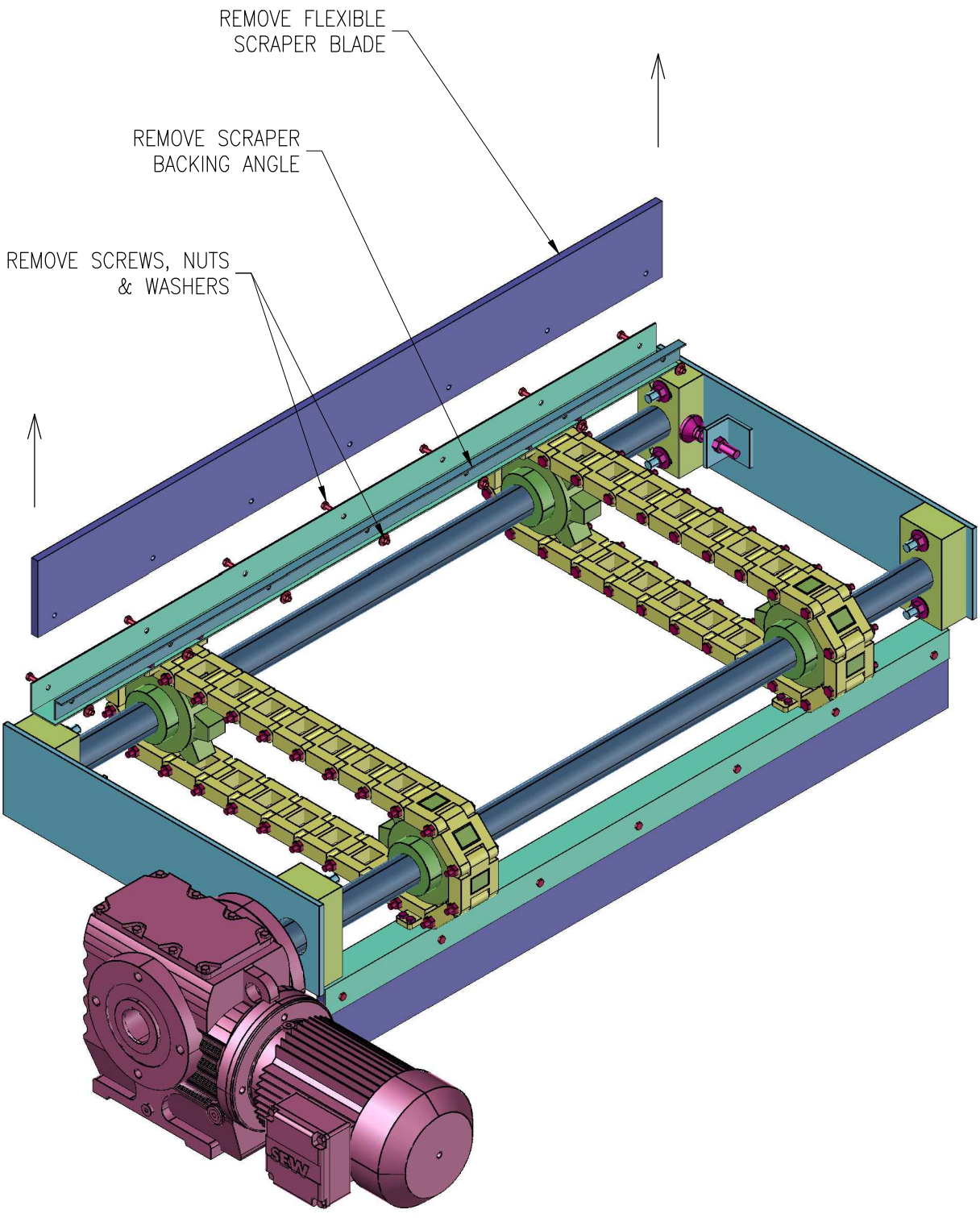
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Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME:					
KROFTA MULTIFLOAT SLUDGE REMOVAL SCRAPER					
DATE: 02/07/12	SCALE: NONE	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:
TITLE: SLUDGE SCRAPER SCRAPER MECHANISM COMPONENTS AND ADJUSTMENT				DRAWING NUMBER: MF–OMTS01–1	REV:

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ROTATE SCRAPER MECHANISM TO POSITION INDIVIDUAL SCRAPER FLIGHTS IN A CONVENIENT WORKING LOCATION.

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Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME: KROFTA MULTIFLOAT SLUDGE REPLACEMENT

DATE: 02/07/12	SCALE: NONE	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:

TITLE: SLUDGE SCRAPER FLEXIBLE SCRAPER BLADE REMOVAL PROCEDURE

DRAWING NUMBER: MF–OMTS01–2

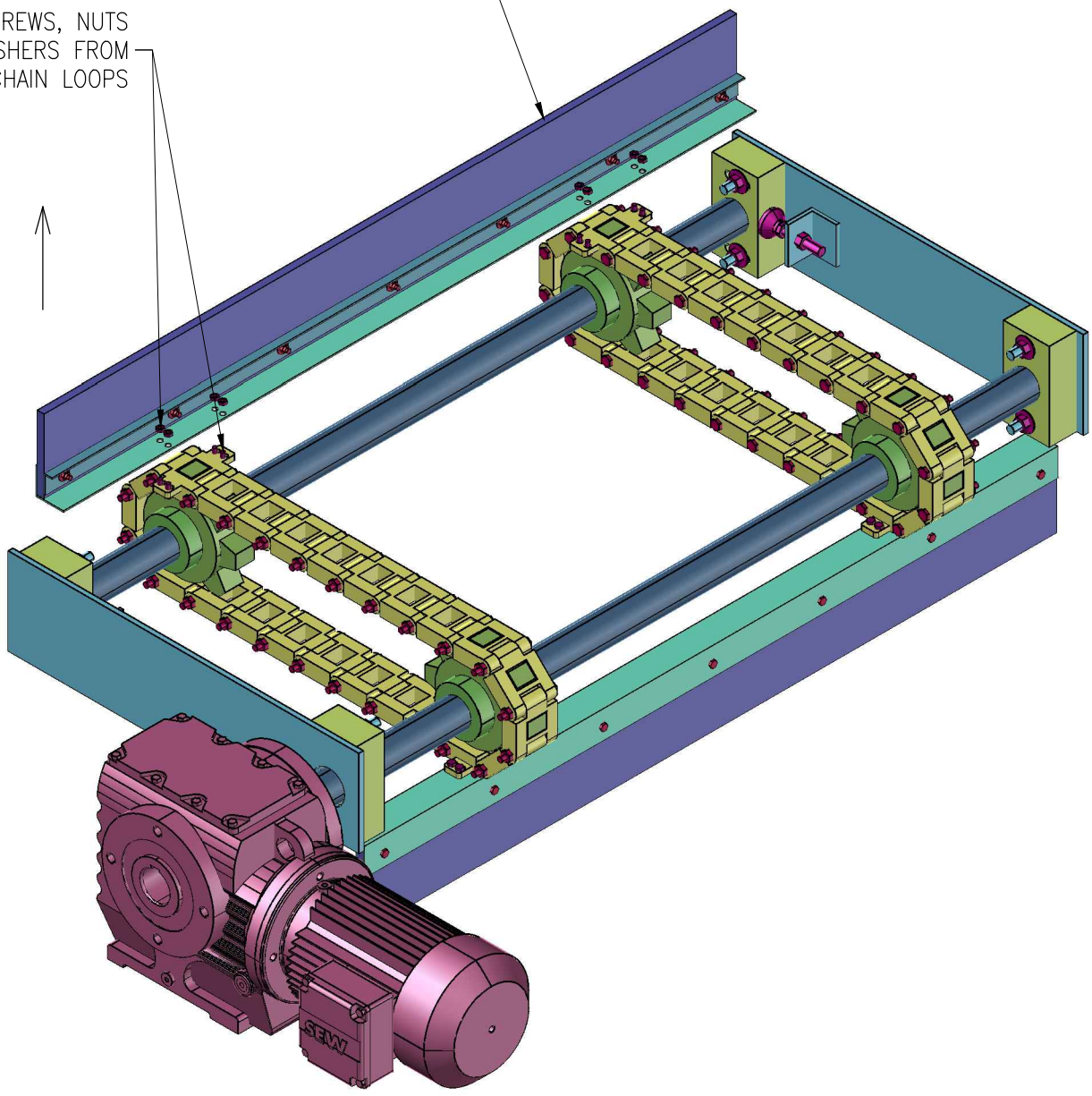
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REV	DESCRIPTION	DWN	DATE	CHK'D	APP'D

LIFT OFF SCRAPER FLIGHT ASSEMBLY FROM CHAIN LOOPS

REMOVE SCREWS, NUTS & WASHERS FROM BOTH CHAIN LOOPS



ROTATE SCRAPER MECHANISM TO POSITION INDIVIDUAL SCRAPER FLIGHTS IN A CONVENIENT WORKING LOCATION.

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Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME:					
KROFTA MULTIFLOAT SLUDGE REMOVAL SCRAPER					
DATE: 02/07/12	SCALE: NONE	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:
TITLE: SLUDGE SCRAPER SCRAPER FLIGHT REMOVAL PROCEDURE				DRAWING NUMBER: MF–OMTS01–3	REV:

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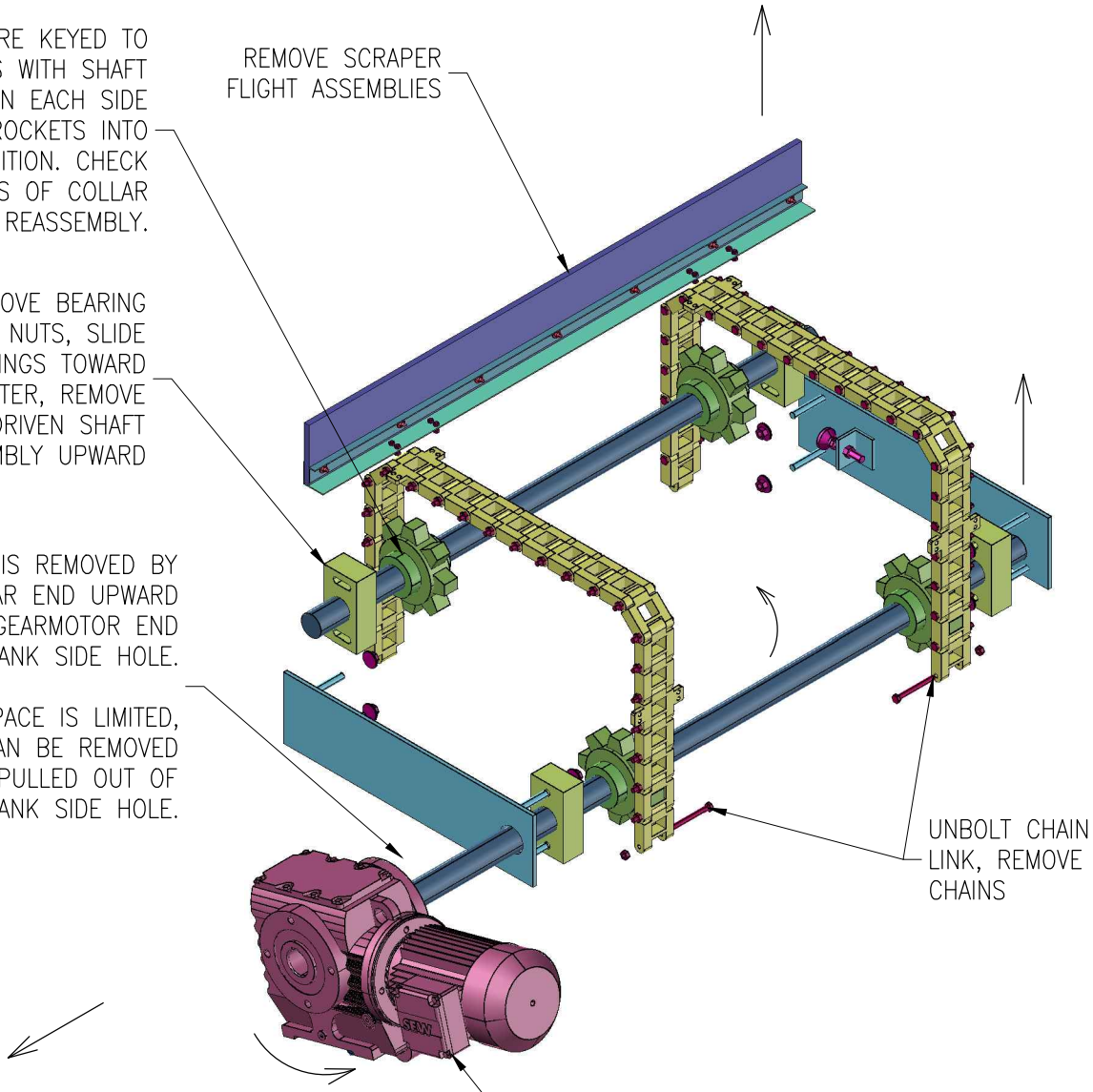
SPROCKETS ARE KEYED TO SHAFTS WITH SHAFT COLLARS ON EACH SIDE TO LOCK SPROCKETS INTO POSITION. CHECK TIGHTNESS OF COLLAR BOLTS AFTER REASSEMBLY.

REMOVE SCRAPER FLIGHT ASSEMBLIES

REMOVE BEARING NUTS, SLIDE BEARINGS TOWARD CENTER, REMOVE DRIVEN SHAFT ASSEMBLY UPWARD

DRIVE SHAFT IS REMOVED BY TIPPING FAR END UPWARD AND PULLING GEARMOTOR END THRU TANK SIDE HOLE.

IF SPACE IS LIMITED, SPROCKETS CAN BE REMOVED AND SHAFT PULLED OUT OF TANK SIDE HOLE.



UNBOLT CHAIN LINK, REMOVE CHAINS

TO REMOVE GEARMOTOR FROM SHAFT, ROTATE AS SHOWN TO CLEAR TORQUE ARM TANK BRACKET, REMOVE BOLT AND WASHER FROM SHAFT END, SLIDE GEARMOTOR OFF SHAFT.

NOTE: TO CATCH DROPPED HARDWARE FROM FALLING INTO MULTIFLOAT UNIT, PLACE A TARP OR SHIELD UNDER SCRAPERS ON TOP OF FLOW PLATES.

KROFTA a Watereau company

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

NAME:					
KROFTA MULTIFLOAT SLUDGE REMOVAL SCRAPER					
DATE: 02/07/12	SCALE: NONE	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:
TITLE: SLUDGE SCRAPER ASSEMBLY REMOVAL PROCEDURE				DRAWING NUMBER: MF–OMTS01–4	REV:

AIR DISSOLVING TUBE

Check the air dissolving tube every three months. If more than 15 psi is required to push air into the ADT with the pressure pump off, the dispersion panels have clogged and must be replaced.

Indications:

From time to time, the ADT panel inserts (vyon) may become clogged or blinded. This will inhibit the compressed air from entering the panel or prevent it from dispersing evenly across the surface of the panel. Should this occur, the efficiency of the ADT will decrease dramatically and performance of the DAF will diminish.

Panels can become clogged from excessive polymer use, oil in the air supply lines, bacteriological growth, extended down times, infrequent routine cleaning, or other chemical excursions.

The first sign of plugging of the panel is often an increase in the % open of the rotometer. Each panel consumes a maximum of 1 SCFM (60 SCFH). If the % open on the rotometer requires that the operator open the rotometer farther open each day to achieve the same air flow rate, the panel may be gradually clogging.

Others signs of clogging or binding may be coarse air bubbles in the DAF unit or poor flotation characteristics. A sample of dissolved air can be obtained from the sample port on the discharge end of the ADT tube. The dissolved air that should be visible should stay in solution for a minimum of 30-60 seconds.

Always check the ADT bleed-off valve to ensure that it is approximately 1/3 open during normal operation. If this valve is closed, air pockets can develop in the tube causing a “plug-flow” around the panel assembly and causing poor air quality in the DAF. If the bleed-off valve is closed, it may also give a false indication that the panels are plugging.

Maintenance:

The ADT panels should be inspected and cleaned whenever there is a shutdown of the system. At a minimum, the panels should be cleaned every 6 months and replaced on a yearly basis.

To clean the panels, remove one or both of the end caps as required. A rough long handled brush should be used to scrub the front cover plate and panel.

Soaking for 12 hours or more in a mild acetic acid solution if they are not grossly plugged can rejuvenate the panels.

Replacement Options:

There are three (3) options available for replacement. A complete pre-assembled package is available from the factory. This will allow for quicker replacement and a short equipment downtime. Also available are panel “inserts” only. This option is significantly cheaper but will require more time to install and an extended downtime. The third option is a factory rebuild of the existing assembly. Ship the assemblies’ back to Krofta and our shop personnel will mount new inserts to the original assembly using factory original materials.

Replacement Procedure:

Should the panels require replacement, extreme care should be taken as not to damage the stainless steel assembly. The assembly can be re-used with replacement inserts if so desired. Make sure to shut the system down and lock out the recycle pressurization pump. Isolate the compressed air source. Reference #1-#6, and #17-22 if replacing the entire assembly with a complete new assembly and not an insert only.

1. Remove the end cap(s) on the ADT. Inspect the gasket(s). The gaskets may need to be replaced once they are removed if they are damaged or stick to the cap or flange face.
2. Remove the galvanized caps on the outside of the ADT itself exposing the threaded support rods.
3. Disconnect the air line(s) exposing the air injection tube.
4. Un-thread the top nut, washer, and Neoprene O-ring on the center stem (air injection).

5. Un-thread the top nut, washer, and Neoprene O-ring on the threaded support rods (2 for each panel).
6. Remove the assembly from the ADT.
7. Un-bolt the 36 (some assemblies may have 36-44) panel retaining bolts. Replace worn or stripped bolts with 10-24 x 5/8" nylock bolts.
8. Break the silicone seal between the panel and the front plate as well as the rear assembly.
9. Remove the old panel insert *** *SAVE*** the panel will be used as a template for the new panel.
10. Using the just removed panel as a template, mark the position of the bolt locations on the new panel insert.
11. Drill holes at the marked positions using a ¼" drill bit.
12. Lay a ~ ¼" bead of SikaFlex 1-A or comparable silicone adhesive between the rear assembly and the panel. Install the panel with the *smooth* side exposed to the front plate or water interface.
13. - Use SikaFlex 1-A or other approved material for food grade applications or drinking water contact.
14. Thread the bolts through the rear assembly and through the new panel.
15. Install the nuts on all of the bolts through the front palate and rear assembly.
16. Let dry 8-12 hours.
17. Re-Install the assembly into the ADT – The front plate should touch the inner edge of the tube with no gaps.
18. Use care in re-installing the nuts, washers, and Neoprene O-rings on the support rods as well as the air injection stem. If not installed properly water may leak from the ADT while it is in use. In addition, the compressed air may not disperse evenly into the panel insert if the Neoprene O-ring is installed improperly. It is also possible that air could leak out of the stem before it reaches the panel if the Neoprene O-ring is not installed correctly. Do not over tighten any of these nuts as they may strip rendering the panel useless.
19. Test the air system. Liquid soap can be used to check for air leaks and proper installation. Cover the injection point and edges of the panel and look for possible leakage. Repair as needed.
20. Replace the end cap(s) and gasket(s).
21. Remove the lockout tags on the pump system.
22. Re-start the system.

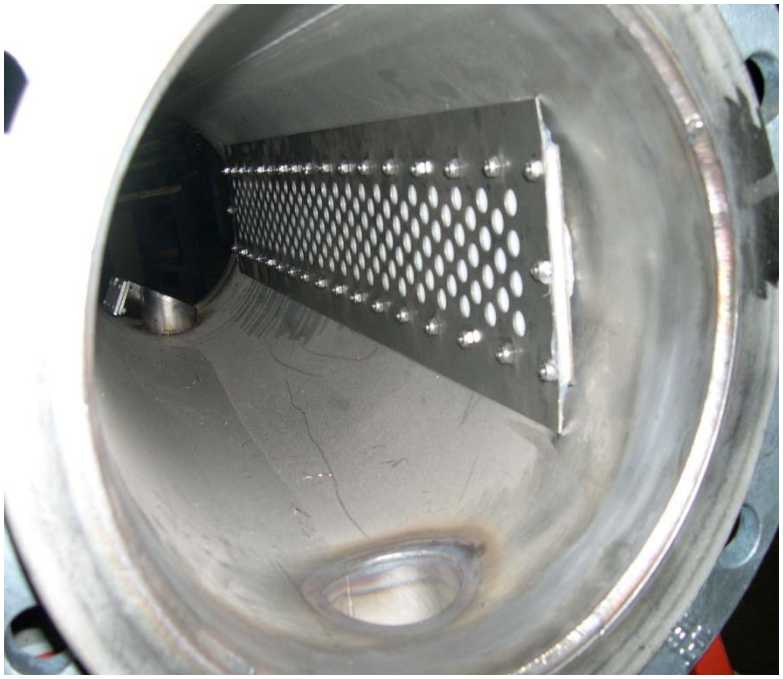
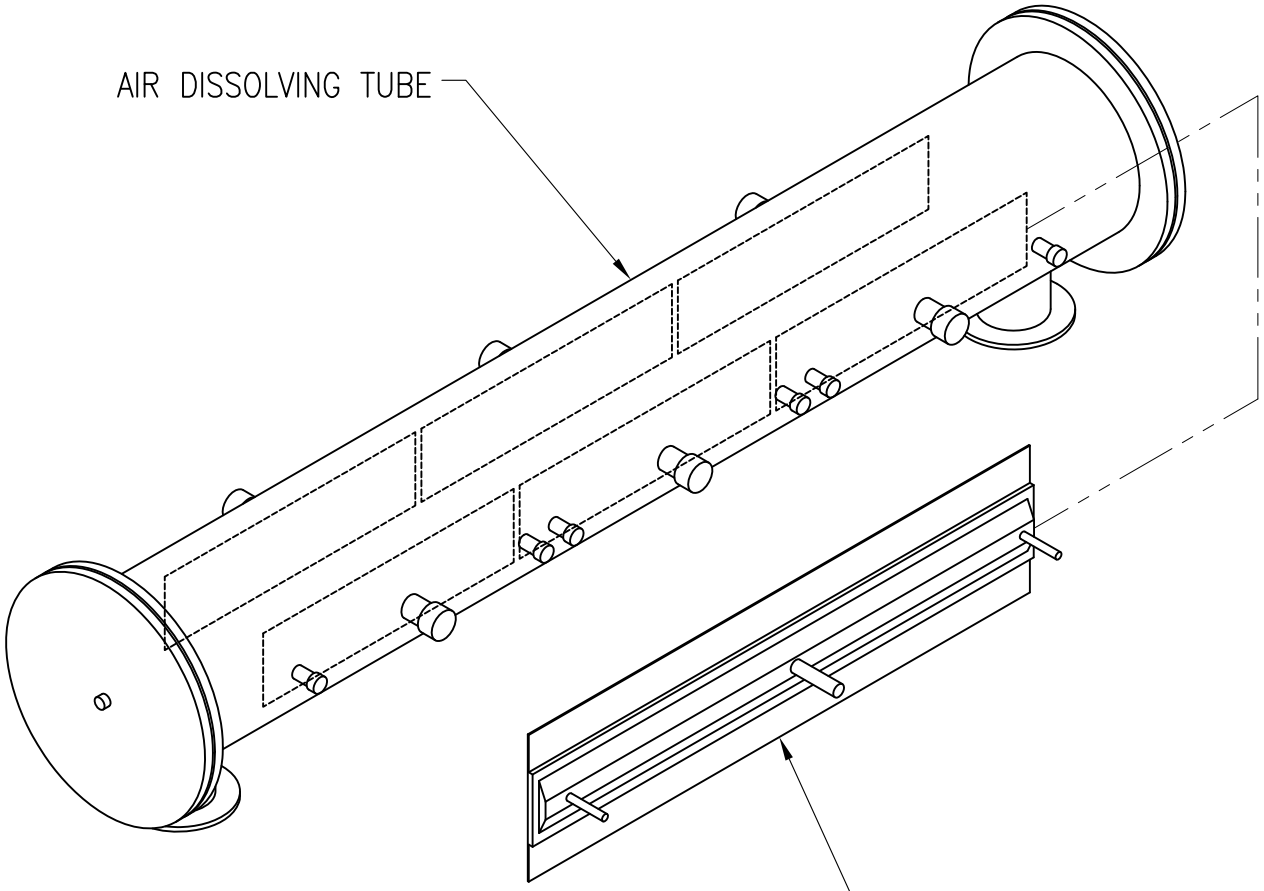


Photo illustrates the inside of an ADT
(As mounted in an ADT300 or ADT500)

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REV	DESCRIPTION	DWN	DATE	CHK'D	APP'D



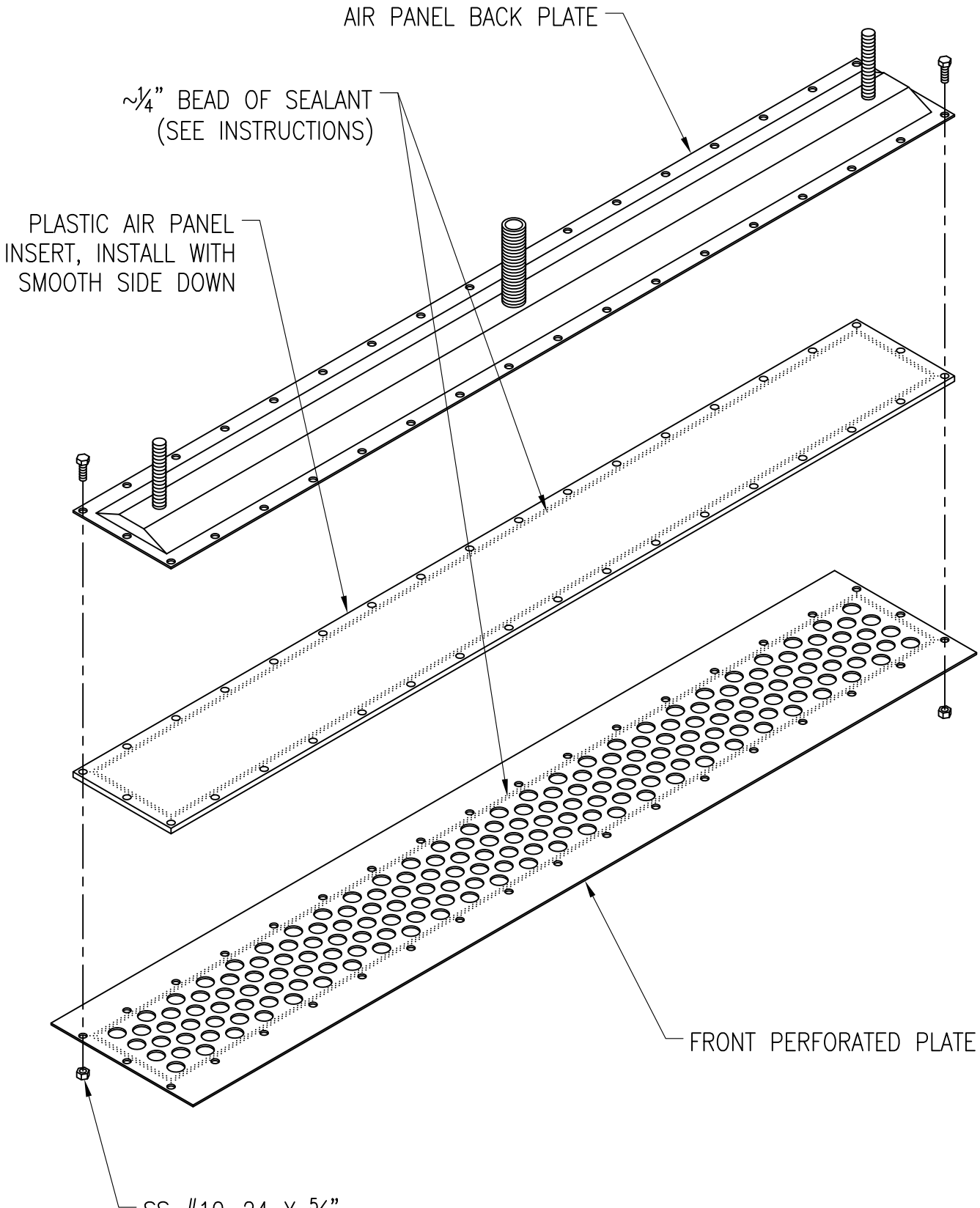
KROFTA a Waterleau company

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 Info@krofta.com

NAME: KROFTA AIR DISSOLVING TUBE					
DATE: 8/08/08	SCALE: NTS	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:
TITLE: AIR PANEL LOCATION				DRAWING NUMBER: 1	REV:

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REV	DESCRIPTION	DWN	DATE	CHK'D	APP'D



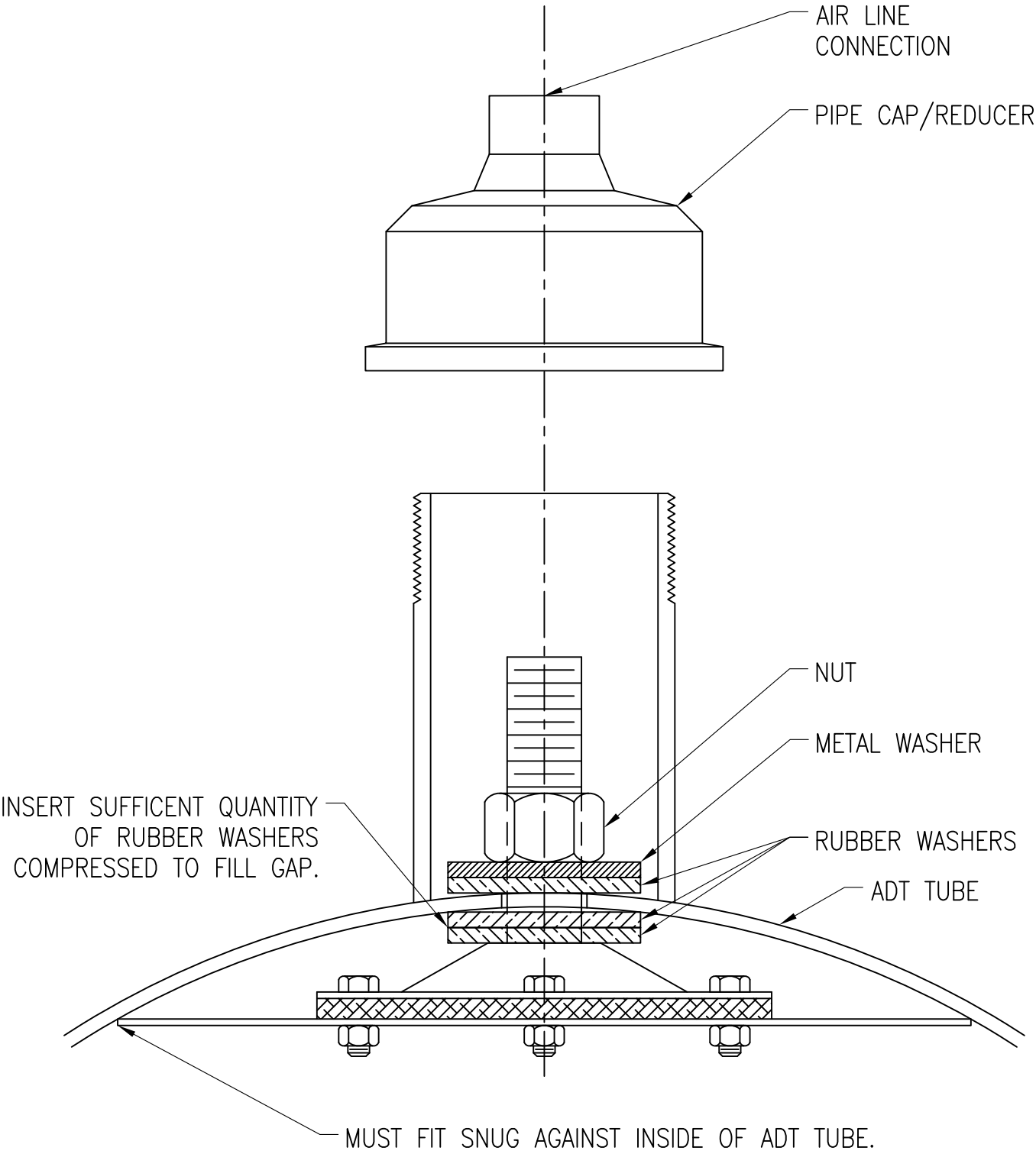
KROFTA a Waterleau company

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 Info@krofta.com

NAME: KROFTA AIR DISSOLVING TUBE					
DATE: 8/08/08	SCALE: NTS	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:
TITLE: AIR PANEL PLASTIC INSERT REPLACEMENT				DRAWING NUMBER: 3	REV:

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REV	DESCRIPTION	DWN	DATE	CHK'D	APP'D



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Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 Info@krofta.com

NAME: KROFTA AIR DISSOLVING TUBE					
DATE: 8/08/08	SCALE: NTS	DRAWN BY: PLN	DESIGNED BY:	CHECKED BY:	APPROVED BY:
TITLE: AIR PANEL REMOVAL & INSTALLATION				DRAWING NUMBER: 2	REV:

OPERATIONAL TROUBLESHOOTING

ADT ADJUSTMENTS

Under normal circumstances, no adjustment should be needed after the initial set up. If adjustment is required, make the following checks:

TAKE A SAMPLE FROM THE SAMPLING POINT

This is the best indication of the ADT operation. The sample should be drawn off into a graduated cylinder or other glass container. By looking closely, the air can be observed in the water. The air bubbles should be very small, giving the water a "milky" opaque appearance. Larger bubbles should not be present. If enough air is present, the floc should rise to the surface at a rate of one foot per minute, leaving clear water underneath. The ADT is functioning properly and requires no adjustment if this is what is observed.

CHEMICAL ADDITION

Commissioning, maintenance, and operation of the chemical feed pumps should be attempted only by qualified and properly trained personnel using all necessary personal protective equipment (PPE) recommended for protection from a chemical, which includes eyewear and chemical specific PPE. A copy of the MSDS for each chemical should be reviewed and thoroughly understood prior to working on any chemical feed system utilized for a specific chemical. Any personnel handling chemicals must use appropriate Personal Protection Equipment (PPE), which may include goggles; face shield; and rubberized coat, pants, and gloves. When performing maintenance on any chemical system, great care should be taken to prevent accidental contact to the chemicals by those persons performing the maintenance task and any other personnel in the area. Contact with chemicals associated with DAF operations has the potential for severe injury to unprotected personnel.

Check to be sure that the chemical pump is functioning properly. A clear piece of pipe in the chemical feed line is useful to allow a visual check of chemical addition into the clarifier.

Changes in the nature of the influent before chemical addition can interfere with the flotation process. Detergents and defoaming agents can cause pH and chemical changes in the influent resulting in poor clarification. Determine that the nature of the influent has remained constant prior to making any chemical changes.

The pH of the waste water stream through the DAF must be monitored and controlled in order to prevent damage to DAF materials and components, to facilitate effective coagulation and flocculation, and to maintain permitted pH levels of the DAF effluent. Failure to properly control and verify pH levels in the DAF system reduces removal efficiency, increases chemical consumption and overall operating costs, may violate discharge permits, and may cause serious and irreversible piping or equipment and material damage that may necessitate repair or replacement of DAF materials, components and ancillary equipment. Krofta Technologies is not liable for such consequences.

Regular verification of the accuracy of pH monitoring and control instrumentation is required. This should be done by comparison to a known standard (buffer solution). The DAF System operator should also document actual chemical usage Vs projected usage to determine the accuracy of automated chemical dosing systems

and to aid in detecting chemical leaks in the system. Failure to properly document the verification methodology and data voids any damage claim.

Elevated temperatures alone or in conjunction with low or elevated pH levels may also increase the likelihood of irreversible damage to DAF materials, components, and ancillary equipment.

Elevated Chloride levels can damage DAF materials and components if not properly monitored and controlled.

KROFTA recommends that an isolation valve should be installed on the discharge side of any pail, drum, tote, tank, or other chemical storage or bulk storage container, and that the isolation valve should be closed and its position verified to prevent accidental discharge or siphoning of any chemical during any maintenance procedures or for any prolonged periods of equipment down time.

Certain agents, gases, coagulants, flocculants, acids, bases/caustics, or any other chemical may adversely affect pH if not controlled and monitored properly, and subsequently may cause severe irreversible damage to Krofta-supplied equipment and materials. Properly maintaining or controlling these levels is the responsibility of the end user. Refer to the chemical vendor-supplied Safety Data Sheets and Specifications for additional safety and exposure precautions, handling recommendations, and materials compatibility.

PRESSURE AND FLOW ADJUSTMENTS

Check the ADT pressure gauges to be sure that the pressures have not changed. If the pressure gauges indicate increasing pressure, this usually means the pressure release valve is plugging. Purge the valve and reset to the correct pressure.

Regulate the ADT air supply to 90 psi, a minimum of 10 PSI higher than the internal tube pressure.

THE BLEED-OFF SIGHT TUBE

The ADT Bleed-Off Sight Tube is an integral component of the Air Dissolving System. The Bleed-Off should be partially open (about 1/3rd) whenever the Air Dissolving System is in operation and checked to insure that an air/water mixture is being discharged. If water only is discharged from the bleed-off, check the system to make sure that it is operating at proper pressure and flow. Increase air into the system in small quantities until an air/water solution is discharged. If air only is discharged from the bleed-off, reduce the air meter settings. Excess air may cause turbulence in the clarifier or excessive foaming.

SOLIDS OVERLOADING PROBLEMS

Overloading is the result of an unusually high solids level in the MULTIFLOAT, as can occur at wash-ups or at times of heavy solids loading from the process. Overloading can cause unclear water and in extreme cases physically clog parts of the system. The most effective solution is to simply decrease the solids loading if possible. If the overload clogs the system with sludge, the system will unclog itself when the overload stops, unless the thick sludge is allowed to clog the plates.

TROUBLESHOOTING TURBULANCE

Excessive turbulence in the solids floatation area of the DAF may be caused by either to excess recycle flow entering the raw water feed or distribution tubes at the base of the U tube may be plugged up with solids. As the air/water, mixture from the ADT enters the unit it is divided into the distribution tubes for even delivery across the unit. There is ¼ inch by one-inch slots that the process water is fed through into the main chamber of the DAF where the solids rise to the float zone and the clean effluent sinks to the clear well. Any debris that is hard and larger than the slots in the distribution tubes will plug the slots and direct water flow to an open slot. If a large number of these slots are blocked pressure builds up in the unit and excessive turbulence is the result.

To clear the blockage the unit must be drained and the end caps for the distribution tubes need to be removed. A piece of 1 ¼" or 1 ½" O.D. by 6 feet long pipe(PVC recommended) can be used as a tool to shear off any protruding debris. When the PVC pipe is sent through the distribution tube, you will be able to "feel" the slots and notice when they are cleared of the material. Using a flashlight, visually inspect the inside of the tubes and confirm the removal of the debris. After the inspection, use a hose to flush out any remaining material. It is very important to remove remaining debris so as not to re-plug the slots.

On the clarified side of the DAF, a plugged or partially plugged extraction area can cause a back up of water flow and manifest itself as turbulence in the float zone. If the purge valve is not working or is not open for a sufficient amount of time to purge out any heavy or sinking solids, over time this condition will build up solids and block the extraction area. It is imperative to inspect the purge valve on a regular basis for functionality and confirm operational status. Make sure the purge valve is opening for a long enough period to purge out any solids that may have accumulated. A visual inspection by way of draining the DAF and opening the access hatch can quickly tell if the area is plugged or clear. It is recommended to have a 5 second purge every sixty minutes for normal operation. Process water conditions may change from day to day and from plant to plant so in times of heavy solids loading you may want to purge the system more often.

AIR DISSOLVING TUBE (ADT) QUICK SETUP & TROUBLSHOOTING GUIDE

TYPICAL OPERATIONAL SETTINGS

Recycle Pump –Pressure at the ADT inlet should be approximately 78 - 80psi.

Air Pressure – The regulated air pressure to the ADT Pneumatic Control Panel must be set 5-10 psi higher than the ADT inlet pressure.

Air Volume – The rotometer(s) should be set for a *maximum* of 30 SCFH or <1 SCFM per air panel. Best results are typically obtained at ~20 SCFH per rotometer

Bleed-Off Valve – The Course Air Bleed-Off Ball Valve must be approximately 1/3 open during normal operation.

Pressure Reducing Globe Valve (Manual Model or Air-Actuated Auto-Purging Model) – Ideally, the globe valve should be set to produce an 8-psi pressure drop across the ADT with an ADT inlet pressure of approximately 78 psi.

INITIAL ADT START-UP PROCEDURES

1.) Close the ball valve at the ADT air injection port on the ADT.

2.) Open the ADT Pressure Reducing Globe Valve, located on the ADT discharge pipe, prior to starting the ADT Recycle Pump to avoid deadheading the pump when the pump is started.

3.) Ensure that the water level in the DAF is high enough to flood the Recycle Pump suction nozzle to avoid pump cavitation when the pump is running.

4.) Start the Recycle Pump.

5.) With the Pressure Reducing Globe Valve fully opened, the recycle flow rate and the pressure drop across the ADT are at their highest. Gradually close the ADT Pressure Reducing Globe until the ADT inlet pressure reading on the 4" dual-port pressure gauge on the ADT Pneumatic Control Panel is at 78 psi (180' HD).

6.) Read the ADT outlet pressure on the 4" dual-port pressure gauge on the ADT Pneumatic Control Panel. The difference between the ADT inlet pressure and outlet pressure should be approximately 8 psi.

7.) If the ADT pressure differential is greater than or less than 8 psi, the recycle flow rate can be determined by looking at the observed pressure differential value on the ADT flow curve and finding the corresponding flow rate for the.

8.) Adjust the Air Filter Regulator on the ADT Pneumatic Control Panel to 90 psig.

9.) Open the ADT Air Supply Isolation Valve(s) to apply air to the ADT Air Panel(s).

10.) At initial system start-up, set the ADT Air Flow Meter(s) at 5-10 SCFH. The airflow rate may need to be increased after the system has operated for a period of time.

11.) Open the ADT Bleed-Off Valve to approximately 1/3 open to bleed off undissolved excess air from the ADT.

TROUBLESHOOTING

Degraded Performance Over Time - Check the air dissolving tube every three months. If more than 15 psi is required to push air into the ADT with the pressure pump off, the dispersion panels have clogged and must be replaced.

Indications:
The ADT panel inserts (vyon) may become clogged or blinded. This will inhibit the compressed air from entering the panel or prevent it from dispersing evenly across the surface of the panel.

Panels can become clogged from excessive polymer use, oil in the air supply lines, or bacteriological growth.

The first sign of plugging of the panel is often an increase in the % open of the rotometer.

Others signs of clogging or binding may be coarse air bubbles in the DAF unit or poor flotation characteristics.

No Recycle Flow – Verify that the Course Air Bleed-Off Valve is set at approximately 1/3 open and is not clogged. Verify that the Pressure Reducing Globe Valve is set correctly and is not clogged.

Indications:
There is no pressure differential shown on the 4" dual-port pressure gauge on the ADT Pneumatic Control Panel.

No rising air micro-bubbles are observed in the DAF viewing window.

The Recycle Pump experiences over-current faults or overloads.

Turbulance -- Excessive turbulence in the solids flotation area of the DAF may be caused by either to excess recycle flow entering the raw water feed or distribution tubes at the base of the U tube may be plugged up with solids.



MULTIFLOAT (MF) MAINTENANCE SCHEDULE*

No.	ITEM	SHIFTLY	WEEKLY	MONTHLY	3-MONTHS	6-MONTHS	YEARLY
1	Inspect Sludge Scraper to Ensure Float Layer is Being Removed	X					
2	Check Scraper Speed and Timer Setting	X					
3	Inspect Rubber Scraper Blades		X				
4	Replace Rubber Scraper Blades (If Needed)					X	
5	Inspect Scraper chain assembly (adjust if needed)		X				
6	Inspect Scraper Gear motor (grease as necessary)				X		
7	Check Auto-Level Control System & Water Height	X					
8	Check/Clean Sludge Conductivity Probes	X					
9	Test Purge Valve		X				
10	Inspect Clearwell vent for debris (Clean as necessary)	X					
11	Check Compressed Air Pressure to ADT (Min. of 90psi)	X					
12	Check Differential Pressure Across ADT (5-10 # Differential)	X					
13	Check ADT Discharge Pressure (Min. 65 psi)	X					
14	Check Rotometer Flow (Max. 30 SCFH)	X					
15	Check ADT Bleed-Off Valve (~1/3 Open)	X					
16	Inspect/Clean ADT Panel(s)					X	
17	Replace ADT Panel(s)						X
18	Check/Flush (purge) Globe Valve	X					
19	Drain and Clean Unit			X			
20	Check All Bolts and Flanges for Tightness			X			
21	Check air pressure & needle valve setting to AOD pumps	X					
22	Inspect DAF Feed & Effluent Pumps for Leaks or Debris	X					
23	Inspect Influent & Effluent FCV's for Function and Moisture in Positioner	X					
24	Drain Compressor and Regulator Traps	X					
25	Verify Compressor Cut-out & Cut-in Pressures (if equipped)	X					
26	Check Compressor oil level fill as necessary (if equipped)		X				
27	Check Compressor filter (if equipped)		X				
28	Check Chemical Metering to Pumps to Ensure Chemicals are Being Dosed – Acid, Caustic, Coagulant & Flocculants	X					
29	Inspect Chemical Feed/Injection Points (valves and fittings)			X			
30	Inspect Polymer Make-up Units	X					

MULTIFLOAT (MF) MAINTENANCE SCHEDULE*							
No.	ITEM	SHIFTLY	WEEKLY	MONTHLY	3-MONTHS	6-MONTHS	YEARLY
31	Clean Polymer Make-up Units			X			
32	Check pH probe for fouling clean as necessary	X					
33	Calibrate pH probe via Buffer solutions			X			
34	Check Turbidity probe for fouling, clean as necessary (If equipped)	X					
35	Calibrate Turbidity probe with Cal solution (If equipped)			X			
36	Lubricate/grease all motors/bearings/gearboxes				X		
*	This is a typical inspection list. Note: individual site conditions vary and may require more frequent inspection, verification and maintenance.	X	X	X	X	X	X

SAFETY RECOMMENDATIONS

This document is an overview of the Safety Requirements for Krofta supplied equipment for the general knowledge of operators and vendors. It is assumed that the facility where Krofta equipment is installed has an established written Safety Program. The following document is recommended protocol for handling Krofta equipment during installation and operation and maintenance procedures but not to supersede the facilities established safety program.

Lockout Tag Out -It is required that whenever personnel are working on or in a Krofta unit or on the ancillary equipment for the Krofta units, that the main disconnect power switch for the unit be placed in the off position and a lock be placed on that switch, with a tag identifying the owner of the lock, to prevent unauthorized or accidental repowering of the systems. At no time should any adjustment, inspection, or maintenance be preformed or undertaken on or in the Krofta unit without the entire unit being completely shut down with the main power switch to the electrical equipment properly shut off and locked and tagged out.

Electrical Control Panel -The electrical control panel contains high voltage electrical components and can be hazardous to personnel through electrical shock should there be accidental contact with those components. During normal operation of the Supracell unit, the cabinet must remain in the closed position. Only qualified and authorized personnel should be allowed access to the interior of the cabinet. No wash-ups of the area near the electrical control cabinet should be allowed without the door being properly closed. Failure to keep the door closed during wash-ups can result in the destruction of the electrical components inside the cabinet and risk of electrical shock to nearby personnel.

Multifloat DAF Units

Guards -All Krofta DAF units are equipped with equipment safety guards for operator protection from outside the unit. Krofta units should not be run without all supplied guards properly installed in place.

Elevated Supracell DAFs -Krofta DAF units are often installed in an elevated position for operation convenience and space savings. It is suggested that elevated units be provided with a platform and railings to provide safe access to the DAF Unit. Normal maintenance procedures on the DAF units are easily and safely conducted from these platforms. Should maintenance procedures require access beyond what is afforded by the platform, additional safety procedures must be employed, specific to that procedure. If the platform is utilized to gain access into the DAF tank, the main control switch must be placed in the off position, locked, and tagged out. See above. Because the DAF unit is elevated, when working beyond the access platform, Krofta recommends utilizing standard OSHA approved fall protection equipment to prevent injury to personnel working in unprotected locations.

Air Dissolving System **-** Krofta DAF units utilize dissolved air in the recycle stream to remove solids. The air is entrained into the recycled water stream in the Krofta Air Dissolving Tube (ADT). That air is supplied to the ADT under pressure by an air compressor at a pressure greater than the pressure to the system provided by the recycle pump. Compressed air or pressurized water has the potential to inflict injury by

accidental release of that energy. Prior to working on the ADT and associated equipment, the main equipment disconnect must be placed in the off position and properly locked and tagged out. See above. After the switch is placed in the off position and locked out, the pressure must be released from the system by opening the bleed valve on the ADT prior to performing any maintenance task.

DAF Influent and Effluent Pumps -For a specific project check to see if the pump(s) are isolated and installed with dedicated electrical disconnects. Prior to any maintenance tasks being performed on the DAF pump, the electrical disconnects for those pumps must be placed in the off position, properly locked, and tagged out. Any residual pressure stored in the piping associated with the specific pump should be released prior to any maintenance procedure. If the pump is not isolated and equipped with dedicated disconnects then follow the proper shutdown procedures and lockout or tag out that equipment.

Sludge Pump -Any maintenance on the sludge pump should only be attempted after shutting down all systems, placing the main power switch in the off position, properly locking out, and tagging that switch. Any residual pressure in the discharge pipe should be released prior to working on the pump.

Chemical Feed Systems -Before any maintenance operation is conducted on any chemical feed system, the main power switch to the entire system must be placed in the off position, properly locked, and tagged out. See above.

Proper operation of a DAF system often requires the use of chemistry to obtain the desired performance of the system. Krofta typically provides the necessary chemical feed pumps and associated tanks to dose the proper chemistry into the system.

Chemical placement within the operating area should adhere to the OSHA standards governing chemical safety.

If a chemical metering system is being commissioned for the first time, the fully installed chemical metering system must be pressure and leak tested using clean water before priming and charging the chemical metering system with the chemical to be used.

Maintenance and operation of the chemical feed pumps should only be attempted by qualified and properly trained personnel using appropriate Personal Protection Equipment (PPE)... When performing maintenance on any chemical system, great care should be taken to prevent accidental contact to the chemicals by those persons performing the maintenance task and any other personnel in the area. Contact with chemicals associated with DAF operations has the potential for severe injury to unprotected personnel. Some chemicals commonly used in water and waste water treatment may damage valves, piping, seal materials, and equipment, including but not limited to stainless steel vessels such as tanks, mixing tubes, and DAFs if the recommended dosing levels, and control, storage, and delivery application techniques are not observed. Appropriate PPE is necessary when working on or around pressurized piping, pumps, valves, tanks, or equipment that may contain any chemical.

Therefore, Krofta recommends that during any maintenance task performed on the chemical feed systems, the maintenance personnel doing that maintenance must be properly trained for handling that specific chemical and that the operator wears, at a minimum, all necessary personal protective equipment (PPE) recommended for protection from that chemical which includes eyewear and chemical specific PPE.

A copy of the MSDS for each chemical handled should be reviewed and thoroughly understood prior to working on any chemical feed system utilized for that specific chemical.

Chemical feed pumps have the potential for developing high pressure in the lines associated with the pump. Every care should be taken to relieve that pressure prior to working on that pump. Failure to relieve pump pressure could result in unnecessary exposure to the pumped chemical and could result in serious personnel injury.

Air Compressor - If an air compressor is provided with your equipment package, please review the following. The Air Compressor cycles on and off according to compressed air consumption in the plant. While in the off mode, the compressor system remains pressurized. Should maintenance be required on the air compressor, that equipment must also be locked out as per the above instruction and any pressure released prior to any maintenance task being performed.

SPARE PARTS

Ordering Replacement Parts:

To order replacement ADT Panel Assemblies, Inserts, or any other Krofta style replacement parts, please contact:

KROFTA TECHNOLOGIES
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917
Email: John.Cronin@Krofta.com
Website: www.kroftatech.com

TRAINING LOG

Company:

Location: **Unit:**

Trainer:

TRAINEE (PRINTED):	TRAINEE (SIGNATURE):	DATE:	TIME:

Comments:

KROFTA/OPERATORS LOG

Company: **Date:**

Location: **Unit:**

Sample ID/#				
Sample Description				
Date				
Hour/Min				
Influent Flow, gpm				
Influent pH				
Influent pH Setpoint & Deadband				
Acid Pump #1 setting				
Caustic Pump #1 setting				
Coagulant #1 Pump Setting				
Coagulant #1 ppm (Panelview)				
Coagulant #1 Drawdown (ml/min)				
Coagulant #2 Pump Setting				
Coagulant #2 ppm (Panelview)				
Coagulant #2 Drawdown (ml/min)				
Polymer #1 Pump Setting				
Polymer #1 ppm (Panelview)				
Polymer #1 Drawdown (ml/min)				
Polymer Dilution Water (psi & gpm)				
Effluent pH				
Effluent pH Setpoint & Deadband				
Acid Pump #2 Setting				
Caustic Pump #2 setting				
ADT psi (in/out)				
Air Pressure (psi & SCFH)				
APGV Settings (Frequency/Duration)				
Sludge Depth, inches				
Sludge Flow, gpm				
Scoop/Scraper Output (rpm & Hz)				
Scoop/Scraper Timer (Frequency/Duration)				
Purge Timer (Frequency/Duration)				
Carriage Speed (rpm & Hz) SPC Only				
Turbidity In (NTU)				
Turbidity Out (NTU)				
Other Parameter Test (In)				
Other Parameter Test (Out)				

Chemicals/Type/Name/Number/ID/Pump Size, Type and Tube Size (if Applicable)

Acid

Caustic

Coagulant #1

Coagulant #2

Polymer #1

Comments:

EQUIPMENT TECHNICAL DATA SHEETS

DAF SLUDGE TRANSFER PUMP

DESCRIPTION

INGERSOLL RAND ARO Model: PD20A-ACP-AAA-B

- AODD Pump, Metallic, Expert Series
  - Air Motor / Air Cap Material: Aluminum
  - Flud Connection: 2" NPT(F)
  - Fluid Cap & Manifold Material: Cast Iron
  - Hardware Material: Carbon Steel
  - Steal Material: Santoprene
  - Ball Material: Santoprene
  - Diaphragm Material: Santoprene

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

OPERATOR'S MANUAL

INCLUDING: OPERATION, INSTALLATION & MAINTENANCE

PD20X-XXX-XXX-B
PE20X-XXX-XXX-B( )

RELEASED: 2-2-05
REVISED: 1-13-12
(REV. 08)

2" DIAPHRAGM PUMP
1:1 RATIO (METALLIC)

READ THIS MANUAL CAREFULLY BEFORE INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT.

It is the responsibility of the employer to place this information in the hands of the operator. Keep for future reference.

SERVICE KITS

Refer to Model Description Chart to match the pump material options.

637309-XX for fluid section repair (see page 4). NOTE: This kit also contains several air motor seals which will need to be replaced.

637374-X major air valve assembly (see page 7).

637421 for air section repair (see page 6).

PUMP DATA

Models ..... see Model Description Chart for "-XXX"
Pump Type ..... Metallic Air Operated Double Diaphragm
Material ..... see Model Description Chart
Weight .. PX20A-XAX-XXX-B( ) ..... 91.4 lbs (41.5 kgs)
PX20A-XCX-XXX-B( ) ..... 147.4 lbs (66.9 kgs)
PX20A-AHX-XXX-B( ), -BHX ... 155.0 lbs (70.3 kgs)
PX20A-ASX-XXX-B( ), -BSX .... 149.8 lbs (68.0 kgs)
PX20A-FHX-XXX-B( ) ..... 169.4 lbs (76.8 kgs)
PX20A-FSX-XXX-B( ) .....162.0 lbs (73.5 kgs)
(add 28.9 lbs [13.1 kg] for stainless steel air motor section)
Maximum Air Inlet Pressure ..... 120 p.s.i.g. (8.3 bar)
Maximum Material Inlet Pressure..... 10 p.s.i.g. (0.69 bar)
Maximum Outlet Pressure ..... 120 p.s.i.g. (8.3 bar)
Maximum Flow Rate ..... 172 g.p.m. (651 l.p.m.)
Displacement / Cycle @ 100 p.s.i.g. .... 1.4 gal. (5.3 lit.)
Maximum Particle Size ..... 1/4" dia. (6.4 mm)
Maximum Temperature Limits (diaphragm / ball / seal material)
E.P.R. / EPDM ..... -60° to 280° F (-51° to 138° C)
Hytrel® ..... -20° to 150° F (-29° to 66° C)
Kynar® PVDF ..... 10° to 200° F (-12° to 93° C)
Nitrile ..... 10° to 180° F (-12° to 82° C)
Santoprene® ..... -40° to 225° F (-40° to 107° C)
PTFE ..... 40° to 225° F (4° to 107° C)
Viton® ..... -40° to 350° F (-40° to 177° C)
Dimensional Data..... see page 8
Noise Level @ 70 p.s.i., 60 c.p.m.① ..... 85.0 db(A)②

① Tested with 67263 muffler assembly installed.
② The pump sound pressure levels published here have been updated to an Equivalent Continuous Sound Level (L_{Aeq}) to meet the intent of ANSI S1.13-1971, CAGI-PNEUROP S5.1 using four microphone locations.

NOTICE: All possible options are shown in the chart, however, certain combinations may not be recommended, consult a representative or the factory if you have questions concerning availability.

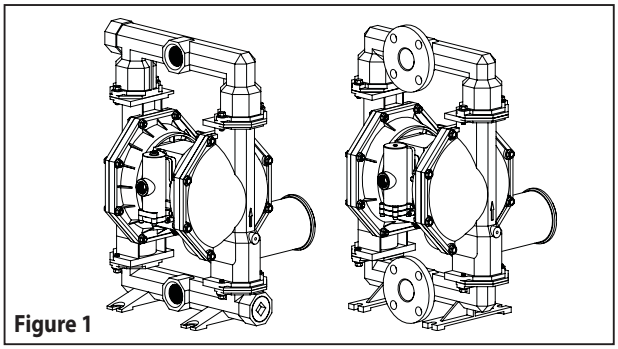


Figure 1

MODEL DESCRIPTION CHART

P X 20 X - X X X - X X X - B (0L)

Electronic Interface
D - None
E - Available

Air Motor / Air Cap Material
A - Aluminum / Aluminum
S - Stainless steel / Stainless steel

Fluid Connection
A - 2 - 11-1/2 N.P.T.F. - 1
B - Rp 2 (2 - 11 BSP parallel)
F - 2" A.N.S.I. / DIN Flange

Fluid Cap & Manifold Material
A - Aluminum
C - Cast Iron
H - Hastelloy®- C
S - Stainless steel

Hardware Material
P - Carbon steel
S - Stainless steel

Seat Material
A - Santoprene
C - Hytrel
E - Carbon steel
F - Aluminum
G - Nitrile
H - Hard 440 stainless steel
K - Kynar PVDF
L - Hastelloy - C
S - 316 Stainless steel

Ball Material
A - Santoprene
C - Hytrel
G - Nitrile
S - 316 Stainless steel
T - PTFE
V - Viton

Diaphragm Material
A - Santoprene
C - Hytrel
G - Nitrile
M - Medical grade Santoprene
T - PTFE / Santoprene
V - Viton

Accessory
0L- Diaphragm Failure Detector

Fluid Section Service Kit Selection

Example: Model #PD20A-ACS-SAA-B
Fluid Section Service Kit # 637309-AA

PD20X - XXX - X X X - B( )
637309 - X X
Ball — Diaphragm

INGERSOLL RAND COMPANY LTD
209 NORTH MAIN STREET – BRYAN, OHIO 43506
(800) 495-0276 • FAX (800) 892-6276
www.ingersollrandproducts.com

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ARO

Ingersoll Rand
Industrial Technologies

OPERATING AND SAFETY PRECAUTIONS

READ, UNDERSTAND AND FOLLOW THIS INFORMATION TO AVOID INJURY AND PROPERTY DAMAGE.



EXCESSIVE AIR PRESSURE
STATIC SPARK



HAZARDOUS MATERIALS
HAZARDOUS PRESSURE

⚠WARNING EXCESSIVE AIR PRESSURE. Can cause personal injury, pump damage or property damage.

- Do not exceed the maximum inlet air pressure as stated on the pump model plate.
- Be sure material hoses and other components are able to withstand fluid pressures developed by this pump. Check all hoses for damage or wear. Be certain dispensing device is clean and in proper working condition.

⚠WARNING STATIC SPARK. Can cause explosion resulting in severe injury or death. Ground pump and pumping system.

- Use the pump grounding screw terminal provided. Use ARO® part no. 66885-1 ground kit or connect a suitable ground wire (12 ga. min.) to a good earth ground source.
- Secure pump, connections and all contact points to avoid vibration and generation of contact or static spark.
- Consult local building codes and electrical codes for specific grounding requirements.
- After grounding, periodically verify continuity of electrical path to ground. Test with an ohmmeter from each component (e.g., hoses, pump, clamps, container, spray gun, etc.) to ground to insure continuity. Ohmmeter should show 0.1 ohms or less.
- Submerse the outlet hose end, dispensing valve or device in the material being dispensed if possible. (Avoid free streaming of material being dispensed.)
- Use hoses incorporating a static wire.
- Use proper ventilation.
- Keep inflammables away from heat, open flames and sparks.
- Keep containers closed when not in use.

⚠WARNING Pump exhaust may contain contaminants. Can cause severe injury. Pipe exhaust away from work area and personnel.

- In the event of a diaphragm rupture, material can be forced out of the air exhaust muffler.
- Pipe the exhaust to a safe remote location when pumping hazardous or inflammable materials.
- Use a grounded 1" minimum i.d. hose between the pump and the muffler.

⚠WARNING HAZARDOUS PRESSURE. Can result in serious injury or property damage. Do not service or clean pump, hoses or dispensing valve while the system is pressurized.

- Disconnect air supply line and relieve pressure from the system by opening dispensing valve or device and / or carefully and slowly loosening and removing outlet hose or piping from pump.

⚠WARNING HAZARDOUS MATERIALS. Can cause serious injury or property damage. Do not attempt to return a pump to the factory or service center that contains hazardous material. Safe handling practices must comply with local and national laws and safety code requirements.

- Obtain Material Safety Data Sheets on all materials from the supplier for proper handling instructions.

⚠WARNING EXPLOSION HAZARD. Models containing aluminum parts cannot be used with 1,1,1-trichloroethane, methylene chloride or other halogenated hydrocarbon solvents which may react and explode.

- Check pump motor section, fluid caps, manifolds and all wetted parts to assure compatibility before using with solvents of this type.

⚠WARNING MISAPPLICATION HAZARD. Do not use models containing aluminum wetted parts with food products for human consumption. Plated parts can contain trace amounts of lead.

⚠ CAUTION Verify the chemical compatibility of the pump wetted parts and the substance being pumped, flushed or recirculated. Chemical compatibility may change with temperature and concentration of the chemical(s) within the substances being pumped, flushed or circulated. For specific fluid compatibility, consult the chemical manufacturer.

⚠ CAUTION Maximum temperatures are based on mechanical stress only. Certain chemicals will significantly reduce maximum safe operating temperature. Consult the chemical manufacturer for chemical compatibility and temperature limits. Refer to PUMP DATA on page 1 of this manual.

⚠ CAUTION Be certain all operators of this equipment have been trained for safe working practices, understand it's limitations, and wear safety goggles / equipment when required.

⚠ CAUTION Do not use the pump for the structural support of the piping system. Be certain the system components are properly supported to prevent stress on the pump parts.

- Suction and discharge connections should be flexible connections (such as hose), not rigid piped, and should be compatible with the substance being pumped.

⚠ CAUTION Prevent unnecessary damage to the pump. Do not allow pump to operate when out of material for long periods of time.

- Disconnect air line from pump when system sits idle for long periods of time.

⚠ CAUTION Use only genuine ARO replacement parts to assure compatible pressure rating and longest service life.

NOTICE Replacement warning labels are available upon request: "Static Spark & Diaphragm Rupture" pn \ 94080.

⚠WARNING	= Hazards or unsafe practices which could result in severe personal injury, death or substantial property damage.
⚠ CAUTION	= Hazards or unsafe practices which could result in minor personal injury, product or property damage.
NOTICE	= Important installation, operation or maintenance information.

GENERAL DESCRIPTION

The ARO diaphragm pump offers high volume delivery even at low air pressure and a broad range of material compatibility options are available. Refer to the model and option chart. ARO pumps feature stall resistant design, modular air motor / fluid sections.

Air operated double diaphragm pumps utilize a pressure differential in the air chambers to alternately create suction and a positive fluid pressure in the fluid chambers, valve checks insure a positive flow of fluid.

Pump cycling will begin as air pressure is applied and will continue to pump and keep up with the demand. It will build and maintain line pressure and will stop cycling once maximum line pressure is reached (dispensing device closed) and will resume pumping as needed.

AIR AND LUBE REQUIREMENTS

⚠WARNING EXCESSIVE AIR PRESSURE. Can cause pump damage, personal injury or property damage.

- A filter capable of filtering out particles larger than 50 microns should be used on the air supply. There is no lubrication required other than the "O" ring lubricant which is applied during assembly or repair.
- If lubricated air is present, make sure that it is compatible with the "O" rings and seals in the air motor section of the pump.

OPERATING INSTRUCTIONS

- Always flush the pump with a solvent compatible with the material being pumped if the material being pumped is subject to "setting up" when not in use for a period of time.
- Disconnect the air supply from the pump if it is to be inactive for a few hours.
- The outlet material volume is governed not only by the air supply, but also by the material supply available at the inlet. The material supply tubing should not be too small or restrictive. Be sure not to use hose which might collapse.
- When the diaphragm pump is used in a forced-feed (flooded inlet) situation, it is recommended that a "check valve" be installed at the air inlet.
- Secure the diaphragm pump legs to a suitable surface to insure against damage by vibration.

PARTS AND SERVICE KITS

Refer to the part views and descriptions as provided on pages 4 through 7 for parts identification and service kit information.

- Certain ARO "Smart Parts" are indicated which should be available for fast repair and reduction of down time.
- Service kits are divided to service two separate diaphragm pump functions: 1. AIR SECTION, 2. FLUID SECTION. The Fluid Section is divided further to match typical part Material Options.

MAINTENANCE

- Provide a clean work surface to protect sensitive internal moving parts from contamination from dirt and foreign matter during service disassembly and reassembly.
- Keep good records of service activity and include the pump in preventive maintenance program.
- Before disassembling, empty captured material in the outlet manifold by turning the pump upside down to drain material from the pump.

FLUID SECTION DISASSEMBLY

1. Remove (61) outlet manifold and (60) inlet manifold.
2. Remove (22) balls, (19) "O" rings (if applicable) and (21) seats.
3. Remove (15) fluid caps.

NOTE: Only PTFE diaphragm models use a primary diaphragm (7) and a backup diaphragm (8). Refer to the auxiliary view in the Fluid Section illustration.

4. Remove the (6) diaphragm washer, (7) or 7 / 8) diaphragms and (5) backup washer.

NOTE: Do not scratch or mar the surface of (1) diaphragm rod.

FLUID SECTION REASSEMBLY

SERVICE NOTE: ARO pn 204214-T diaphragm assembly tool is recommended for use when reassembling the pump.

- Reassemble in reverse order. Refer to the torque requirements on page 5.
- Clean and inspect all parts. Replace worn or damaged parts with new parts as required.
- Lubricate (1) diaphragm rod and (144) "U" cups with Lubriplate® FML-2 grease (94276 grease packet is included in service kit).
- For models with PTFE diaphragms: Item (8) Santoprene diaphragm is installed with the side marked "AIR SIDE" towards the pump center body. Install the (7) PTFE diaphragm with the side marked "FLUID SIDE" towards the (15) fluid cap.
- Re-check torque settings after the pump has been re-started and run a while.

• Hytrel® and Viton® are registered trademarks of the DuPont Company • Loctite® is a registered trademark of Henkel Loctite Corporation • Kynar® is a registered trademark of Arkema Inc. • • Santoprene® is a registered trademark of Monsanto Company, licensed to Advanced Elastomer Systems, L.P. • ARO® is a registered trademark of Ingersoll-Rand Company • • Lubriplate® is a registered trademark of Lubriplate Division (Fiske Brothers Refining Company) • 262™, 271™ and 572™ are trademarks of Henkel Loctite Corporation •

PARTS LIST / PX20X-XXX-XXX-B( ) FLUID SECTION

❶ 637309-XX Fluid section service kit includes: Balls (see Ball Option, refer to -XX in chart below), Diaphragms (see Diaphragm Option, refer to -XX in chart below) and items 19, 70, 144, 175 (listed below) and 174 and 94276 Lubriplate FML-2 grease (page 6).

SEAT OPTIONS PX20X-XXX-XXX-B( )

"21"							
-XXX	Seat	Qty	Mtl	-XXX	Sitz	Qty	Mtl
-AXX	94328-A	(4)	[Sp]	-HXX	94354	(4)	[SH]
-CXX	94328-C	(4)	[H]	-KXX	94477-K	(4)	[K]
-EXX	95677	(4)	[C]	-LXX	95639	(4)	[Ha]
-FXX	95673	(4)	[A]	-SXX	94353	(4)	[SS]
-GXX	94328-G	(4)	[B]				

BALL OPTIONS PX20X-XXX-XXX-B( )

❶ "22" (2-1/2" diameter)							
-XXX	Ball	Qty	Mtl	-XXX	Ball	Qty	Mtl
-XAX	93358-A	(4)	[Sp]	-XSX	94805	(4)	[SS]
-XCX	93358-C	(4)	[H]	-XTX	93358-4	(4)	[T]
-XGX	93358-2	(4)	[B]	-XVX	93358-3	(4)	[V]

NOTE: Seat options -AXX, -CXX and -GXX do not require item 19 "O" ring.

DIAPHRAGM OPTIONS PX20X-XXX-XXX-B( )

	❶ Service kit	❶ "7"			❶ "8"			❶ "19" (1/8" x 3-5/8" o.d.)		
-XXX	-XX = (Ball) -XX = (Diaphragm)	Diaphragm	Qty	Mtl	Diaphragm	Qty	Mtl	"O" Ring	Qty	Mtl
-XXA	637309-XA	94329-A	(2)	[Sp]	-----	---	---	94356	(4)	[E]
-XXC	637309-XC	94329-C	(2)	[H]	-----	---	---	Y327-237	(4)	[V]
-XXG	637309-XG	94329-G	(2)	[B]	-----	---	---	Y325-237	(4)	[B]
-XXM	637309-XM	94329-M	(2)	[MSp]	-----	---	---	Y328-237	(4)	[T]
-XXT	637309-XT	94355-T	(2)	[T]	94330-A	(2)	[Sp]	Y328-237	(4)	[T]
-XXV	637309-XV	95344	(2)	[V]	-----	---	---	Y327-237	(4)	[V]

MATERIAL CODE

[A] = Aluminum
[B] = Nitrile
[C] = Carbon Steel
[Co] = Copper
[CI] = Cast Iron
[E] = E.P.R.
[H] = Hytrel
[Ha] = Hastelloy - C
[K] = Kynar PVDF
[MSp] = Medical grade Santoprene
[SH] = Hard Stainless Steel
[Sp] = Santoprene
[SS] = Stainless Steel
[T] = PTFE
[V] = Viton

CENTER SECTION PART OPTIONS PX20X-XXX-XXX-B( )

			PD20A-XXX-XXX-B( )		PE20A-XXX-XXX-B( )		PD20S-XXX-XXX-B( )		PE20S-XXX-XXX-B( )	
Item	Description (size)	Qty	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl
5	Backup Washer	(2)	96503	[A]	96503	[A]	94357-2	[SS]	94357-2	[SS]
68	Air Cap	(1)	94324-1	[A]	94715-1	[A]	94349-1	[SS]	94349-1	[SS]
69	Air Cap	(1)	94324-2	[A]	94715-2	[A]	94349-2	[SS]	94349-2	[SS]
76	Pipe Plug (1/8 - 27 N.P.T. x 0.27")	(1)	-----	---	Y17-50-S	[SS]	-----	---	Y17-50-S	[SS]
126	Pipe Plug (1/4 - 18 N.P.T. x 7/16")	(2)	-----	---	Y17-51-S	[SS]	Y17-51-S	[SS]	Y17-51-S	[SS]
131	Screw (M10 x 1.5 - 6g x 120 mm)	(4)	94531	[C]	94531	[C]	96656	[SS]	96656	[SS]
❶❷175	"O" Ring (3/32" x 1" o.d.)	(2)	Y325-117	[B]	Y325-117	[B]	-----	---	-----	---
❶❷	(3/32" x 1-1/16" o.d.)	(2)	-----	---	-----	---	Y325-118	[B]	Y325-118	[B]
181	Roll Pin (5/32" o.d. x 3/4" long)	(4)	-----	---	-----	---	Y178-56-S	[SS]	Y178-56-S	[SS]

MANIFOLD THREAD / FLUID CAP MATERIAL OPTIONS PX20X-XXX-XXX-B( )

			PX20X-XAX-		PX20X-XCX-		PX20X-XHX-		PX20X-FHX-		PX20X-XSX-		PX20X-FSX-	
Item	Description (size)	Qty	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl
6	Diaphragm Washer	(2)	96503	[A]	94357-2	[SS]	94357-3	[Ha]	94357-3	[Ha]	94357-2	[SS]	94357-2	[SS]
9	Washer	(2)	93065	[SS]	93065	[SS]	95683	[Ha]	95683	[Ha]	93065	[SS]	93065	[SS]
14	Screw (5/8" - 18 x 2-1/2")	(2)	Y5-111-T	[SS]	Y5-111-T	[SS]	95682	[Ha]	95682	[Ha]	Y5-111-T	[SS]	Y5-111-T	[SS]
15	Fluid Cap	(2)	94325	[A]	94346	[CI]	95679	[Ha]	95679	[Ha]	95570	[SS]	95570	[SS]
60	Inlet Manifold	(1)	94327-[❸]	[A]	94347-[❸]	[CI]	95680-[❸]	[Ha]	96341 ❹	[Ha]	95510-[❸]	[SS]	95512 ❹	[SS]
61	Outlet Manifold	(1)	94326-[❸]	[A]	94348-[❸]	[CI]	95681-[❸]	[Ha]	96342 ❹	[Ha]	95511-[❸]	[SS]	95513 ❹	[SS]
63	Pipe Plug (2 - 11-1/2 N.P.T.)	(2)	Y17-128	[A]	Y17-28-C	[C]	-----	---	-----	---	-----	---	-----	---
	R 2 (2 - 11 BSP, taper)	(2)	94439-2	[A]	94439-1	[C]	-----	---	-----	---	-----	---	-----	---

EXTERNAL HARDWARE OPTION PX20X-XXX-XXX-B( )

			PX20X-XXP-XXX-B( )		PX20X-XXS-XXX-B( )	
Item	Description (size)	Qty	Part No.	Mtl	Part No.	Mtl
26	Screw (M10 x 1.5 - 6g x 34 mm)	(8)	94409-1	[C]	94409-2	[SS]
27	Screw (M10 x 1.5 - 6g x 45 mm)	(16)	94990-1	[C]	94990	[SS]
29	Nut (M10 x 1.5 - 6h)	(16)	94992-1	[C]	94992	[SS]

COMMON PARTS

Item	Description (size)	Qty	Part No.	Mtl
1	Rod	(1)	94358	[C]
43	Ground Lug (see page 7)	(1)	93004	[Co]
❶❷ 70	Gasket	(2)	94100	[B]

Item	Description (size)	Qty	Part No.	Mtl
❶❷ 144	"U" Cup (3/16" x 1-3/8" o.d.)	(2)	Y186-51	[B]
❷ 180	Gasket (0.406" i.d. x 0.031" thick)	(4)	94098	[Co]

❷ Air motor kit parts, see pages 6 and 7.
❸ For N.P.T.F. thread models (PX20X-AXX-XXX-B) use "-1". For BSP thread models (PX20X-BXX-XXX-B) use "-2".
❹ Flange models
❺ "Smart Parts", keep these items on hand in addition to the service kits for fast repair and reduction of down time.

PARTS LIST / PX20X-XXX-XXX-B( ) FLUID SECTION

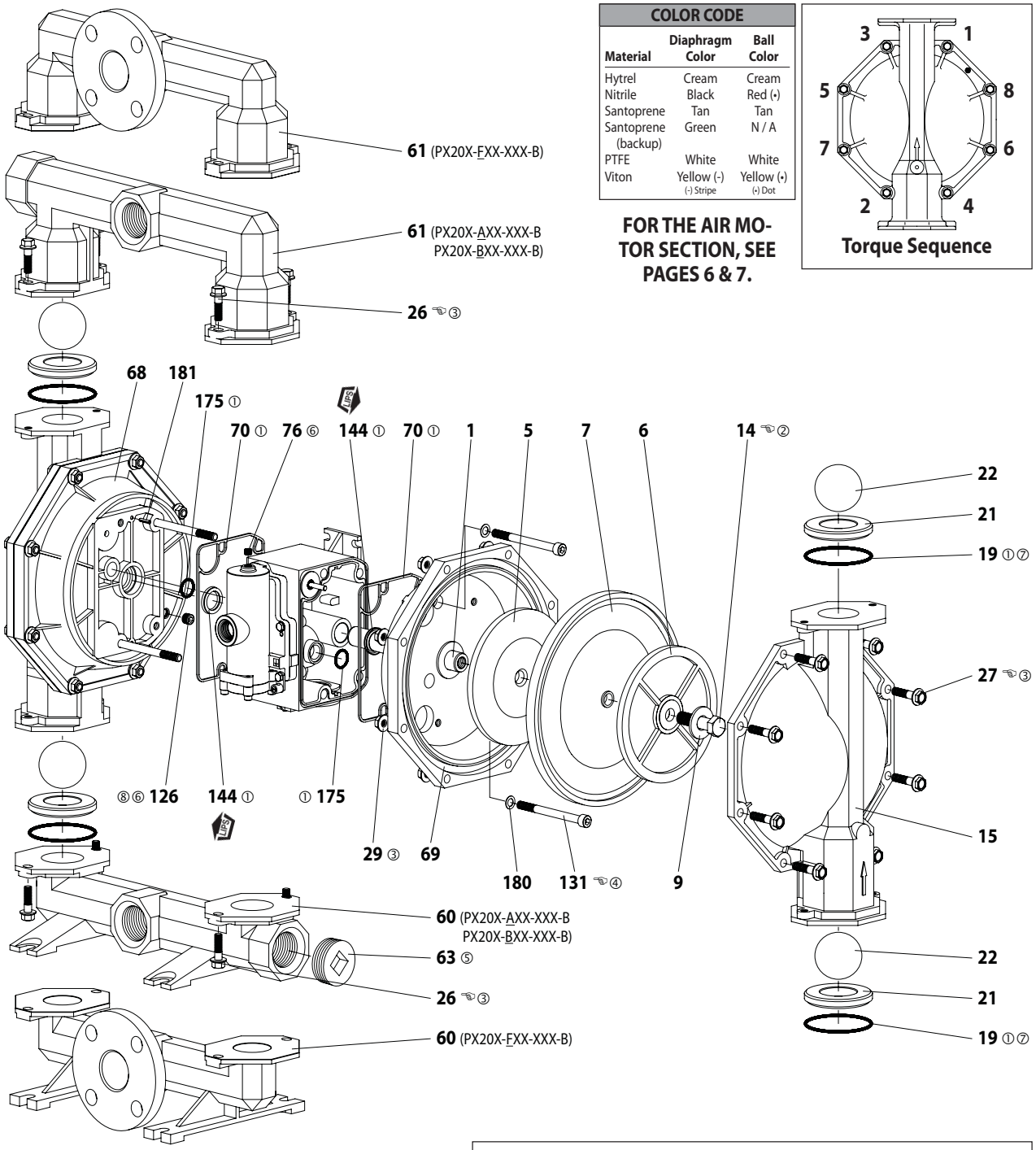


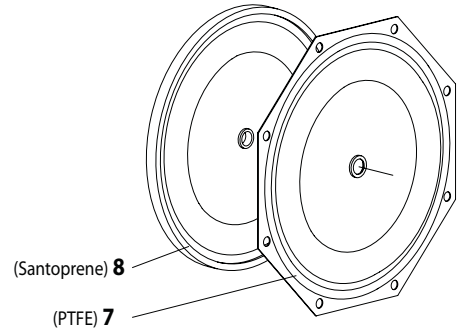
Figure 2

COLOR CODE		
Material	Diaphragm Color	Ball Color
Hytrel	Cream	Cream
Nitrile	Black	Red (•)
Santoprene	Tan	Tan
Santoprene (backup)	Green	N / A
PTFE	White	White
Viton	Yellow (-) (-) Stripe	Yellow (•) (•) Dot

FOR THE AIR MOTOR SECTION, SEE PAGES 6 & 7.

Torque Sequence

View for PX20X-XXX-XXT-B (PTFE diaphragm) configuration only.



☞ ASSEMBLY TORQUE REQUIREMENTS ☜

NOTE: DO NOT OVERTIGHTEN FASTENERS.
ALL FASTENERS ARE METRIC.

(14) Diaphragm screw, 65 - 70 ft lbs (88.1 - 94.9 Nm).
(26) Screw, 30 - 40 ft lbs (40.7 - 54.2 Nm).
(27) Screw, 30 - 40 ft lbs (40.7 - 54.2 Nm).
(131) Screw, 35 - 40 ft lbs (47.5 - 54.2 Nm).

LUBRICATION / SEALANTS

① Apply Lubriplate FML-2 grease to all "O" rings, "U" cups and mating parts.
② Apply Loctite® 271™ to threads.
③ Apply anti-seize compound to threads and bolt and nut flange heads which contact pump case when using stainless steel fasteners.
④ Apply Loctite 262™ to threads at assembly.
⑤ Apply PTFE tape to threads.
⑥ Apply Loctite 572™ to threads.
⑦ Not used with PX20X-XXX-AXX-B, -CXX and -GXX.
⑧ Not used with PX20X-XXX-XXX-B0L.

Note: Lubriplate FML-2 is a white food grade petroleum grease.

PARTS LIST / PX20X-XXX-XXX-B( ) AIR MOTOR SECTION

❷ Indicates parts included in 637421 air section service kit shown below and items (70), (144), (175) and (180) shown on page 4.

AIR MOTOR PARTS

Item	Description (size)	Qty	Part No.	Mtl
101	Center Body (PX20A-XXX-XXX-B)	(1)	94028	[A]
	(PX20S-XXX-XXX-B)	(1)	94109	[SS]
103	Bushing	(1)	94092	[D]
105	Screw (M6 x 1 - 6g x 20 mm)	(4)	95887	[SS]
111	Spool	(1)	95651	[D]
118	Actuator Pin (0.250" x 2.276" long)	(2)	94083	[SS]
121	Sleeve	(2)	94084	[D]
127	90° St. Elbow (1-1/2 - 11-1/2 N.P.T.)	(1)	94860	[C / I]
128	Set Screw (1/4" - 20 x 1/4")	(2)	Y29-42-S	[SS]
❷ 132	Gasket	(1)	94099	[B]
133	Lockwasher (1/4") (PX20A-XXX-XXX-B)	(3)	Y117-416-C	[C]
	(PX20S-XXX-XXX-B)	(3)	Y14-416-T	[SS]
134	Screw (M6 x 1 - 6g x 30 mm)	(4)	96358	[SS]
135	Valve Housing (PD20A-XXX-XXX-B)	(1)	96334-1	[A]
	(PD20S-XXX-XXX-B)	(1)	96337-1	[SS]
	(PE20A-XXX-XXX-B)	(1)	96334-2	[A]
	(PE20S-XXX-XXX-B)	(1)	96337-2	[SS]
136	Plug (PX20A-XXX-XXX-B)	(1)	96335	[A]
	(PX20S-XXX-XXX-B)	(1)	96339	[SS]
❷ 137	"O" Ring (1/16" x 2" o.d.)	(1)	Y325-32	[B]
❷ 138	"U" Cup (3/16" x 1.792" o.d.)	(1)	95966	[B]
❷ 139	"U" Cup (3/16" x 1-1/4" o.d.)	(1)	Y186-50	[B]
140	Valve Insert	(1)	95650	(Ck)
141	Valve Plate	(1)	95659	(Ck)
❻❷ 146	"O" Ring (3/32" x 1-1/16" o.d.)	(1)	Y325-118	[B]
❻❷ 147	"O" Ring (1/8" x 1/2" o.d.)	(2)	Y325-202	[B]
❼❷ 166	Track Gasket	(1)	94026	[B]
❷ 167	Pilot Piston (includes 168 and 169)	(1)	67164	[D]
168	"O" Ring (3/32" x 5/8" o.d.)	(2)	94433	[U]
169	"U" Cup (1/8" x 7/8" o.d.)	(1)	Y240-9	[B]
170	Piston Sleeve	(1)	94081	[Br]
❷ 171	"O" Ring (3/32" x 1-1/8" o.d.)	(1)	Y325-119	[B]
❷ 172	"O" Ring (1/16" x 1-1/8" o.d.)	(1)	Y325-22	[B]
❷ 173	"O" Ring (1/16" x 1-3/8" o.d.)	(2)	Y325-26	[B]
❶❷ 174	"O" Ring (1/8" x 1/2" o.d.)	(2)	Y325-202	[B]
❷ 176	Diaphragm (check valve)	(2)	94102	[Sp]
❷ 199	Track Gasket	(1)	95666	[B]
❷ 200	Gasket	(1)	95665	[B]
201	Muffler Kit (includes item 127)	(1)	67213	
233	Adapter Plate (PX20A-XXX-XXX-B)	(1)	96336	[A]
	(PX20S-XXX-XXX-B)	(1)	96338	[SS]
240	Screw (M6 x 1 - 6g x 16 mm)	(2)	95991	[SS]
❷ 241	Track Gasket	(1)	96344	[B]
❷ 242	"O" Ring (1/16" x 7/32" o.d.)	(1)	Y325-5	[B]
❷ 243	"O" Ring (1/8" x 5/8" o.d.)	(1)	Y325-204	[B]
❷ 244	"O" Ring (1/8" x 7/8" o.d.)	(1)	Y325-208	[B]
❶ ❷	Lubriplate FML-2 grease	(1)	94276	
	Lubriplate Grease Packets (10)		637308	

❶ Items included in fluid section service kit, see pages 4 and 5.
❻ Used on models PX20S-XXX-XXX-B( ) only.
❼ Used on models PX20A-XXX-XXX-B( ) only.

MATERIAL CODE

[A] = Aluminum
[B] = Nitrile
[Br] = Brass
[C] = Carbon Steel
[Ck] = Ceramic
[D] = Acetal
[I] = Iron
[Sp] = Santoprene
[SS] = Stainless Steel
[U] = Polyurethane

AIR MOTOR SECTION SERVICE

Service is divided into two parts - 1. Pilot Valve, 2. Major Valve.
GENERAL REASSEMBLY NOTES:

- Air Motor Section service is continued from Fluid Section repair.
- Inspect and replace old parts with new parts as necessary. Look for deep scratches on metallic surfaces, and nicks or cuts in "O" rings.
- Take precautions to prevent cutting "O" rings upon installation.
- Lubricate "O" rings with Lubriplate FML-2 grease.
- Do not over-tighten fasteners. Refer to torque specification block on view.
- Re-torque fasteners following restart.
- SERVICE TOOLS - To aid in the installation of (168) "O" rings onto the (167) pilot piston, use tool # 204130-T, available from ARO.

PILOT VALVE DISASSEMBLY

1. A light tap on (118) actuator pin should expose the opposite (121) sleeve, (167) pilot piston and other parts.
2. Remove (170) sleeve. Inspect inner bore of sleeve for damage.

PILOT VALVE REASSEMBLY

1. Clean and lubricate parts not being replaced from service kit.
2. Install new (171 and 172) "O" rings. Replace (170) sleeve.
3. Install new (168) "O" rings and (169) seal - Note the lip direction. Lubricate and replace (167) pilot piston.
4. Reassemble remaining parts. Replace (173 and 174) "O" rings.

MAJOR VALVE DISASSEMBLY

1. Remove (135) valve block and (233) adapter plate, exposing (132 and 166) gaskets and (176) checks.
2. Remove (233) adapter plate, releasing (140) valve insert, (141) valve plate, (199, 200 and 241) gaskets and (243 and 244) "O" rings.
3. Remove (136) plug and (137) "O" ring, releasing (111) spool.

MAJOR VALVE REASSEMBLY

1. Install new (138 and 139) "U" cups on (111) spool - **LIPS MUST FACE EACH OTHER.**
2. Insert (111) spool into (135) valve block.
3. Install (137 and 242) "O" rings on (136) plug and assemble plug to (135) valve block, securing with (105) screws.
4. Install (140) valve insert, (141) valve plate, (199) gasket and (243 and 244) „O" rings into (135) valve block. NOTE: Assemble (140) valve insert with "dished" side toward (141) valve plate. Assemble (141) valve plate with part number identification toward (140) valve insert.
5. Assemble (200 and 241) gaskets and (233) adapter plate to (135) valve block, securing with (240) screws.
6. Assemble (132 and 166) gaskets and (176) checks to (101) center body.
7. Assemble (135) valve block and components to (101) center body, securing with (134) screws.

PARTS LIST / PX20X-XXX-XXX-B( ) AIR MOTOR SECTION

⑨ **Substitute these "O" rings for (166) gasket on models PX20S-XXX-XXX-B( ).**

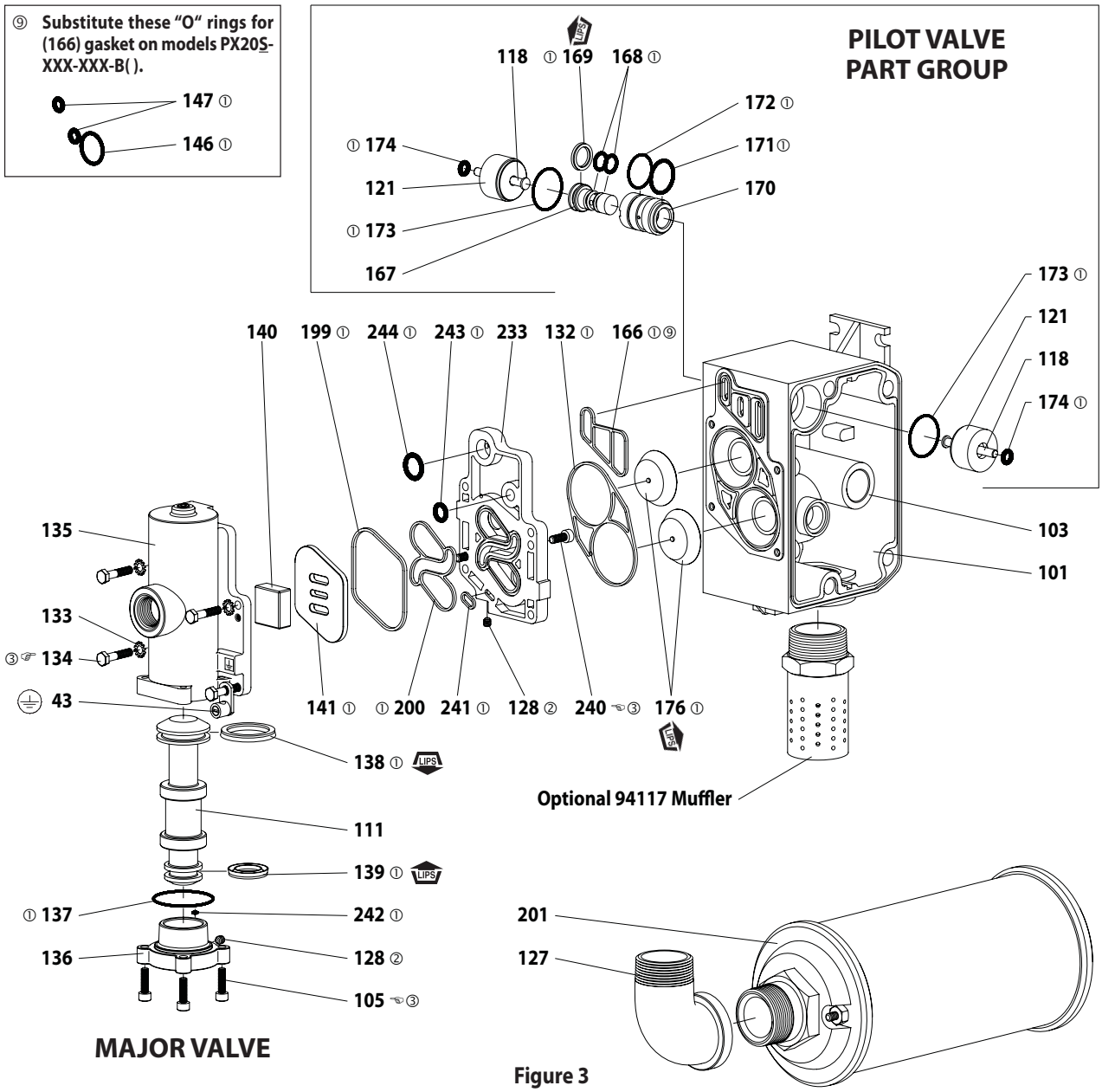


Figure 3

☞ ASSEMBLY TORQUE REQUIREMENTS ☜

NOTE: DO NOT OVERTIGHTEN FASTENERS.
ALL FASTENERS ARE METRIC.

(105) Screw, 40 - 50 in. lbs (4.5 - 5.6 Nm).
(134) Screw, 40 - 50 in. lbs (4.5 - 5.6 Nm).
(240) Screw, 40 - 50 in. lbs (4.5 - 5.6 Nm).

LUBRICATION / SEALANTS

① **Apply Lubriplate FML-2 grease to all "O" rings, "U" cups and mating parts.**
② **Apply Loctite 271 to threads.**
③ **Apply anti-seize compound to threads and bolt and nut flange heads which contact pump case when using stainless steel fasteners.**

A replacement major valve service assembly is available separately, which includes the following:

637374-2 for models PD20A-XXX-XXX-B: 105 (4), 111, 128 (2), 132, 133 (3), 134 (4), 135, 136, 137, 138, 139, 140, 141, 166, 176 (2), 199, 200, 233, 240 (2), 241, 242, 243 and 244.

637374-3 for models PE20A-XXX-XXX-B: 76, 105 (4), 111, 128 (2), 132, 133 (3), 134 (4), 135, 136, 137, 138, 139, 140, 141, 166, 176 (2), 199, 200, 233, 240 (2), 241, 242, 243 and 244.

637374-4 for models PD20S-XXX-XXX-B: 105 (4), 111, 128 (2), 132, 133 (3), 134 (4), 135, 136, 137, 138, 139, 140, 141, 146, 147, 176 (2), 199, 200, 233, 240 (2), 241, 242, 243 and 244.

637374-5 for models PE20S-XXX-XXX-B: 76, 105 (4), 111, 128 (2), 132, 133 (3), 134 (4), 135, 136, 137, 138, 139, 140, 141, 146, 147, 176 (2), 199, 200, 233, 240 (2), 241, 242, 243 and 244.

TROUBLE SHOOTING

Product discharged from exhaust outlet.
- Check for diaphragm rupture.
- Check tightness of (14) diaphragm screw.

Air bubbles in product discharge.
- Check connections of suction plumbing.
- Check "O" rings between intake manifold and inlet side fluid caps.
- Check tightness of (14) diaphragm screw.

Motor blows air or stalls.
- Check (176) check valve for damage or wear.
- Check for restrictions in valve / exhaust.

Low output volume, erratic flow or no flow.
- Check air supply.
- Check for plugged outlet hose.
- Check for kinked (restrictive) outlet material hose.
- Check for kinked (restrictive) or collapsed inlet material hose.
- Check for pump cavitation - suction pipe should be sized at least as large as the inlet thread diameter of the pump for proper flow if high viscosity fluids are being pumped. Suction hose must be a non-collapsing type, capable of pulling a high volume.
- Check all joints on the inlet manifolds and suction connections. These must be air tight.
- Inspect the pump for solid objects lodged in the diaphragm chamber or the seat area.

DIMENSIONAL DATA

Dimensions shown are for reference only, they are displayed in inches and millimeters (mm).

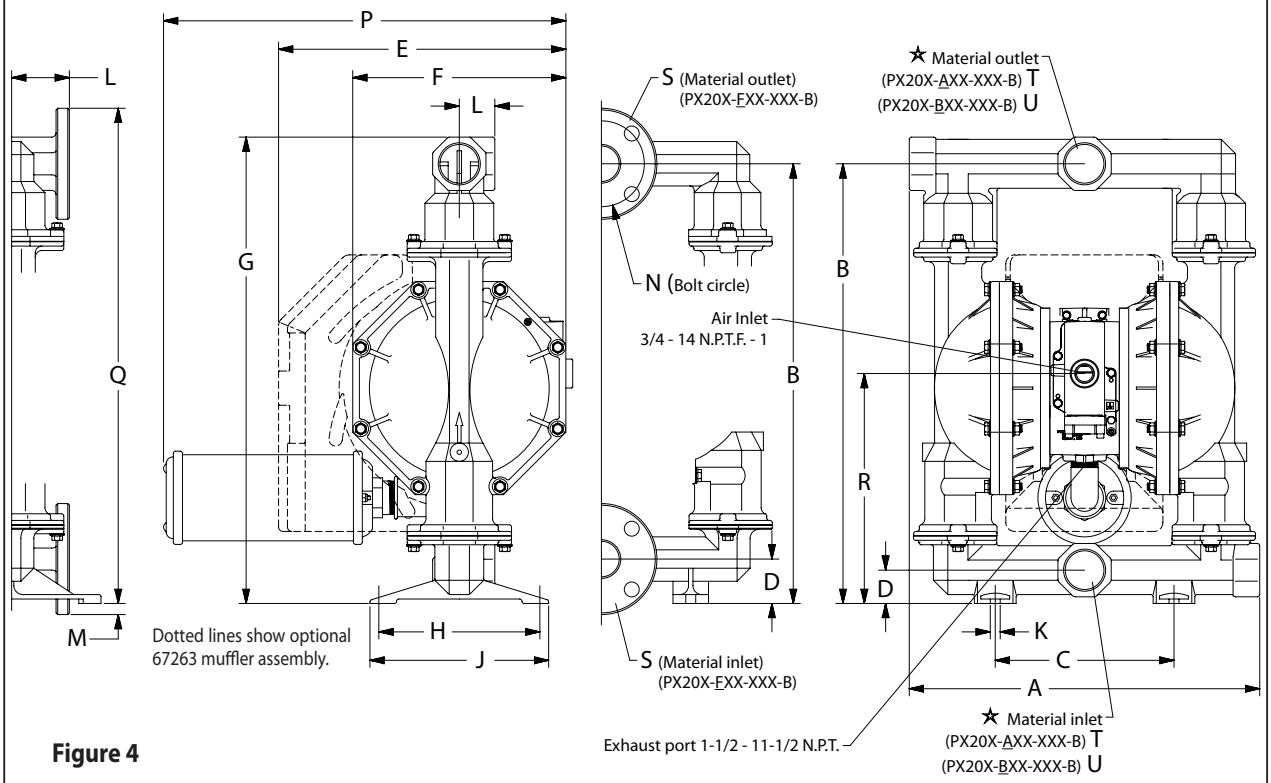


Figure 4

DIMENSIONS

A - see below	F - 12" (304.8 mm)	L - see below	R - see below
B - 24-3/4" (628.7 mm)	G - 26-1/4" (666.8 mm)	M - 5/8" (15.9 mm)	S - 2" A.N.S.I. / DIN Flange
C - 10-1/16" (255.6 mm)	H - 9-1/16" (230.2 mm)	N - 4.834" (122.8 mm)	T - 2 - 11-1/2 N.P.T.F. - 1
D - see below	J - 10-1/16" (255.6 mm)	P - 21-5/8" (548 mm)	U - Rp 2 (2 - 11 BSP, parallel)
E - 16-3/16" (411.2 mm)	K - 9/16" (14.3 mm)	Q - 27-7/8" (708.0 mm)	

☆ Side Discharge Ports are not available on PX20X-XSX-X-B Models.

	"A"	"D"	"L"	"R"
PX20X-XAX-XXX-B( )	19-3/4" (501.7 mm)	1-7/8" (47.6 mm)	2" (50.8 mm)	12-15/16" (328.6 mm)
PX20X-XCX-XXX-B( )	19-3/4" (501.7 mm)	1-7/8" (47.6 mm)	2" (50.8 mm)	12-15/16" (328.6 mm)
PX20X-AHX-XXX-B( )	19-1/4" (488.7 mm)	2-1/2" (63.5 mm)	2-3/32" (53.0 mm)	13-9/16" (344.5 mm)
PX20X-BHX-XXX-B( )	19-1/4" (488.7 mm)	2-1/2" (63.5 mm)	2-3/32" (53.0 mm)	13-9/16" (344.5 mm)
PX20X-ASX-XXX-B( )	19-3/8" (492.1 mm)	2-1/2" (63.5 mm)	2-3/32" (53.2 mm)	13-9/16" (344.5 mm)
PX20X-BSX-XXX-B( )	19-3/8" (492.1 mm)	2-1/2" (63.5 mm)	2-3/32" (53.2 mm)	13-9/16" (344.5 mm)
PX20X-FHX-XXX-B( )	19-1/4" (488.7 mm)	2-1/2" (63.5 mm)	3-1/4" (82.6 mm)	13-9/16" (344.5 mm)
PX20X-FSX-XXX-B( )	19-3/8" (492.1 mm)	2-1/2" (63.5 mm)	3-1/4" (82.6 mm)	13-9/16" (344.5 mm)

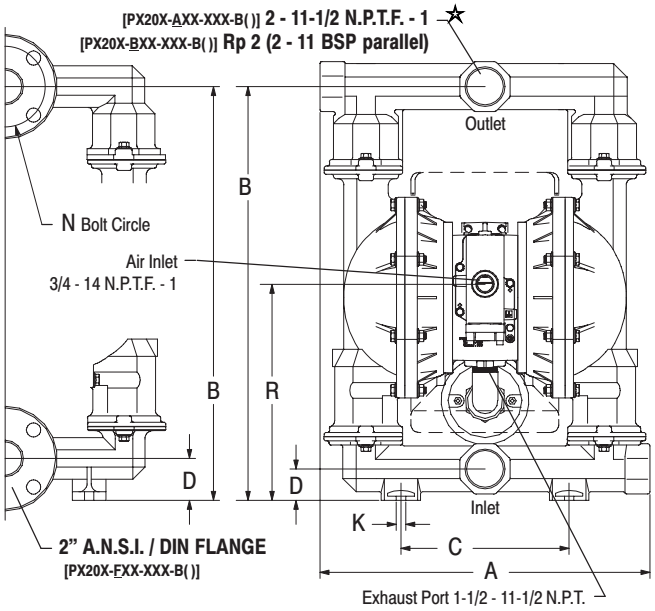
SALES & ENGINEERING DATA

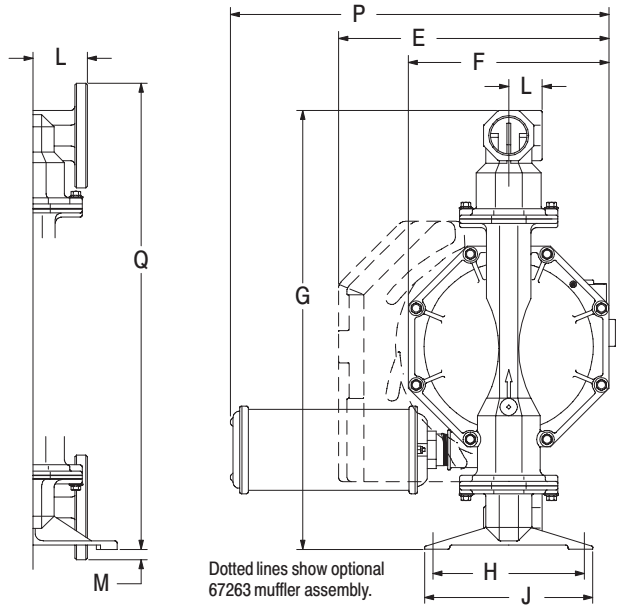
PD20A-XXX-XXX-B / PD20S-XXX-XXX-B
PE20A-XXX-XXX-B( ) / PE20S-XXX-XXX-B( )
2'' METALLIC DIAPHRAGM PUMP

RATIO SERIES:	1:1
FLUID P.S.I. RANGE:	20 - 120

RELEASED: 2-3-05
REVISED: 9-15-11
(REV. 05) S-1338

DIMENSIONAL DATA





DIMENSIONS

A	see below	G	26-1/4" (666.8 mm)	M	5/8" (15.9 mm)
B	24-3/4" (628.7 mm)	H	9-1/16" (230.2 mm)	N	4.834" (122.8 mm)
C	10-1/16" (255.6 mm)	J	10-1/16" (255.6 mm)	P	21-5/8" (548 mm)
D	see below	K	9/16" (14.3 mm)	Q	27-7/8" (708.0 mm)
E	16-3/16" (411.2 mm)	L	see below	R	see below
F	12" (304.8 mm)				

SPECIFICATIONS

CONSTRUCTION

Model Series . . . . . PD20A-X-X-B / PD20S-X-X-B
. . . . . PE20A-X-X-B( ) / PE20S-X-X-B( )
Pump Type . . . . . Metallic, Air Operated, Double Diaphragm
Ratio 1:1
Material Inlet / Outlet (female)
PX20X-AXX-XXX-B( ) . . . . . 2 - 11-1/2 N.P.T.F. - 1
PX20X-BXX-XXX-B( ) . . . . . Rp 2 (2 - 11 BSP parallel)
PX20X-FXX-XXX-B( ) . . . . . 2" A.N.S.I. / DIN Flange
Air Inlet (female) . . . . . 3/4 - 14 N.P.T.F. - 1
Air Exhaust (female) . . . . . 1-1/2 - 11-1/2 N.P.T.
Weight . PX20A-XAX-XXX-B( ) . . . . . 91.4 lbs (41.5 kgs)
PX20A-XCX-XXX-B( ) . . . . . 147.4 lbs (66.9 kgs)
PX20A-AHX-XXX-B( ), -BHX . . . 155.0 lbs (70.3 kgs)
PX20A-ASX-XXX-B( ), -BSX . . . 149.8 lbs (68.0 kgs)
PX20A-FHX-XXX-B( ), ... 169.4 lbs (76.8 kgs)
PX20A-FSX-XXX-B( ), ... 162.0 lbs (73.5kgs)
(add 28.9 lbs [13.1 kgs] for stainless steel air motor section)
Air Section Service Kit 637421
Fluid Section Service Kit 637309-XX
Major Air Valve Assembly 637374-X

PX20X-XXX-X[X][X] -B( )
637309 -[X][X]
Diaphragm Material
Ball Material

EXAMPLE: Model # PD20A-AAP-AAA-B
Fluid Section Service Kit is 637309-AA

PERFORMANCE

Air Inlet Pressure Range . . . . . 20 - 120 p.s.i. (1.4 - 8.3 bar)
Maximum Material Inlet Pressure . . . . . 10 p.s.i. (0.69 bar)
Fluid Pressure Range . . . . . 20 - 120 p.s.i. (1.4 - 8.3 bar)
Maximum Flow Rate . . . . . 172 g.p.m. (651 l.p.m.)
Displacement / Cycle @ 100 p.s.i. . . . . . 1.4 gal. (5.3 lit.)
Maximum Particle Size . . . . . 1/4" dia. (6.4 mm)
Maximum Temperature Limits (diaphragm / ball / seal material)
E.P.R. / EPDM . . . . . -60° to 280° F (-51° to 138° C)
Hytrel® . . . . . -20° to 150° F (-29° to 66° C)
Nitrile . . . . . 10° to 180° F (-12° to 82° C)
PVDF (Kynar®) . . . . . 10° to 200° F (-12° to 93° C)
Santoprene® . . . . . -40° to 225° F (-40° to 107° C)
PTFE . . . . . 40° to 225° F (4° to 107° C)
Viton® . . . . . -40° to 350° F (-40° to 177° C)
Noise Level @ 70 p.s.i. - 60 c.p.m.① . . . 85.0 db(A)②

① Tested with 67263 muffler assembly installed.
② The pump sound pressure level has been updated to an Equivalent Continuous Sound Level (L_{Aeq}) to meet the intent of ANSI S1. 13-1971, CAGI-PNEUROP S5.1 using four microphone locations.

ACCESSORIES:
66312 Air Line Connection Kit
67263 Continuous Muffler
94117 Int. Muffler

	"A"	"D"	"L"	"R"
PX20X-XAX-XXX-B( )	19-3/4" (501.4 mm)	1-7/8" (47.6 mm)	2" (50.8 mm)	12-15/16" (328.6 mm)
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PX20X-AHX-XXX-B( ), -BHX	19-1/4" (488.7 mm)	2-1/2" (63.5 mm)	2-3/32" (53.0 mm)	13-9/16" (344.5 mm)
PX20X-ASX-XXX-B( ), -BSX	19-1/4" (488.7 mm)	2-1/2" (63.5 mm)	2-3/32" (53.0 mm)	13-9/16" (344.5 mm)
PX20X-FHX-XXX-B( ), -FSX	19-1/4" (488.7 mm)	2-1/2" (63.5 mm)	3-1/4" (82.6 mm)	13-9/16" (344.5 mm)

NOTE: Dimensions are shown in inches and (mm), supplied for reference only and are typically rounded up to the nearest 1/16 inch.

★ **Side Discharge Ports are not available on PX20X-XSX-X-B Models.**

INGERSOLL RAND COMPANY LTD
209 NORTH MAIN STREET – BRYAN, OHIO 43506
✆ (800) 495-0276 • FAX(800) 892-6276
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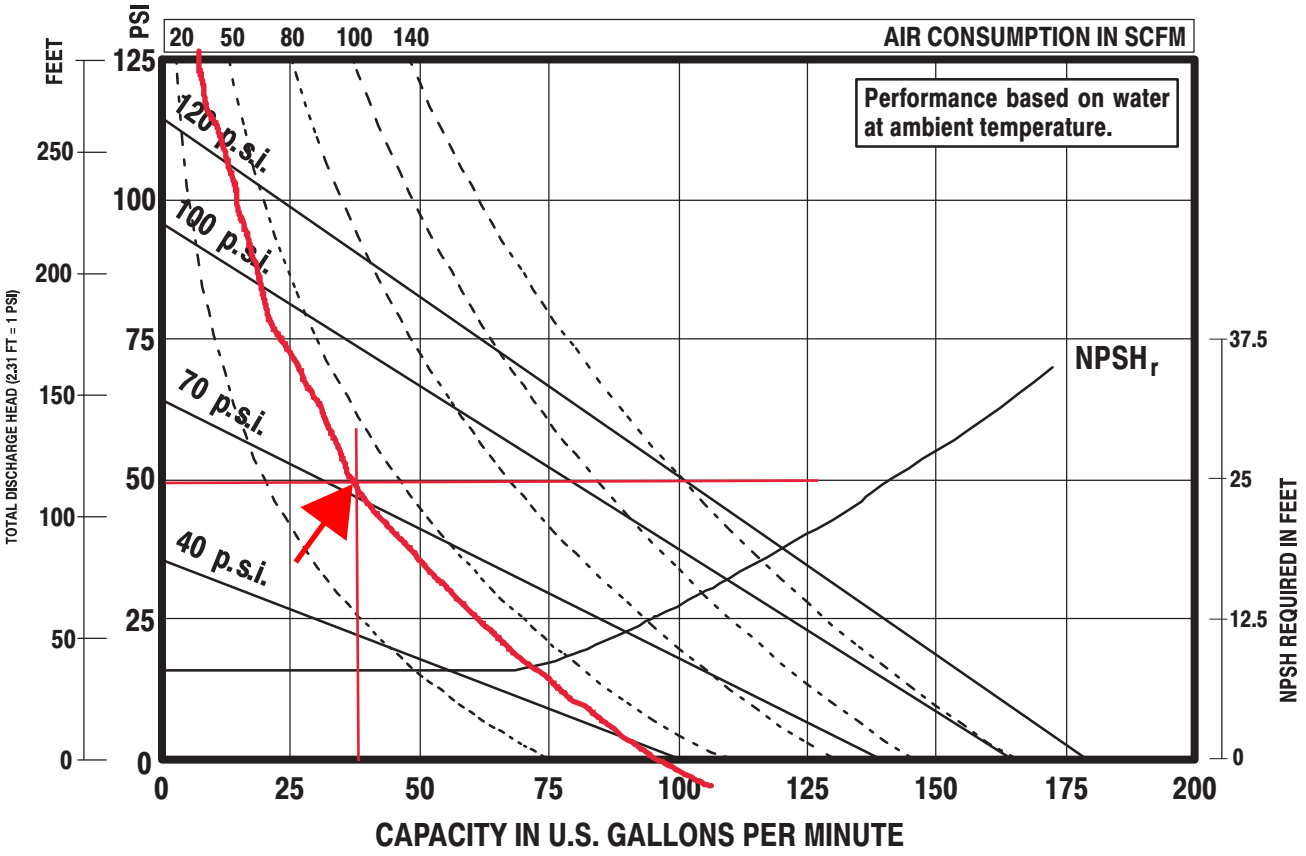
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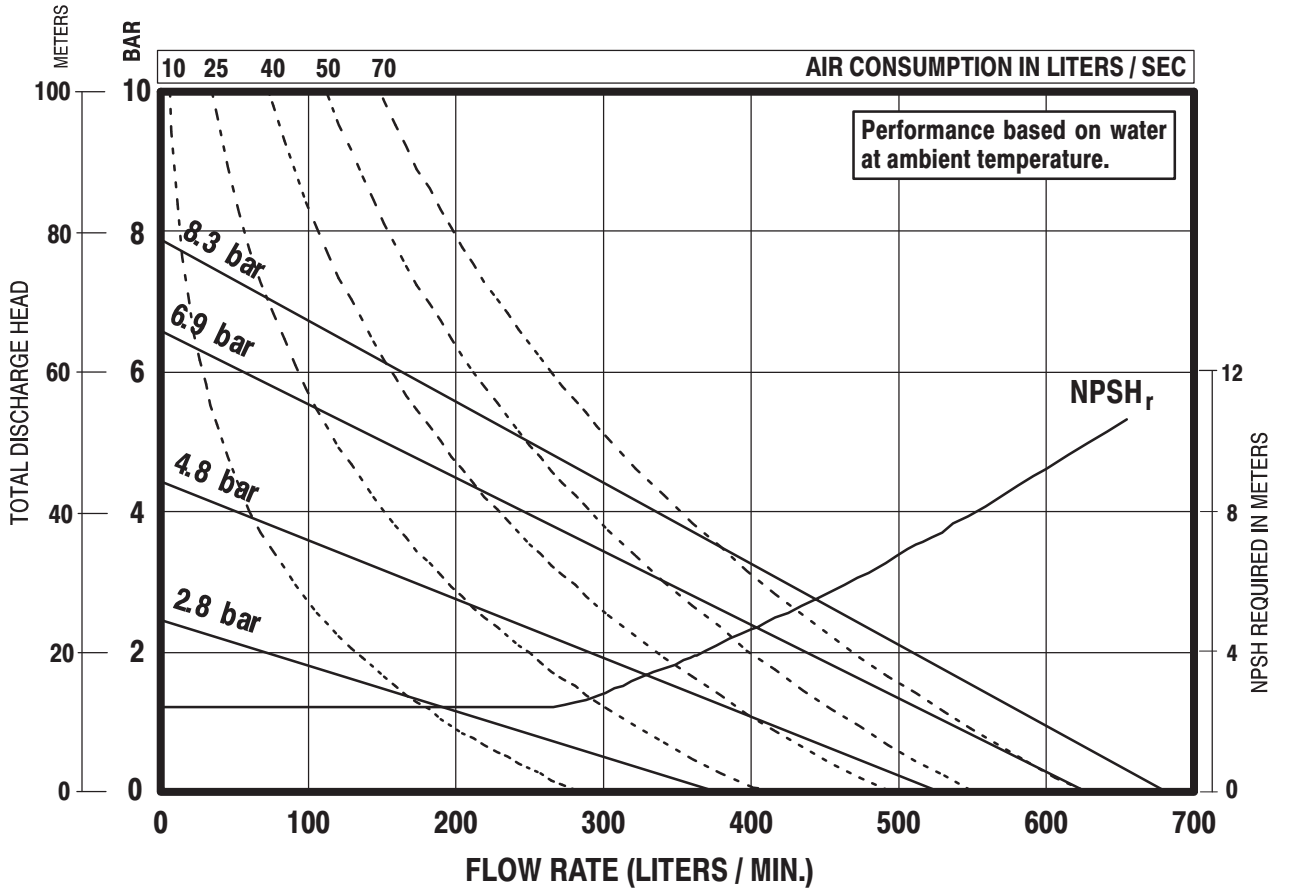
ARO

Ingersoll Rand Industrial Technologies

PERFORMANCE CURVES

PD20X-XXX-XXX-B / PE20X-XXX-XXX-B( ) 2" METALLIC DIAPHRAGM PUMP





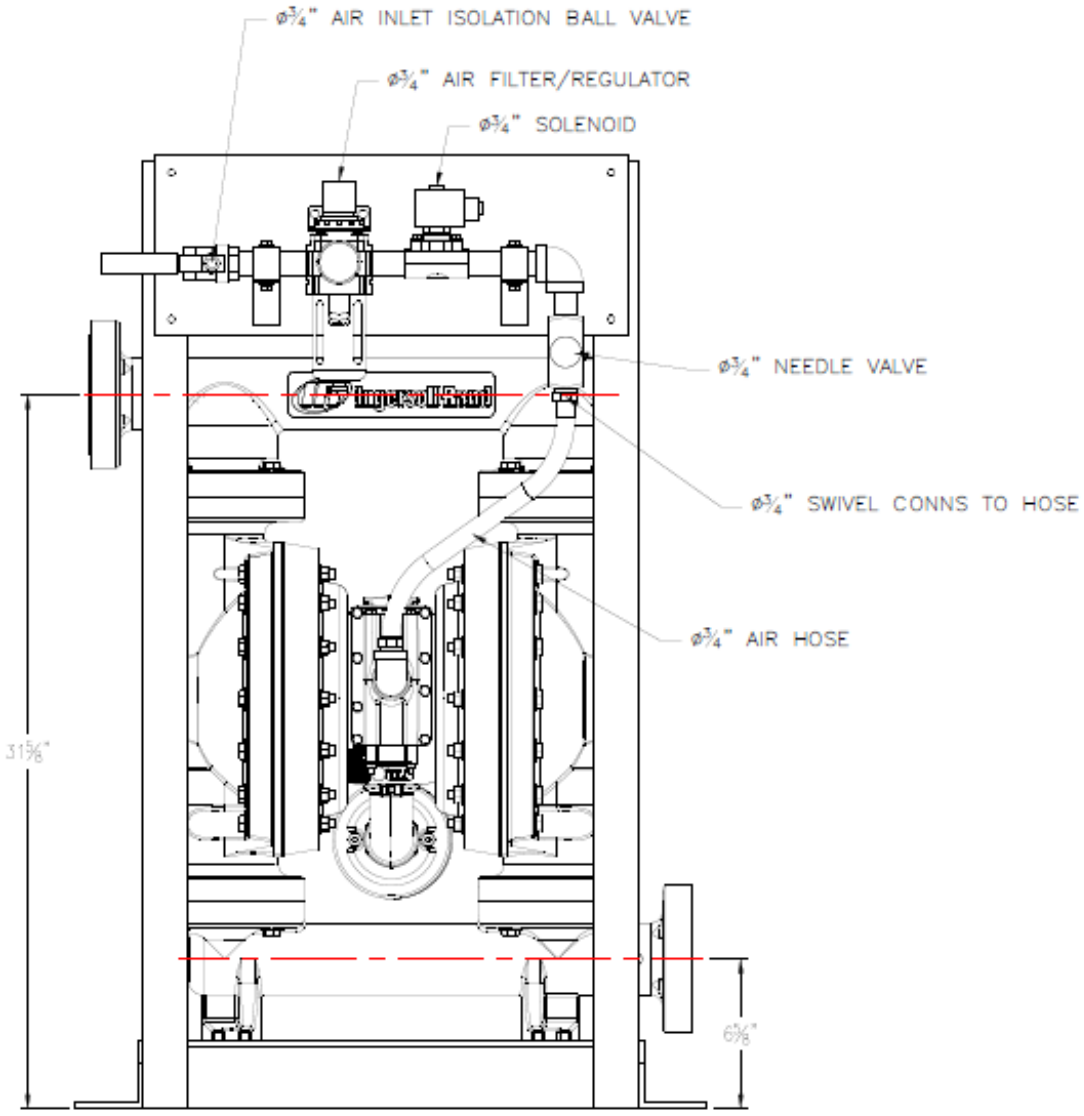
EQUIPMENT TECHNICAL DATA SHEETS

AIR DIAPHRAGM SLUDGE TRANSFER PUMP

PNEUMATIC CONTROL PANEL W/ COMPONENTS

1. Isolation Valve, Air Inlet
2. Air Pressure Filter/Regulator ~ 50-60 psi
    a. Sludge Pump Air Supply
3. Solenoid Valve, Sludge Pump Air Supply
4. Needle Valve, Air Flow Control to Pump
5. Pressure Gauge, Pump Discharge (shipped loose)
6. Isolation Valves, Pump Suction / Discharge (shipped loose)
7. Air Supply Hose

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917



KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

EQUIPMENT TECHNICAL DATA SHEETS

ISOLATION BALL VALVE

Isolation Valve - Air Inlet
- 3/4" NPT Flowtek S80 Full Port Ball Valve

Isolation Valve - Pump Suction / Discharge
- 2" NPT Flowtek S80 Full Port Ball Valve

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

A Bray High Performance Company

Flow-Tek®
A Subsidiary of BRAY INTERNATIONAL, Inc.

2 Piece Threaded Full Port Ball Valves: 1/4" - 4"



Flow-Tek's Series S80 ball valves have been designed to meet the needs of the chemical, textile and process industries. Standard 2-piece valve bodies are available in Stainless Steel. Stainless Steel bodies are investment cast and solution annealed for the highest quality and added strength. All body castings are marked with a foundry heat number for full traceability.

These quarter turn valves feature a full port design that minimizes pressure drops with smooth flow characteristics.

Other features include low operating torque, adjustable stem packing, blowout proof stems, and stainless steel safety latch handles.

Pressure Rating 1000 psi WOG
Steam Rating 150 psi WSP

Temperature Range
-50°F to +450°F
-46°C to +232°C

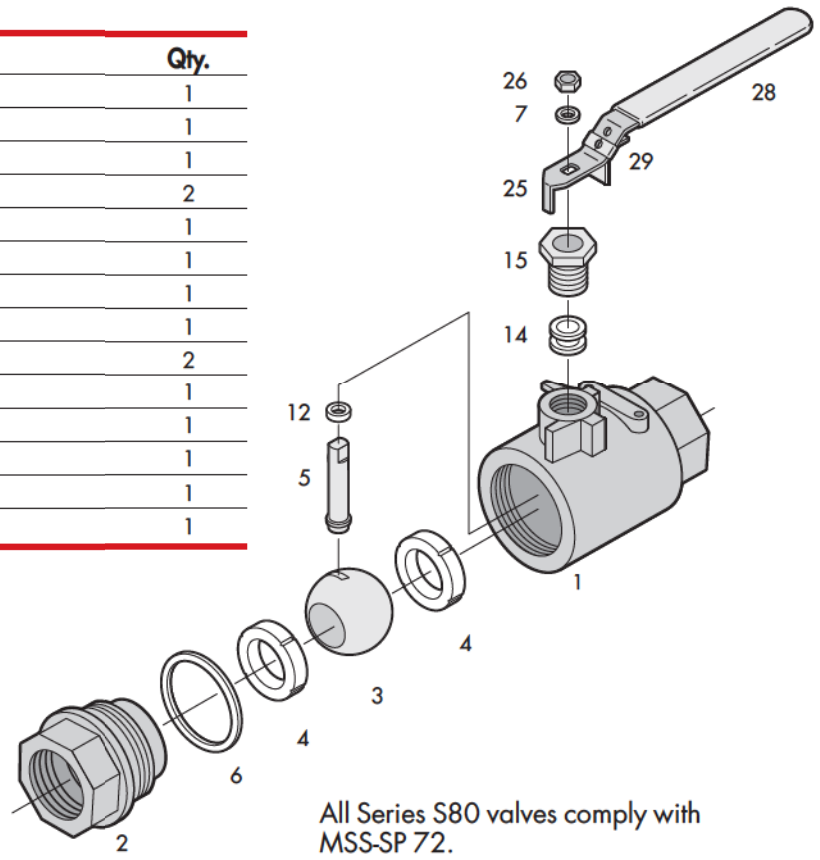
End Connections Threaded - NPT

Body Material Stainless Steel

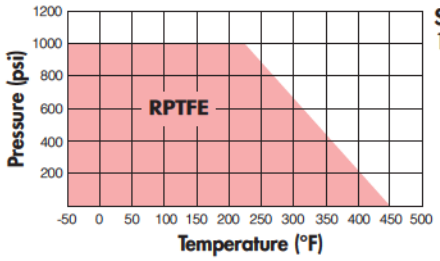
Technical Data

COMPONENTS AND MATERIALS

Item	Name	Stainless Steel	Qty.
1	Body	ASTM A351 Gr CF8M	1
2	End Cap	ASTM A351 Gr CF8M	1
3	Ball	SS316	1
4	Seat	RPTFE	2
5	Stem	ASTM A479 Type 316	1
6	Body Seal	RPTFE	1
7	Spring Washer	SS300	1
12	Thrust Washer	RPTFE	1
14	Stem Packing	RPTFE	2
15	Packing Gland	SS304	1
25	Handle	SS304	1
26	Handle Nut	SS304	1
28	Handle Sleeve	Vinyl	1
29	Locking Device	SS300	1



PRESSURE/TEMPERATURE



STEAM RATING:
150 psi WSP

All Series S80 valves comply with MSS-SP 72.

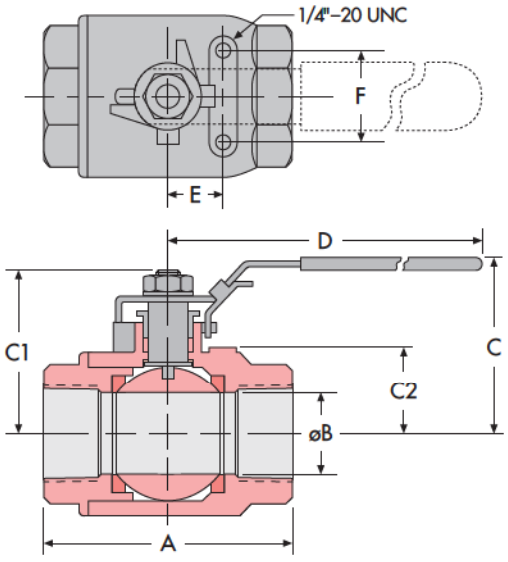
All valves are tested in accordance with MSS-SP 72.

Vacuum Service to 29 inches Hg. gauge.

DIMENSIONS AND WEIGHTS

Size ins / mm	A	øB Port	C	C1	C2	D	E	F	Cv	Torque lbs-in* / Nm	Weight lbs / kg
1/4 8	2.1 54	0.46 12	2.1 54	1.6 40	0.48 12.2	3.8 97	0.5 12.7	1.12 28.5	10	65 7.3	0.5 0.23
3/8 10	2.1 54	0.49 12.5	2.1 54	1.6 40	0.48 12.2	3.8 97	0.5 12.7	1.12 28.5	12	65 7.3	0.5 0.23
1/2 15	2.5 62.5	0.59 15	2.4 61	1.8 46	0.76 19.3	3.9 100	0.5 12.7	1.14 29	38	65 7.3	0.8 0.36
3/4 20	2.6 73	0.79 20	2.4 61	2.0 50	0.85 21.6	4.8 122	0.5 12.7	1.4 35	66	85 9.5	1.2 0.54
1 25	3.3 84.5	0.98 25	2.9 75	2.3 58	1.02 25.9	5.7 145	0.9 22.9	1.4 35	105	125 14.1	1.9 0.86
1 1/4 32	4 102	1.25 32	3.1 79	2.5 64	1.20 30.5	5.9 150	0.9 22.9	1.5 38	190	230 26	2.5 1.1
1 1/2 40	4.3 110	1.50 38	3.3 84.5	3.0 75	1.47 37.4	7.2 182	0.9 22.9	1.5 38	275	300 33.9	4.0 1.8
2 50	4.8 122.5	2.00 50	3.8 96	3.3 85	1.71 43.4	7.2 182	0.9 22.9	1.5 38	480	365 41.2	6.5 2.95
2 1/2 65	6.2 158	2.50 65	5.0 126	4.5 115	2.20 55.9	9.8 250	1.4 35.6	2.2 55	797	650 73.4	11.3 5.13
3 80	7.2 183	3.00 80	5.3 135.5	5.1 130	2.97 75.4	9.8 250	1.4 35.6	2.2 55	1210	765 86.4	16.9 7.7
4 100	8.8 225	4.00 100	6.1 156	5.8 148	3.40 86.4	14.4 365	1.4 35.6	2.2 55	2055	3000 339	33.2 15.1

Note: dual mounting pads for 2 1/2", 3" and 4".



Flow-Tek®
A Subsidiary of BRAY INTERNATIONAL, Inc.
8323 N. Eldridge Pkwy #100 Houston, Texas 77041
832.912.2300 Fax: 832.912.2301
www.flow-tek.com

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F-2201_EN_S80_2009-08

EQUIPMENT TECHNICAL DATA SHEETS

FILTER REGULATOR

AIR FILTER / REGULATOR:

SMC Pneumatics – Model#AW40-N06BDG-6Z, 3/4" NPT, w/ bracket, auto-drain valve, gauge, and nylon bowl. 0-160 psi

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Filter Regulator

AW1000 to 4000

CAD

Standard Specifications

Model		AW1000	AW2000	AW3000	AW4000	AW4000-06
Port size		M5 X 0.8	1/8 1/4	1/4 3/8	1/4 3/8 1/2	3/4
Fluid		Air				
Proof pressure		1.5MPa				
Max. operating pressure		1.0MPa				
Set pressure range		0.05 to 0.7MPa	0.05 to 0.85MPa			
Gauge port size		1/16	1/8	1/8	1/4	1/4
Ambient and fluid temperature		–5 to 60°C (No freezing)				
Filtration		5μm				
Drain capacity (cm^3)		2.5	8	23	45	45
Bowl material		Polycarbonate				
Construction		Relieving style				
Weight (kg)		0.09	0.36	0.53	1.09	1.15
Accessory (Std. equipment)	Bowl guard	—	—	●	●	●

Accessory (option)/Part No.

Description \ Model			Part No. AW1000	AW2000	AW3000	AW4000	AW4000-06
Accessory	Bracket		B120	B220	B320	B420	B420
	Gauge (1)	1.0MPa	G27-10-R1	G36-10-□01	G36-10-□01	G46-10-□02	G46-10-□02
		0.2MPa	(G27-10-R1)(2)	G36-2-□01	G36-2-□01	G46-2-□02	G46-2-□02
	Auto drain float style (3)	N.O.	—	—	AD43	AD44	AD44
		N.C.	—	—	AD53	AD54	AD54
	Auto drain pressure differential		AD61	AD62	—	—	—

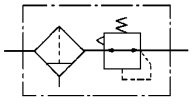
Note 1) □ in the part number for gauge (e.g. G36-10-□01) indicates threading. No symbol for Rc(PT) and "N" for NPT.
Note 2) A gauge for pressure 1.0MPa is used.
Note 3) Minimum operating pressure N.O.: 0.1MPa, N.C.: 0.15MPa
∗ "–01, –02, –03, –04, –06," after the part numbers indicates port size. (01: 1/8, 02: 1/4, 03: 3/8, 04: 1/2, 06: 3/4).
∗ Gauge for "AW1000-M5G-1" is "G27-10-R1" for the pressure at 1.0MPa.

Minimizes space and piping due to the integration of the filter and the regulator.

Direct operated, relieving style

Order Made P.1.8-6

JIS symbol





AW3000



AW2000



AW1000



AW3000-□BG



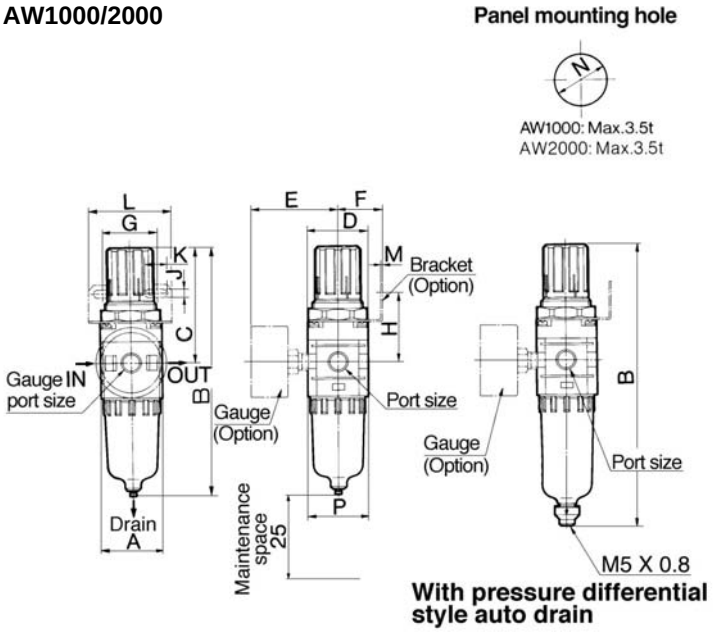
AW2000-□BG



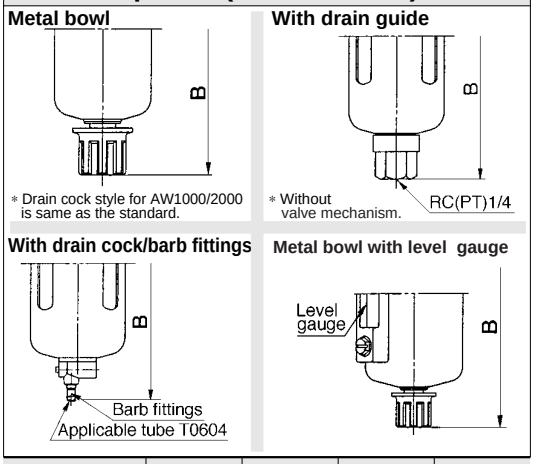
AW1000-□BG

Dimensions CAD

AW1000/2000



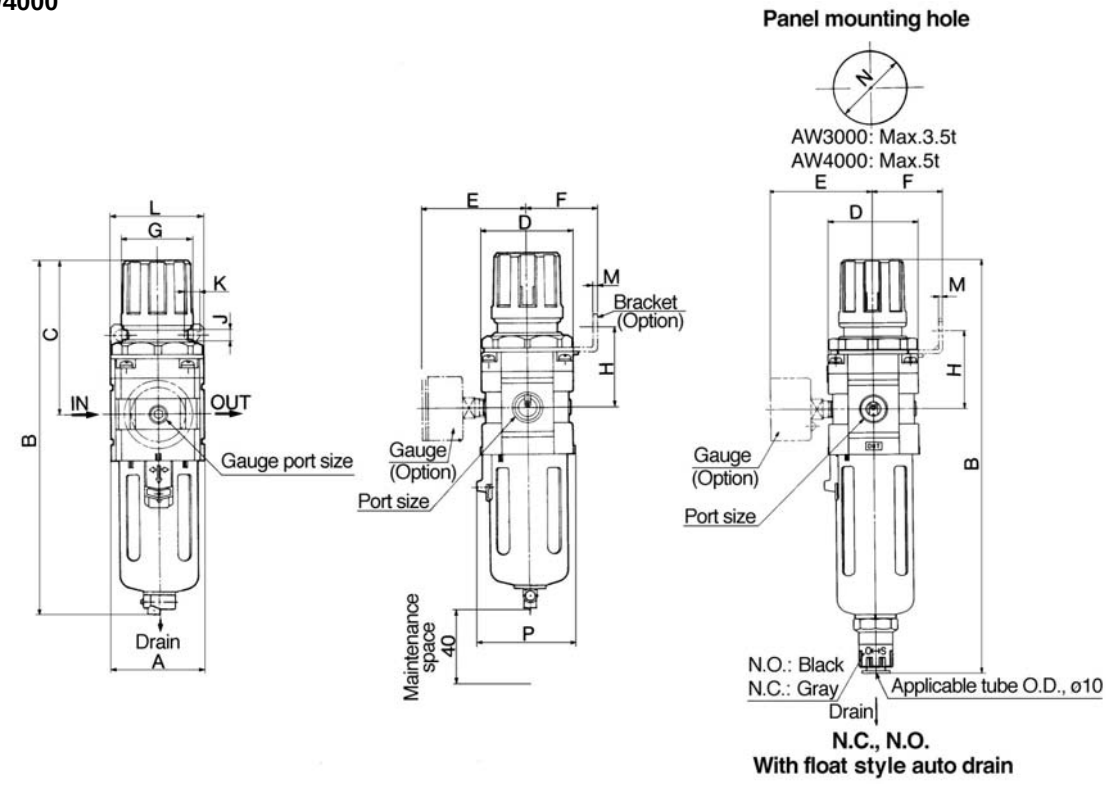
Options (AW3000/4000)



Model	With barb fittings	With drain guide	Metal bowl	Metal bowl with level gauge
	B	B	B	B
AW1000	——	——	109.5	——
AW2000	——	——	164.5	——
AW3000	216	213.5	220.5	240.5
AW4000	267.5	265	272	292
AW4000-06	271.5	269.5	276.5	296.5

*Dimensions except for B is the same as the shown on the left.

AW3000/4000



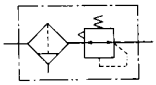
Model	Port size	A	B	C	D	E	Bracket mounting dimensions F	G	H	J	K	L	M	N	P	With auto drain Float B	Press. Diff. B
AW1000	M5 X 0.8	25	109.5	50.5	25	26	25	28	30	4.5	6.5	40	2.0	20.5	28	—	130
AW2000	1/8, 1/4	40	164.5	78	40	56.8	30	34	44	5.4	15.4	55	2.3	33.5	40	—	187.5
AW3000	1/4, 3/8	53	207.5	92.5	53	60.8	41	40	46	6.5	8.0	53	2.3	42.5	56	248.5	—
AW4000	1/4, 3/8, 1/2	70	259	112	70	70.5	50	54	54	8.5	10.5	70	2.3	52.5	73	300	—
AW4000-06	3/4	75	263	114	70	70.5	50	54	56	8.5	10.5	70	2.3	52.5	73	304	—

CAD
AW1000 —— SAC1000, #4
AW2000 —— SAC2000, #4
AW3000 —— SAC2503, #4
AW4000 —— SAC4000, #4
AW4000-06 —— SAC4006, #4

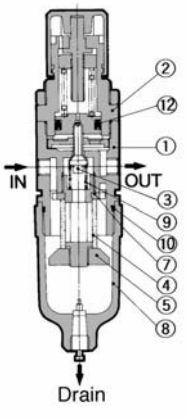
AW1000 to 4000

Construction

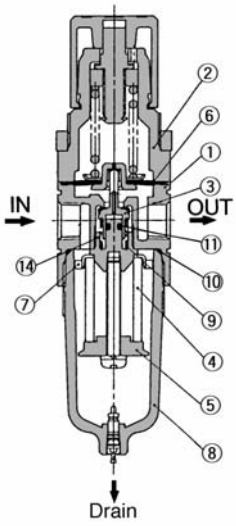
JIS symbol



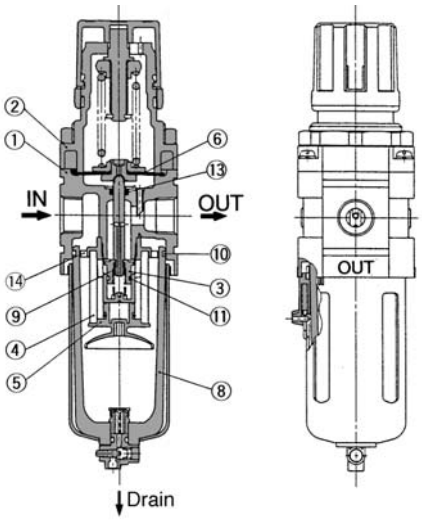
AW1000



AW2000



AW3000/4000



Component Parts

No.	Description	Material			Note
		AW1000, 2000	AW3000	AW4000, 4000-06	
①	Body	Zinc die cast	Aluminum die cast		Painted Silver
②	Bonnet	Polyacetal		Aluminum die cast	Painted Black

Replacement Parts

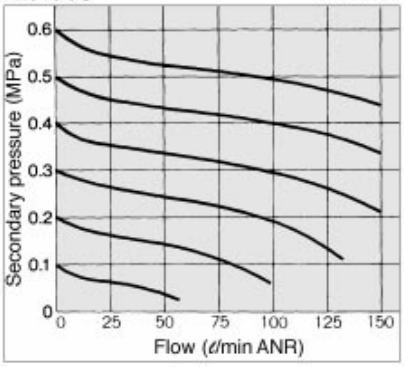
No.	Description	Material	Part No.				
			AW1000	AW2000	AW3000	AW4000	AW4000-06
③	Valve assembly	Brass, NBR	134819	1349160	1315216A	1316212A	1316213A
④	Element	Non-woven material	111344	1129116	111585	1116103	1116103
⑤	Baffle	Indicated in (parentheses).	111312 (POM)	11295 (PBT)	1315541 (POM)	1316276 (POM)	1316276 (POM)
⑥	Diaphragm assembly	NBR	——	131445A	1315215A	1316211A	1316211A
⑦	Deflector	PBT	11133A	1129111	——	——	——
⑧	Bowl assembly(1)	Poly-carbonate	C100F	C200F	C300F	C400F	C400F
⑨	Valve spring	Stainless steel	134824	1349158	131525	131625	131625
⑩	Bowl O ring	NBR	111325	11297	111512	111636	111636
⑪	Valve O ring	NBR	——	1349247	131544	131645	131645
⑫	Mini Y packing	NBR	MYN-10A	——	——	——	——
⑬	O ring	NBR	——	——	JIS B2401P5	JIS B2401P5	JIS B2401P5
⑭	Valve guide	Indicated in (parentheses).	——	134132 (ZDC)	1315540 (POM)	1316275 (POM)	1316275 (POM)

Note 1) Bowl guard (SPC) is attached to the bowl assembly of "AW3000" to "AW4000-06".

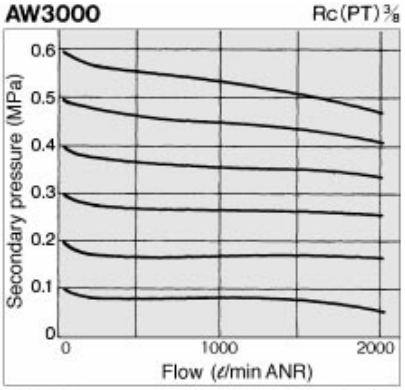
Flow Characteristics

Conditions: Supply pressure 0.7MPa

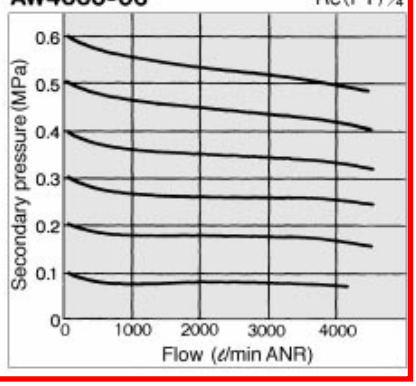
AW1000 M5 X 0.8



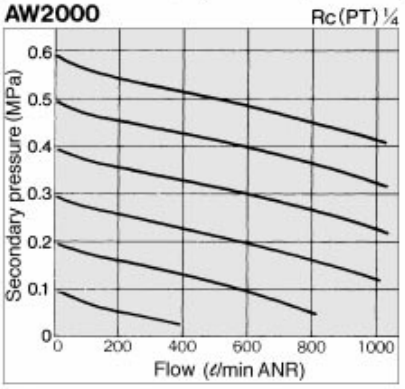
AW3000 Rc(PT) 3/8



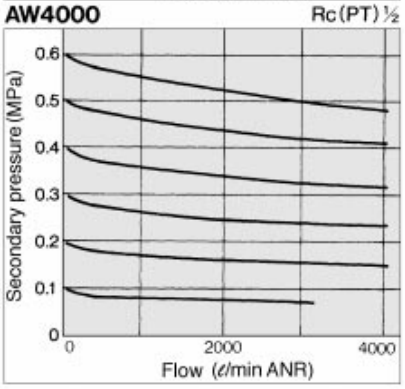
AW4000-06 Rc(PT) 3/4



AW2000 Rc(PT) 1/4



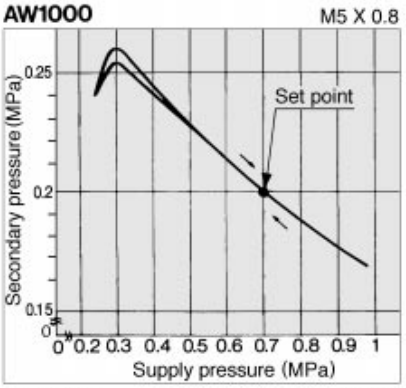
AW4000 Rc(PT) 1/2



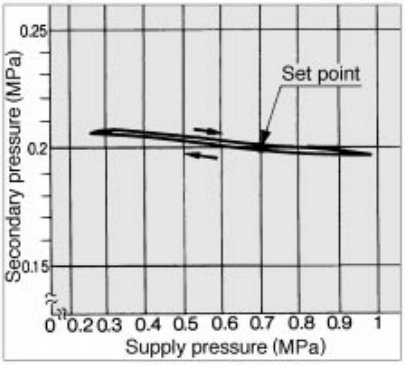
Pressure Characteristics

Conditions: Supply pressure 0.7MPa, Secondary pressure 0.2MPa, Flow 20 ℓ/min (ANR)

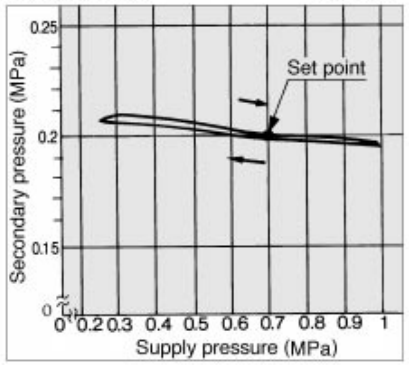
AW1000 M5 X 0.8



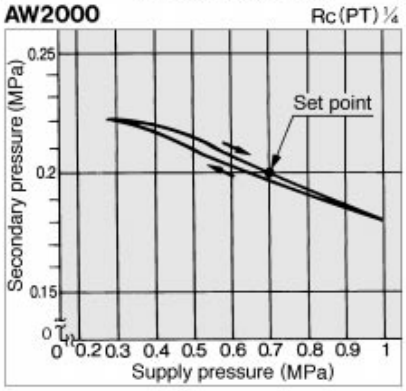
AW3000 Rc(PT) 3/8



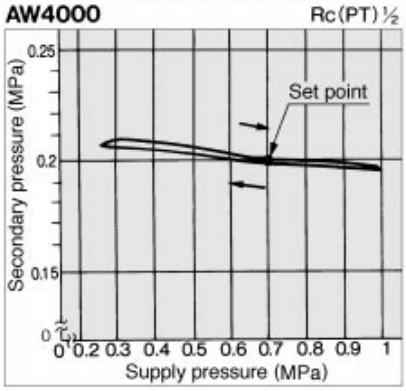
AW4000-06 Rc(PT) 3/4



AW2000 Rc(PT) 1/4



AW4000 Rc(PT) 1/2



AW1000 to 4000

How to Order

AW **30** **00** – **[ ]** **03** **BG** – **2N**

Filter Regulator

Body size

10	M5
20	1/8
30	3/8
40	1/2

Thread

—	Metric (M5)
	Rc(PT)
N	NPT
F	G(PF)

Port size

M5	M5 X 0.8
01	1/8
02	1/4
03	3/8
04	1/2
06	3/4

Accessory

Symbol		Description	Applicable model
—		—	—
B		Bracket	AW1000 to AW4000-06
C	Auto drain	Auto drain float style (N.C.)	AW3000 to AW4000-06
D	Auto drain	Auto drain pressure differential	AW1000/2000
	Auto drain	Auto drain float style (N.O.)	AW3000 to AW4000-06
G	Gauge	Without limit indicator	AW1000
	Gauge	With limit indicator	AW2000 to AW4000-06

Option

1(1)	Set at 0.02 to 0.2MPa
2	Metal bowl
6	Nylon bowl
8	Metal bowl with level gauge (AW3000/4000 only)
C	Bowl guard (AW2000 only)
J(2)	Drain guide (AW3000/4000 only)
N	Non relieving
R	Flow direction: Right to left
W	With drain cock and barb fittings (AW 3000/4000 only) (For nylon ø6, ø4)

∗If more than one symbol is required to be listed when ordering, list in the alphabetical order. (Ex. 2NR)

Note 1) Only regulating spring is different from the standard model.
Note 2) Without valve mechanism

Option Combinations

◎Combinable ▭Impossible ●Depends on the model

	Description	Symbol	Auto drain			Option									Applicable Filter Regulator			
			D	D	C	1	2	6	8	C	J	N	R	W	AW1000	AW2000	AW3000	AW4000
Accessory	Auto drain pressure differential style	D				◎	◎	◎		●		◎	◎		◎	◎		
	Auto drain float style (N.O.)	D				◎	◎	◎	◎			◎	◎				◎	◎
	Auto drain float style (N.C.)	C				◎	◎	◎	◎			◎	◎				◎	◎
Option	0.02 to 0.2MPa	–1	◎	◎	◎		◎	◎	●	●	●	◎	◎	●	◎	◎	◎	◎
	Metal bowl	–2	◎	◎	◎	◎					●	◎	◎		◎	◎	◎	◎
	Nylon bowl	–6	◎	◎	◎	◎				●	●	◎	◎	●	◎	◎	◎	◎
	Metal bowl with level gauge	–8		◎	◎	◎					◎	◎	◎				◎	◎
	With bowl guard	–C	◎			◎		◎				◎	◎			◎		
	Drain guide (Bore size: 1/4)	–J				◎	◎	◎	◎			◎	◎				◎	◎
	Non relieving	–N	◎	◎	◎	◎	◎	◎	●	●	●		◎	●	◎	◎	◎	◎
	Flow direction: Right to left	–R	◎	◎	◎	◎	◎	◎	●	●	●	◎		●	◎	◎	◎	◎
	One-touch drain cock with barb fittings	–W				◎		◎				◎	◎				◎	◎

⚠ Precautions

Be sure to read before handling. Refer to p.0-26 and 0-27 for Safety Instructions and common precautions on the products mentioned in this catalog, and refer to p.1.0-1 and 1.0-2 for precautions on every series.

Selection

⚠Warning

①The residual secondary pressure cannot be released by releasing the supply pressure. To release the residual pressure, use a filter regulator designed for such use.

Installation and Adjustment

⚠Warning

①Set up the regulator while verifying the pressure that is indicated on the supply and the secondary pressure gauges. Turning the handle excessively could damage the internal parts.

①The pressure gauge that is provided with the product for setting a pressure between 0.02 to 0.2MPa is the 0.2MPa style. To prevent damage to the pressure gauge, make sure that pressure in excess of 0.2MPa is not applied.

③The adjustment handle must be operated manually. Using a tool to turn the handle could lead to damage.

⚠Caution

①Release the lock to adjust the pressure. After the adjustment, engage the lock.
Failure to observe this procedure could damage the handle or cause the secondary pressure to fluctuate.

1) On the AW1000 and AW2000 styles, pull the adjustment handle to release the lock and push the handle to engage the lock. If it does not lock easily, turn the handle slightly clockwise or counterclockwise before pushing it.

2) On the AW3000 and AW4000 styles, pull the adjustment handle to release the lock. (An orange colored line is provided at the bottom of the adjustment handle for visual checking.) Push the adjustment handle to engage the lock. If it does not lock easily, turn the handle slightly clockwise or counterclockwise; then, push it until the orange colored line is no longer visible.



Maintenance Inspection

⚠Warning

①Replace the filter element within 2 years of operation or before the pressure drop reaches 0.1MPa. Failure to observe this precaution could damage the filter element.

EQUIPMENT TECHNICAL DATA SHEETS

SOLENOID VALVE – 2-WAY

FOR:

SLUDGE TRANSFER PUMP AIR FEED - ON/OFF

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

ASCO® Red-Hat®

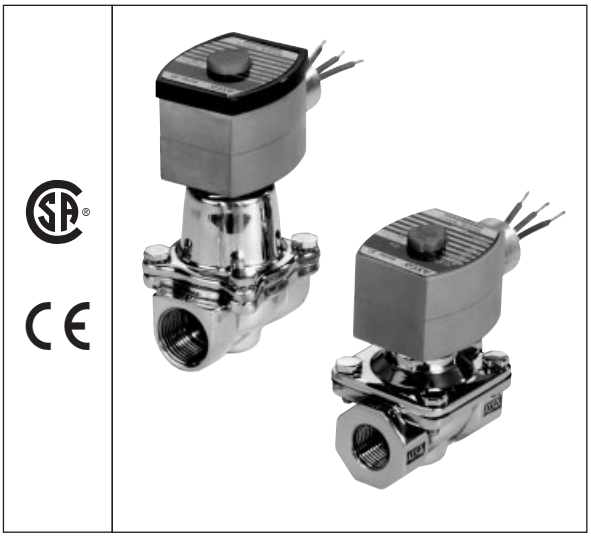
Pilot Operated
General Service Solenoid Valves
Brass or Stainless Steel Bodies
3/8" to 2 1/2" NPT

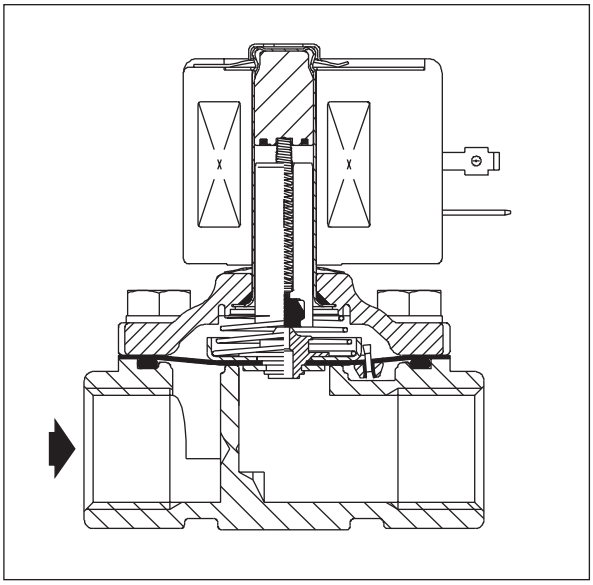
NC
NO

2/2
SERIES
8210

Features

- Wide range of pressure ratings, sizes, and resilient materials provide long service life and low internal leakage.
- High Flow Valves for liquid, corrosive, and air/inert gas service.
- Industrial applications include:
  - Car wash
  - Laundry equipment
  - Air compressors
  - Industrial water control
  - Pumps





Construction

Valve Parts in Contact with Fluids		
Body	Brass	304 Stainless Steel
Seals and Discs	NBR or PTFE	
Disc-Holder	PA	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
F	16.8	16.1	35	180	272610	97617	272614	97617
F	-	17.1	40	93	238610	-	238614	-
F	-	20	43	240	99257	-	99257	-
F	-	20.1	48	240	272610	-	272614	-
H	30.6	-	-	-	-	74073	-	74073
H	40.6	-	-	-	-	238910		238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages available when required.

Solenoid Enclosures

Standard: Red-Hat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; Red-Hat - Type I.
Optional: Red-Hat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; Red-Hat - Explosionproof and Watertight, Types 3, 4, 4X, 7, and 9.
(To order, add prefix "EF" to catalog number, except Catalog Numbers 8210B57, 8210B58, and 8210B59. Valves not available with Explosionproof enclosures.)
See Optional Features Section for other available options.

Nominal Ambient Temperature Ranges:

Red-Hat II/
Red-Hat AC: 32˚F to 125˚F (0˚C to 52˚C)
Red-Hat II DC: 32˚F to 104˚F (0˚C to 40˚C)
Red-Hat DC: 32˚F to 77˚F (0˚C to 25˚C)
(104˚F/40˚C occasionally)
Refer to Engineering Section for details.

Approvals:

CSA certified. Red-Hat II meets applicable CE directives.
Refer to Engineering Section for details.

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)							Max. Fluid Temp. °F		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	3/8	1.5	①	150	125	-	40	40	-	180	150	8210G73 ③	1P	●	8210G36 ③	1P	●	6.1/F	11.6/F
3/8	5/8	3	0	150	150	-	40	40	-	180	150	8210G93	5D	❍	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G1	6D	❍	-	-	-	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	-	-	-	175	-	8210G6	5D	❍	-	-	-	17.1/F	-
1/2	7/16	2.2	①	150	125	-	40	40	-	180	150	8210G15 ③	2P	●	8210G37 ③	2P	●	6.1/F	11.6/F
1/2	5/8	4	0	150	150	-	40	40	-	180	150	8210G94	5D	❍	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	-	175	150	-	-	-	8210G87	7D	●	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G2	6D	❍	-	-	-	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G7	5D	❍	-	-	-	17.1/F	-
1/2	3/4	4	5	-	300	-	-	300	-	180	125	8210G227	5D	❍	-	-	-	17.1/F	40.6/H
3/4	5/8	4.5	0	150	150	125	40	40	-	175	150	-	-	-	8210G88	7D	●	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G9	9D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	5	0	150	150	-	40	40	-	180	150	8210G95	8D	❍	-	-	-	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G3	11D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	6	0	-	-	-	200	180	180	-	77	8210B26 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G26 ② ‡	40P	●	-	-	-	16.1F	-
1	1	13	0	-	-	-	100	100	80	-	77	8210B54 ‡	31D	-	8210D89	15D	-	-	30.6/H
1	1	13	0	150	125	125	-	-	-	180	-	8210G54	41D	●	8210G89	45D	●	16.1/F	-
1	1	13	5	150	150	100	125	125	125	180	150	8210G4	12D	❍	-	-	-	6.1/F	11.6/F
1	1	13.5	0	300	225	115	-	-	-	200	-	8210G27 ‡	42P	●	-	-	-	20.1/F	-
1	1	13.5	10	300	300	300	-	-	-	175	-	8210G78 ②	13P	-	-	-	-	17.1/F	-
1 1/4	1 1/8	15	0	-	-	-	100	100	80	-	77	8210B55 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	1 1/8	15	0	150	125	125	-	-	-	180	-	8210G55	43D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	5	150	150	100	125	125	125	180	150	8210G8	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	1 1/4	22.5	0	-	-	-	100	100	80	-	77	8210B56 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G56 ‡	44D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	5	150	150	100	125	125	125	180	150	8210G22	18D	●	-	-	-	6.1/F	11.6/F
2	1 3/4	43	5	150	125	90	50	50	50	180	150	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	1 3/4	45	5	150	125	90	50	50	50	180	150	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	125	125	80	180	150	8210G33	23D	●	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	250	200	200	250	200	200	180	180	8210G11 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	125	125	80	180	150	8210G34	23D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G30	37D	●	10.1/F	11.6/F
1/2	5/8	4	5	250	200	200	250	200	200	180	180	8210G12 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	3/4	5.5	0	150	150	125	125	125	80	180	150	8210G35	25D	●	-	-	-	10.1/F	11.6/F
3/4	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G38	38D	●	10.1/F	11.6/F
3/4	3/4	6.5	5	-	-	-	250	200	200	-	180	8210C13	24D	●	-	-	-	-	16.8/F
3/4	3/4	6.5	5	250	200	200	-	-	-	180	-	8210G13	46D	●	-	-	-	16.1/F	-
1	1	13	0	125	125	125	-	-	-	180	-	8210B57 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	1	13	5	-	-	-	125	125	125	-	180	8210D14	26D	●	-	-	-	-	16.8/F
1	1	13	5	150	150	125	-	-	-	180	-	8210G14	47D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	0	125	125	125	-	-	-	180	-	8210B58 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	1 1/8	15	5	-	-	-	125	125	125	-	180	8210D18	28D	●	-	-	-	-	16.8/F
1 1/4	1 1/8	15	5	150	150	125	-	-	-	180	-	8210G18	48D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	0	125	125	125	-	-	-	180	-	8210B59 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	1 1/4	22.5	5	-	-	-	125	125	125	-	180	8210D32	29D	●	-	-	-	-	16.8/F
1 1/2	1 1/4	22.5	5	150	150	125	-	-	-	180	-	8210G32	49D	●	-	-	-	16.1/F	-
2	1 3/4	43	5	-	-	-	125	125	125	-	150	8210103	30P	●	-	-	-	-	16.8/F
2	1 3/4	43	5	125	125	125	-	-	-	180	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	1 3/4	45	5	-	-	-	125	125	125	-	150	8210104	27P	●	-	-	-	-	16.8/F
2 1/2	1 3/4	45	5	125	125	125	-	-	-	180	-	8210G104	51P	●	-			16.1/F	-

Notes: ① 5 psi on Air; 1 psi on Water.
② Valve provided with PTFE main disc.
③ Valve includes Ultem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve.
Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless Steel disc-holder.
‡ Must have solenoid mounted vertical and upright.

Specifications (Metric units)

Pipe Size (ins.)	Orifice Size (mm)	Kv Flow Factor (m3/h)	Operating Pressure Differential (bar)							Max.Fluid Temp. °C		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	10	1.29	①	10	9	-	3	3	-	81	65	8210G73 ③	1P	●	8210G36 ③	1P	●	6.1/F	11.6/F
3/8	16	2.57	0	10	10	-	3	3	-	81	65	8210G93	5D	❍	-	-	-	10.1/F	11.6/F
3/8	16	2.57	0.3	14	10	9	9	7	7	81	65	8210G1	6D	❍	-	-	-	6.1/F	11.6/F
3/8	16	2.57	0.3	21	21	21	-	-	-	79	-	8210G6	5D	❍	-	-	-	17.1/F	-
1/2	11	1.89	①	10	9	-	3	3	-	81	65	8210G15 ③	2P	●	8210G37 ③	2P	●	6.1/F	11.6/F
1/2	16	3.43	0	10	10	-	3	3	-	81	65	8210G94	5D	❍	-	-	-	10.1/F	11.6/F
1/2	16	3.43	0	10	10	9	3	3	-	79	65	-	-	-	8210G87	7D	●	17.1/F	11.6/F
1/2	16	3.43	0.3	14	10	9	9	7	7	81	65	8210G2	6D	❍	-	-	-	6.1/F	11.6/F
1/2	16	3.43	0.3	21	21	21	-	-	-	79	-	8210G7	5D	❍	-	-	-	17.1/F	-
1/2	19	3.43	0.3	-	21	-	-	21	-	81	52	8210G227	5D	❍	-	-	-	17.1/F	40.6F
3/4	16	3.86	0	10	10	9	3	3	-	79	65	-	-	-	8210G88	7D	●	17.1/F	11.6/F
3/4	19	4.29	0.3	9	9	9	7	6	5	81	65	8210G9	9D	❍	-	-	-	6.1/F	11.6/F
3/4	19	4.29	0	10	10	-	3	3	-	81	65	8210G95	8D	❍	-	-	-	10.1/F	11.6/F
3/4	19	5.57	0.3	17	10	7	9	9	9	81	65	8210G3	11D	❍	-	-	-	6.1/F	11.6/F
3/4	19	5.14	0	-	-	-	14	12	12	-	25	8210B26 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	19	5.14	0	24	21	14	-	-	-	92	-	8210G26 ② ‡	40P	●	-	-	-	16.1F	-
1	25	11.14	0	-	-	-	7	7	6	-	25	8210B54 ‡	31D	-	8210D89	15D	-	-	30.6/H
1	25	11.14	0	10	9	9	-	-	-	81	-	8210G54	41D	●	8210G89	45D	●	16.1/F	-
1	25	11.14	0.3	10	10	7	9	9	9	81	65	8210G4	12D	❍	-	-	-	6.1/F	11.6/F
1	25	11.57	0	21	16	8	-	-	-	92	-	8210G27 ‡	42P	●	-	-	-	20.1/F	-
1	25	11.57	0.7	21	21	21	-	-	-	79	-	8210G78 ②	13P	-	-	-	-	17.1/F	-
1 1/4	29	12.86	0	-	-	-	7	7	6	-	25	8210B55 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	29	12.86	0	10	9	9	-	-	-	81	-	8210G55	43D	●	-	-	-	16.1/F	-
1 1/4	29	12.86	0.3	10	10	7	9	9	9	81	65	8210G8	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	32	19.29	0	-	-	-	7	7	6	-	25	8210B56 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	32	19.29	0	10	9	9	-	-	-	81	-	8210G56 ‡	44D	●	-	-	-	16.1/F	-
1 1/2	32	19.29	0.3	10	10	7	9	9	9	81	65	8210G22	18D	●	-	-	-	6.1/F	11.6/F
2	44	36.86	0.3	10	9	6	3	3	3	81	65	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	44	38.57	0.3	10	9	6	3	3	3	81	65	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	16	2.57	0.0	10	10	9	9	9	6	81	65	8210G33	23D	●	-	-	-	10.1/F	11.6/F
3/8	16	2.57	0.3	17	14	14	17	14	14	81	81	8210G11 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	16	3.43	0	10	10	9	9	9	6	81	65	8210G34	23D	●	-	-	-	10.1/F	11.6/F
1/2	16	2.57	0	10	10	7	9	9	6	81	65	-	-	-	8210G30	37D	●	10.1/F	11.6/F
1/2	16	3.43	0.3	17	14	14	17	14	14	81	81	8210G12 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	19	4.71	0	10	10	9	9	9	6	81	65	8210G35	25D	●	-	-	-	10.1/F	11.6/F
3/4	16	2.57	0	10	10	7	9	9	6	81	65	-	-	-	8210G38	38D	●	10.1/F	11.6/F
3/4	19	5.57	0.3	-	-	-	17	14	14	-	81	8210C13	24D	●	-	-	-	-	16.8/F
3/4	19	5.57	0.3	17	14	14	-	-	-	81	-	8210G13	46D	●	-	-	-	16.1/F	-
1	25	11.14	0	9	9	9	-	-	-	81	-	8210B57 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	25	11.14	0.3	-	-	-	9	9	9	-	81	8210D14	26D	●	-	-	-	-	16.8/F
1	25	11.14	0.3	10	10	9	-	-	-	81	-	8210G14	47D	●	-	-	-	16.1/F	-
1 1/4	29	12.86	0	9	9	9	-	-	-	81	-	8210B58 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	29	12.86	0.3	-	-	-	9	9	9	-	81	8210D18	28D	●	-	-	-	-	16.8/F
1 1/4	29	12.86	0.3	10	10	9	-	-	-	81	-	8210G18	48D	●	-	-	-	16.1/F	-
1 1/2	32	19.29	0	9	9	9	-	-	-	81	-	8210B59 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	32	19.29	0.3	-	-	-	9	9	9	-	81	8210D32	29D	●	-	-	-	-	16.8/F
1 1/2	32	19.29	0.3	10	10	9	-	-	-	81	-	8210G32	49D	●	-	-	-	16.1/F	-
2	44	36.86	0.3	-	-	-	9	9	9	-	65	8210103	30P	●	-	-	-	-	16.8/F
2	44	36.86	0.3	9	9	9	-	-	-	81	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	44	38.57	0.3	-	-	-	9	9	9	-	65	8210104	27P	●	-	-	-	-	16.8/F
2 1/2	44	38.57	0.3	9	9	9	-	-	-	81	-	8210G104	51P	●	-	-	-	16.1/F	-

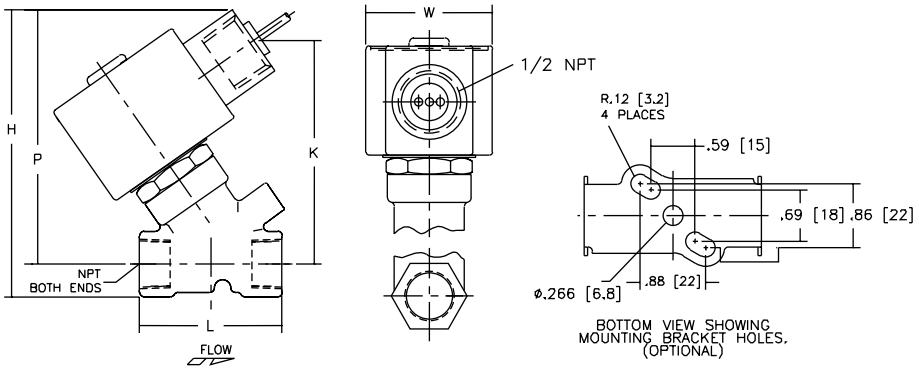
Notes:
① 0.3 bar on Air; 0.0 bar on Water.
② Valve provided with PTFE main disc.
③ Valve includes UItem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve. Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless Steel disc-holder.
‡ Must have solenoid mounted vertical and upright.

Dimensions: inches (mm)

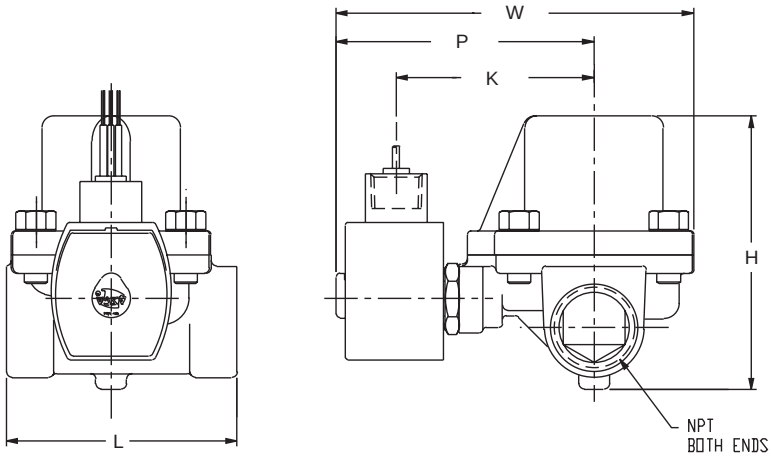
Constr. Ref. No.		H	K	L	P	W
1*	ins.	3.85	3.00	1.91	3.41	1.69
	mm	98	76	49	87	43
2*	ins.	4.17	3.25	2.28	3.63	1.69
	mm	106	83	58	92	43
13	ins.	4.44	3.22	3.75	4.19	5.81
	mm	113	82	95	106	147
5	ins.	3.84	2.31	2.75	3.28	2.28
	mm	98	59	70	83	58
6*	ins.	3.38	1.94	2.75	2.80	2.28
	mm	86	49	70	71	58
7	ins.	4.19	2.50	2.81	3.47	2.39
	mm	106	64	71	88	61
8	ins.	4.13	2.47	2.81	3.44	2.29
	mm	105	63	71	87	58
9*	ins.	3.66	2.10	2.81	2.96	2.28
	mm	93	53	71	75	58
10*①	ins.	5.25	X	2.81	4.59	2.31
	mm	133	X	71	117	59
11*	ins.	4.16	2.66	3.84	3.52	2.75
	mm	106	68	98	89	70
12	ins.	5.64	3.15	3.75	4.01	3.36
	mm	143	80	95	102	85
15*	ins.	5.34	X	3.75	4.47	3.84
	mm	136	X	95	114	98
16	ins.	5.64	3.15	3.66	4.01	3.56
	mm	143	80	93	102	90
18	ins.	6.11	3.30	4.38	4.16	3.92
	mm	155	84	111	106	100
20*	ins.	7.33	3.71	5.06	4.57	4.87
	mm	186	94	129	116	124
21*	ins.	7.33	3.71	5.50	4.57	4.87
	mm	186	94	140	116	124
23	ins.	4.35	2.65	2.75	3.79	2.28
	mm	110	67	70	96	58
24	ins.	5.06	X	3.78	4.44	2.75
	mm	129	X	96	113	70
25	ins.	4.64	2.81	2.81	3.94	2.28
	mm	118	71	71	100	58
26	ins.	6.53	X	3.75	4.91	3.19
	mm	166	X	95	125	81
27	ins.	8.22	X	5.50	5.47	4.87
	mm	209	X	140	139	124
28	ins.	6.53	X	3.66	4.91	3.19
	mm	166	X	93	125	81
29	ins.	7.03	X	4.38	5.06	4.40
	mm	179	X	111	129	112

① Valves must be mounted with solenoid vertical and upright.
* DC dimensions slightly larger.

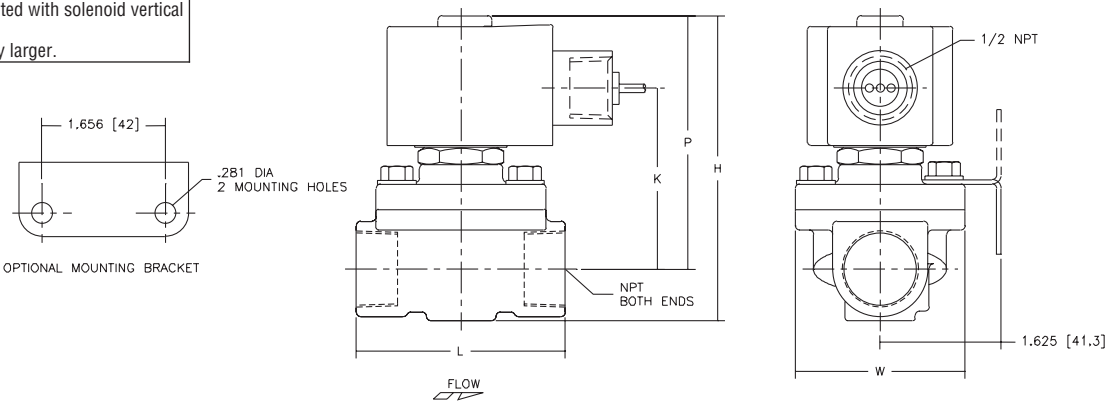
Constr. Refs. 1, 2



Constr. Ref. 13



Constr. Refs. 5-9, 11, 20, 21, 23 , 25, 37,38

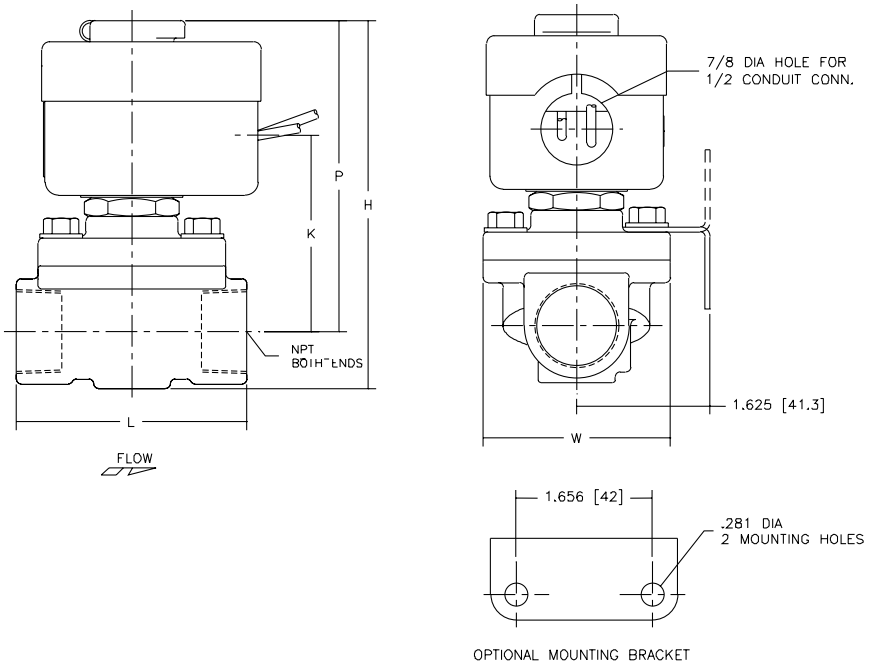


Dimensions: inches (mm)

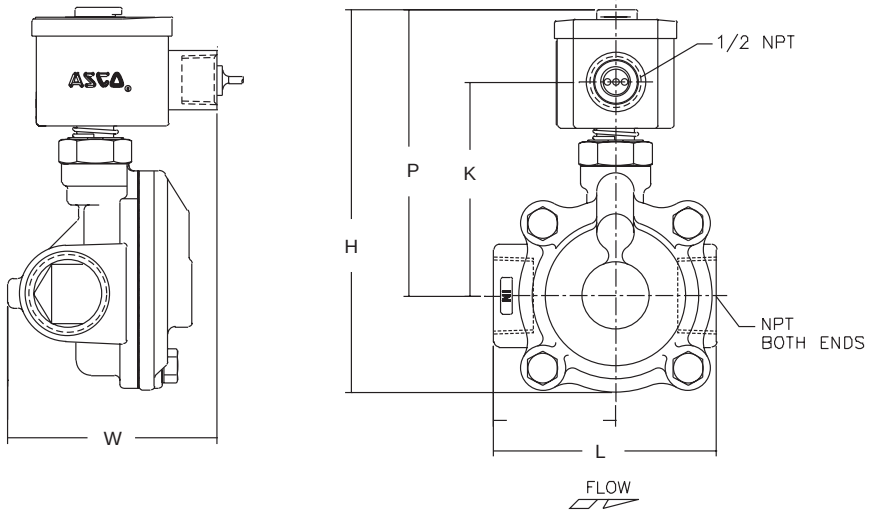
Constr. Ref. No.		H	K	L	P	W
30	ins.	8.22	X	5.06	5.47	4.87
	mm	209	X	129	139	124
31	ins.	5.25	X	3.75	4.44	3.25
	mm	133	X	95	113	83
32	ins.	5.69	X	3.66	4.69	3.25
	mm	145	X	93	119	83
33	ins.	6.06	X	4.38	4.94	3.91
	mm	154	X	111	125	99
34	ins.	6.91	X	3.75	6.09	3.25
	mm	176	X	95	155	83
35	ins.	7.34	X	3.66	6.34	3.25
	mm	186	X	93	161	83
36	ins.	7.66	X	4.38	6.56	3.91
	mm	1.95	X	111	167	99
37	ins.	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
38	ins.	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
39	ins.	5.42	2.31	2.75	4.86	3.80
	mm	138	59	70	123	97
40	ins.	5.20	3.29	2.81	4.50	2.28
	mm	132	83	71	114	58
41	ins.	5.13	3.10	3.75	4.32	3.25
	mm	130	79	95	110	83
42	ins.	6.43	4.40	3.93	5.62	3.25
	mm	163	112	100	143	83
43	ins.	5.57	3.35	3.66	4.57	3.25
	mm	142	85	93	116	83
44	ins.	5.90	3.57	4.38	4.79	3.91
	mm	150	91	111	122	99
45	ins.	5.26	3.17	3.75	4.38	3.84
	mm	134	81	95	111	98
46	ins.	4.95	3.10	3.84	4.31	2.75
	mm	126	79	98	110	70
47	ins.	6.43	3.59	3.75	4.81	3.52
	mm	163	91	95	122	90
48	ins.	6.43	3.59	3.66	4.81	3.73
	mm	163	91	93	122	95
49	ins.	6.91	3.75	4.38	4.96	4.40
	mm	176	95	111	126	112
50	ins.	8.13	4.15	5.06	5.37	4.87
	mm	207	105	129	136	124
51	ins.	8.13	4.15	5.50	5.37	5.18
	mm	207	105	140	136	132

IMPORTANT: Valves may be mounted in any position, except as noted in specifications table.

Constr. Refs. 10, 15, 24, 26-36

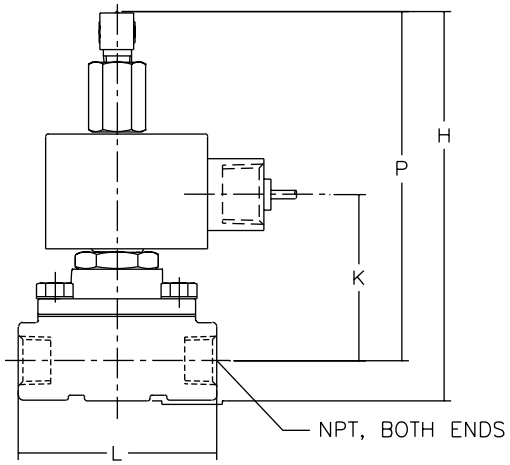


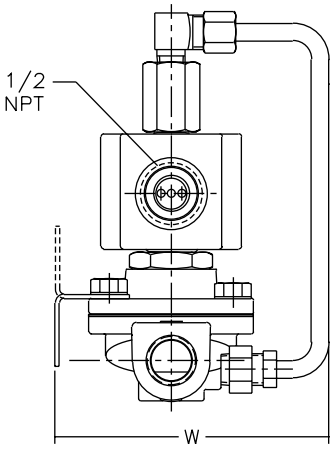
Constr. Refs. 12, 16, 18



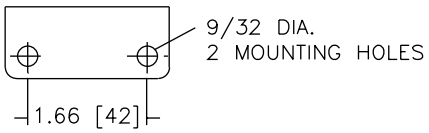
Dimensions: inches (mm)

Constr. Refs. 39



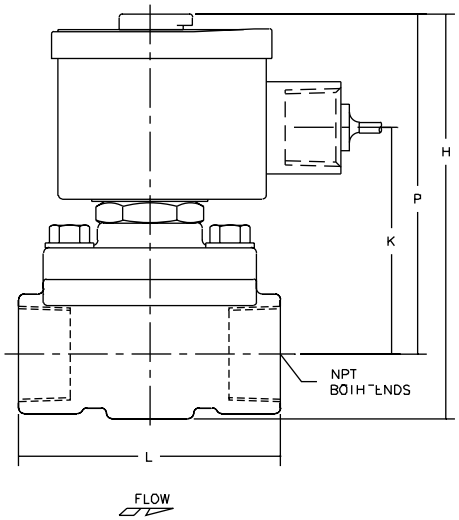


FLOW

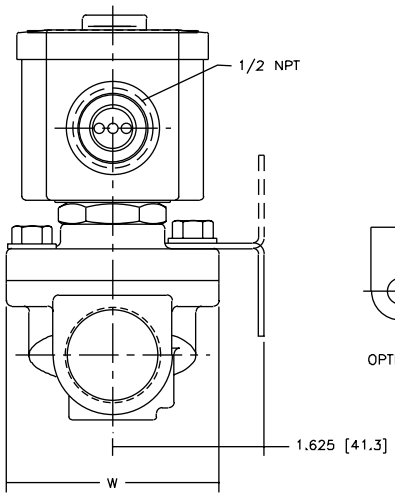


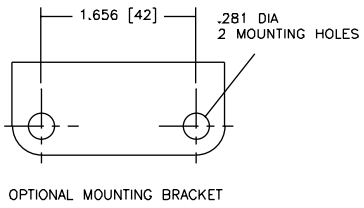
SHOWING MOUNTING
BRACKET ONLY

Constr. Refs. 40-51



FLOW





OPTIONAL MOUNTING BRACKET

EQUIPMENT TECHNICAL DATA SHEETS

NEEDLE VALVE

FOR:
AIR DIAPHRAGM SLUDGE PUMP AIR INLET

NEEDLE – MANUAL FLOW ADJUSTMENT VALVE:

Materials: Brass Body, Fluoroelastomer Rubber Seal, Brass Needle
Type: NPT(F) Connections, w/ Manual Flow Adjustment Knob Operator

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Valve Function	Flow Adjustment
Valve Type	Needle
Actuation	Manual
Valve Operation	Handle
Handle Style	Knob
Handle Type	Standard
Fitting Type	Connector
Shape	Straight
For Use With	Water, Oil, Air, Argon, Helium, Krypton, Neon, Xenon
Connection Type	Pipe
Connection Style	Threaded
Pipe Size	1/2
Gender	Female
Thread Type	NPTF
Flow Coefficient (Cv)	1.2
Maximum Pressure	2000 psi @ 400° F
Temperature Range	-15° to 400° F
Seat Type	Metal-to-Metal
Body Material	Brass
Seal Material	Fluoroelastomer Rubber
Needle Material	Brass
End-to-End Length	2 1/2"
Overall	
Height	3 1/8"
Length	2 1/2"
Chemical Resistance (Excellent)	Air, Argon, Helium, Krypton, Neon, Oil, Water, Xenon
Warning Message	Chemical compatibility must be determined by the customer based on the conditions in which the product is being used, including the presence of other chemicals, temperature, and consistency.
RoHS	RoHS 3 (2015/863/EU) compliant with exemption 6(c) - Lead in copper alloy
REACH	Not Compliant

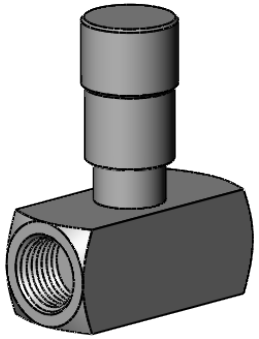
KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

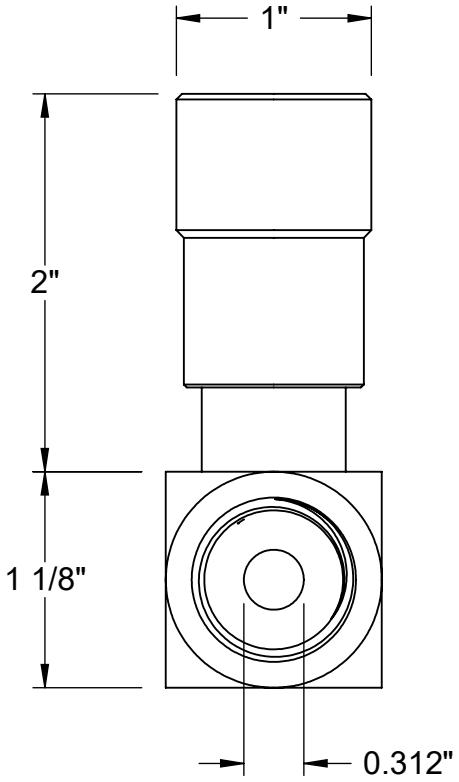
DFARS	Specialty Metals COTS-Exempt
Country of Origin	United States
USMCA Qualifying	No
Schedule B	848120.0040
ECCN	EAR99

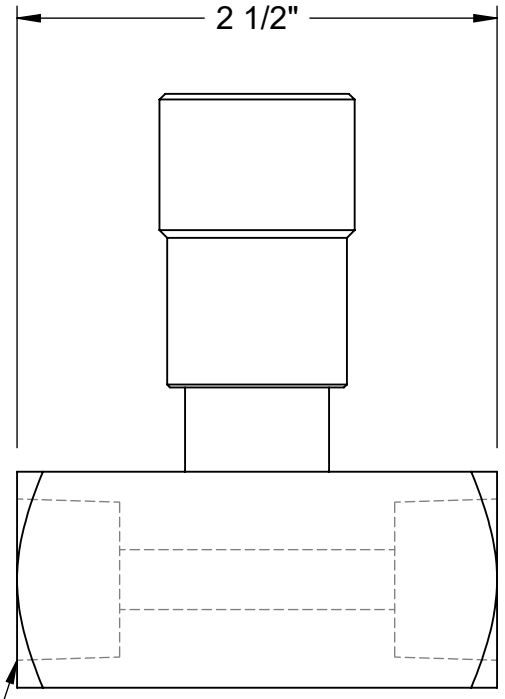
The color-coded threads and numerical markings on these valves ensure consistent and repeatable settings. One full revolution of the handle reveals a new color to indicate the set point. Turn the handle to adjust flow in small increments for metering, sampling, and other applications requiring fine flow control. Valves have metal-to-metal seats that resist temperature fluctuations.

Flow coefficient (Cv) is the amount of water (in gallons per minute) at 60° F that will flow through a fully open valve with a difference of 1 psi between the inlet and the outlet.

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917







1/2 NPTF Pipe Size, 14 Threads Per Inch,
0.53" Thread Engagement

McMASTER-CARR® CAD http://www.mcmaster.com	PART NUMBER **46425K14**
© 2021 McMaster-Carr Supply Company Information in this drawing is provided for reference only.	Easy-Set Precision Flow-Adjustment Valve

EQUIPMENT TECHNICAL DATA SHEETS

PRESSURE GAUGE
SLUDGE PUMP DISCHARGE

Pressure Guage w/ Mini Seal:

Ashcroft® Duralife® Pressure Gauge with Flush Mini Diaphragm Seal, 2.5", 0 - 100 Psi, SS, 1009, 251009AW02LXLL100#/08330SX02TXCGCY

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Data Sheet

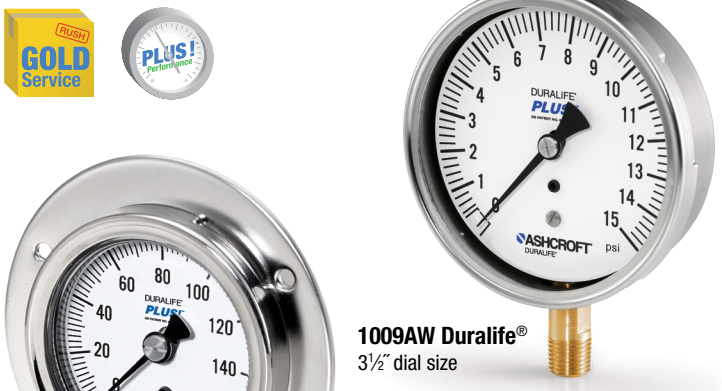
1009 2½″, 3½″ Stainless Steel Pressure Gauges

FEATURES

- Meets ASME B40.100 specifications
- All welded stainless steel construction
- ***PLUS***™ Performance option dampens vibration, shock and pulsation effects
- MSL helium leak tested to 1X10^{-6} scc/s
- Ventable fill plug
- Wide selection of connections

TYPICAL USES

- Pumps and compressors
- Boilers
- Equipment skids
- Specialized OEM equipment
- Hydraulics and pneumatics
- Severe ambient conditions
- Ammonia and refrigeration



1009AW Duralife®
3½″ dial size



1009SW Duralife®
2½″ dial size with front flange



1009SW Duralife®
2½″ dial size

SPECIFICATIONS

Accuracy:	±1% of span (Dry) (ASME B40.100 Grade 1A) ±1.5% of span (Liquid filled)
Size:	2½″, 3½″
Ranges:	AW: Vacuum, compound, to 1,000 psi SW: Vacuum, compound to 15,000 psi
Process Connection Location:	Lower, lower back, top, 3 o'clock, 9 o'clock
Process Connection Size:	¼ NPT Male, ½ NPT Male , and others listed on page 2
Movement:	304 SS with glass filled polyester segment
Dial:	Black figures on white background
Pointer:	Black, aluminum
Weather Protection:	IP65 (Plug closed), IP54 (Plug vented) NEMA 4 (Plug closed)
Mounting Option:	U-clamp, front or back flange
Dampening:	Liquid fill or ***PLUS!***™ Performance
Approval:	RoHS, CRN, CE/UKCA

WETTED COMPONENTS

Model	Bourdon Tube	Process Connection Material
SW	316L Stainless Steel	316L Stainless Steel
AW	316L Stainless Steel	Aluminum bronze

NON-WETTED COMPONENTS

Case	Window	Ring (bayonet removable)
304 Stainless Steel	Polycarbonate	304 Stainless Steel
316L Stainless Steel (OPT.)	Polycarbonate	316L Stainless Steel (OPT.)

KEY BENEFITS

- Power*Flex*™ movement provides superior resistance to shock, vibration and pulsation
- True Zero™ reduces reading errors by using "zero box" instead of conventional dial pins
- Field fillable

MIN/MAX TEMPERATURE LIMITS

Version	Ambient	Process	Storage
Dry	-40 to 200 °F (-40 to 93 °C)	-40 to 250 °F (-40 to 121 °C)	-40 to 250 °F (-40 to 121 °C)
PLUS!™	-40 to 150 °F (-40 to 66 °C)	-40 to 200 °F (-40 to 93 °C)	-40 to 150 °F (-40 to 66 °C)
Glycerin Fill	20 to 150 °F (-7 to 66 °C)	20 to 200 °F (-7 to 93 °C)	0 to 150 °F (-18 to 66 °C)
Silicone Fill	-40/150 °F (-40 to 66 °C)	-40 to 200 °F (-40 to 93 °C)	-40 to 150 °F (-40 to 66 °C)
Halocarbon Fill	-40/150 °F (-40 to 66 °C)	-40 to 200 °F (-40 to 93°C)	-40 to 150 °F (-40 to 66 °C)

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ASHCROFT®
Trust the shield.®

1009 2½″, 3½″ Stainless Steel Pressure Gauges

251009AW02LXLL100# / 08330SX02TXCGCY

ORDERING CODE: Example:	251009	SW	L	02	L	XC4	100#
Dial Size/Model Code							
25 - 251009	251009						
35 - 351009							
System							
AW - 316L SS tube/Aluminum, bronze connection (max. pressure 1,000 psi)							
SW - 316L SS tube/316L SS process connection (max. pressure 15,000 psi)		SW					
Case Fill							
(blank) Dry gauge							
L - Liquid filled case (glycerin standard)			L				
Process Connection Size							
01 - 1/8 NPT Male							
02 - ¼ NPT Male				02			
04 - ½ NPT Male (SW models only)							
RW - SAE-4, 7/16″ - 20 Straight thread							
EJ - 7/16″ X 20 UNF-3A 37° flare							
KJ - ¼″ Straight JIS, BSP - 1009SW							
KA - ¼″ Tapered JIS, BSP - 1009SW							
13 - G ¼″ DIN							
JP - ¼″ Tubing, (SW models only) N/A with throttle plug, N/A ranges above 6,000 psi							
JQ - 6mm Tubing, (SW models only) N/A with throttle plug, N/A ranges above 6,000 psi							
JL - 9/16″ 18 UNF-2A, (SW models only) N/A on 25 1009							
JR - 3/8″ Tubing, (SW models only) N/A with throttle plug, N/A on ranges above 6,000 psi							
Process Connection Location							
L - Lower					L		
B - Lower back							
D - Side (3 o'clock)							
E - Side (9 o'clock)							
T - Top							
Options (If choosing an option(s) must include an "X")						X__	
Dampening							
GV - Silicone filling (add to glycerine filled case)							
GX - Halocarbon® filling (add to glycerine filled case)							
LL - ***PLUS!***™ Performance							
NZ - ***PLUS!***™ Performance silicone free							
T4 - Push in throttle plug brass (orifice 0.007″)							
TS - Stainless helical throttle plug (standard with liquid fill and XLL (SWL) gauges 1500# and above							
TU - Throttle plug (orifice 0.013) (standard with liquid fill and XLL gauges 30# to 1000#)							
WP - No throttle plug							
ZF - Food grade silicone (add to glycerine filled gauge)							
Mounting							
FF - Front flange							
FW - Back flange							
UC - U-clamp							
Case/Movement							
LC - Weld nuts (when required on lower connect)							
LJ - Liquid fillable dry case (throttle plug is standard)							
VY - Krytox™ lubricated movement							
YW - 316L Stainless steel case/ring (only available with system 1009SW & SWL)							

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ASHCROFT®
Trust the shield.®

1009 2½˝, 3½˝ Stainless Steel Pressure Gauges

ORDERING CODE: (continued) Example:	251009	SW	L	02	L	XC4	100#
Options (If choosing an option(s) must include an "X")						X__	
Windows							
SG - Safety glass							
Pointers							
EO - Red set hand - adjustable (not available with liquid filled units)							
SH - Red set hand - stationary single							
SJ - Red set hand - stationary single							
MP - Adjustable pointer - micrometer							
Tags							
DA - Dial marking							
NH - Stainless steel tag							
NN - Paper tag							
Test and Calibration Report							
6B - Cleaned for gaseous oxygen service (for liquid filled Halocarbon® (GX) required, N/A on ranges greater than 10,000 psi)							
6W - Cleaned for gases other than oxygen							
C3 - Material certification (consult factory for availability)							
C4 - Traceable calibration certificate						C4	
HY - Hydrostatic test - when attached to a diaphragm seal add HY code to gauge and seal product code (if attached to seal charge will be on gauge only)							
KH - Any calibration other than standard							
MF - Mercury free							
MQ - Positive material identification (PMI) (only available with stainless steel systems,tube, tip, and socket)							
Refrigerants - (consult factory for available dials)							
R1 - Refrigerant 11							
R2 - Refrigerant 12							
R3 - Refrigerant 22							
R4 - Refrigerant 502							
R5 - Ammonia - (must have stainless steel wetted parts)							
R6 - Refrigerant 114							
R7 - Refrigerant 500							
R8 - Refrigerant 134A							
R9 - Refrigerant 123							
Other							
AB - Absolute pressure (gauge is offset by 14.7 psi, contact inside sales for more information)							
PR - Receiver gauge (N/A on liquid filled gauges - consult factory for available dials)							
Range (see range table for all standard ranges)							
100# - 100 psi							100#

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1009 2½˝, 3½˝ Stainless Steel Pressure Gauges

STANDARD RANGES

	psi	bar	kPa	MPa	kg/cm²
Vaccuum	30IMV	N1BR	N100KP	N0.1MP	N1KG
	–	N1/0.6BR	N1/0.6BR	N0.1/0.6MP	N1/0.6KG
	30IMV&15#	–	–	–	–
	–	N1/1.5BR	N100/150KP	N0.1/15MP	N1/1.5KG
	30IMV&30#	–	–	–	–
	–	N1/3BR	N100/300KP	N0.1/3MP	N1/3KG
Compound	30IMV&60#	–	–	–	–
	–	N1/5BR	N100/500KP	N0.1/5MP	N1/5KG
	30IMV&100#	–	–	–	–
	30IMV&150#	–	–	–	–
	30IMV&300#	–	–	–	–
	–	N1/9BR	N100/900KP	N0.1/9MP	N1/9KG
	15#	1BR	100KP	.1MP	1KSC
	20#	–	–	–	–
	–	1.6BR	160KP	.16MP	1.6KSC
	30#	–	–	–	–
	–	2.5BR	250KP	.25MP	2.5KSC
	60#	4BR	400KP	.4MP	4KSC
	–	6BR	600KP	.6MP	6KSC
	100#	–	–	–	–
	120#	–	–	–	–
	–	10BR	1,000KP	1MP	10KSC
	160#	–	–	–	–
	200#	–	–	–	–
	–	16BR	1,600KP	1.6MP	16KSC
	300#	–	–	–	–
	–	25BR	2,500KP	2.5MP	25KSC
	400#	–	–	–	–
	500#	–	–	–	–
	600#	40BR	4,000KP	4MP	40KSC
	800#	–	–	–	–
	–	60BR	6,000KP	6MP	60KSC
	1,000#	–	–	–	–
	1,500#	100BR	10,000KP	10MP	100KSC
	2,000#	–	–	–	–
	–	160BR	16,000KP	16MP	160KSC
	3,000#	–	–	–	–
	–	250BR	25,000KP	25MP	250KSC
	4,000#	–	–	–	–
	5,000#	–	–	–	–
	6,000#	400BR	40,000KP	40MP	400KSC
	8,000#	–	–	–	–
	–	600BR	60,000KP	60MP	600KSC
	10,000#	–	–	–	–
	15,000#	1,000BR	100,000KP	100MP	1,000KSC

Positive Pressure

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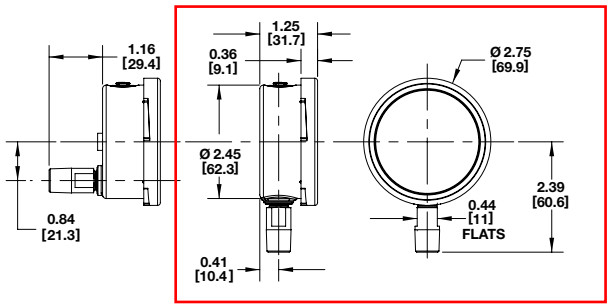
ASHCROFT®
Trust the shield.®

1009 2½″, 3½″ Stainless Steel Pressure Gauges

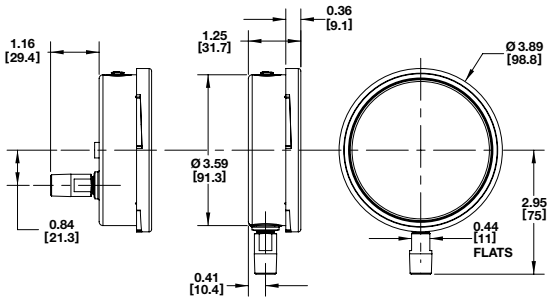
DIMENSIONS in [ ] are millimeters

For reference only, consult Ashcroft for specific dimensional drawings

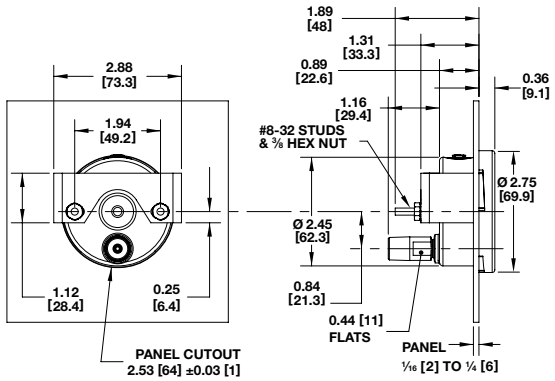
2½″ 1009 Lower and Back Connect



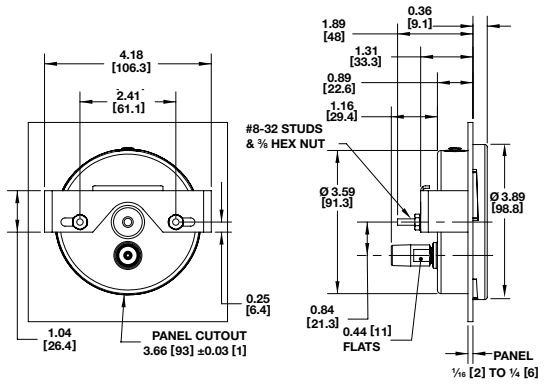
3½″ 1009 Lower and Back Connect



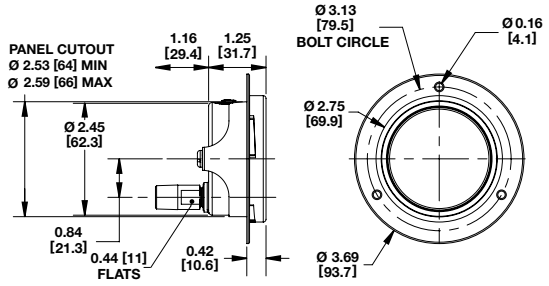
2½″ 1009 Back Connect (XUC)



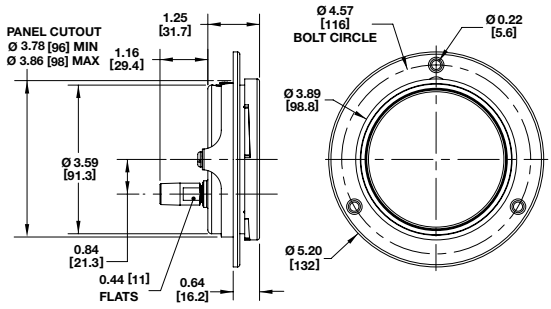
3½″ 1009 Back Connect (XUC)



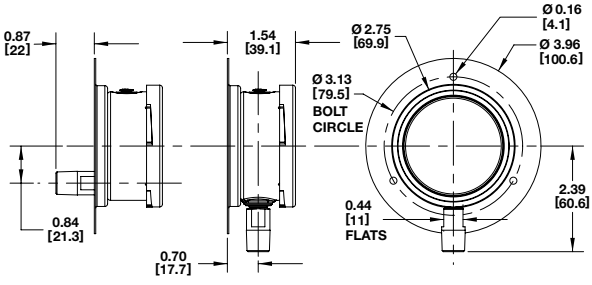
2½″ 1009 Back Connect (XFF)



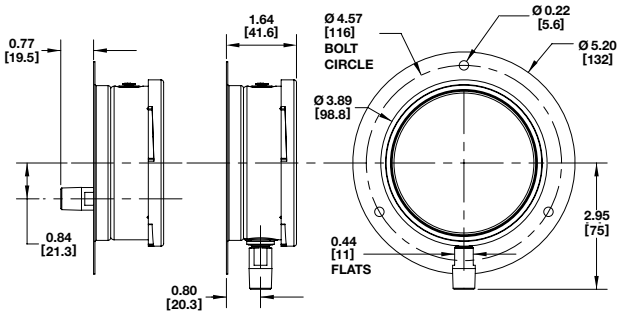
3½″ 1009 Back Connect (XFF)



2½″ 1009 Lower and Back Connect (XFW)



3½″ 1009 Lower and Back Connect (XFW)



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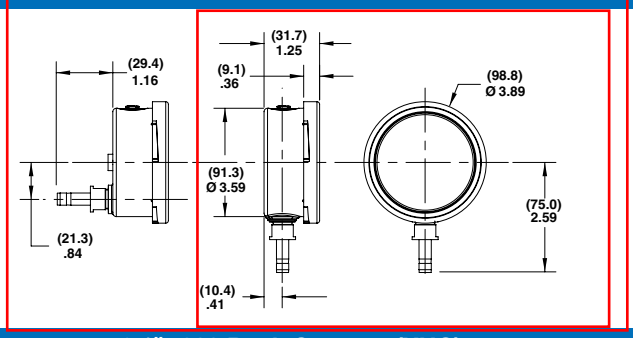
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1009 2½″, 3½″ Stainless Steel Pressure Gauges

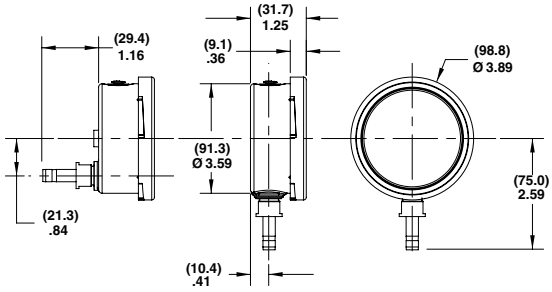
DIMENSIONS in [ ] are millimeters

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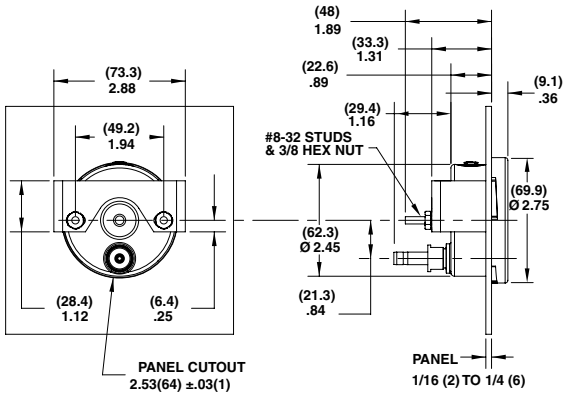
2½″ 1009 Lower and Back Connect



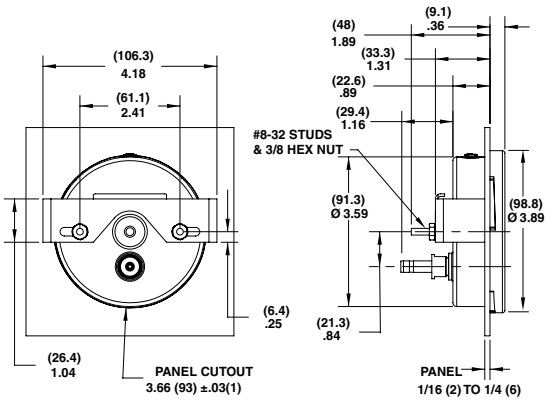
3½″ 1009 Lower and Back Connect



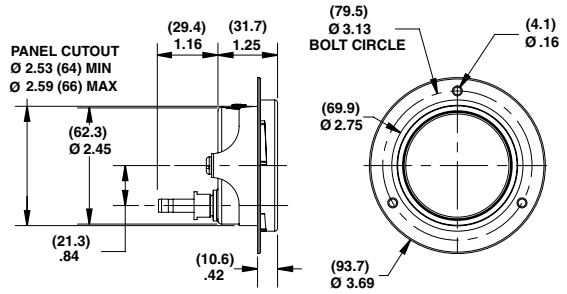
2½″ 1009 Back Connect (XUC)



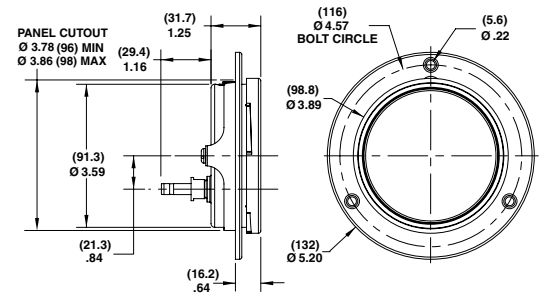
3½″ 1009 Back Connect (XUC)



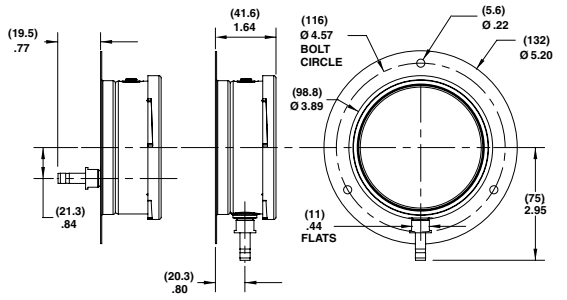
2½″ 1009 Back Connect (XFF)



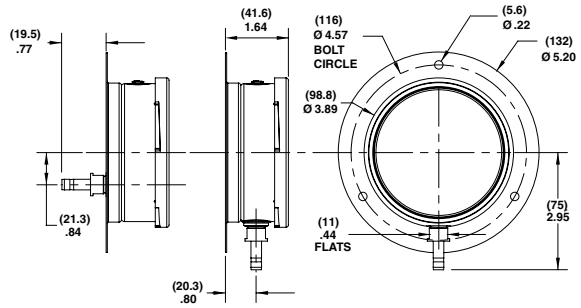
3½″ 1009 Back Connect (XFF)



2½″ 1009 Lower and Back Connect (XFW)



3½″ 1009 Lower and Back Connect (XFW)



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ASHCROFT®
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330 All-Welded Flush Mini Seal

FEATURES

- All-welded construction
- No gaskets or bolts
- Compact size to fit in limited-space areas

TYPICAL USES

- Pulp and paper
- Chemical and petrochemical
- Pharmaceutical
- Food and beverage



330
Threaded Seal

SPECIFICATIONS

Connection style:	Threaded
Process Connection:	1 NPT
Instrument Connection:	¼ or ½ NPT Female
MAWP:	3,000 psi
Fill Fluid:	See table 1

WETTED COMPONENTS

Diaphragm	Top Housing (threads)
316L SS	316L SS

KEY BENEFITS

- **All-stainlesss corrosion-resistant design**
- **Flush design prevents clogging or buildup of process media**

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1.800.328.8258

ASHCROFT®
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330 All-Welded Flush Mini Seal

251009AW02LXLL100# / 08330SX02TXCGCY

TABLE 1 - FILL FLUIDS

Fill Fluid	Temperature	Viscosity (cSt at RT)	Variation Code	Notes
Glycerin (food grade)	0°F to 400°F (-18°C to 204°C)	1,300	CG	Direct-mounting only. Not for use with vacuum service
50 cSt Silicone	-40°F to 500°F (-40°C to 260°C)	50	CK	
10 cSt Silicone	-40°F to 500°F (-40°C to 260°C)	10	DJ	
Halocarbon® 4.2	-70°F to 300°F (-57°C to 199°C)	4.2	CF	For use with oxygen/oxidizing process media
Slytherm® 800	-40°F to 750°F (-40°C to 400°C)	10	HA	High temperature applications
Sylthern® XLT	-150°F to 500°F (-100°C to 260°C)	1.4	CC	Low temperature applications
Calflo® AF	-20°F to 600°F (-29°C to 316°C)	60	KF	High temperature, silicone-free
Mineral Oil	10°F to 400°F (-12°C to 204°C)	75	MY	
Neobee® M-20 (food grade)	5°F to 400°F (-15°C to 204°C)	9.5	NM	
Silicone (food grade)	-40°F to 500°F (-40°C to 260°C)	350	CZ	
Distilled Water	40°F to 185°F (4°C to 85°C)	0.9	FJ	
50/50 Glycerin/Water	15°F to 200°F (-9°C to 93°C)	30	GH	
Propylene Glycol	-50°F to 325°F (-46°C to 163°C)	54	CV	
Ethylene Glycol	20°F to 325°F (-7°C to 163°C)	14	FK	
50/50 Ethylene Glycol/Water	-25°F to 190°F (-32°C to 88°C)	2.9	CT	
80/20 Glycerin/Water	15°F to 225°F (-9°C to 107°C)	270	GR	
95/5 Water/Propylene Glycol	40°F to 185°F (4°C to 85°C)	1.0	PY	

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330 All-Welded Flush Mini Seal

251009AW02LXLL100# / 08330SX02TXCGCY

ORDERING CODE Example:	08	330	SX	02T	XCK	DU
Process Connection Size						
08 - 1 NPT Male	08					
Seal Type						
330 Flush threaded seal		330				
Diaphragm Material						
SX - 316L SS			SX			
Instrument Connection Size						
02T - ¼ NPT				02T		
04T - ½ NPT						
Options (if choosing option(s) must include an "X")					X__	
Fill Fluid (See Table 1 above for more available fill fluids)						
CK - 50 cSt Silicone					CK	
Optional Features						
NH - SS instrument tag						
DU - Instrument welded to seal (instrument connection must be of like material to top housing)						DU
MQ - Positive material identification						
6B - Cleaned for oxygen service						

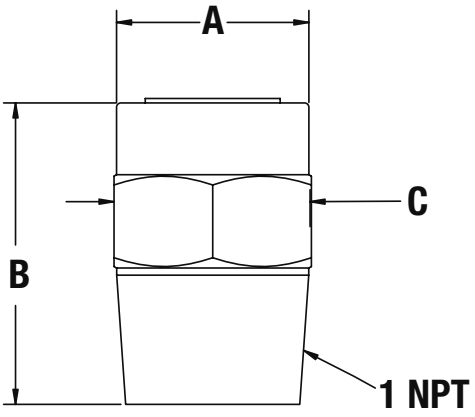
When selecting an instrument, refer to the Min/Max Guide for compatibility with this diaphragm seal or scan the QR code to the right.

DIMENSIONS in [ ] are millimeters

For reference only, consult Ashcroft for specific dimensional drawings

330 FLUSH MINI-SEAL

Model	A	B	C
330	1.34 [34]	2.13 [54]	1.38 [35]



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EQUIPMENT TECHNICAL DATA SHEETS

ADDITIONAL COMPONENTS

AIR SUPPLY HOSE:

VALU FLEX 3/4" ID Red General Service Thermoid Hose 200 PSI EPDM Tube and Cover.
Includes 3/4: MNPT Brass Swivel Connections.

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Thermoid®

Made in U.S.A.



HOSE PRODUCTS CATALOG

VALU FLEX®

Available in Red, Black, Green, Yellow and Blue

Valu Flex® is one of the most versatile general service air and water hoses available today. Valu Flex hoses are lightweight, flexible, and resists abrasion, heat and ozone, making them useful in various applications. Valu Flex hoses, stocked in 200 and 300 PSI, are available in special orders in a wide variety of sizes and colors with color coding for safety and operational improvement.

⚠ WARNING
Do not use this product as a steam hose or fuel (for example petroleum-based fuels and oils) hose.

CAUTION: This product is not recommended for environments where oil is present.



Representative image photo see BRANDING below for product stamp.

RESISTANCE



Abrasion Heat Ozone Weathering

BRANDING: Thermoid Valu Flex Size PSI WP Made In USA Month/Day/Year Time Stamp

COVER COLOR: Red, Black, Green, Yellow and Blue
- Allows for Color Coding

CONSTRUCTION

TUBE: EPDM, ARPM - Class C
- Heat Resistant

COVER: EPDM
- Abrasion Resistant
- Ozone and Weather Resistant

REINFORCEMENT: Spiral Polyester Yarn
- Provides a Working Pressure to 200-300 psi
- Easier to Route Assemblies
- Easier to Coil and Handle
- Less Susceptible to Premature Failure than Braided Hose if Subjected to Torque

TEMPERATURE RANGE: -40°F to +212°F, -40°C to +100°C

PACKAGING: Reels or †50 ft. Lengths – 1 Per Carton (¾" I.D. Only)
- 300-700 ft. Reels Depending on I.D.
- Over 80% One Piece Reels
- Less Scrap
- Most Footage per Reel vs. Competition

PRESSURELESS CURE SYSTEM
- Minimal Cast (Natural Curvature of the Hose)
- Extends the Life of the Rubber Compounds

AIR MANDREL MANUFACTURING PROCESS
- No Internal Contamination of the Inside Diameter Due to the Lubricant
- Eliminates the Need for Customers to Flush the Hose

Product Number	Packaging	Nominal I.D.		Nominal O.D.		Reinforcement Spirals	Working Pressure		Min. Bend Radius		Weight	
	Reels (ft.)	(inches)	(mm)	(inches)	(mm)		(psi)	(Mpa)	(inches)	(mm)	(lb/ft)	(Kg/m)
RED												
00114504200	700	¼	6.35	0.49	12.45	2	200	1.38	1.50	38.10	0.08	0.12
00114504400	700	¼	6.35	0.50	15.75	2	300	2.07	1.50	38.10	0.08	0.12
00114505200	700	5⁄16	7.94	0.58	14.73	2	200	1.38	2.00	50.80	0.09	0.13
00114505400	700	5⁄16	7.94	0.58	15.75	2	300	2.07	2.00	50.80	0.09	0.13
00114506200	700	⅜	9.53	0.68	17.53	2	200	1.38	2.25	57.15	0.15	0.22
00114506400	700	⅜	9.53	0.69	17.53	2	300	2.07	2.25	57.15	0.15	0.22
00114508200	700	½	12.70	0.81	20.64	4	200	1.38	3.00	76.20	0.25	0.37
00114508400	700	½	12.70	0.84	21.43	4	300	2.07	3.00	76.20	0.25	0.37
00114510200	700	⅝	15.88	0.93	23.62	4	200	1.38	3.75	95.25	0.30	0.45
00114510400	700	⅝	15.88	1.00	25.40	4	300	2.07	3.75	95.25	0.30	0.45
00114512200	700	¾	19.05	1.15	29.21	4	200	1.38	4.50	114.30	0.38	0.57
00114512400	700	¾	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.41	0.61
00114516300	700	1	25.40	1.37	34.80	4	200	1.38	7.00	177.80	0.51	0.76
00114516400	700	1	25.40	1.43	36.20	4	300	1.38	7.00	177.80	0.51	0.76
00114520200	550	1-¼	31.75	1.75	44.45	4	200	1.38	8.75	222.25	0.81	1.21
00114524200	400	1-½	38.10	2.00	50.80	4	200	1.38	10.50	266.70	0.89	1.34
00114532200	250	2	50.80	2.55	64.77	4	200	1.38	14.00	355.60	1.28	1.90

VALU FLEX® *continued*

Product Number	Packaging	Nominal I.D.		Nominal O.D.		Reinforcement Spirals	Working Pressure		Min. Bend Radius		Weight	
	Reels (ft.)	(inches)	(mm)	(inches)	(mm)		(psi)	(Mpa)	(inches)	(mm)	(lb/ft)	(Kg/m)
RED	**50 ft. Lengths**											
00114506251	1 per carton	3/8	9.53	0.69	17.53	2	200	1.38	2.25	57.15	0.15	0.22
00114506451	1 per carton	3/8	9.53	0.69	17.53	2	300	2.07	2.25	57.15	0.15	0.22
00114512251	1 per carton	3/4	19.05	1.15	29.21	4	200	1.38	4.50	114.30	0.38	0.57
00114512255	28 per pallet	3/4	19.05	1.15	29.21	4	200	1.38	4.50	114.30	0.38	0.57
00114512451	1 per carton	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.41	0.61
00114512454	28 per pallet	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.41	0.61
BLACK	**Reels (ft.)**											
00114603200	700	3/16	4.76	0.44	11.11	2	200	1.38	N/A	N/A	0.07	0.11
00114604200	700	1/4	6.35	0.49	12.45	2	200	1.38	1.50	38.10	0.08	0.12
00114604400	700	1/4	6.35	0.50	15.75	2	300	2.07	1.50	38.10	0.08	0.12
00114605200	700	5/16	7.94	0.58	14.73	2	200	1.38	2.00	50.80	0.09	0.13
00114605400	700	5/16	7.94	0.58	15.75	2	300	2.07	2.00	50.80	0.09	0.13
00114606200	700	3/8	9.53	0.69	17.53	2	200	1.38	2.25	57.15	0.15	0.22
00114606400	700	3/8	9.53	0.69	17.53	2	300	2.07	2.25	57.15	0.15	0.22
00114608200	700	1/2	12.70	0.81	20.64	4	200	1.38	3.00	76.20	0.24	0.36
00114608400	700	1/2	12.70	0.84	21.43	4	300	2.07	3.00	76.20	0.24	0.36
00114610200	700	5/8	15.88	0.93	23.62	4	200	1.38	3.75	95.25	0.29	0.43
00114610400	700	5/8	15.88	1.00	25.40	4	300	2.07	3.75	95.25	0.29	0.43
00114612200	700	3/4	19.05	1.15	29.21	4	200	1.38	4.50	114.30	0.36	0.54
00114612400	700	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.40	0.60
00114616200	700	1	25.40	1.37	34.8	4	200	1.38	7.00	177.80	0.49	0.73
00114616400	700	1	25.40	1.43	36.32	4	300	2.07	7.00	177.80	0.49	0.73
00114620200	550	1-1/4	31.75	1.75	44.45	4	200	1.03	8.75	222.25	0.79	1.18
00114624200	400	1-1/2	38.10	2.00	50.80	4	200	1.03	10.50	266.70	0.90	1.34
00114632200	250	2	50.80	2.55	64.77	4	200	1.03	14.00	355.60	1.08	1.61
BLACK	**50 ft. Lengths**											
00114612454	1 per carton	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.40	0.60
GREEN	**Reels (ft.)**											
00114806400	700	3/8	9.53	0.69	17.53	2	300	2.07	2.25	57.15	0.15	0.22
00114808400	700	1/2	12.70	0.84	21.34	4	300	2.07	3.00	76.20	0.25	0.37
00114812400	700	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.41	0.61
00114816400	700	1	25.40	1.43	36.20	4	300	2.07	7.00	177.80	0.54	0.80
GREEN	**50 ft. Lengths**											
00114812454	28 per pallet	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.41	0.61
YELLOW	**Reels (ft.)**											
00114906400	700	3/8	9.53	0.69	17.53	2	300	2.07	2.25	57.15	0.15	0.22
00114908400	700	1/2	12.70	0.84	21.34	4	300	2.07	3.00	76.20	0.24	0.36
00114912400	700	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.37	0.55
00114916400	700	1	25.40	1.43	36.20	4	300	2.07	7.00	177.80	0.54	0.80
YELLOW	**50 ft. Lengths**											
00114912452	28 per pallet	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.37	0.55
BLUE	**Reels (ft.)**											
00115006400	700	3/8	9.53	0.69	17.53	2	300	2.07	2.25	57.15	0.15	0.22
00115008400	700	1/2	12.70	0.84	21.43	4	300	2.07	3.00	76.20	0.25	0.37
00115012400	700	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.37	0.55
00115016400	700	1	25.40	1.43	36.20	4	300	2.07	7.00	177.80	0.54	0.80
BLUE	**50 ft. Lengths**											
00115012454	1 per carton	3/4	19.05	1.15	29.21	4	300	2.07	4.50	114.30	0.37	0.55

EQUIPMENT TECHNICAL DATA SHEETS

ADT / DAF RECYCLE PUMP

DESCRIPTION

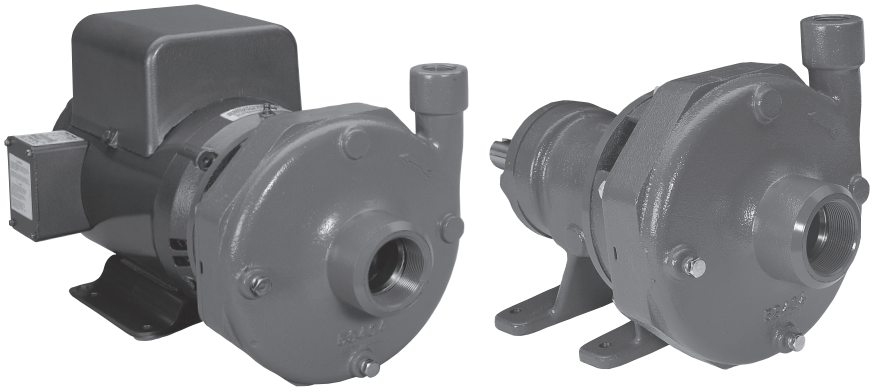
Goulds Model 3656 Close Coupled Centrifugal Pump – Size: 1x2-8 w/ 10 HP, 3600 RPM, 460V/3PH/60H, PE, TEFC, Motor

- See attached specifications for Materials of Construction, info on Baseplate, Coupling, Mechanical Seal, Motor, etc.
- Design Point: 80 GPM @ 180' TDH

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

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Let's Solve Water

TECHNICAL BROCHURE
B363756S R7



3656/3756 S-Group

BUILT IN THE USA
ENGINEERED, ASSEMBLED & TESTED

CAST IRON, BRONZE FITTED CENTRIFUGAL PUMPS

BOMBAS CENTRÍFUGAS EN HIERRO FUNDIDO CON ACCESORIOS DE BRONCE

GOULDS WATER TECHNOLOGY
a xylem brand

A FULL RANGE OF PRODUCT FEATURES

The 3656 and 3756 S-Group pumps from Goulds Water Technology have been designed with technical benefits to meet the needs of users in a variety of water supply, recirculation, and cooling applications.

- The model 3656 offers close coupled design for space saving and simplified maintenance.
- The model 3756 offers a bearing frame mounted design for flexibility of installation and drive arrangements.
- Back pull-out to reduce maintenance down time.
- Standard Type 21 mechanical seal for both reliability and availability. Carbon/ceramic/BUNA standard, with other faces and elastomers available.
- 3656/3756 available in all iron, bronze fitted or all bronze construction for application versatility.
- Replaceable wearing components include stainless steel shaft sleeve and casing and hub wear rings to maintain peak efficiency.
- Packed box sealing is also available as an option.
- Enclosed impeller design, dynamic balancing and renewable wear rings reduce losses affecting performance and pump life.
- Suction and discharge pipe connections are NPT threaded, except 3 x 4 – 7 which has 125 lb. ANSI flat faced flanges.
- Rigid cast iron motor adapter provides support and registered fits maintain positive unit alignment.
- Standard NEMA motor frame, JM or JP shaft extension, C-face mounting, single phase or three phase, 3500 or 1750 RPM. Open drip proof and totally enclosed fan cooled. *
- Optional explosion proof motors available.*
- Optional rigid carbon steel bedplate, sheet metal coupling guard and T. B. Woods spacer coupling for 3756 models.
- DRINKING WATER NSF/ANSI 61 & 372 **NSF 61 Certification:** Pumps assembled at the factory are certified to the NSF/ANSI 61 Drinking Water System Components Standard. (Minimum usage of 2L/day for BF models. Buna seal models are not certified.)

* Premium efficiency where required by Department of Energy regulations.

UNA AMPLIA GAMA DE VARIADAS CARACTERÍSTICAS

Las bombas 3656 y 3756 del Grupo S de Goulds Water Technology han sido diseñadas con beneficios técnicos para satisfacer las necesidades de los usuarios en variadas aplicaciones de suministro y recirculación de agua y aplicaciones de refrigeración.

- *El modelo 3656 cuenta con diseño de acoplamiento corto para ahorrar espacio y simplificar el mantenimiento.*
- *El modelo 3756 cuenta con diseño de montaje sobre bastidor que ofrece gran flexibilidad en los arreglos de instalación y accionamiento.*
- *Desmontaje posterior que reduce el tiempo de inactividad por mantenimiento.*
- *Sello mecánico estándar Tipo 21, brinda gran confiabilidad y asegura la disponibilidad. Estándar de carbono/cerámica/BUNA, también se encuentran disponibles con otras caras y elastómeros.*
- *Los modelos 3656 y 3756 se fabrican en todo hierro, con accesorios de bronce o en todo bronce, para una mayor versatilidad de aplicación.*
- *Los componentes de desgaste reemplazables incluyen los anillos de desgaste de la carcasa y del rodete y la camisa del eje, de acero inoxidable, para mantener la eficiencia pico.*
- *El diseño de impulsor encerrado, balanceo dinámico y anillos de desgaste reemplazables reducen las pérdidas que afectan el desempeño y la vida de la bomba.*
- *Las conexiones de succión y descarga son roscadas NPT, con excepción de la bomba de 3 x 4 – 7, que cuenta con bridas de cara lisa ANSI de 125 lbs.*
- *El adaptador rígido del motor, de hierro fundido, ofrece soporte y los montajes registrados mantienen el alineamiento positivo de la unidad.*
- *Motor con bastidor NEMA estándar, extensión de eje JM, montaje en cara C, monofásico o trifásico, 3500 ó 1750 RPM. Abierto a prueba de filtraciones o totalmente encerrado enfriado por ventilador.**
- *Motores a prueba de explosiones disponibles como opción.**
- *Placa de asiento rígida de acero al carbono, protector de acoplamiento de chapa metálica y acoplamiento espaciador T. B. Woods disponibles como opción en los modelos 3756.*
- *Certificación del NSF 61: Las bombas ensambladas en la fábrica se certifican a los componentes de consumición del circuito de agua de NSF/ANSI 61 estándar. (El uso mínimo de 2L/day para el FB modela. Los modelos del sello del Buna no se certifican.)*

** Eficacia superior donde se requiera por el Ministerio de regulaciones de la Energía.*

3656/3756 S-GROUP NUMBERING SYSTEM FOR ALL UNITS BUILT AFTER AUGUST 3, 1998

SISTEMA DE NUMERACIÓN DEL GRUPO S, MODELOS 3656/3756, PARA TODAS LAS UNIDADES FABRICADAS LUEGO DEL 3 DE AGOSTO DE 1998

The various versions of the 3656 and 3756 S-Group are identified by a product code number on the pump label. This number is also the catalog number for the pump. The meaning of each digit in the product code number is shown below.

Not all combinations of motor, impeller and seal options are available for every pump model. Please check with Goulds Water Technology on non-cataloged numbers.

Not recommended for operation beyond printed H-Q curve. For critical application conditions consult factory.

Las diferentes versiones de los modelos 3656 y 3756 del Grupo S se identifican con un número de código de producto en la etiqueta de la bomba. Este número es también el número de catálogo de la bomba. A continuación se ilustra el significado de cada dígito en el código del producto.

No todas las combinaciones de motor, impulsor y sellos están disponibles para cada modelo. Consulte a Goulds Water Technology sobre números que no aparecen en el catálogo.

No se recomienda la operación más allá de la curva impresa de H-Q (carga-capacidad). Para aplicaciones bajo condiciones críticas, consulte con la fábrica.

Example Product Code, *Ejemplo del código de producto*

9 BF 1 H 2 G 0 H R

Casing Rotation, Optional

R = 3 o'clock B = 6 o'clock L = 9 o'clock

NOTE: Rotation when viewed from suction end of pump. Standard discharge position is 12 o'clock.

Rotación de la cubierta, opcional

R = 3 hora B = 6 hora L = 9 hora

NOTA: *Rotación cuando está visto del extremo de la succión de la bomba. La posición estándar de la descarga es las 12.*

High Head Impeller (1½ x 2 – 6H Only), *Impulsor de carga alta (1½ x 2 – 6H únicamente)*

Mechanical Seal and O-ring, *Sello mecánico y anillo en O*

Type 21 Mechanical Seal, *Tipo 21 Sello Mecánico*					
Seal Code, *Código del Sello*	**Rotary, *Rotativo***	**Stationary, *Estacionario***	**Elastomers, *Elastómeros***	**Metal Parts, *Partes Metálicas***	**Part No., *Pieza Número***
0	Carbon, *Carbón*	Ceramic, *Cerámica*	BUNA-N	316 SS, *316 Acero inoxidable*	10K13
1		Sil-Carbide, *Carburo de silicona*	EPR		10K19
3			Viton		10K27
5	Sil-Carbide				10K64
9	Packed Box Design with BUNA O-Ring, Diseño de prensaestopas empacado con anillo en O de BUNA				15K16

Note: 10K27 replaces obsolete 10K25, ***Nota:*** *La 10K27 reemplace la obsoleta 10K25.*

Impeller Option Code, *Código de opción de impulsor*

NOTE: For trimmed impellers, use T for impeller code. ***NOTA:*** *Para los impulsores cortados, utilice T para el código del impulsor.*

Impeller Code, *Código del impulsor*	22BF	9BF	3BF		5BF	4BF	6BF
	1 x 2 - 7	1 x 2 - 8	1½ x 2 - 6	1½ x 2 - 6H	1½ x 2 - 8	2½ x 3 - 7	3 x 4 - 7
	Dia.	Dia.	Dia.	Dia.	Dia.	Dia.	Dia.
A	6¾"	8 1/16"	5 15/16"	5 15/16"	8 1/16"	7 1/16"	7 1/16"
B	6 7/16	7 5/8	5 5/8	5 5/8	7 5/8	6 7/8	6 3/8
C	6	7 5/16	5 1/8		6¾	6 9/16	6
D	5¾	7	4¾		5¾	6	5½
E	5½	6½			7¾	5 11/16	5 1/8
F	5 1/16	6 3/16			7	5 7/16	4 11/16
G	4 13/16	5 3/8			6¼	5 3/16	
H	4 9/16	5 1/8			6 1/8	4¾	
J	4 3/8					4½	
K	4 1/16					4 1/16	
L	3 13/16						

NOTE: Impellers will be trimmed in 1/16" increments only. If you are ordering a trim within 1/16" of the standard impeller, you will receive the standard impeller trim.

NOTA: *Los impulsores serán cortados en 1/16" incrementos solamente. Si usted está pidiendo un ajuste dentro de 1/16" del impulsor estándar, usted recibirá el ajuste estándar del impulsor.*

Driver, *Elemento motor*

1 = 1 PH, ODP
2 = 3 PH, ODP
3 = 3 PH, 575 V, ODP
4 = 1PH, TEFC
5 = 3 PH, TEFC
6 = 3 PH, 575 V, TEFC
7 = 3 PH, XP
8 = 3 PH, 575 V, XP
9 = 3 PH, TE PE
0 = 1 PH, XP
A = 3 PH, 575 TE PE
B = 3 PH, ODP PE
C = 3 PH, WD PE
D = 3 PH, 575 ODP PE
E = 3 PH, XP PE
F = 1 PH, ODP PE
G = 1 PH, TEFC PE

1 PH, fase = Monofásico; 3 PH, fases = Trifásico

For frame mounted version, substitute the letters "FRM" in these positions.

Para las versiones de montaje en bastidor, reemplazar las letras en esta ubicación con "FRM".

HP Rating, *Potencia nominal, HP*

C = ½ HP E = 1 HP G = 2 HP J = 5 HP L = 10 HP M = 15 HP
D = ¾ HP F = 1½ HP H = 3 H P K = 7½ HP N = 20 HP

Driver: Hertz/Pole/RPM, *Elemento motor: Hertz/Polos/RPM*

1 = 60 Hz, 2 pole, 3500 RPM 3 = 60 Hz, 6 pole, 1150 RPM 5 = 50 Hz, 4 pole, 1450 RPM
2 = 60 Hz, 4 pole, 1750 RPM 4 = 50 Hz, 2 pole, 2900 RPM

Material, *Material*

BF = Bronze fitted, *Accesorios de bronce* AI = All iron, *Todo hierro* AB = All bronze, *Todo bronce*

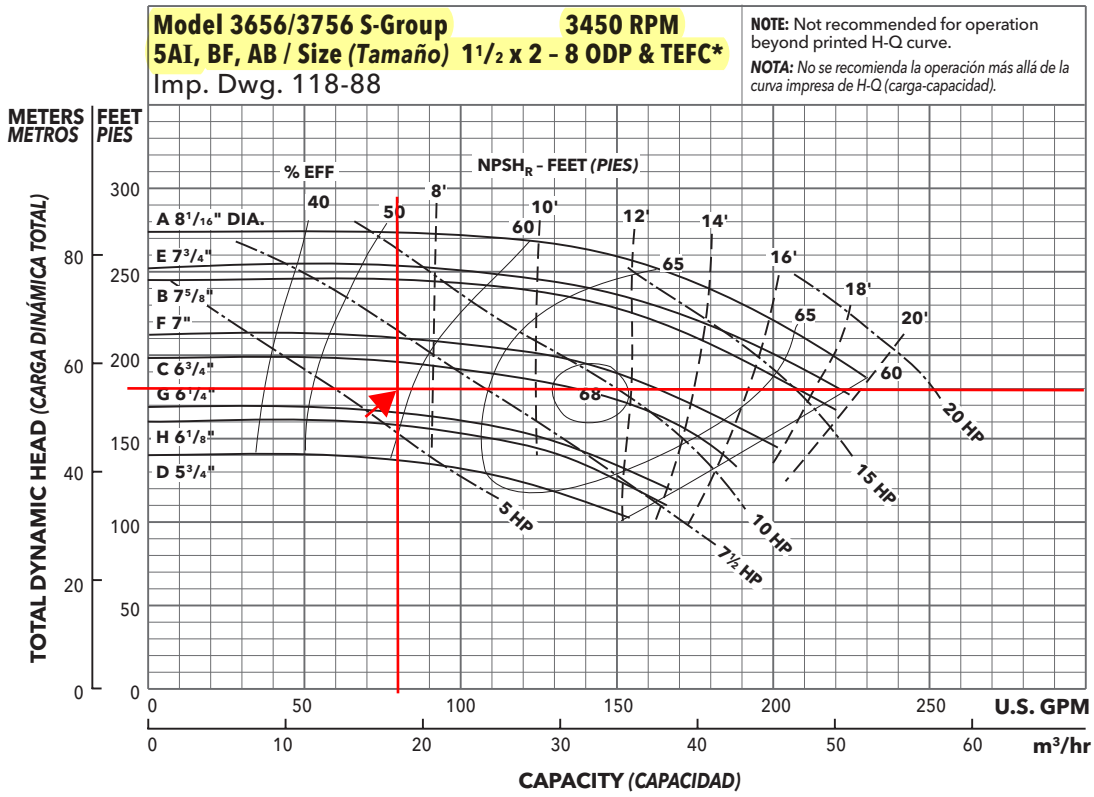
Pump Size, *Tamaño de bomba*

3 = 1½ x 2 – 6(H) 4 = 2½ x 3 – 7 5 = 1½ x 2 – 8 6 = 3 x 4 – 7* 9 = 1 x 2 – 8 22 = 1 x 2 – 7

*Flanged design suction and discharge. *Succión y descarga brida del diseño.*

The 1 x 2 – 8 and 1 x 2 – 7 are only available in Bronze Fitted. *Los tamaños 1 x 2 – 8 y 1 x 2 – 7 están disponibles con accesorios de bronce únicamente.*

PERFORMANCE CURVES – 60 HZ, 3500 RPM
CURVAS DE DESEMPEÑO – 60 HZ, 3500 RPM



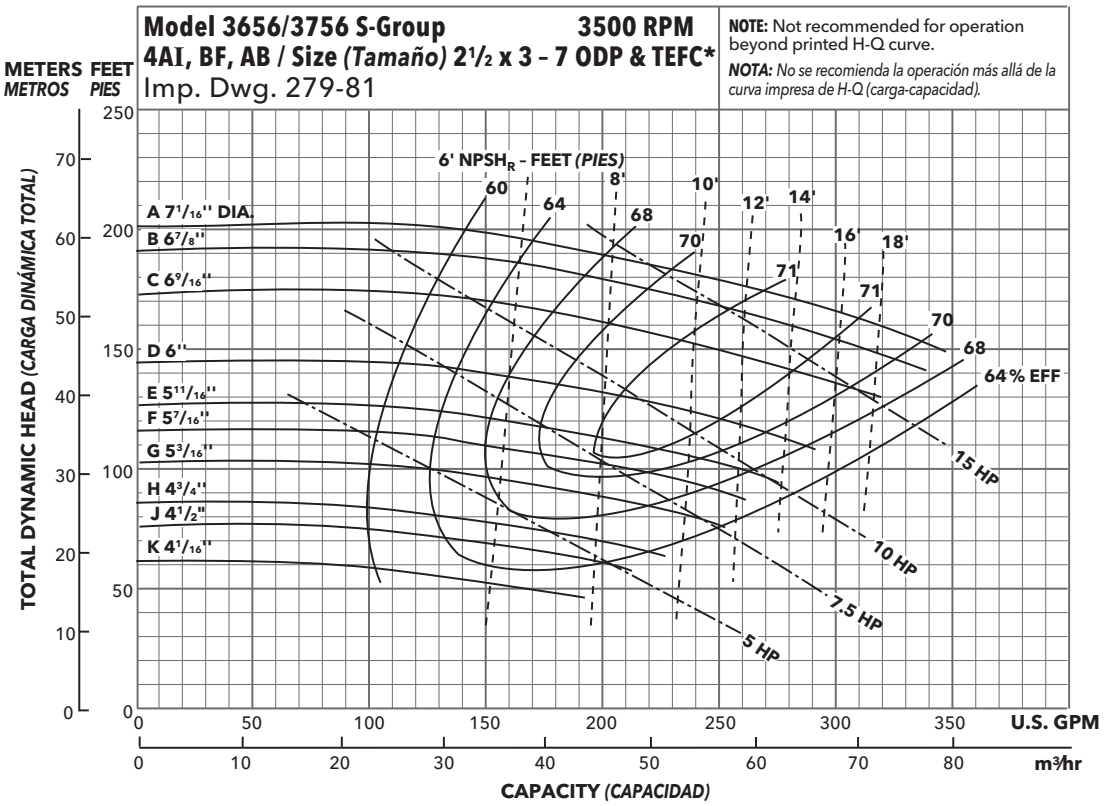
Optional Impeller *Impulsor optativo*	
Ordering Code *Código de pedido*	**Dia.** *Diá.*
A	8 1/16"
E	7 3/4"
B	7 5/8"
F	7
C	6 3/4
G	6 1/4
H	6 1/8
D	5 3/4

NOTE: Pump will pass a sphere to 5/16" diameter.

NOTA: *La bomba dejará pasar una esfera de hasta 5/16 de pulgada de diámetro.*

* Premium efficiency where required by Department of Energy regulations.

** Eficacia superior donde se requiera por el Ministerio de regulaciones de la Energía.*



Optional Impeller *Impulsor optativo*	
Ordering Code *Código de pedido*	**Dia.** *Diá.*
A	7 1/16"
B	6 7/8
C	6 9/16
D	6
E	5 1/16
F	5 7/16
G	5 3/16
H	4 3/4
J	4 1/2
K	4 1/16

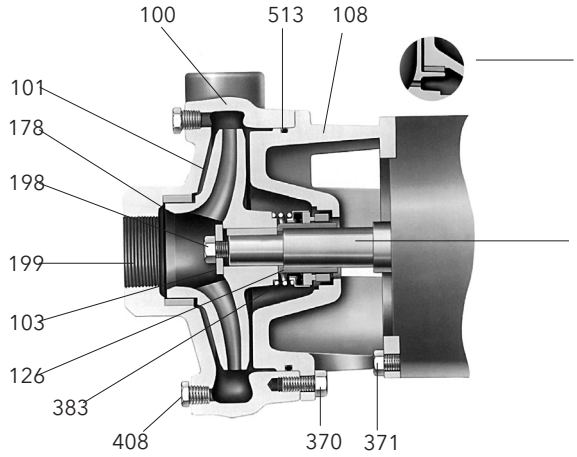
NOTE: Pump will pass a sphere to 7/16" diameter.

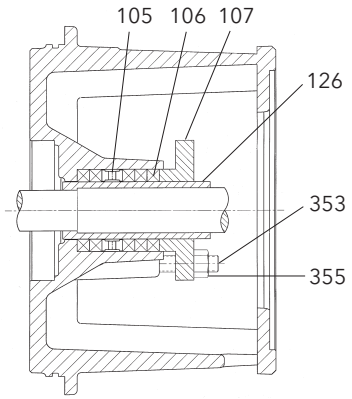
NOTA: *La bomba dejará pasar una esfera de hasta 7/16 de pulgada de diámetro.*

* Premium efficiency where required by Department of Energy regulations.

** Eficacia superior donde se requiera por el Ministerio de regulaciones de la Energía.*

3656 S-GROUP MATERIALS OF CONSTRUCTION
MATERIALES DE CONSTRUCCIÓN - GRUPO S, MODELO 3756





Packed Box Arrangement
Caja prensaestopas

Item No. *No. Ítem*	Description *Descripción*	Materials, *Materiales*		
		All Iron *Todo hierro*	Bronze Fitted *Accesorios de bronce*	All Bronze *Todo bronce*
100	Casing, *Carcasa*	1001	1001	1101
101	Impeller, *Impulsor*		1101	
103	Casing wear ring, *Anillo de desgaste de la carcasa*		1618	1618
108	Adapter, *Adaptador*		1003	1003
184	Seal housing, *Cubierta del sello*①	One piece with adapter, *Una pieza con adaptador*		1101
126	Shaft sleeve, *Camisa del eje*	AISI Type 300 series stainless steel *Acero inoxidable serie AISI tipo 300*		
198	Impeller bolt, *Perno del impulsor*			
199	Impeller washer, *Arandela del impulsor*			
178	Impeller key, *Chaveta del impulsor*	Carbon Steel, *Acero al carbono*		
370	Hex head cap screw (adapter to case), *Tornillo de cabeza hexagonal (del adaptador a la cubierta)*	Steel SAE 1200 Grade 5 *Acero SAE 1200 grado 5*		
371	Hex head cap screw (adapter to motor), *Tornillo de cabeza hexagonal (del adaptador al motor)*			
383	Mechanical seal, *Sello mecánico*	See seal chart, *Ver tabla del sello*		
408	Pipe plug ¼" or ⅜", *Tapón de tubos de ¼ de pulgada ó ⅜ de pulgada*	Steel, *Acero*		Bronze, *Bronce*
513	O-ring, *Anillo en O*	BUNA-N, *BUNA-N*		

① For separate seal housing and adapter construction, all bronze material only, see repair parts page.

Para la construcción separada del compartimiento del sello y el adaptador, materiales de bronce únicamente, consulte la página de piezas de repuesto.

Material Code, *Código de material*	Engineering Standard, *Norma de ingeniería*
1003	Cast iron ASTM A48 CL30, *Hierro fundido ASTM A48 CL30*
1101	Silicon bronze ASTM B584, C87500, *Siliciuro de bronce ASTM B584, C87500*
1618	Bizmuth brass, *Latón al bismuto*

Packed Box Arrangement, *Caja prensaestopas*

Item No., *No. Ítem*	Description, *Descripción*	Materials, *Materiales*
105	Lantern ring, *Aro de linterna*	Teflon™
106	Packing, 5 rings; *Empaquetadura, 5 aros*	Teflon Impregnated, *Impregnado de Teflon*
107	Gland, *Casquillo*	AISI 316SS
126	Shaft sleeve, *Camisa del eje*	AISI Type 300 Series Stainless Steel *Acero inoxidable serie AISI tipo 300*
353	Gland stud, *Perno del casquillo*	
355	Gland nut, *Tuerca del casquillo*	

NOTE:
Pumps will be shipped with top-vertical discharge position as standard. For other orientations, remove casing bolts – rotate discharge to desired position – replace and tighten bolts to 25 ft./lbs. Note that discharge may extend below motor mounting surface in bottom-horizontal position; adequate clearance must be provided.

NOTA:
Las bombas salen de la fábrica con la descarga orientada en posición vertical superior de manera estándar. Para modificar la orientación, retirar los pernos de la carcasa, hacer girar la descarga hasta la posición deseada y volver a colocar los pernos, ajustándolos a una torsión de 25 pies/libras. Se ha de notar que la descarga se puede extender por debajo de la superficie de montaje del motor en la posición horizontal inferior; por lo tanto, debe proveerse suficiente espacio.

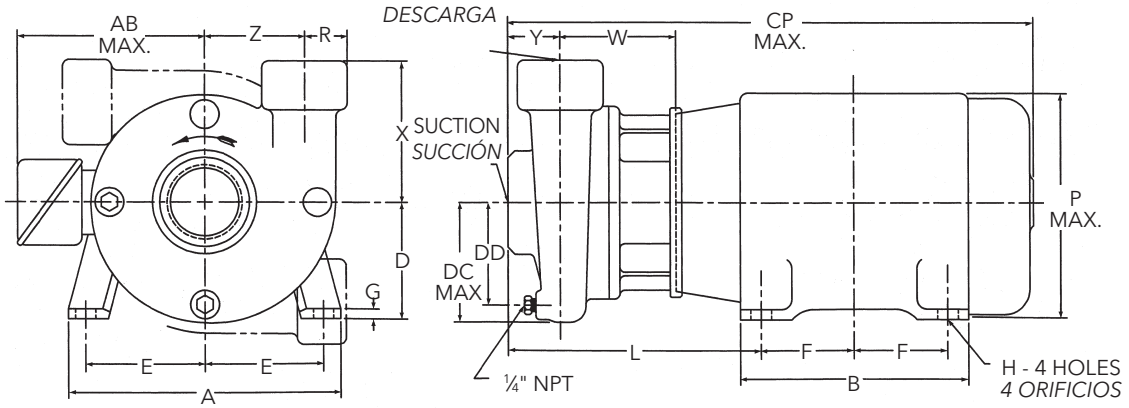
Type 21 Mechanical Seal, *Tipo 21 sello mecánico*

Seal Code, *Código del Sello*	Rotary, *Rotativo*	Stationary, *Estacionario*	Elastomers, *Elastómeros*	Metal Parts, *Partes Metálicas*	Part No., *Pieza Número*
0	Carbon, *Carbón*	Ceramic, *Cerámica*	BUNA-N	316 SS, *316 Acero inoxidable*	10K13
1		Sil-Carbide, *Carburo de silicona*	EPR		10K19
3			Viton		10K27
5	Sil-Carbide				10K64
9	Packed Box Design with BUNA O-Ring, *Diseño de prensaestopas empacado con anillo en O de BUNA*				15K16

Note: 10K27 replaces obsolete 10K25, ***Nota:*** *La 10K27 reemplace la obsoleta 10K25.*

3656 S-GROUP DIMENSIONS AND WEIGHTS
GRUPO S, MODELO 3656 - PESO Y DIMENSIONES

MECHANICAL SEAL
SELLO MECÁNICO



Pump Dimensions and Weights (Dimension "L" determined by Pump and Motor)
Peso y dimensiones de la bomba *(la dimensión "L" está determinada por la bomba y el motor)*

Pump *Bomba*	Suction *Succión*	Discharge *Descarga*	CP Max.	DC Max.	DD	R	W	X	Y	Z	Wt. (lbs.) *Pesos (libras)*	Motor Frame Size, *Tamaño del bastidor*			
												140	180	210	250
												L			
1 x 2 – 7	2	1	24¾	4¼	3½	1 1/16	4 1/8	5½	3	4	52	10	10 5/8	–	–
1 x 2 – 8					4		3 15/16	5¾	3 3/16	4¼	52			11 5/8	–
1½ x 2 – 6		1½	24½		3½	1¼	4¼	4½	2 5/8	3½	34	9¾	10 3/8	–	–
1½ x 2 – 8			29 1/8	5 3/8	4 5/8			5		4¼	54			11 3/8	11 7/8
2½ x 3 – 7	3	2½	25½	5 1/8	4½	1 13/16		6	3	4	49	10 1/8	10¾	11¾	12¼
3 x 4 – 7	4*	3*	25 3/16	5¾	5 1/8	3¾	4 3/8		2½	4½	82	9¾	10 3/8	11 3/8	–

*For use with ANSI class 150 mating flange. All others are NPT connections.
** Para uso con brida de contacto ANSI clase 150. Todas las demás son conexiones NTP.*

Motor Dimensions and Weights (may vary with manufacturer)*
Peso y dimensiones del motor *(pueden variar de acuerdo al fabricante) **

Frame Size JM *Tamaño del bastidor JM*	A	AB (Max.)	B	D	E	F	G	H	P (Max.)	Weight (lbs.) *Pesos (libras)*
143	6½	6 15/16	6½	3½	2¾	2	1/8	3/8	7 10/16	54
145						2½				56
182	8 11/16	7½	6½	4½	3¾	2¼	3/8	7/16	9 9/16	109
184						2¾				110
213	9¾	9 10/16	9 9/16	5¼	4¼	2¾	5/8	7/16	11¼	152
215						3½				179
254 TCZ	11½	12 10/16	11½	6¼	5	4 1/8	¼	½	13½	392
256 TCZ						5				390

NOTE:
All pumps shipped in vertical discharge position. May be rotated in 90° increments. Tighten casing bolts to 25 ft./lbs. torque.

NOTA:
Todas las bombas se embarcan con la descarga en posición vertical. Esta posición puede rotarse en incrementos de 90°. Ajustar los pernos de la carcasa a una torsión de 25 pies/libras.

Motor Frames and Horsepower, ***Bastidores del motor y potencia en HP***

Motor Frame *Bastidor del motor*	3500 RPM						1750 RPM					
	1 Phase			3 Phase			1 Phase			3 Phase		
	ODP*	TEFC*	XP*	ODP*	TEFC*	XP*	ODP*	TEFC*	XP*	ODP*	TEFC*	XP*
143JM	1, 1½	1, 1½	–	1, 1½	1, 1½	–	½, ¾, 1	½, ¾, 1	½	½, ¾, 1	½, ¾, 1	–
145JM	2	2	–	2, 3	2	2	1½	1½	–	1½, 2	1½, 2	–
182JM	3	3	3	5	3	3	2	2, 3	2	3	3	3
184JM	5	5	–	7½	5	5	3	–	–	5	5	–
213JM	7½	–	–	10	7½	7½	–	–	–	–	–	–
215JM	10	7½, 10	–	15	10, 15	10	–	–	–	–	–	–
254TCZ	–	–	–	20	–	15	–	–	–	–	–	–
256TCZ	–	–	–	–	20	20	–	–	–	–	–	–

All dimensions in inches and weights in lbs. Do not use for construction purposes.
Todas las dimensiones están en pulgadas, el peso en libras. No utilizar para fines de construcción.

* Premium efficiency where required by Department of Energy regulations.

** Eficacia superior donde se requiera por el Ministerio de regulaciones de la Energía.*

SPECIFICATIONS

Capacities to:
550 GPM (125 m^3/hr) at 3500 RPM
350 GPM (79 m^3/hr) at 1750 RPM

Heads to:
280 feet TDH (85 m) at 3500 RPM
67 feet TDH (20 m) at 1750 RPM

Working pressure to:
175 PSIG (12 bars)

Suction pressure to:
100 PSIG (7 bars)

Maximum temperature to:
212°F (100°C) with standard seal or 250°F (121°C) with optional seal.

Motor:
NEMA standard JM frame or JP frame for 3656 or T-frame for 3756. Open drip-proof*, totally enclosed fan cooled* and explosion proof* enclosures available. Single Phase (115/208-230V) ½-1 HP, (115/230V) 1½-3 HP and three phase (230/460V) ½-25 HP.

Direction of Rotation:
Clockwise viewed from motor end.

* Premium efficiency where required by Department of Energy regulations.

ESPECIFICACIONES

Capacidad hasta:
550 GPM (125 m ^{3}/hr) a 3500 RPM
350 GPM (79 m ^{3}/hr) a 1750 RPM

Cargas hasta:
280 pies (85 m) carga dinámica total a 3500 RPM
67 pies (20 m) carga dinámica total a 1750 RPM

Presión de operación hasta:
175 PSIG (12 bars)

Presión de succión hasta:
100 PSIG (7 bars)

Temperatura máxima:
212 °F (100 °C) con sello estándar o
250 °F (121 °C) con sello optativo.

Motor:
Bastidor NEMA JM estándar en el modelo 3656 y bastidor NEMA T estándar en el modelo 3756. Las cubiertas disponibles son: abierta a prueba de filtración, totalmente encerrada con enfriamiento por ventilador* y a prueba de explosiones*. Monofásico (115/208 – 230 V), ½ a 1 HP; (115/230 V) ½ a 3 HP y Trifásico (230/460 V) ½ a 25 HP.*

Dirección de rotación:
Dextrorsa (sentido de las agujas del reloj) cuando se mira desde el extremo del motor.

** Eficacia superior donde se requiera por el Ministerio de regulaciones de la Energía.*

TYPICAL APPLICATIONS

- Booster service
- Spraying systems
- Irrigation
- Water circulation
- Liquid transfer
- General purpose pumping

APLICACIONES TÍPICAS

- *Servicio de refuerzo*
- *Sistemas de rociado*
- *Sistemas de riego*
- *Circulación de agua*
- *Transferencia de líquidos*
- *Aplicaciones de bombeo en general*

EQUIPMENT TECHNICAL DATA SHEETS

FLOW TUBE & TRANSMITTER

DAF INFLUIENT FLOW TUBE & TRANSMITTER:
McCrometer Ultramag 5000 Meter
UM506-2SR025S1-AM (6")

ANSI Class 150# (285psi rating) Flanges
Remote Mount Converter/Transmitter with 25ft of Remote Mount Cable
DC Power with Single 4-20mA and Dual Digital Output
For Additional Specs please refer to the attached

DAF RECYCLE FLOW TUBE & TRANSMITTER:
McCrometer Ultramag 5000 Meter
UM502-2SR025D1-AM (2")

ANSI Class 150# (285psi rating) Flanges
Remote Mount Converter/Transmitter with 25ft of Remote Mount Cable
DC Power with Single 4-20mA and Dual Digital Output
For Additional Specs please refer to the attached

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

HACH ULTRA MAG™

Ultra Mag Flow Meter Specification Sheet

Ultra Mag 3000 utilizes the ProComm Go electronics which allows AC or DC power with battery backup or straight battery operation with pulse and 4-20mA outputs with an accuracy of +/- 1.0% of reading.

Ultra Mag 5000 utilizes the ProComm Max electronics which allows AC or DC power with Modbus, pulse and 4-20mA outputs with an accuracy of +/- 0.5% of reading.

Applications

Ultra Mag flow meters are intended to be used both in clean drinking water and waste water applications. These can include:

- Raw/well source water
- Distribution/ networks
- Water storage
- Revenue/billing
- Pumping stations
- Water treatment
- Final water discharge
- Storm water
- Waste water pumping stations
- Effluent final discharge

Performance Advantages

- Flanged models need only 1 pipe diameter upstream of most flow disturbers
- No obstruction to the flow
- No moving parts to wear or break
- Maintenance free
- Choice of Accuracy +/- 0.2% OR +/- 0.5%
- Debris or solids will not clog the meter
- No head loss
- Bi-directional flow
- Empty pipe detection
- Unaffected by changes in density and viscosity
- No risk of liner delamination or separation
- Wide flow range
- Separated power and signal cables



Standard and Hazardous Location Models

Ultra Mag is designed to work in ordinary circumstances and in hazardous locations. It is available as either the standard model or as a hazard location (HL) model, which is certified by MET (Ultra Mag 3000 only).

Certifications

Ultra Mag series currently has three certifications for quality and safety:

- ISO 9001:2015 certified quality management system
- Certified to NSF / ANSI Standards
- Certified by IAPMO R&T to NSF/ANSI 61 for material safety and NSF/ANSI 372 for low lead content

Additionally, Ultra Mag 3000 is certified for hazardous location:

- Certified by MET to UL 61010-1 / CSA C22.2 No. 61010-1
  - Class I, Division 2, Groups A-D, T4
  - Class I, Zone 2, IIC T4

Available Ultra Mag End Connections

Nominal Line Size	AWWA CL D	AWWA CL F	ANSI 150#	ANSI 300#
1.5 in			x	x
2 in			x	x
2.5 in			x	x
3 in			x	x
4 in	x		x	x
6 in	x		x	x
8 in	x		x	x
10 in	x		x	x
12 in	x		x	x
14in	x	x	x	x
16 in	x	x	x	x
18 in	x	x	x	x
20 in	x	x	x	x
24 in	x	x	x	x
30 in	x	x	x	x
36 in	x	x	x	x
42 in	x		x	
48 in	x		x	



NSF/ANSI/CAN 61 & NSF/ANSI 372

Hach's Flow Solutions by McCROMETER

Quality Manufacturing

Ultra Mag flow meters are manufactured to the highest standard available for mag meters. The flanged end tube design permits use in a wide range of applications with up to 500 PSI working pressure. The fabricated tube is stainless steel with steel or stainless steel flanges and is lined with UltraLiner™, an NSF approved, fusion bonded epoxy material.

Signal Transmitters / Transmitters

The signal transmitter is always located at the sensor and changes the raw flow data into usable flow information to allow the measurements, functional programming, and data reporting to be communicated through the transmitters display and outputs. There are two different transmitter models used in various applications. Both transmitters are available as either meter mount or remote mount.

• ProComm GO Transmitter

Ultra Mag 3000 flow meter is accompanied by the ProComm GO electronics and is battery powered, ideal for remote installations and locations with unreliable power sources.

- Output options include pulse, 4-20mA, Modbus, and telemetry
- Battery powered with optional solar, AC or DC power with battery backup
- DIY battery replacement and in-field programming available via USB cable and laptop
- 5-year expected battery life
- Rated to 140F
- UL, CSA certifications
- CRN (ANSI), CE, UL certifications

• ProComm Max Transmitter

Ultra Mag 5000 is offered with the ProComm Max electronics, offering greater accuracy and more sophisticated output options for users needing superior system integration and data collection.

- Output options include Digital Pulse, 4-20mA, Hart, Modbus, and Ethernet IP
- Datalogger and optional AMI/AMR
- AC/DC powered
- Rated to 140F
- CE, UL, CSA certification
- CRN (ANSI), CE, UL, CSA certifications

Installation

Ultra Mag flow meter installation is similar to placing a short length of flanged end pipe in the line. The meter can be installed vertically, horizontally, or inclined on suction or discharge lines. The meter must have a full pipe of liquid for proper operation. Fluid must be grounded to the downstream flange of the sensor using McCrometer 316 SS grounding rings. For best performance, grounding rings are recommended for all sizes.

The meter needs to be located a minimum distance before and after flow disturbances, such as elbows, pumps, partially opened valves, and changes in pipe diameter. The uneven flow created by these obstructions can vary with each system.

The minimum distance is measured in pipe diameters (D). To ensure accuracy locate the sensor upstream and downstream of flow disturbances as follows:

1½" to 3" Flanged style meters	0D upstream / 0D downstream
Ultra Mag 3000, 4" -24" Steel flanged meters	2D upstream / 1D downstream
Ultra Mag 5000, 4" - 48" Steel flanged meters	1D upstream / 0D downstream

All blending and chemical injection should be done early enough so the flow media is thoroughly mixed prior to entering the measurement area.

Meter Grounding Recommendations

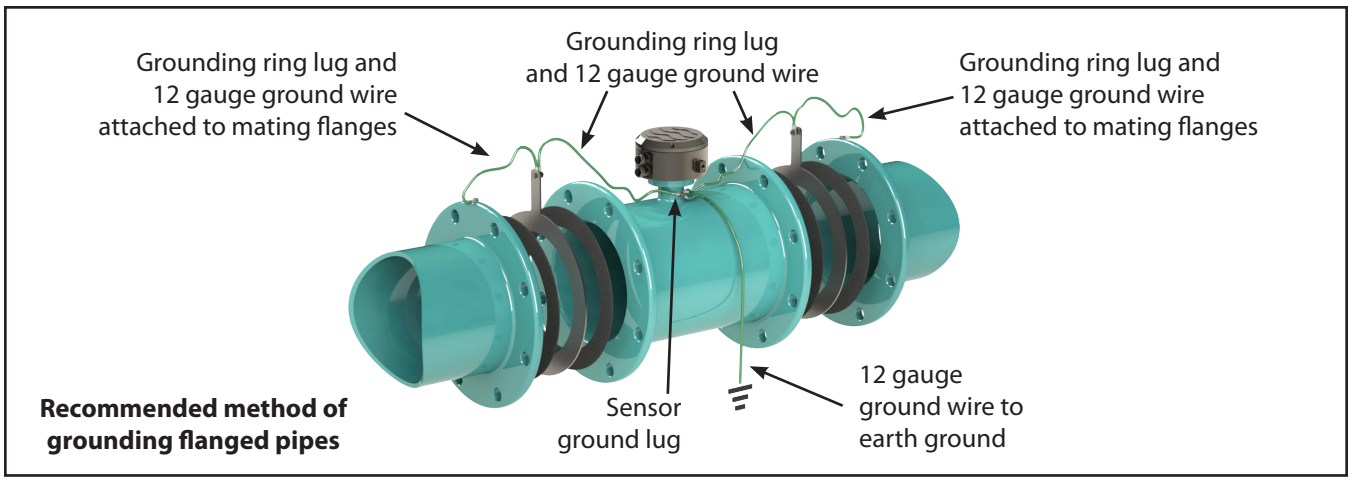
Grounding the meter body for safety according to national (NEC) or local electrical codes is recommended on ALL meter installations.

All Field Mag flow meter installations require minimum grounding with a 12-gauge ground wire to an earth ground.

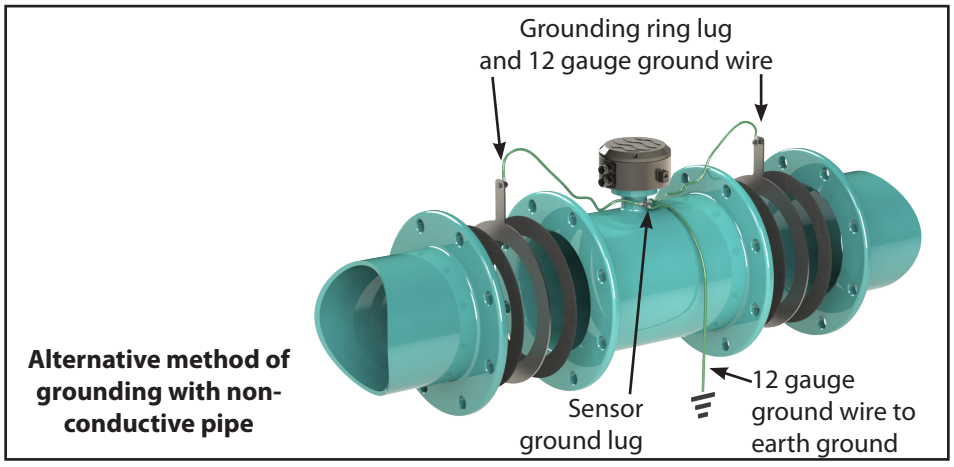
Flanged end meters

When installing into a PVC or plastic pipe system, grounding rings for flanged meters are recommended for all sizes. Flanges on the Field Mag sensor have a non-conductive coating and may not require grounding rings. For best performance, McCrometer provides grounding rings for all sizes.

For best performance, grounding the fluid column is recommended when the meter is installed in an electrically noisy environment, such as with VFD pumps or nearby electrical systems with insufficient grounding.



Recommended method of grounding flanged pipes



Alternative method of grounding with non-conductive pipe

Ultra Mag Flow Meter Specifications

All specifications apply to both Ultra Mag 3000 and Ultra Mag 5000 models except where noted.

Physical Specifications

Measurement Method	Electromagnetic flow based on Faraday's Law
Directionality	Forward and reverse flow indication and forward, reverse, net totalization are standard with all meters
Pipe Sizes	Ultra Mag 3000: 1½, 2", 2½, 3", 4", 6", 8", 10", 12", 14", 16", 18", 20", 24" Ultra Mag 5000: 1½, 2", 2½, 3", 4" 6", 8", 10", 12", 14", 16", 18", 20", 24", 30", 36", 42", 48"
Body Style	Flanged tube
Liner	206N
Electrodes	Type 316 stainless steel, Hastelloy optional
Electrode Shape	Standard shape
Electrical Connections	• Compression gland seals • Quick-Connect
Signal Transmitter	• Ultra Mag 3000: ProComm GO transmitter • Ultra Mag 5000: ProComm Max transmitter
Transmitter Mount	Either meter mount or remote mount
Sensor Cable Lengths	• **Standard**: 25'/7.6 m McCrometer supplied submersible cable with each remote mount unit. • **Optional:** Up to 500'/152.4 m, or 25'/7.6 m max for ProComm GO • **Custom Quick Connect:** Available in standard cable lengths: Feet: 25, 50, 75, 100, 125, 150, 175, 200, 500 Meters: 7.6, 15.25. 22.5, 30.5, 38.1, 45.75, 53.3, 61, 152.4 Custom quick connect cables at additional cost.

Performance and Operational Specifications

Operating Temperature	-10 to 60 °C (14 to 140 °F)
Storage Temperature	-15 to 60 °C (5 to 140 ° F)
IP Rating	• Quick Connect (NEMA 6P/IP68 with remote transmitter) • Compression gland seals (NEMA 6P/IP68 with remote transmitter)
Sensor Submersibility Depth	**With standard strain relief cable:** 1.8 m (6 ft.) **With optional quick connect cable:** 9 m (30 ft.)
Pressure Rating	• AWWA CL D, 150 PSI maximum working pressure • ANSI #150, 285 PSI maximum • ANSI #300, 500 PSI maximum
Velocity Range	0.2 to 32 FPS

Ultra Mag Flow Meter Specifications (cont.)

Performance and Operational Specifications (cont.)

Accuracy	• Ultra Mag 3000: Battery powered: 1% of measured value ±0.006 ft/s (±0.0018 m/s) • Ultra Mag 5000: Standard: +/- 0.5% of measured value ±0.006 ft/s (±0.0018 m/s) Optional: +/- 0.2% of measured value ±0.006 ft/s (±0.0018 m/s) **IMPORTANT NOTICE ON FLOW METER ACCURACY:** The Ultra Mag 3000 flow meter with remote display's cable and electronics are factory calibrated for accuracy as a single unit. Changing the cable length, even with the splice kit, changes the accuracy of the meter and invalidates the calibration certificate. The Ultra Mag 5000 flow meter does not have this restriction. Multiple point wet flow calibrations are conducted on every complete flow tube with its signal transmitter. If desired, the tests can be witnessed by the customer. The McCrometer test facilities are traceable to the National Institute of Standards & Technology. Uncertainty relative to flow is ±0.15%.
Repeatability	±0.05% or ±.0008ft/s (±0.25mm/s), whichever is greater
Head Loss	None. No obstruction in line and no moving parts
Conductivity	5 µs/cm
Pipe Run Requirements	**3000:** 1½" to 3" Flanged style meters — 0D upstream / 0D downstream 4" - 24" Steel flanged meters — 2D upstream / 1D downstream **5000:** 1½" to 3" Flanged style meters — 0D upstream / 0D downstream 4" - 48" Steel flanged meters — 1D upstream / 0D downstream

Other Specifications

Certifications and Approvals	**Ultra Mag 3000**
	Standard model:
	• ISO 9001:2015 certified quality management system
	• Certified by MET to UL 61010-1
	• Certified to NSF / ANSI Standards*
	HL Model:
	• ISO 9001:2015 certified quality management system
	• Certified by MET to UL 61010-1 and MET C22.2 No. 61010-1-04
	  • Class I, Division 2, Groups A B C D, T4
	  • Class I, Zone 2, IIC T4
	• Certified to NSF / ANSI Standards*

	Ultra Mag 5000 • ISO 9001:2015 certified quality management system • Certified to NSF / ANSI Standards*
System Options	Stainless steel ID tag
Meter Options and Accessories	• Extended warranty • Hastelloy® electrodes • ANSI flanges • Special lay lengths, including ISO standard lay lengths • Additional sensor cable up to 475' • Quick connect cable fittings • Transmitter sun shield • Smart Output™ (Sensus or Itron compatible) • Battery or battery-solar powered transmitter (ProComm GO only)
Warranty	**Meter:** 2 year warranty **Liner:** Lifetime guarantee

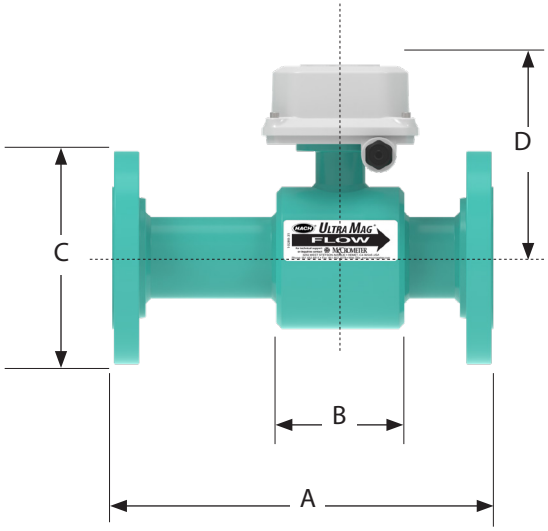
* Certified by IAPMO R&T to NSF/ANSI 61 for material safety and NSF/ANSI 372 for low lead content.

Flow Meter Dimensions and Weights

1½" to 3" Models

Pipe Size (Nominal)	Flow Ranges (0.2 to 32 FPS) Min-Max GPM	DIMENSIONS (Lay Lengths)							Est. Shipping Weight (lbs.)*	
		A		B	C		D			
		CL150 ANSI 150#	CL300 ANSI 300#		CL150 ANSI 150#	CL300 ANSI 300#	CL150 ANSI 150#	CL300 ANSI 300#	CL150 ANSI 150#	CL300 ANSI 300#
1 ½"	1.29-200	11	14	4.5	5.0	6.1	6.5	7.25	93	not offered
2"	1.29-200	11	14	4.5	6.0	6.5	6.5	7.25	93	70
2 ½"	3.25-510	13.4	15.5	4.5	7.0	7.5	7.0	7.75	94	not offered
3"	3.25-510	13.4	15.5	4.5	7.5	8.25	7.0	7.75	94	80

* For remote mount meters, add 4 lbs for ProComm Max transmitter.

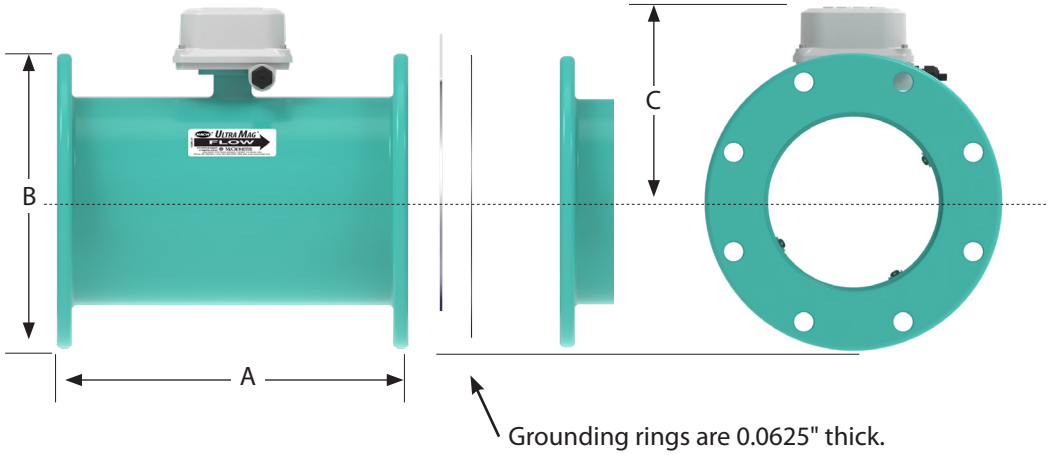


Dimensions and Weights (cont.)

4" to 12" Flanged End Body Style

Pipe Size (Nominal)	Flow Ranges (0.2 to 32 FPS) Min-Max GPM	DIMENSIONS (Lay Lengths)												Est. Shipping Weight (lbs.)*		
		A					B			C						
		AWWA	ANSI		ISO ANSI		AWWA	ANSI		AWWA	ANSI			AWWA	ANSI	
		150# Class D	150# CL150	300# CL300	150# CL150	300# CL300	150# Class D	150# CL150	300# CL300	150# Class D	150# CL150	300# CL300		150# Class D	150# CL150	300# CL300
4"	6.97-1110	13.4	13.4	13.4	9.00	10.00	9.0	9.0	10.0	9.25	9.25	9.25		86	167	167
6"	16.1-2560	14.6	14.6	14.6	11.00	12.50	11.0	11.0	12.5	10.25	10.25	10.25		98	186	186
8"	29.2-4670	16.1	17.25	17.25	13.50	15.00	13.5	13.5	15.0	11.25	11.25	11.25		118	250	250
10"	46.3-7400	18.5	18.5	18.5	16.00	17.50	16.0	16.0	17.5	12.5	12.5	12.5		168	290	290
12"	67.3-10760	19.7	19.7	19.7	19.00	20.50	19.0	19.0	20.5	13.5	13.5	13.5		210	350	350

*Shipping weights are estimated and may change due to specific order packaging

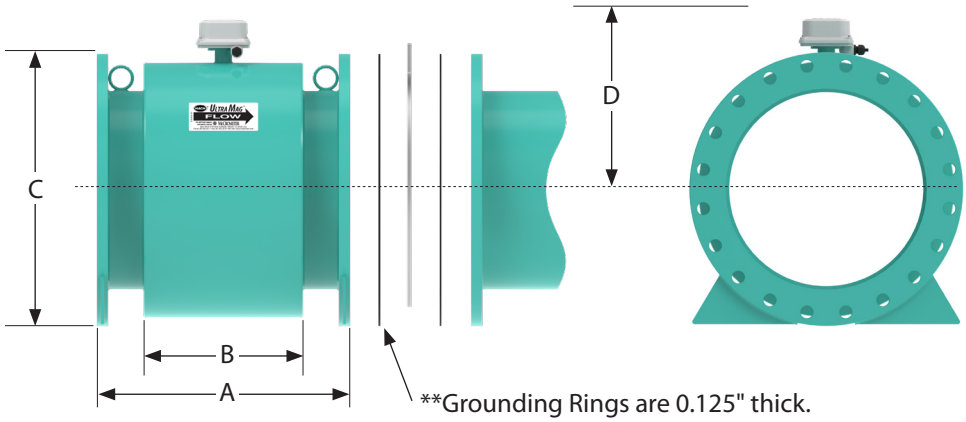


Dimensions and Weights (cont.)

14+" Flanged End Body Style

Pipe Size (nom.)	Flow Ranges (0.2 to 32 FPS) Min-Max GPM	DIMENSIONS												Est. Shipping Weight (lbs.)*			
		A						B	C				D**				
		AWWA		ANSI		ISO ANSI			AWWA		ANSI			AWWA		ANSI	
		150# Class D	300# Class F	150# CL150	300# CL300	150# CL150	300# CL300		150# Class D	300# Class F	150# CL150	300# CL300		150# Class D	300# Class F	150# CL150	300# CL300
14"	90.1-14410	21.70	22.75	22.75	22.75	21.00	23.00	10.38	21.00	23.00	21.00	23.00	13.56	290	370	370	550
16"	117-18670	23.60	25.25	25.25	25.25	23.50	25.50	12.38	23.50	25.50	23.50	25.50	14.31	352	443	443	639
18"	149-23820	23.60	25.25	25.25	25.25	25.00	28.00	12.38	25.00	28.00	25.00	28.00	15.31	400	492	492	801
20"	186-29600	25.60	28.25	28.25	28.25	27.50	30.50	14.38	27.50	30.50	27.50	30.50	16.25	465	603	603	973
24"	269-43040	30.70	35.75	35.75	35.75	32.00	36.00	18.88	32.00	36.00	32.00	36.00	18.25	658	864	864	1373
30"	418-66740	35.80	41.75	41.75	41.75	not offered		22.38	38.75	43.00	38.75	43.00	21.87	1067	1463	1463	2150
36"	607-97000	46.10	46.10	46.10	46.10			21.38	46.00	50.00	46.00	50.00	24.87	1529	2083	2083	3125
42"	831-132900	48.05	not offered	48.05	not offered			21.38	52.75	not offered	52.75	not offered	27.56	2113	2852	contact factory	
48"	1091-174440	50.00		50.00				21.38	59.50		59.50		30.56	2445	3139		

*Shipping weights are estimated and may change due to specific order packaging
** DIM D represents the remote transmitter height in relation to the meter centerline.



Ultra Mag 3000 Part Number Matrix

UM3	-									-		-		-		-		-	
Nominal Line Size																			
1.5"	0C																		
2"	02																		
2.5"	0D																		
3"	03																		
4"	04																		
6"	06																		
8"	08																		
10"	10																		
12"	12																		
14"	14																		
16"	16																		
18"	18																		
20"	20																		
24"	24																		
Flange Connections																			
AWWA Class D (150 psi Rating) *(Standard)*		1																	
ANSI Class 150# (285 psi Rating)		2																	
ANSI Class 300# (300 psi Rating)		3																	
AWWA Class F (300 psi Rating)		4																	
Wafer Style (2 & 3" Only)		N																	
Electrode Material Options																			
S316 Stainless Steel *(Standard)*			S																
Hastelloy			H																
Converter Mounting and Cable Connector Options																			
Meter Mount Converter				M															
IP68 Strain Relief [Remote Mount] (Standard)				R															
IP68 Quick Connect Potted Connector [Remote Mount]				Q															
Converter Power Options																			
Battery Power *(Standard)*					B														
Solar Power, Battery Backup					S														
A/C Power, Battery Backup					E														
DC Power, Battery Backup					F														
Converter Output Options																			
No Outputs *(Standard)*																			
No Outputs, DC cable only						0													
Two Digital Out						1													
4-20mA Analog only						2													
4-20mA Analog + Two Dig Out						3													
DC Power/ Analog Out Cable Options																			
No DC Power or Outputs *(Standard)*																			
No Cable - Output Configured (Quick Conn)							0												
6 ft (Open Leads)							1												
25 ft (Open Leads)							2												
50 ft (Open Leads)							3												

Ultra Mag 3000 Part Number Matrix (cont.)

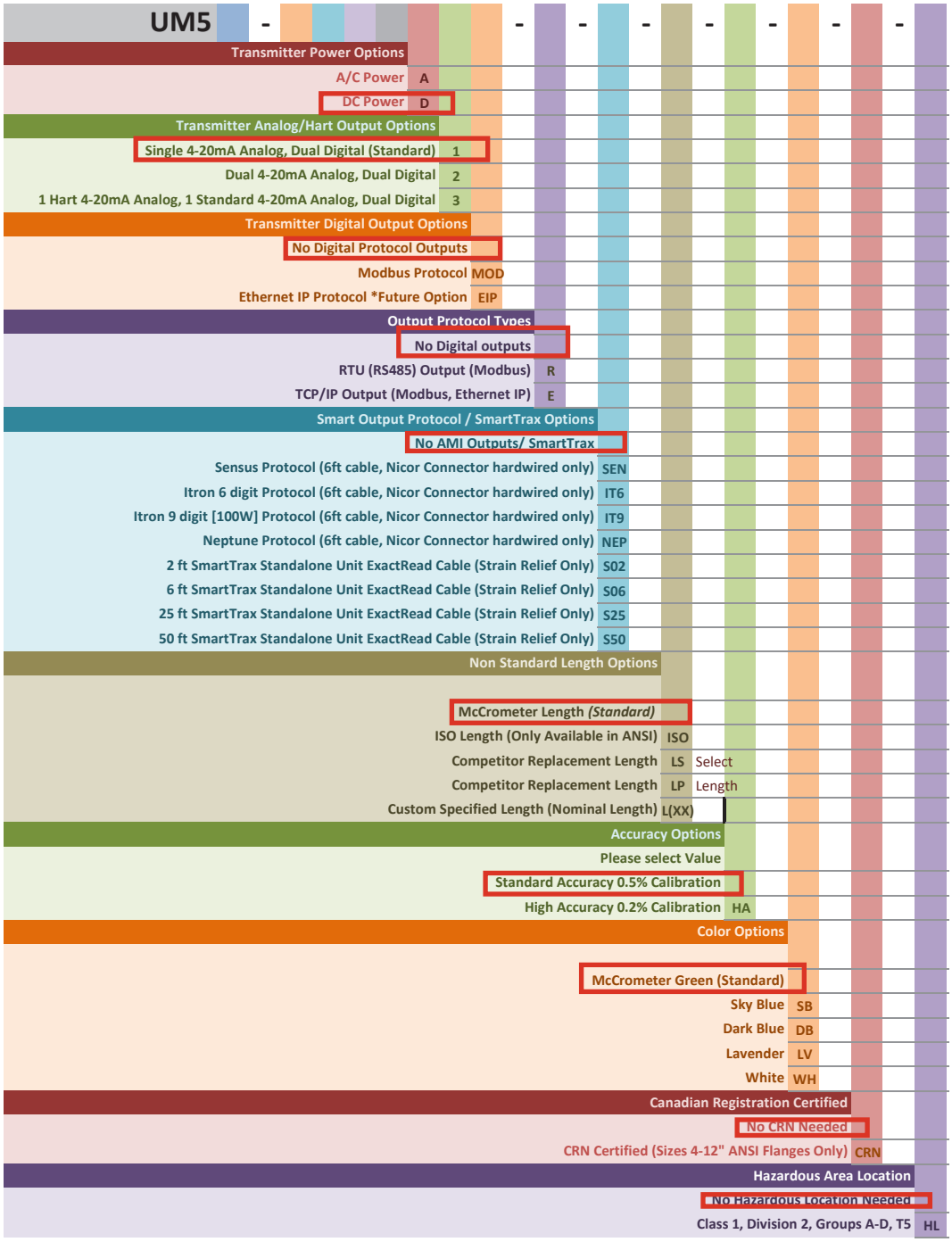
UM3	-							-		-		-		-		-		-	
Pulse Cable Length Options																			
No Outputs *(Standard)*																			
No Cable - Output Configured (Quick Conn)							0												
6 ft (Open Leads)							1												
25 ft (Open Leads)							2												
50 ft (Open Leads)							3												
Output Cable Terminal Options																			
Strain Relief								1											
Quick Connect Cable Terminals								**2**											
Smart Output Protocol / SmartTrax Options																			
No AMI Outputs/SmartTrax Options																			
Sensus Protocol (6ft cable, Nicor Connector hardwired only)									SEN										
Itron 6 digit Protocol (6ft cable, Nicor Connector hardwired only)									IT6										
Itron 9 digit [100W] Protocol (6ft cable, Nicor Connector hardwired only)									IT9										
Neptune Protocol (6ft cable, Nicor Connector hardwired only)									NEP										
2 ft SmartTrax Standalone Unit ExactRead Cable (Strain Relief Only)									S02										
6 ft SmartTrax Standalone Unit ExactRead Cable (Strain Relief Only)									S06										
25 ft SmartTrax Standalone Unit ExactRead Cable (Strain Relief Only)									S25										
50 ft SmartTrax Standalone Unit ExactRead Cable (Strain Relief Only)									S50										
Non Standard Length Options																			
McCrometer Length *(Standard)*																			
ISO Length (Only Available in ANSI)										ISO									
Competitor Replacement Length										LS	Select								
Competitor Replacement Length										LP	Length								
Custom Specified Length (Nominal Length)										L(XX)									
Color Options																			
McCrometer Green (Standard)																			
Sky Blue												SB							
Dark Blue												DB							
Lavender												LV							
White												WH							
No Batteries, Battery Tray Options																			
Includes Batteries (Standard)																			
No Batteries (Alkaline Tray)															NBA				
No Batteries (Lithium Tray)															NBL				
Canadian Registration Certified																			
No CRN Needed																			
CRN Certified (Sizes 4-12" ANSI Flanges Only)																	CRN		
Hazardous Area Location																			
No Hazardous Location Needed																			
Class 1, Division 2, Groups A-D, T5																			HL

Ultra Mag 5000 Part Number Matrix

UM5 -								-		-		-		-		-		-
Nominal Line Size																		
1.5"	0C																	
2"	02																	
2.5"	0D																	
3"	03																	
4"	04																	
6"	06																	
8"	08																	
10"	10																	
12"	12																	
14"	14																	
16"	16																	
18"	18																	
20"	20																	
24"	24																	
30"	30																	
36"	36																	
42"	42																	
48"	48																	
End Connection Options																		
AWWA Class D (150 psi Rating) *(Standard)*		1																
ANSI Class 150# (285 psi Rating)		2																
ANSI Class 300# (300 psi Rating)		3																
AWWA Class F (300 psi Rating)		4																
Wafer Style (2 & 3" Only)		N																
Electrode Material Options																		
S316 Stainless Steel *(Standard)*			S															
Hastelloy			H															
Transmitter Mounting and Cable Connector Options																		
Meter Mount Converter				M														
IP68 Strain Relief [Remote Mount] (Standard)				R														
'68 Quick Connect Potted Connector [Remote Mount]				Q														
Remote Cable Length Options																		
Meter Mount Converter [No remote Cable]					000													
25 feet (Standard)					025													
50 feet					050													
75 feet					075													
100 feet					100													
125 feet					125													
150 feet					150													
175 feet					175													
200 feet					200													
500 feet					500													

UM506-2SR025S1-AM (6")

Ultra Mag 5000 Part Number Matrix (cont.)



ProComm GO Specifications

Physical Specifications

Electronic Housing	Diecast aluminum, powder coated enclosure w/ tamper resistant seal, 6½" x 6½" x 43/8" tall
Transmitter Dimensions	See "Dimensions" section for meter mount and remote mount transmitter dimensions.
Power	**Battery:** Standard: three 3.6V lithium-thionyl chloride (Li-SOCI2) D size batteries with two AA backup batteries **AC Power:** 100-240VAC/45-66Hz (4W) **DC Power:** Linear power supply 10-35VDC (4 W)
Electrical Connections	• Optional shielded cable for 10-32VDC/4-20 mA output • Optional shielded cable for pulse out

Performance and Operational Specifications

Battery Life	Five-year expected battery life, five-year battery warranty
Location	Indoor or outdoor use
Altitude	Operating: 2000 meters Storage: 12,000 meters
Operating Temperature	-4° to 140° F (-20° to 60° C)
Storage Temperature	-4° to 140° F (-20° to 60° C)
Relative Humidity	0% to 100%
IP Rating	IP67 Die cast aluminum transmitter
Outputs	**Digital output:** Digital pulse (open collector) output for volumetric - Two isolated digital pulse (open collector) outputs for volumetric - AMI output **Analog output:** 4-20mA: Galvanically Isolated, 16 Bit resolution. All power configurations (including battery). Note: 9-30 VDC loop power required (not supplied via transmitter)

Display and Measurement

Display	• 2-Line LCD display (no backlight) • Non-volatile memory • Anti-reverse totalizer (standard) • Total (to 9 digits of precision)	• Flow rate and velocity (to 5 digits of precision) • Two alarms: low battery and empty pipe (optional) • Opening lid activates display
Digits	5 Rate, 9 Total	

Units

GPM	Gallons per minute	IGM	Imperial gal per minute	CFM	Cubic feet per minute
MGD	Mega gal per day	MI9	Miners inch (9G)	B5M	Barrels per minute (55G)
CFS	Cubic feet per second	MI1	Miners inch (11.22G)	B5H	Barrels per hour (55G)
MLD	Megaliters per day	APD	Acre feet per day	B5D	Barrels per day (55G)
LPS	Liters per second	KLH	Kiloliters per hour	B4M	Barrels per minute (42G)
CMH	Cubic meters per hour	LPH	Liters per hour	B4H	Barrels per hour (42G)
LPM	Liters per minute	CMM	Cubic meters per minute	B4D	Barrels per day (42G)
GPH	Gallons per hour	CFM	Cubic feet per minute		

ProComm GO Specifications (cont.)

Display and Measurement (cont.)

Totalizer Units

GAL	Gallons	B42	Barrel (42G)	MH1	Miners Inch Hour (11.22G)
CUF	Cubic Feet	B46	Barrel (46G)	MD1	Miners Inch Day (11.22G)
AFT	Acre Feet	B55	Barrel (55G)	MH9	Miners Inch Hour (9G)
CUM	Cubic Meters	IMG	Imperial Gallon	MD9	Miners Inch Day (9G)
LIT	Liters	AIN	Acre Inch	KGL	Kilo Gallons
MML	Megaliter	TON	Ton (Short)	MGL	Mega Gallons
MTT	Metric Ton (KL)	MM1	Miners Inch Minute (11.22G)	IN3	Cubic Inch
B31	Barrel (31G)	MM9	Miners Inch Minute (9G)		

Data Logger

Standard with all models, minimum of five years of data stored

Other Specifications

Options and Accessories

- Data Logger - included as standard with five years of data storage at default (12hr) interval. (Cable sold separately)
- AC, DC, and battery powered with battery backup powered available

Safety

- IEC 61010-1, Pollution Degree II
- Overvoltage protection Category III

Certifications

Standard Model

- ISO 9001:2015 certified quality management system
- CE
- Certified by MET to UL 61010-1

HL Model

- ISO 9001:2015 certified quality management system
- CE
- Certified by MET to UL 61010-1 and MET C22.2 No. 61010-1-04
  - Class I, Division 2, Groups A B C D, T4
  - Class I, Zone 2, IIC T4

Note: ProComm GO with SmartTrax On Board is not available for hazardous locations.

ProComm Max Specifications

Physical Specifications

Electronic Housing	Diecast aluminum, powder coated enclosure w/ tamper resistant seal
Transmitter Dimensions	Remote Mount: Height: 7.3" (18.5 cm) Width: 8.5" (21.6 cm) Depth: 4.3" (10.9 cm) Meter Mount: Height: 6.9" (17.5 cm) Width: 7.2" (18.25 cm) Depth: 6.2" (15.7 cm)
Power	AC Power: 100-240 VAC / 47-66 Hz (10 W) DC Power: 10-35 VDC (10 W) Note: AC or DC must be specified at time of ordering.
Connection Options	Conduit option: 1/2" NPT threaded connections
Galvanic Isolation	All outputs are galvanically isolated from power supply up to 500 V
Conductivity	Minimum conductivity of 5µS/cm

Performance and Operational Specifications

Location	Indoor or outdoor use
Operating and Storage Temperature	-4° to 140° F (-20° to 60° C)
IP Rating	IP67 Die cast aluminum transmitter
Standard Outputs	Single 4-20mA (standard). Galvanically isolated and fully programmable for zero and full scale. A second 4-20mA is available. Two separate digital programmable outputs: open collector transistor usable for pulse, frequency, or alarm settings. • Volumetric Pulse • Range Indication • Maximum switching voltage: 35 VDC • Maximum switching current: 100mA • Insulation from other secondary circuits: 500V
Optional Outputs	• Modbus • HART • Ethernet IP • Datalogger • Smart Output™ (Sensus, Itron 6, Itron 9)

Display and Measurement

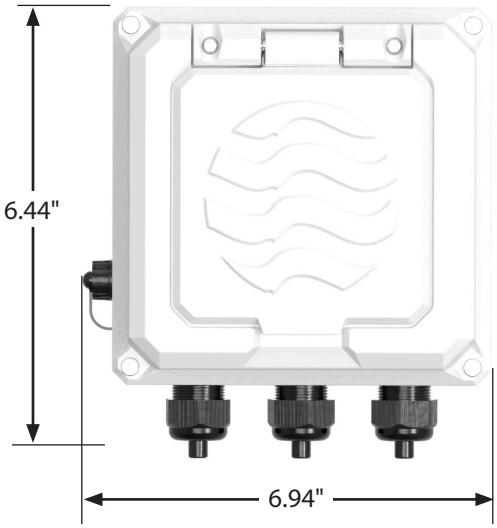
Keyboard and Display	Can be used to access and change set-up parameters using six membrane keys and an LCD display
Units	GAL Gallons; CUF Cubic Feet; AFT Acre Feet; CUM Cubic Meters; LIT Liters; MML Megaliter; MTT Metric Ton (KL); B31 Barrel (31G); B42 Barrel (42G); B46 Barrel (46G); B55 Barrel (55G); IMG Imperial Gallon; AIN Acre Inch; TON Ton (Short); MM1 Miners Inch Minute (11.22G); MM9 Miners Inch Minute (9G); MH1 Miners Inch Hour (11.22G); MD1 Miners Inch Day (11.22G); MH9 Miners Inch Hour (9G); MD9 Miners Inch Day (9G); KGL Kilo Gallons; MGL Mega Gallons; IN3 Cubic Inch

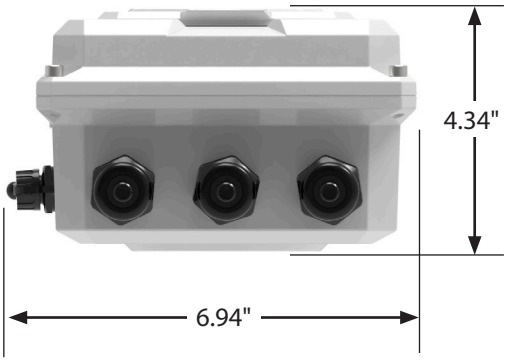
Other Specifications

• ISO 9001:2015 certified quality management system • CE	

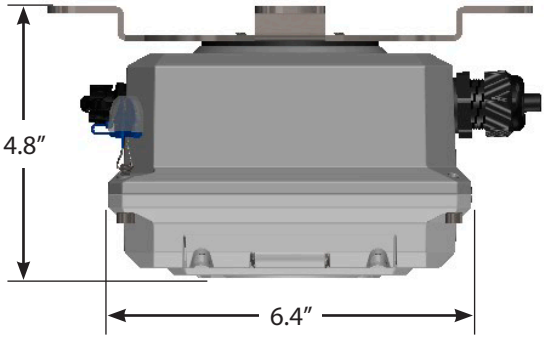
ProComm GO Transmitter Dimensions

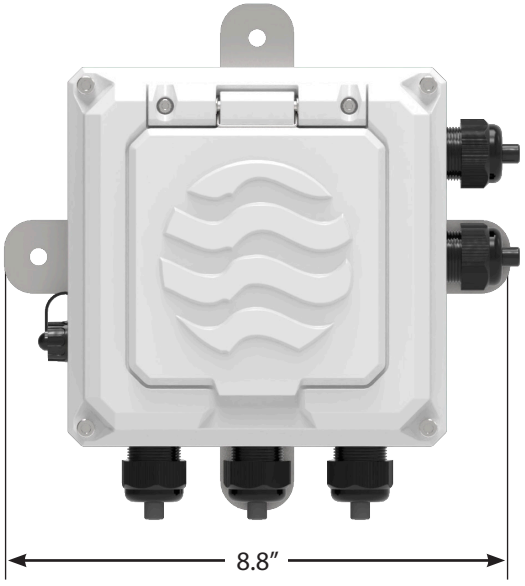
Meter mount converter

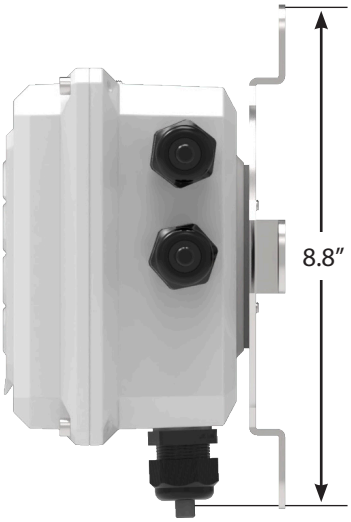




Remote mount converter

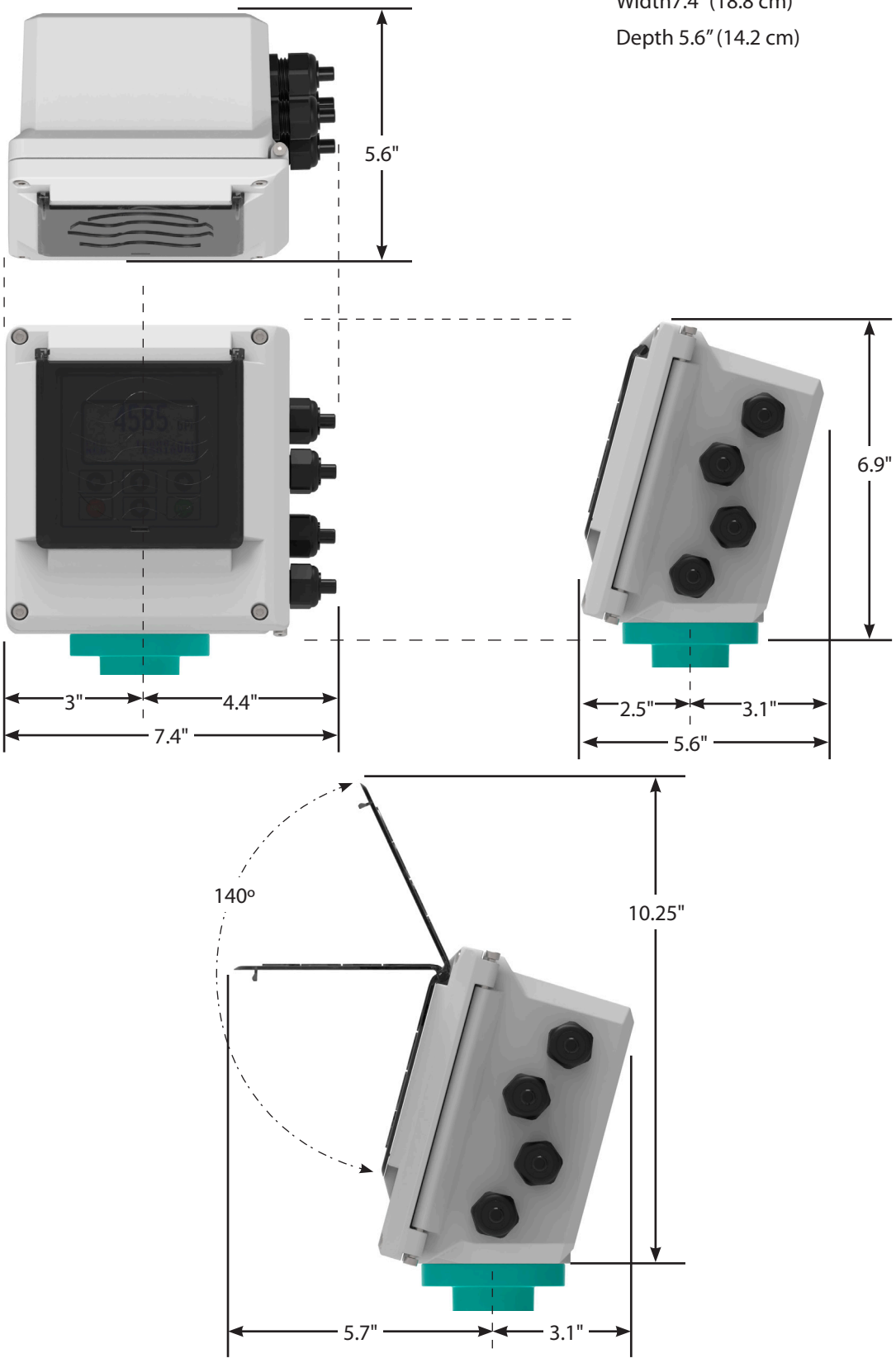






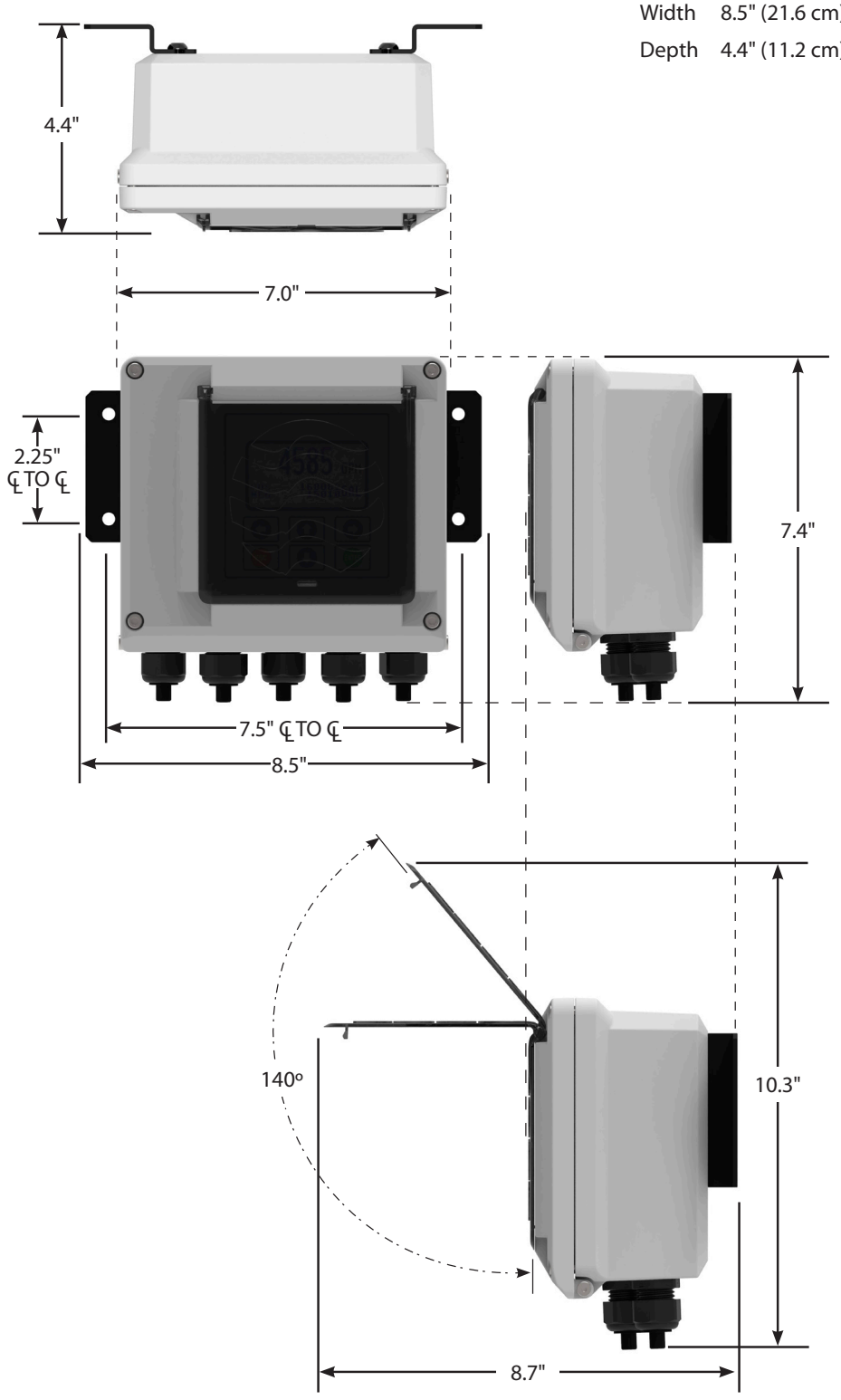
ProComm Max Transmitter Dimensions

Height 6.9" (17.6 cm)
Width7.4" (18.8 cm)
Depth 5.6" (14.2 cm)



ProComm Max Transmitter Dimensions (cont.)

Height 7.4" (18.9 cm)
Width 8.5" (21.6 cm)
Depth 4.4" (11.2 cm)





McCrometer, Inc.
3255 West Stetson Avenue
Hemet, CA 92545 USA
Tel: 951-652-6811
800-220-2279
Fax: 951-652-3078
customerservice@mccrometer.com
www.mccrometer.com

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EQUIPMENT TECHNICAL DATA SHEETS

CONDUCTIVITY PROBES & RELAY
DAF SLUDGE LEVEL

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Series DC
For Remote Applications

Series DC controls are designed for applications where only direct current power is available. DC units can be used as differential level controls or single point alarm contactors. Because of solid state reliability, plug-in convenience, and choice of 12 or 24 VDC supply voltage, Warrick DC controls can be used with confidence in many applications.

Contact Design	SPDT 1 N.O. & 1 N.C. (1 form C), non-powered contacts
Contact Rating	5 amp @ 30 VDC or 120 VAC Resistive 1/8 hp
Mode of Operation	Direct/Inverse, factory set
Sensitivity	0 - 1M ohm maximum, factory set
Primary Voltage	12 VDC, 24 VDC, negative ground (±20%)
Supply Current	40 mA when relay energized, 10 mA w/relay de-energized
Secondary Voltage	12 VDC
Terminal Style	Screw connector
Temperature	-50°F to +150°F (-46°C to +65°C)
Options	Time Delay

How to Order

Use the **Bold** characters from the chart below to construct a product code.

DC **X** **X** **X** **X** **XX** **XX**

Series
DC

Supply Voltage
1 – 12 VDC
2 – 24 VDC

Sensitivity
B – 22K
C – 100K
D – 470K
E – 1M

Mode of Operation
D – Direct
I – Inverse

Enclosure
0 – None
1 – NEMA 1
4 – NEMA 4

Time Delay (increasing level) **01-30** sec.

Time Delay (decreasing level) **01-30** sec.

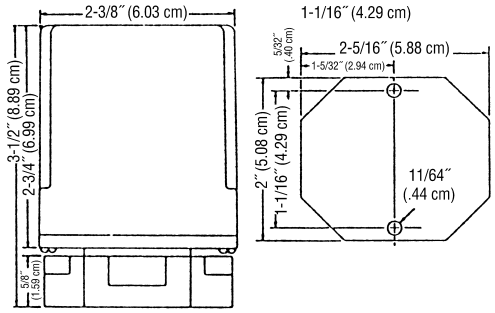


Series DC

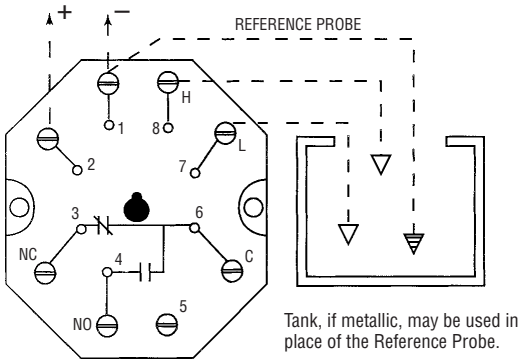
Applications

- Single and Differential Service
- Solar and Wind Powered Pumps
- Portable Cleaning Equipment
- Battery-Powered Level Control
- Well Pumps
- Remote Reservoirs
- Remote Irrigation
- Onboard Ship Level Control

Dimensions



Wiring



Tank, if metallic, may be used in place of the Reference Probe.

Warrick® Sensor Fittings and Probes

Warrick Liquid Level Sensors are available in single- and multi-probe models and with a variety of fittings. The versatility of the Warrick design makes these sensors ideal for a diverse range of applications.

Examples include:

- Food and Beverage
- Caustics and Acids
- Sumps
- Reservoirs
- Pharmaceuticals
- Boilers and Steam Generators
- Ponds
- Sewage and Wastewater

Probe Styles

- Metal Rods
- Wire Suspended
- Corrosion Resistant
- Sanitary



Fitting Styles

- 3/8˝ to 3˝ Threaded Mount
- Bracket Mount
- Flange Mount
- External Mount
- Sanitary Mount
- Condulet Mount



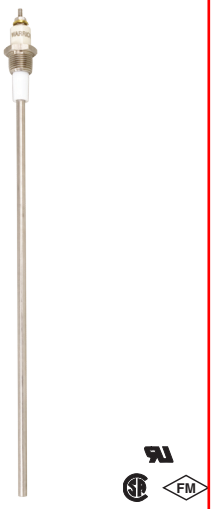
Sensor Selection Chart

SERIES		3E	3N	3F	3G	3C	3K	3J	3L	3M	3MT	3S	3R	3T	3B	3H	3W	3Y
Page Number		E-23	E-23	E-22	E-22	E-26	E-26	E-21	E-21	E-28	E-28	E-27	E-24	E-24	E-23	E-21	E-25	E-25
Body Options	Flange			•	•													
	Pipe Thread	•			•			•										
	Flat Mount		•		•													
	Side Chamber					•	•											
	Non-Contact Electrodes											•						
	Food Grade Connection									•	•							
	Bracket Mount											•						
Fitting Body Material Options	Brass	•	•	•		•		•										
	PVC		•	•	•													
	1018 Carbon Steel			•														
	Stainless Steel	•		•														
	Forged Steel			•														
	Nylon									•	•							
	Cast Iron	•				•	•	•				•						
Housing Material	Coated Aluminum	•	•	•		•	•	•				•						
	Polycarbonate				•													
Number of Probes	1 to 3		•					•										
	1 to 4					•	•			•	•							
	1 to 7	•		•	•							•						
Electrodes	Electrode Only								•				•	•	•	•	•	•

Designed for OEM

- Compact
- One-Piece Probe/Body Construction
- Quick Install & Connect
- Order Sized to Your Spec

These Warrick fitting are designed for OEM use. They are shipped ready for quick installation. Integrated probes eliminate pre-assembly tasks, and avoid potential vibration-induced loosening when installed with power tools. Choose from single- or multi-electrode probe series. Gems supplies these series with probes pre-cut to lengths you specify.

Series	3J	3H	3L
			
Probe Quantity	1, 2 or 3	1	1
Mounting Size	1" NPT	3/8" NPT or 5/8" NF/NFE	1/8" NPT
Materials			
Body	Case iron or red brass	316 stainless steel	316 stainless steel
Terminal Housing	Diecast aluminum, epoxy coated (optional)	—	—
Probe	316 stainless steel	316 stainless steel	316 stainless steel
Insulation	Teflon®	Teflon®	Teflon®
Probe Diameter	3/16"	1/4"	3/16"
Pressure/Temperature	0 psig @ 500°F	250 psig @ 406°F	150 psig @ 365°F
Approvals	—	U.L. File #MP2489, Vol. 1 Sec. 1; CSA; FM	U.L. File #MP2489
Use the **Bold** characters from the chart below to construct a product code.	**3J X X X X** Series **3J** Number of Probes **1** – One **2** – Two **3** – Three Body Material[1] **B** – Cast Iron **C** – Red Brass **D** – 316L SS Housing **0** – None **1** – Optional Housing Length of Probes[2] **A** – All probes 10-1/4˝ **C** – For lengths less than 10-1/4˝ indicate length as inches in decimal form	**3H X X X** Series **3H** Thread **1** – 3/8˝ - 18 NPT **2** – 5/8˝ - 18 UNF **3** – 5/8˝ - 24 UNEF Sleeve[1] **B** – Teflon® 3/4˝ Long Length (Feet)[2] **1** – One **2** – Two **3** – Three	**3L 1 X XX** Series **3L** Connection Size **1** – 1/8˝ NPT **2** – 2-1/4˝ NPT Insulator Length **D** – Teflon® 1-1/4˝ Length in Inches[1, 2] **02** – Two **03** – Three **04** – Four **05** – Five **06** – Six **07** – Seven **08** – Eight **09** – Nine **10** – Ten **11** – Eleven **12** – Twelve
Notes Custom options available. Consult factory.	1. Probes are stainless steel. 2. 10-1/4˝ maximum	1. Longer Teflon® sleeves are available. Contact factory or your representative 2. Custom probe and insulation lengths are available. Contact your representative.	1. 12˝ maximum 2. Indicate fractional inches in decimal form (01.75 = 1-3/4˝)

Form 159
Sheet P/N 7800447
Rev. C

Warrick® Direct Current Controls Series

Installation and Operation Bulletin

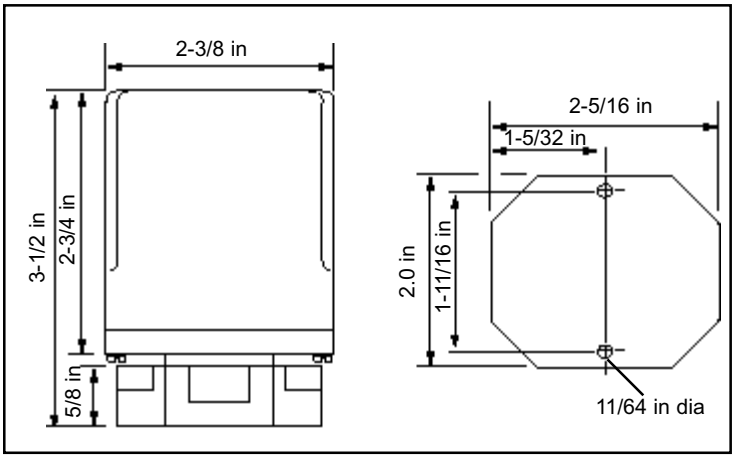
This bulletin should be used by experienced personnel as a guide to the installation of Series Direct Current Controls. Selection or installation of equipment should always be accompanied by competent technical assistance. We encourage you to contact Gems Sensors or its local representative if further information is required.

Installation

1. Remove the plug-in module from the octal base. When plug-module is removed, the pin number identification can be see on the octal base.
2. Mount the octal socket (base) on a rigid vertical or horizontal surface using two #6 or #8 screws. The controls should be mounted within an enclosure of proper NEMA integrity.
3. After the base has been mounted, refer to the applicable wiring diagram. Connect the electrodes to the designated terminals of the socket using #14-#18 AWG wire for interconnecting leads. Be sure that the control is wired in accordance with the appropriate application drawing.
4. Wire the appropriate load contact in series with the "Hot" lead of the load device. **Note**: Load current rating must not exceed the maximum rating of the relay contact.
5. In accordance with the proper wiring diagram, connect the negative side (-) of the power supply to terminal #1 of the octal socket and the positive side (+) of the supply to terminal #2 of the socket. Verify that the power supply output voltage correlates to the data label on the control. **Caution: Reversal of power supply leads from designated polarity may damage the internal solid-state circuitry of the control. Verify the correct polarity of the power supply connections before proceeding to step #6.**
6. Plug the DC level control into the octal socket. Numbers at the base of the pins match the numbers on the installed base. The control is keyed for proper installation; the unit will not plug in if the pins are not properly aligned.

Warrick Controls recommends that you inspect and clean the electrode rods annually.

Dimensional Diagram



Use copper (60/70° C) wire only. Torque to 20 inch pounds.

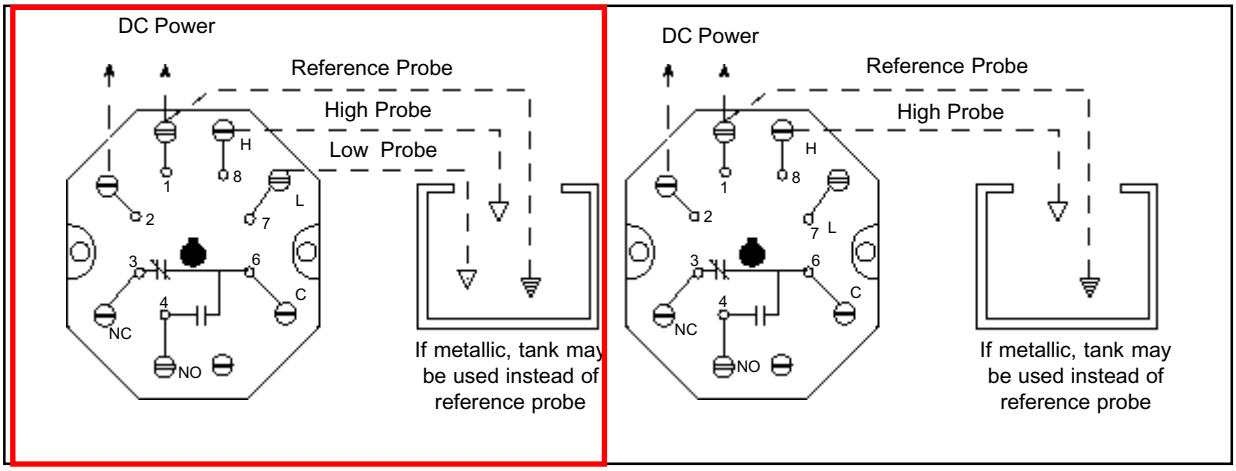
DC XXXX XX XX

- Time Delay: (decreasing level 1-30 sec)
- Time Delay: (increasing level 1-30 sec)
- Enclosure: **0**- none, **1**- NEMA 1, **4**- NEMA 4
- Mode: **D**- direct, **I**- inverse
- Sensitivity (ohms): **B**- 22K, **C**- 100K, **D**- 470K, **E**- 1M
- Supply Voltage: **1**- 12 VDC, **2**- 24 VDC

Specifications

Contact Design:	SPDT (1 form C) 1 Normally Open (N.O.) and 1 Normally Closed (N.C.)
Contact Ratings:	5A @ 30 VDC or 120 VAC, 4A @ 240 VAC resistive, 1/8th Hp 120 VAC, 240 VAC pilot duty code C150
Contact Life:	Mechanical - 20 million operations. Electrical - 100,000 operations minimum @ rated load
Electronics Module:	Solid-state components epoxy sealed in a black polystyrene plug-in style housing
Supply Voltage	12 or 24 VDC - Negative ground, ±20%
Supply Current:	12 VDC Model - Relay de-energized 10mA, Relay energized 40mA
Sensitivity Range:	0-1M maximum specific resistance, ohm factory set
Temperature Range:	-50° to +150° F

Wiring Diagram



Differential Level Wiring

Connect negative side (-) of VDC supply line to terminal #1 and positive (+) side to terminal #2. **Note**: Check polarity of power connections. Connect terminal #8 (H) to the high electrode and terminal #7 (L) to the low electrode. Terminal #1 can be grounded to tank if the tank is metallic. When the tank is not metallic, terminal #1 must be connected to an additional electrode of length equal to or longer than the longest probe.

Operation

Direct Mode: The control energizes closing load contact 4-6 and opening load contact 3-6 when the level rises to the short electrode connected to terminal #8. The control remains energized until the level recedes below the long electrode connected to terminal #7.

Inverse Mode: The control de-energizes opening load contact 4-6 and closing load contact 3-6 when the level rises to the short electrode connected to terminal #8. The control remains de-energized until the level recedes below the long electrode connected to terminal #7.

Note: For single level service controls utilizing both increasing and decreasing time delays, a jumper wire is required between terminals #7 and 8.

Single Level Wiring

Connect negative side (-) of VDC supply line to terminal #1 and positive side (+) to terminal #2. **Note:** Check polarity of power connections. Connect terminal #8 (H) to the electrode. Terminal #1 can be grounded to tank if the tank is metallic. When the tank is not metallic, terminal #1 must be connected to an additional electrode of length equal to or longer than the longest probe.

Operation

Direct Mode: The control energizes closing load contact 4-6 and opening contact 3-6 when the level rises to the electrode connected to terminal #8. The control de-energizes and the contacts return to their de-energized state when the level recedes below the electrode connected to terminal #8.

Inverse Mode: The control de-energizes opening load contacts 4-6 and closing load contact 3-6 when the level rises to the electrode connected to terminal #8. The control energizes and the contacts return to the energized state when the level recedes below the electrode connected to terminal #8.

Gems Sensors Inc.
One Cowles Road
Plainville, CT 06062-1198
Tel: 860-793-4579
Fax: 860-793-4580

EQUIPMENT TECHNICAL DATA SHEETS

DAF LEVEL TRANSMITTER

DAF LEVEL TRANSMITTER:
Tek-Trol Tek-Bar 3110A Series Differential Pressure Transmitter
Tek-Bar 3110A-D-4-FM-1-SS-1-LCD-FC-CPC (D-4)
Range Option: 1.5 to 150 in H2O MWP 2000psi/13.79Mpa (D-4)
Approvals : FM Approval (Class I Div I) (FM)
Process Connection : 1/4" NPT Female/Stainless Steel/316 LSST (1-SS)
Electrical Connection : 1/2" NPT Female (1)
Options : 5 Digit LCD (Local Indication Only) (LCD)
Options : Factory Configuration, No Certificate (FC)
Flush Flanged Seal Upper Insert: Welded (8mm); 316SS Process Conn: 3.0"-150# ANSI (CPC)
Configuration: Rotatable Flange (FC)
Flg Material: 316SS Diaphragm & Wetted Parts: 316SS; MWP: 275 PSI; No Gasket
Attachment: DP/GP Dual Side Xmtr - Close Coupled Fill: Silicone 200-10,
Attached to: High Side of DP Unit, Inst. Conn.: Direct Connection
Instrument to seal Seal Conn.: Direct Connection - Instrument to seal

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

TEKTROL
Technology Solutions

TEK-BAR 3110A

Explosion-Proof Differential Pressure Transmitter

PRESSURE



www.tek-trol.com

Flow | Level | Temperature | Pressure | Valves | Analyzers | Accessories | TekValSys

Introduction

The Tek-Bar 3110A Explosion-Proof Differential Pressure Transmitter have excellent stability, high accuracy, and include features that facilitate easy installation, start up, and minimum maintenance thereby lowering process downtime and overall cost of ownership in the long run. These transmitters are equipped with an automatic temperature compensation function integrated into its advanced signal processing circuitry to ensure high reliability and performance corresponding to change of ambient temperature.

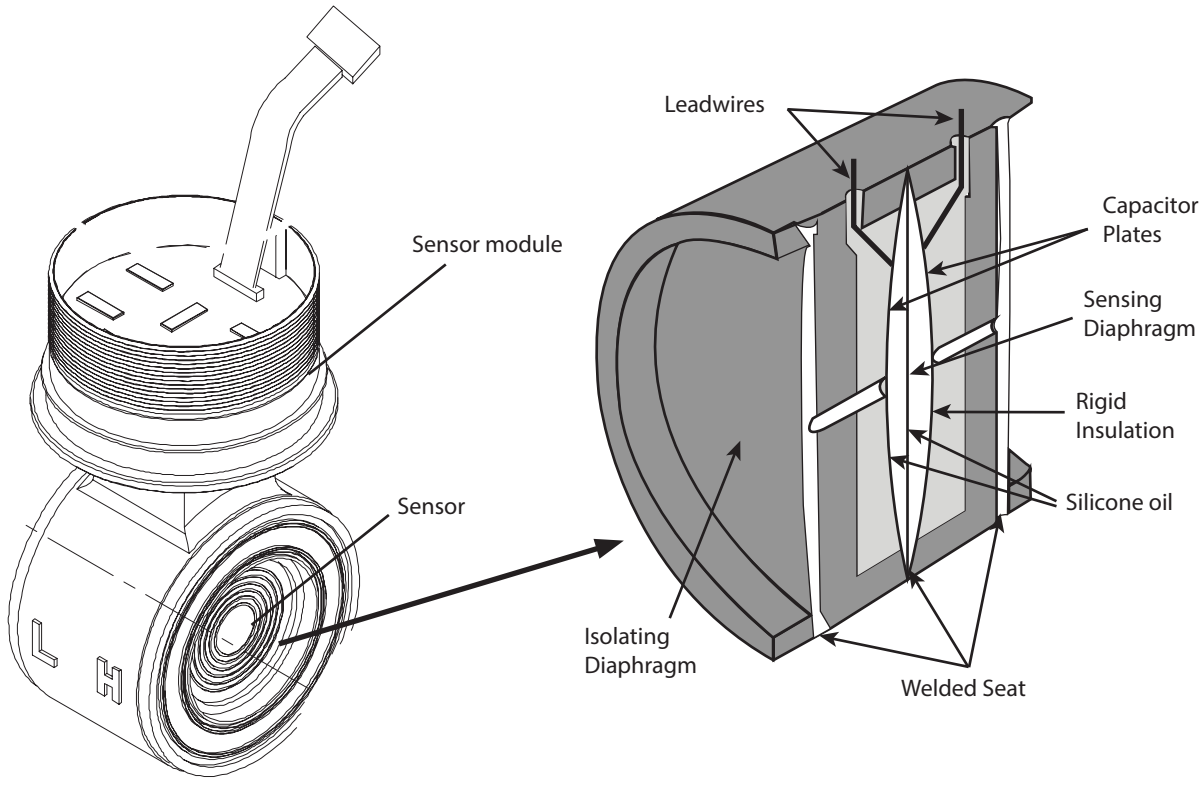
Measuring Principle

The Tek-Bar 3110A Explosion-Proof Differential Pressure Transmitter uses Capacitance pressure sensors. It consists of two metal plates that are separated by sensing diaphragm. An electrically insulating fill fluid (silicon oil), transfers the movement from isolating diaphragm to the sensing diaphragm. The capacitance characteristics of the sensing element changes. These signal transfer to the electronic circuitry of transmitter that converts the change in capacitance to the output signal. Capacitance transmitters are configured for differential pressure measurement. Usual outputs are voltage or current.

Capacitance can be calculated using the formula:

$$C = \varepsilon(A)/(d)$$

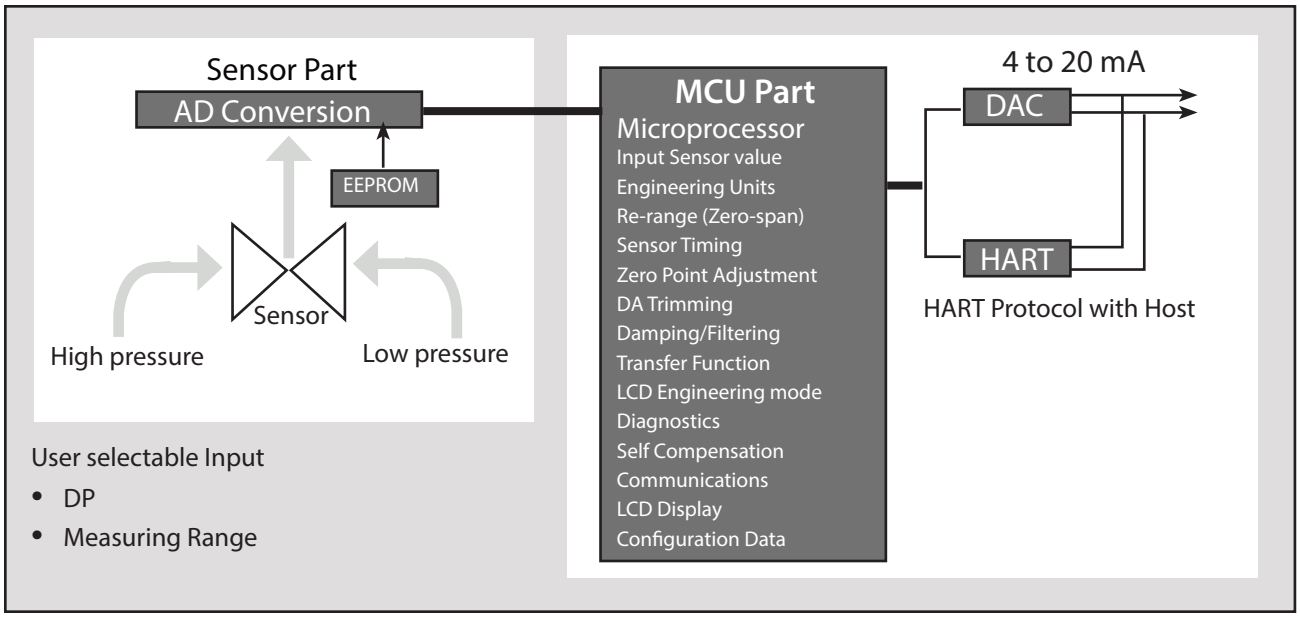
Where,
C- Capacitance,
ε-Dielectric Constant
A-Area of plate
d-Distance between capacitor plates



Operation

Electronic Module:

The Electronics module consists of a circuit board sealed in an enclosure. It consists of a MCU module, a power module, an analog module, a LCD module and a terminal module. The MCU module acquires the digital value from the analog module and applies correction coefficients selected from EEPROM. The output section of the power module converts the digital signal to a 4 to 20 mA output. The MCU module communicates with the HART based Configurator. The Power module have a DC-to-DC power conversion circuit and an Input/output isolation circuit. An optional LCD module plugs into the MCU module and displays the digital output in the user-configured unit.



Sensor Input:

The model Tek-Bar 3110A Explosion-Proof Differential Pressure Transmitter uses capacitance type pressure sensor. The transmitter is used in level and flow applications.

The sensor module converts the capacitance or the resistance to the digital value. The MCU module calculates the process pressure based on the digital value.

The sensor modules include the following features:

- The software of the transmitter compensates for the thermal effects, improving performance
- Precise Input Compensation during operation is achieved with temperature and pressure correction coefficients that are characterized over the range the transmitter and stored in the sensor module EEPROM memory
- EEPROM stores sensor information and correction coefficients separately from MCU module, allowing for easy repair, reconfiguration and replacement

Features/Benefits

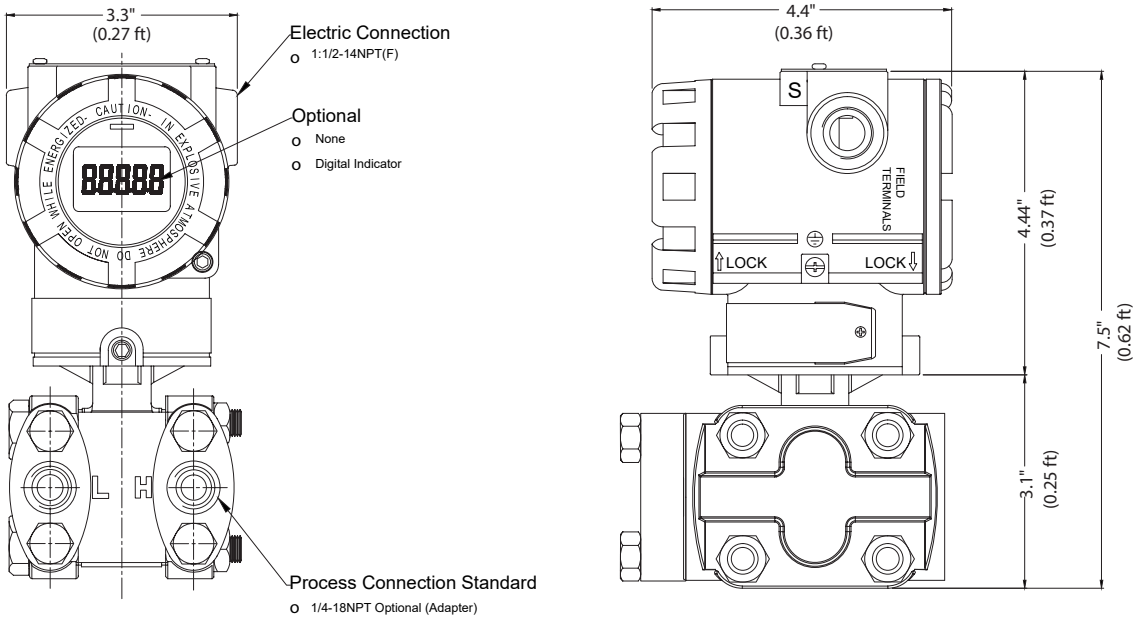
- Operator can calibrate device using zero/span button, no handheld calibrator required. Optionally handheld device communicator can be used to calibrate devices
- Digital communication HART protocol, latest version
- Fail-safe mode process function for detecting any abnormal condition occurring
- Standard accuracy ±0.075%, High enhanced Accuracy ±0.04% available.
- Automatic ambient temperature compensation improve performance of device
- It can be used as flow meter and should be installed vertically without using additional flanges
- Various Output: 4-20 mA, digital signals
- The mounting bracket can be rotated up to 360° and LCD display up to 270°
- EEPROM write protection

Applications

- It can be used as a flowmeter; it can check flow rate and total flow
- Level monitoring
- Used to measure liquid, gas, and steam flow

Dimensional Drawing

Standard Model



Specifications

Technical Specification

Parameter	Description
Accuracy	0.075% of Span standard, High enhanced accuracy ±0.04% of span available in conformance to ±3 Sigma
Turndown	100:1
Stability	5 years standard, Optional 3 year ±0.10% of URL available
Maximum Working Pressure	2000 psi std, High Pressure 4500 psig available
Hydrostatic Test Pressure	1.5 times MWP
Burst Pressure	10000 psig (68.9MPa)
Process Temperature Limits	-40 °F to +248 °F
Ambient Temperature Effect	±[0.019%URL+0.125% Span] / 82.4 °F
Ambient Temperature	-40 °F to +185 °F
Humidity Limits	5% to 100% RH
Power Supply Effects	±0.005% of Span per Volt
Mounting Position Effects	Zero Shift up to 350Pa No Span Effect
Display (Optional)	5 digit LCD display
Failure Mode	Fail High: Current ≥21.1 mA
	Fail Low: Current ≤3.78 mA
Damping Time	0.25 to 60 sec
Volumetric Displacement	<0.005 cu in
Vibration Effect	±0.1% of URL per IEC60770-1 site conditions
EMC Immunity	EN50081-2,EN50082-2,IEC801-3

Electrical Specification

Parameter	Description
Power Supply	12 to 45 VDC
HART loop resistance	250 to 550 ohm
Output Signal	4 mA to 20 mA or HART®
Isolation	500 Vrms (707 VDC)

Physical Specifications

Parameter	Description
Isolating Diaphragm	316LSST
Drain and Vent Valve	316SST
Flange and Adapter	316SST
O-ring	Viton, PTFE
Fill Fluid	Silicone oil or Inert fill
Paint	Epoxy-Polyester or Polyuret
Mounting Bracket	304SST with U-bolt (304SST) for 2-inch pipe
Nameplate	304SST
Electronic Housing	Aluminum (Option:316LSST)
Bolts and Bolting Flange	304SST
Process Connection Size	¼" NPT Female
Electrical Connections	½" NPT Female
Weight (excluding Option Items)	8.589 lb (Standard)
	11.882 lb (SST Housing)
2" Pipe Stanchion Type bracket	Angle or Flat type
Approvals	FM (Class I Div I)

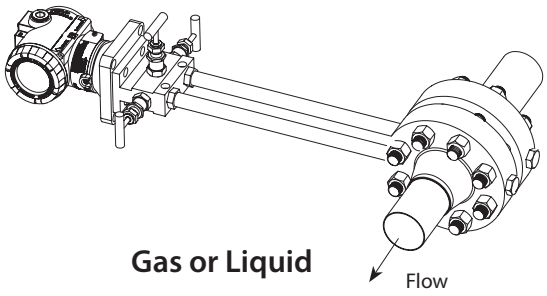
Measuring Range Limit For Tek-Bar 3110A

Range Code	Calibrated Span (Min. to Max.)		Lower Range Limit		Upper Range Limit	
3	0.6 to 30 in w.c	0.15 to 7.5 kPa	-30 in w.c.	-7.5 kPa	30 in w.c.	7.5 kPa
4	1.5 to 150 in w.c	0.373 to 37.3 kPa	-150 in w.c.	-37.3 kPa	150 in w.c.	37.3 kPa
5	7.5 to 750 in w.c	1.865 to 186.5 kPa	-750 in w.c.	-186.5 kPa	750 in w.c.	186.5 kPa
6	1 to 100 psi	6.9 to 690 kPa	-100 psi	-690 kPa	100 psi	690 kPa
7	3 to 300 psi	20.68 to 2068 kPa	-300 psi	-2068 kPa	300 psi	2068 kPa

Installation

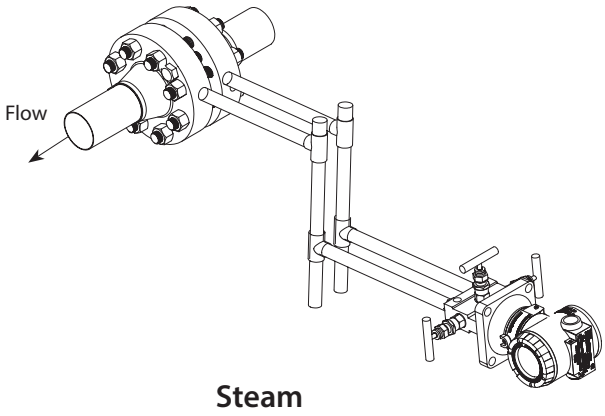
Liquid Flow Measurement

- Place taps to the side of the line to prevent sediment deposits on the transmitters process isolators
- Mount the transmitter beside or below the taps so gases can vent into the process line
- Mount drain/vent valve upward to allow gases to vent



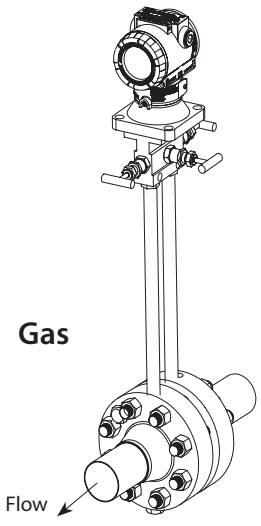
Steam Flow Measurement

- Place taps to the side of the line
- Mount the transmitter below the taps to ensure that the impulse piping will stay filled with condensate
- In steam service above 250 °F (121 °C), fill impulse lines with water to prevent the steam from contacting the transmitter directly and to ensure accurate measurement at start-up



Gas Flow Measurement

- Place taps in the top or side of the line
- Mount the transmitter beside or above the taps so liquid will drain into the process line



Note: For steam or other elevated temperature services, it is important that temperatures at the process connection do not exceed the transmitters process temperature limits.

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Model Chart

Example	Tek-Bar 3110A	D	3	FM	1	1	LCD	Tek-Bar 3110A-D-3-FM-1-1-LCD
Series	Tek-Bar 3110A	G						Explosion-Proof Differential Pressure Transmitter Gauge Pressure
Range Options			D-2					0.30 to 6 in H2O MWP 2000psi/13.79 Mpa
			D-3					0.6 to 30 in H2O MWP 2000psi/13.79 Mpa
			D-4					1.5 to 150 in H2O MWP 2000psi/13.79 Mpa
			D-5					7.5 to 750 in H2O MWP 2000psi/ 13.79 Mpa
			D-6					1 to 100 psi MWP 2000psi/ 13.79 Mpa
			D-7					3 to 300 psi MWP 2000psi/ 13.79 Mpa
			D-8					10 to 1000 psi MWP 2000psi/ 13.79 Mpa
			A-4					0.30 to 36
			A-5					1.5 to 217 psiA
			A-6					3 to 360 psiA
			G-2					0 to 6 H2O
			G-3					0.6 to 30 H2O
			G-4					1.5 to 150
			G-5					7.5 to 750 in H2O
			G-6					1 to 100 psi
			G-7					3 to 300 psi
			G-8					10 to 1000 psi
			G-9					30 to 3000 psi
			G-0					60 to 6000 psi
			H-4					1.5 to 150 H2O MWP 4500psi/31Mpa
			H-5					7.5 to 750 H2O MWP 4500psi/31Mpa
			H-6					1 to 100 psi MWP 4500psi/31Mpa
			H-7					3 to 300 psi MWP 4500psi/31Mpa
			X					Special
Approval Rating				FM				FM Approval (Class I Div I)
				ATEX IEC				ATEX Flameproof or ATEX Instrinsic Safe Approval Exd IIC T4....TP6
Process Connection					1-SS			¼" NPT Female/Stainless Steel/316 LSST
					1- SH			¼" NPT Female/Stainless Steel/HAST-C
					1- ST			¼" NPT Female/Stainless Steel/Tantalum
					1- SM			¼" NPT Female/Stainless Steel/Monel
					1- HH			¼" NPT Female/HAST-C/HAST-C
					X			Diaphragm Seal
Electrical Connection						1		½" NPT Female
						2		M-20 with ATEX Only
Options							LCD	5 Digit LCD (Local Indication Only)
							BA	Stainless Steel Bracket (Angle type) with SST Bolt
							BF	Stainless Steel Bracket (Flat type) with SST Bolt
							3WF	3-Way Manifold Valve
							5WF	5-Way Manifold Valve
							O	½"-14 NPTF, Oval Flange Process Connection Adapter (Includes 2 O-Rings, an adapter, and 2 bolts)
							B	Blind Unit
							SIL	SIL-2
							MR	Marine Approval ABS
							MP	Multi Planar/Bottom entry/Vertical
							LP	Lightning Protector Internal

							T	Teflon O Rings Replaces Standard Viton
							CC	Custom Calibration with 5 point Calibration Certicate
							FC	Factory Conguration, No Certicate
							TAG	Stainless Steel Hang Tag
							LV	12 VDC Low Voltage, 4-wire, 1-5 VDC output, No HART
							EA	0.04%
							O2	O2 Cleaning
							MTC	Material Test Certicate 2.1
							IP68	Submersible Rated (Electrical Conduit Seals)
							WX	Extended Warranty
							SSH	316 Stainless Steel Housing
							FT	Includes Flow Totaizer W/LF Pulse Output
							WH	Wirless HART W/Adaptor
							HT	Hydro Test
							MTR	Material Test Report 3.1
							PMI	Positive Material Identication
							CPC	Custom Product Code/Diaphram Seal

Popular Models

Model Number	Description
3110A-D-3-FM-1-1-LCD	Explosion-proof DP Pressure Transmitter, 0-30" w.c., LCD
3110A-D-4-FM-1-1-LCD	Explosion-proof DP Pressure Transmitter, 0-150" w.c., LCD
3110A-D-5-FM-1-1-LCD	Explosion-proof DP Pressure Transmitter, 0-750" w.c., LCD
3110A-D-6-FM-1-1-LCD	Explosion-proof DP Pressure Transmitter, 0-100 psid, LCD
3110A-D-7-FM-1-1-LCD	Explosion-proof DP Pressure Transmitter, 0-300 psid, LCD

Customer Service & Support



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DOC # TEK/TPS/CAT/240606/3110A/r00.6
TEK-TROL LLC

www.tek-trol.com

Tek-Trol LLC

796 Tek Drive Crystal Lake,

IL 60014, USA

+1 847-857-6076 | tektrol@tek-trol.com | www.tek-trol.com

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PRESSURE

Explosion-Proof Differential Pressure Transmitter

Tek-Bar 3110A



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1 FEATURES

- Operator can calibrate device using zero/span button, no handheld calibrator required
- High accuracy up to ±0.075%
- Various Output: 4-20 mA, digital signals
- EEPROM write protection
- Fail-safe mode process function for detecting any abnormal condition occurring
- The mounting bracket can be rotated up to 360 ° and LCD display up to 270 °
- Automatic ambient temperature compensation improve performance of device

3 APPLICATIONS

- Distilleries
- Water and waste water industries
- Oil and Gas
- Pharmaceutical
- Dairy industries

CONTACT US

796 Tek Drive, Crystal Lake,
IL 60014 USA

+1 847 857 6076

Email: tektrol@tek-trol.com

www.tek-trol.com

2 SPECIFICATION

Accuracy	±0.075% of span
Rangeability	100:1 turn down
Maximum working pressure limit	2000 PSI
Process temperature limits	-40 °F to +248 °F
Stability	3 year ±0.10% of URL
Ambient temperature effect	±[0.019%URL+0.125% Span] / 82.4 °F
Ambient temperature	-40 °F to +185 °F
Humidity limits	5% to 100% RH
Power supply effects	±0.005% of Span per Volt
Mounting position effects	Zero Shift up to 350Pa no span effect
Display (optional)	5 digit LCD display
Damping time	0.25 to 60 sec
Failure mode	Fail High: Current ≥21.1 mA Fail Low: Current ≤3.78 mA
Power supply	12 to 45 VDC
Weight (excluding option items)	8.589 lb (Standard), 11.882 lb (SST Housing)
Output signal	4 mA to 20 mA or HART®
Isolation	500 Vrms (707 VDC)
HART loop resistance	250 to 550 ohm
Process connection size	¼" NPT female
Electrical connections	½" NPT female
2" Pipe stanchion type bracket	Angle or flat type
Approvals	FM (Class I Div I)
Bolts and bolting flange	304SST
Electronic housing	Aluminum (Option:316LSST)
Mounting bracket	304SST with U-bolt (304SST) for 2" pipe
Paint	Epoxy-Polyester or Polyuret
Fill fluid	Silicone oil or inert fill
O-ring	Viton, PTFE
Isolating diaphragm	316SST

TEKTROL

Technology Solutions

TEK-BAR 3110A

Explosion-Proof Differential Pressure Transmitter

Instruction Manual

Document Number: IM-3110A



www.tek-trol.com

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NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

For technical assistance, contact
Customer Support
796 Tek-Drive
Crystal Lake, IL 60014
USA
Tel: +1 847 857 6076

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1 Safety Instructions

1.1 Intended Use

Tek-Bar 3110A is a Pressure Transmitter used for measuring differential pressure.
The manufacturer is not liable for damage caused by improper or non-designated use.

1.2 Certification

Tek-Bar 3110A has FM approval (Class I Div. I)

1.3 Safety Instructions from the manufacturer

1.3.1 Disclaimer

The manufacturer will not be held accountable for any damage that happens by using its product, including, but not limited to direct, indirect, or incidental and consequential damages.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.
The manufacturer has the right to modify the content of this document, including the disclaimer, at any time for any reason without prior notice, and will not be answerable in any way for the possible consequence of such changes.

1.3.2 Product Liability and Warranty

The operator shall bear authority for the suitability of the device for the specific application. The manufacturer accepts no liability for the consequences of misuse by the operator. Wrong installation or operation of the devices (systems) will cause the warranty to be void. The respective Terms and Conditions of Sale, which forms the basis for the sales contract shall also apply.

1.3.3 Information Concerning the Documentation

To prevent any injury to the operator and damage to the device it is essential to read the information in this document and read the applicable national standard, and safety instruction. These operating instructions contain all the information that is required in various stages, like product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

1.4 Safety Precautions

You must read these instructions carefully prior to installing and commissioning the device. These instructions are an important part of the product and must be kept for future reference. Only by observing these instructions, optimum protection of both personnel and the environment, as well as safe and fault-free operation of the device can be ensured.

For additional information that are not discussed in this manual, contact the manufacturer

Warnings and Symbols Used
The following safety symbol marks are used in this operation manual and on the instrument.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE

Indicates that operating the hardware or software in this manner may damage it or lead to system failure.

1.5 Packaging, Transportation, and Storage

This section contains information regarding packaging, transportation, and storage.

1.5.1 Packaging

The original package consists of

1. Tek-Bar 3110A Explosion-Proof Differential Pressure Transmitter
2. Accessories (optional)
3. Documentation



NOTE

Unpack and check the contents for damages or signs of rough handling. Report damage to the manufacturer immediately. Check the contents against the packing list provided.

1.5.2 Transportation

- Avoid impact shocks to the device and prevent it from getting wet during transportation.
- Verify local safety regulations, directives, and company procedures with respect to hoisting, rigging, and transportation of heavy equipment.
- Transport the product to the installation site using the original manufacturer's packing whenever possible.

1.5.3 Storage

If this product is to be stored for a long period of time before installation, take the following precautions:

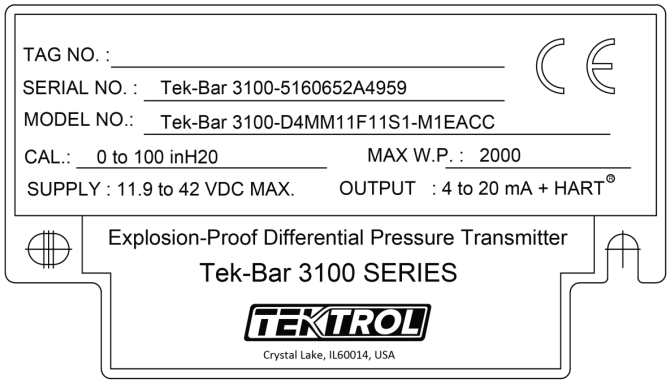
- Store your product in the manufacturer's original packing used for shipping.
- Storage location should conform to the following requirements:
  - Free from rain and water
  - Free from vibration and impact shock
  - At room temperature with minimal temperature and humidity variation
- Before storing a used flowmeter remove any fluid from the flowmeter line completely. Properties of the instrument can change when stored outdoors.

1.6 Nameplate

The nameplate lists the order number and other important information, such as design details and technical data.

NOTE

Check the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.



2 Product Description

This section covers the reference and specification data, as well as ordering information.

2.1 Introduction

The Tek-Bar 3110A Explosion-Proof Differential Pressure Transmitters have excellent stability, high accuracy, and include features that facilitate easy installation, start up, and minimum Maintenance thereby lowering process downtime and overall cost of ownership in the long run. These transmitters are equipped with an automatic temperature compensation function integrated into its advanced signal processing circuitry to ensure high reliability and performance corresponding to change of ambient temperature.

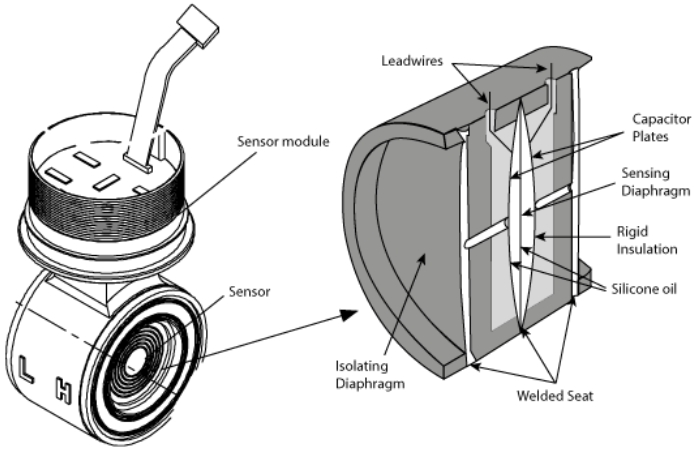
2.2 Measuring Principle

The Tek-Bar 3110A Explosion-Proof Differential Pressure Transmitter uses capacitance pressure sensors. It consists of two metal plates that are separated by a sensing diaphragm. An electrically insulating fill fluid (silicon oil) transfers the movement from the isolating

diaphragm to the sensing diaphragm. The capacitance characteristics of the sensing element changes. These signals transfer to the electronic circuitry of transmitter that converts the change in capacitance to the output signal. Usual outputs are voltage or current.
Capacitance can be calculated using the formula:

$$C = \varepsilon \frac{A}{d}$$

Where,
C-Capacitance
ε-Dielectric Constant
A-Area of Plate
d-Distance between Capacitor Plates



2.3 Specifications

2.3.1 General Specifications

Parameter	Description
Accuracy	± 0.075% of Span
Turndown	100:1
Stability	5 Years
Process Temperature Limits	-40°F to 248°F (-40°C to 120°F)
Ambient Temperature Effect	± [0.019%URL+0.125% Span] / 82.4ºF
Ambient Temperature	-40°F to 185°F (-40°C to 85°C)
Humidity Limits	5% to 100% RH
Damping Time	0.25 to 60sec
Power Supply Effects	±0.005% of Span per Volt
Mounting Position Effects	Zero Shift up to 350Pa No Span Effect
Display(optional)	5 Digit LCD Display
Failure Mode	Fail High: Current ≥ 21.1mA
	Fail Low: Current ≤ 3.78mA

2.3.2 Electrical Specifications

Parameter	Description
Power Supply	12 to 45VDC
HART Loop Resistance	250 to 550 ohms
Output Signal	4mA to 20mA or HART®
Isolation	500 Vrms (707VDC)

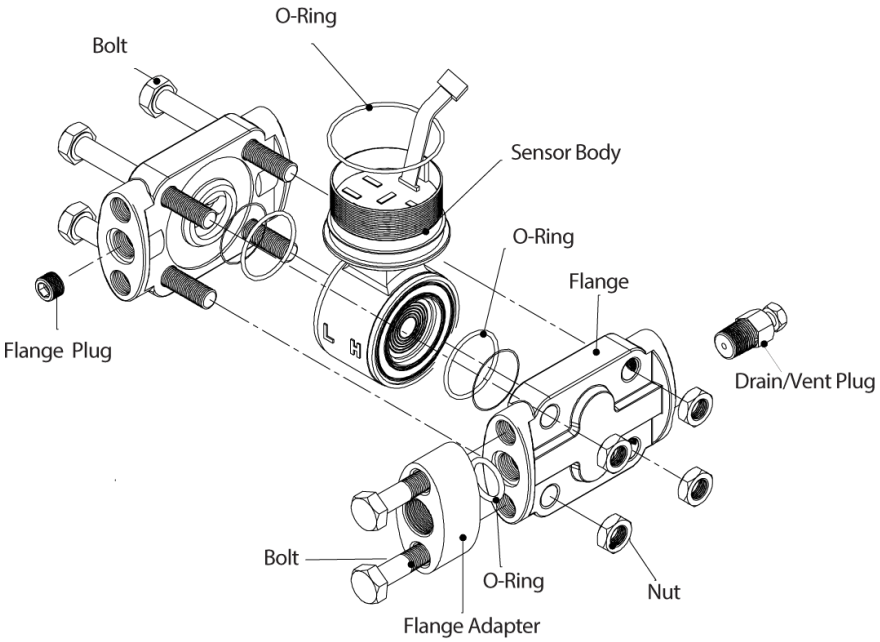
2.3.3 Physical Specifications

Parameter	Description
Isolating Diaphragm	316L SST
Drain & Vent Valve	316 SST
Flange & Adapter	316 SST
O-ring	Viton, PTFE
Fill Fluid	Silicone Oil or Inert Fill
Paint	Epoxy-Polyester or Polyuret
Mounting Bracket	304 SST with U-bolt (304SST) for 2-inch Pipe
Nameplate	304 SST
Electronic Housing	Aluminum (option:316L SST)
Bolts & Bolting Flange	304 SST
Process Connection Size	¼" NPT Female
Electrical Connections	½"NPT Female
Weight (excluding option items)	8.59lb (Standard) 11.79lb (SST Housing)
2" Pipe Stanchion Type bracket	Angle or Flat type
Housing Class	Waterproof (IP67), 4X
Approvals	FM (class I, Div. I)

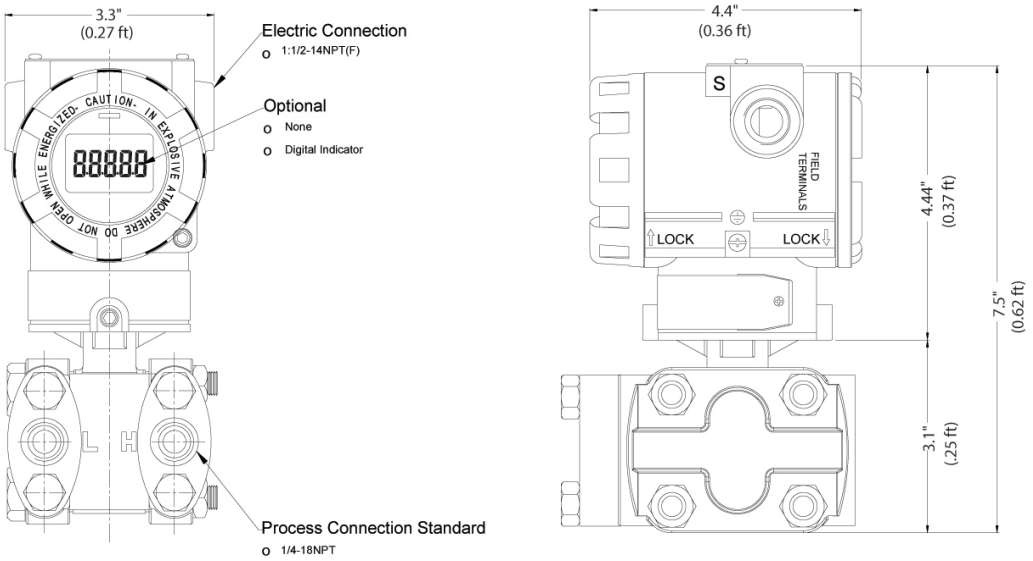
2.3.4 Measuring Range Limit for Tek-Bar 3110A

Range Code	Calibrated Span (Min. to Max.)		Lower Range Limit		Upper Range Limit	
3	0.6 to 30 in w.c	0.15 to 7.5 kPa	-30 in w.c	-7.5 kPa	30 in w.c	7.5 kPa
4	1.5 to 150 in w.c	0.373 to 37.3 kPa	-150 in w.c	-37.3 kPa	150 in w.c	37.3 kPa
5	7.5 to 750 in w.c	1.865 to 186.5 kPa	-750 in w.c	-186.5 kPa	750 in w.c	186.5 kPa
6	1 to 100 psi	6.9 to 690 kPa	-100 psi	-690 kPa	100 psi	690 kPa
7	3 to 300 psi	20.68 to 2068 kPa	-300psi	-2068 kPa	300 psi	2068 kPa

2.4 Exploded View of Transmitter



2.5 Dimensional Drawings



2.6 Model Chart

Example	Tek-Bar 3110A	3	FM	1	1	LCD	Tek-Bar 3110A-3-FM-1-1-LCD
Series	Tek-Bar 3110A						Explosion-Proof Differential Pressure Transmitter
Range Options		D-2 D-3 D-4 D-5 D-6 D-7 D-8 A-4 A-5 A-6 G-2 G-3 G-4 G-5 G-6 G-7 G-8 G-9 G-0 H-4 H-5 H-6 H-7 X					0.30 to 6 in H2O MWP 2000psi/13.79 Mpa 0.6 to 30 in H2O MWP 2000psi/13.79 Mpa 1.5 to 150 in H2O MWP 2000psi/13.79 Mpa 7.5 to 750 in H2O MWP 2000psi/ 13.79 Mpa 1 to 100 psi MWP 2000psi/ 13.79 Mpa 3 to 300 psi MWP 2000psi/ 13.79 Mpa 10 to 1000 psi MWP 2000psi/ 13.79 Mpa 0.30 to 36 1.5 to 217 psiA 3 to 360 psiA 0 to 6 H2O 0.6 to 30 H2O 1.5 to 150 7.5 to 750 in H2O 1 to 100 psi 3 to 300 psi 10 to 1000 psi 30 to 3000 psi 60 to 6000 psi 1.5 to 150 H2O MWP 4500psi/31Mpa 7.5 to 750 H2O MWP 4500psi/31Mpa 1 to 100 psi MWP 4500psi/31Mpa 3 to 300 psi MWP 4500psi/31Mpa Special
Approval Rating			FM ATEX IEC				FM Approval (Class I Div I) ATEX Exd/Exia Exd IIC T4....TP6
Process Connection				1-SS 1- SH 1- ST 1- SM 1- HH X			¼" NPT Female/Stainless Steel/316 LSST ¼" NPT Female/Stainless Steel/HAST-C ¼" NPT Female/Stainless Steel/Tantalum ¼" NPT Female/Stainless Steel/Monel ¼" NPT Female/HAST-C/HAST-C Diaphragm Seal
Electrical Connection					1 2		½" NPT Female M-20 with ATEX Only
Options						LCD BA BF 3WF 5WF O B SIL MR MP LP T CC	5 Digit LCD (Local Indication Only) Stainless Steel Bracket (Angle type) with SST Bolt Stainless Steel Bracket (Flat type) with SST Bolt 3-Way Manifold Valve 5-Way Manifold Valve ½"-14 NPTF, Oval Flange Process Connection Adapter (Includes 2 O-Rings, an adapter, and 2 bolts) Blind Unit SIL-2 Marine Approval ABS Multi Planar/Bottom entry/Vertical Lightning Protector Internal Teflon O Rings Replaces Standard Viton Custom Calibration with 5 point Calibration Certificate

								TAG	Stainless Steel Hang Tag
								LV	12 VDC Low Voltage, 4-wire, 1-5 VDC output, No HART
								EA	0.04%
								O2	O2 Cleaning
								MTC	Material Test Certificate 2.1
								IP68	Submersible Rated (Electrical Conduit Seals)
								WX	Extended Warranty
								SSH	316 Stainless Steel Housing
								FT	Includes Flow Totaizer W/LF Pulse Output
								WH	Wirless HART W/Adaptor
								HT	Hydro Test
								MTR	Material Test Report 3.1
								PMI	Positive Material Identification
								CPC	Custom Product Code/Diaphram Seal

3 Installation

WARNING

The instrument installed in the process is under pressure. Never loosen the process connector bolts to avoid the accident

3.1 Selecting the Installation Location

The transmitter is designed to withstand the severe environmental conditions. However, to ensure stable and accurate operation for the years, observe the following precautions when selecting an installation location.

- **Ambient Temperature**
  Avoid locations subject to wide temperature variations or a significant temperature gradient. If the location is exposed to radiant heat from plant equipment's, provide adequate thermal insulation and/or ventilation

- **Ambient Atmosphere**
  Avoid installing the transmitter in a corrosive atmosphere. If the transmitter must be installed in a corrosive atmosphere, there must be adequate ventilation as well as measures to prevent intrusion or stagnation of rainwater in conduits

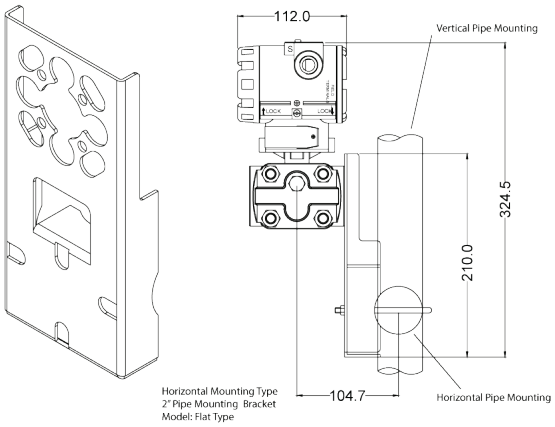
- **Shock and Vibration**
  Select an installation site with minimum shock and vibration (although the transmitter is designed to be relatively resistant to shock and vibration)

3.2 Installation Procedure

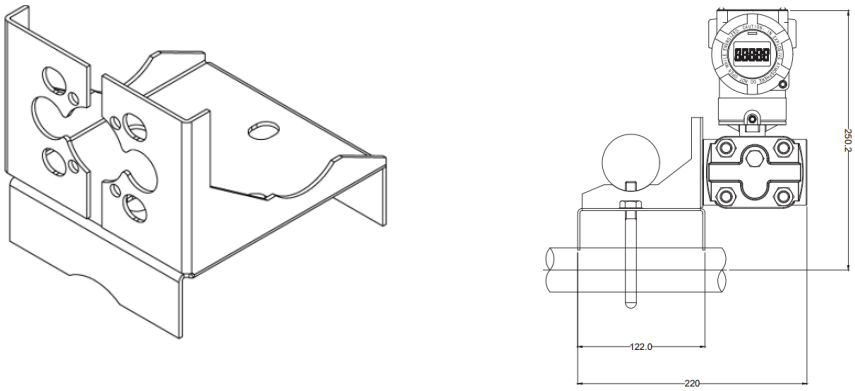
This section provides the information concerning installation of the transmitter for safe operation. It provides the procedures and instruction for mounting, transmitter functions, and installation in specific applications.

3.2.1 Mount the Transmitter Using Mounting Brackets

3.2.1.1 Vertical Mount Type



3.2.1.2 Horizontal Mount Type

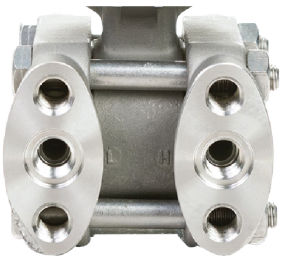


3.2.2 Process Flange Orientation

Mount the process flanges with sufficient clearance for process connections. For safety reasons, place the drain/vent valves so the process fluid is directed away from possible human contact when the vents are used. In addition, consider the need for a testing or calibration input.

3.2.3 Process Connection

Before mounting the transmitter, check the position of high(H) and low(L) pressure side. The process connection of Explosion-Proof Differential Pressure Transmitter is ¼”NPT Female.



NOTE

Process connection should also be engaged with a minimum of 7 thread connections and housing rotation set screw (below front cover) tightened to prevent housing from rotating

3.2.4 Housing Rotation



- To improve the visibility of LCD display
- Loosen the housing screw
- Rotate housing to the desired location up to 360°
- Re-tighten the housing screw

3.2.5 Terminal Side of Transmitter

Mount the transmitter so the terminal side is accessible to the operator.

3.2.6 LCD Display Rotation

If the device cannot be operated in a vertical position you can turn the digital display to make it easier to read. To do this, proceed as follows:
Unscrewing the two screws on either side of the LCD screen allows the screen to be rotated 90° clockwise or counter clockwise. An integral indicator can be installed in the following three directions.



3.2.7 Conduit Installation

If all connections are not sealed, excess moisture accumulation can damage the transmitter make sure to mount the transmitter with the electrical housing positioned downward for drainage. To avoid moisture accumulation in the housing, install wiring with a drip loop, and ensure the bottom of the drip loop is mounted lower than the conduit connections or the transmitter housing.

NOTE

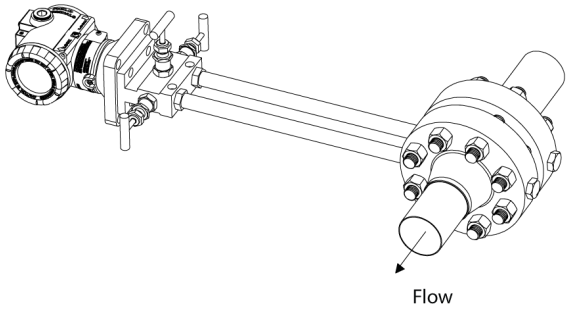
Conduit thread must be engaged with a minimum of 5 thread connections.

3.3 Mounting Requirements

Impulse piping configurations depend on specific measurement conditions.

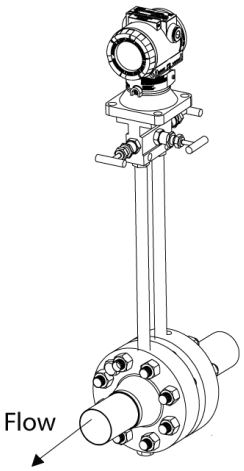
3.3.1 Liquid Flow Measurement

- Place the taps to the side of the line to prevent sediment deposits on the transmitters process isolators
- Mount the transmitter beside or below the taps so gases can vent into the process line
- Mount drain/vent the valve upward to allow gases to vent



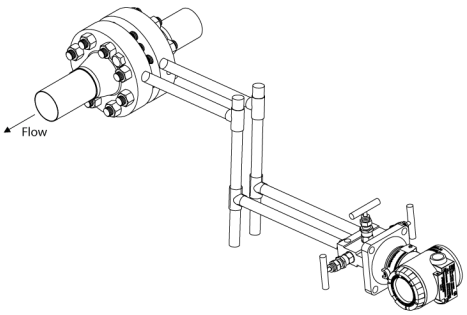
3.3.2 Gas Flow Measurement

- Place the taps in the top or side of the line
- Mount the transmitter beside or above the taps so liquid will drain into the process line



3.3.3 Steam Flow Measurement

- Place taps to the side of the line
- Mount the transmitter below the taps to ensure that the impulse piping will stay filled with condensate
- In steam service above 250°F (121°C), fill impulse lines with water to prevent the steam from contacting the transmitter directly and to ensure accurate measurement at start-up



NOTE

For steam or other elevated temperature services, it is important that temperatures at the process connection do not exceed the transmitters process temperature limits

3.3.4 Zero Trim after Installation

- Sensor Zero Trim should be done immediately after transmitter is installed because zero point can shift due to mounting status of the sensor pick up.
- For sensor zero trim, make input pressure of transmitter zero prior to initiating zero trim calibration. Any sensor trim done in field must be carried out after final installation of transmitter. Also, if applying external pressure to the transmitter make ensure that the display is sufficiently stabilized (after approximately 10 to 15 seconds), before initiating any trim function.
- There are 3 recommendations for making input pressure “Zero”.
  - One is to apply a “Zero” pressure source (mandatory for absolute pressure models)
  - Second is to apply equal pressure on both HP and LP ports (DP models only)
  - The third option is to open equalizing valve of manifolds installed and venting to atmospheric pressure (allowed only for Gauge & DP type models only)
- Sensor zero trim can be performed using an external HHC (Handheld calibrator), PC or PDA configurator, and/or using Zero/Span local push buttons provided on the transmitter.
- When using local push buttons refer to section 5.3 of this manuals for detailed instructions. If using an external HHT or HART® PC configurator, refer to the user manual supplied by the third-party supplier.

4 Electrical Connection

WARNING

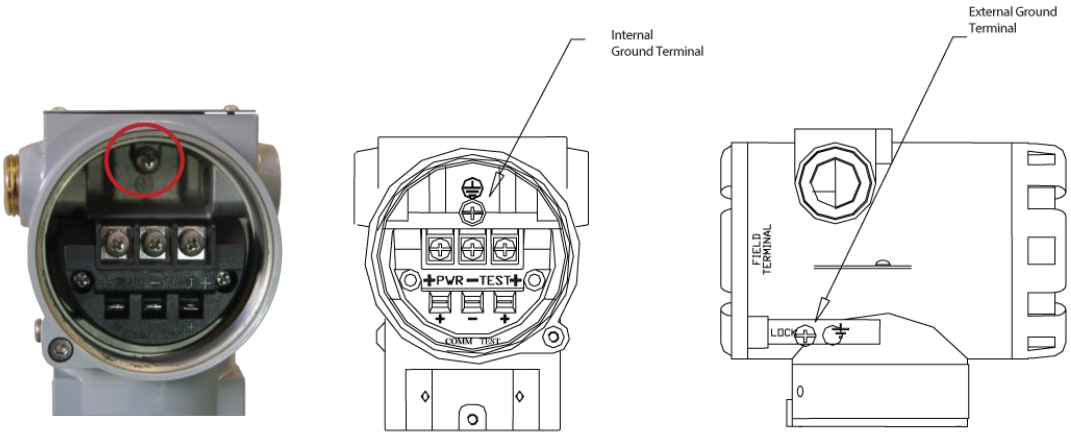
- Cables may only be connected when the power is switched off! Since the transmitters have no switch-off elements, overcurrent protection devices, lightning protection and/or energy isolating devices must be provided by the customer
- The device must be grounded to a spot in accordance with regulations to protect personnel against electric shocks

NOTE

- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the safety instructions or installation or control drawings.
- Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate
- Use shielded twisted pairs to yield best results. To ensure proper communication, use 24 AWG or larger wire, and do not exceed 1500 m

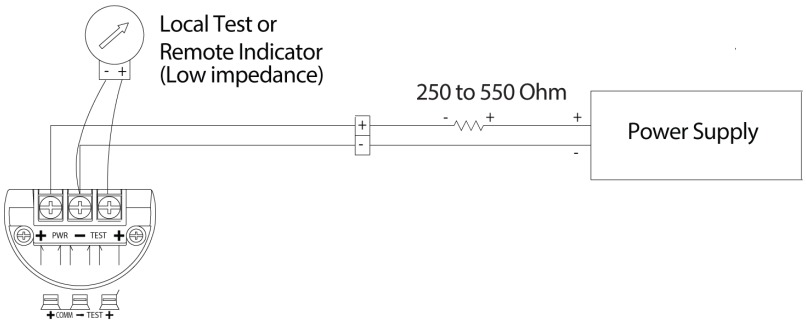
4.1 Grounding of Measuring Device

Provide for proper grounding (earth ground) at designated points (external or internal). There is a ground terminal provided on the inside and the outside of the terminal box. Either one of these terminals may be used for grounding the transmitter.



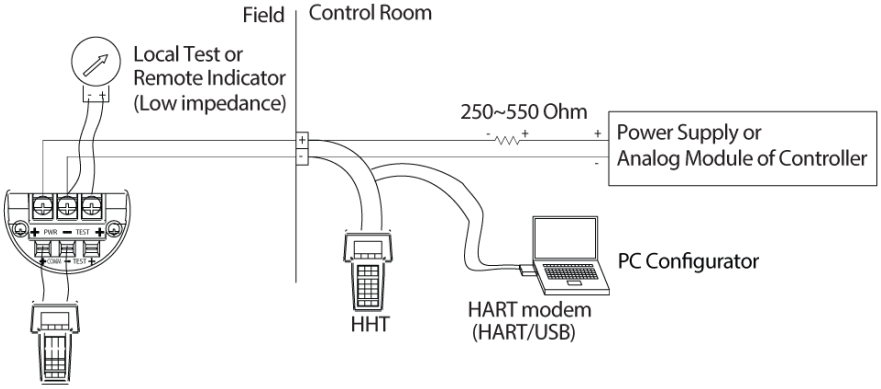
4.2 Power Supply Connection

- Remove the housing cover on terminal compartment side. Do not remove the cover in explosive atmospheres when the circuit is alive. Signal wiring supplies all power to the transmitter
- Connect the positive lead to the terminal marked (+) and the negative lead to the terminal marked (pwr/comm-). Do not connect powered signal wiring to the test terminals. Power could damage the test diode



4.3 Connection to the HART Handheld Communicator

HART Communicator requires a loop resistance between 250Ω and 550Ω.
Transmitter operates on 11.9 –45VDC.

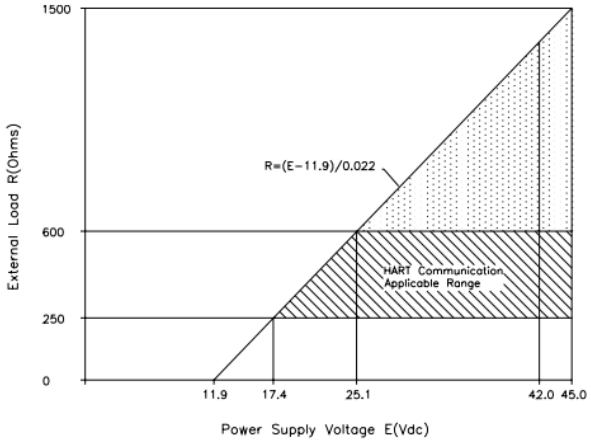


Power Supply for 4 to 20mA HART

The transmitter operates on 12 to 45VDC. The 250 Ω resistor require to communicate with Field Communicator.

Load Limitation

Maximum loop current is 24mA,
Load resistance R,
R = (E-11.9) / 0.022 (E = Power Supply Voltage)



5 Operation

This section contains information about a basic operation of the pressure transmitter. It provides procedure and instructions to perform basic setup and configuration functions.

5.1 Local Operation and Display

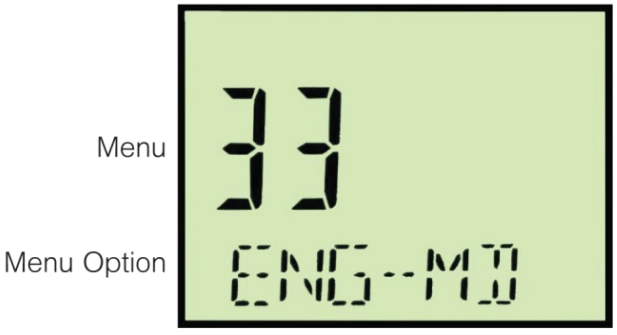
Tek-Bar 3110A is available with the optional display. Parameters setting of transmitters are done by using LCD display and buttons. The displays indicate output and diagnostic messages.

5.1.1 Operation without Display

If LCD display is not available, the use HART for communication. (Refer section 5.5)

5.1.2 Operation with LCD Display

The local display enables you to read all important parameters directly at the measuring point and configure the device using the function matrix. The LCD display indicates output and diagnostic messages on display. The LCD display features a two-line display with 5-digit. The first line displays measured value and the second line display the engineering units.



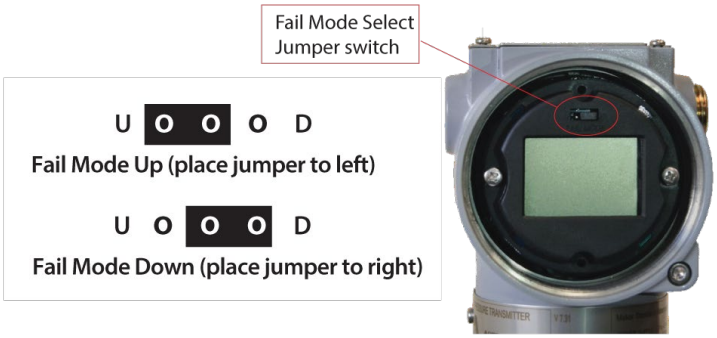
5.2 Basic Setup

This session provides information of detailed setup required for transmitters function.

5.2.2 Failure Mode Alarm

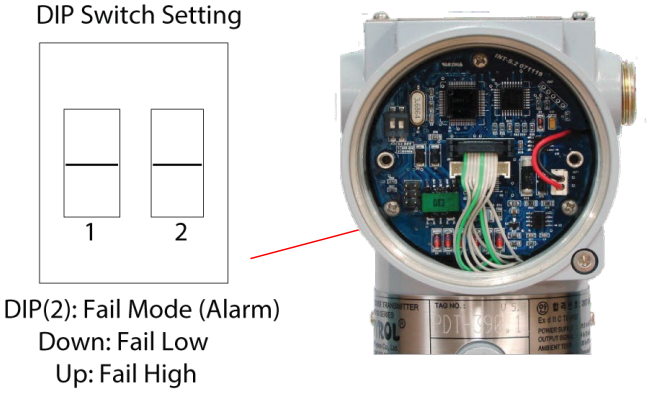
The Tek-Bar 3110A Transmitter automatically and continuously perform self-diagnostic functions. If the self-diagnostic routines detect a failure the transmitter drives its output outside of the normal saturation values. The transmitter will drive its output low or high based on the position of the failure mode alarm jumper.

Level	4 to 20mA Saturation	4 to 20mA alarm
Low/Down	3.9mA	≤3.75mA
High/Up	20.8mA	≥21.75mA



Fail Mode Selection (Fail High/UP or Low/DOWN) can be configured using the appropriate jumper switch provided on the LCD module or DIP switches included on the main CPU Module. For units provided with a LCD module one can select desired fail-safe mode directly from the jumper switch included in the front display and this setting overrides the DIP settings on the back-end main CPU module. However, in case of blind units select your required DIP switch settings from the DIP switch labelled (2)marked on the main CPU board.

Selected Fail Mode	**Jumper status on LCD and DIP Switch (2) on CPU Module**		**DIP Switch (2) Setting on CPU Module**
	CPU Module	**LCD Module**	**CPU Module**
Fail Down	Down	D	Down
Fail Up	Down	U	Up
	Up	D and U	



5.2.3 Damping Time

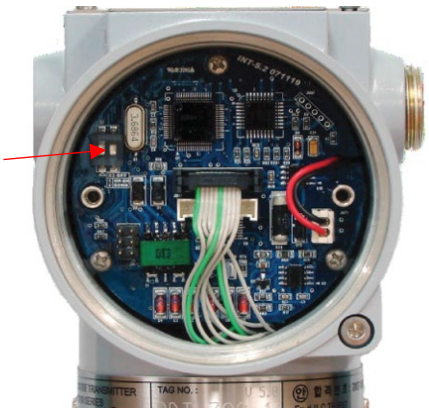
The “Damp” command introduces a delay in the micro-processing which increases the response time of the transmitter; smoothing variations in output readings caused by rapid input changes. Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the loop dynamics within your system. The default damping value is 1 seconds, and it can be set to any of ten pre-configured damping values between 0 and 60 seconds.

5.2.4 Security Jumper (EEPROM-Write Protect)

Protects the against a change of Configuration Parameter of the transmitter to Write protect jumper. The EEPROM (Electrically Erasable Programmable ROM) restores various configuration variables in the transmitter. To protect the change configuration variable data in software, on the hardware side there is Write-Protect mode and jumper switch selected and segmented "EEP-Write DIS / EN" in the main CPU module. Thus, if you connect the jumper to DIS you cannot change configuration data in EEPROM. When you connect the jumper to EN you can change the configuration data in EEPROM. If there is no connected jumper, it is classified EN. At the factory before shipment, it is configured "EN".

You can prevent changes to the transmitter configuration data with the write protection jumper. Security is controlled by the security (write protect) jumper located on the electronics board or LCD display. Position the jumper on the transmitter circuit board in the “ON” position to prevent an accidental or deliberate change of configuration data. If the transmitter writes protection jumper is in the “ON” position, the transmitter will not accept any “Writes” to its memory. Configuration changes, such as digital trim and re-ranging, cannot take place when the transmitter security is on.

DIP (1) = WR_EN (EEPROM Write Enable)
DOWN: Enable Configuration Changes
UP: DISABLE /LOCK Configuration Changes



5.2.5 Loop Test

The Loop Test verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed loop. Perform the following procedure for a loop test.

- Connect a reference meter to the transmitter
- Select the loop test of HHT and operate the loop test
- Select output current (4mA/20mA/etc.)
- If the readings match, then the transmitter and the loop are configured and functioning properly

If the readings do not match, then you may have the current meter attached to the wrong loop, there may be a fault in the wiring, the transmitter may require an output trim, or the electrical current meter may be malfunctioning.

5.3 Configuration

This section provides detailed information and procedure of push button functions and handheld communicator.

5.3.1 Zero and Span magnetic Buttons

The zero and span adjustment is a way of configuring the transmitter when the communicator is not available.



The local push button allows for local configuration of basic parameters of a transmitter in absence of a HHT or external HART® enabled configurators.
To re-range, the transmitter using the span and zero buttons, perform the following procedure.
The top nameplate (right side only) is located in the upper part of the transmitter. Slide the nameplate anti-clockwise (slightly until the Zero/Span button is visible and fully accessible.

A single operation of individual buttons (labelled Zero/Span respectively) will initiate a zero/span configuration process as found in conventional transmitters requiring an external pressure source. However, as these are smart transmitters most configuration functions such as zero trim, zero adjustment, selecting units, re-ranging (or setting URL/LRL), damping time, display resolution, LCD preference etc can be done without any external pressure source or HHT.

Setting URL/LRL *U*sing *E*xternal *P*ressure *S*ource

A. Zero (or LRL) Calibration

Apply the desired 4mA pressure value to the transmitter. Apply required LRL pressure on the transmitter over 10 second and press “Zero” button over 5 seconds until “Zero” is displayed on LCD display. Once the input pressure for LRL value is stabilized press the “zero” button again until display shows “-ZE- “in LCD window. Release button and wait 2-3 seconds for transmitter to calibrate the LRL value (applied as PV input). If Zero Procedure was incorrectly performed display will show “ZR-Er” error code indicating failure and possible LRL setting out of sensor range capabilities

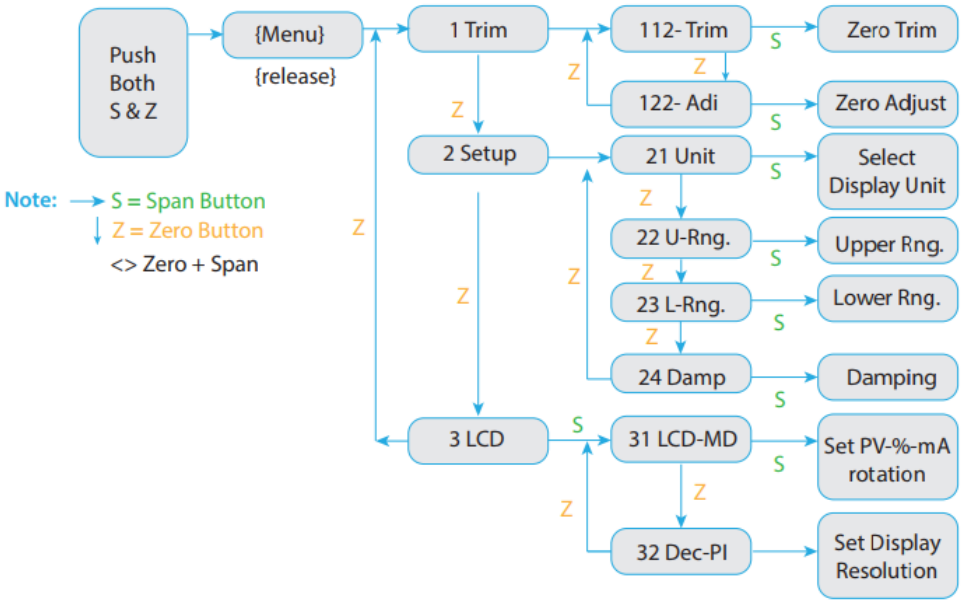
B. Span (or URL) Calibration

Apply the desired 20mA pressure value to the transmitter. Apply required URL pressure on the transmitter over 10 second and press “Span” button over 5 seconds until “Span” is displayed on LCD display. Once the input pressure for URL value is stabilized press the “Span” button again until display shows “-SP- “in LCD window. If Span calibration is incorrect display will prompt failure by displaying “SPEr” error code* indicating failure and possible URL setting out of sensor range capabilities

5.3.2 Advance Configuration Via Push Button.

This includes re-ranging of transmitters (Set URL/LRL) without an external pressure source. To access advanced configuration and enter programming menu press both (Zero + Span) buttons simultaneously for 5 seconds. When display reads “Menu” release both push buttons immediately. This will put user into top of main programming menu indicated by message “1-TRIM” on display. To navigate through main menus and /or sub-menus:

- Use (Zero) button to scroll down a menu (or sub-menu if active).
  Example press/release (Zero) to scroll down from main menu 1-Trim> 2-Setup > 3-LCD >1-Trim > 2-Setup etc. or from an active sub-menu press/release (zero) to scroll down within a sub menu example 21-Units> 22-URL > 23-LRL > 24-Damping > 21- Units > 22-URL etc
- Use (Span) button to enter a specific sub-menu or data input function.
  Example pressing (Span) button from main menu will put user into sub-menu “11>Zero Trim”. Releasing and Pressing (Span) button again will initiate Zero Trim configuration or release and pressing (Zero) button instead will increment user down to sub-menu “12>Zero ADJ”
- Within an active sub-menu use of (Span) button also acts as a key to allow user to save changes and exit programming mode
- For moving back to previous menu press (Zero + Span) button together. During numeric value entry mode use (Zero + Span) button together to save numeric data inputted and exit from programming menu



5.3.3 Steps to Input Numeric Data Value

Specific functions that need users to input a numerical value are found under sub-menu

12 Zero Adjustment
22 Change Upper Range Value
23 Change Lower Range Value
24 Damping Second

Due to limited flexibility with only 2 push buttons available for configuration, it is not possible to directly input numeric values within this sub-menu. Instead, the correct sequence requires user to first set an increment (10x) rate e.g., 0.01, 0.1, 1.0, 10. 100, 1000 etc and then proceed with changing numeric value by the set rate increment. For example, to input a numeric value as “3810” from existing the displayed value of “0000”:

- First Set increment rate as “1000”
- Increase display “0000” value 3 times in steps of1000 till it reads “3000”
- Then set increment rate again as “100”
- Increase 8 times in steps of 100 till display reads “3800”
- Set increment rate again as 10
- Increase 1 time for a step change of 10till display reads 3810

When activating these sub-menus (by pushing down & releasing (Span) button from within its active menu the display will automatically prompt for “Set Inc” message.

1. To select an increment rate press (Zero) button when “Set Inc” message is displayed on LCD sub-menu. Release (Zero) button when display value changed. Each subsequent (Zero) push-release key stroke will shift display decimal point to left. Example when display shows “Set Inc” 0.01. Subsequently for every push- release keystroke of (Zero) button the display will cycle from >0.1>1.0>10 >100>1000>0.1>1.0 etc

2. Once desired “Set Inc” (viz. 0.1, 1, 10, 100 etc) increment rate is set push the (Span) button to accept and enable set numeric “Value” mode. When executing (Span) button from “Set Inc” menu the LCD display will typically show the last saved numerical value along with a “Value” message on second line indicating that user can now initiate changes by incrementing or decrementing numeric value

3. From within “Value” menu press either (Zero) or (Span) button (not both) will allow the numeric value to increment (Zero) or decrement (Span) by the “Set Inc” value selected by user in the previous step (2)

4. After desired numeric value is displayed, push down on (Zero + Span) buttons together to accept new data inputted and this will bring user back to menu

5. Repeat steps (1) through (3) detailed above until the final numeric value required is displayed under set “Value” Menu

6. To store final numeric value to EEPROM push (Zero + Span) button twice to save and exit. Pushing Zero + Span once from “Value” menu will bring user back to “Set Inc” menu step (1). However, pressing (Zero + Span) buttons together second time (from “Set Inc” menu). Release button when screen shows “Inc Ok” message after which it will save the last numeric value inputted and bring user back to measurement mode

7. If successful display will read -DONE- else “BR-ERR” to indicate failure. If display shows “RANGOVR” it indicates numerical value inputted is out of specification

5.3.4 Push Button Sequence for Each Programming Sub-Menu

5.3.4.1 Zero Trim (Sub Menu 11)

1. Enter programming menu by pushing both (Zero + Span) button together for 5 seconds. Release buttons when LCD displays menu and display will automatically change to “1 TRIM” confirming access into programming menu
2. Push (Span) button when “1 TRIM” message appears to enter 11 Z-Trim sub-menus
3. To execute the zero trim sub-menu function push (Span) button when 11 Z-TRIM message appears on LCD display

NOTE

Make sure process input to the transmitter is at true zero else this may create an incorrect zero offset. If a wrong zero is suspected, execute zero trim again ensuring the proper steps & correct Zero PV input is applied to transmitter

5.3.4.2 Zero Adjustment (Sub Menu 12)

Example used to show changing the PV value as 14.

- Enter programming menu by pushing both (Zero + Span) button together for 5 seconds. Release buttons when LCD displays menu and display will automatically change to “1 TRIM” confirming access into programming menu
- Push (Span) button when 1 TRIM message appears to enter 11 Z-Trim sub menus. Push (Zero) to change display to menu 12 Z-ADJ
- To execute the zero-adjustment function push (Span) button when 12 Z-ADJ message appears on LCD display
- When “Set Inc” message appear, push the zero button repeatedly until 10.0 message appears on LCD. And then push (Span) button to accept and proceed into input “Value” menu
- When “Value” message appears on display, increment forward (Span) or decrement backward (Zero) to set the LCD value to “10.0”. The LCD display will increment or decrement by factor of 10 which is the (Set Inc Value) selected in previous menu. Once desired base value of “10” is displayed push (Zero + Span) button to accept new value and “Set Inc” message appears upon which release buttons
- From menu where “Set Inc” message appears again, change the LCD value to 1.0 by pushing (Zero) button once and then push (Span) button to enter input “Value” menu.
- Here push (Span) or (Zero) to increment or decrement by Set Inc (1) until display reads “14”. Push (Zero + Span) button after LCD value is changed to 14.0 and release both button when display reads “Set Inc”
- To save the numeric value of 14 set from previous steps push (Zero + Span) buttons from the “Set Inc” menu to save and exit. Display will show “Inc Ok” at which point release buttons
- Display with show “-DONE- “confirming changes has been accepted and then default back into measurement mode. This completes the Zero adjustment configuration
- If display shows “BT-ERR” instead of “-DONE- “repeat all steps once again
- If display shows “ADJ-U” or “ADJ-L” the inputted numerical value is out of specification for zero adjustment range for the supplied range codes

5.3.4.3 Change Units (Sub-Menu 21) – Example Set Units to "psig"

- Enter programming menu by pushing both (Zero + Span) button together for 5 seconds. Release buttons when LCD displays menu and display will automatically change to "1 TRIM" confirming access into programming menu
- Push (Zero) button when 1 TRIM message appears on LCD. Release button when display changes to 2 SETUP
- To move into sub menu push (Span) button when 2 SETUP message appears on display. Release button when 21 UNIT message is displayed
- You are now in the change units sub menu. To execute this function push (Span) button when 21 UNIT message appears on display. Release button when display changes to 211 (xxx) where " xxx " is the last units (e.g. bar, kpa, "H_2O etc) saved previously
- Push/release (Zero) button repeatedly to toggle through all available units. When desired "psig" units are displayed save and exit by pushing (Span) button

5.3.4.4 Change URL/ Upper Range Value (Sub-Menu 22)

- Enter programming menu by pushing both (Zero + Span) button together for 5 seconds. Release buttons when LCD displays menu and display will automatically change to "1 TRIM" confirming access into programming menu
- Push (Zero) button when "1 TRIM" message appears on LCD. Release button when display changes to "2 SETUP"
- To move into sub directory push (Span) button when "2 SETUP" message appears on display. Release button when display changes to "21 UNIT" message
- Push (Zero) button to move down to sub-menu 22. When display shows "22 U-RNG" release button. You are now in URL sub menu
- To execute this function push (Span) button when "22 U - RNG" message appears on display. Release button when display changes to 221 (xxxx) where xxxx is last configured URL value saved

5.3.4.5 Change LRL/ Lower Range Value (Sub-Menu 23)

- Enter programming menu by pushing both (Zero + Span) button together for 5 seconds. Release buttons when LCD displays menu and display will automatically change to "1 TRIM" confirming access into programming menu
- Push (Zero) button when "1 TRIM" message appears on LCD. Release button when display changes to "2 SETUP"
- To move into sub directory push (Span) button when "2 SETUP" message appears on display. Release button when 21 UNIT message is displayed
- Push (Zero) button to move down to sub-menu 22. When display shows "22 U-RNG" release button
- Push (Zero) button to move down to sub-menu 23. When display shows "23 L-RNG" release button
- You are now in change LRL sub menu. To execute this function push (Span) button and release when "231 xxxx" message appears on display. Where xxxx is last configured LRL value saved

NOTE

When setting URL/LRL numeric data ensure values being inputted fall within the allowed minimum/maximum specifications published for the installed sensor range code. Only if display shows -DONE- will the transmitter update its stored configuration & accept the new values. If out of limits the transmitter will reject values entered and default to previous saved values after displaying a "RANG OVR" error message

5.3.4.6 Changes Damping Value (Sub-Menu 24)

- Enter programming menu by pushing both (Zero + Span) button together for 5 seconds. Release buttons when LCD displays menu and display will automatically change to "1 TRIM" confirming access into programming menu
- Push (Zero) button when "1 TRIM" message appears on LCD. Release button when display changes to "2 SETUP"
- To move into sub directory push (Span) button when "2 SETUP" message appears on display. Release button when 21 UNIT message is displayed
- Push (Zero) button to move down to sub-menu 22. When display shows "22 U-RNG" release button
- Push (Zero) button to move down to sub-menu 23. When display shows "23 L-RNG" release button
- Push (Zero) button to move down to sub-menu 24. When display shows "24 DAMP" release button
- You are now in change damping sub menu. To execute this function push (Span) button when "24-Damping" message appears on display. Release button when display changes to 241 (xxxx) when xxxx is last configured damping value saved

5.3.4.7 Change LCD Mode (Cyclic or Fixed Display) (Menu 31)

- Enter programming menu by pushing both (Zero + Span) button together for 5 seconds. Release buttons when LCD displays menu and display will automatically change to "1 TRIM" confirming access into programming menu
- Push (Zero) button when "1 TRIM" message appears on LCD. Release button when display changes to "2 SETUP"
- Push (Zero) button and release when display changes to "3 LCD".
- To move into sub directory push (Span) button after "3 LCD" message appears on display. Release button when 31 LCD-MD messages is displayed
- To enter this sub-menu push (Span) button and release when display changes to 311. Bottom line of display will show current mode setting e.g. NOR-RO, NOR-PV etc
- Push (Zero) button to cycle through available mode options and select desired LCD rotation mode. Options are:
  NOR–RO (rotate all PV, %,mA), NOR-PV (Fixed PV),
  NOR-% (Fixed %), NOR-mA Fixed,
  ENG–RO, ENG-PV, ENG-% or ENG-mA
- Push (Span) to save changes and EXIT programming mode

5.3.4.8 Change LCD Resolution (Sub-Menu 32)

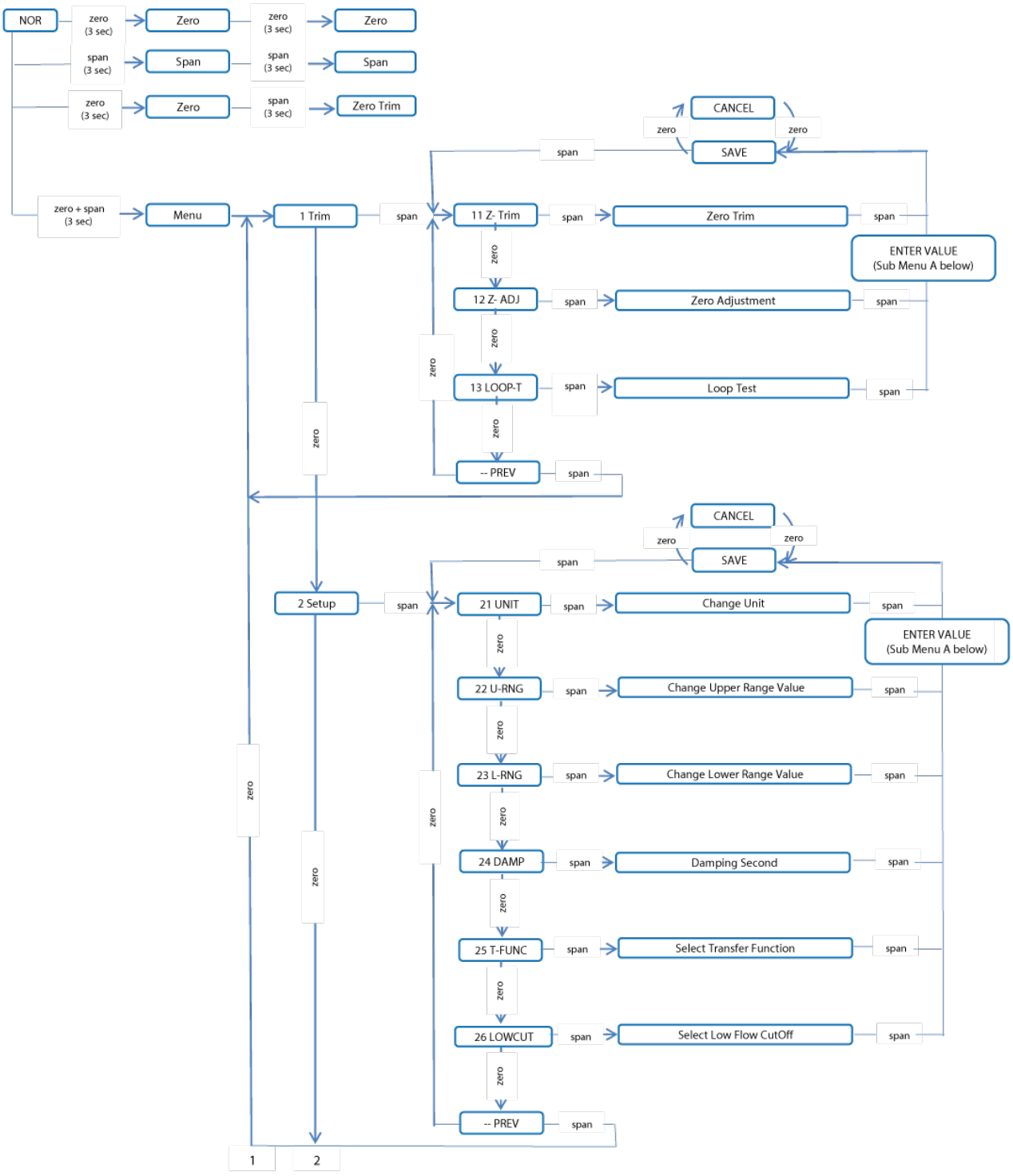
- Enter programming menu by pushing both (Zero + Span) button together for 5 seconds. Release buttons when LCD displays menu and display will automatically change to “1 TRIM” confirming access into programming menu
- Push (Zero) button when “1 TRIM” message appears on LCD. Release button when display changes to “2 SETUP”
- Push (Zero) button and release when display changes to “3 LCD”.
- To move into sub directory push (Span) button after “3 LCD” message appears on display. Release button when 31 LCD-MD messages are displayed
- Push (Zero) button to move down one sub-menu and release button when “32- DEC-PL” message is displayed
- Push (Span) button to execute this sub-function. Release button when the display changes to 0.0. Note 0.0 will be displayed on the first line of LCD. The second line will indicate mode options viz. AUTO, 5-0, 4-1 etc

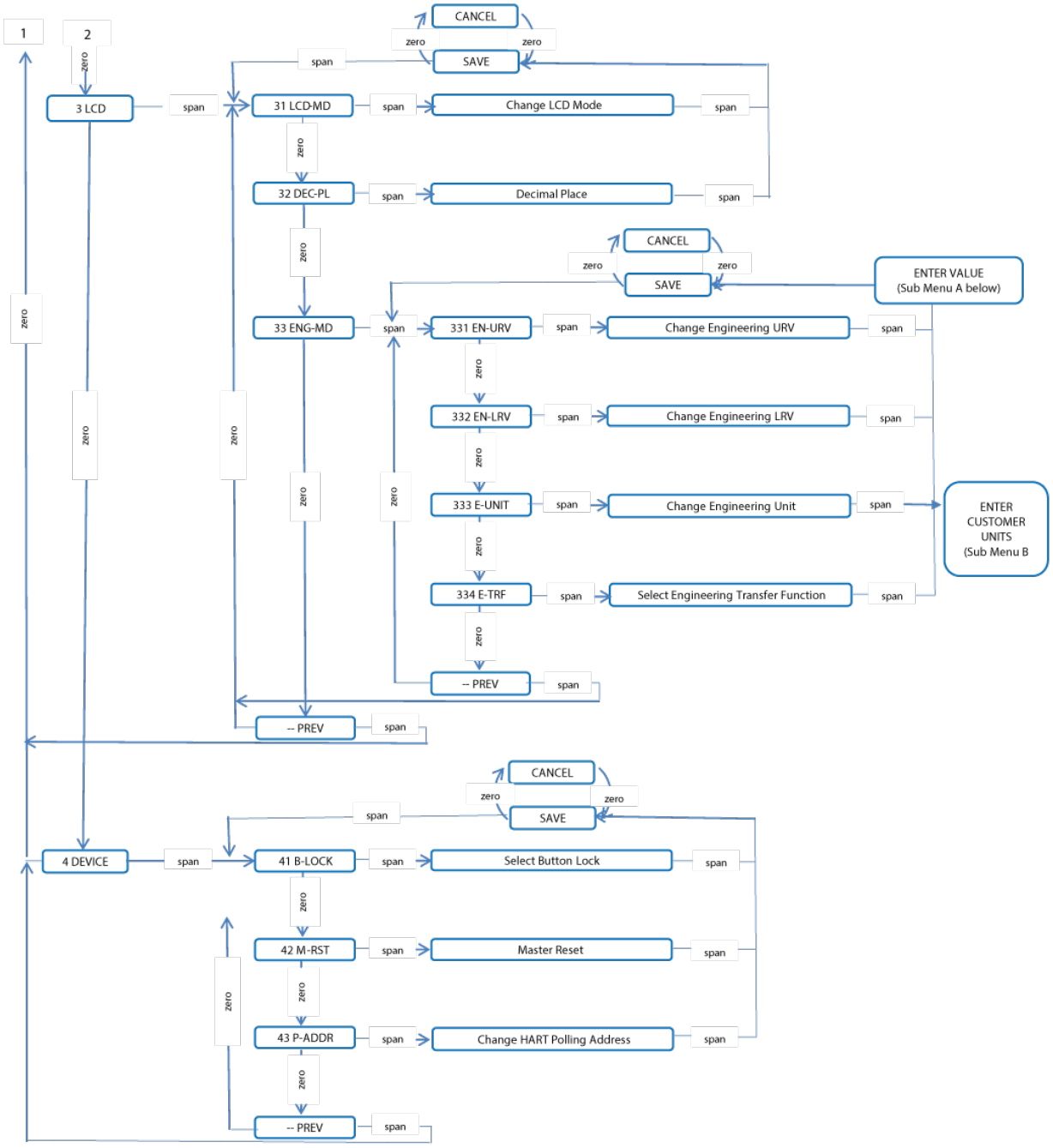
All available resolution modes are listed below in Table:

Model	Description	Max. Value
AUTO	Auto ranging of display	99999
5-0	Non decimal place	99999
4-1	Display one decimal place	9999.9
3-2	Display two decimal places	999.99
2-3	Display three decimal places	99.999
1-4	Display four decimal places	9.9999

- Push (Zero) to cycle through display options i.e. AUTO, 5-0, 4-1, 3-2, 2-3 and 1-4 and once desired resolution is displayed push (Span) to save and exit

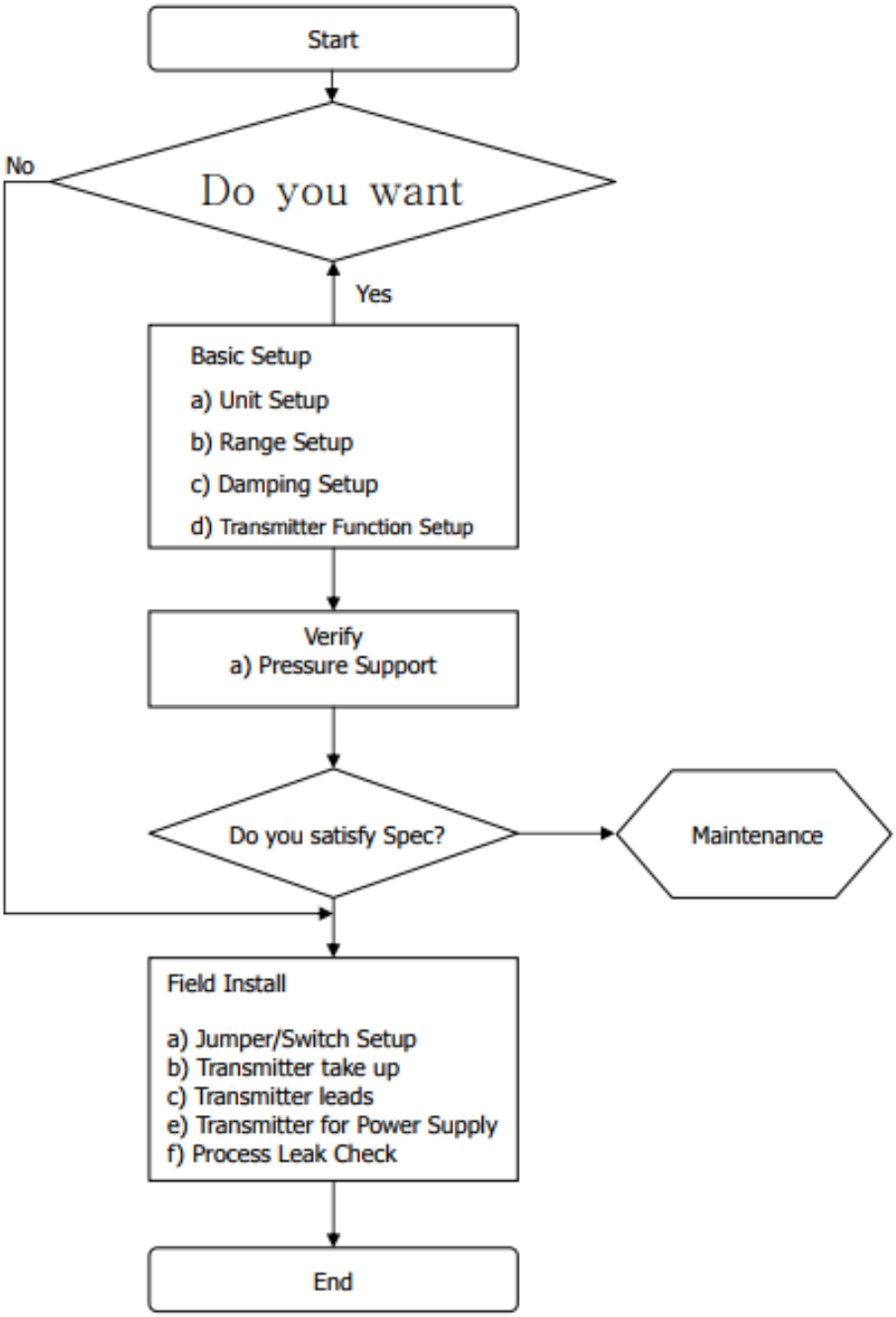
5.4 Menu Tree


NOR
zero (3 sec)
Zero
zero (3 sec)
Zero
span (3 sec)
Span
span (3 sec)
Span
zero (3 sec)
Zero
span (3 sec)
Zero Trim
zero + span (3 sec)
Menu
1 Trim
span
11 Z- Trim
span
Zero Trim
span
CANCEL
zero
zero
SAVE
span
ENTER VALUE (Sub Menu A below)
zero
12 Z- ADJ
span
Zero Adjustment
span
zero
13 LOOP-T
span
Loop Test
span
zero
-- PREV
span
zero
zero
2 Setup
span
21 UNIT
span
Change Unit
span
CANCEL
zero
zero
SAVE
span
ENTER VALUE (Sub Menu A below)
zero
22 U-RNG
span
Change Upper Range Value
span
zero
23 L-RNG
span
Change Lower Range Value
span
zero
24 DAMP
span
Damping Second
span
zero
25 T-FUNC
span
Select Transfer Function
span
zero
26 LOWCUT
span
Select Low Flow CutOff
span
zero
-- PREV
span
zero
zero
1
2


1
2
zero
3 LCD
span
CANCEL
zero
zero
SAVE
span
31 LCD-MD
span
Change LCD Mode
span
zero
32 DEC-PL
span
Decimal Place
span
zero
CANCEL
zero
zero
SAVE
ENTER VALUE
(Sub Menu A below)
zero
33 ENG-MD
span
331 EN-URV
span
Change Engineering URV
span
zero
332 EN-LRV
span
Change Engineering LRV
span
zero
333 E-UNIT
span
Change Engineering Unit
span
ENTER
CUSTOMER
UNITS
(Sub Menu B
zero
334 E-TRF
span
Select Engineering Transfer Function
span
zero
-- PREV
span
-- PREV
span
CANCEL
zero
zero
SAVE
span
4 DEVICE
span
41 B-LOCK
span
Select Button Lock
span
zero
42 M-RST
span
Master Reset
span
zero
43 P-ADDR
span
Change HART Polling Address
span
zero
-- PREV
span

5.5 Handheld Communicator

If custom display is not available, then configure transmitter parameter using communicator. Decimal point position, Upper range value, Lower range value, Engineering units are configured. See the below flow chart.



6 Troubleshooting

This section provides troubleshooting techniques for most common operating problems.

6.1 Hardware Diagnostics

If you suspect a malfunction despite the absence of any diagnostic messages on the HHT, follow the table below to verify that the transmitter hardware and process connections are in good working order:

Symptom	Potential Source	Corrective Action
Transmitter Does Not Communicate with HART Communication	Loop Wiring	Check for a minimum of 250 ohms resistance between the power supply and HHT.
		Check for adequate voltage to the transmitter. The transmitter always requires 11.9 to 45VDC.
		Check for intermittent shorts, open circuits, and multiple grounds
High Output	Sensor Input Failure	Connect HHT and enter the Transmitter test mode to isolate a sensor failure.
	Loop Wiring	Check for dirty or defective terminals, interconnecting pins, or receptacles.
	Power Supply	Check the output voltage of the power supply at the transmitter terminals. It should be 11.9 to 45VDC in spite of loop scale
	Electronics Module	Connect HHT and enter the Transmitter test mode to isolate module failure. Check the sensor limits to ensure calibration adjustments are within the sensor range.

Symptom	Potential Source	Corrective Action
Erratic Output	Loop Wiring	Check the output voltage of the power supply at the transmitter terminals. It should be 11.9 to 45VDC.
		Check for intermittent shorts, open circuits, and multiple grounds.
		Check for proper polarity at the signal terminals.
		In case measuring electric current while digital communication, output appear around +-0.013mA
	Electronics Module	Connect HHT and enter the transmitter test mode to isolate an electronics mode failure.
Low Output or No Output	Sensor Element	Connect HHT and enter the Transmitter test mode to isolate the sensor failure.
		Check the PV to see if it is out of range.
	Loop Wiring	Check for adequate voltage to the transmitter. The transmitter always requires 11.9 to 45VDC.

		Check for intermittent shorts, open circuits, and multiple grounds.
		Check polarity of signal terminal
		Check the loop impedance.
	Electronics Module	Connect HHT and check the sensor limits to ensure calibration adjustments are within the sensor range.

6.2 Error Codes

Tek-Bar 3120A Explosion-Proof Differential Pressure Transmitter LCD Display error codes.

Message	**Description**
ADJ-U	Out of Zero setting value when Zero Adj function using button (upper side)
ADJ-L	Out of Zero setting value when Zero Adj function using button (lower side)
ZERO	Initial message in using the Zero button
SPAN	Initial message in using the Span button
BT-ERR	Button Input Sequence Error
P-LOCK	Button Input Error when Protect Locked
ZT-ERR	Setting Limit (10%) Error when in Zero Trim
-TR-	Zero Trim Complete
ZR-ERR	Setting Limit Error when executing the Zero button function
SP-ERR	Setting Limit Error when executing the Span button function
-ZR-	Zero button function Complete
-SP-	Span button function Complete
-ZA-	Zero Adjustment done
-DONE-	Setting Done using button
RNGOVR	Setting Limit error when executing other setting function
LCD_OV	Over figure values for LCD
SCD-ER	Sensor Code Error
F-RST	Flash Setting Data Rese
F-LOCK	While Flash Setting Data Reset, Protect Locked
F-FAIL	Flash Setting Data Reset Failure
-FR-	Flash Reset Done
A-RST	Analog EEPROM Initializing Start
A-STOR	Analog EEPROM Whole Write
A-FAIL	Analog EEPROM Whole Write Failure



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TEKTROL

www.tek-trol.com

Tek-Trol LLC

796 Tek Drive Crystal Lake,
IL 60014, USA

+1 847-857-6076 | tektrol@tek-trol.com | www.tek-trol.com

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Flow | Level | Temperature | Pressure | Valves | Analyzers | Accessories | TekValSys

EQUIPMENT TECHNICAL DATA SHEETS

PRESSURE GAUGE
KROFTA AIR DISSOLVING TUBE (ADT)

PRESSURE GAUGE:

Ashcroft® Duragauge® Pressure Gauge: Size: 4.5"; Range: 0-100 Psi; 1/2" NPT Process Connection
Part #: 451279RSL04LXLL100#

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Data Sheet

ASHCROFT®
Trust the shield.®

1279 Duragauge® Pressure Gauge

ADT PRESSURE GAUGE

FEATURES

- Custom dial printing options
- Micrometer adjustable pointer
- ***PLUS!***™ Performance option dampens vibration, shock and pulsation effects
- Pressure range from vacuum to 30,000 psi
- NSF-61 Compliant

TYPICAL USES

- Refineries
- Chemical and petrochemical plants
- Offshore oil rigs
- Water and wastewater pressure control
- Pulp and water
- Mining and metals
- Equipment skids
- Specialized OEM equipment
- Cryogenics



1279
4½″ dial size

Certified to NSF/ANSI/CAN 61

SPECIFICATIONS

Accuracy:	±0.5% of span (ASME B40.100 Grade 2A)		
Size:	4½″		
Range:	Vacuum, compound to 30,000 psi		
Process Connection Location:	Lower, back, side, top		
Process Connection:	¼ NPT, ½ NPT, 9/16-18 UNF-2B Aminco® (high pressure connection)		
Case Style:	Solid front with pressure relief back		
Window:	Glass (STD.), acrylic, shatter proof glass, non-glare glass (OPT.)		
Movement:	Rotary, adjustable, 400 SS, Teflon™ coated		
Movement Materials:	400 SS, Teflon™ coated pinion gear and segment		
Dial:	Aluminum, white background, black scale		
Pointer:	Micrometer, adjustable, aluminum		
Weather Protection:	Case	IP Rating	Ordering Code
	Dry	Case not sealed, recommended for weather protected environment only	S
	Dry, field fillable	IP66	SH
	Liquid filled	IP66	SL
Dampening Options:	Liquid: glycerin, silicone, Halocarbon®, ***PLUS!***™ Performance		
Mounting:	Stem, surface, flush (STD.), pipe, remote (OPT.)		
Approvals:	CE/UKCA, CRN, NSF-61		

WETTED COMPONENTS

Bourdon Tube	Process Connection	Joints
316L Stainless steel	316L Stainless steel	Welded
316L Stainless steel	Steel	Welded
K-Monel® 500	Monel® 400, Steel	Welded
C510 Pho. Bronze	Brass	Silver Brazed

KEY BENEFITS

- **Available with a wide variety of accessory and diaphragm seal assemblies**
- **Available with high process temperature dissipation siphons**

MIN/MAX TEMPERATURE LIMITS

Version	Ambient	Process	Storage
Dry	-20 °F to 200 °F (-29 °C to 93 °C)	-20 °F to 250 °F (-29 °C to 121 °C)	-40 °F to 250 °F (-40 °C to 121 °C)
PLUS!™	-40 °F to 150 °F (-40 °C to 66 °C)	-40 °F to 200 °F (-40 °C to 93 °C)	-40 °F to 150 °F (-40 °C to 66 °C)
Glycerin fill	20 °F to 150 °F (-7 °C to 66 °C)	20 °F to 150 °F (-7 °C to 66 °C)	0 °F to 150 °F (-18 °C to 66 °C)
Silicone fill	-40 °F to 150 °F (-40 °C to 66 °C)	-40 °F to 200 °F (-40 °C to 93 °C)	-40 °F to 150 °F (-40 °C to 66 °C)
Halocarbon® fill	-40 °F to 150 °F (-40 °C to 66°C)	-40 °F to 200 °F (-40 °C to 93 °C)	-40 °F to 150 °F (-40 °C to 66 °C)

NON-WETTED COMPONENTS

Case	Ring	Pressure Relief Back
Phenolic	Threaded, Polycarbonate (meets UL 94 V-0)	Polycarbonate (Meets UL 94 V-0)

Note: Other than discoloration of the dial and hardening of the gasketing that may occur as ambient or process temperatures exceeds 150 °F, non-liquid-filled gauges with standard glass windows, can withstand continuous operating temperatures up to 250 °F (121 °C). Liquid-filled gauges can withstand 200 °F (93 °C) but glycerin fill and acrylic window will tend to yellow. Accuracy at temperatures above or below the reference ambient temperature of 68 °F (20 °C) will be affected by approximately .4% per 25 °F. Gauges with welded joints will withstand 750 °F (400 °C), 450 °F (232 °C) with silver brazed joints for short times without rupture, although other parts of the gauge will be destroyed and calibration will be lost. For continuous use and for process or ambient temperatures above 250 °F (121 °C), a diaphragm seal or capillary or siphon is recommended.

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ASHCROFT®
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1279 Duragauge® Pressure Gauge

ORDERING CODE Example:	451279	S	SH	04	L	XLL	15#
Dial Size/Model Code							
451279 - 4½″ solid front	451279						
System (tube and process connection)							
A - Bronze tube, brass process connection, Max. pressure connection 1,000 psi							
P - K-Monel® 500 tube, Monel® 400 process connection, Max. pressure 30,000 psi							
R - 316L SS tube, steel process connection, Max. pressure 20,000 psi							
S - 316 SS tube, 316L SS process connection, Max. pressure 20,000 psi (NSF-61 Compliant)		S					
Case Design							
S - Solid front case, dry							
SH - Solid front case, dry (IP66 NEMA 4X)			SH				
SL - Solid front case, liquid filled (glycerin STD.)							
Process Connection Sizes							
02 - ¼ NPT Male, N/A for ranges over 20,000 psi							
04 - ½ NPT Male, N/A for ranges over 20,000 psi				04			
09 - 9/16 18 UNF-2B, Aminco® high pressure fitting, pressures over 20,000 psi (STD.)							
AM - AND 10050-4 (¼ tubing connection)							
RW - SAE 7/16 & 20 Straight thread							
Process Connection Location							
L - Lower					L		
B - Back							
D - Side (3 o'clock)							
E - Side connection (9 o'clock)							
T - Top connection							
Options (If choosing an option(s) must include a "X") (See Table 1 on page 3 for more options)						–X__	
GV - Silicone case fill							
GX - Halocarbon® case fill							
LL - ***PLUS!***™ Performance						LL	
ND - PLUS! Performance, silicone free (glycerin and silicone filled gauges)							
NZ - ***PLUS!***™ Performance, silicone free dry gauges							
X1P - IP65 dry case (case cannot by liquid filled)							
NH - SS tag wired to case							
PD - Acrylic window (STD. with liquid filled or hermetically sealed cases)							
SG - Safety Glass							
C4 - Traceable calibration certificate							
6B - Cleaned for oxygen service							
5G - Attach one accessory to gauge. Applicable to PL02 pressure limiting valve, V01,V02,V03 valves, 1098, 1100, 1198, 2198 siphons, 7001, 7004 needle valves, 1115 capillary, 1106 pulsation dampner, 1112, PD02 pressure snubbers, MDV swivel adapter, 2265 electric warning contact							
Range (coding examples only, see range table on page 3 for all standard ranges)							
Single Scales							
15# - 15 psi							15#
1BR - 1 bar							
1KSC - 1 kg/cm²							
100KP - 100 kPa							
Dual Scales							
15#/BR - 15 psi inner scale, 1 bar outer scale							
1BR/# - 1 bar inner scale, 15 psi outer scale							

When selecting a diaphragm seal or isolation ring, refer to the Min/Max Guide for compatibility with this gauge or scan the QR code to the right.

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1279 Duragauge® Pressure Gauge

TABLE 1

CODE	OPTION
AB	Gauges calibrated to compensate for absolute pressure
C3	Material Traceability Report per EN 10204 3.1 (S and P wetted parts only)
DA	Dial marking (text marking on the dial)
D3	DuraVis™ retroreflective dial
EP	Maximum pointer (adjustable, N/A with liquid filled or hermetically sealed cases)
HY	Hydrostatic/pneumatic testing. (System with ranges 15 -400 PSI pressurized to 150% of rated system pressure for 5 minutes. Ranges 600 PSI - 10,000 PSI pressurized to 130% system pressure for 5 minutes.)
MQ	Positive Material Identification
NG	Non-glare glass (N/A with liquid fill or hermetically sealed cases)
OS	Overload stop
SG	Safety glass
SH	Red set hand, stationary
TM	2″ Pipe mounting bracket
TS	Throttle screw (STD. with liquid filled, hermetically sealed or ***PLUS!***™ Performance)
VS	Underload stop
56	Flush mounting ring

STANDARD PRESSURE RANGES

	psi	bar	kPa	mPa	KG (kg/cm²)
Vacuum	30IMV	N1BR	N100KP	N1MP	N1KSC
	–	N1/0.6BR	N100/60KP	0.1/0.06MP	N1/0.6KSC
Compound	V/15#	–	–	–	–
	–	N1/1.5BR	N100/150KP	N0.1/0.15MP	N1/1.5KSC
	V/30#	–	–	–	–
	–	N1/3BR	N100/300KP	N0.1/0.3MP	N1/3KSC
	V/60#	–	–	–	–
	–	N1/5BR	N100/500KP	N0.1/0.5MP	N1/5KSC
	V/100#	–	–	–	–
	–	N1/9BR	N100/900KP	N0.1/0.9MP	N1/9KSC
Positive Pressure	15#	1BR	100KP	0.1MP	1KSC
	20#	–	–	–	–
	–	1.6BR	160KP	0.16MP	1.6KSC
	30#	–	–	–	–
	–	2.5BR	250KP	0.25MP	2.5KSC
	60#	4BR	400KP	0.4MP	4KSC
	–	6BR	600KP	0.6MP	6KSC
	100#	–	–	–	–
	120#	–	–	–	–
	–	10BR	1000KP	1MP	10KSC
	160#	–	–	–	–
	200#	–	–	–	–
	–	16BR	1600KP	1.6MP	16KSC
	300#	–	–	–	–
	–	25BR	2500KP	2.5MP	25KG
	400#	–	–	–	–
	500#	–	–	–	–
	600#	40BR	4000KP	4MP	40KSC
	800#	–	–	–	–
	–	60BR	6000KP	6MP	60KSC
	1000#	–	–	–	–
	1500#	100BR	10000KP	10MP	100KG
	2000#	–	–	–	–
	–	160BR	16000KP	16MP	160KSC
	3000#	–	–	–	–
	–	250BR	25000KP	25MP	250KSC
	4000#	–	–	–	–
	5000#	–	–	–	–
	6000#	400BR	40000KP	40MP	400KSC
	8000#	–	–	–	–
	–	600BR	60000KP	60MP	600KSC
	10000#	–	–	–	–
	15000#	1000BR	100000KP	100MP	1000KSC
	20000#	-	-	-	-
	-	1600BR	-	160MP	1600KSC
	30000#	-	-	-	-

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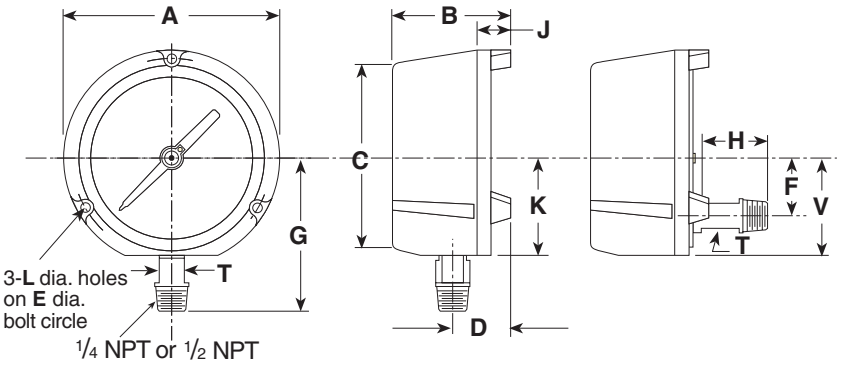
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DIMENSIONS in [ ] are millimeters

For reference only, consult Ashcroft for specific dimensional drawings

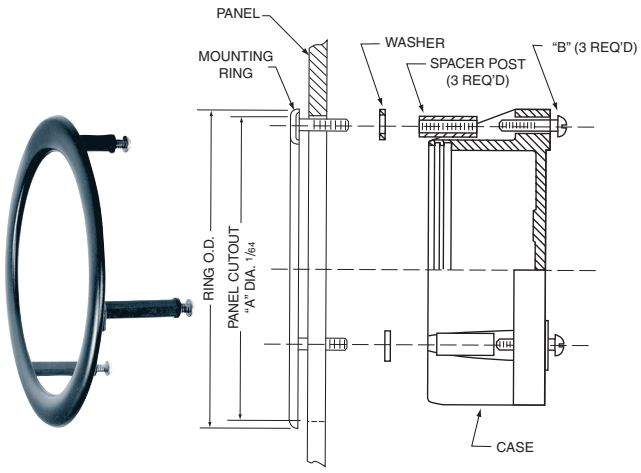
Dial Size Inches	A	B	C	D	E	F	G	H	J	K	L	T	V	Weight oz/kg
4½	5.81 [147.6]	3.36 [85.3]	5.07 [128.7]	1.60 [40.6]	5.375 [137]	1.62 [41.2]	3.92 [99.6]	0.73 [18.4]	0.94 [23.9]	2.62 [66.7]	0.218 [5.5]	0.62 [15.7]	2.62 [66.7]	2.5 (Dry) 3.5 (L.F.)



1278M Series Flush Mounting Ring

1278M Series Flush Mounting Ring. Used to flush mount gauge case 1279(*)S. Black finish (STD.); Polished SS finish (OPT.)

Gauge Size Inches	Ring O.D.	"A" DIA.	"B" Size of 3 Screws	"C" Size of Washers
4½	6 [152]	5.625 [148]	#10-24 x 1⅝	7/16 x 17/64 x 5/8



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EQUIPMENT TECHNICAL DATA SHEETS

PRESSURE GAUGE
SLUDGE PUMP DISCHARGE

Pressure Guage w/ Mini Seal:

Ashcroft® Duralife® Pressure Gauge with Flush Mini Diaphragm Seal, 2.5", 0 - 100 Psi, SS, 1009, 251009AW02LXLL100#/08330SX02TXCGCY

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Data Sheet

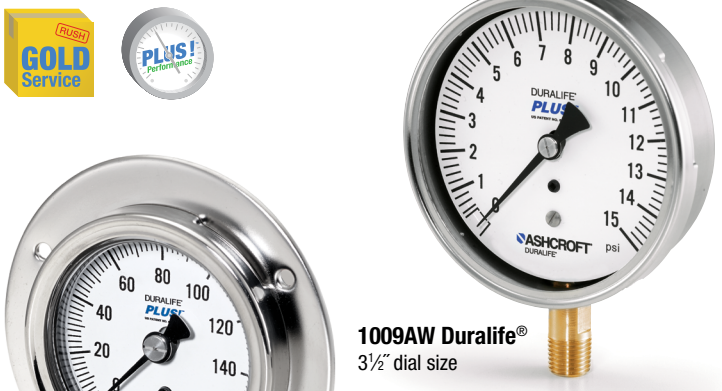
1009 2½″, 3½″ Stainless Steel Pressure Gauges

FEATURES

- Meets ASME B40.100 specifications
- All welded stainless steel construction
- ***PLUS***™ Performance option dampens vibration, shock and pulsation effects
- MSL helium leak tested to 1X10^{-6} scc/s
- Ventable fill plug
- Wide selection of connections

TYPICAL USES

- Pumps and compressors
- Boilers
- Equipment skids
- Specialized OEM equipment
- Hydraulics and pneumatics
- Severe ambient conditions
- Ammonia and refrigeration



1009AW Duralife®
3½″ dial size



1009SW Duralife®
2½″ dial size with front flange



1009SW Duralife®
2½″ dial size

SPECIFICATIONS

Accuracy:	±1% of span (Dry) (ASME B40.100 Grade 1A) ±1.5% of span (Liquid filled)
Size:	2½″, 3½″
Ranges:	AW: Vacuum, compound, to 1,000 psi SW: Vacuum, compound to 15,000 psi
Process Connection Location:	Lower, lower back, top, 3 o'clock, 9 o'clock
Process Connection Size:	¼ NPT Male, ½ NPT Male , and others listed on page 2
Movement:	304 SS with glass filled polyester segment
Dial:	Black figures on white background
Pointer:	Black, aluminum
Weather Protection:	IP65 (Plug closed), IP54 (Plug vented) NEMA 4 (Plug closed)
Mounting Option:	U-clamp, front or back flange
Dampening:	Liquid fill or ***PLUS!***™ Performance
Approval:	RoHS, CRN, CE/UKCA

WETTED COMPONENTS

Model	Bourdon Tube	Process Connection Material
SW	316L Stainless Steel	316L Stainless Steel
AW	316L Stainless Steel	Aluminum bronze

NON-WETTED COMPONENTS

Case	Window	Ring (bayonet removable)
304 Stainless Steel	Polycarbonate	304 Stainless Steel
316L Stainless Steel (OPT.)	Polycarbonate	316L Stainless Steel (OPT.)

KEY BENEFITS

- Power*Flex*™ movement provides superior resistance to shock, vibration and pulsation
- True Zero™ reduces reading errors by using "zero box" instead of conventional dial pins
- Field fillable

MIN/MAX TEMPERATURE LIMITS

Version	Ambient	Process	Storage
Dry	-40 to 200 °F (-40 to 93 °C)	-40 to 250 °F (-40 to 121 °C)	-40 to 250 °F (-40 to 121 °C)
PLUS!™	-40 to 150 °F (-40 to 66 °C)	-40 to 200 °F (-40 to 93 °C)	-40 to 150 °F (-40 to 66 °C)
Glycerin Fill	20 to 150 °F (-7 to 66 °C)	20 to 200 °F (-7 to 93 °C)	0 to 150 °F (-18 to 66 °C)
Silicone Fill	-40/150 °F (-40 to 66 °C)	-40 to 200 °F (-40 to 93 °C)	-40 to 150 °F (-40 to 66 °C)
Halocarbon Fill	-40/150 °F (-40 to 66 °C)	-40 to 200 °F (-40 to 93°C)	-40 to 150 °F (-40 to 66 °C)

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ASHCROFT®
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1009 2½″, 3½″ Stainless Steel Pressure Gauges

251009AW02LXLL100# / 08330SX02TXCGCY

ORDERING CODE: Example:	251009	SW	L	02	L	XC4	100#
Dial Size/Model Code							
25 - 251009	251009						
35 - 351009							
System							
AW - 316L SS tube/Aluminum, bronze connection (max. pressure 1,000 psi)							
SW - 316L SS tube/316L SS process connection (max. pressure 15,000 psi)		SW					
Case Fill							
(blank) Dry gauge							
L - Liquid filled case (glycerin standard)			L				
Process Connection Size							
01 - 1/8 NPT Male							
02 - ¼ NPT Male				02			
04 - ½ NPT Male (SW models only)							
RW - SAE-4, 7/16″ - 20 Straight thread							
EJ - 7/16″ X 20 UNF-3A 37° flare							
KJ - ¼″ Straight JIS, BSP - 1009SW							
KA - ¼″ Tapered JIS, BSP - 1009SW							
13 - G ¼″ DIN							
JP - ¼″ Tubing, (SW models only) N/A with throttle plug, N/A ranges above 6,000 psi							
JQ - 6mm Tubing, (SW models only) N/A with throttle plug, N/A ranges above 6,000 psi							
JL - 9/16″ 18 UNF-2A, (SW models only) N/A on 25 1009							
JR - 3/8″ Tubing, (SW models only) N/A with throttle plug, N/A on ranges above 6,000 psi							
Process Connection Location							
L - Lower					L		
B - Lower back							
D - Side (3 o'clock)							
E - Side (9 o'clock)							
T - Top							
Options (If choosing an option(s) must include an "X")						X__	
Dampening							
GV - Silicone filling (add to glycerine filled case)							
GX - Halocarbon® filling (add to glycerine filled case)							
LL - ***PLUS!***™ Performance							
NZ - ***PLUS!***™ Performance silicone free							
T4 - Push in throttle plug brass (orifice 0.007″)							
TS - Stainless helical throttle plug (standard with liquid fill and XLL (SWL) gauges 1500# and above							
TU - Throttle plug (orifice 0.013) (standard with liquid fill and XLL gauges 30# to 1000#)							
WP - No throttle plug							
ZF - Food grade silicone (add to glycerine filled gauge)							
Mounting							
FF - Front flange							
FW - Back flange							
UC - U-clamp							
Case/Movement							
LC - Weld nuts (when required on lower connect)							
LJ - Liquid fillable dry case (throttle plug is standard)							
VY - Krytox™ lubricated movement							
YW - 316L Stainless steel case/ring (only available with system 1009SW & SWL)							

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ASHCROFT®
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1009 2½˝, 3½˝ Stainless Steel Pressure Gauges

ORDERING CODE: (continued) Example:	251009	SW	L	02	L	XC4	100#
Options (If choosing an option(s) must include an "X")						X__	
Windows							
SG - Safety glass							
Pointers							
EO - Red set hand - adjustable (not available with liquid filled units)							
SH - Red set hand - stationary single							
SJ - Red set hand - stationary single							
MP - Adjustable pointer - micrometer							
Tags							
DA - Dial marking							
NH - Stainless steel tag							
NN - Paper tag							
Test and Calibration Report							
6B - Cleaned for gaseous oxygen service (for liquid filled Halocarbon® (GX) required, N/A on ranges greater than 10,000 psi)							
6W - Cleaned for gases other than oxygen							
C3 - Material certification (consult factory for availability)							
C4 - Traceable calibration certificate						C4	
HY - Hydrostatic test - when attached to a diaphragm seal add HY code to gauge and seal product code (if attached to seal charge will be on gauge only)							
KH - Any calibration other than standard							
MF - Mercury free							
MQ - Positive material identification (PMI) (only available with stainless steel systems,tube, tip, and socket)							
Refrigerants - (consult factory for available dials)							
R1 - Refrigerant 11							
R2 - Refrigerant 12							
R3 - Refrigerant 22							
R4 - Refrigerant 502							
R5 - Ammonia - (must have stainless steel wetted parts)							
R6 - Refrigerant 114							
R7 - Refrigerant 500							
R8 - Refrigerant 134A							
R9 - Refrigerant 123							
Other							
AB - Absolute pressure (gauge is offset by 14.7 psi, contact inside sales for more information)							
PR - Receiver gauge (N/A on liquid filled gauges - consult factory for available dials)							
Range (see range table for all standard ranges)							
100# - 100 psi							100#

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1009 2½˝, 3½˝ Stainless Steel Pressure Gauges

STANDARD RANGES

	psi	bar	kPa	MPa	kg/cm²
Vaccuum	30IMV	N1BR	N100KP	N0.1MP	N1KG
	–	N1/0.6BR	N1/0.6BR	N0.1/0.6MP	N1/0.6KG
	30IMV&15#	–	–	–	–
	–	N1/1.5BR	N100/150KP	N0.1/15MP	N1/1.5KG
	30IMV&30#	–	–	–	–
	–	N1/3BR	N100/300KP	N0.1/3MP	N1/3KG
Compound	30IMV&60#	–	–	–	–
	–	N1/5BR	N100/500KP	N0.1/5MP	N1/5KG
	30IMV&100#	–	–	–	–
	30IMV&150#	–	–	–	–
	30IMV&300#	–	–	–	–
	–	N1/9BR	N100/900KP	N0.1/9MP	N1/9KG
	15#	1BR	100KP	.1MP	1KSC
	20#	–	–	–	–
	–	1.6BR	160KP	.16MP	1.6KSC
	30#	–	–	–	–
	–	2.5BR	250KP	.25MP	2.5KSC
	60#	4BR	400KP	.4MP	4KSC
	–	6BR	600KP	.6MP	6KSC
	100#	–	–	–	–
	120#	–	–	–	–
	–	10BR	1,000KP	1MP	10KSC
	160#	–	–	–	–
	200#	–	–	–	–
	–	16BR	1,600KP	1.6MP	16KSC
	300#	–	–	–	–
	–	25BR	2,500KP	2.5MP	25KSC
	400#	–	–	–	–
	500#	–	–	–	–
	600#	40BR	4,000KP	4MP	40KSC
	800#	–	–	–	–
	–	60BR	6,000KP	6MP	60KSC
	1,000#	–	–	–	–
	1,500#	100BR	10,000KP	10MP	100KSC
	2,000#	–	–	–	–
	–	160BR	16,000KP	16MP	160KSC
	3,000#	–	–	–	–
	–	250BR	25,000KP	25MP	250KSC
	4,000#	–	–	–	–
	5,000#	–	–	–	–
	6,000#	400BR	40,000KP	40MP	400KSC
	8,000#	–	–	–	–
	–	600BR	60,000KP	60MP	600KSC
	10,000#	–	–	–	–
	15,000#	1,000BR	100,000KP	100MP	1,000KSC

Positive Pressure

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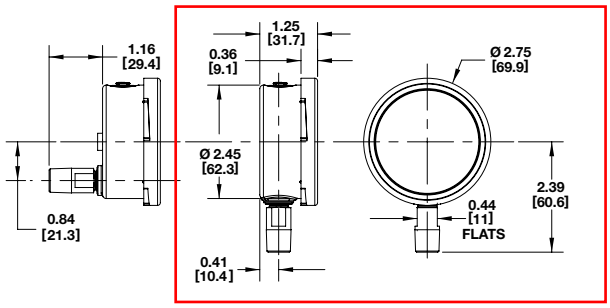
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1009 2½″, 3½″ Stainless Steel Pressure Gauges

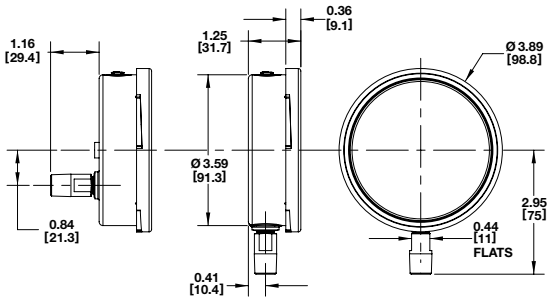
DIMENSIONS in [ ] are millimeters

For reference only, consult Ashcroft for specific dimensional drawings

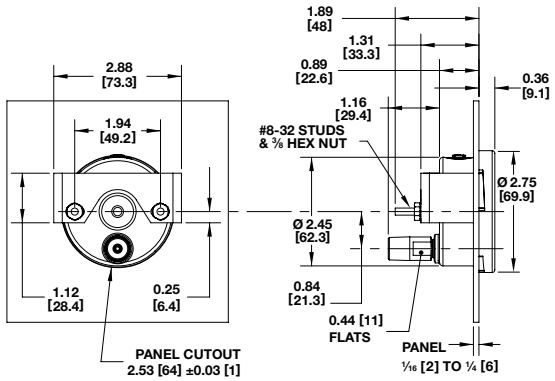
2½″ 1009 Lower and Back Connect



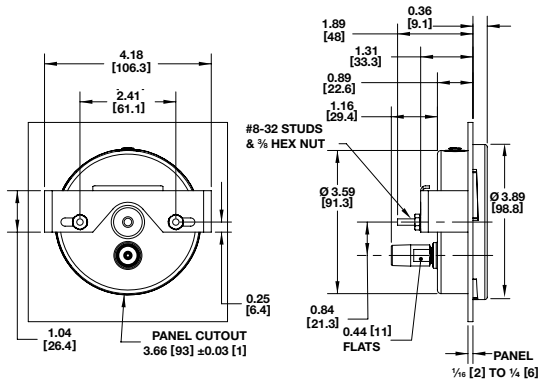
3½″ 1009 Lower and Back Connect



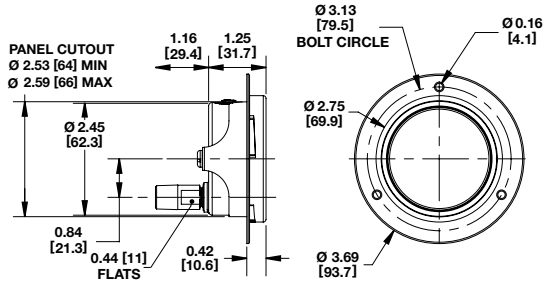
2½″ 1009 Back Connect (XUC)



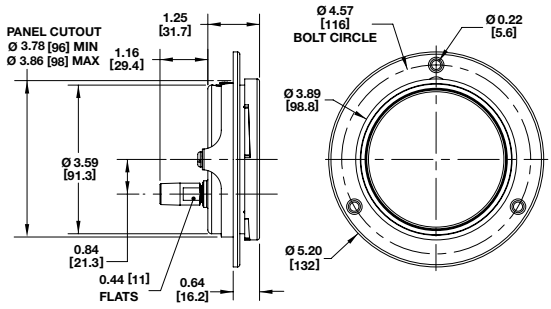
3½″ 1009 Back Connect (XUC)



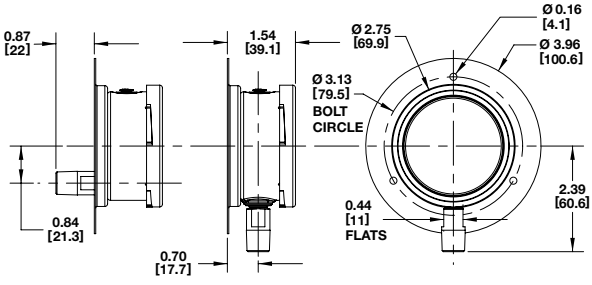
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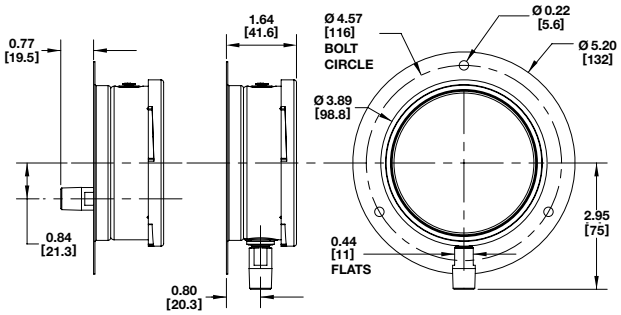
3½″ 1009 Back Connect (XFF)



2½″ 1009 Lower and Back Connect (XFW)



3½″ 1009 Lower and Back Connect (XFW)



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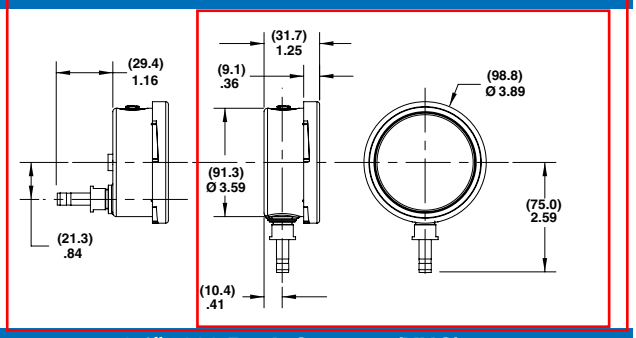
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1009 2½″, 3½″ Stainless Steel Pressure Gauges

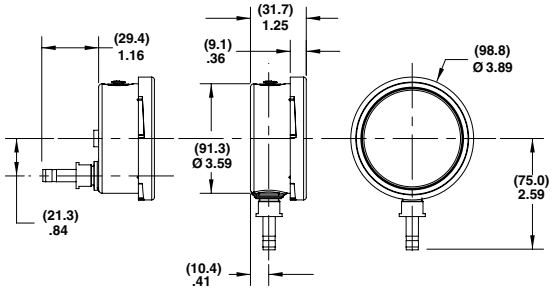
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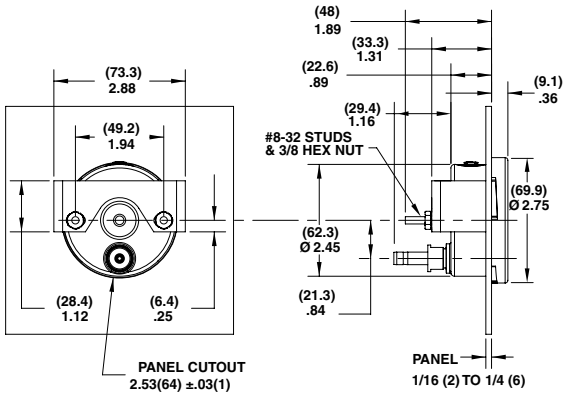
2½″ 1009 Lower and Back Connect



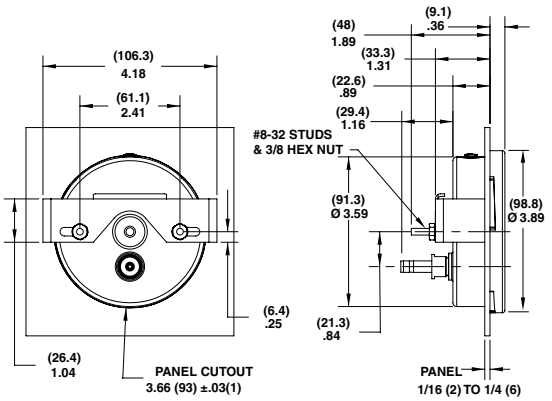
3½″ 1009 Lower and Back Connect



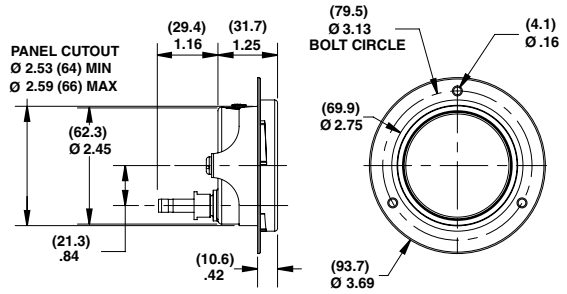
2½″ 1009 Back Connect (XUC)



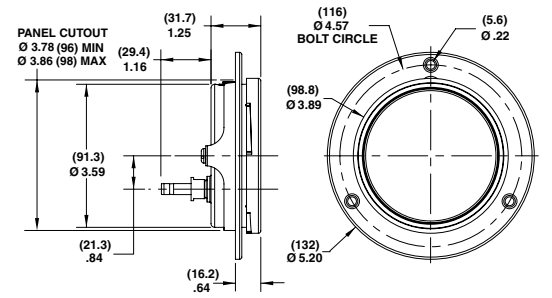
3½″ 1009 Back Connect (XUC)



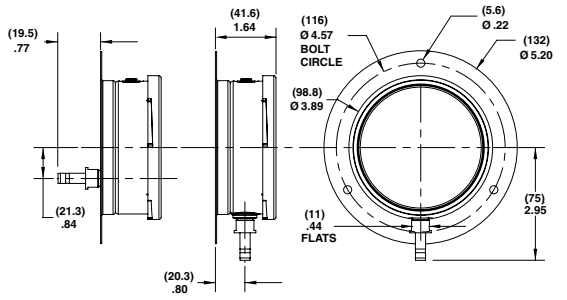
2½″ 1009 Back Connect (XFF)



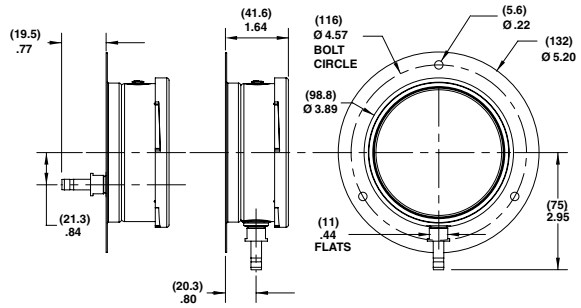
3½″ 1009 Back Connect (XFF)



2½″ 1009 Lower and Back Connect (XFW)



3½″ 1009 Lower and Back Connect (XFW)



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ASHCROFT®
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330 All-Welded Flush Mini Seal

FEATURES

- All-welded construction
- No gaskets or bolts
- Compact size to fit in limited-space areas

TYPICAL USES

- Pulp and paper
- Chemical and petrochemical
- Pharmaceutical
- Food and beverage



330
Threaded Seal

SPECIFICATIONS

Connection style:	Threaded
Process Connection:	1 NPT
Instrument Connection:	¼ or ½ NPT Female
MAWP:	3,000 psi
Fill Fluid:	See table 1

WETTED COMPONENTS

Diaphragm	Top Housing (threads)
316L SS	316L SS

KEY BENEFITS

- **All-stainlesss corrosion-resistant design**
- **Flush design prevents clogging or buildup of process media**

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1.800.328.8258

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330 All-Welded Flush Mini Seal

251009AW02LXLL100# / 08330SX02TXCGCY

TABLE 1 - FILL FLUIDS

Fill Fluid	Temperature	Viscosity (cSt at RT)	Variation Code	Notes
Glycerin (food grade)	0°F to 400°F (-18°C to 204°C)	1,300	CG	Direct-mounting only. Not for use with vacuum service
50 cSt Silicone	-40°F to 500°F (-40°C to 260°C)	50	CK	
10 cSt Silicone	-40°F to 500°F (-40°C to 260°C)	10	DJ	
Halocarbon® 4.2	-70°F to 300°F (-57°C to 199°C)	4.2	CF	For use with oxygen/oxidizing process media
Slytherm® 800	-40°F to 750°F (-40°C to 400°C)	10	HA	High temperature applications
Sylthern® XLT	-150°F to 500°F (-100°C to 260°C)	1.4	CC	Low temperature applications
Calflo® AF	-20°F to 600°F (-29°C to 316°C)	60	KF	High temperature, silicone-free
Mineral Oil	10°F to 400°F (-12°C to 204°C)	75	MY	
Neobee® M-20 (food grade)	5°F to 400°F (-15°C to 204°C)	9.5	NM	
Silicone (food grade)	-40°F to 500°F (-40°C to 260°C)	350	CZ	
Distilled Water	40°F to 185°F (4°C to 85°C)	0.9	FJ	
50/50 Glycerin/Water	15°F to 200°F (-9°C to 93°C)	30	GH	
Propylene Glycol	-50°F to 325°F (-46°C to 163°C)	54	CV	
Ethylene Glycol	20°F to 325°F (-7°C to 163°C)	14	FK	
50/50 Ethylene Glycol/Water	-25°F to 190°F (-32°C to 88°C)	2.9	CT	
80/20 Glycerin/Water	15°F to 225°F (-9°C to 107°C)	270	GR	
95/5 Water/Propylene Glycol	40°F to 185°F (4°C to 85°C)	1.0	PY	

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ashcroft.com
info@ashcroft.com
1.800.328.8258

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330 All-Welded Flush Mini Seal

251009AW02LXLL100# / 08330SX02TXCGCY

ORDERING CODE Example:	08	330	SX	02T	XCK	DU
Process Connection Size						
08 - 1 NPT Male	08					
Seal Type						
330 Flush threaded seal		330				
Diaphragm Material						
SX - 316L SS			SX			
Instrument Connection Size						
02T - ¼ NPT				02T		
04T - ½ NPT						
Options (if choosing option(s) must include an "X")					X__	
Fill Fluid (See Table 1 above for more available fill fluids)						
CK - 50 cSt Silicone					CK	
Optional Features						
NH - SS instrument tag						
DU - Instrument welded to seal (instrument connection must be of like material to top housing)						DU
MQ - Positive material identification						
6B - Cleaned for oxygen service						

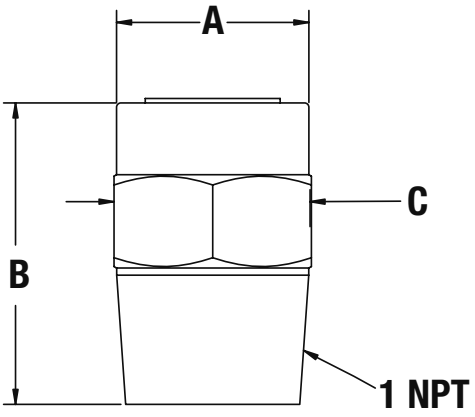
When selecting an instrument, refer to the Min/Max Guide for compatibility with this diaphragm seal or scan the QR code to the right.

DIMENSIONS in [ ] are millimeters

For reference only, consult Ashcroft for specific dimensional drawings

330 FLUSH MINI-SEAL

Model	A	B	C
330	1.34 [34]	2.13 [54]	1.38 [35]



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EQUIPMENT TECHNICAL DATA SHEETS

PRESSURE SWITCH
KROFTA AIR DISSOLVING TUBE (ADT)
LOW AIR PRESSURE

Pressure Guage w/ Mini Seal:

Ashcroft® Duralife® Pressure Gauge with Flush Mini Diaphragm Seal, 2.5", 0 - 100 Psi, SS, 1009, 251009AW02LXLL100#/08330SX02TXCGCY

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

ADT LOW AIR PRESSURE SWITCH

B-Series Switches – Pressure, Differential Pressure & Hydraulic







FEATURES

B-Series switches have proven reliable in such harsh environments as:

- ***Offshore oil rigs***
- ***Chemical and petrochemical plants***
- ***Pulp and paper mills***
- ***Steel mills***
- ***Power plants***
- ***Water and sewage-treatment plants***
- ***Other corrosive environments***

Ashcroft Inc. supplies highly reliable Ashcroft® switches and controls for industrial and process applications. We begin with rock-solid designs, matching the most appropriate technology with the safety and reliability requirements of the applications. The materials of construction are specified to Ashcroft's exacting standards, and product is built to last in the toughest applications. Our modern, responsive manufacturing facility is supported by an extensive network of stocking distributors and factory sales offices located in virtually every part of the world. Special application assistance is always just a telephone call away.

The Ashcroft B-Series switch line is designed to satisfy most switch requirements. Materials of construction have been selected for long life. A wide variety of precision switch elements are available to meet every application requirement, including hermetically sealed contacts for added reliability and safety. The actuators we use have been proven in more than 20 years of service in the world's plants and mills. Special designs are available for fire safety, NACE, limit control and other more stringent requirements. Simplicity and ease of use are stressed to improve reliability of the installation.

Applications include: pumps, compressors, washers, filters, degreasers, evapora-tors, recovery systems, food processing, ground support equipment, reverse osmosis systems, heat exchangers, hydraulic systems, lubrication systems, marine equipment, textile machinery, heating and air conditioning equipment.

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Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

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B-Series Switches – Pressure, Differential Pressure & Hydraulic

Pressure & Differential Pressure Switches

B-Series pressure, differential pressure and vacuum switches use two different actuators depending on setpoint requirements. For setpoints between 2 and 3000 psi, the simple, rugged diaphragm-sealed piston actuator is used. This design features high reliability and choice of actuator seal materials for virtually every application. An optional welded design is also available for setpoints up to 1000 psi for maximum reliability. This design is available in 316 SS or Monel. Differential pressure models use a unique, dual diaphragm-sealed piston design that features very high static operating pressures and small size.

For setpoints between 4.5 and 150 inches of H_2O, a large diaphragm is used for increased sensitivity in both pressure and differential pressure designs with good choice of materials of construction.

All standard models feature ±1 percent of range setpoint repeatability and a minimum of 400 percent of range proof pressures.

These standard designs perform well in applications where shock and vibration could be a problem and may be used in conjunction with Ashcroft diaphragm seals in extreme services such as slurries or abrasive process fluids.

PRESSURE/VACUUM SWITCHES

Nominal Range[1]			Overpressure Ratings		Approximate Deadband[2] Switch Element				
			Proof psi	Burst psi	20, 26, 27	21, 24, 31	50	22	32, 42
Vacuum									
–30″ Hg	–760mm Hg	-100 kPa	250	400	0.3-0.7	1.5-3.0	0.5-2.2	0.4-1.5	2.1-4.2
Compound									
–15″ H_2O/ 15″ H_2O	–375mm H_2O/ 375mm H_2O	–3.7 kPa/ 3.7 kPa	20	35	0.15-.75/ 0.15-.75	1.5-2.5/ 1.5-2.5	0.45-2.0/ 0.45-2.0	0.5-1.2/ 0.5-1.2	2.1-3.5/ 2.1-3.5
–30″ H_2O/ 30″ H_2O	–760mm H_2O/ 760mm H_2O	–7.5 kPa/ 7.5 kPa	20	35	0.30-.60/ 0.30-.60	1.5-2.5/ 1.5-2.5	0.45-2.0/ 0.45-2.0	0.5-1.5/ 0.5-1.5	2.1-3.5/ 2.1-3.5
–30″ Hg/ 15 psi	–760mm Hg/ 1.0 kg/cm²	–100 kPa/ 100 kPa	250	400	0.5-1.0/ 0.3-0.7	2.0-3.0/ 0.5-1.5	0.75-2.5/ 0 .5-1.0	0.7-1.8/ 0.7-1.4	2.8-4.2/ 0.7-2.1
–30″ Hg/ 30 psi	–760mm Hg/ 2.0 kg/cm²	–100 kPa/ 200 kPa	250	400	1.0-1.5/ 0.3-0.8	3.0-6.0/ 1.0-2.0	1.2-4.5/ 0.7-1.5	1.4-2.4 0.4-1.3	4.2-8.4/ 1.4-2.8
–30″ Hg/ 60 psi	–760mm Hg/ 4.0 kg/cm²	–100 kPa/ 400 kPa	250	400	2.0-3.0/ 0.7-1.5	5.0-9.0/ 3.0-5.0	2.5-7.0/ 1.1-4.0	2.8-4.5 1.0-2.3	7.0-12.0/ 4.2-7.0
Pressure									
10″ H_2O	250mm H_2O	2.5 kPa	20	35	0.2-0.5	1.0-2.0	0.35-1.5	0.4-1.0	1.4-2.8
30″ H_2O	750mm H_2O	7.5 kPa	20	35	0.3-0.6	1.5-2.5	0.45-2.0	0.5-2.0	2.1-3.5
60″ H_2O	1500mm H_2O	15 kPa	20	35	0.5-1.3	1.5-3.5	0.9-2.5	0.7-3.0	2.1-5.0
100″ H_2O	2500mm H_2O	25 kPa	20	35	0.6-1.6	2.5-5.5	1.1-4.0	1.0-4.0	3.5-7.7
150″ H_2O	3750mm H_2O	37 kPa	20	35	1.0-2.5	4.5-8.5	1.7-6.5	2.0-6.0	6.0-12.0
15 psi	1.0 kg/cm²	100 kPa	500	1500	0.1-0.35	0.5-1.5	0.2-1.0	0.4-1.0	0.7-2.1
30 psi	2.0 kg/cm²	200 kPa	500	1500	0.1-0.50	0.5-1.5	0.3-1.0	0.4-1.0	0.7-2.1
60 psi	4.0 kg/cm²	400 kPa	500	1500	0.3-1.0	1.0-3.5	0.7-2.5	0.6-2.0	1.4-5.0
100 psi	7.0 kg/cm²	700 kPa	1000	3000	0.5-1.7	1.5-5.0	1.1-3.5	1.0-4.5	2.1-7.0
200 psi	14 kg/cm²	1400 kPa	1000	3000	1-3	5-13	2-9	3.0-7.5	7.0-18.2
400 psi	28 kg/cm²	2800 kPa	2400	3000	4-7.5	5-24	5.5-15	4.0-11.0	7.0-33.6
600 psi	42 kg/cm²	4200 kPa	2400	3000	4-11	9-30	7-20	5.0-23.0	12.6-42
1000 psi	70 kg/cm²	7000 kPa	12000	18000	7-30	30-110	18-70	15-80	42-154
3000 psi	210 kg/cm²	2100 kPa	12000	18000	15-60	80-235	37-160	30.0-230	112-329

DIFFERENTIAL PRESSURE SWITCHES

Nominal Range[1]			Pressure Ratings		Approximate Deadband[2] Switch Element				
			Static Working Pressure	Proof psi	20, 26, 27	21, 24, 31	50	22	32, 42
30″ H_2O	750mm H_2O	7.5 kPa	5.4	21.6	0.3-0.6	1.5-2.5	0.45-2.0	0.5-2.0	2.1-3.5
60″ H_2O	1500mm H_2O	15 kPa	5.4	21.6	0.5-1.3	1.5-3.5	0.9-2.5	0.7-3.0	2.1-5.0
100″ H_2O	2500mm H_2O	25 kPa	5.4	21.6	0.6-1.6	2.5-5.5	1.1-4.0	1.0-4.0	3.5-7.7
150″ H_2O	3750mm H_2O	37 kPa	5.4	21.6	1.0-2.5	4.5-8.5	1.8-6.5	2.0-6.0	6.3-12.0
15 psid	1.0 kg/cm²	100 kPa	500	2000	0.5-1.0	2.0-5.0	0.7-3.5	0.7-1.4	2.8-7.0
30 psid	2.0 kg/cm²	200 kPa	500	2000	1.0-2.0	2.0-5.0	1.5-3.5	1.4-2.8	2.8-7.0
60 psid	4.0 kg/cm²	400 kPa	500	2000	2.0-4.0	3.0-6.0	3.0-4.5	2.8-5.6	4.2-8.5
100 psid	7.0 kg/cm²	700 kPa	1000	4000	4.0-10.0	11.0-20.0	7.0-15.0	6.0-14.0	16.0-28.0
200 psid	14.0 kg/cm²	1400 kPa	1000	4000	5.0-15.0	12.0-40.0	10.0-26.0	7.0-21.0	17.0-56.0
400 psid	28.0 kg/cm²	2800 kPa	1000	8000	10.0-20.0	20.0-60.0	15.0-40.0	14.0-28.0	28.0-84.0
600 psid	42 0 kg/cm²	4200 kPa	1000	8000	20.0-40.0	80.0-150.0	30.0-115.0	30.0-56.0	112.0-210.0

Values shown are for zero static working pressure.

NOTES:

1 Switches may generally be set between 15% and 100% of nominal range on increasing pressure. Consult factory for applications where setpoints must be lower.

2 All deadbands are given in English units as shown in the nominal range column. Deadbands shown are for switches with Buna N diaphragm. Approximate deadbands for optional diaphragms:

Viton:	Multiply Buna N value by 1.4
Teflon:	Multiply Buna N value by 1.2
Stainless Steel:	Multiply Buna N value by 1.7
Monel:	Multiply Buna N value by 1.7
Dual Switch Element:	Multiply single switch element value by 1.6 for approximate deadband.

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B-Series Switches – Pressure, Differential Pressure & Hydraulic

B-SERIES PRESSURE AND DIFFERENTIAL PRESSURE SWITCH MODEL NUMBER:

To specify the exact switch desired, select entries from appropriate tables as shown in example below.

1		2		3	4			5
B	4	2	0	B	X	P	K	600 PSI

1 – ENCLOSURE	
B4	Pressure switch, Type 400, watertight enclosure meets NEMA 3, 4, 4X, 13 and IP66 requirements.
B7(1)	Pressure switch, Type 700, explosion-proof enclosure meets Div. 1 & 2, NEMA 7, 9 and IP66 requirements.
D4	Differential pressure switch, Type 400, water-tight enclosure meets NEMA 3, 4, 4X, 13 and IP66 requirements.
D7(1)	Differential pressure switch, Type 700, explosion-proof enclosure meets Div. 1 & 2, NEMA 7, 9 and IP66 requirements.

3 – ACTUATOR SEAL					
		Range			
Code and Material	**Process Temperature Limits °F**(9)	**Vac. ˝ H_2O**	**0-600 psi**	**1000 psi**	**3000 psi**
B – Buna-N	0 to 150	•	•	•	•
V – Viton	20 to 300	•	•	•	
T – Teflon	0 to 150	•	•	•	•
S – 316L(8)	0 to 300		•	•	
P – Monel(8)	0 to 300		•	•	

4 – OPTIONS	5 – RANGE
Use table from page 5	Select from table on page 2

NOTES:

1 Standard housing epoxy coated aluminum. Use variation code XYW for 316SS housing.
2 Not available with psid ranges.
3 Dual switches are 2 SPDT snap-action switches, not independently adjustable.
4 Wires cannot be terminated inside B400 switch enclosure.
5 Not available with type 700 enclosure.
6 Estimated dc. rating, 2.5A, 28 Vdc (not UL listed).
7 Estimated dc rating, 0.4A, 120 Vdc (not UL listed).
8 Available on pressure only.
9 Ambient operating temperature limits –20 to 150°F, all styles, setpoint shift of ±1% of range per 50°F temperature change is normal. Switches are calibrated at 70°F reference.

2 – SWITCH ELEMENT SELECTION		
Order Code	**Switch Elements UL/CSA Listed SPDT**	
20(7)	Narrow deadband ac	15A, 125/250 Vac
21	Ammonia service	5A, 125/250 Vac
22(6)	Hermetically sealed switch, narrow deadband	5A, 125/250 Vac
23	Heavy duty ac	22A, 125/250 Vac
24(1)	General purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc; 6A, 30 Vdc
25(2)	Heavy duty dc	10A, 125 Vac or dc, ⅛ HP, 125 Vac or dc
26(7)	Sealed environment proof	15A, 125/250 Vac
27	High temperature 300°F	15A, 125/250 Vac
28(5)	Manual reset trip on increasing	15A, 125/250 Vac
29(5)	Manual reset trip on decreasing	15A, 125/250 Vac
31	Low level (gold) contacts	1A, 125 Vac
32	Hermetically sealed switch, general purpose	11A, 125/250 Vac 5A, 30 Vdc
42	Hermetically sealed switch, gold contacts	1A, 125 Vac
50	Variable deadband	15A, 125/250 Vac
	UL/CSA Listed Dual (2 SPDT)	
61(7)	Dual narrow deadband	15A, 125/250 Vac
62(7)	Dual sealed environment proof	15A, 125/250 Vac
63	Dual high temp. 300°F	15A, 125/250 Vac
64	Dual general purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc
65	Dual ammonia service	5A, 125/250 Vac
67(4,6)	Dual hermetically sealed switch, narrow deadband	5A, 125/250 Vac
68(4)	Dual hermetically sealed switch, general purpose	11A, 125/250 Vac 5A, 30 Vdc
70	Dual low level gold contacts	1A, 125 Vac
71(4)	Dual hermetically sealed switch, gold contacts	1A, 125 Vac

B-Series Switches – Pressure, Differential Pressure & Hydraulic

OPTIONAL FEATURES AND ACCESSORIES

B-SERIES SWITCH OPTIONS							
		Appicable Switch Series					
		Pressure		Differential Pressure		H	
Code	Description	(psi)	(in. H_2O)	(psi)	(in. H_2O)		Notes
XBP	Wall Mounting Bracket in. H_2O		•		•		
XBX	½″ Male NPT Bushing					•	
XCH	Chained Cover	•	•	•	•	•	
XC8	CSA Approval	•	•	•	•		10
XCN	ATEX Directive 94/9/EC/IECEx Rating	•	•	•	•		15
XD2	Dual Seal Rating (700 Series only)	•			•		
XFM	FM Approval – Single Element	•	•	•	•		14
	FM Approval – Dual Element	•	•	•	•		14
XFP	Fungus Proofing	•	•	•	•	•	
XFS	Factory Adjusted Setpoint	•	•	•	•	•	2
XG3	Belleville Actuator	•					13,14
XG5	UL Limit Control to 150″ H_2O				•		1, 14
XG6	UL Limit Control to 600 psi	•					1, 14
XG7	Secondary Chamber with Vent	•					11
XG8	Steam Limit Control to 300 psi	•					7
XG9	Fire Safe Welded Actuator	•					7
XHS	High Static Differential Pressure			•			12
XHX	High Pressure, 40 psi, (static) d/p only 160 psi (proof) d/p only 100 psi (proof) pressure only (″ H_2O)		•		•		
XJK	Left Conduit Connection	•	•	•	•	•	8
XJL	¾″ to ½″ Reducing Bushing	•	•	•	•	•	
XJM	Metric Electrical Conduit Connection M20 x 1.5	•	•	•	•	•	
XK3	Terminal Block (700 Series only)	•	•	•	•		6
XLE	6 foot Leads on the Micro Switch	•	•	•	•	•	
XNH	Tagging Stainless Steel	•	•	•	•	•	
XNN	Paper Tag	•	•	•	•	•	
XPK	Pilot Light(s) Top Mounted	•	•	•	•	•	4
XPM	¾″ Sealed Conduit Connection with 16″ Lead Wires	•	•	•	•	•	
XTA	316 Stainless Steel Pressure Connection for in. H_2O Range		•		•		
XTM	2″ Pipe Mounting Bracket	•	•	•	•		
XUD	316 Stainless Steel Pressure Conn.			•			
X06	Pressure Connection: ½ NPT Male, ¼ NPT Female 316 Stainless Steel (Combination)	•	•	•	•		5
X07	½ NPTF Press. Conn., 316 SS	•	•	•	•		9
X6B	Cleaned for Oxygen Service	•	•	•			3
	Diaphragm Seal	•	•	•	•		

NOTES:

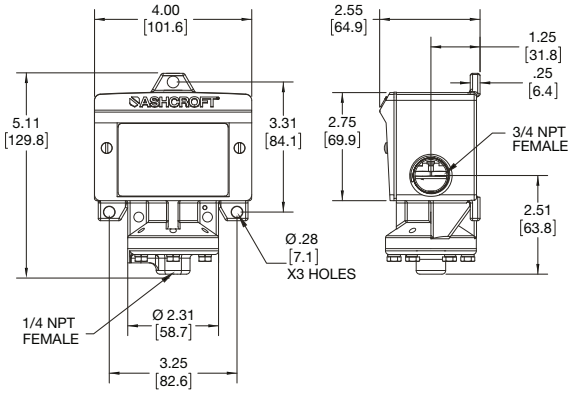
1 Buna N and Viton diaphragm.
2 Advise static or working pressure for differential pressure switches.
3 Buna N cannot be cleaned for oxygen service.
4 N/A on 700 Series.
5 Standard with 1000 and 3000 psi ranges. Bottom connection only on DP in H_2O ranges.
6 Terminal Blocks standard with 700 dual switches.
7 Stainless steel diaphragm only.
8 Standard on 700 Series. N/A with DPDT element on 400 Series.
9 N/A with Monel diaphragm.
10 Standard on 400 Series.
11 SS diaphragm required. Teflon diaphragm is the backup. NEMA 7 only.
12 Buna N and Viton diaphragm – 15#D & 30#D only.
13 24, 32, 64 or 68 element only.
14 N/A on all combinations.
15 700 Series only.

Ex II 2GD
Ex d IIC T6 Gb
Ex t IIIC T85° C Db IP 6X
(Ta = –20°C to +60°C)

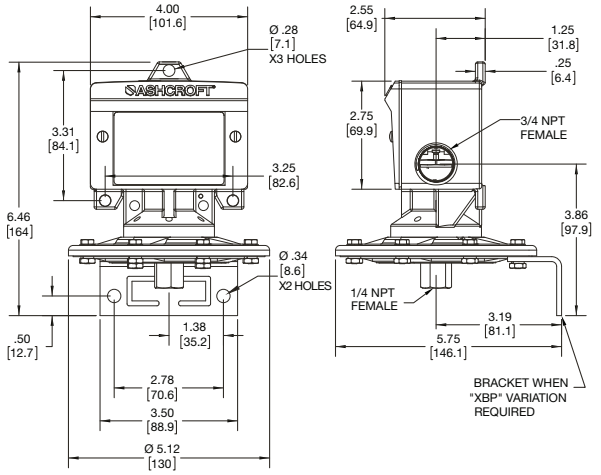
B-Series Switches – Pressure, Differential Pressure & Hydraulic

Dimensions – 400 Series

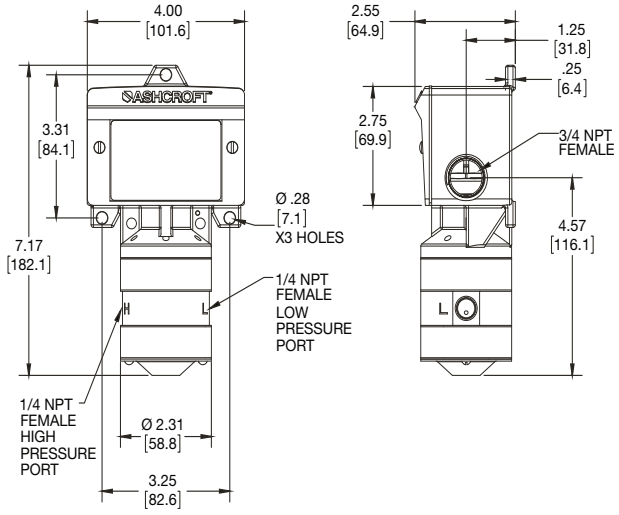
Pressure switch – psi ranges



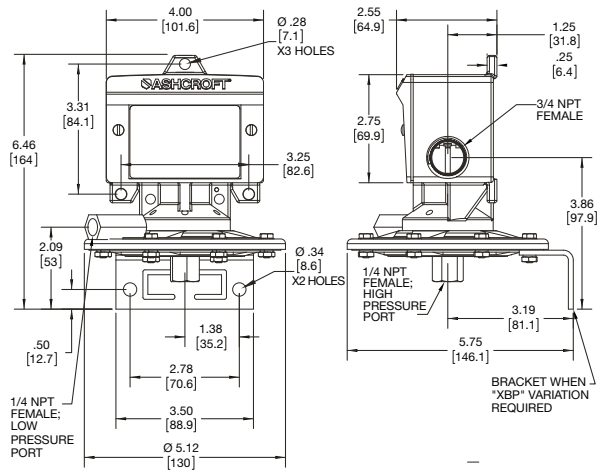
Pressure switch – inches of water ranges



Differential pressure switch – psi differential ranges



Differential pressure switch – inches of water ranges



ASHCROFT®
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World Headquarters

Ashcroft Inc.
250 E. Main Street
Stratford, CT 06614-5145 U.S.A.
Tel: (203) 378-8281
Fax: (203) 385-0408
email: info@ashcroft.com
www.ashcroft.com

International Operations

Brazil
Willy Instrumentos de Medicao e
Controle Ltda.
Rua Joao Pessoa, 620
09520-000
Sao Caetano Do Sul-Sao Paulo-Brazil
Tel: 55-11-4224-7402
Fax: 55-11-4224-7477
email: contato@ashcroft.com
www.ashcroft.com.br

China
Ashcroft Instruments (Suzhou) Co., Ltd.
1508 Lin-hu Avenue
Ascendas Lin-hu Industrial Square
Wujiang Fenhu Economic Zone
Wujiang China, 215211
Tel: 011-86-512-6326-9101
Fax: 011-86-512-6326-9106
www.ashcroft.com

France
Ashcroft Instruments GmbH Sales Office
48, Chemin des Landes
69700 Montagny
France
Tel: 33 (0) 9 65 32 71 31
Fax: 33 (0) 4 72 39 10 57
email: ashcroft.france@wanadoo.fr

Germany
Ashcroft Instruments GmbH
Postfach 11 20, D-52490
Baesweiler, Germany
Max-Planck-Strasse 1, D-52499
Baesweiler, Germany
Tel: 49-2401-8080
Fax: 49-2401-808 125
email: sales@ashcroft.com
www.ashcroft.eu

India
Ashcroft India Pvt. Ltd.,
Plot 2306, G.I.D.C. Chhatral,
Ta. Kalol, Dist. Gandhinagar,
Chhatral 382729, India.
Tel: 91-2764-233681/82/83
Fax: 91-2764-233440
sales@ashcroftindia.com
www.ashcroftindia.com

Mexico
Ashcroft Instruments Mexico, S.A. de C.V.
General Mariano Arista No. 54 Nave 8
Col. Argentina Poniente
Deleg. Miguel Hidelgo
11230 Mexico City, Mexico
Tel: 525-550-82-3030
Fax: 525-550-82-3027
email: jmendieta@ashcroft.com.mx

Saudi Arabia
AARICO
P.O. Box 12031
Jubail Industrial City 31961
Kingdom of Saudi Arabia
Tel: 966-3-341-0278
Fax: 966-3-341-7624
email:anil@aarico.net
www.ashcroft-alrushaid.com

Singapore
Ashcroft Instruments Singapore Pte. Ltd.
Block 1004 Toa Payoh North
#07-15/17
Singapore 318995
Tel: 65-6252-6602
Fax: 65-6252-6603
email: John.Wong@ashcroft.com.sg

United Kingdom
Ashcroft Instruments GmbH Sales Office
Cambridge Office
Unit 17 & 18 William James House
Cowley Road
Cambridge CB4 0WX
Tel: 44-0-1223-395500
Fax: 44-0-1223-395501
email: sales@ashcroftuk.com

Venezuela
Manufacturas Petroleras Venezolanas S.A.
KM7 Carretera A
El Mojan Calle 18
#15B355 Zona
Ind. Norte Sector Canchancha
Maracaibo Edo Zulia Venezuela
Tel: 58-261-757-9070
Tel: 58-261-742-4372
Fax: 58-261-757-9461
email: contactenos@mapvensa.com
www.mapvensa.com

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Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

EQUIPMENT TECHNICAL DATA SHEETS

TURBIDITY TRANSMITTER

TURBIDITY TRANSMITTER:
E&H pH Transmitter - Model: CM442-4PC2/0; CM442-AAM1A2F061A
Liquiline CM442
Transmitter liquid analysis pH/ORP
Digital sensors; Memosens protocol, Navigator+softkeys, graphical display, Plug&play for sensors +modules, SD-slot data logger, alarm relay, IP66+IP67, NEMA Type 4X enclosure.

AA Approval: Non-hazardous area
M1 Sensor Input: 1x digital sensor
A2 Communication: 2x output 0/4...20mA, HART
F0 Additional Features: W/o
6 Power supply: 24VDC
1 Cable Entry: NPT
A Cable Entry Set: enclosed

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

TI00444C/07/EN/23.19
71478325
2019-11-30

Technical Information
Liquiline CM442/CM444/CM448

Multiparameter transmitter with a maximum of eight measuring channels based on digital Memosens technology



For monitoring and controlling processes in industry and the environmental sector

Application

- Water and wastewater
- Power stations
- Chemical industry
- Other industrial applications

Your benefits

- Highly flexible:
  - Able to connect up to 8 Memosens sensors
  - Mathematics functions calculate new measured values
  - Digital fieldbuses (HART, PROFIBUS, Modbus, Ethernet/IP, PROFINET) and integrated web server
  - Choice of cleaning function, controller and alarm relay
  - Optional digital or analog inputs/outputs
- Maximum process safety thanks to standardized operating concept across all devices in the Liquiline, sampler and analyzer platform
- Fast commissioning thanks to:
  - Memosens: lab-calibrated sensors & hot plug-and-play
  - Preconfigured Liquiline transmitters
  - Easy extension and adaptation
- Minimum inventory:
  - Cross-platform, modular concept (e.g. identical modules irrespective of parameters)
  - Integration into FieldCare and W@M facilitates effective asset management

Endress+Hauser
People for Process Automation

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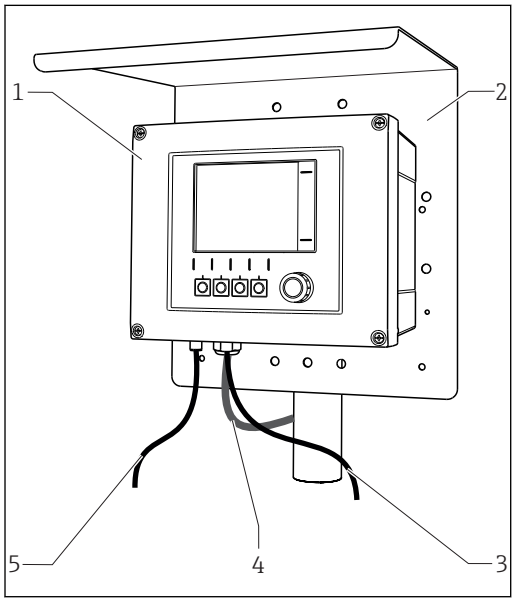
Function and system design

Measuring system

The overview shows examples of measuring systems. Other sensors and assemblies can be ordered for conditions specific to your application (www.endress.com/products).

Measuring point

A complete measuring system comprises:
- TransmitterLiquiline
- Sensors with Memosens technology
- Assemblies to suit the sensors used
- Post or rail mounting (optional)
- Weather protection cover (optional)

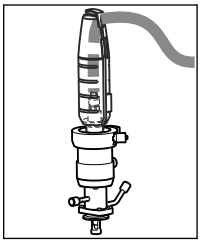


1 Measuring system (e.g. two-channel device)

1 Liquiline
2 Weather protection cover CYY101 (optional)
3, 5 Sensor cable CYK10 or fixed cable
4 Power supply cable (to be provided by the customer)

pH value or ORP

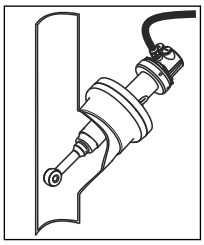
pH measurement in drinking water (→ Fig.)
- Retractable assembly Cleanfit CPA871
- Sensor Orbisint CPS11D
- Measuring cable CYK10



ORP in drinking water
- Dipfit CYA112 immersion assembly
- Sensor Orbisint CPS12D
- Measuring cable CYK10

Conductivity

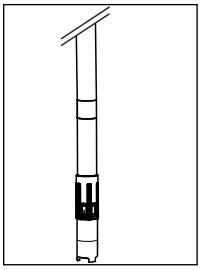
Inductive conductivity measurement in wastewater treatment
- Sensor Indumax CLS50D
- Sensor fixed cable



Conductive conductivity measurement in power plant cooling water
- Sensor Condumax CLS15D
- Measuring cable CYK10

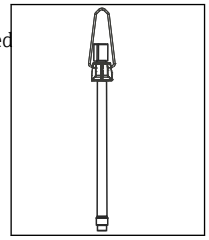
Oxygen

Oxygen in aeration basins
- Dipfit CYA112 immersion assembly
- Holder CYH112
- Sensor
  - COS61D (optical) with fixed cable (→ Fig.)
  - COS51D (amperometric), cable CYK10



Nitrate and SAC

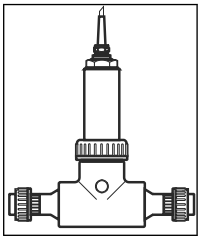
Nitrate in wastewater
- Sensor CAS51D-**A2 with fixed cable
- Dipfit CYA112 immersion assembly
- Holder CYH112



SAC in the wastewater treatment outlet
- Sensor CAS51D-**2C2 with fixed cable
- Dipfit CYA112 immersion assembly
- Holder CYH112

Turbidity and interface

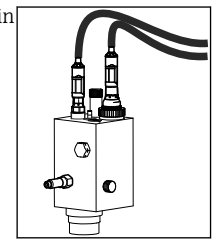
Turbidity in industrial water
- Sensor Turbimax CUS51D with fixed cable (→ Fig.)
- Assembly Flowfit CUA250
- Spray head CUR3 (optional)



Interface in the primary clarifier
- Sensor Turbimax CUS71D
- Assembly CYA112
- Holder CYH112

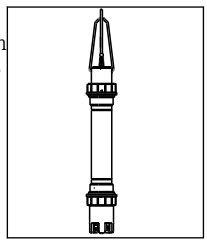
Disinfection

Free available chlorine (and pH) in drinking water
- Sensor CCS142D
- Sensor CPS11D
- Measuring cable CYK10
- Flow assembly CCA250



Ion-selective electrodes

Ammonium and nitrate measurement in the aeration basin
- Sensor CAS40D with fixed cable
- Holder CYH112

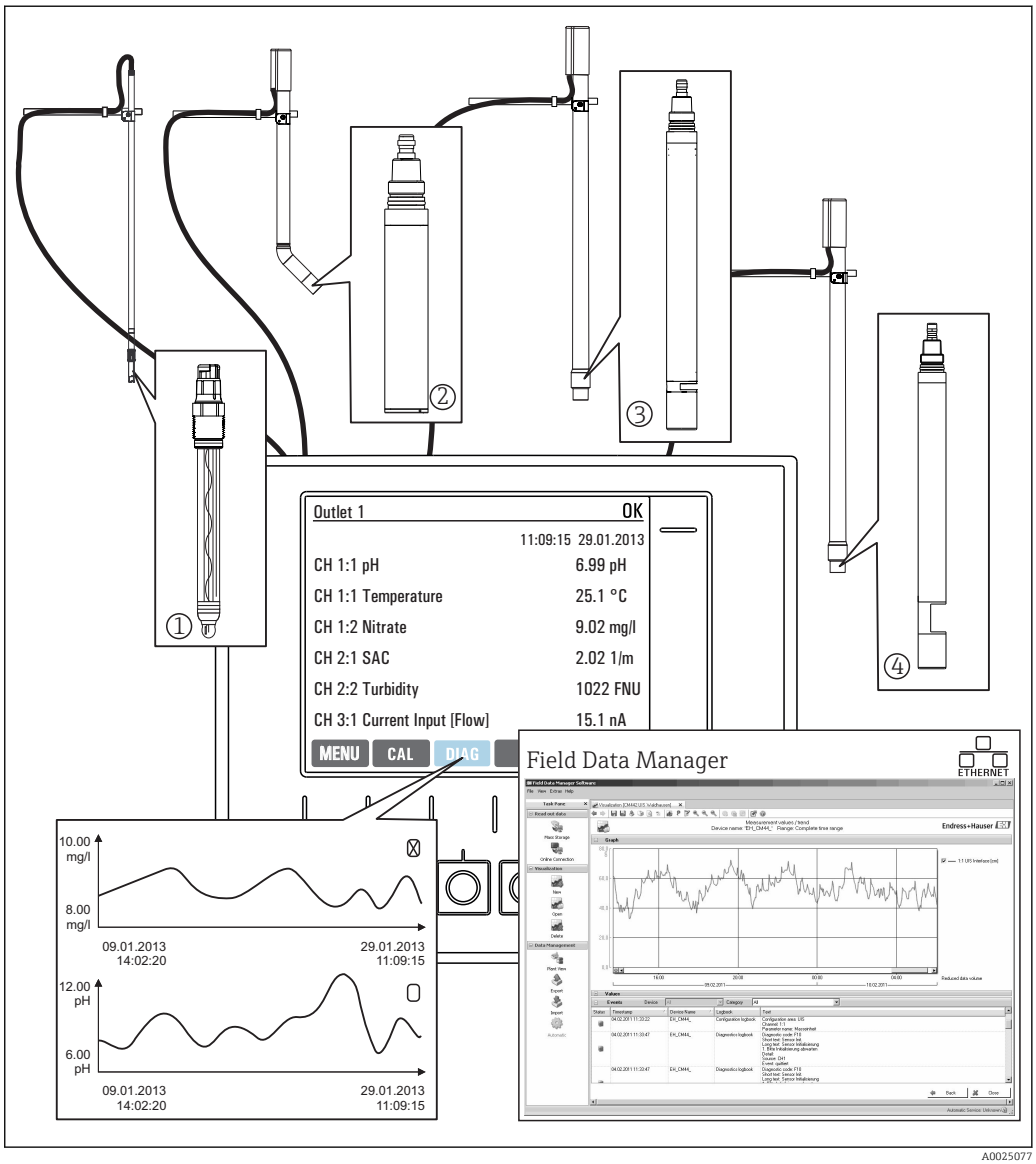


If mounting outdoors, always use the weather protection cover (see "Accessories") to protect the transmitter against weather conditions.

Application example

Measuring point at wastewater treatment plant outlet (open channel)

- Transmitter CM444-AAM44A0FF with:
  4x Memosens, Modbus TCP, 4 x relays for cleaning/limit value, 2 x analog current input
- pH and temperature with CPS11D, item 1, (www.endress.com/cps11d)
- Turbidity with CUS51D, item 2, (www.endress.com/cus51d)
- Nitrate with CAS51D, item 3, (www.endress.com/cas51d)
- Spectral absorption coefficient with CAS51D, item 4, (www.endress.com/cas51d)
- Flow from external measurement via current input
- Assembly holder CYH112 with assemblies CYA112 (www.endress.com/cyh112)



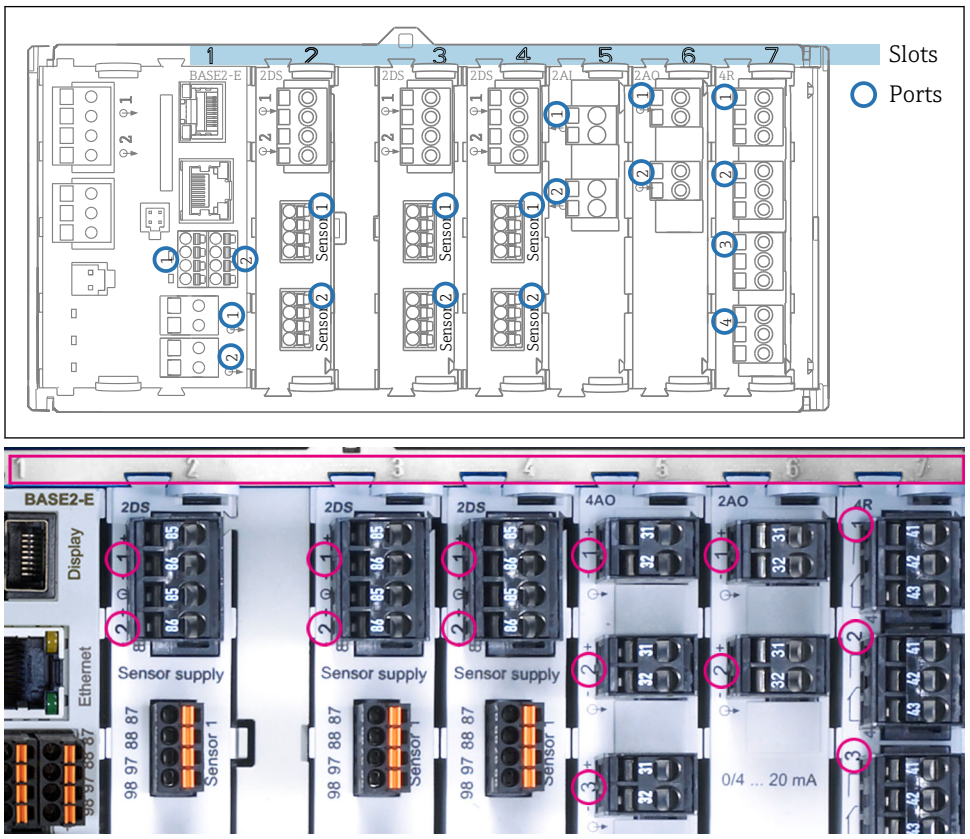
2 *Measuring point at wastewater treatment plant outlet*

Data retention

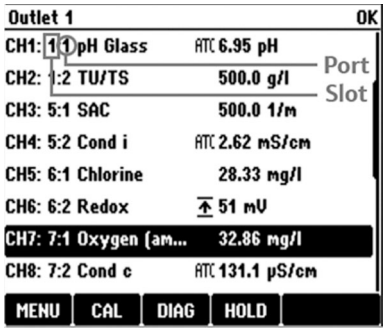
- Storage of all measured values, incl. values of external sources, in the non-volatile memory (data logbook)
- Data called up on site via user-defined measuring menu and load curve display of the data logbook
- Transmission of data by ethernet, CDI interface or SD card and storage in a tamper-proof database (Field Data Manager)
- Data export to csv file (for Microsoft Excel)

Device architecture

Slot and port assignment



3 *Slot and port assignment of the hardware modules*



4 *Slot and port assignment on the display*

- Inputs are assigned to measuring channels in the ascending order of the slots and ports.
  Adjacent example:
  "CH1: 1:1 pH glass" means:
  Channel 1 (CH1) is slot 1 (basic module) : Port 1 (input 1), pH glass sensor
- Outputs and relays are named according to their function, e.g. "current output", and are displayed in ascending order with the slot and port numbers

Order of the modules

Depending on the version ordered, the device is supplied with a number of electronic modules, which are assigned in a specific sequence in ascending order to slots 0 to 7. If you do not have a particular module, the next moves up automatically:

- The basic module (which is always present) always occupies slots 0 and 1
- Fieldbus module 485
- Memosens input module 2DS (DS = digital sensor)
- Extension module for digital inputs and outputs DIO (DIO = digital input and output)
- Current input module 2AI (AI = analog input)
- Current output module 4AO or 2AO (AO = analog output)
- Relay modules AOR, 4R or 2R (AOR = analog output + relay, R = relay)

Modules with 4 ports are connected before modules of the same type with 2 ports.

Basic rule for hardware upgrades

Please note the following if upgrading the device:

- The sum of all current inputs and outputs may not exceed 8!
- A maximum of two "DIO" modules may be used.

Determining the hardware delivery status

You must be aware of the type of modules and the number of them supplied with the device you have ordered to determine the delivery status of your Liquiline.

- Basic module
  One basic module in all versions. Always occupies slots 0 and 1.
- Fieldbus module
  Optional, and only one fieldbus module is possible.
- Input modules
  - Must be clearly assigned to the number of optional inputs ordered.
  - Examples:
    2 current inputs = module 2AI
    4 Memosens inputs = 2 inputs with basic module + module 2DS with 2 further inputs
- Current outputs and relays
  Various module combinations can exist.
  The following table will help you determine which modules your device has, depending on the type and number of outputs.

	Relays		
Current outputs	**0**	**2**	**4**
2	-	1 x 2R	1 x 4R
4	1 x 2AO	1 x AOR	1 x 2AO + 1 x 4R
6	1 x 4AO	1 x 4AO + 1 x 2R	1 x 4AO + 1 x 4R
8	1 x 4AO + 1 x 2AO	1 x 4AO + 1 x 2AO + 1 x 2R	1 x 4AO + 1x 2AO + 1 x 4R

▶ Sum up the number of modules and sort them according to the specified sequence → 6.
↳ This will give you the slot assignment for your device.

Terminal diagram

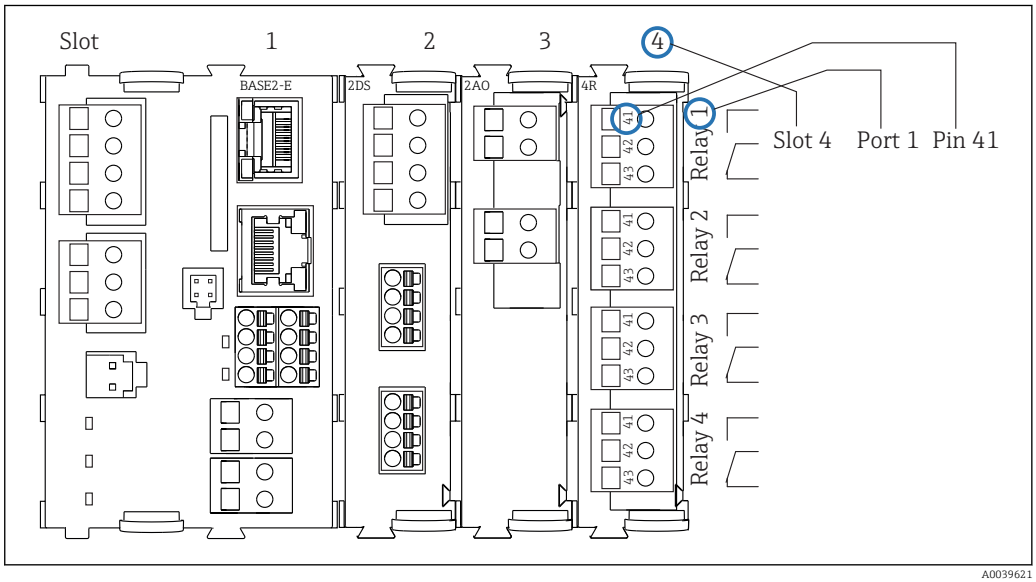
The unique terminal name is derived from:

Slot no. : Port no. : Terminal

Example, NO contact of a relay

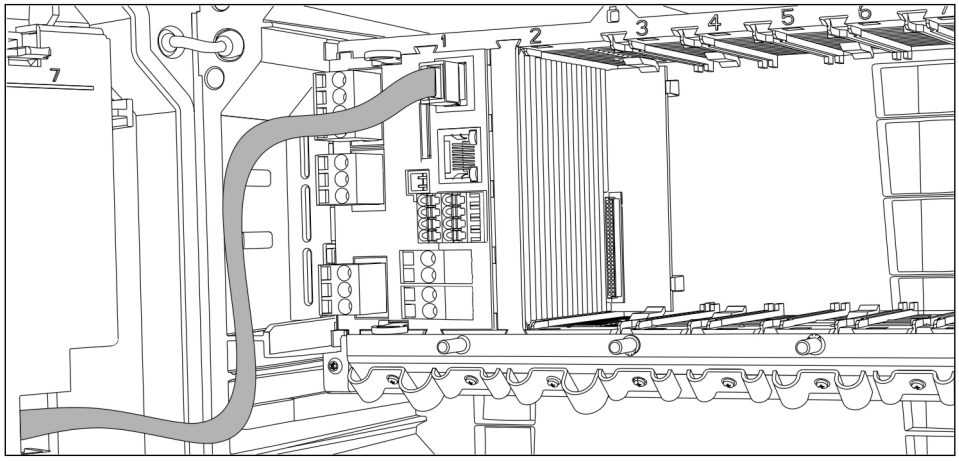
Device with 4 inputs for digital sensors, 4 current outputs and 4 relays

- Base module BASE2-E (contains 2 sensor inputs, 2 current outputs)
- 2DS module (2 sensor inputs)
- 2AO module (2 current outputs)
- 4R module (4 relays)



5 *Creating a terminal diagram using the example of the NO contact (terminal 41) of a relay*

Device configuration using the example of a CM442-M1A1F0***

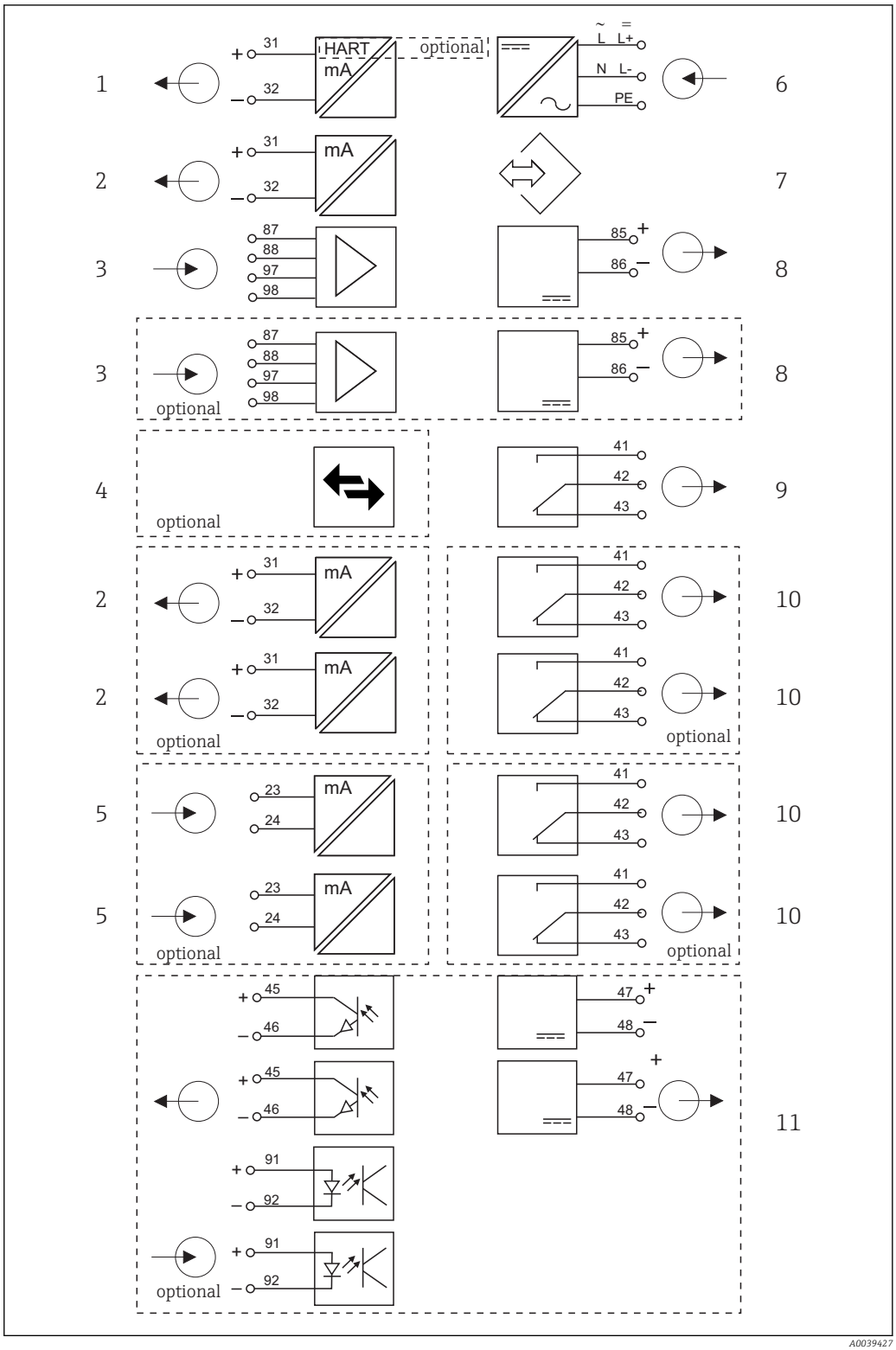


Ordered basic device (example)	▪ Order code CM442-**M1A1F0* ▪ Functionality: 1 x Memosens, 2 current outputs without HART
Extension options without additional modules	Activation with activation code: ▪ Second Memosens input (71114663) ▪ HART (71128428) ▪ EtherNet/IP + web server (71449914) ▪ Modbus TCP + web server (71449915) ▪ PROFINET + web server (71449901) ▪ Web server (71449918)
Extension options by using an extension module in free slot 2	PROFIBUS DP or Modbus RS485 with module 485 incl. activation code: ▪ PROFIBUS DP (71140888) ▪ Modbus RS485 (71140889) If module 485 is retrofitted, any existing current outputs are disabled! Additional inputs or outputs, relays: ▪ Module 2AI (71135639): 2 current inputs ▪ Module 2AO (71135632): 2 current outputs ▪ Module AOR (71111053): 2 current outputs, 2 relays ▪ Module 2R (71125375) or 4R (71125376): 2 or 4 relays ▪ Module DIO (71135638): 2 digital inputs and 2 digital outputs

Device upgrade to CM444 or CM448	▪ Upgrade kit 71470973 (100 to 230 V AC) or 71470975 (24 V DC)
	  ▪ Extension power supply unit and backplane
	  ▪ Basic module BASE2-E (Memosens inputs same as for base device)
	  ▪ 6 slots for extension modules
	▪ Extension options:
	  ▪ Second Memosens input (71114663), additional modules same as for CM442
	  ▪ Up to 8 measuring channels by using an appropriate number of Memosens input modules 2DS (71135631)

Basic rule for extensions	The sum of all current inputs and outputs may not exceed 8.
Restrictions if using CUS71D sensors for interface measurement	▪ CM442: Only one CUS71D can be connected. The second Memosens input may not be used. ▪ If extending to CM444: Every combination of CUS71D or other sensors is possible. All Memosens inputs (max. 4) can be used. ▪ An extension to CM448 is **not advisable** as the maximum number of Memosens inputs remains limited to 4.
Product Configurator	www.endress.com/cm442

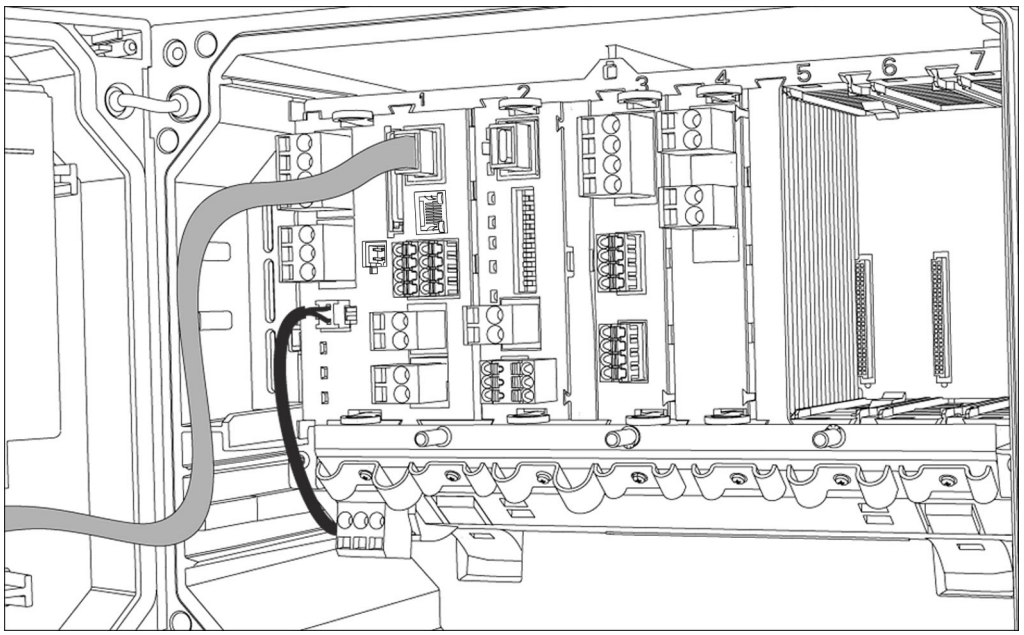
Function diagram CM442



6 *Function diagram CM442*

1 *Current output 1:1, + HART (optional)*
2 *Current outputs (2 x optional)*
3 *2 x Memosens input (1 x optional)*
4 *PROFIBUS DP/Modbus/Ethernet (optional)*
5 *2 x current input (optional)*
6 *Power supply*
7 *Service interface*
8 *Power supply, fixed cable sensors*
9 *Alarm relay*
10 *2 or 4 x relays (optional)*
11 *2 digital inputs and outputs (optional)*

Device configuration using the example of a CM444-M42A1FA***



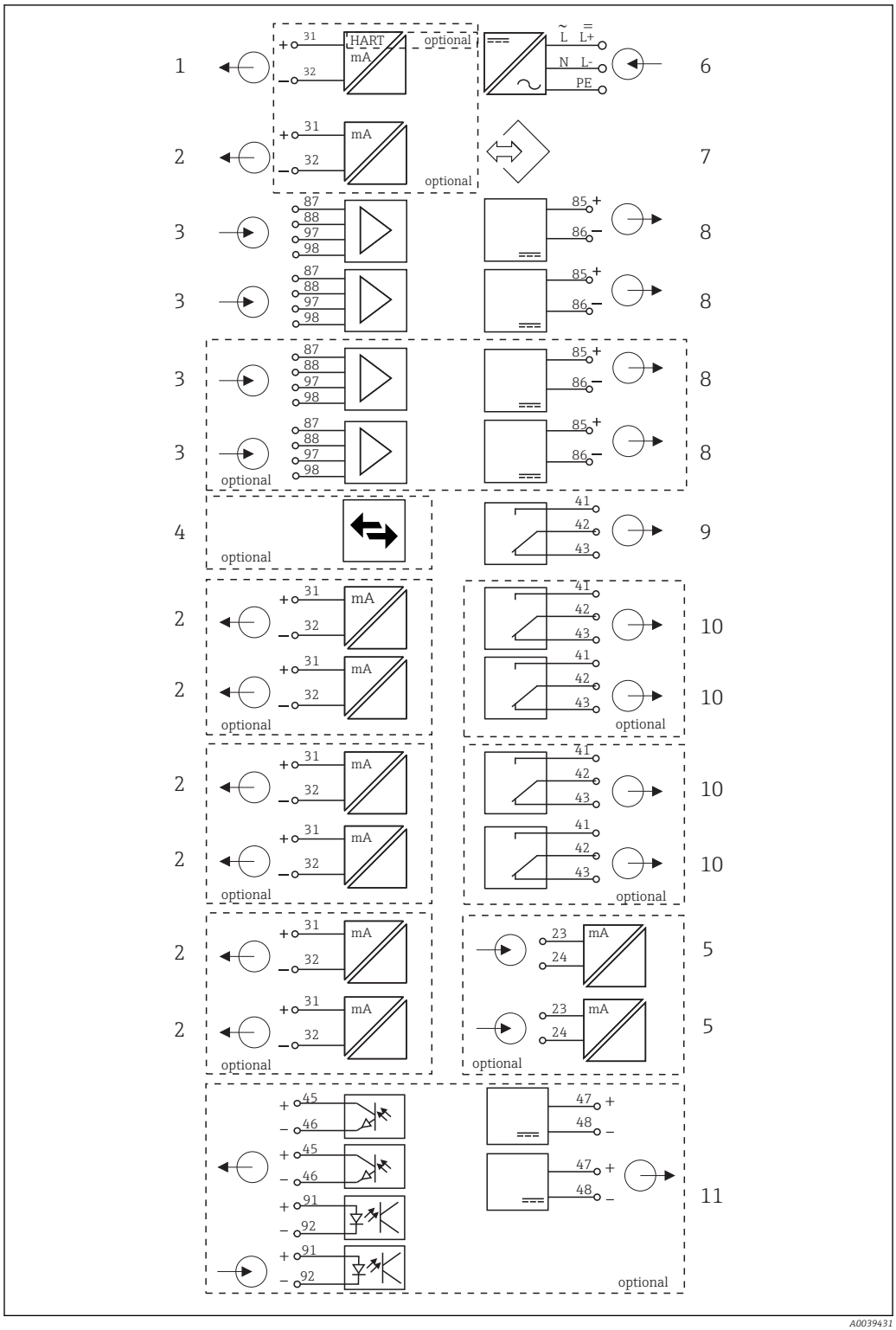
A0042349

Ordered basic device (example)	▪ Order code CM444-**M42A1FA*
	▪ Functionality:
	  ▪ 4 x Memosens (2 on BASE2-E module + 2 on an extension module 2DS)
	  ▪ PROFIBUS communication (module 485)
	  ▪ Web server (BASE2-E module)
	  ▪ 2 current outputs without HART (on BASE2-E module)
	  ▪ 2 current inputs (module 2AI)
	3 slots are still free in this example. More or fewer slots can be free in other versions.

Extension options without additional modules	None
Modification options without additional modules	Communication type changed by entering activation code. This disables the communication type used previously! Modbus RS485 + web server (71135636) Retrofit by removing module 485 and entering the activation code for: ▪ Modbus TCP + web server (71449915) ▪ EtherNet/IP + web server (71449914) ▪ PROFINET + web server (71449901) ▪ HART (71128428) ▪ Web server (71449918)
Extension options by using extension modules in free slots 5-7	Only the following is possible for the example above: ▪ Module 2R (71125375) or 4R (71125376): 2 or 4 relays ▪ Module DIO (71135638): 2 digital inputs and 2 digital outputs If extending to 8 measuring channels: Module 2DS (71135631): 2 Memosens inputs Additional inputs or outputs and relays if fieldbus module 485 is removed: ▪ Module 2AO (71135632): 2 current outputs ▪ Module AOR (71111053): 2 current outputs, 2 relays ▪ Module 2R (71125375) or 4R (71125376): 2 or 4 relays ▪ Module DIO (71135638): 2 digital inputs and 2 digital outputs If module 485 is removed and an Ethernet-based fieldbus is used via BASE2-E module, a maximum of up to 6 current outputs can be operated in addition. Only two current outputs are possible with module 485.
Basic rule for extensions	The sum of all current inputs and outputs may not exceed 8.

Restrictions if using CUS71D sensors for interface measurement	▪ In the case of CM444, every combination of Memosens sensors (max. 4) is possible. ▪ An extension to CM448 is not advisable as the maximum number of Memosens inputs when using CUS71D remains limited to 4.
Product Configurator	www.endress.com/cm444

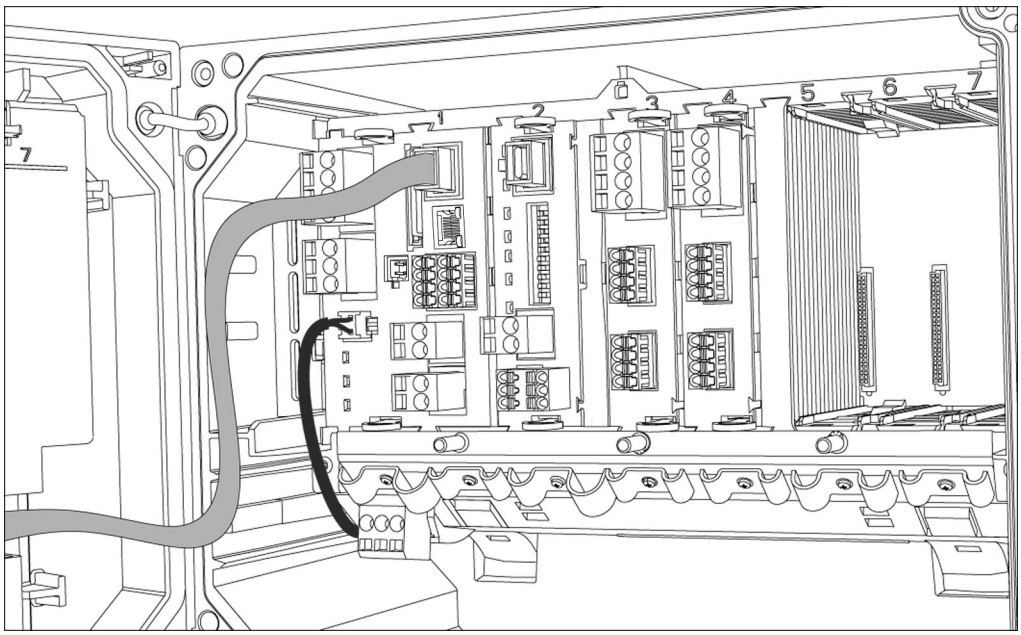
Function diagram CM444



7 *Function diagram CM444*

1 *Current output 1:1, + HART (both optional)*
2 *Max. 7 x current output (optional)*
3 *Memosens input (2 x standard + 2 x optional)*
4 *PROFIBUS DP/Modbus/Ethernet (optional)*
5 *2 x current input (optional)*
6 *Power supply*
7 *Service interface*
8 *Power supply, fixed cable sensors*
9 *Alarm relay*
10 *2 or 4 x relays (optional)*
11 *2 digital inputs and outputs (optional)*

Device configuration using the example of a CM448-26A1***

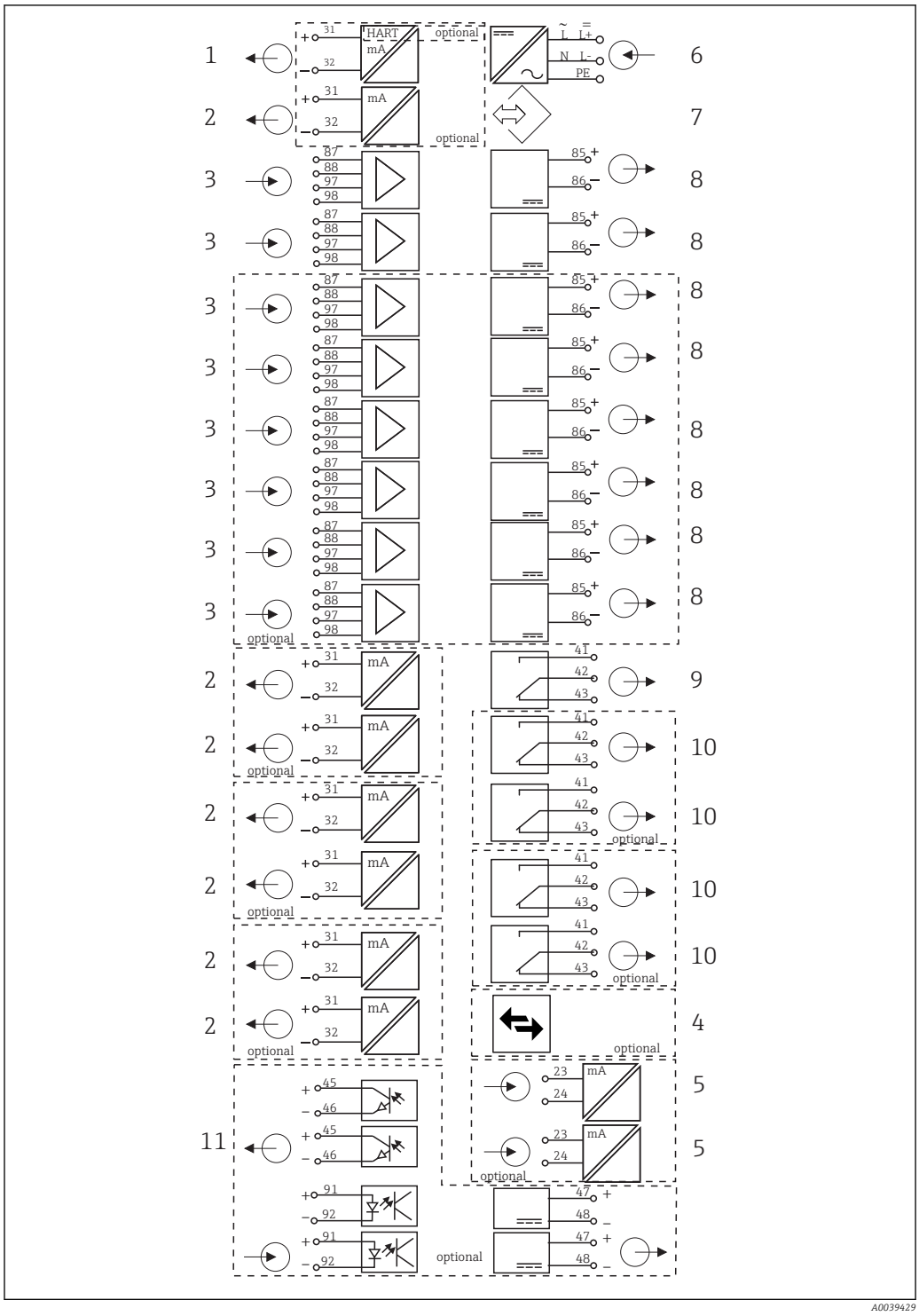


A0042350

Ordered basic device (example)	▪ Order code CM448-**26A1*
	▪ Functionality:
	  ▪ 6 x Memosens (2 on BASE2-E module + 2 on two 2DS extension modules)
	  ▪ PROFIBUS communication (module 485)
	  ▪ Web server (BASE2-E module)
	3 slots are still free in this example. More or fewer slots can be free in other versions.

Extension options without additional modules	Activation code for the use of current outputs of the basic module: 2 current outputs (71140891)
Modification options without additional modules	Communication type changed by entering activation code. This disables the communication type used previously! Modbus RS485 + web server (71135636) Retrofit by removing module 485 and entering the activation code for communication via the BASE2 module: ▪ Modbus TCP + web server (71449915) ▪ EtherNet/IP + web server (71449914) ▪ PROFINET + web server (71449901) ▪ HART (71128428) ▪ Web server (71449918)
Extension options by using extension modules in free slots 5-7	If extending to 8 measuring channels: Module 2DS (71135631): 2 Memosens inputs Additional inputs or outputs, relays: ▪ Module 2AO (71135632): 2 current outputs ▪ Module 2AI (71135639): 2 current inputs ▪ Module AOR (71111053): 2 current outputs, 2 relays ▪ Module 2R (71125375) or 4R (71125376): 2 or 4 relays ▪ Module DIO (71135638): 2 digital inputs and 2 digital outputs If module 485 is removed and an Ethernet-based fieldbus is used, a maximum of up to 6 current outputs can be operated in addition. Only two current outputs are possible with module 485.
Basic rule for extensions	The sum of all current inputs and outputs may not exceed 8.
Restrictions if using CUS71D sensors for interface measurement	The maximum number of Memosens inputs that can be used is limited to 4! Here, every combination of CUS71D and other Memosens sensors is then possible.
Product Configurator	www.endress.com/cm448

Function diagram CM448



8 Function diagram CM448

1 *Current output 1:1, + HART (both optional)*
2 *Max. 7 x current output (optional)*
3 *Max 8 x Memosens input (2 x of which are optional)*
4 *PROFIBUS DP/Modbus/Ethernet (optional)*
5 *2 x current input (optional)*
6 *Power supply*
7 *Service interface*
8 *Power supply, fixed cable sensors*
9 *Alarm relay*
10 *2 or 4 x relays (optional)*
11 *2 digital inputs and outputs (optional)*

Communication and data processing

Communication protocols:
Fieldbus systems
- HART
- PROFIBUS DP (Profile 3.02)
- Modbus TCP or RS485
- PROFINET
- Ethernet/IP

Only one type of Fieldbus communication can ever be active. The last activation code entered decides which bus is used.

The device drivers available make it possible to perform a basic setup and display measured values and diagnostics information via the fieldbus. A full device configuration via the fieldbus is not possible.

Extension module 485 and current outputs
For PROFIBUS DP, and Modbus RS485 communication protocols:
- CM442
  Current outputs cannot be used in parallel. Any existing current outputs are deactivated with the installation of 485.
- CM444/CM448
  A maximum of 2 current outputs can be used in parallel.

Ethernet functionality via Base2 module and current outputs
- CM442
  A maximum of 2 current outputs can be used in parallel.
- CM444 and CM448
  A maximum of 6 current outputs can be used in parallel.

Bus termination on the device
- Via slide switch at bus module 485
- Displayed via LED "T" on bus module 485

Dependability

Reliability

Memosens
Memosens makes your measuring point safer and more reliable:
- Non-contact, digital signal transmission enables optimum galvanic isolation
- No contact corrosion
- Completely watertight
- Sensor can be calibrated in a lab, thus increasing the availability of the measuring point in the process
- Intrinsically safe electronics mean operation in hazardous areas is not a problem.
- Predictive maintenance thanks to recording of sensor data, e.g.:
  - Total hours of operation
  - Hours of operation with very high or very low measured values
  - Hours of operation at high temperatures
  - Number of steam sterilizations
  - Sensor condition

Heartbeat diagnostics

- Heartbeat diagnostics screen with graphic indicators for the health of the device and sensor and with a maintenance or (sensor-dependent) calibration timer
- Heartbeat status information on the health of the device and the condition of the sensor
  - ☺: Sensor/device condition or maintenance timer > 20 %; no action is required
  - 😐: Sensor/device condition or maintenance timer > 5 ≤ 20 %, maintenance not yet urgent but should be scheduled
  - ☹: Sensor/device condition or maintenance timer < 5 %, maintenance is recommended
- The Heartbeat sensor condition is the assessment of the calibration results and the sensor diagnostic functions.

An unhappy smiley can be due to the calibration result, the measured value status or to the operating hours limit having been exceeded. These limits can be configured in the sensor setup in a way that adapts the Heartbeat diagnostics to the application.

Heartbeat and NAMUR category
The Heartbeat status indicates the sensor or device condition while the NAMUR categories (F, C, M, S) assess the reliability of the measured value. The two conditions can correlate but do not have to.

- **Example 1**
  - The number of remaining cleaning cycles for the sensor reaches 20% of the defined maximum number. The Heartbeat symbol changes from ☺ to 😐. The measured value is still reliable so the NAMUR status signal does not change.
  - If the maximum number of cleaning cycles is exceeded, the Heartbeat symbol changes from 😐 to ☹. While the measured value can still be reliable, the NAMUR status signal changes to M (maintenance required).
- **Example 2**
  The sensor breaks. The Heartbeat status changes immediately from ☺ to ☹ and the NAMUR status signal also changes immediately to F (failure).

Heartbeat Monitoring

Sensor data from Memosens sensors are transmitted via the EtherNet/IP, PROFINET, PROFIBUS DP, HART, Modbus RTU and Modbus TCP fieldbus protocols. These data can be used for predictive maintenance, for instance.

Examples include:
- Total hours of operation
- Hours of operation with very high or very low measured values
- Hours of operation at high temperatures
- Number of steam sterilizations
- Sensor identification
- Calibration information

For detailed information on "Ethernet/IP communication", see the product pages on the Internet (→ SD01293C).

For detailed information on "Modbus communication", see the product pages on the Internet (→ SD01189C).

For detailed information on "PROFINET communication", see the product pages on the internet (→ SD02490C).

For detailed information on "PROFIBUS communication", see the product pages on the Internet (→ SD01188C).

More detailed information on HART communication is provided on the product pages on the Internet (→ SD01187C).

Heartbeat Verification

Heartbeat Verification makes it possible to verify the correct operation of the measuring device without interrupting the process. This verification can be documented anytime.

Sensor Check System (SCS)

The Sensor Check System (SCS) monitors the high impedance of the pH glass. An alarm is issued if a minimum impedance value is undershot or a maximum impedance is exceeded.
- Glass breakage is the main reason for a drop in high impedance values
- The reasons for increasing impedance values include:
  - Dry sensor
  - Worn pH glass membrane

For the SCS, upper and lower limit values can be enabled or disabled independently of one another.

Process Check System (PCS)

The process check system (PCS) checks the measuring signal for stagnation. An alarm is triggered if the measuring signal does not change over a specific period (several measured values).

The main causes of stagnating measured values are:
- Contaminated sensor, or sensor outside of medium
- Sensor defective
- Process error (e.g. through control system)

Self-monitoring functions

Current inputs are deactivated in the event of overcurrent and reactivated once the overcurrent stops. Board voltages are monitored and the board temperature is also measured.

USP and EP

The limit functions for pharmaceutical water in accordance with USP and EP specifications are implemented in the software for conductivity measurements:
- "Water for Injection" (WFI) as per USP <645> and EP
- "Highly Purified Water" (HPW) as per EP
- "Purified Water" (PW) as per EP

The uncompensated conductivity value and the temperature are measured for the USP/EP limit functions. The measured values are compared against the tables defined in the standards. An alarm is triggered if the limit value is exceeded. Furthermore, it is also possible to configure an early warning alarm that signals undesired operating states before they occur.

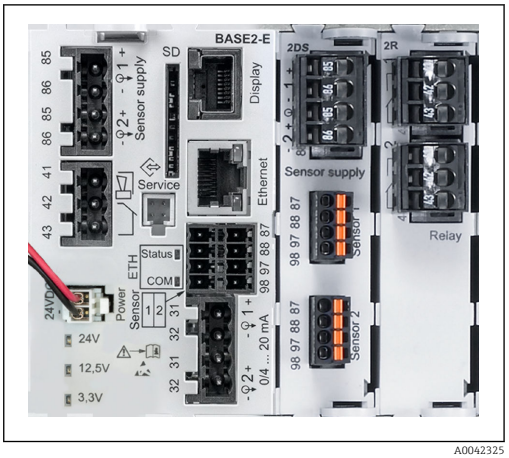
ChemocleanPlus

Freely programmable sequence control
- e.g. for automatic sensor cleaning in retractable assemblies for reliable measurement results in processes with a high risk of contamination
- Individual, time-based activation of 4 outputs e.g. relays
- Starting, stopping or pausing of activities via digital input or fieldbus signals e.g. from limit position switches

Maintainability

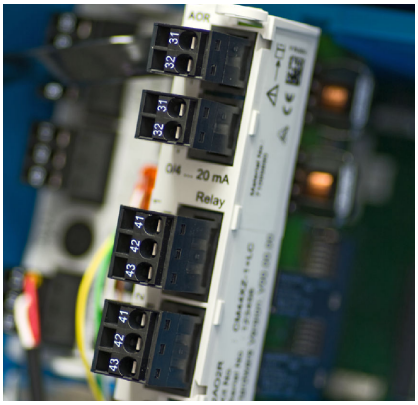
Modular design

The modular transmitter design means it can be easily adapted to suit your needs:
- Retrofit extension modules for new or extended range of functions, e.g. current outputs, relays and digital communication
- Upgrade to maximum eight-channel measurement
- Optional: M12 sensor connector for connecting any kind of Memosens sensor
- Optional: CDI connector for external access to the service interface (avoids having to unscrew the housing cover)



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9 *CM444: example*

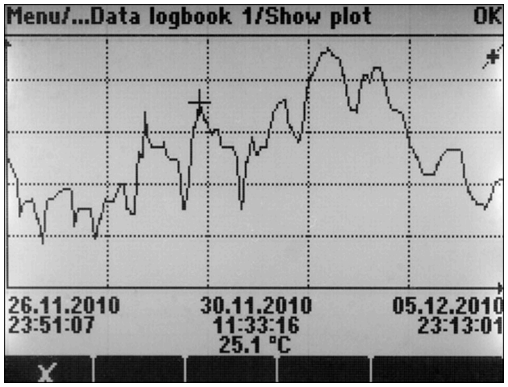


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10 *Extension module*

Data logger function

- Adjustable scan time: 1 to 3600 s (1 h)
- Data logbooks:
  - Max. 8 data logbooks
  - 150,000 entries per logbook
  - Graphic display (load curves) or numerical list
- Calibration logbook: max. 75 entries
- Hardware version logbook:
  - Hardware configuration and modifications
  - Max. 125 entries
- Version logbook:
  - E.g. software updates
  - Max. 50 entries
- Operation logbook: max. 250 entries
- Diagnostics logbook: max. 250 entries



11 Data logbook: Graphic display

Logbooks remain unchanged even after a software update.

SD card

The exchangeable storage medium enables:
- Quick and easy software updates and upgrades
- Data storage of internal device memory (e.g. logbooks)
- Transfer of complete configurations to a device with an identical setup (backup function)
- Transfer of configurations without the TAG and bus address to devices with an identical setup (copy function)
- Saving of screenshots for documentation purposes

Endress+Hauser offers industry-approved SD cards as accessories. These memory cards provide maximum data security and integrity.

Other SD cards up to a maximum weight of 5 g can also be used. However, Endress+Hauser does not accept any responsibility for the data security of such cards.

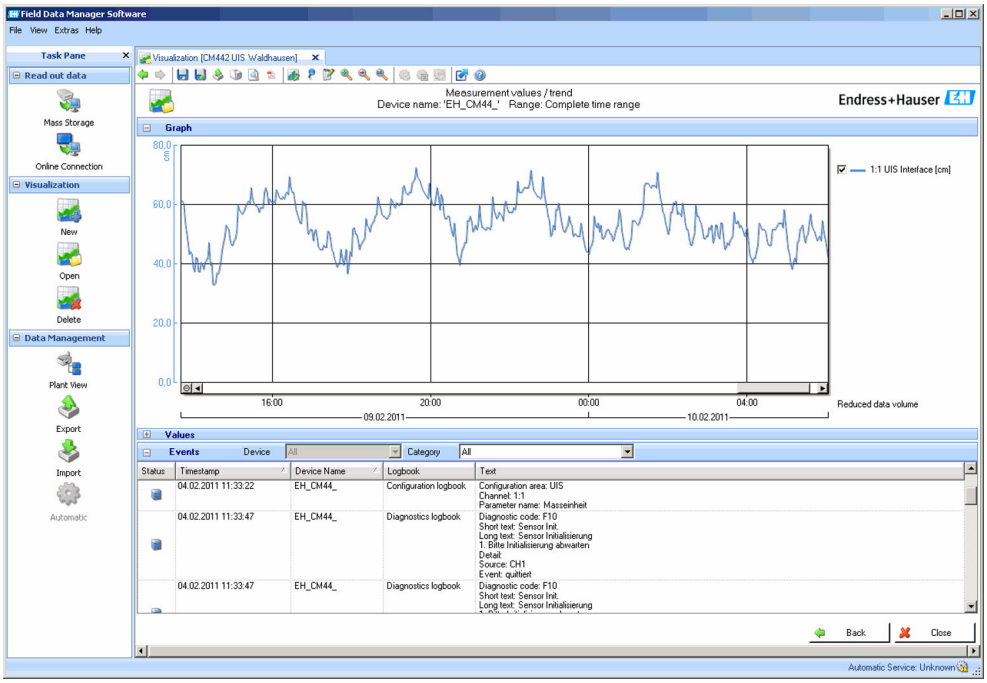
External signals for device control and for activating external devices

Hardware options, e.g. module "DIO" with 2 digital inputs and 2 digital outputs or fieldbus module "485" enable the following:
- via a digital input signal
  - measuring range switching for conductivity (upgrade code required, see accessories)
  - switching between different calibration datasets in the case of optical sensors
  - an external hold
  - a cleaning interval to be triggered
  - switching on and off a PID controller, e.g. via the proximity switch of the CCA250
  - the use of the input as an "analog input" for pulse-frequency modulation (PFM)
- via a digital output signal
  - the static transmission (similar to a relay) of diagnostic states, point level switch states etc.
  - the dynamic transmission (comparable to a non-wearing "analog output") of PFM signals, e.g. to control dosing pumps.

FieldCare and Field Data Manager

FieldCare
Configuration and asset management software based on FDT/DTM technology
- Complete device configuration when connected via FXA291 and service interface
- Access to a number of configuration parameters and identification, measuring and diagnostic data when connected via HART modem
- Logbooks can be downloaded in CSV format or binary format for "Field Data Manager" software

Field Data Manager
Visualization software and database for measuring, calibration and configuration data
- SQL database which is protected against manipulation
- Functions to import, save and print out logbooks
- Load curves to display measured values



A0016009

12 *Field Data Manager: Load curves*

Virtual process values (mathematical functions)

In addition to "real" process values, which are provided by connected physical sensors or analog inputs, mathematical functions can be used to calculate a maximum of 8 "virtual" process values.

The "virtual" process values can be:
- Output via a current output or a fieldbus
- Used as a controlled variable
- Assigned as a measured variable to a limit switch
- Used as a measured variable to trigger cleaning
- Displayed in user-defined measuring menus

The following mathematical functions are possible:
- Calculation of pH from two conductivity values according to VGB 405 RL, e. g. in boiler feedwater
- Difference between two measured values from different sources, e. g. for membrane monitoring
- Differential conductivity, e. g. for monitoring the efficiency of ion exchangers
- Degassed conductivity, e. g. for process controls in power plants
- Redundancy for monitoring two or three redundant sensors
- rH calculation based on the measured values of a pH and an ORP sensor
- Calculation of the remaining capacity of a cation exchanger
- Formula editor

Concentration tables

When the device is delivered from the factory, tables are saved in the device that allow inductive conductivity measurements to be converted to concentrations of certain substances. 4 user-defined tables are also possible.

The following factory concentration tables are available:

NaOH	0 to 15 %	0 to 100 °C (32 to 212 °F)
NaOH	25 to 50%	2 to 80 °C (36 to 176 °F)
HCl	0 to 20 %	0 to 65 °C (32 to 149 °F)
HNO_3	0 to 30 %	2 to 80 °C (36 to 176 °F)
H_2SO_4	0.5 to 27 % and 35 to 85 %	0 to 100 °C (32 to 212 °F)
H_2SO_4	93 to 100 %	10 to 115 °C (50 to 239 °F)
H_3PO_4	0 to 40 %	2 to 80 °C (36 to 176 °F)
NaCl	0 to 26 %	2 to 80 °C (36 to 176 °F)

Safety

Real-time clock

The device has a real-time clock, which is buffered by a button cell battery if the power supply fails.

This ensures that the device continues to keep the correct date and time when it is restarted and that the time stamp for the logbooks is correct.

Data security

All settings, logbooks etc. are stored in a non-volatile memory to ensure that the data are retained even in the event of a disruption to the power supply.

Measuring range switching for conductivity

- Can be used in CIP processes e.g. for safe monitoring of phase separations
- Switching between 4 complete parameter sets:
  - Conductivity operating mode
  - Concentration tables
  - Temperature compensation
  - Output signal range
  - Limit value switch
- Via digital inputs or fieldbus

Measured value compensation for oxygen and conductivity

- Pressure or temperature compensation
- Input signals from external sensors via current input or fieldbus
- Signals from connected temperature sensors

Password protection

Password-protected login
- For remote operation via web server
- For local operation

Process safety

Two independent PID controllers
- One- or two-sided control
- Limit switches
- 4 cleaning programs which can be programmed independently of each other

IT security

Our warranty is valid only if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the device and associated data transfer, must be implemented by the operators themselves in line with their security standards.

Input

Measured variables	→ Documentation of the connected sensor
Measuring ranges	→ Documentation of the connected sensor
Types of input	▪ Digital sensor inputs for sensors with Memosens protocol ▪ Analog current inputs (optional) ▪ Digital inputs (optional)
Input signal	Depending on version: ▪ Max. 8 x binary sensor signal ▪ 2 x 0/4 to 20 mA (optional), passive, potentially isolated from one another and from the sensor inputs ▪ 0 to 30 V
Cable specification	**Cable type** Memosens data cable CYK10 or sensor fixed cable, each with cable end sleeves or M12 round-pin connector (optional) **Cable length** Max. 100 m (330 ft)

Digital inputs, passive

Electrical specification	▪ drawing power (passive) ▪ Galvanically isolated
Span	▪ High: 11 to 30 V DC ▪ Low: 0 to 5 V DC
Nominal input current	max. 8 mA
PFM function	Minimum pulse width: 500 µs (1 kHz)
Test voltage	500 V
Cable specification	Max. 2.5 mm^2 (14 AWG)

Current input, passive

Span	> 0 to 20 mA
Signal characteristic	Linear
Internal resistance	Non-linear
Test voltage	500 V

Output

Output signal

Depending on version:
- 2 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- 4 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- 6 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- 8 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- Optional HART communication (only via current output 1:1)

HART	
Signal encoding	FSK ± 0.5 mA via current signal
Data transmission rate	1200 baud
Galvanic isolation	Yes
Load (communication resistor)	250 Ω

PROFIBUS DP/RS485	
Signal encoding	EIA/TIA-485, PROFIBUS DP-compliant acc. to IEC 61158
Data transmission rate	9.6 kBd, 19.2 kBd, 45.45kBd, 93.75 kBd, 187.5 kBd, 500 kBd, 1.5 MBd, 6 MBd, 12 MBd
Galvanic isolation	Yes
Connectors	Spring terminal (max. 1.5 mm), bridged internally (T-function), optional M12
Bus termination	Internal slide switch with LED display

Modbus RS485	
Signal encoding	EIA/TIA-485
Data transmission rate	2,400, 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200 baud
Galvanic isolation	Yes
Connectors	Spring terminal (max. 1.5 mm), bridged internally (T-function), optional M12
Bus termination	Internal slide switch with LED display

Ethernet and Modbus TCP	
Signal encoding	IEEE 802.3 (Ethernet)
Data transmission rate	10/100 MBd
Galvanic isolation	Yes
Connection	RJ45, M12 optional
IP address	DHCP (default) or configuration via menu

EtherNet/IP	
Signal encoding	IEEE 802.3 (Ethernet)
Data transmission rate	10/100 MBd
Galvanic isolation	Yes
Connection	RJ45, M12 optional (D-encoded)
IP address	DHCP (default) or configuration via menu

PROFINET	
Signal encoding	IEEE 802.3 (Ethernet)
Data transmission rate	100 MBd
Galvanic isolation	Yes
Connection	RJ45, M12 optional (D-encoded)
Name of station	Via DCP protocol using the configuration tool (e.g. Siemens PRONETA)
IP address	Via DCP protocol using the configuration tool (e.g. Siemens PRONETA)

Signal on alarm

Adjustable, as per NAMUR Recommendation NE 43
- In measuring range 0 to 20 mA (HART is not available with this measuring range):
  Failure current from 0 to 23 mA
- In measuring range 4 to 20 mA:
  Failure current from 2.4 to 23 mA
- Factory setting for failure current for both measuring ranges:
  21.5 mA

Load

Max. 500 Ω

Linearization/transmission behavior

Linear

Digital outputs, passive

Electrical specification

- Passive
- Open collector, max. 30 V, 15 mA
- Maximum voltage drop 3 V

External power supply

When using an onsite auxiliary voltage supply and an onsite digital input:
Recommended minimum auxiliary voltage = 3 V + V_{IHmin}
(V_{IHmin} = minimum input voltage required (high-level input voltage)

PFM function

Minimum pulse width: 500 µs (1 kHz)

Auxiliary voltage

Electrical specification
- Galvanically isolated
- Unregulated, 24 V DC
- Max. 50 mA (per DIO module)

Test voltage

500 V

Cable specification

Max. 2.5 mm^2 (14 AWG)

Current outputs, active

Span

0 to 23 mA

2.4 to 23 mA for HART communication

Signal characteristic

Linear

Electrical specification

Output voltage
Max. 24 V

Test voltage
500 V

Cable specification

Cable type
Recommended: shielded cable

Cable specification
Max. 2.5 mm² (14 AWG)

Relay outputs

Electrical specification

Relay types
- 1 single-pin changeover contact (alarm relay)
- 2 or 4 single-pin changeover contacts (optional with extension modules)

Maximum load
- Alarm relay: 0.5 A
- All other relays: 2.0 A

Relay switching capacity

Base module (Alarm relay)

Switching voltage	Load (max.)	Switching cycles (min.)
230 V AC, cosΦ = 0.8 to 1	0.1 A	700,000
	0.5 A	450,000
115 V AC, cosΦ = 0.8 to 1	0.1 A	1,000,000
	0.5 A	650,000
24 V DC, L/R = 0 to 1 ms	0.1 A	500,000
	0.5 A	350,000

Extension modules

Switching voltage	Load (max.)	Switching cycles (min.)
230 V AC, cosΦ = 0.8 to 1	0.1 A	700,000
	0.5 A	450,000
	2 A	120,000
115 V AC, cosΦ = 0.8 to 1	0.1 A	1,000,000
	0.5 A	650,000
	2 A	170,000
24 V DC, L/R = 0 to 1 ms	0.1 A	500,000
	0.5 A	350,000
	2 A	150,000

Cable specification

Max. 2.5 mm² (14 AWG)

Protocol-specific data

HART

Manufacturer ID	11_h
Device type	$155D_h$
Device revision	001_h
HART version	7.2
Device description files (DD/DTM)	www.endress.com/hart Device Integration Manager DIM
Device variables	16 user-definable and 16 predefined device variables, dynamic variables PV, SV, TV, QV
Supported features	PDM DD, AMS DD, DTM, Field Xpert DD

PROFIBUS DP

Manufacturer ID	11_h
Device type	$155D_h$
Profile version	3.02
GSD files	www.endress.com/profibus Device Integration Manager DIM
Output values	16 AI blocks, 8 DI blocks
Input variables	4 AO blocks, 8 DO blocks
Supported features	▪ 1 MSCY0 connection (cyclical communication, master class 1 to slave) ▪ 1 MSAC1 connection (acyclical communication, master class 1 to slave) ▪ 2 MSAC2 connections (acyclical communication, master class 2 to slave) ▪ Device lock: The device can be locked using the hardware or software. ▪ Addressing using DIL switches or software ▪ GSD, PDM DD, DTM

Modbus RS485

Protocol	RTU/ASCII
Function codes	03, 04, 06, 08, 16, 23
Broadcast support for function codes	06, 16, 23
Output data	16 measured values (value, unit, status), 8 digital values (value, status)
Input data	4 setpoints (value, unit, status), 8 digital values (value, status), diagnostic information
Supported features	Address can be configured using switch or software

Modbus TCP

TCP port	502
TCP connections	3
Protocol	TCP
Function codes	03, 04, 06, 08, 16, 23
Broadcast support for function codes	06, 16, 23
Output data	16 measured values (value, unit, status), 8 digital values (value, status)
Input data	4 setpoints (value, unit, status), 8 digital values (value, status), diagnostic information
Supported features	Address can be configured using DHCP or software

Ethernet/IP

Log	EtherNet/IP	
ODVA certification	Yes	
Device profile	Generic device (product type: 0x2B)	
Manufacturer ID	$0x049E_h$	
Device type ID	$0x109C_h$	
Polarity	Auto-MIDI-X	
Connections	CIP	12
	I/O	6
	Explicit message	6
	Multicast	3 consumers
Minimum RPI	100 ms (default)	
Maximum RPI	10000 ms	
System integration	EtherNet/IP	EDS
	Rockwell	Add-on-Profile Level 3, Faceplate for Factory Talk SE
IO data	Input (T → O)	Device status and diagnostic message with highest priority Measured values: ▪ 16 AI (analog input) + Status + Unit ▪ 8 DI (discrete input) + Status
	Output (O → T)	Actuating values: ▪ 4 A0 (analog output) + status + unit ▪ 8 DO (discrete output) + Status

PROFINET

Protocol	"Application layer protocol for decentral device periphery and distributed automation", PNIO Version 2.34
Communication type	100 MBit/s
Conformance Class	Conformance Class B
Netload Class	Netload Class II
Baud rate	Automatic 100 Mbps with full-duplex detection
Cycle times	From 32 ms
Device profile	Application interface identifier 0xF600 Generic device
PROFINET interface	1 port, Realtime Class 1 (RT_CLASS_1)
Manufacturer ID	$0x11_h$
Device type ID	0x859C D_h
Device description files (GSD)	Information and files under: ▪ www.endress.com On the product page for the device: Documents/Software → Device drivers ▪ www.profibus.com On the website under Products/Product Finder
Polarity	Auto-polarity for automatic correction of crossed TxD and RxD pairs
Supported connections	▪ 1 x AR (IO Controller AR) ▪ 1 x AR (IO-Supervisor Device AR connection allowed) ▪ 1 x Input CR (Communication Relation) ▪ 1 x Output CR (Communication Relation) ▪ 1 x Alarm CR (Communication Relation)
Configuration options for measuring device	▪ Web browser ▪ Manufacturer-specific software (FieldCare, DeviceCare) ▪ Device master file (GSD), can be read out via the integrated web server of the measuring device
Configuration of the device name	DCP protocol
Supported functions	▪ Identification & Maintenance Simple device identification via: ▪ Process control system ▪ Nameplate ▪ Measured value status The process variables are communicated with a measured value status ▪ Blinking feature (FLASH_ONCE) via the local display for simple device identification and assignment ▪ Device operation via operating tools (e.g. FieldCare, DeviceCare)
System integration	For information on system integration, see the Operating Instructions ▪ Cyclic data transmission ▪ Overview and description of the modules ▪ Status coding ▪ Startup configuration ▪ Factory setting

Web server

The Web server enables full access to the device configuration, measured values, diagnostic messages, logbooks and service data via standard WiFi/WLAN/LAN/GSM or 3G routers with a user-defined IP address.

TCP port	80
Supported features	▪ Remote-controlled device configuration(1 session) ▪ Save/restore device configuration (via SD card) ▪ Logbook export (file formats: CSV, FDM) ▪ Access to Web server via DTM or Internet Explorer ▪ Login ▪ Web server can be switched off

Power supply

Supply voltage

CM442

Depending on version:
- 100 to 230 V AC, 50/60 Hz
  Maximum permitted fluctuation of mains supply voltage: ± 15 % of nominal voltage
- 24 V AC/DC, 50/60 Hz
  Maximum permitted fluctuation of mains supply voltage: + 20/- 15 % of nominal voltage

CM444 and CM448

Depending on the version,:
- 100 to 230 V AC, 50/60 Hz
  Maximum permitted fluctuation of mains supply voltage: ± 15 % of nominal voltage
- 24 V DC
  Maximum permitted fluctuation of mains supply voltage: + 20/- 15 % of nominal voltage

NOTICE

The device does not have a power switch!
- ► Provide a protected circuit breaker in the vicinity of the device at the place of installation.
- ► The circuit breaker must be a switch or power switch, and must be labeled as the circuit breaker for the device.
- ► At the supply point, the power supply must be isolated from dangerous live cables by double or reinforced insulation in the case of devices with a 24 V supply voltage.

Power consumption

CM442

Depending on supply voltage
- 100 to 230 V AC and 24 V AC:
  Max. 55 VA
- 24 V DC:
  Max. 22 W

CM444 and CM448

Depending on supply voltage
- 100 to 230 V AC:
  Max. 73 VA
- 24 V DC:
  Max. 68 W

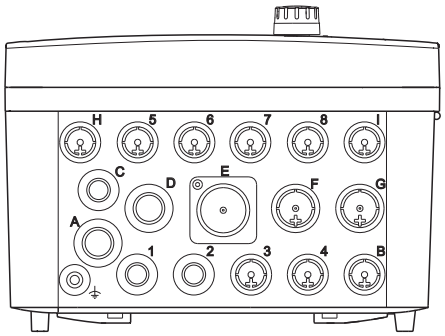
Fuse

Fuse not exchangeable

Overvoltage protection

Integrated overvoltage/lightning protection as per EN 61326
Protection category 1 and 3

Cable entries

Identification of the cable entry on housing base	Suitable gland
B, C, H, I, 1-8	M16x1.5 mm/NPT3/8"/G3/8
A, D, F, G	M20x1.5 mm/NPT1/2"/G1/2
E	-
⏚	M12x1.5 mm
 A0018025	**Recommended assignment** 1-8 Sensors 1-8 A Power supply B RS485 In or M12 DP/RS485 C Can be used freely D,F,G Current outputs and inputs, relays H Can be used freely I RS485 Out or M12 Ethernet E Do not use

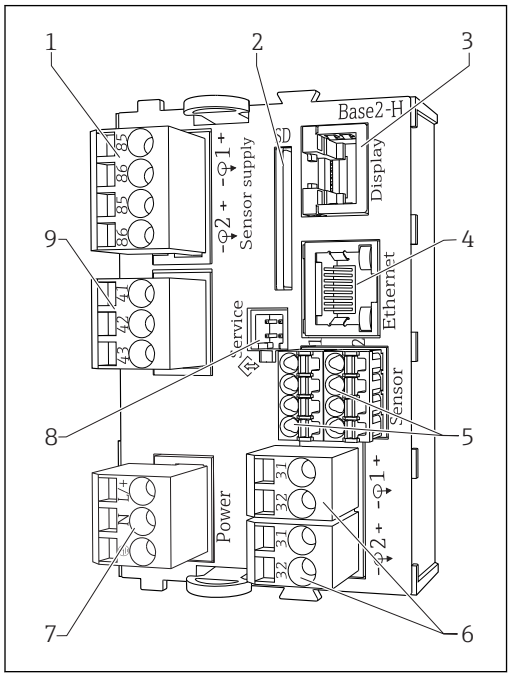
Cable specification

Cable gland	Permitted cable diameter
M16x1.5 mm	4 to 8 mm (0.16 to 0.32")
M12x1.5 mm	2 to 5 mm (0.08 to 0.20")
M20x1.5 mm	6 to 12 mm (0.24 to 0.48")
NPT3/8"	4 to 8 mm (0.16 to 0.32")
G3/8	4 to 8 mm (0.16 to 0.32")
NPT1/2"	6 to 12 mm (0.24 to 0.48")
G1/2	7 to 12 mm (0.28 to 0.48")

Cable glands mounted at the factory are tightened with 2 Nm.

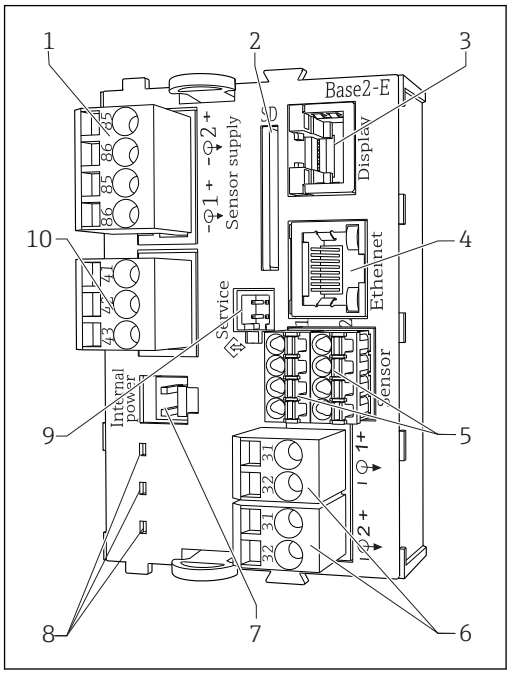
Electrical connection

Basic module



13 *Basic module BASE2-H or -L (two-channel device)*

1 *Power supply for digital fixed cable sensors with Memosens protocol*
2 *SD card slot*
3 *Slot for display cable* [1)]
4 *Ethernet interface*
5 *Connections for 2 Memosens sensors*
6 *Current outputs*
7 *Power connection*
8 *Service interface*
9 *Alarm relay connection*

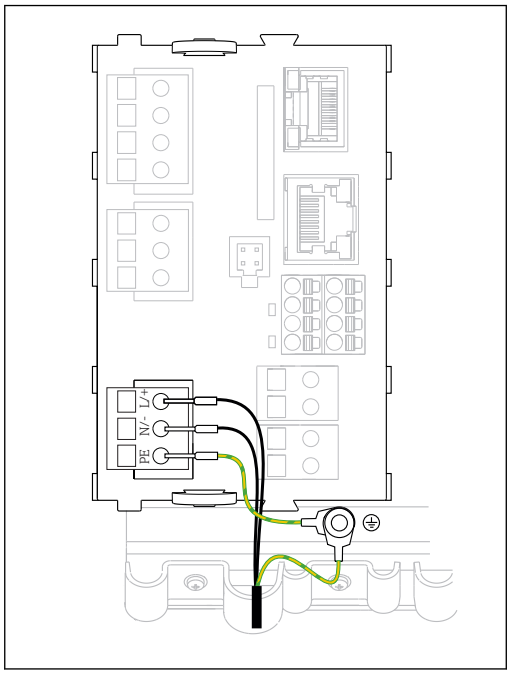


14 *Basic module BASE2-E (four- and eight-channel device)*

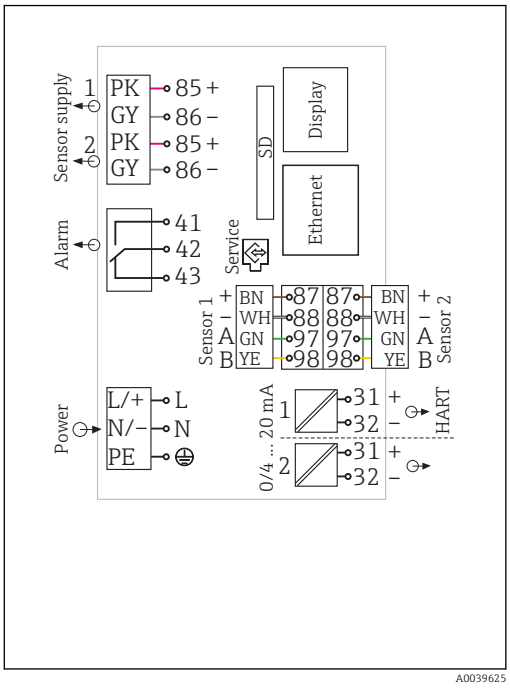
1 *Power supply for digital fixed cable sensors with Memosens protocol*
2 *SD card slot*
3 *Slot for display cable* [1)]
4 *Ethernet interface*
5 *Connections for 2 Memosens sensors*
6 *Current outputs*
7 *Socket for internal supply cable* [1)]
8 *LEDs*
9 *Service interface*
10 *Alarm relay connection*

[1)] Internal device connection. Do not disconnect the plug!

Connecting supply voltage for CM442



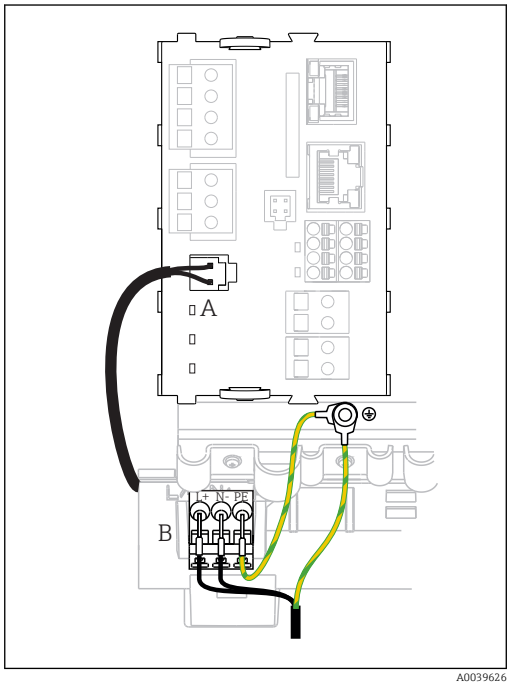
15 *Connecting power supply on the BASE2-H or -L*



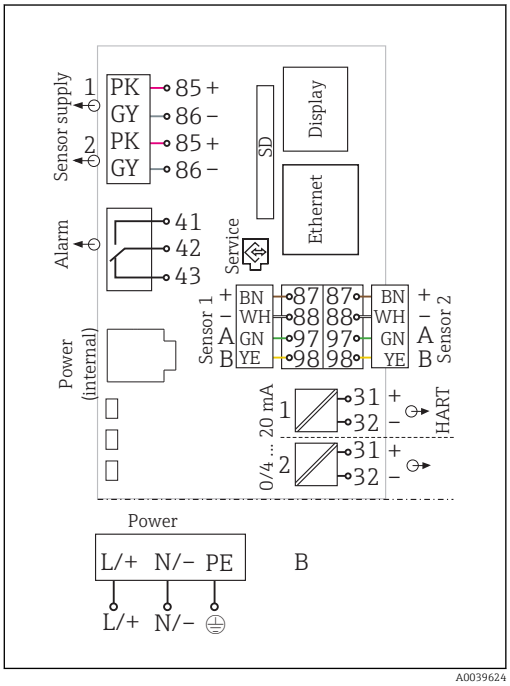
16 *Overall wiring diagram for BASE2-H or -L*

H Power unit 100 to 230 VAC
L Power unit 24 VAC or 24 VDC

Connecting supply voltage for CM444 and CM448



17 *Power supply connection on the BASE2-E*



18 *Overall wiring diagram for BASE2-E and extension power unit (B)*

A Internal power supply cable
B Extension power unit

Connecting optional modules

With extension modules you can purchase additional functions for your device.

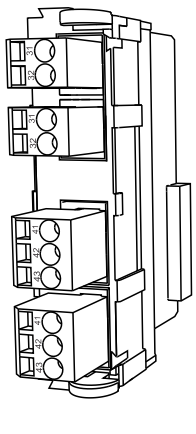
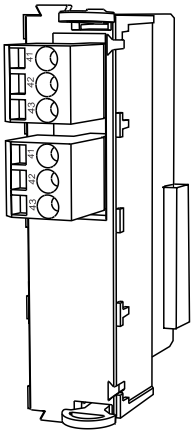
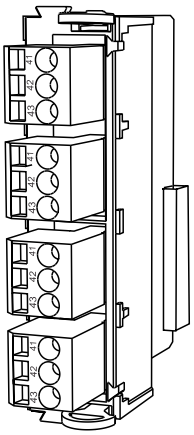
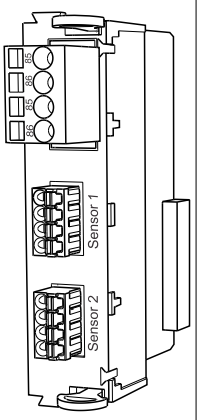
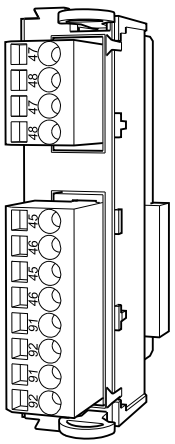
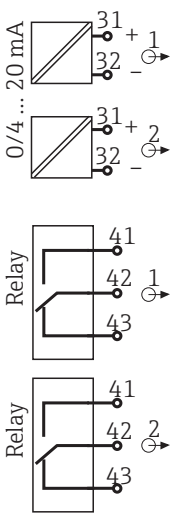
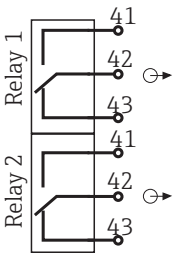
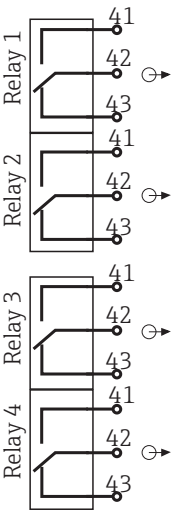
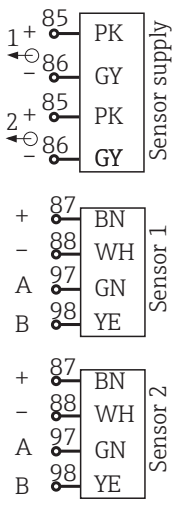
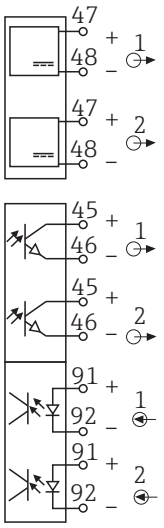
NOTICE

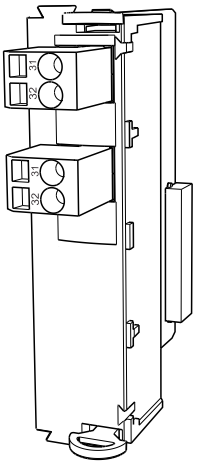
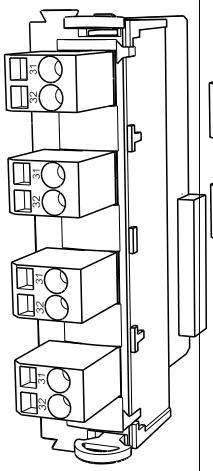
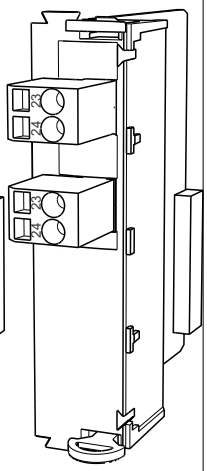
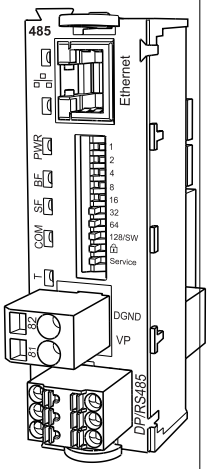
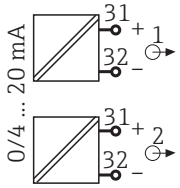
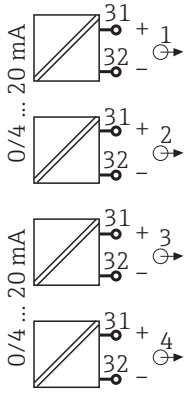
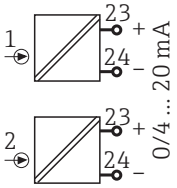
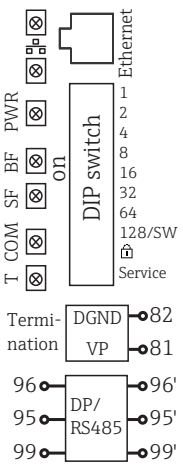
Unacceptable hardware combinations (due to conflicts in power supply)

Incorrect measurements or total failure of the measuring point as a result of heat build-up or overloading

- If you are planning to extend your controller, make sure the resulting hardware combination is permitted (Configurator at www.endress.com/CM442 or .../CM444 or .../CM448).
- Please note that if you are extending CM442 to CM444 or CM448, you must additionally fit an extension power supply unit and an extension backplane. You must then also use basic module BASE-E.
- Remember that the sum of all current inputs and outputs may not exceed 8.
- Make sure not to use more than 2 "DIO" modules. More "DIO" modules are not permitted.
- Please contact your Endress+Hauser sales center should you have any questions.

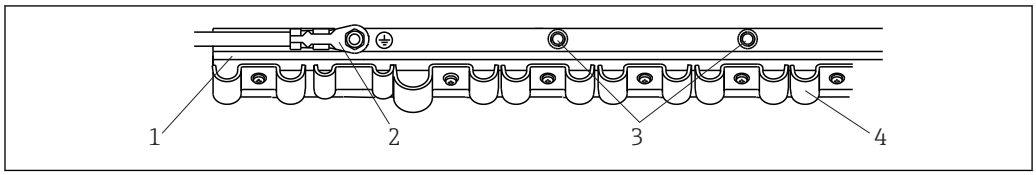
Overview of all the modules available

Module name				
AOR	**2R**	**4R**	**2DS**	**DIO**
				
▪ 2 x 0/4 to 20 mA analog outputs ▪ 2 relays ▪ Order No. 71111053	▪ 2 relays ▪ Order No. 71125375	▪ 4 relays ▪ Order No. 71125376	▪ 2 digital sensor inputs ▪ 2 power supply systems for digital sensors ▪ Order No. 71135631	▪ 2 digital inputs ▪ 2 digital outputs with auxiliary voltage ▪ Order No. 71135638
				

Module name				
2AO	**4AO**	**2AI**	**485**	
				
▪ 2 x 0/4 to 20 mA analog outputs ▪ Order No. 71135632	▪ 4 x 0/4 to 20 mA analog outputs ▪ Order No. 71135633	▪ 2 x 0/4 to 20mA analog inputs ▪ Order No. 71135639	▪ Ethernet (web server or Modbus TCP) ▪ 5V power supply for PROFIBUS DP termination ▪ RS485 (PROFIBUS DP or Modbus RS485) ▪ Use of BASE2 module disables Ethernet port of module 485 ▪ Order No. 71135634	
				

PROFIBUS DP (module 485)
Contacts 95, 96 and 99 are bridged in the connector. This ensures that PROFIBUS communication is not interrupted if the connector is disconnected.

Protective ground connection



19 *Cable mounting rail and associated function*

1 *Cable mounting rail*
2 *Threaded bolt (protective ground connection, central grounding point)*
3 *Additional threaded bolts for ground connections*
4 *Cable clamps (fixing and grounding the sensor cables)*

Sensor connection

Sensors with Memosens protocol

Sensor types	Sensor cable	Sensors
Digital sensors **without** additional internal power supply	With plug-in connection and inductive signal transmission	▪ pH sensors ▪ ORP sensors ▪ Combined sensors ▪ Oxygen sensors (amperometric and optical) ▪ Conductivity sensors with conductive measurement of conductivity ▪ Chlorine sensors (disinfection)
	Fixed cable	Conductivity sensors with inductive measurement of conductivity
Digital sensors with additional internal power supply	Fixed cable	▪ Turbidity sensors ▪ Sensors for interface measurement ▪ Sensors for measuring the spectral absorption coefficient (SAC) ▪ Nitrate sensors ▪ Optical oxygen sensors ▪ Ion-sensitive sensors

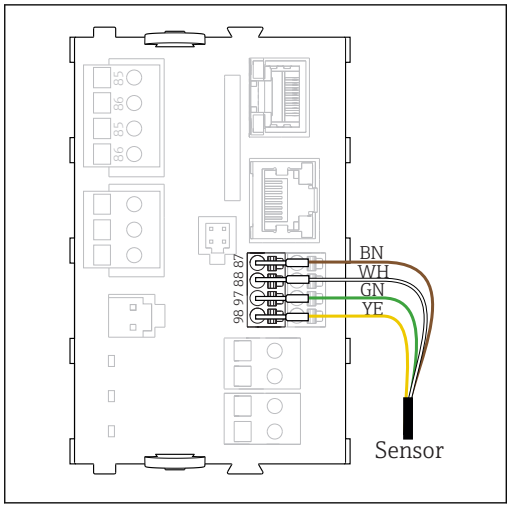
The following rule applies if connecting CUS71D sensors:

- CM442
  - Only one CUS71D is possible; an additional sensor is not permitted.
  - The second sensor input may also not be used for another type of sensor.
- CM444
  No restrictions. All the sensor inputs can be used as required.
- CM448
  - If a CUS71D is connected, the number of sensor inputs that can be used is limited to a maximum of 4.
  - Of these, all 4 inputs can be used for CUS71D sensors.
  - Every combination of CUS71D and other sensors is possible, provided that the total number of connected sensors does not exceed 4.

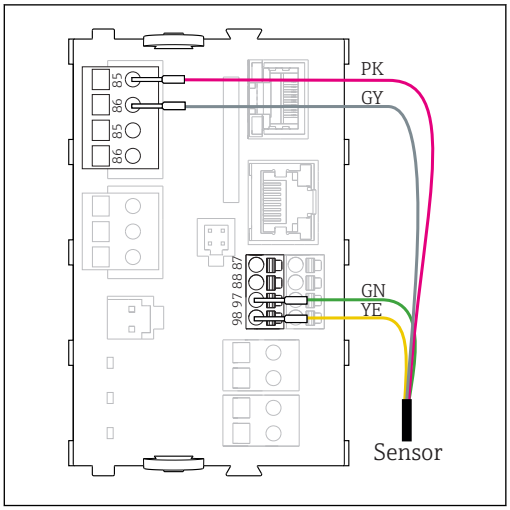
Types of connection

- Direct connection of the sensor cable to the terminal connector of the sensor module 2DS or of the base module-L, -H or -E (→ 20 ff.)
- Optional: Sensor cable plug connected to the M12 sensor socket on the underside of the device
  With this type of connection, the device is already wired at the factory (→ 23).

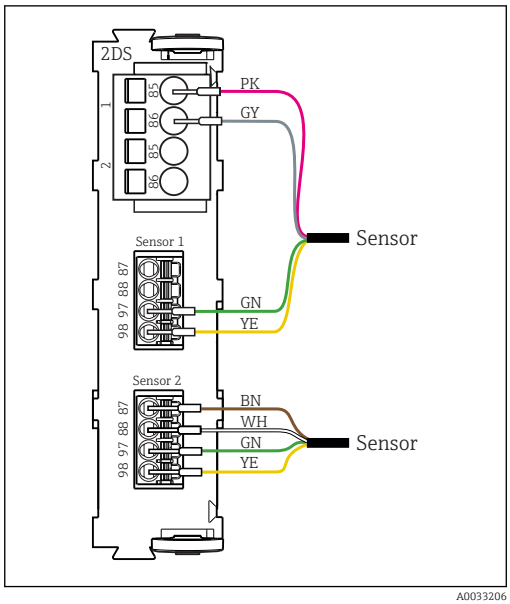
Sensor cable connected directly



20 *sensors without additional supply voltage*

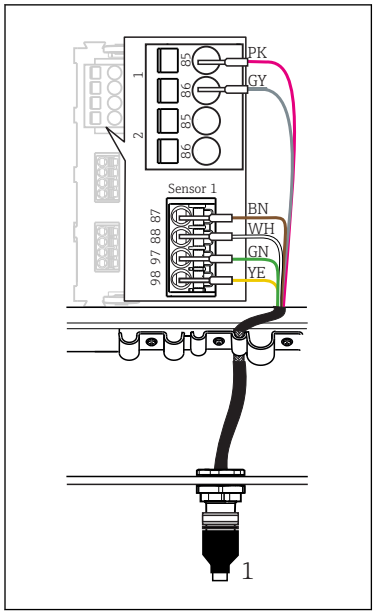


21 *sensors with additional supply voltage*



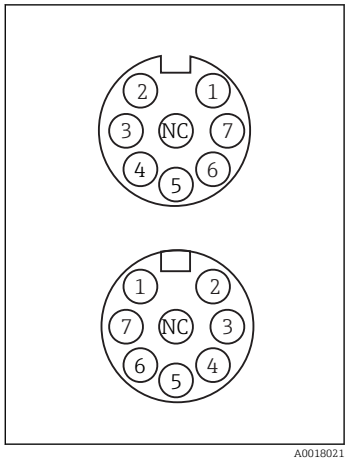
22 *sensors with and without additional supply voltage at sensor module 2DS*

connection via M12 plug-in connection



23 M12 plug-in connection (e.g. at sensor module)

1 Sensor cable with M12 connector



24 M12 assignment Top: socket Bottom: connector (top view in each case)

1 PK (24 V)
2 GY (Ground 24 V)
3 BN (3 V)
4 WH (Ground 3 V)
5 GN (Memosens)
6 YE (Memosens)
7, NC Not connected

Device versions with a pre-installed M12 socket are ready-wired upon delivery.

Please note the following:
- The internal device wiring is always the same regardless of what kind of sensor you connect to the M12 socket (plug&play).
- The signal or power supply cables are assigned in the sensor head in such a way that the PK and GY power supply cables are either used (e.g. optical sensors) or not (e.g. pH or ORP sensors).

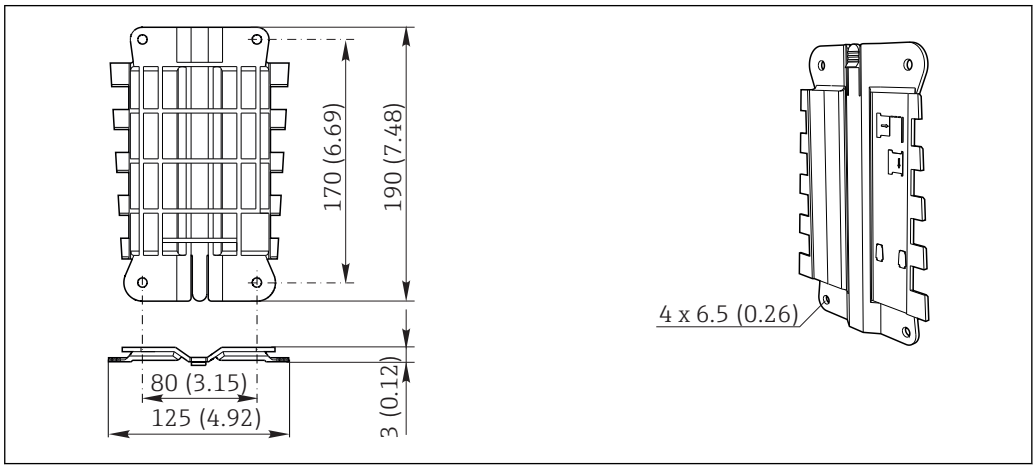
Performance characteristics

Response time	**Current outputs** t_{90} = max. 500 ms for an increase from 0 to 20 mA **Current inputs** t_{90} = max. 330 ms for an increase from 0 to 20 mA **Digital inputs and outputs** t_{90} = max. 330 ms for an increase from low to high
Reference temperature	25 °C (77 °F)
Measured error for sensor inputs	→ Documentation of the connected sensor
Measured error for current inputs and outputs	**Typical measured errors:** < 20 µA (with current values < 4 mA) < 50 µA (with current values 4 to 20 mA) at 25 °C (77 ° F) each **Additional measured error depending on the temperature:** < 1.5 µA/K
Frequency tolerance of digital inputs and outputs	≤ 1%
Resolution of current inputs and outputs	< 5 µA
Repeatability	→ Documentation of the connected sensor

Installation

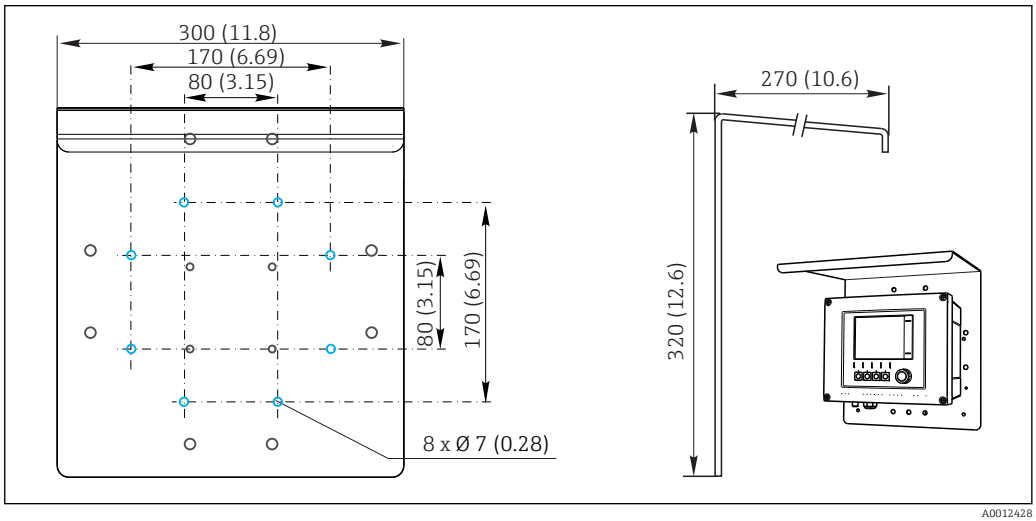
Installation conditions

Mounting plate



25 *Mounting plate, dimensions in mm (in)*

Weather protection cover

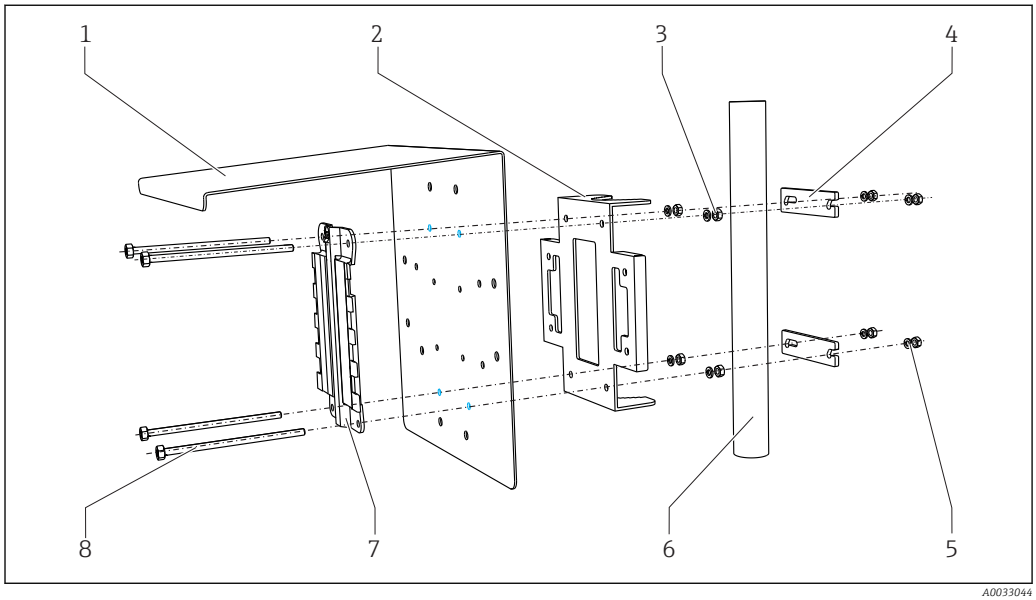


26 *Dimensions in mm (in)*

Installation

Post mounting

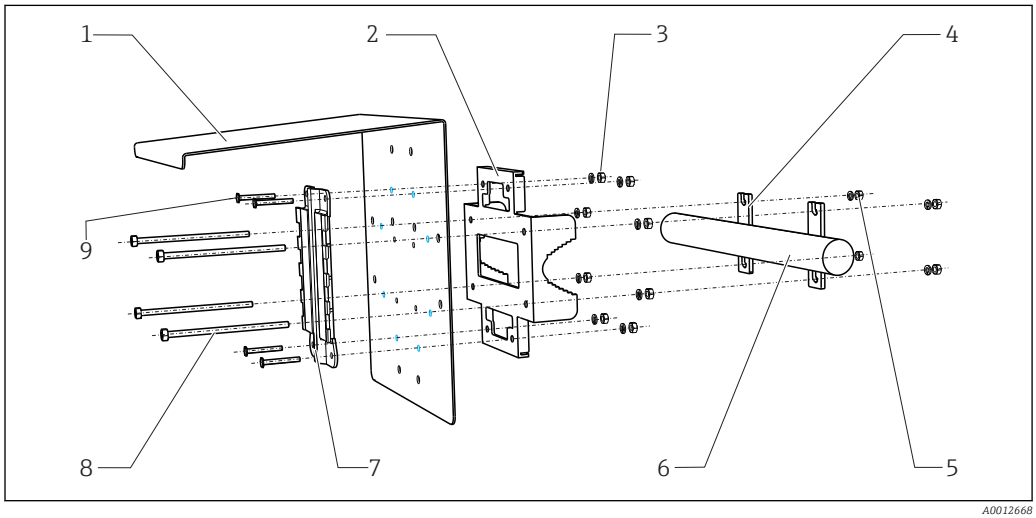
You require the post mounting kit (optional) to mount the unit on a pipe, post or railing (square or circular, clamping range 20 to 61 mm (0.79 to 2.40")).



27 *Post mounting*

1	*Weather protection cover (optional)*	5	*Spring washers and nuts (post mounting kit)*
2	*Post mounting plate (post mounting kit)*	6	*Pipe or railing (circular/square)*
3	*Spring washers and nuts (post mounting kit)*	7	*Mounting plate*
4	*Pipe clamps (post mounting kit)*	8	*Threaded rods (post mounting kit)*

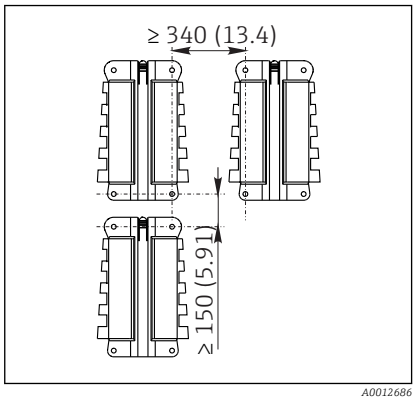
Rail mounting



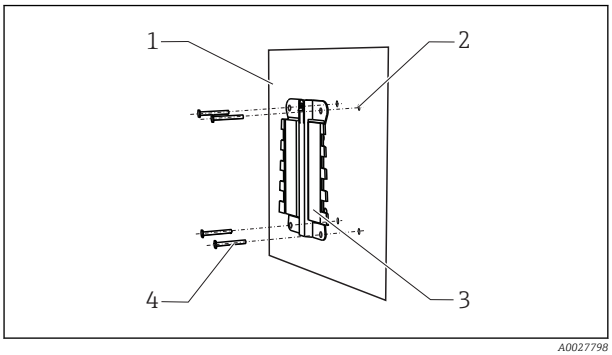
28 *Rail mounting*

1	*Weather protection cover (optional)*	6	*Pipe or railing (circular/square)*
2	*Post mounting plate (post mounting kit)*	7	*Mounting plate*
3	*Spring washers and nuts (post mounting kit)*	8	*Threaded rods (post mounting kit)*
4	*Pipe clamps (post mounting kit)*	9	*Screws (post mounting kit)*
5	*Spring washers and nuts (post mounting kit)*		

Wall mounting



29 *Installation clearance in mm (in)*



30 *Wall mounting*

1 *Wall*
2 *4 drill holes* [1)]
3 *Mounting plate*
4 *Screws Ø 6 mm (not part of scope of supply)*

[1)] *The size of the drill holes depends on the wall plugs used. The wall plugs and screws must be provided by the customer.*

Environment

Ambient temperature range

CM442
−20 to 60 °C (0 to 140 °F)

CM444
- Generally −20 to 55 °C (0 to 130 °F), with the exception of packages under the second list item
- −20 to 50 °C (0 to 120 °F) for the following packages:
  - CM444-**M40A7FI******+...
  - CM444-**M40A7FK******+...
  - CM444-**N40A7FI******+...
  - CM444-**N40A7FK******+...
  - CM444-**M4AA5F4******+...
  - CM444-**M4AA5FF******+...
  - CM444-**M4AA5FH******+...
  - CM444-**M4AA5FI******+...
  - CM444-**M4AA5FK******+...
  - CM444-**M4AA5FM******+...
  - CM444-**M4BA5F4******+...
  - CM444-**M4BA5FF******+...
  - CM444-**M4BA5FH******+...
  - CM444-**M4BA5FI******+...
  - CM444-**M4BA5FK******+...
  - CM444-**M4BA5FM******+...
  - CM444-**M4DA5F4******+...
  - CM444-**M4DA5FF******+...
  - CM444-**M4DA5FH******+...
  - CM444-**M4DA5FI******+...
  - CM444-**M4DA5FK******+...
  - CM444-**M4DA5FM******+...

CM448
- Generally −20 to 55 °C (0 to 130 °F), with the exception of packages under the second list item
- −20 to 50 °C (0 to 120 °F) for the following packages:
  - CM448-***6AA******+...
  - CM448-***8A4******+...
  - CM448-***8A5******+...
  - CM448-**28A3******+...
  - CM448-**38A3******+...
  - CM448-**48A3******+...
  - CM448-**58A3******+...
  - CM448-**68A3******+...
  - CM448-**26A5******+...
  - CM448-**36A5******+...
  - CM448-**46A5******+...
  - CM448-**56A5******+...
  - CM448-**66A5******+...
  - CM448-**22A7******+...
  - CM448-**32A7******+...
  - CM448-**42A7******+...
  - CM448-**52A7******+...
  - CM448-**62A7******+...
  - CM448-**A6A5******+...
  - CM448-**A6A7******+...
  - CM448-**B6A5******+...
  - CM448-**B6A7******+...
  - CM448-**C6A5******+...
  - CM448-**C6A7******+...
  - CM448-**D6A5******+...
  - CM448-**D6A7******+...

Storage temperature

-40 to +80 °C (-40 to 175 °F)

Humidity

10 to 95 %, non-condensating

Degree of protection

IP 66/67, impermeability and corrosion resistance in accordance with NEMA TYPE 4X

Vibration resistance

Environmental tests
Vibration test based on DIN EN 60068-2, October 2008
Vibration test based on DIN EN 60654-3, August 1998

Post or pipe mounting

Frequency range	10 to 500 Hz (sinusoidal)	
Amplitude	10 to 57.5 Hz: 57.5 to 500 Hz:	0.15 mm 2 g [1]
Test duration	10 frequency cycles/ spatial axis, in 3 spatial axes (1 oct./min)	

Wall mounting

Frequency range	10 to 150 Hz (sinusoidal)	
Amplitude	10 to 12.9 Hz: 12.9 to 150 Hz:	0.75 mm 0.5 g [1]
Test duration	10 frequency cycles/ spatial axis, in 3 spatial axes (1 oct./min)	

1) g ... gravitational acceleration (1 g ≈ 9.81 m/s^2)

Electromagnetic compatibility

Interference emission and interference immunity as per EN 61326-1:2013, Class A for Industry

Electrical safety

IEC 61010-1, Class I equipment
Low voltage: overvoltage category II
Environment < 3000 m (< 9840 ft) above MSL

Degree of contamination

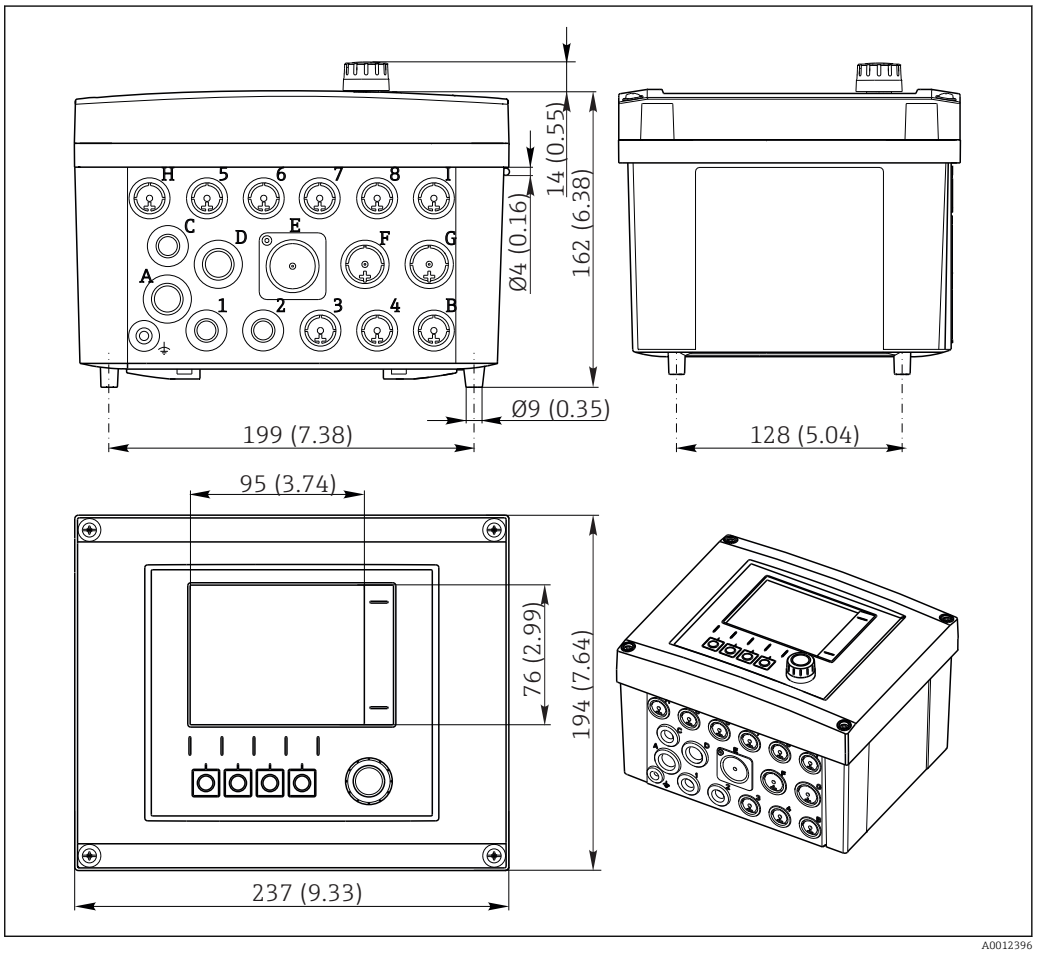
The product is suitable for pollution degree 4.

Pressure compensation to environment

Filter made of GORE-TEX used as pressure compensation element
Ensures pressure compensation to environment and guarantees IP protection.

Mechanical construction

Dimensions



31 Dimensions of field housing in mm (inch)

Weight

Complete device	Approx. 2.1 kg (4.63 lbs), depending on the version
Individual module	Approx. 0.06 kg (0.13 lbs)

Materials

Housing base	PC-FR
Display cover	PC-FR
Display foil and soft keys	PE
Housing seal	EPDM
Module side panels	PC-FR
Module covers	PBT GF30 FR
Cable mounting rail	PBT GF30 FR, stainless steel 1.4301 (AISI304)
Clamps	Stainless steel 1.4301 (AISI304)
Threaded fasteners	Stainless steel 1.4301 (AISI304)
Cable glands	Polyamide V0 as per UL94

Operability

Display

Graphic display:
- Resolution: 240 x 160 pixel
- Back light with switch-off function
- Red display background for alarms alerts users to errors
- Transflective display technology for maximum contrast even in bright environments
- User-definable measuring menus mean you can always keep track of the values that are important for your application.

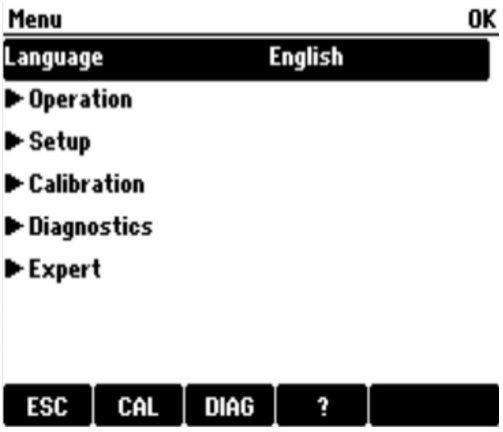
Operating concept

The simple and structured operating concept sets new standards:
- Intuitive operation with the navigator and soft keys
- Fast configuration of application-specific measurement options
- Easy configuration and diagnosis thanks to plain-text display
- All languages that can be ordered are available in every device



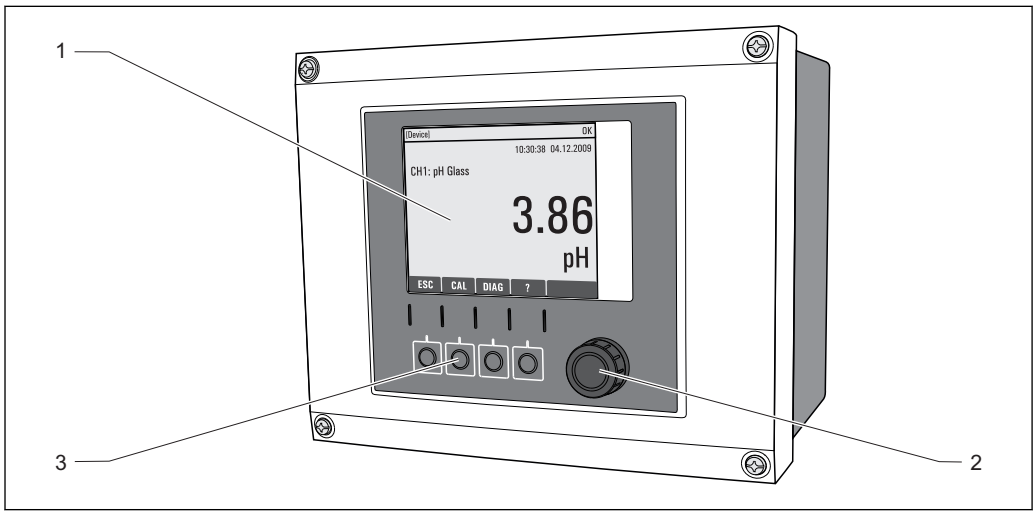
A0025228

32 Easy operation



33 Plain-text menu

Local operation



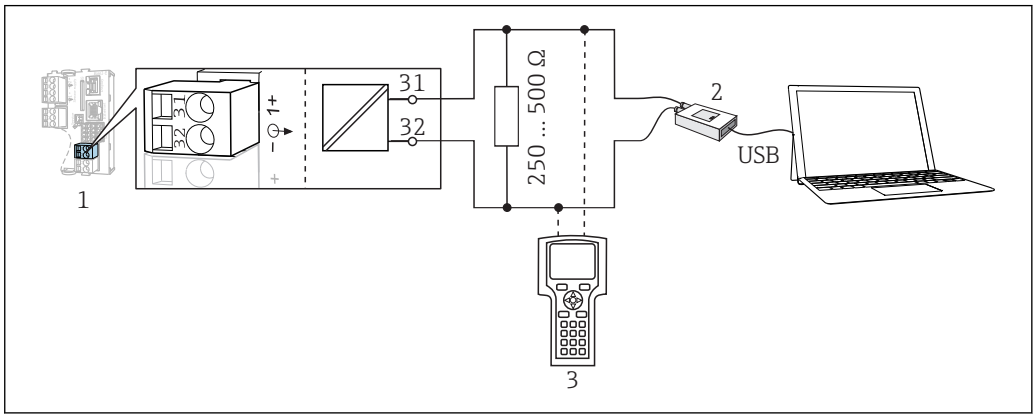
A0011764

34 Overview of operation

1 Display (with red display background in alarm condition)
2 Navigator (jog/shuttle and press/hold function)
3 Soft keys (function depends on menu)

Remote operation

Via HART (e.g. via HART modem and FieldCare)

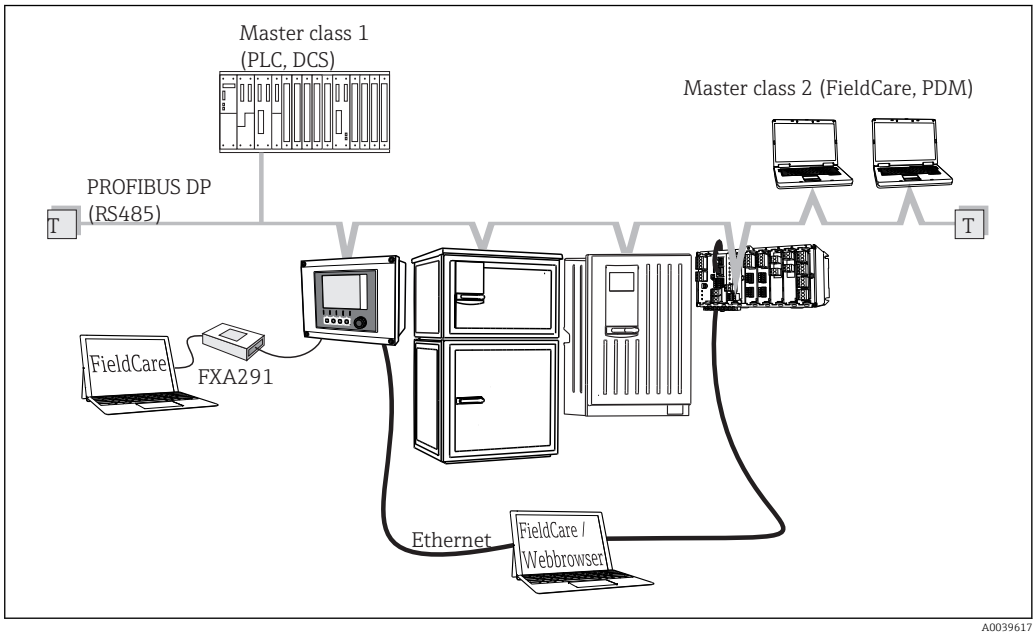


35 *HART using modem*

1 Device module Base2-L, -H or -E: current output 1 with HART
2 HART modem for connection to PC, e.g. Commubox FXA191 (RS232) or FXA195 [1] (USB)
3 HART handheld terminal

[1] Switch position "on" (substitutes the resistor)

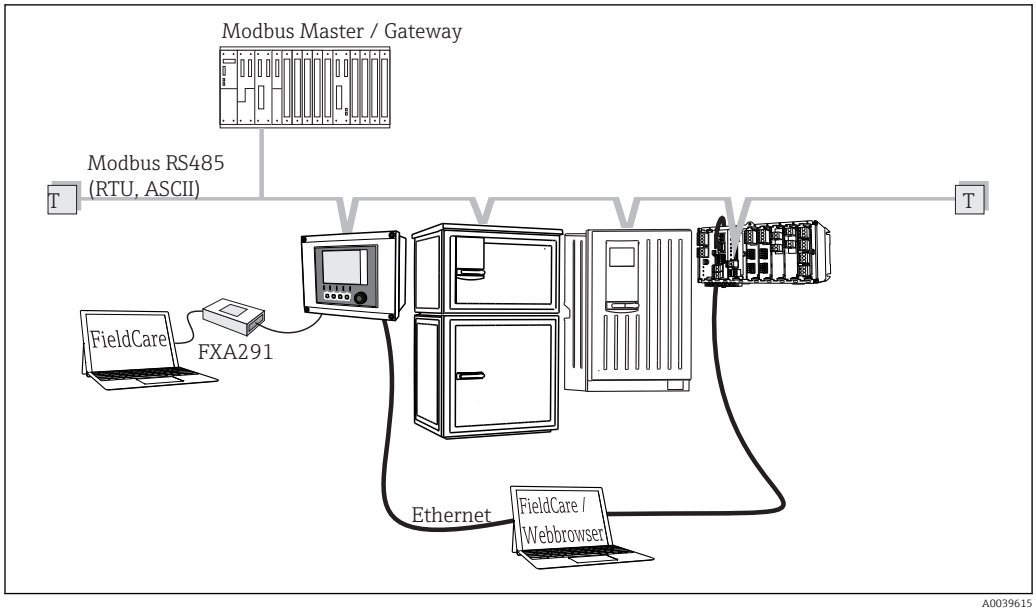
Via PROFIBUS DP



36 *PROFIBUS DP*

T Terminating resistor

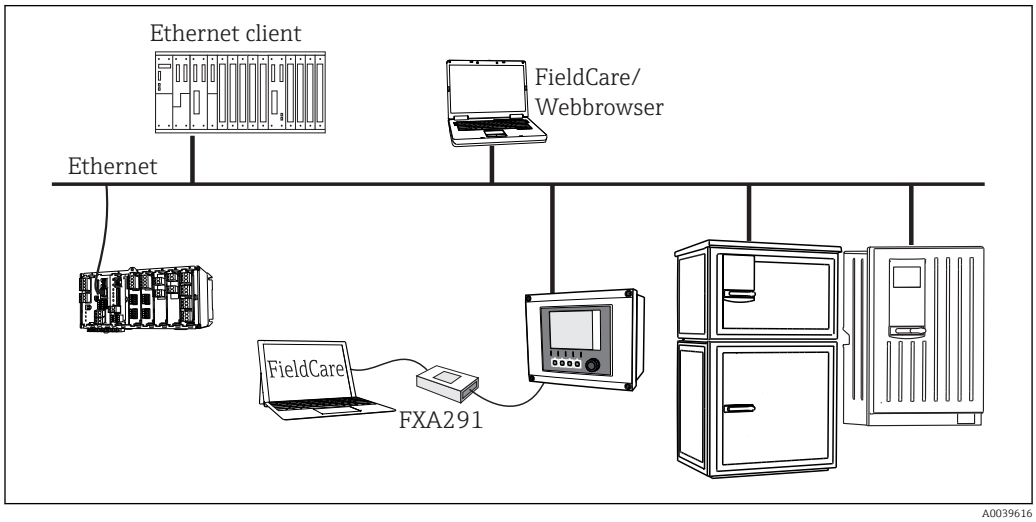
Via Modbus RS485



37 Modbus RS485

T Terminating resistor

Via Ethernet: web server/Modbus TCP/PROFINET/EtherNet/IP



38 Modbus TCP or EtherNet/IP or PROFINET

Language packages

The language selected in the product structure is the operating language preset at the factory. All other languages can be selected using the menu.

- English (US)
- German
- Chinese (Simplified, PR China)
- Czech
- Dutch
- French
- Italian
- Japanese
- Polish
- Portuguese
- Russian
- Spanish
- Swedish
- Turkish

- Hungarian
- Croatian
- Vietnamese

The availability of other languages can be checked via the product structure at www.endress.com/cm442 or .../cm444 or .../cm448.

Certificates and approvals

CE mark

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EU directives. The manufacturer confirms successful testing of the product by affixing to it the CE mark.

EAC

The product has been certified according to guidelines TP TC 004/2011 and TP TC 020/2011 which apply in the European Economic Area (EEA). The EAC conformity mark is affixed to the product.

cCSAus

The device has been certified with regard to its electrical safety and for NI Class I Div. 2 cCSAus explosion-proof environments. It meets the requirements in accordance with:

- CLASS 2252 06 - Process Control Equipment
- CLASS 2252 86 - Process Control Equipment - Certified to US Standards
- CLASS 2258 03 - Process Control Equipment - Intrinsically Safe and Non-incendive Systems - For Hazardous Locations
- CLASS 2258 83 - Process Control Equipment - Intrinsically Safe and Non-incendive Systems - For Hazardous Locations - Certified to US Standards
- FM3600
- FM3611
- FM3810
- UL50E
- IEC 60529
- CAN/CSA-C22.2 No. 0
- CAN/CSA C22.2 No. 94
- CSA Std. C22.2 No. 213
- CAN/CSA-C22.2 No. 61010-1
- CAN/CSA-C22.2 No. 60529
- UL/ANSI/ISA 61010-1
- ANSI - ISA 12 12 01

MCERTS

CM442 only
The device has been assessed by Sira Certification Service and complies with "MCERTS Performance Standards for Continuous Water Monitoring Equipment, Part 2: online analysers, Version 3.1, dated August 2010"; Certificate No.: Sira MC140246/01.

Marine approvals

A selection of the devices and sensors have type approval for marine applications, issued by the following classification societies: ABS (American Bureau of Shipping), BV (Bureau Veritas), DNV-GL (Det Norske Veritas-Germanischer Lloyd) and LR (Lloyd's Register). Details of the order codes of the approved devices and sensors, and the installation and ambient conditions, are provided in the relevant certificates for marine applications on the product page on the Internet.

Ordering information

Product page

www.endress.com/cm442

www.endress.com/cm444

www.endress.com/cm448

Product Configurator

On the product page there is a **Configure** button to the right of the product image.

1. Click this button.
   ↳ The Configurator opens in a separate window.
2. Select all the options to configure the device in line with your requirements.
   ↳ In this way, you receive a valid and complete order code for the device.
3. Export the order code as a PDF or Excel file. To do so, click the appropriate button on the right above the selection window.

For many products you also have the option of downloading CAD or 2D drawings of the selected product version. Click the **CAD** tab for this and select the desired file type using picklists.

Scope of delivery

The scope of delivery comprises:
- 1 multichannel controller in the version ordered
- 1 mounting plate
- 1 wiring label (attached at the factory to the inside of the display cover)
- 1 printed copy of the Brief Operating Instructions in the language ordered

Accessories

The following are the most important accessories available at the time this documentation was issued.

► For accessories not listed here, please contact your Service or Sales Center.

Protective cover

CYY101
- Weather protection cover for field devices
- Absolutely essential for field installation
- Material: stainless steel 1.4301 (AISI 304)
- Order No. CYY101-A

Post mounting kit

Post mounting kit CM44x
- For securing the field housing to horizontal and vertical posts and pipes
- Order No. 71096920

Measuring cable

Memosens data cable CYK10
- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk10

Technical Information TI00118C

Memosens data cable CYK11
- Extension cable for digital sensors with Memosens protocol
- Product Configurator on the product page: www.endress.com/cyk11

Technical Information TI00118C

Sensors

Glass electrodes

Orbisint CPS11D
- pH sensor for process technology
- Optional SIL version for connecting to SIL transmitter
- With dirt-repellent PTFE diaphragm
- Product Configurator on the product page: www.endress.com/cps11d

Technical Information TI00028C

Memosens CPS31D
- pH electrode with gel-filled reference system with ceramic diaphragm
- Product Configurator on the product page: www.endress.com/cps31d

Technical Information TI00030C

Ceraliquid CPS41D
- pH electrode with ceramic junction and KCl liquid electrolyte
- Product Configurator on the product page: www.endress.com/cps41d

Technical Information TI00079C

Ceragel CPS71D
- pH electrode with reference system including ion trap
- Product Configurator on the product page: www.endress.com/cps71d

Technical Information TI00245C

Memosens CPS171D
- pH electrode for bio-fermenters with digital Memosens technology
- Product Configurator on the product page: www.endress.com/cps171d

Technical Information TI01254C

Orbipore CPS91D
- pH electrode with open aperture for media with high dirt load
- Product Configurator on the product page: www.endress.com/cps91d

Technical Information TI00375C

Orbipac CPF81D
- Compact pH sensor for installation or immersion operation
- In industrial water and wastewater
- Product Configurator on the product page: www.endress.com/cpf81d

Technical Information TI00191C

Enamel pH electrodes

Ceramax CPS341D
- pH electrode with pH-sensitive enamel
- Meets highest demands of measuring accuracy, pressure, temperature, sterility and durability
- Product Configurator on the product page: www.endress.com/cps341d

Technical Information TI00468C

ORP sensors

Orbisint CPS12D
- ORP sensor for process technology
- Product Configurator on the product page: www.endress.com/cps12d

Technical Information TI00367C

Ceraliquid CPS42D
- ORP electrode with ceramic junction and KCl liquid electrolyte
- Product Configurator on the product page: www.endress.com/cps42d

Technical Information TI00373C

Ceragel CPS72D
- ORP electrode with reference system including ion trap
- Product Configurator on the product page: www.endress.com/cps72d

Technical Information TI00374C

Orbipac CPF82D
- Compact ORP sensor for installation or immersion operation in process water and wastewater
- Product Configurator on the product page: www.endress.com/cpf82d

Technical Information TI00191C

Orbipore CPS92D
- ORP electrode with open aperture for media with high dirt load
- Product Configurator on the product page: www.endress.com/cps92d

Technical Information TI00435C

pH ISFET sensors

Tophit CPS441D
- Sterilizable ISFET sensor for low-conductivity media
- Liquid KCl electrolyte
- Product Configurator on the product page: www.endress.com/cps441d

Technical Information TI00352C

Tophit CPS471D
- Sterilizable and autoclavable ISFET sensor for food and pharmaceutics, process engineering
- Water treatment and biotechnology
- Product Configurator on the product page: www.endress.com/cps471d

Technical Information TI00283C

Tophit CPS491D
- ISFET sensor with open aperture for media with high dirt load
- Product Configurator on the product page: www.endress.com/cps491d

Technical Information TI00377C

pH and ORP combined sensors

Memosens CPS16D
- Combined pH/ORP sensor for process technology
- With dirt-repellent PTFE diaphragm
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cps16D

Technical Information TI00503C

Memosens CPS76D
- Combined pH/ORP sensor for process technology
- Hygienic and sterile applications
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cps76d

Technical Information TI00506C

Memosens CPS96D
- Combined pH/ORP sensor for chemical processes
- With poison-resistant reference with ion trap
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cps96d

Technical Information TI00507C

Conductivity sensors with inductive measurement of conductivity

Indumax CLS50D
- High-durability inductive conductivity sensor
- For standard and hazardous area applications
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cls50d

Technical Information TI00182C

Indumax H CLS54D
- Inductive conductivity sensor
- With certified, hygienic design for foodstuffs, beverages, pharmaceuticals and biotechnology
- Product Configurator on the product page: www.endress.com/cls54d

Technical Information TI00508C

Conductivity sensors with conductive measurement of conductivity

Condumax CLS15D
- Conductive conductivity sensor
- For pure water, ultrapure water and hazardous area applications
- Product Configurator on the product page: www.endress.com/CLS15d

Technical Information TI00109C

Condumax CLS16D
- Hygienic, conductive conductivity sensor
- For pure water, ultrapure water and Ex applications
- With EHEDG and 3A approval
- Product Configurator on the product page: www.endress.com/CLS16d

Technical Information TI00227C

Condumax CLS21D
- Two-electrode sensor in plug-in head version version
- Product Configurator on the product page: www.endress.com/CLS21d

Technical Information TI00085C

Memosens CLS82D
- Four-electrode sensor
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cls82d

Technical Information TI01188C

Oxygen sensors

Oxymax COS22D
- Sterilizable sensor for dissolved oxygen
- With Memosens technology or as an analog sensor
- Product Configurator on the product page: www.endress.com/cos22d

Technical Information TI00446C

Oxymax COS51D
- Amperometric sensor for dissolved oxygen
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cos51d

Technical Information TI00413C

Oxymax COS61D
- Optical oxygen sensor for drinking water and industrial water measurement
- Measuring principle: quenching
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cos61d

Technical Information TI00387C

Memosens COS81D
- Sterilizable, optical sensor for dissolved oxygen
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cos81d

Technical Information TI01201C

Disinfection sensors

CCS142D
- Membrane-covered amperometric sensor for free chlorine
- Measuring range 0.01 to 20 mg/l
- With Memosens technology
- Product Configurator on the product page: www.endress.com/ccs142d

Technical Information TI00419C

Ion-selective sensors

ISEmax CAS40D
- Ion selective sensors
- Product Configurator on the product page: www.endress.com/cas40d

Technical Information TI00491C

Turbidity sensors

Turbimax CUS51D
- For nephelometric measurements of turbidity and solids in wastewater
- 4-beam scattered light method
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cus51d

Technical Information TI00461C

Turbimax CUS52D
- Hygienic Memosens sensor for turbidity measurement in drinking water, process water and in utilities
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cus52d

Technical Information TI01136C

SAC and nitrate sensors

Viomax CAS51D
- SAC and nitrate measurement in drinking water and wastewater
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cas51d

Technical Information TI00459C

Interface measurement

Turbimax CUS71D
- Immersion sensor for interface measurement
- Ultrasonic interface sensor
- Product Configurator on the product page: www.endress.com/cus71d

Technical Information TI00490C

Additional functionality

Hardware extension modules

Kit, extension module AOR
- 2 x relay, 2 x 0/4 to 20 mA analog output
- Order No. 71111053

Kit, extension module 2R
- 2 x relay
- Order No. 71125375

Kit, extension module 4R
- 4 x relay
- Order No. 71125376

Kit, extension module 2AO
- 2 x 0/4 to 20 mA analog output
- Order No. 71135632

Kit, extension module 4AO
- 4 x analog output 0/4 to 20 mA
- Order No. 71135633

Kit, extension module 2DS
- 2 x digital sensor, Memosens
- Order No. 71135631

Kit, extension module 2AI
- 2 x 0/4 to 20 mA analog input
- Order No. 71135639

Kit, extension module DIO
- 2 x digital input
- 2 x digital output
- Auxiliary voltage supply for digital output
- Order No. 71135638

Kit, extension module 485
- Can be extended to PROFIBUS DP or Modbus RS485. This requires an additional activation code which can be ordered separately.
- Order No. 71135634

Upgrade kit, extension module 485 with PROFIBUS DP
- Extension module 485
- PROFIBUS DP (+ Ethernet configuration)
- Order No. 71140888

Upgrade kit, extension module 485 with Modbus RS485
- Extension module 485
- Modbus RS485 (+ Ethernet configuration)
- Order No. 71140889

Kit CM442: upgrade kit to CM444/CM448
- Extension power supply unit 100 to 230 V AC and extension backplane
- Basic module
- You must quote the serial number of the device when ordering the kit.
- Order No. 71470973

Kit CM442: upgrade kit to CM444/CM448
- Extension power supply unit 24 V DC and extension backplane
- Basic module
- You must quote the serial number of the device when ordering the kit.
- Order No. 71470975

Firmware and activation codes

SD card with Liquiline firmware
- Industrial Flash Drive, 1 GB
- Order No. 71127100

You must quote the serial number of the device when ordering the activation code.

Activation code for digital HART communication
Order No. 71128428

Activation code for PROFIBUS DP
Order No. 71135635

Activation code for Modbus RS485
Order No. 71135636

Activation code for PROFINET + web server for BASE2
Order No. 71449901

Activation code for Ethernet/IP + web server for BASE2
Order No. 71449914

Activation code for Modbus TCP + web server for BASE2
Order No. 71449915

Activation code for web server for BASE2
Order No. 71449918

Kit CM442: activation code for 2nd digital sensor input
Order No. 71114663

Kit CM444/CM448: upgrade code for 2 x 0/4 to 20 mA for BASE2-E
On request

Activation code for feedforward control
- Requires current input or fieldbus communication
- Order No. 71211288

Activation code for measuring range switch
- Requires digital inputs or fieldbus communication
- Order No. 71211289

Activation code for ChemocleanPlus
- Requires relays or digital outputs or fieldbus communication and optional digital inputs
- Order No. 71239104

Activation code for Heartbeat Verification and Monitoring
Order No. 71367524

Activation code for ion exchanger operating time
- Configure the mathematical function
- Order No. 71367531

Activation code for mathematics
- Formula editor
- Order No. 71367541

Software

Memobase Plus CYZ71D
- PC software to support laboratory calibration
- Visualization and documentation of sensor management
- Sensor calibrations stored in database
- Product Configurator on the product page: www.endress.com/cyz71d

Technical Information TI00502C

Field Data Manager Software MS20
- PC software for central data management
- Visualization of series of measurements and logbook events
- SQL database for secure data storage

FieldCare SFE500
- Universal tool for field device configuration and management
- Supplied with a complete library of certified DTMs (Device Type Manager) for operation of Endress +Hauser field devices
- Order according to product order structure
- www.endress.com/sfe500

Other accessories

SD card
- Industrial Flash Drive, 1 GB
- Order No. 71110815

Cable glands

Kit CM44x: gland M
- Set, 6 pieces
- Order No. 71101768

Kit CM44x: gland NPT
- Set, 6 pieces
- Order No. 71101770

Kit CM44x: gland G
- Set, 6 pieces
- Order No. 71101771

Kit CM44x: dummy plug for cable gland
- Set, 6 pieces
- Order No. 71104942

M12 built-in socket and cable junction with Velcro strip

Kit CM42/CM442/CM444/CM448: external CDI socket
- Socket with terminated connecting cables and counter nut
- Order No. 51517507

Kit CM442/CM444/CM448/CSF48: M12 built-in socket for digital sensors
- Pre-terminated
- Order No. 71107456

Kit CM442/CM444/CM448/CSF48: M12 built-in socket for PROFIBUS DP/Modbus RS485
- B-coded, pre-terminated
- Order No. 71140892

Kit CM442/CM444/CM448/CSF48: M12 built-in socket for Ethernet
- D-coded, pre-terminated
- Order No. 71140893

Kit: external CDI socket, complete
- Retrofit kit for CDI interface, with terminated connecting cables
- Order No. 51517507

Cable junction with Velcro strip
- 4 pieces, for sensor cable
- Order No. 71092051

Communication-specific accessories

Commubox FXA195
Intrinsically safe HART communication with FieldCare via the USB port

Technical Information TI00404F

Commubox FXA291
Connects the CDI interface of measuring devices with the USB port of the computer or laptop

Technical Information TI00405C

Wireless HART adapter SWA70
- Wireless device connection
- Easily integrated, offers data protection and transmission safety, can be operated in parallel with other wireless networks, minimum cabling complexity

Technical Information TI00061S

System components

RIA14, RIA16
- Field display unit for integration into 4-20 mA circuits
- RIA14 in flameproof metal enclosure

Technical Information TI00143R and TI00144R

RIA15
- Process display unit, Digital display unit for integration into 4-20 mA circuits
- Panel mounting
- With optional HART communication

Technical Information TI01043K

www.addresses.endress.com

Endress+Hauser

People for Process Automation

EQUIPMENT TECHNICAL DATA SHEETS

TURBIDITY SENSOR

TURBIDITY SENSOR:
E&H Turbidity Sensor Model: CUS51D-10K6/0; CUS51D-AAC1A3
Turbimax CUS51D
Turbidity Sensor, optical.
Application: Water, waste water
Digital Sensor, Memosens protocol
Sensor head: G1, NPT3/4
Automatic sensorcheck

AA Approval: Non-hazardous area
C1 Application/Measuring Range: Process water, filtratables
A Adaption Cable: Fixed cable; crimp sleeves
3 Cable Length: 7m

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

TI00461C/07/EN/17.19
71438793
2019-01-31

Technical Information
Turbimax CUS51D

Sensor for turbidity and solids content



Application

Turbimax CUS51D is a sensor for all wastewater treatment applications.

- Turbidity measurement in the outlet
- Solids content in sludge activation and recirculation
- Solids content in sludge treatment
- Filterable matter in outlet of WWTPs

Your benefits

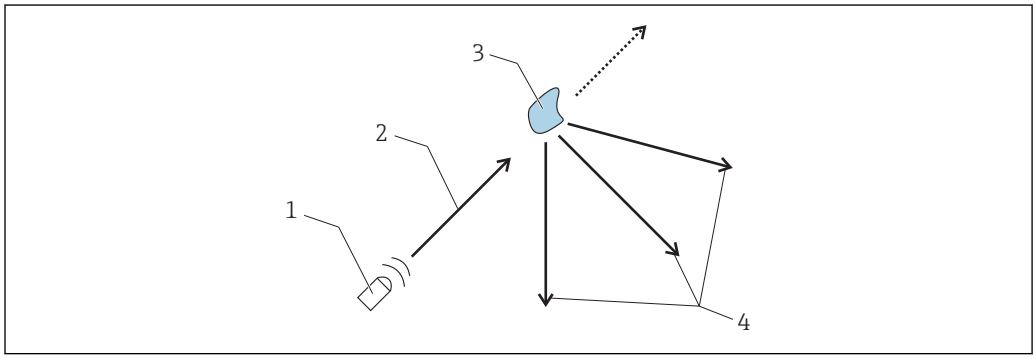
- All sensor principles (90°, 135° and 4-beam pulsed light) are contained in the sensor head and enable optimum adaptation to the measuring task.
- The sensor is calibrated in the factory (on the basis of formazine). All selectable applications (e.g. activated sludge) are pre-calibrated, thereby enabling quick and easy commissioning.
- Standardized communication (Memosens technology) enables "plug and play".
- Intelligent sensor - all characteristics and calibration values are stored in the sensor.
- Customer calibrations with 1 to 5 points (max.) - can be performed in the lab or at place of installation.

Endress+Hauser
People for Process Automation

Function and system design

Measuring principle

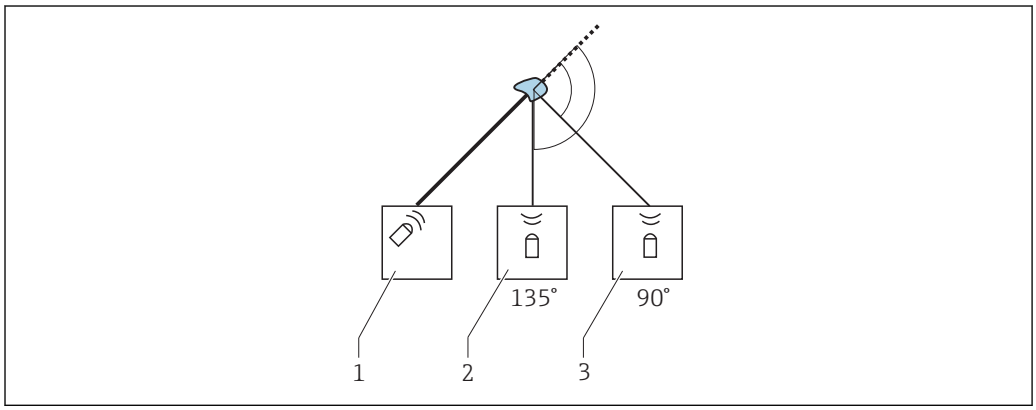
For turbidity measurement a light beam is directed through the medium and is deflected from its original direction by optically denser particles, e.g. particles of solid matter. This process is also called scattering.



1 Deflection of light

1 Light source
2 Light beam
3 Particle
4 Scattered light

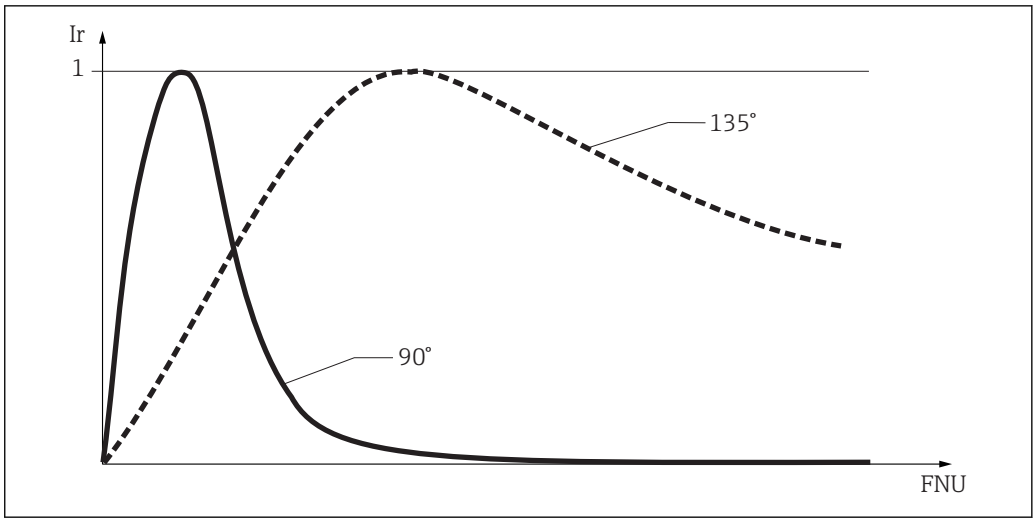
The incident light is scattered in many directions, i.e. at different angles to the direction of propagation. 2 angle ranges are of particular interest here:
- Light scattered at a 90° angle is used primarily for turbidity measurement in drinking water.
- Light scattered at a 135° angle extends the dynamic range for high particle densities.



2 Principle mode of operation of turbidity sensor

1 Light source
2 135° light receiver
3 90° light receiver

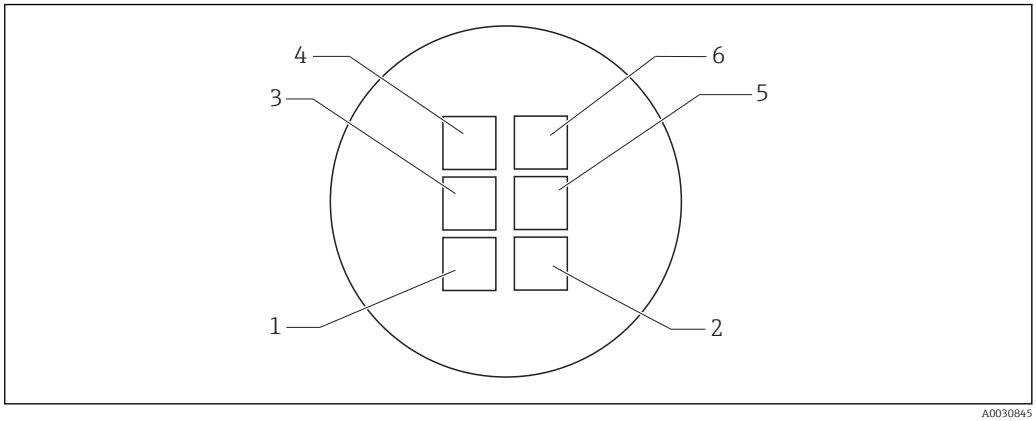
If the particle density in the medium is low, a large amount of light is scattered in the 90°channel and a small amount of light is scattered in the 135° channel. As the particle density increases, this ratio shifts (more light in the 135° channel, less light in the 90° channel).



3 *Signal distribution as a function of the particle density*

Ir Relative intensity
FNU Turbidity unit

The CUS51D turbidity sensor has 2 sensor units, which are independent of each other and arranged in parallel. The application-dependent evaluation of both signals leads to stable measured values.



4 *Arrangement of light sources and light receivers*

1, 2 Light sources 1 and 2
3, 5 135° light receiver
4, 6 90° light receiver

The sensor covers a broad range of turbidity and solids measurements thanks to the optical arrangement with 2 light sources, each with 2 light receivers placed at different angles (90° and 135°).

- As soon as the customer selects an application, e.g. activated sludge, the optical method best suited for the particular measuring task is automatically activated in the sensor (e.g. 90° measurements with both light sources).
- The double sensing system (2 light sources with 2 receivers per source) largely compensates for measured errors caused by fouling (4-beam pulsed light method → 3).

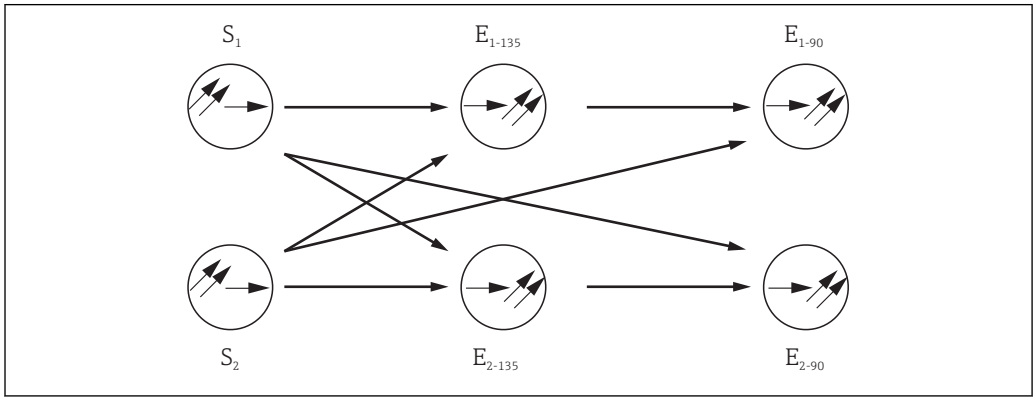
The sensor types available vary in terms of their measuring ranges and therefore the range of available applications.

Measuring methods

4-beam pulsed light method

The method is based on 2 light sources and 4 light receivers. Long-life LEDs are used as monochromatic light sources. These LEDs are pulsed alternately and generate 4 scattered light signals per LED pulse at the receivers.

This offsets interference influences such as extraneous light, LED aging, fouling of windows and absorption in the medium. Depending on the chosen application, different scattered light signals are processed. The signal type, number and calculation are stored in the sensor.



5 4-beam pulsed light method

S_1 S_2 Light source

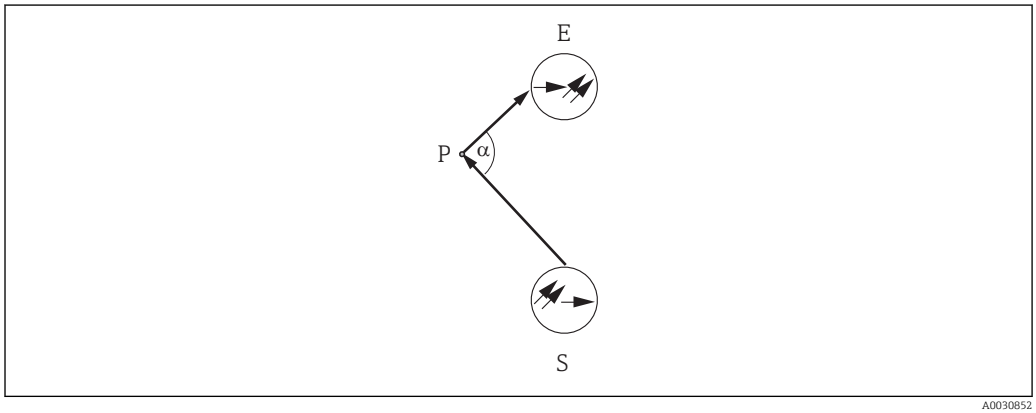
E_{90} Light receiver for 90° scattered light

E_{135} Light receiver for 135° scattered light

90° scattered light method

Measurement is performed with a wavelength of 860 Nm (634.3 lbf ft), as described in ISO 7027 / EN 27027.

The emitted light beam is scattered by the solid particles in the medium. The scattered radiation generated in this way is measured by scattered light receivers, which are arranged at an angle of 90° to the light sources. The turbidity of the medium is determined by the amount of scattered light.

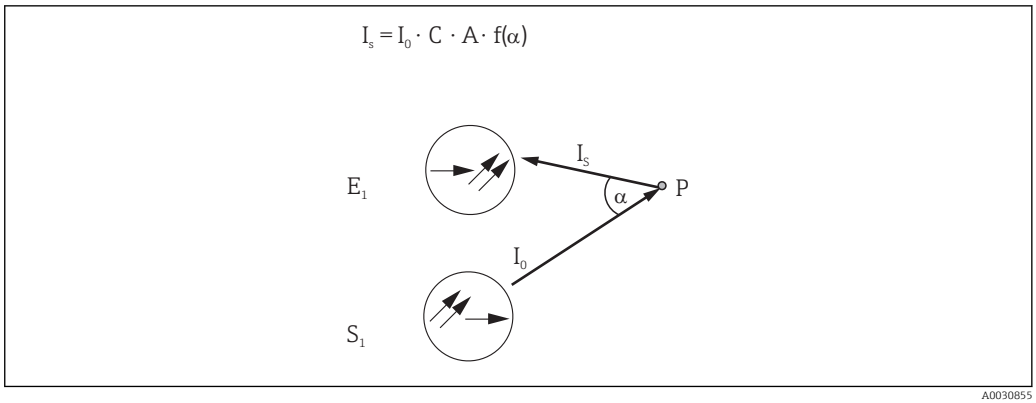


6 90° scattered light method

S Light source
E Receiver
P Particle

135° backscattered light method

The emitted light beam is scattered by the solid particles in the medium. The backscattering generated is measured by scattered light receivers, which are arranged next to the light sources. The turbidity of the medium is determined based on the quantity of back-scattered light. It is possible to measure very high turbidity values with this type of scattered light measurement.



7 *Principle of backscattered light method*

I_o *Intensity of transmitted light*
I_s *Intensity of scattered light*
A *Geometric factor*
C *Concentration*
P *Particle*
f(α) *Angle correlation*

Sensor monitoring

The optical signals are continuously monitored and analyzed for plausibility. If inconsistencies occur, an error message is output via the transmitter. The function is disabled by default.

In addition, the following fault states are detected in conjunction with the sensor check system of the Liquiline M:
- Implausibly high or low measured values
- Disturbed regulation due to incorrect measured values

Applications

Fields of application

Application (models)	Fields of application/use	Unit	Compensation*
Formazine	Industrial water, WWTP outlet	FNU / NTU	
Kaolin	Filterable matter, industrial water, WWTP outlet, low concentrations of activated sludge	mg/l ; g/l; ppm; %	
SiO_2	SiO_2, mineral-based solids (sand)	g/l; ppm; %	X
TiO_2	TiO_2, (white media)	g/l; ppm; %	X
Thin sludge	Thin sludge, ranging from activated sludge to clear water	g/l; ppm; %	
Activated sludge	Activated sludge basin and similar media	g/l; ppm; %	X
Waste activated sludge	Universal use for sludge in wastewater sector between 5 and 50 g/l (activated sludge, return activated sludge, ...)	g/l; ppm; %	X
Univ. sludge	Universal use ranging from clear water to sludge with a high concentration of solids, e.g. sludge extraction in thickeners. 0 g/l bis 50 g/l	g/l; ppm; %	X
Digested sludge	Contaminated sludge, black - homogeneous	g/l; ppm; %	

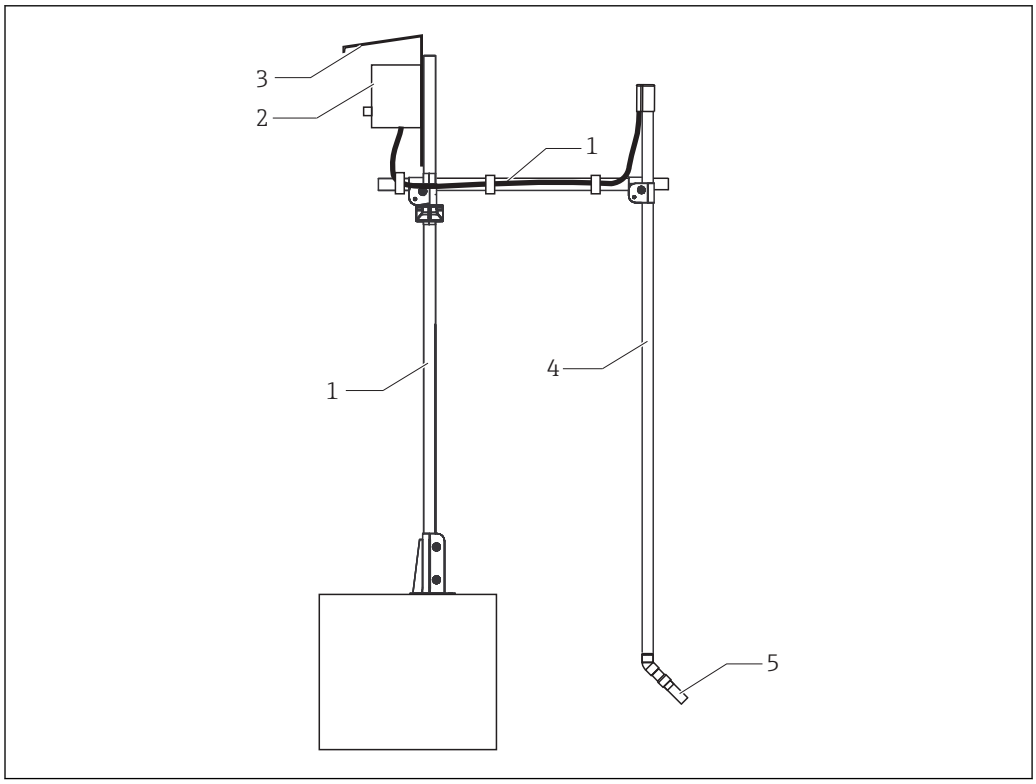
* Contamination compensation with 4-beam pulsed light

NOTICE

Multiple scattering in the following applications: formazine, kaolin and thin sludge
If the specific operational range is exceeded, the measured value displayed by the sensor can decrease despite increasing turbidity or increasing TS content. The indicated operational range is reduced in the case of highly absorbing (e.g. dark) media.
- ▶ In the case of highly absorbing (e.g. dark) media, determine the operational range experimentally beforehand.

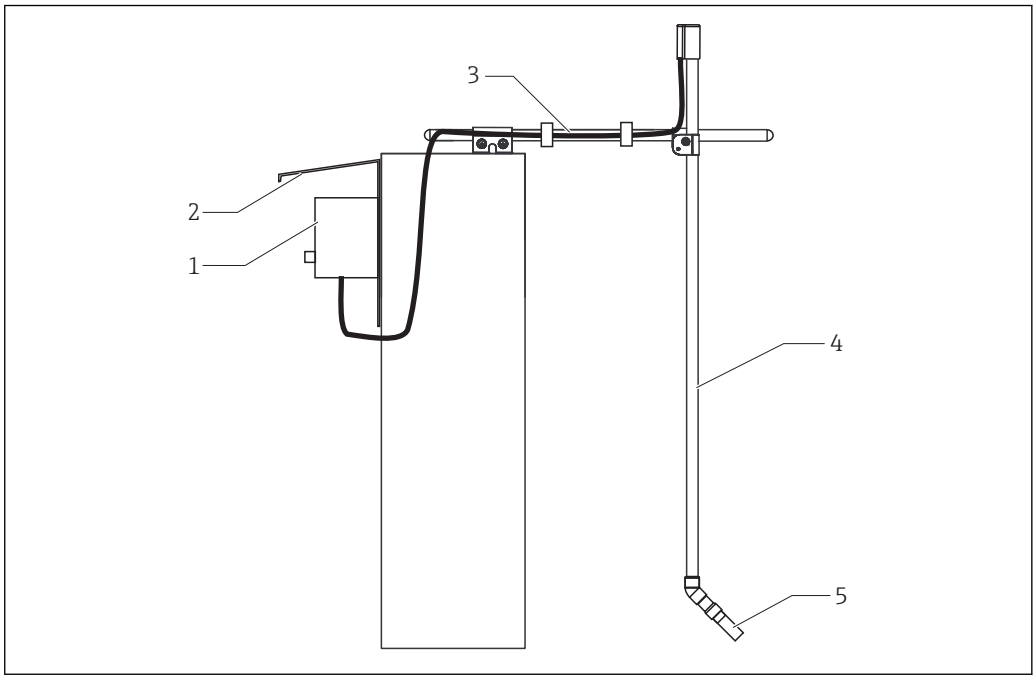
Measuring system

A complete measuring system comprises:
- Turbimax CUS51D turbidity sensor
- Liquiline CM44x multi-channel transmitter
- Assembly:
  - Flexdip CYA112 assembly and Flexdip CYH112 holder or
  - Retractable assembly, e.g. Cleanfit CUA451



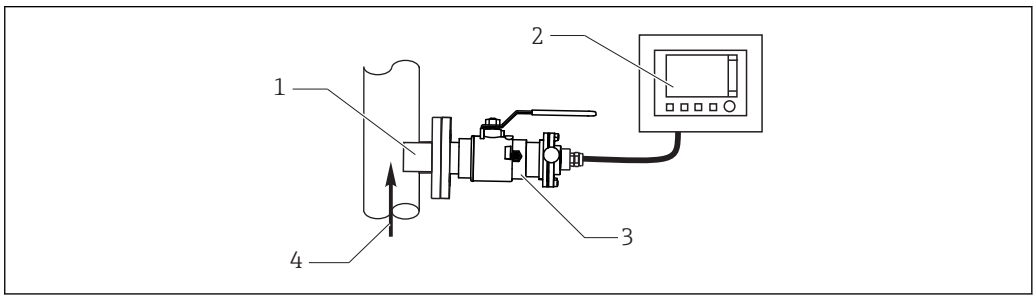
8 Measuring system with immersion assembly (example)

1 Flexdip CYH112 holder
2 Liquiline CM44x multi-channel transmitter
3 Protective cover
4 Flexdip CYA112 assembly
5 Turbimax CUS51D turbidity sensor



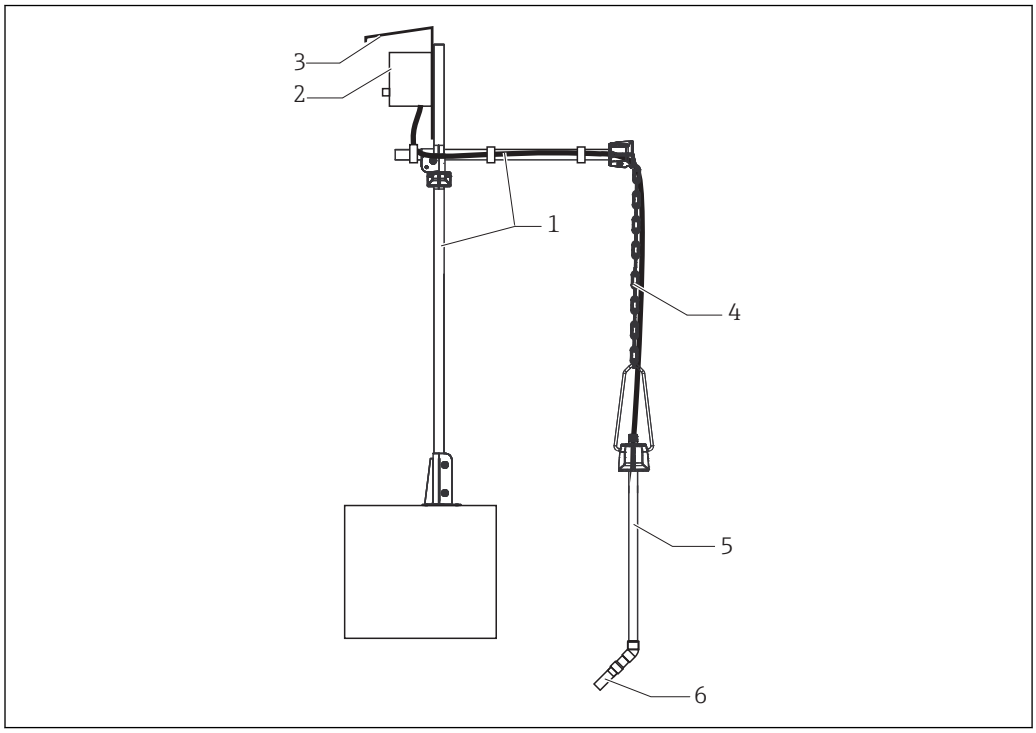
9 *Measuring system with immersion assembly (example)*

1 *Liquiline CM44x multi-channel transmitter*
2 *Protective cover*
3 *Flexdip CYH112 holder*
4 *Flexdip CYA112 assembly*
5 *Turbimax CUS51D turbidity sensor*



10 *Measuring system with retractable assembly (example)*

1 *Turbimax CUS51D turbidity sensor*
2 *Liquiline CM44x multi-channel transmitter*
3 *Cleanfit CUA451 retractable assembly*
4 *Direction of flow*



11 *Measuring system with immersion assembly on chain holder system*

1 *Flexdip CYH112 holder*
2 *Liquiline CM44x multi-channel transmitter*
3 *Protective cover*
4 *Chain of Flexdip CYH112 holder*
5 *Flexdip CYA112 assembly*
6 *Turbimax CUS51D turbidity sensor*

Input

Measured variable

- Turbidity
- Solids content
- Temperature

Measuring range

CUS51D-**C1		Application
Turbidity	0,000 to 4000 FNU Display range up to 9999 FNU	Formazine
Solids content	0 to 5 g/l	Kaolin, filterable matter
Temperature	−20 to 80 °C (−4 to 176 °F)	

CUS51D-**D1		Application
Turbidity	0,000 to 4000 FNU Display range up to 9999 FNU	Formazine
Solids content	0 to 300 g/l 0 to 30 %	Solids content depending on the selected application (see list)
Temperature	–20 to 80 °C (–4 to 176 °F)	

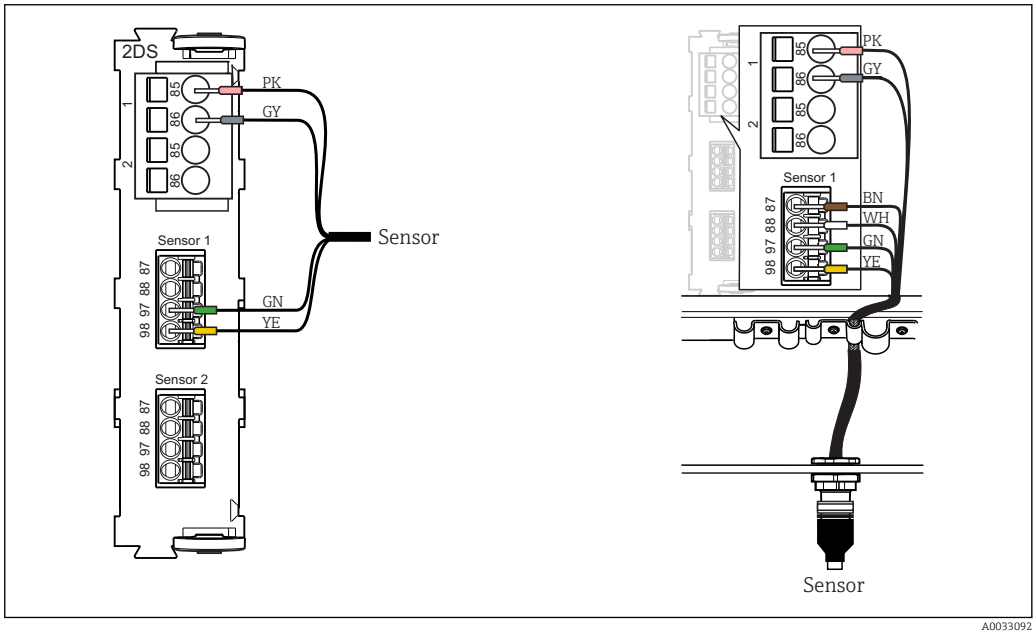
Measuring range with solids content:

For solids, the achievable ranges depend very much on the media that are actually present and may differ from the recommended operating ranges. Extremely inhomogeneous media may cause fluctuations in measured values, thus narrowing the measuring range.

Power supply

Electrical connection

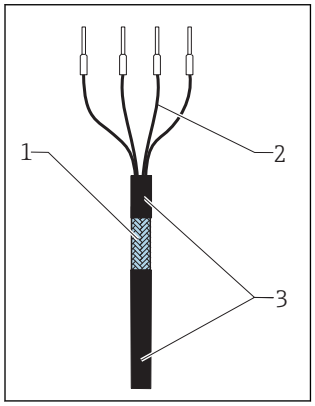
The following connection options are available:
- via M12 connector (version: fixed cable, M12 connector)
- via sensor cable to the plug-in terminals of a sensor input on the transmitter (version: fixed cable, end sleeves)



12 *Sensor connection to sensor input (left) or via M12 connector (right)*

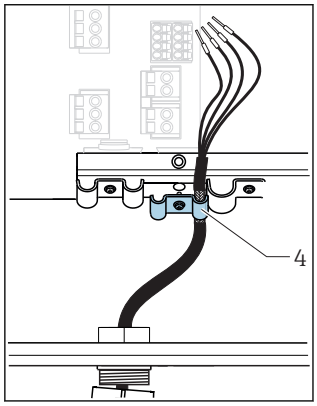
Connecting the cable shield

Cable sample (does not necessarily correspond to the original cable supplied)



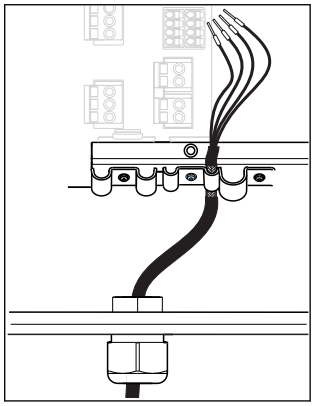
13 Terminated cable

1 Outer shield (exposed)
2 Cable cores with ferrules
3 Cable sheath (insulation)



14 Inserting the cable

4 Grounding clip



15 Tightening the screw (2 Nm (1.5 lbf ft))

The cable shield is grounded by the grounding clip

The maximum cable length is 100 m (328.1 ft).

Performance characteristics

Reference operating conditions

20 °C (68 °F), 1013 hPa (15 psi)

Maximum measured error

Turbidity: < 2% of measured value or 0.1 FNU (the greater value applies in each case).

Solids: < 5% of the measured value or 1% of the upper range value (the greater value applies in each case); applies to sensors that are calibrated for the observed measuring range.

The measured error encompasses all inaccuracies of the measuring chain (sensor and transmitter). However, it does not include the inaccuracy of the reference material used for calibration.

Factory calibration

FNU and NTU in accordance with application table

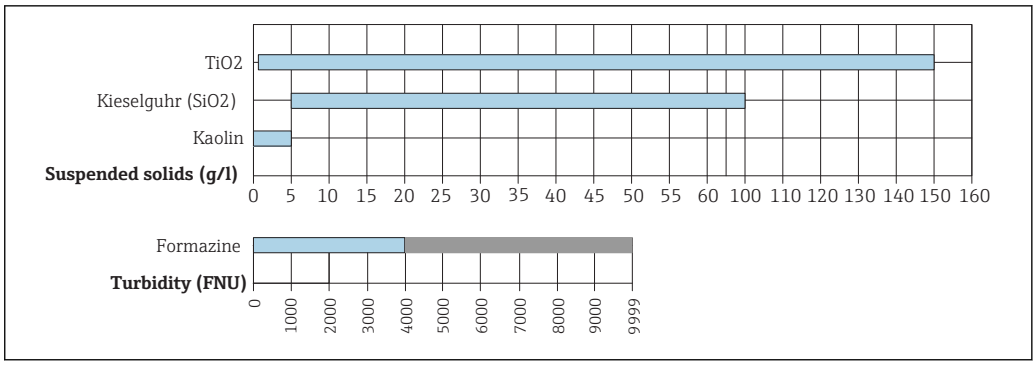
Standard: 3 points

Applications

The sensor has been calibrated in the factory for "formazine" applications. All other applications are precalibrated with reference samples and require calibration to the corresponding application.

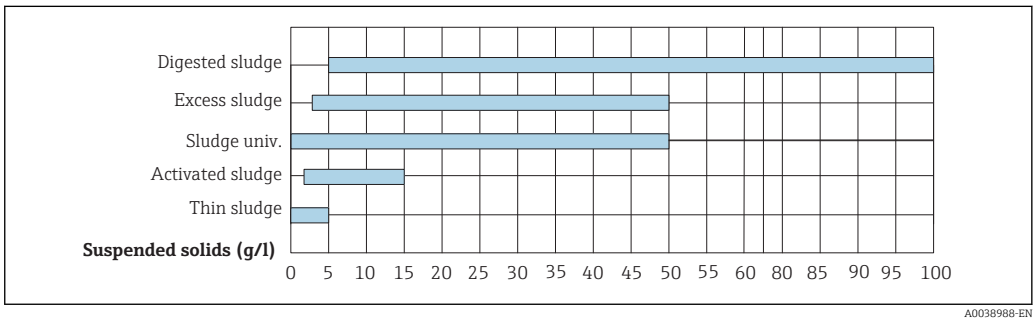
Calibration can be performed with up to 5 points.

Clear water application type	Recommended operating ranges	CUS51D	
		C1	D1
Application: Formazine	0 to 4000 FNU	X	X
Application: Kaolin	0 to 5 g/l	X	X
Application: SiO_2	5 to 100 g/l		X
Application: titanium dioxide	0.2 to 150 g/l		X



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Solids application type	Recommended operating ranges	CUS51D	
		C1	D1
Application: thin sludge	0 to 5 g/l		X
Application: activated sludge	2 to 15 g/l		X
Application: waste activated sludge	3 to 50 g/l		X
Application: univ. sludge	0 to 50 g/l		X
Digested sludge application	5 to 100 g/l / 300 g/l		X



A0038988-EN

For solids, the achievable ranges depend very much on the media that are actually present and may differ from the recommended operating ranges.

Drift

Working on the basis of electronic controls, the sensor is largely free of drifts.

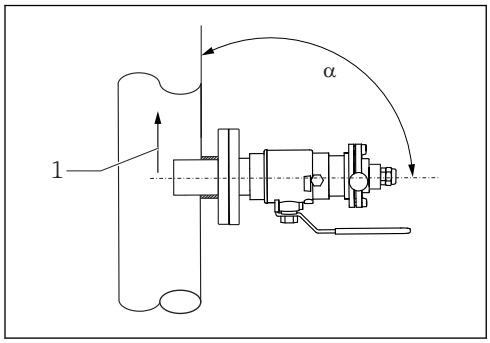
Detection limits

Application	Measuring range	Detection limit
Formazine	0 to 50 FNU	0.006 FNU
	0 to 4000 FNU	0.4 FNU
Kaolin	0 to 5000 mg/l	0.85 mg/l

Installation

Installation instructions

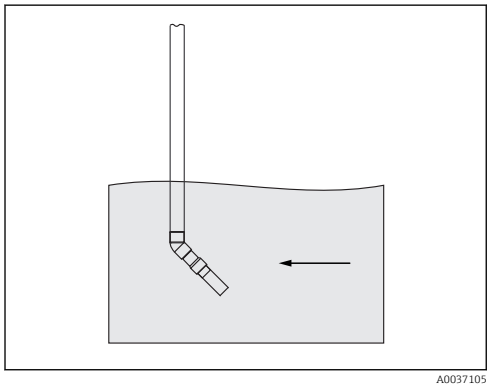
Installation options:
- with Cleanfit W CUA451 retractable assembly
- with Flexdip CYA112 wastewater assembly and Flexdip CYH112 holder
- with Flowfit CYA251 flow assembly



16 *Installing with retractable assembly*

1 Direction of flow

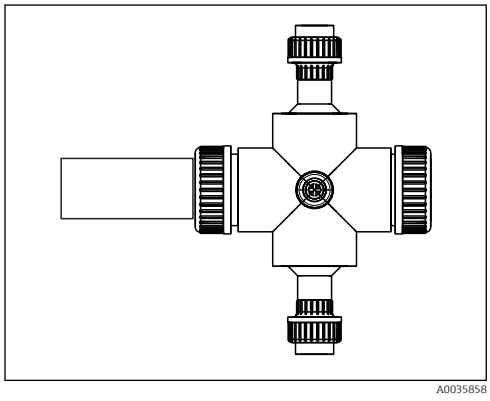
Arrow 1 points in the direction of flow.
The installation angle α must not exceed 90°.
The recommended installation angle is 75°.
The optical windows in the sensor must be aligned either parallel to the direction of flow (α = 90°) or against the direction of flow (α < 90°).
The medium pressure may not exceed 2 bar (29 psi) for manual assembly retraction.



17 *Installing with wastewater assembly*

The arrow points in the direction of flow.
The installation angle is 45° (preferably) or 90°.

- If you are using the sensor in open basins, install the sensor in such a way that air bubbles cannot accumulate on it.
- If you are using the sensor in highly aerated basins, install the sensor at an angle of 90° to reduce the effects of air bubbles.

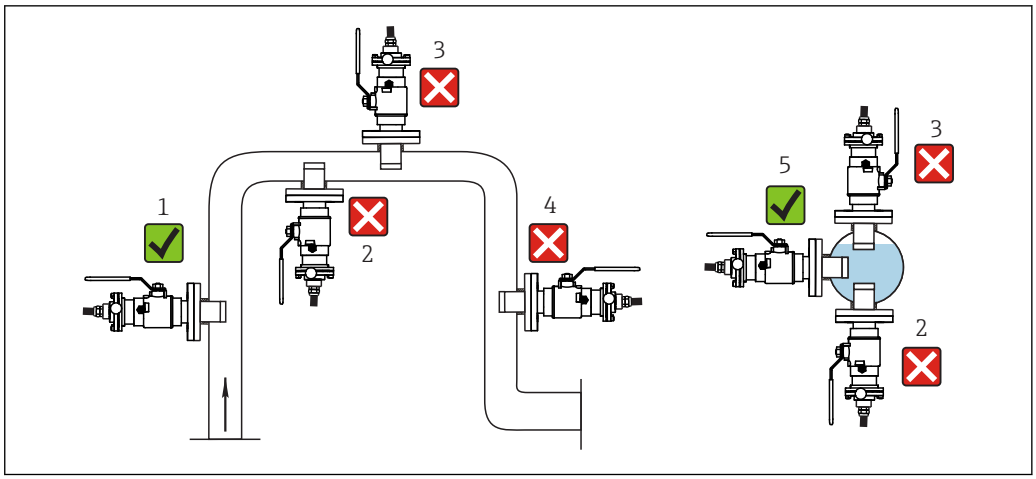


18 *Installing with CYA251 flow assembly*

The installation angle is 90°.
For turbidity measurements < 200 FNU, the backscattering of the internal surfaces of the assembly causes distortions in the measured values.

Pipes

The following diagram shows different installation scenarios in pipes, indicating whether or not they are permitted.



19 *Orientations and positions (with CUA451 retractable assembly)*

- When using reflective materials (e.g. stainless steel), the pipe diameter must be at least 100 mm (3.9 in). An onsite calibration is recommended.
- Install the sensor in places with consistent flow conditions.
- The best installation location is in the ascending pipe (item 1). Installation is also possible in the horizontal pipe (item 5).
- Do not install in places where air spaces or bubbles occur (item 3) or where sedimentation may occur (item 2).
- Avoid installation in the down pipe (item 4).
- When measuring turbidity < 200 FNU, the backscattering of the pipe wall causes distortions in the measured values. For this reason, a multipoint calibration is recommended here.
- Avoid fittings downstream from pressure reduction stages which can lead to outgassing.

Environment

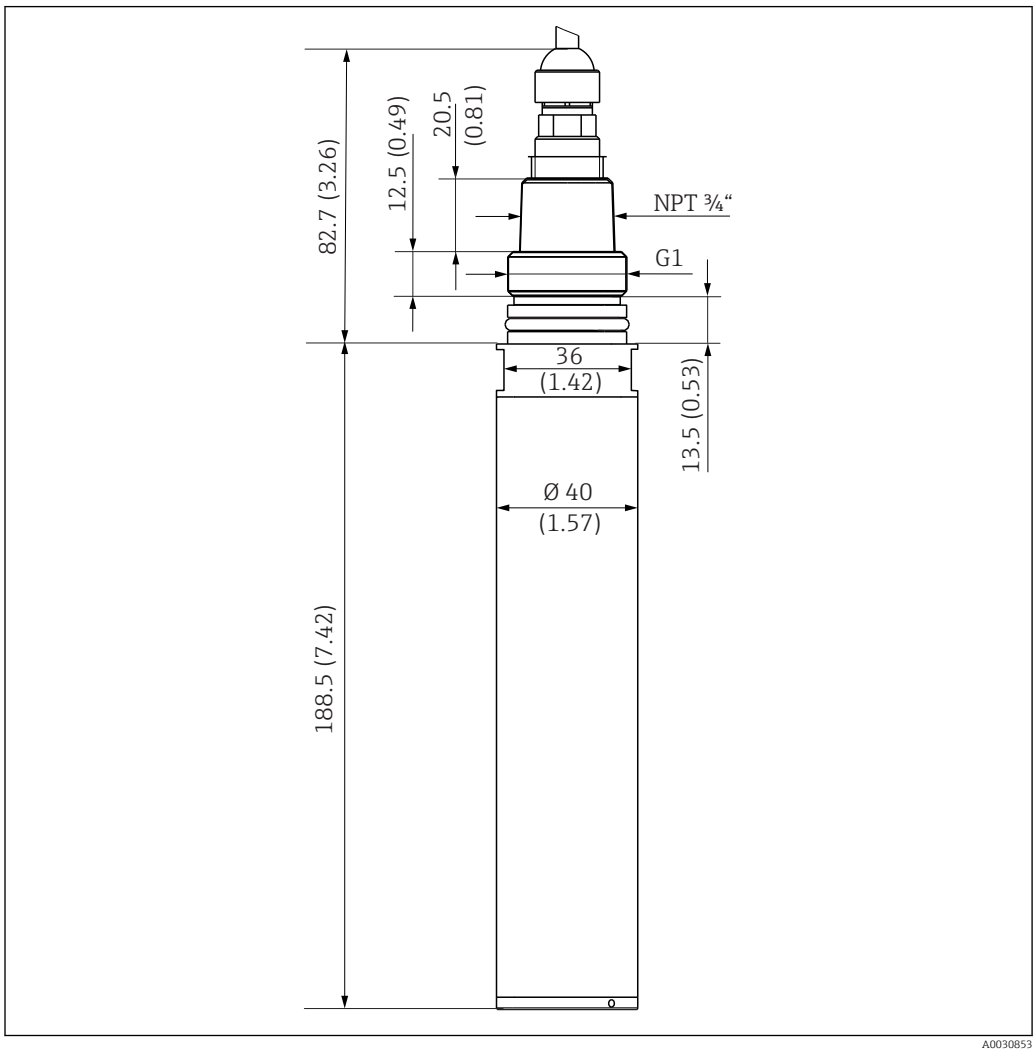
Ambient temperature range	–20 to 60 °C (–4 to 140 °F)
Storage temperature	–20 to 70 °C (–4 to 158 °F)
Degree of protection	IP 68 (1 m (3.3 ft) water column, 60 days, 1 mol/l KCl)
Electromagnetic compatibility (EMC)	Interference emission and interference immunity as per ▪ EN 61326-1:2013 ▪ EN 61326-2-3:2013 ▪ NAMUR NE21: 2012

Process

Process temperature range	–5 to 50 °C (23 to 122 °F) Up to 80 °C (176 °F) for a short period of time (1 h)
Process pressure range	0.5 to 10 bar (7.3 to 145 psi) (abs.)
Minimum flow	No minimum flow required. For solids which have a tendency to form deposits, ensure that sufficient mixing is performed.

Mechanical construction

Dimensions



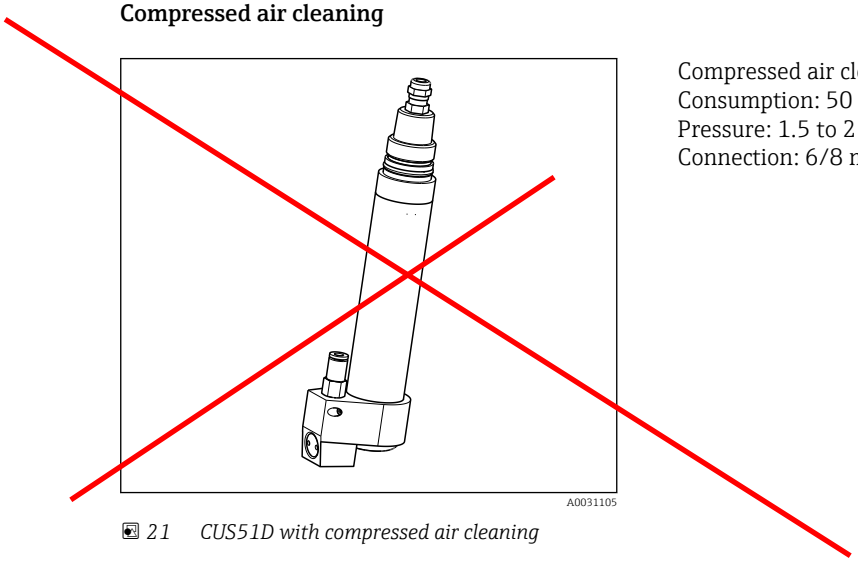
20 Dimensions. Dimensions: mm (in)

Dimensions for compressed air cleaning → 16

Weight	Approx. 0.7 kg (1.5 lb)without cable	
Materials	Sensor	Stainless steel 1.4404 (AISI 316 L) Stainless steel 1.4571 (AISI 316 Ti)
	Optical windows	Sapphire
	O-rings	EPDM
Process connections	G1 and NPT ¾"	

Accessories

Compressed air cleaning



Compressed air cleaning
Consumption: 50 l/min (13.2 gal/min)
Pressure: 1.5 to 2 bar (22 to 30 psi)
Connection: 6/8 mm or 6.35 mm (¼")

21 CUS51D with compressed air cleaning

Certificates and approvals

CE mark

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EU directives. The manufacturer confirms successful testing of the product by affixing to it the CE mark.

Electromagnetic compatibility

Interference emission and interference immunity as per
- EN 61326-1:2013
- EN 61326-2-3:2013
- NAMUR NE21: 2012

ISO 7027

The measuring method used with the sensor complies with the ISO 7027-1:2016 standard.

EAC

The product has been certified according to guidelines TP TC 004/2011 and TP TC 020/2011 which apply in the European Economic Area (EEA). The EAC conformity mark is affixed to the product.

Ordering information

Product page

www.endress.com/cus51d

Product Configurator

On the product page there is a **Configure** button to the right of the product image.

1. Click this button.
   ↳ The Configurator opens in a separate window.
2. Select all the options to configure the device in line with your requirements.
   ↳ In this way, you receive a valid and complete order code for the device.
3. Export the order code as a PDF or Excel file. To do so, click the appropriate button on the right above the selection window.

For many products you also have the option of downloading CAD or 2D drawings of the selected product version. Click the **CAD** tab for this and select the desired file type using picklists.

Scope of delivery

The delivery comprises:
- 1 Turbimax CUS51D sensor, version as ordered
- 1 Operating Instructions BA00461C

Accessories

The following are the most important accessories available at the time this documentation was issued.

▶ For accessories not listed here, please contact your Service or Sales Center.

Assemblies

FlowFit CUA120
- Flange adapter for mounting turbidity sensors CUS
- Product Configurator on the product page: www.endress.com/cua120

Technical Information TI096C

Flexdip CYA112
- Immersion assembly for water and wastewater
- Modular assembly system for sensors in open basins, channels and tanks
- Material: PVC or stainless steel
- Product Configurator on the product page: www.endress.com/cya112

Technical Information TI00432C

Cleanfit CUA451
- Manual retractable assembly made of stainless steel with ball valve shut-off for turbidity sensors
- Product Configurator on the product page: www.endress.com/cua451

Technical Information TI00369C

Flowfit CYA251
- Connection: See product structure
- Material: PVC-U
- Product Configurator on the product page: www.endress.com/cya251

Technical Information TI00495C

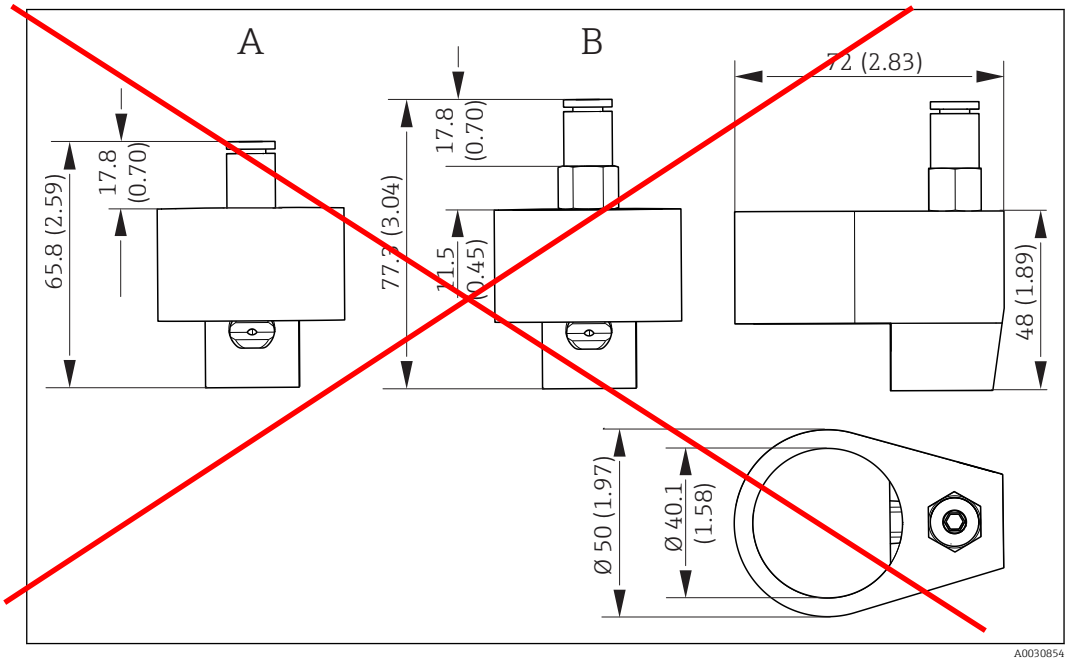
Holder

Flexdip CYH112
- Modular holder system for sensors and assemblies in open basins, channels and tanks
- For Flexdip CYA112 water and wastewater assemblies
- Can be affixed anywhere: on the ground, on the capstone, on the wall or directly onto railings.
- Plastic or stainless steel version
- Product Configurator on the product page: www.endress.com/cyh112

Technical Information TI00430C

Compressed air cleaning

Compressed air cleaning for CUS51D
- Connection: 6 mm (0.24 in) or 8 mm (0.31 in) (metric) or 6.35 mm (0.25 in)
- Materials: POM/V4A
- 6 or 8 mm order no.: 71110782
- 6.35 mm order no.: 71110783



22 *Compressed air cleaning. Dimensions: mm (in)*

A Version 6 mm (0.24 in)
B Version 6.35 mm (0.25 in)

Compressor

- For compressed air cleaning
- 230 V AC order no. 71072583
- 115 V AC order no. 71194623

www.addresses.endress.com

Endress+Hauser

People for Process Automation

EQUIPMENT TECHNICAL DATA SHEETS

TURBIDITY SENSOR RETRACTABLE ASSEMBLY

TURBIDITY SENSOR RETRACTABLE ASSY:
E&H Turbidity Probe Retractable Assy - Model: CUA451-B1D
CLEANFIT CUA451
ARetractable asembly for turbidity / SS sensors with ball valve, manual operation up to 2 bar. Material ss 316L / 1.4408 (ball valve). Withstand over pressure of 10 bar, with Integrated cleaning chamber.

B Sensor Lift: Extended ca. 270mm
1 Application: CUS41, CUS51D (G1, 200-220mm)
D Process Connection: Flange ANSI 2" 150 LBS

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

TI00369C/07/EN/14.19
71430946
2019-01-31

Technical Information
Cleanfit CUA451

Manually operated retractable assembly for water, wastewater and process media



Application

Drinking water and process water:
- Filter monitoring and filter backflushing
- Monitoring of phase separation processes
- Raw water monitoring
- Sludge treatment in water works

Wastewater treatment plants:
- Sludge in recirculation line
- Sludge centrifuge monitoring
- Primary sludge and sludge treatment

Process media from all kinds of industry:
- Raw water and process water monitoring
- Cooling water monitoring
- Recirculation lines
- Sludge treatment in water works

Your benefits

- One assembly for all applications
- Sensor cleaned without interrupting the process
- Robust design: process pressure up to 10 bar (145 psi), manually operable up to 2 bar (29 psi)
- Process adaptation with 2" threaded adapter or flange

Endress+Hauser
People for Process Automation

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Function and system design

The assembly is operated manually.

The vent cock or the the rinse connections (if used) are in open contact with the medium in the measuring position and when the assembly is retracted/inserted, and are therefore exposed to the process pressure.

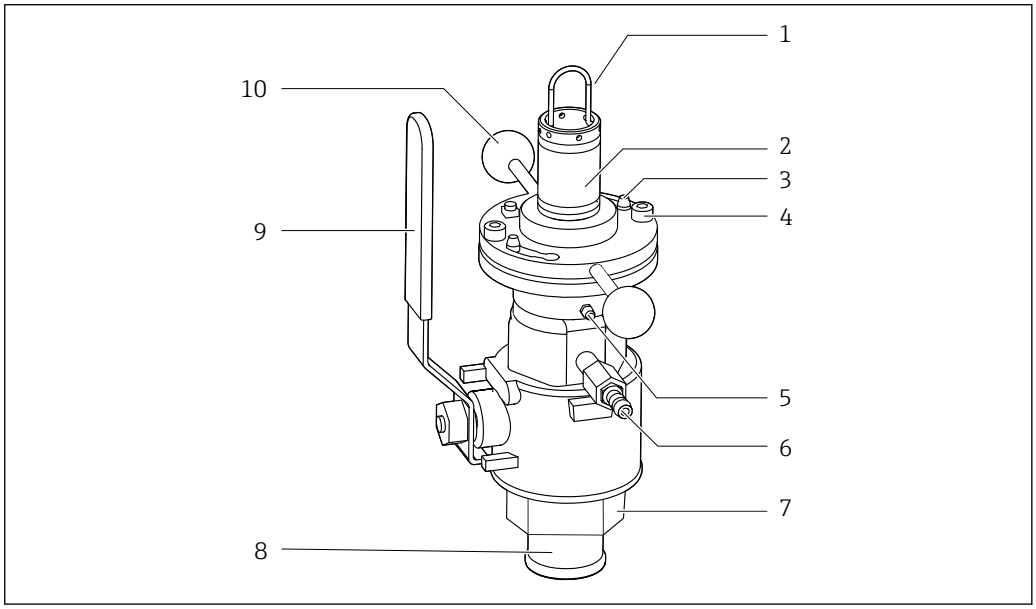
The vent cock or the rinse connections (if used) must be closed when inserting/retracting the assembly.

In the service position (sensor moved back into the assembly as far as possible and ball valve closed), the assembly is sealed from the process by the ball valve.

This means that cleaning, calibration or sensor replacement can be performed without interrupting the process.

The assembly can be inserted/retracted manually at process conditions up to a process pressure of approx. 2 bar (29 psi).

Structure of the assembly



1 *Assembly in operational state (ball valve open)*

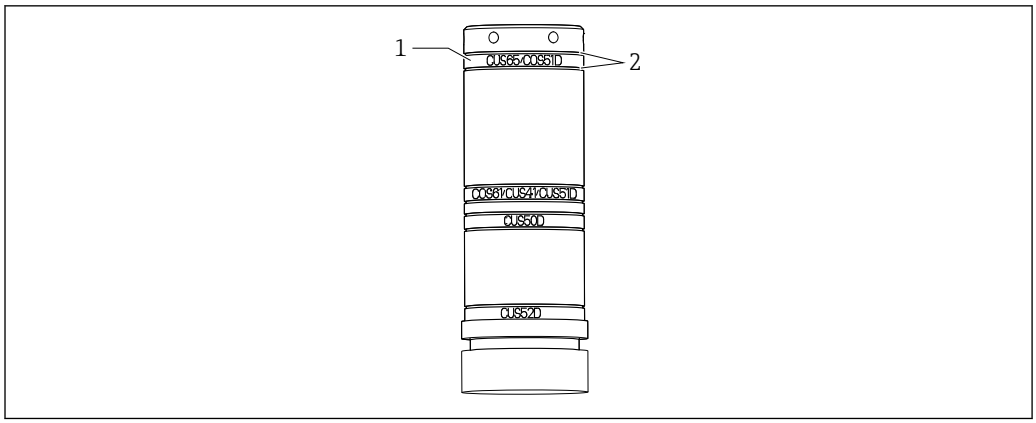
1 *Bracket for sensor holder*
2 *Sensor holder*
3 *Bayonet lock*
4 *Securing screws*
5 *Grease nipple*
6 *Ball valve for venting or rinse connection*
7 *Process connection*
8 *Retraction pipe*
9 *Hand lever for opening/closing the ball valve*
10 *Handles*

An additional rinse chamber valve can be mounted in the locking screw.

Structure of the sensor holder

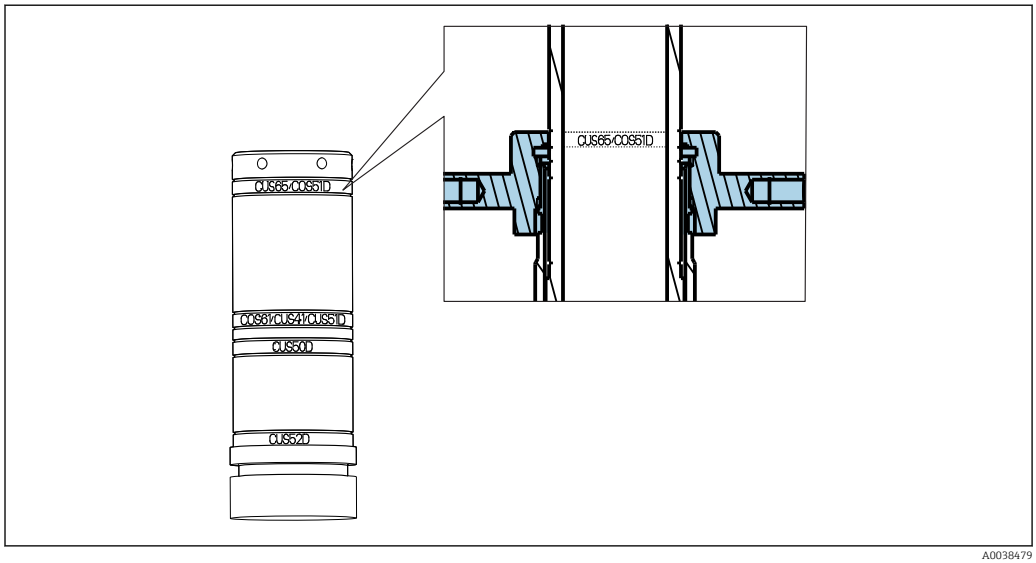
The sensor holder is used to position the sensor correctly in order to ensure correct measuring accuracy.

If the sensor is not positioned correctly, the ball valve may be blocked or the sensor may be located in the dead space as a result.



2 Short sensor holder

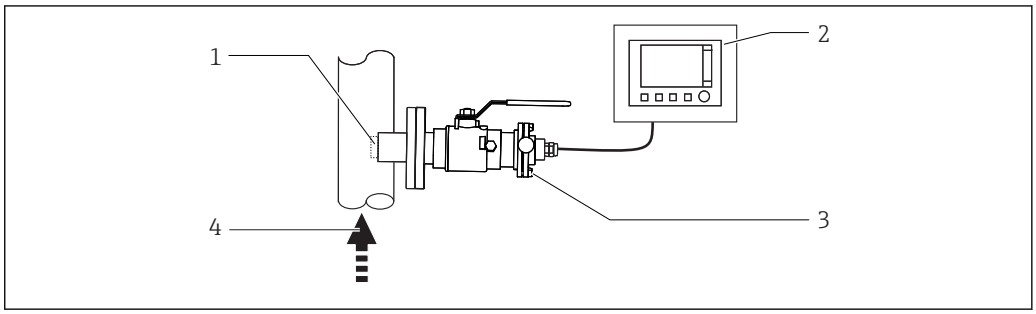
1 Mounting position of the bayonet nut to hold the relevant sensor
2 Grooves of the safety rings to mount the bayonet nut



3 Mounting position of the bayonet nut for CUS65D

The name indicated on the holder serves as a mounting aid. The bayonet nut covers over the marking for the selected sensor position.

Measuring system



A0038660

4 *Orientations, schematic*

1 *Sensor (see Accessories)*
2 *Transmitter*
3 *CUA451 retractable assembly*
4 *Direction of flow*

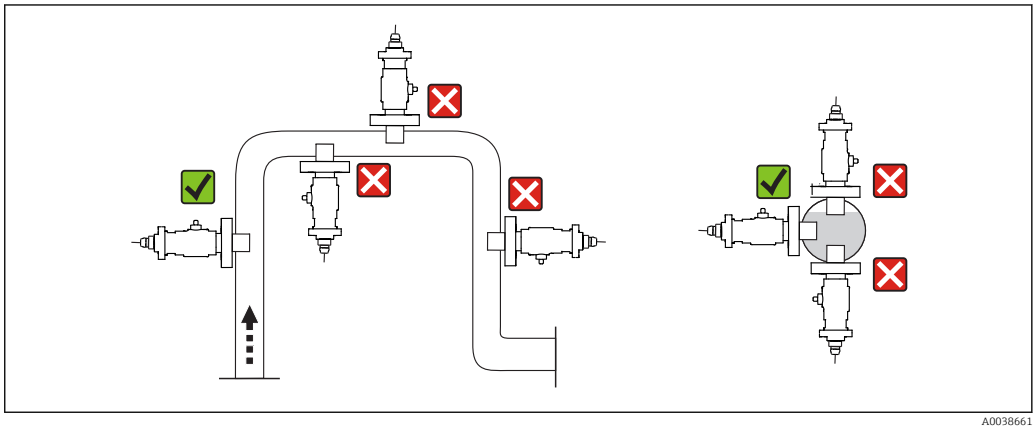
The orientation depends on the sensor head. Pay attention to the Operating Instructions for the relevant sensor.

- Make sure to avoid a siphon effect at the rinse chamber outlet. The inflow to the rinse chamber is always from below.

Installation

Orientation

The following diagram shows different installation positions in pipes, and indicates whether they are permitted or not.



A0038661

5 *Schematic of installation positions and orientations*

- Ideally, the assembly should be mounted in an ascending pipe. Installation in a horizontal pipe is also possible.

- When using reflective materials (e.g. stainless steel), the pipe diameter must be at least 100 mm (4"). An onsite calibration is recommended.
- Install the sensor in places with uniform flow conditions.
- Do not install the sensor in places where air may collect or foam bubbles form or where suspended particles may settle.
- Avoid installation in the down pipe.
- Avoid fittings downstream from pressure reduction stages which can lead to outgassing.

Installation instructions

- Install the assembly in places with uniform flow conditions. The minimum pipe diameter is DN 80.

The installation instructions depend on the sensor used.

Detailed installation instructions are provided in both the Technical Information and in the Operating Instructions for the particular sensor.

Environment

Ambient temperature range

0 to 50 °C (32 to 122 °F)

Process

Medium temperature

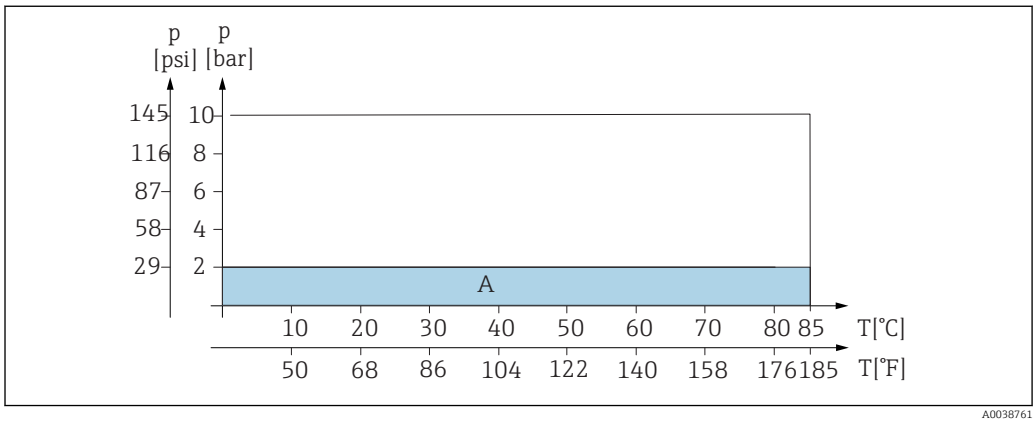
0 to 85 °C (32 to 185 °F)

Medium pressure

Max. 10 bar (145 psi)

For manual insertion/retraction of the assembly, the medium pressure must not exceed 2 bar (29 psi)! Also take the process conditions of the sensor used into consideration!

Pressure/temperature ratings



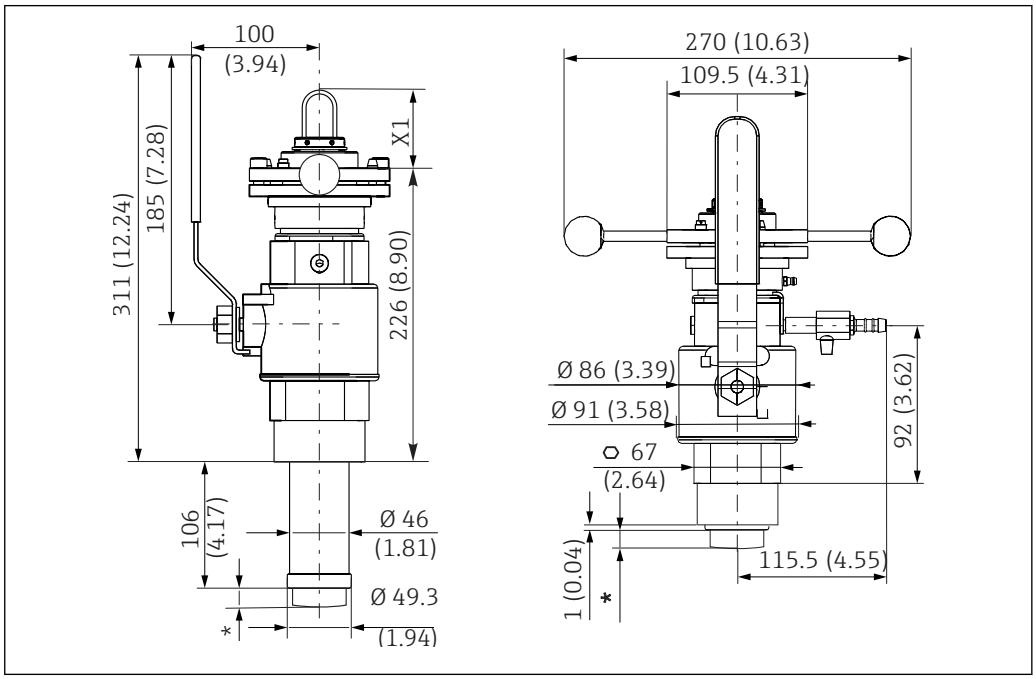
6 *Pressure/temperature ratings*

A Range in which the assembly can be operated manually

Mechanical construction

Dimensions

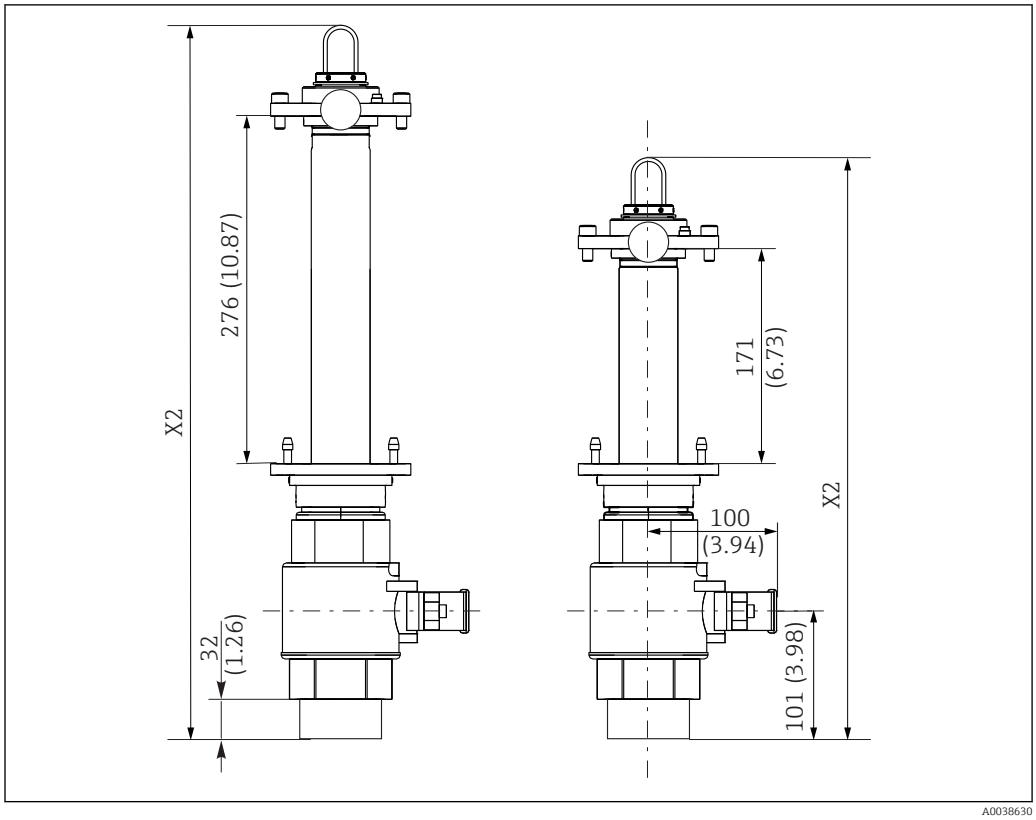
Assembly with G2 thread and weld-in adapter in measuring position (long and short stroke)



7 Dimensions in mm (in)

X1 Dimensions depend on the sensor

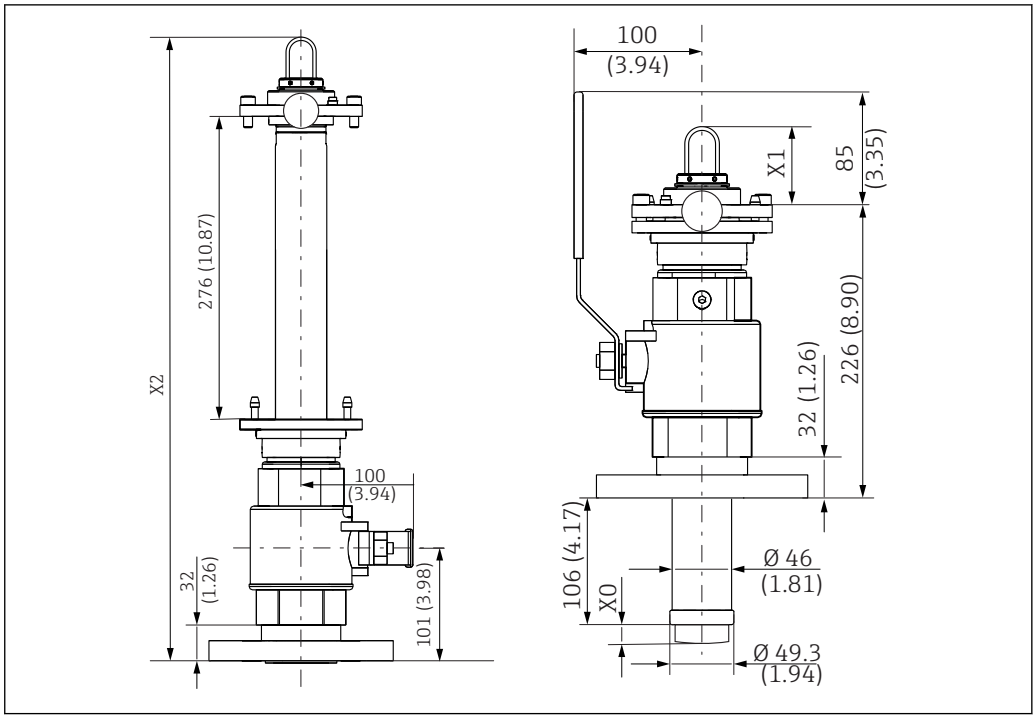
Assembly with G2 thread and weld-in adapter in service position (long and short stroke)



8 Dimensions in mm (in)

X2 Dimensions depend on the sensor

Assembly with flange connection



9 *Dimensions in mm (in)*

X0 Dimensions depend on the sensor

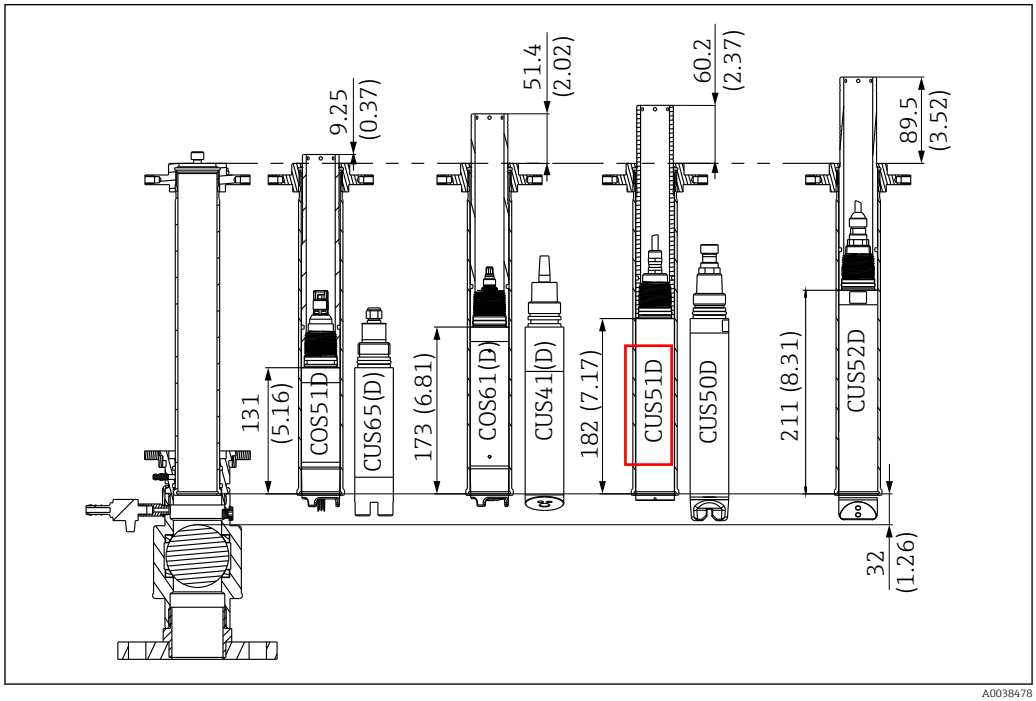
Sensor	X0
CUS52D	26.5 (1.04)
CUS50D	26.3 (1.04)
CUS41/CUS51D, COS61D	14 (0.55)
CUS65, COS51D	21.3 (0.84)

Sensor measuring position	X1
CUS52D	139 (5.47)
CUS50D	110 (4.33)
CUS41/CUS51D, COS61D	101 (3.98)
CUS65, COS51D	59 (2.32)

Sensor service position, long	X2
CUS52D	638 (25.12)
CUS50D	609 (23.98)
CUS41/CUS51D, COS61D	600 (23.62)
CUS65, COS51D	558 (21.97)

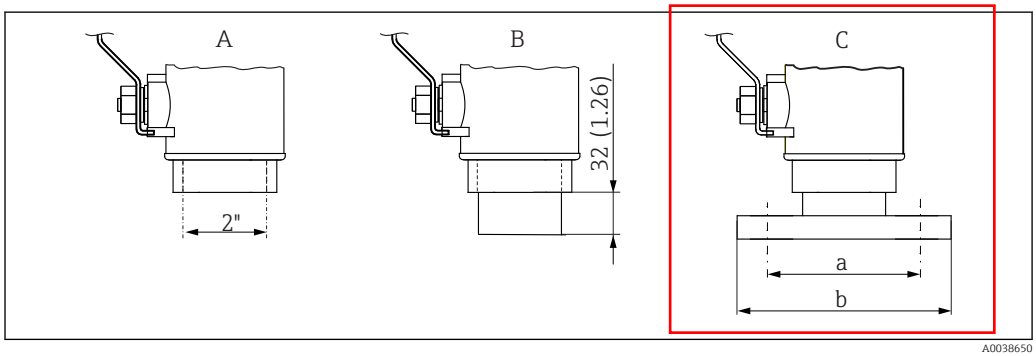
Sensor service position, short	X2
CUS52D	533 (20.98)
CUS50D	504 (19.84)
CUS41/CUS51D, COS61D	495 (19.49)
CUS65, COS51D	453 (17.83)

Sensor holder with sensors



10 *Dimensions of sensor holder with sensors in mm (in)*

Process connections



11 *Dimensions of process connections in mm (in)*

A Internal thread G2
B Internal thread G2 with weld-in adapter
C Flange DN 50 / PN 16 (as per EN 1092-1) and flange ANSI 2" / 150 lbs
a DN 50: Ø 125 (4.92), ANSI 2": Ø 120.7 (4.75)
b DN 50: Ø 165 (6.50), ANSI 2": Ø 152.4 (6.00)

Rinse connection and vent cock

Rinse connection nozzles
Connection options:
- 2 x ball valve with hose connection OD 9mm (see "Accessories"). (A ball valve is included in the delivery for the assembly. On its own it acts as a vent cock.)
- Customer's own rinse connections with G1/8 external thread
- 2 x G1/8 (internal)

Vent cock
Ball valve with hose connection OD 9 mm

Weight

Depending on version: 8 to 11 kg (17.6 to 24.3 lbs)

Materials

Wetted:	Viton (seals)
	Stainless steel 1.4404 (AISI 316 L)
	Nickel-plated brass (vent cock or rinse connection)
Not wetted:	Stainless steel 1.4404 (AISI 316 L)

Certificates and approvals

CE/PED

The assembly has been manufactured according to good engineering practice as per Article 4, Paragraph 3 of the Pressure Equipment Directive 2014/68/EU and is therefore not required to bear the CE label.

Ordering information

Product page

www.endress.com/CUA451

Product Configurator

On the product page there is a **Configure** button to the right of the product image.

1. Click this button.
   ↳ The Configurator opens in a separate window.
2. Select all the options to configure the device in line with your requirements.
   ↳ In this way, you receive a valid and complete order code for the device.
3. Export the order code as a PDF or Excel file. To do so, click the appropriate button on the right above the selection window.

For many products you also have the option of downloading CAD or 2D drawings of the selected product version. Click the **CAD** tab for this and select the desired file type using picklists.

Scope of delivery

The delivery comprises:
- Assembly in the version ordered
- Operating Instructions

Accessories

The following are the most important accessories available at the time this documentation was issued.

► For accessories not listed here, please contact your Service or Sales Center.

Device-specific accessories

Sensors

Turbimax CUS50D
- For nephelometric measurements of turbidity and solids in wastewater
- 4-beam scattered light method
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cus50d

Technical Information TI00461C

Turbimax CUS51D
- For nephelometric measurements of turbidity and solids in wastewater
- 4-beam scattered light method
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cus51d

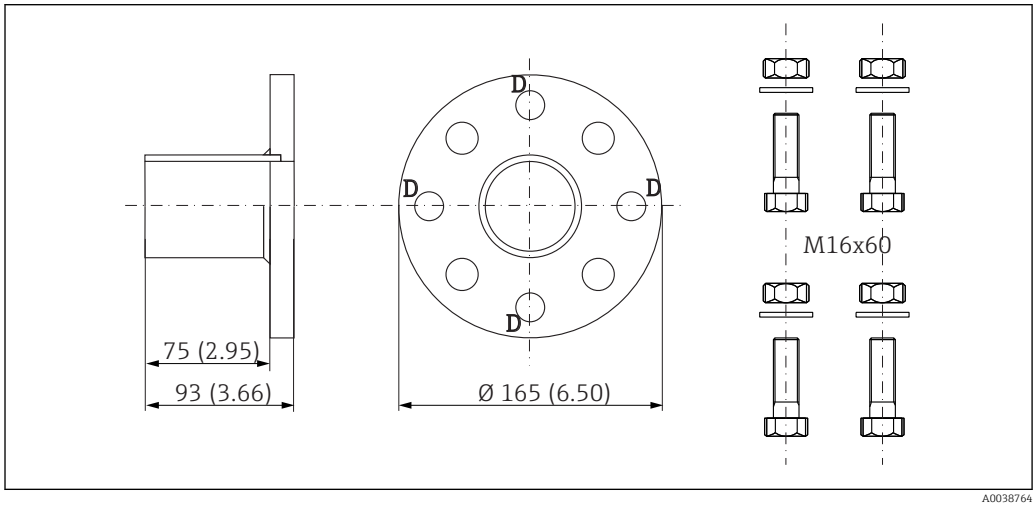
Technical Information TI00461C

Turbimax CUS52D
- Hygienic Memosens sensor for turbidity measurement in drinking water, process water and in utilities
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cus52d

Technical Information TI01136C

Welding socket

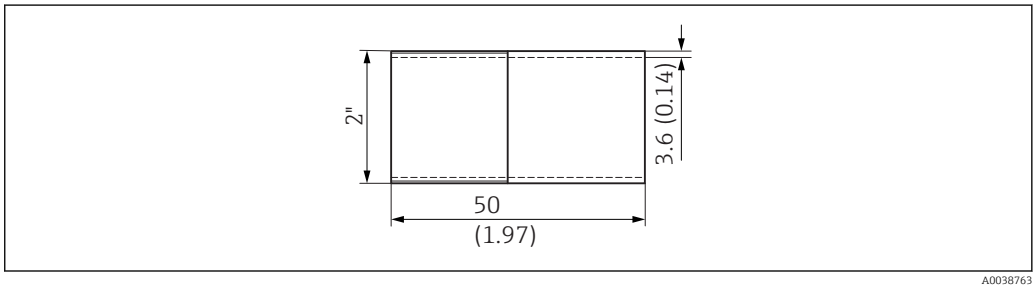
Welding socket
- Welding socket for pipe diameter from 80 mm, with combination flange DN 50 / ANSI 2":
  - Bores for DN 50 flange: 4 x 90° Ø18 on bolt circle Ø125 (4.92)
  - Bores for ANSI 2" flange: 4 x 90° Ø19 on bolt circle Ø121 (4.75)
- Flange seal, 4 screws M16x60, 4 M16 nuts including washers,
- Stainless steel 1.4571 (AISI 316 Ti)
- Order No. 50080249



12 Welding socket, dimensions in mm (in)

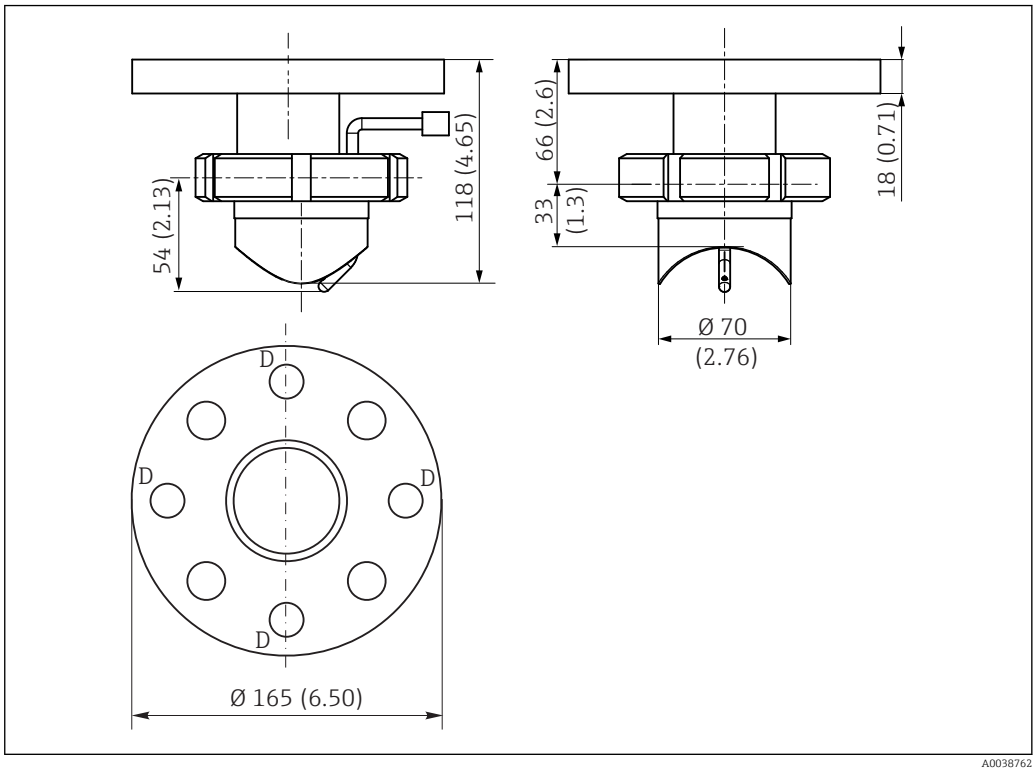
D Markings for bores, DN 50 flange

Welding nipple
- Welding nipple for 2" thread
- Stainless steel 1.4404 (AISI 316 L)
- Order No. 71265347



13 Welding nipple, dimensions in mm (in)

Welding rinse socket DN 65
- For automatic spray cleaning of CUS51D/31/41 sensors in pipes and vessels:
  - Bores for DN 50 flange: 4 x 90° Ø18 on bolt circle Ø125
  - Bores for ANSI 2" flange: 4 x 90° Ø19 on bolt circle Ø121
- Rinse connection: external thread R¼
- With removable rinse nozzle
- Up to 6 bar (87 psi), 80 °C (176 °F)
- Order No. 51500912



14 Welding rinse socket, dimensions in mm (in)

D Markings for bores, DN 50 flange

Service-specific accessories

Ball valve for rinse chamber
- As rinse connection complementing or replacing the vent cock supplied;
- Order No. 51512982

O-ring set
- Viton + FPM
- Order No. 51512981

www.addresses.endress.com

Endress+Hauser

People for Process Automation

EQUIPMENT TECHNICAL DATA SHEETS

PVC ISOLATION BALL VALVES

COAGULANT METERING SKID ISOLATION VALVES:

- Spears PVC Compact Isolation Ball Valves
    - 1/2" Type 21 PVC Ball Valve w/ FKM O-Ring

MISC SAMPLE VALVES:

- Spears PVC Compact Isolation Ball Valves
    - 1/2" & 3/4" Type 21 PVC Ball Valve w/ FKM O-Ring

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917



Features – PVC, CPVC

This industrial grade, quarter turn shutoff valve is popular where maintenance-free installations are desired for a variety of chemical processing, industrial and OEM applications. IPS Sizes 1/2" - 4" available with socket, threaded or flanged end connectors, 6" size available with socket or flanged end connectors. 6" valve uses high-efficiency lever style handle for easier operation.

- Chemical & Corrosion Resistant PVC or CPVC Construction
- Maintenance-Free Sealed Unit
- Schedule 80 Full-Bore Design
- High Impact Polypropylene Handle
- Spears® Single O-ring Safe-T-Shear® Stem Design
- EPDM or FKM O-rings
- Self Adjusting PTFE Floating Seat Design
- Sizes 1/2" - 2" Pressure Rated to 235 psi @ 73°F, Sizes 3" - 6" and all Flanged Pressure Rated to 150 psi @ 73°F
- EPDM valves NSF® Certified for Potable Water use
- Suitable for Vacuum Service
- Assembled with Silicone-Free, Water Soluble Lubricant
- Manufactured to ASTM F 1970

Note: Valve size 6" uses Lever Handle (not shown)

Sample Engineering Specification

All thermoplastic ball valves shall be Compact sealed unit type constructed from PVC Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, Cell Classification 23447. All O-rings shall be EPDM or FKM. All valves shall have Safe-T-Shear® stem and Polypropylene handle. All EPDM valves shall be certified by NSF® International for use in potable water service. All 1/2" - 2" valves shall be pressure rated at 235 psi, all 3" - 6" and all flanged valves shall be pressure rated at 150 psi for water at 73°F, as manufactured by Spears® Manufacturing Company.

Quick-View Valve Selection Chart

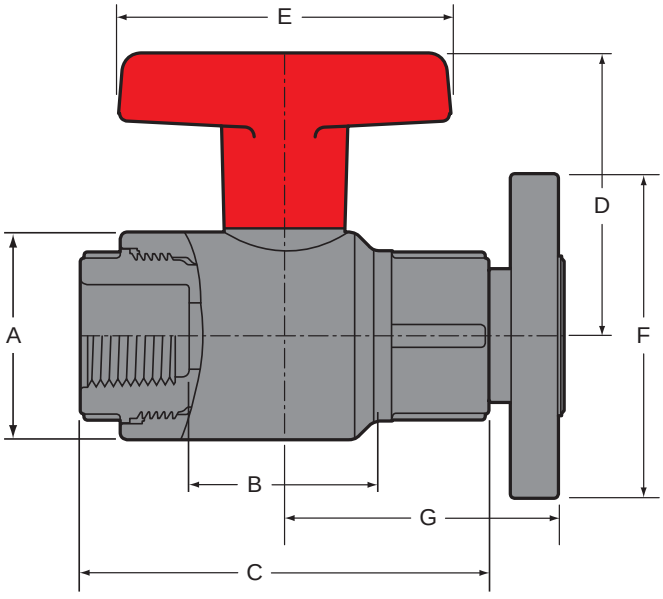
Valve Size	O-ring Material	PVC Part Numbers[1]			Pressure Rating
		Socket	Threaded	Flanged	
1/2	EPDM	2122-005	2121-005	2123-005	235 psi Non-Shock Water @ 73°F (Flanged 150 psi Non-Shock) Water @ 73°F
	FKM	2132-005	2131-005	2133-005	
3/4	EPDM	2122-007	2121-007	2123-007	
	FKM	2132-007	2131-007	2133-007	
1	EPDM	2122-010	2121-010	2123-010	
	FKM	2132-010	2131-010	2133-010	
1-1/4	EPDM	2122-012	2121-012	2123-012	
	FKM	2132-012	2131-012	2133-012	
1-1/2	EPDM	2122-015	2121-015	2123-015	
	FKM	2132-015	2131-015	2133-015	
2	EPDM	2122-020	2121-020	2123-020	
	FKM	2132-020	2131-020	2133-020	
3	EPDM	2122-030	2121-030	2123-030	150 psi Non-Shock Water @ 73°F
	FKM	2132-030	2131-030	2133-030	
4	EPDM	2122-040	2121-040	2123-040	
	FKM	2132-040	2131-040	2133-040	
6	EPDM	2122-060	---	2123-060	
	FKM	2132-060	---	2133-060	

1: For CPVC valves, add the letter "C" to the part numbers listed (e.g., 2131-005**C**).

Optional Accessories*

- Round Safety Handle
- Stem Extension Kit
- Mini-Mount Actuation Mounting Kit
- 2" Square/T-Style Operator Nut

*See ***"BALL VALVE ACCESSORIES"*** section for details of individual products.



Dimensions, Weights, Operating Torque & C_V Values

Nominal Size	Dimension Reference (inches, ± 1/16)								Approx. Wt. (Lbs.)		Oper.[2] Torque (in.-lb.)	C_V[3] Values	
	A	B[1]		C	D	E[4]	F	G	PVC	CPVC		Soc/Thd	Flanged
		Socket	Threaded										
1/2	1-11/16	1-5/8	1-7/8	3-3/8	2-5/16	2-3/4	3-1/2	2-17/32	.31	.32	20	36	20
3/4	2-1/8	1-15/16	2-7/16	4-1/16	2-11/16	3-1/4	3-7/8	2-27/32	.49	.52	30	74	42
1	2-7/16	2-1/16	2-3/8	4-7/16	2-7/8	3-3/4	4-1/4	3-1/16	.64	.69	40	141	80
1-1/4	2-13/16	2-3/8	3	4-15/16	3-5/16	4-1/8	4-5/8	3-13/32	.93	.98	60	284	163
1-1/2	3-1/4	2-13/16	3-1/2	5-5/8	3-11/16	4-1/2	5	4	1.39	1.45	80	402	229
2	4-1/16	3-3/8	4-7/16	6-1/2	4-3/8	5-1/4	5-7/8	4-13/32	2.33	2.45	90	706	429
3	5-5/16	4-9/16	5-1/2	8-5/16	5-1/2	7-21/32	7-1/2	5-7/16	4.49	5.02	300	1660	1079
4	7-3/8	6-3/16	7-3/16	10-5/32	6-5/8	10-27/32	9-1/16	6-7/8	9.50	10.24	400	3104	2028
6[4]	10-3/16	8	10-3/4	14-1/8	8-1/16	14-5/16	11-1/4	8-21/32	21.48	23.41	900	7942	5268

1: Valve Lay Length
2: Torque required at valve maximum internal pressure rating, 5 ft./sec. flow velocity.
3: Gallons per minutes at 1 psi pressure loss. Values calculated from valve laying length, based on derivative of Hazen-Williams equation with surface roughness factor of C =150.
4: 6" valve has lever handle, dimension is from valve centerline (not illustrated)

Temperature Pressure Rating

System Operating Temperature °F (°C)			100 (38)	110 (43)	120 (49)	130 (54)	140 (60)	150 (66)	160 (71)	170 (77)	180 (82)	190 (88)	200 (93)	210 (99)
Valve Pressure Rating psi (MPa)	1/2" - 2"	PVC	235 (1.62)	211 (1.45)	150 (1.03)	75 (.52)	50 (.34)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)
		CPVC	235 (1.62)	219 (1.51)	170 (1.17)	145 (1.00)	130 (.90)	110 (.76)	90 (.62)	80 (.55)	70 (.48)	60 (.41)	50 (.34)	-0- (-0-)
	3" - 6"	PVC	150 (1.03)	135 (.93)	110 (.76)	75 (.52)	50 (.34)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)
		CPVC	150 (1.03)	140 (.97)	130 (.90)	120 (.83)	110 (.76)	100 (.70)	90 (.62)	80 (.55)	70 (.48)	60 (.41)	50 (.34)	-0- (-0-)

NOT FOR DISTRIBUTION OF COMPRESSED AIR OR GASES

EQUIPMENT TECHNICAL DATA SHEETS

BUTTERFLY ISOLATION VALVES

FOR:

ADT ISOLATION VALVES
POLYMER INLET ISOLATION VALVE

APPOLLO BALL VALVES:
PART #: 76F-100-A SERIES

Materials: 316SS Full Port Ball Valve. See attached Speck Sheet for more details. Sizes: 3/8" (F)NPT; 1/2" (F)NPT; 3/4" (F)NPT

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

76F-100-A SERIES

STAINLESS STEEL FULL PORT BALL VALVE

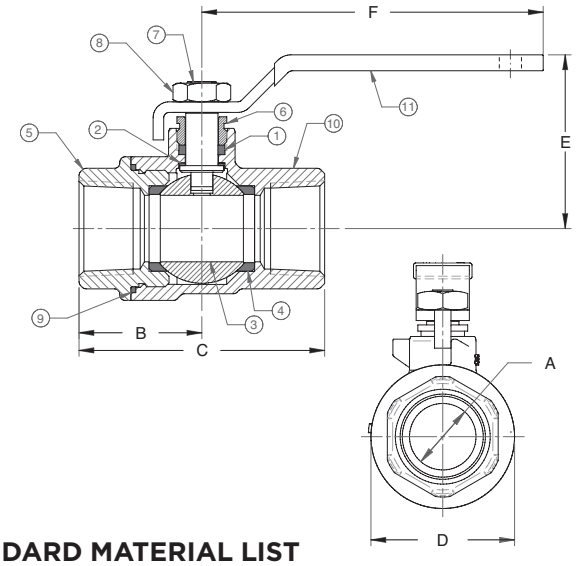
LEADFREE CERTIFIED

5 YEAR WARRANTY MADE IN USA

Female NPT Thread, 1/4"-3" 1000 CWP (psig), Cold Non-Shock. (See referenced P/T chart)
150 psig Saturated Steam.
Vacuum Service to 29 inches Hg.
MSS SP-110 Compliant.
Designed, cast, machined, assembled, and 100% factory tested in USA.

FEATURES

- Investment cast components
- Reinforced seats
- Blowout-proof stem design
- Adjustable packing gland
- Stainless steel lever and nut



STANDARD MATERIAL LIST

	PART	MATERIAL
1	Stem packing	MPTFE
2	Stem bearing	RPTFE
3	Ball	A276-316SS (1/4" to 2", except 1-1/4") A276-316SS or A351-CF8M stainless (1-1/4") A351-CF8M stainless (3")
4	Seat (2)	RPTFE (2" & smaller); RTFM (3")
5	Retainer	ASTM A276-316SS (1/4" & 3/8") ASTM A351-CF8M stainless (1/2" to 3")
6	Gland	A276-316 Stainless Steel
7	Stem	A276-316 Stainless Steel
8	Lever nut	304 Stainless Steel
9	Body Seal	RPTFE (1/2" to 3")
10	Body	A351-CF8M
11	Lever and grip	SS w/vinyl

- Fire safe to API 607 (requires -24 suffix)
- Meets NACE MR0175 (2000) & MR0103 (2012)
- CSA CGA 3.16-M88 (Requires "GS" suffix)
- NSF/ANSI/CAN 61 Section 8, Annex G (1/4" to 2")
- NSF/ANSI 372 - Drinking Water System Components - Lead Content

OPTIONS AVAILABLE

(MORE INFORMATION IN SECTION J)

- Minimum quantities apply
- To specify an option, replace the "01" standard suffix with the suffix of the option.
- To specify multiple options, replace the "01" suffix with the desired suffixes in the numerical order shown below. NOTE: Not all suffixes can be combined together.

(SUFFIX)	OPTION	SIZES
-P -27-	BSPP (Parallel) Thread Connection	1/2" to 2"
-T -27-	BSPT (Tapered) Thread Connection	1/2" to 3"
-02-	Stem Grounded	1/2" to 3"
-08-	90º Reversed Stem	1/2" to 2"
-11-	Therma-Seal™ Insulating Tee Handle	1/4" to 2"
-14-	Side Vented Ball (Uni-Directional)	3/8" to 3"
-24-	Graphite Packing, PTFE Body Seal, RPTFE Bearing (API 607, 6th Edition, ISO 10497:2010)	1/2" to 3"
-27-	Standard Configuration, SS Latch-Lock Lever & Nut	3/8" to 3"
-30-	Cam-Lock and Grounded	1/2" to 2"
-32-	SS Tee Handle & Nut	1/2" to 2"
-35-	PTFE Trim	3"
-39-	SS Hi-Rise Locking Wheel Handle, SS Nut	1/2" to 2"
-40-	Cyl-Loc and Grounded	1/2" to 2"
-44-	Seal Welded	All
-45-	Less Lever & Nut	1/2" to 3"
-46-	Latch Lock Lever - Lock in Closed Position Only	1/2" to 2"
-47-	SS Latch Lock Oval Handle	1/2" to 2"
-48-	SS Oval Handle (No Latch) & Nut	1/4" to 2"
-49-	No Lubrication. Assembled Dry.	1/2" to 3"
-50-	2-1/4" CS Locking Stem Extension	1/2" to 2"
-56-	Multifill Seats & Packing	1/2" to 3"
-57-	Oxygen Cleaned	All
-60-	Static Grounded Ball & Stem	1/2" to 3"
-GS-	CSA CGA 3.16 (RTFE Seat - All sizes)	All
-UA-	AIS (American Iron & Steel) Compliant	1/2" to 3"

Pressure/Temperature Ratings - Page M-12, Graph No. 8

DIMENSIONS

PART NO.	SIZE	A	B	C	D	E	F	WT.
76F-101-27	1/4"	0.37	0.95	1.91	1.12	1.60	3.85	0.47
76F-102-27	3/8"	0.37	0.95	1.91	1.12	1.60	3.85	0.44
76F-103-27A	1/2"	0.50	1.21	2.35	1.27	1.73	3.85	0.57
76F-104-27A	3/4"	0.81	1.39	2.77	1.62	1.96	3.85	0.91
76F-105-27A	1"	1.00	1.67	3.34	2.00	2.27	4.75	1.38
76F-106-27A	1-1/4"	1.25	1.96	3.92	2.73	3.21	7.77	4.17
76F-107-27A	1-1/2"	1.50	2.05	4.10	2.92	3.31	7.77	4.69
76F-108-27A	2"	2.00	2.37	4.74	3.75	3.69	7.77	6.90
76F-100-27A	3"	3.00	3.70	7.40	5.68	5.23	10.00	22.40

*LEAD FREE: The wetted surfaces of this product shall contain no more than 0.25% lead by weighted average. Complies with Federal Public Law 111-380. ANSI 3rd party approved and listed.

REV. 22AUG23

EQUIPMENT TECHNICAL DATA SHEETS

BUTTERFLY ISOLATION VALVES

FOR:

DAF UNCLARIFIED WATER INLET ISOLATION VALVE
DAF CLARIFIED WATER OUTLET ISOLATION VALVE
DAF RECYCLE OUTLET ISOLATION VALVE

BRAY SERIES 31 BUTTERFLY VALVES:
PART #: SIZE – 31/324/A153 MADE IN AMERICA

Materials: Ductile Iron lug body, 316SS Disc, 316SS stem, EPDM Seat Type: Full-Lug, Manual Lever Operator

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Bray CONTROLS



RESILIENT SEATED

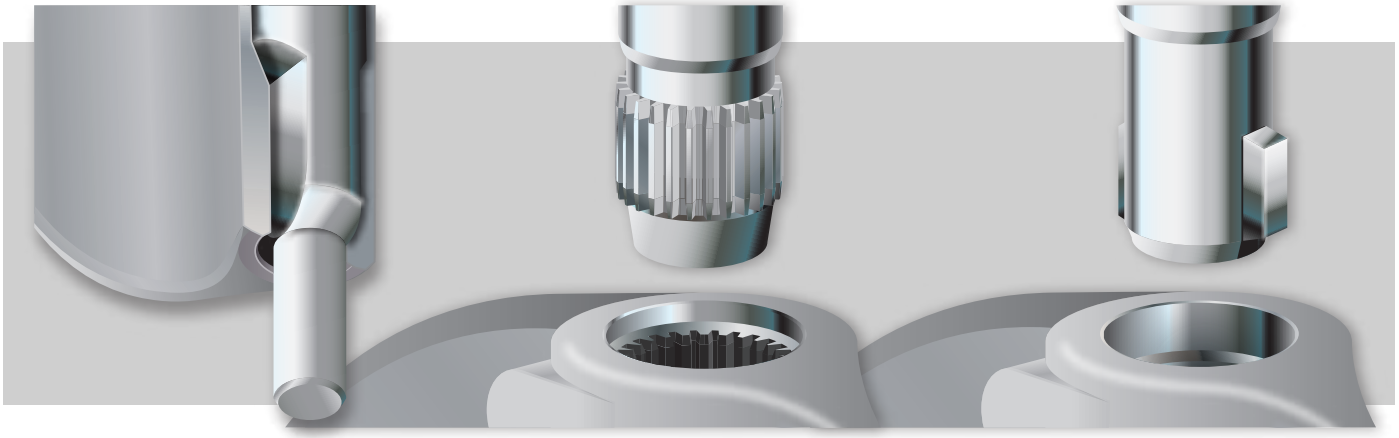
Butterfly Valves

DESIGN BENEFITS

1 ISOLATION FROM LINE MEDIA

achieved in two fundamental design concepts:

A. INTERNAL DISC/STEM CONNECTION Bray offers three disc-to-stem connections: Double 'D', Splined, and Double Key. These internal, non-wetted connections eliminate exposed external disc-to-stem connections such as screws or taper pins.



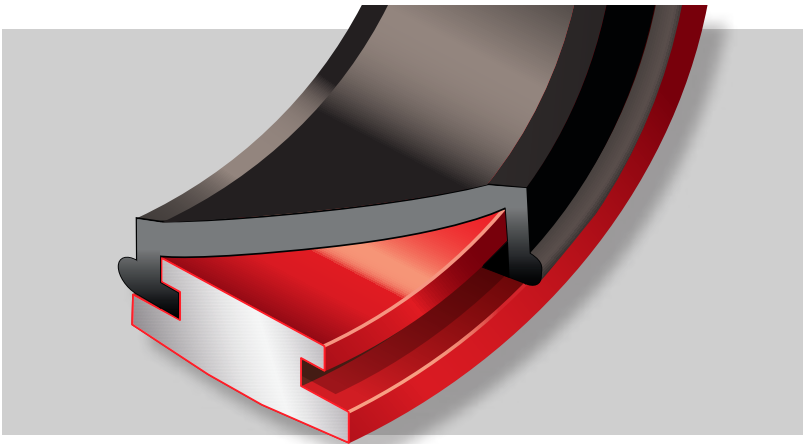
1. Double D: precision machined flats on the stem and in the disc.
Sizes 2"– 20" (50mm–500mm)

2. Spline: male splines in the stem and female in the disc.
Standard Sizes 22"– 48" (550mm–1200mm)
Selected Sizes 54"– 120" (1400mm–3000mm)

3. Double Keyed: keyways machined into disc matching keys in the stem
Selected Sizes 54"– 120" (1400mm–3000mm)

Disassembly of Bray's internal connection is performed by simply pulling the stem out of the disc. Bray's precision machining of the disc and the stem connection minimizes hysteresis and produces maximum strength engagements. All stem designs incorporate a blow-out proof feature.

B. SEAT DESIGN Bray's seat design provides complete isolation of flowing media from the body and stem by a totally encasing design. Designed to seal with slip-on or weld-neck flanges.



Tongue-and-groove

2 INTERNATIONAL COMPATIBILITY

Valve mounting top flanges meet ISO 5211 standards for direct mounting of manual operators and power actuators. All Bray valves have extended necks which allow for at least 2" piping insulation.



3 ACTUATOR MOUNTING

Due to a modular concept of design, all Bray actuators including Handles, Gear Operators, Pneumatic and Electric Actuators mount directly to Bray resilient seated valves. No brackets are required. This allows for simple installation in the field, minimizes possible misalignment and reduces overall height.

EXTERNAL COATING OPTIONS

1 POLYESTER BODY COATING

Bray's standard product offers valve bodies with a polyester coating, providing excellent corrosion and wear resistance to the valve's surface. The Bray polyester coating is a hard, gloss red finish.

Chemical Resistant

Resists a broad range of chemicals including dilute acids and alkalis, petroleum solvents, alcohols, greases and oils. Also offers outstanding resistance to humidity and water.

Weatherability

Resistant to ultra-violet radiation.

Abrasion Resistant

Excellent resistance to abrasion.

Impact Resistant

Withstands impact without chipping or cracking.

2 NYLON 11 COATING:

Nylon 11 also has superior corrosion resistance and has been used successfully in many applications such as water, cement, food and seawater.

Weatherability

Bray's Nylon 11 coating has been salt spray tested in excess of 2000 hours and used in seawater immersion service for over 25 years without any deterioration of the coating resulting in no corrosion to the coated metal components.

Abrasion Resistant

Excellent resistance to abrasion.

Impact Resistant

Excellent - no chipping or cracking.

Other customer specified coating materials are available. Please consult your local Bray representative for your specific application.

3 SEACORR COATING:

FDA Epoxy pigmented with 316L Stainless Steel Flake available for corrosive environments as tested per ASTM B-117 salt spray test for 2000 hours.





SEAT MATERIALS

Seat Temperature Ranges

EPDM	-20°F (-29°C)	250°F (121°C)	FKM	0°F (-18°C)	400°F (204°C)
BUNA-N	0°F (-18°C)	212°F (100°C)	Polyurethane	-20°F (-29°C)	176°F (80°C)

EPDM (Peroxide Cured)

EPDM is the abbreviated name for Ethylene Propylene Diene Monomer. In general industry, one may see other abbreviations or trade names used in lieu of EPDM such as EPT, Nordel, ECD, or EPR. Typically these are the same materials as EPDM.

EPDM is a standard seat material offered in Bray resilient-seated butterfly valves. It is the most universal and economical of seat materials offered by Bray; that is, it may be used in a wider range of applications than BUNA-N. Of important significance also is the fact all EPDM seat materials sold by Bray are Food Grade. Bray's EPDM Food Grade seats are perfectly suitable for sanitary applications as well as standard industrial uses. EPDM is also available as a covering for Series 20 discs.

BUNA-N (Black & White)

BUNA-N is the commonly used name for Nitrile synthetic rubber. Nitrile is a copolymer of acrylonitrile and butadiene. BUNA-N is sometimes referred to as NBR, Nitrile, or Hycar. BUNA-N is an excellent general purpose seat material which is particularly suitable for hydrocarbon service. BUNA-N is a standard Bray seat material and is Food Grade; thus suitable for sanitary applications. Note, BUNA-N is also available as a covering for Series 20 disc stems.

FKM

FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (Fluoroelastomers) such as Viton® (DuPont). FKM has some outstanding characteristics such as improved acid, oil, and temperature resistance over standard seat materials.

POLYURETHANE

Urethane seats are primarily used for their ability to resist abrasive wear. Urethane can be used on a reasonably broad range of services. Urethane will withstand severe impact, recover its original shape after distortion and resist abrasion better than other elastomers such as EPDM and BUNA-N.

Seat material availability depends on valve size & series. Please consult your local Bray representative for your specific application.



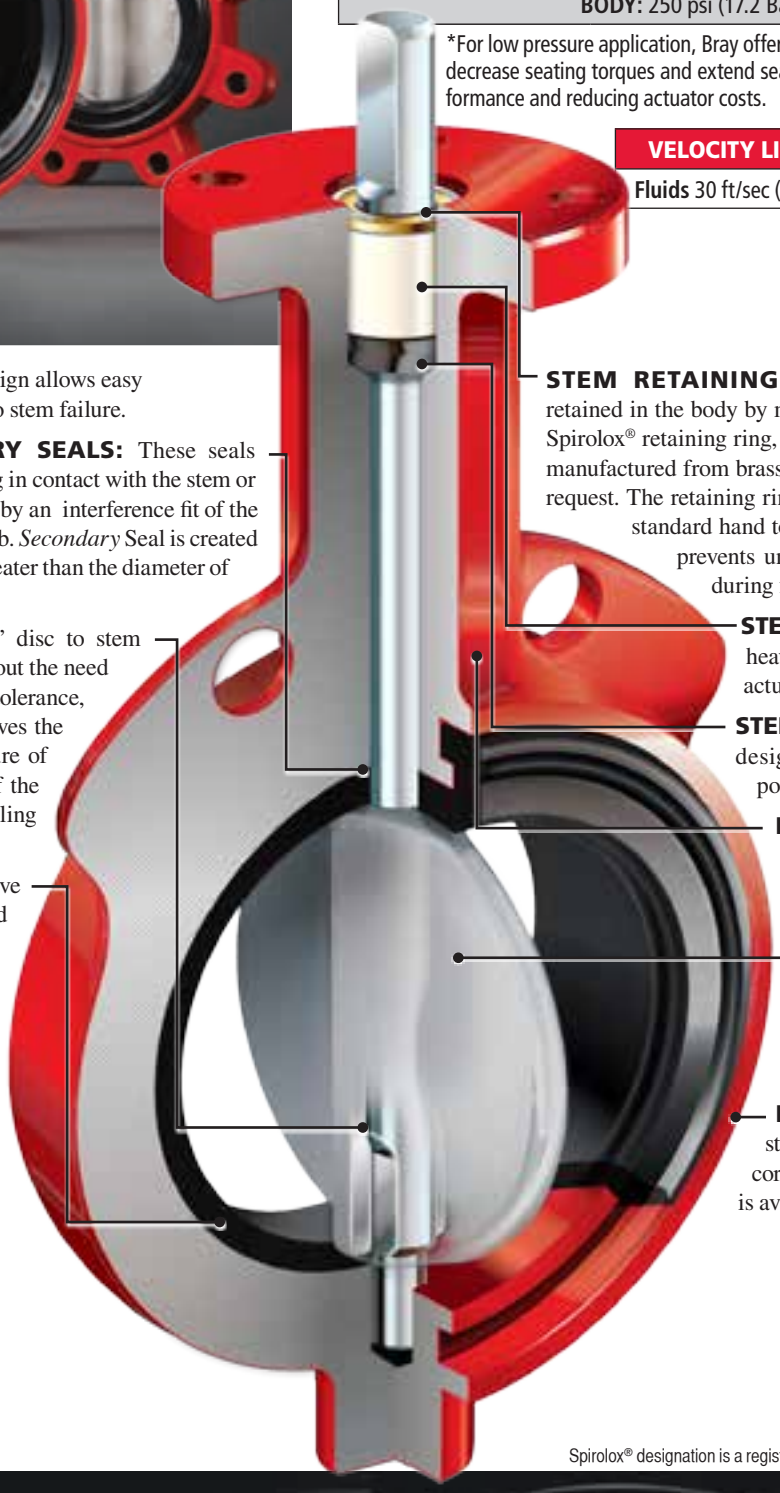


SERIES 30/31 2"-20" (50mm-500mm)

PRESSURE RATINGS		
BIDIRECTIONAL BUBBLE-TIGHT SHUT-OFF – Standard Disc* Downstream Flanges/Disc in Closed Position		
S30/31 Standard Disc*	2-12" (50-300mm)	175 psi (12 Bar)
	14-20" (350-500mm)	150 psi (10.3 Bar)
DEAD-END SERVICE – Lug Bodies/Standard Disc* No Downstream Flanges/Disc in Closed Position		
S31	2-12" (50-300mm)	75 psi (5.2 Bar)
	14-20" (350-500mm)	50 psi (3.4 Bar)
BODY: 250 psi (17.2 Bar) CWP		

*For low pressure application, Bray offers a standard reduced disc diameter to decrease seating torques and extend seat life, thus increasing the valve's performance and reducing actuator costs.

VELOCITY LIMITS For On/Off Services:	
Fluids 30 ft/sec (9 m/s)	**Gases** 175 ft/sec (54 m/s)



High strength through-stem design allows easy disassembly and reduced disc to stem failure.

PRIMARY & SECONDARY SEALS: These seals prevent line media from coming in contact with the stem or body. *Primary* Seal is achieved by an interference fit of the molded seat flat with the disc hub. *Secondary* Seal is created because the stem diameter is greater than the diameter of the seat stem hole.

STEM: Precision double "D" disc to stem connection drives the disc without the need for screws or pins. The close tolerance, double "D" connection that drives the valve disc is an exclusive feature of the Bray valve. Disassembly of the Bray stem is just a matter of pulling the stem out of the disc.

SEAT: Bray's tongue and groove seat design lowers torque and provides complete isolation of flowing media from the body. The seat also features a molded O-ring which eliminates the use of flange gaskets.

STEM RETAINING ASSEMBLY: The stem is retained in the body by means of a unique Stainless Steel Spirolox® retaining ring, a thrust washer and two C-rings, manufactured from brass as standard, stainless steel upon request. The retaining ring may be easily removed with a standard hand tool. The stem retaining assembly prevents unintentional removal of the stem during field service.

STEM BUSHING: Non-corrosive, heavy duty acetal bushing absorbs actuator side thrust.

STEM SEAL: Double "U" cup seal design is self-adjusting and gives positive sealing in both directions.

NECK: Extended neck length allows for 2" of piping insulation and is easily accessible for mounting actuators.

DISC: Casting is spherically machined and hand polished to provide a bubble-tight shut off, minimum torque, and longer seat life.

BODY: One-piece wafer or lug style. Polyester coating for excellent corrosion resistance. Nylon 11 coating is available as an option.

Spirolox® designation is a registered trademark of Kaydon Ring and Seal, Inc.



SERIES 31H

2"-20" (50mm-500mm)

Series 31H Lug valves are drilled and tapped to meet ASME Class 125/150 and PN16 flanges. Series 31H Valves will not be automated.

PRESSURE RATINGS	
BIDIRECTIONAL BUBBLE-TIGHT SHUT OFF & DEAD-END SERVICE	
2-20" (50-500mm)	250 psi (17.2 Bar)
BODY: 250 psi (17.2 Bar) CWP	

VELOCITY LIMITS For On/Off Services:	
Fluids 30 ft/sec (9 m/s)	**Gases** 175 ft/sec (54 m/s)

STANDARD MATERIALS SELECTION 31H	
Body	Cast Iron Ductile Iron
Disc	Aluminum Bronze Nylon 11 Coated Ductile Iron 316 Stainless Steel
Stem	416 Stainless Steel
Seat	Bonded EPDM Bonded BUNA-N

Material availability depends on valve size & series. Other materials are available. Please consult your local Bray representative for your specific application.

STANDARD MATERIALS SELECTION S30/31

NAME	MATERIAL
Body	Cast Iron
	Ductile Iron
	Carbon Steel
	Aluminum
Disc	Aluminum Bronze
	Coated Ductile Iron
	Nylon 11 Coated Ductile Iron
	Halar® Coated Ductile Iron
	304 Stainless Steel
	316 Stainless Steel
	Duplex Stainless Steel
	Super Duplex Stainless Steel
	Hastelloy®
Stem	416 Stainless Steel
	304 Stainless Steel
	316 Stainless Steel
	Monel K500
Seat	BUNA-N – Food Grade
	EPDM – Food Grade
	FKM*
	White BUNA-N – Food Grade
	Bonded EPDM
	Bonded BUNA-N



Material availability depends on valve size & series. Other materials are available. Please consult your local Bray representative for your specific application.

*FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (also called Fluoroelastomers).
Hastelloy® is a registered trademark of Haynes International, Inc.
Halar® is a registered trademark of Ausimont U.S.A., Inc.



ACTUATORS & ACCESSORIES



SERIES 70 *ELECTRIC*

Torque	300 to 18,000 lb-ins (34-2030 Nm)
Voltage	VAC: 24, 120, 220 VDC: 12, 24
Standard Enclosure	NEMA 4, 4X
Explosion Proof:	NEMA 4, 4X, 7 and 9

The Series 70 is a low profile, compact and powerful actuator with customer-friendly features.

- Manual declutchable handwheel
- Local high visibility position indicator
- Digital interface available
- Optional microprocessor based modulating control



SERIES 73 *ELECTRIC*

Torque	100 to 600 lb-ins (11-70 Nm)
Voltage	VAC: 120, 220 VDC: 12, 24
Standard Enclosure	NEMA 4, 4X, IP65

The Series 73 is a low cost electric actuator for rotary valves.

- Powered by permanent split-capacitor, reversible induction motor
- All AC motors provided with an internal motor brake
- Heavy duty spur gear system
- Heater available to prevent damage to components due to condensation
- LED position indication



SERIES 92/93 *PNEUMATIC*

Buna pneumatic actuators are rack and pinion, opposed-piston actuators available in two versions: double acting and spring return.

- Maximum pressure rating of 140 psi (9.7 bar) and a temperature range of -20°F (-29°C) to +200°F (+95°C)
- Two independently adjustable travel stop screws and a cam on the output shaft to permit precise bidirectional adjustment of movement in both the open and closed positions for quarter turn valves (+5° to -5° limit adjustment)
- Integral porting
- Standard units have anodized aluminum bodies with polyester coated end caps.
- Special coatings and materials available for corrosive environments
- NAMUR accessory compatible



SS ACTUATOR



TRAVEL STOP



SPRING RETURN

ACTUATORS & ACCESSORIES



SERIES 50 - Valve Status Monitors

- 10 amps at 125 or 250 volts AC
- Internal travel switches that are prewired to a terminal block



SERIES 52 - Valve Status Monitors

- ProxSensor provides 2 proximity sensors in one fully sealed, compact enclosure.
- AC, DC, Intrinsically Safe and BUS Network versions are offered.



SERIES 63 - 3 & 4 way solenoids

- Waterproof (NEMA 4,4X) and explosion proof (NEMA 7,9) housings are standard
- NPT and IP65 DIN connections are offered with both single and dual coils



SERIES 6A
Electro-Pneumatic Positioners

- Precise, microprocessor driven flow control and advanced communication
- For use with either double or single acting actuators



Serial Bus Communication

- Bray offers several products featuring serial bus communication.
- Multiple protocols available. Consult your local Bray representative.

Manual Operators



SERIES 1 - Handle & Notch Plate

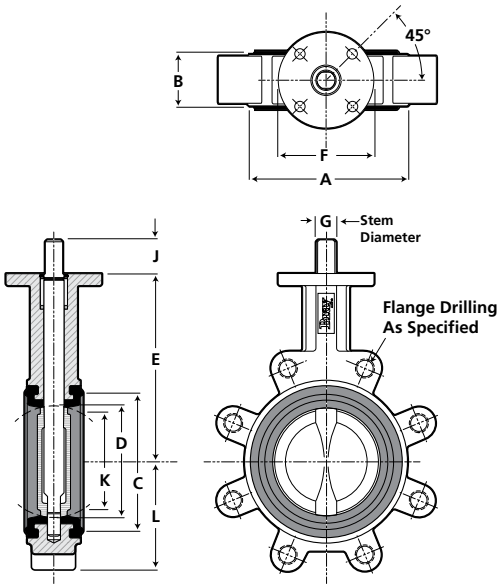


SERIES 4 - Gear Operator

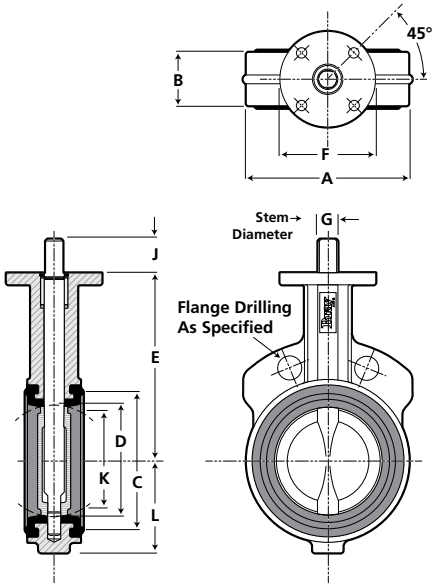


SERIES 5 - Declutchable Gear Operator

Series 31 Lug



Series 30 Wafer





IMPERIAL DIMENSIONS: Inches																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	H	J	K	L		Adapter Code	Weight (lbs.)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
2	3.69	1.62	2.00	2.85	5.50	3.54	2.76	4	.39	.55	39	1.25	1.32	2.22	2.30	A	5.5	7.0	4.75	4	.62-11
2 1/2	4.19	1.75	2.50	3.36	6.00	3.54	2.76	4	.39	.55	.39	1.25	1.91	2.47	2.57	A	7.0	8.0	5.50	4	.62-11
3	4.88	1.75	3.00	4.15	6.25	3.54	2.76	4	.39	.55	.39	1.25	2.55	2.81	2.81	A	7.5	9.0	6.00	4	.62-11
4	6.06	2.00	4.00	5.16	7.00	3.54	2.76	4	.39	.63	.43	1.25	3.57	3.41	4.09	B	11.5	15.0	7.50	8	.62-11
5	7.06	2.12	5.00	6.16	7.50	3.54	2.76	4	.39	.75	.51	1.25	4.63	4.03	4.61	C	14.0	20.0	8.50	8	.75-10
6	8.12	2.12	5.75	7.02	8.00	3.54	2.76	4	.39	.75	.51	1.25	5.45	4.53	5.06	C	17.0	23.0	9.50	8	.75-10
8	10.50	2.50	7.75	9.47	9.50	5.91	4.92	4	.57	.87	.63	1.25	7.45	5.75	6.05	D	34.0	42.0	11.75	12	.75-10
10	12.75	2.50	9.75	11.47	10.72	5.91	4.92	4	.57	1.18	.87	2.00	9.53	7.12	7.69	E	49.0	66.0	14.25	12	.88-9
12	14.88	3.00	11.75	13.47	12.25	5.91	4.92	4	.57	1.18	.87	2.00	11.47	8.12	9.02	E	67.0	88.0	17.00	12	.88-9

Note: K dimension is disc chordal dimension at valve face.

METRIC DIMENSIONS: Millimeters																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	H	J	K	L		Adapter Code	Weight (Kg)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
50	94	43	51	72	140	90	70	4	10	14	10	32	34	56	58	A	2.5	3	121	4	.62-11
65	106	46	64	85	152	90	70	4	10	14	10	32	49	63	65	A	3	3.5	140	4	.62-11
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100	154	52	102	131	178	90	70	4	10	16	11	32	91	87	104	B	5	7	191	8	.62-11
125	181	56	127	156	190	90	70	4	10	19	13	32	118	102	117	C	6	9	216	8	.75-10
150	206	56	146	178	203	90	70	4	10	19	13	32	138	115	129	C	8	10	241	8	.75-10
200	267	60	197	240	241	150	125	4	14	22	16	32	189	146	154	D	15	19	298	12	.75-10
250	324	68	248	291	273	150	125	4	14	30	22	51	242	181	195	E	22	30	362	12	.88-9
300	378	76	298	342	311	150	125	4	14	30	22	51	291	206	229	E	30	40	432	12	.88-9

Note: K dimension is disc chordal dimension at valve face.

Drawings are for reference only. Please refer to Bray ES drawings on the Bray website, www.bray.com. Bray reserves the right to change product dimensions without notice.

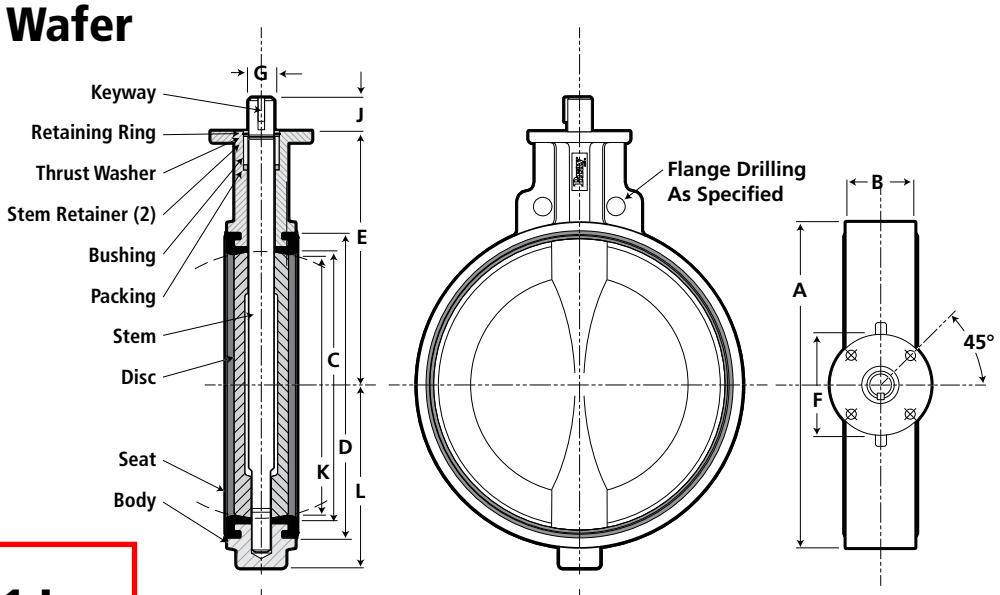
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Bray Order No.: _____

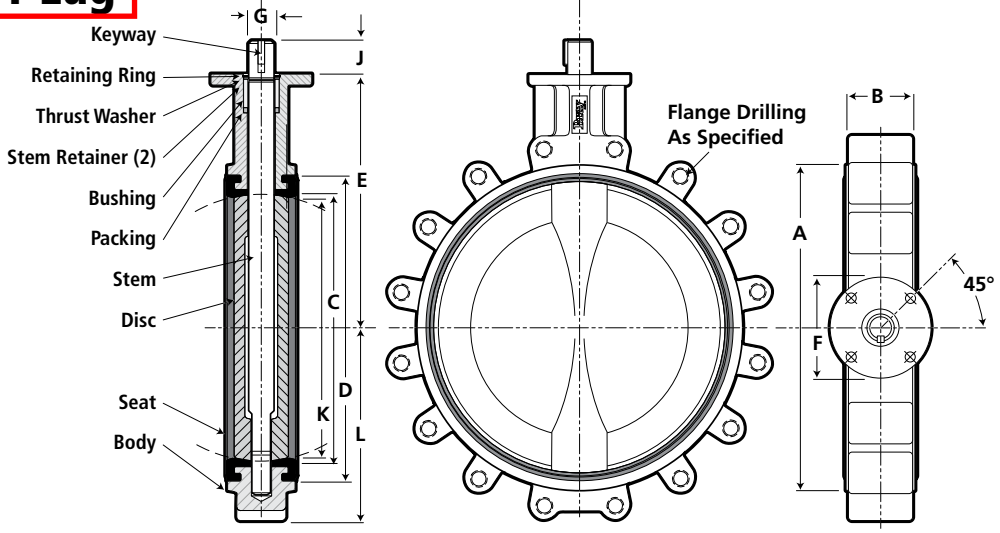
SR Drawing #30/31-2/12-im August 2012- Rev. 0

Customer/Project: _____

Series 30 Wafer



Series 31 Lug



IMPERIAL DIMENSIONS: Inches																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	J	Key Size	K	L		Adapter Code	Weight (lbs.)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
14	17.05	3.00	13.25	15.28	13.62	5.91	4.92	4	.57	1.38	2.00	.39x.39	13.04	9.38	9.93	F	95	114	18.75	12	1.00-8
16	19.21	4.00	15.25	17.14	14.75	5.91	4.92	4	.57	1.38	2.00	.39x.39	14.85	10.75	11.30	F	135	166	21.25	16	1.00-8
18	21.12	4.25	17.25	19.47	16.00	8.27	6.50	4	.81	1.97	2.50	.47x.39	16.85	12.00	12.15	G	200	226	22.75	16	1.12-7
20	23.25	5.00	19.25	21.59	17.25	8.27	6.50	4	.81	1.97	2.50	.47x.39	18.73	14.00	14.00	G	260	305	25.00	20	1.12-7

Note: K dimension is disc chordal dimension at valve face.

METRIC DIMENSIONS: Millimeters																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	J	Key Size	K	L		Adapter Code	Weight (Kg)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
350	433	76	337	388	346	150	125	4	14	35	51	10x10	331	238	252	F	43	52	476	12	1.00-8
400	488	102	387	442	375	150	125	4	14	35	51	10x10	377	273	287	F	61	75	540	16	1.00-8
450	536	108	438	495	406	210	165	4	21	50	64	12x10	428	305	309	G	91	103	578	16	1.12-7
500	591	127	489	548	438	210	165	4	21	50	64	12x10	476	348	358	G	118	138	635	20	1.12-7

Note: K dimension is disc chordal dimension at valve face.

Drawings are for reference only. Please refer to Bray ES drawings on the Bray website, www.bray.com. Bray reserves the right to change product dimensions without notice.

SR Drawing #30/31-14/20-im August 2012- Rev. 0

Inquire/P.O. No.:_____

Customer/Project: _____

Bray Order No.: _____

EQUIPMENT TECHNICAL DATA SHEETS

PNEUMATIC BUTTERFLY VALVES
MODULATING

DAF INFLUENT FLOW CONTROL VALVE:
BRAY SERIES 31 BUTTERFLY VALVES W/ PNEUM SPRING RETURN F/C ACTUATOR & ELECTRO-PNEUMATIC POSITIONER

4" BRAY 31/324/A153, LUG BFV (DI BODY, 316SS DISC, 316SS STEM, EPDM SEAT) SUFFIX A153
= MADE IN AMERICA
WITH BRAY SERIES 93/119(3) SPRING RETURN FAIL CLOSED PNEUAMTIC ACTUATOR, & 6A ELECTRO-PNEUMATIC POSITIONER WITH FEEDBACK & GAUGES.
`

DAF LEVEL CONTROL VALVE:
BRAY SERIES 31 BUTTERFLY VALVES W/ PNEUM SPRING RETURN F/O ACTUATOR & ELECTRO-PNEUMATIC POSITIONER

6" BRAY 31/324/A153, LUG BFV (DI BODY, 316SS DISC, 316SS STEM, EPDM SEAT) SUFFIX A153
= MADE IN AMERICA
WITH BRAY SERIES 93/119(5) SPRING RETURN FAIL CLOSED PNEUAMTIC ACTUATOR, & 6A ELECTRO-PNEUMATIC POSITIONER WITH FEEDBACK & GAUGES.

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Bray CONTROLS



RESILIENT SEATED

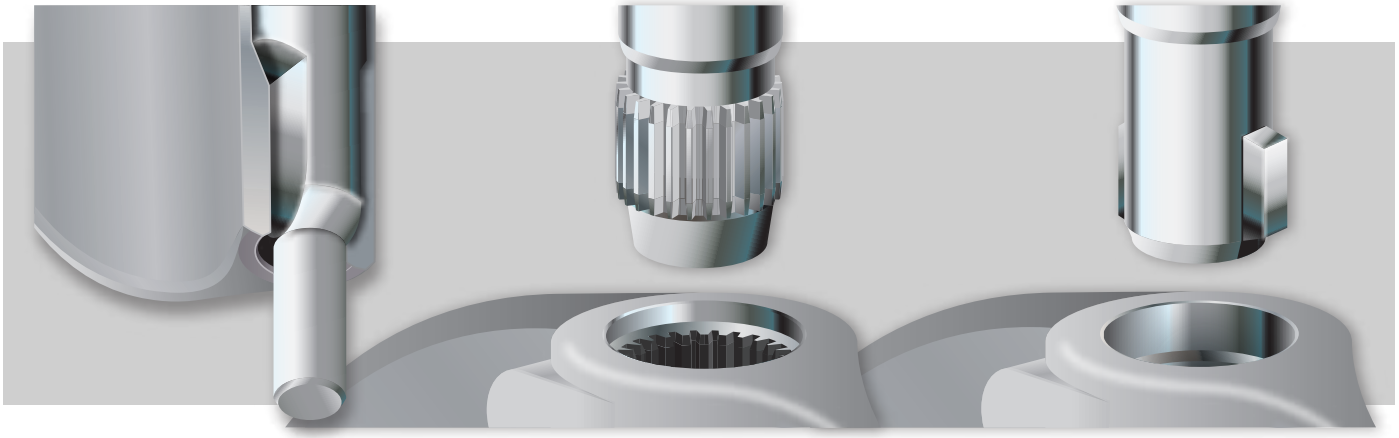
Butterfly Valves

DESIGN BENEFITS

1 ISOLATION FROM LINE MEDIA

achieved in two fundamental design concepts:

A. INTERNAL DISC/STEM CONNECTION Bray offers three disc-to-stem connections: Double 'D', Splined, and Double Key. These internal, non-wetted connections eliminate exposed external disc-to-stem connections such as screws or taper pins.



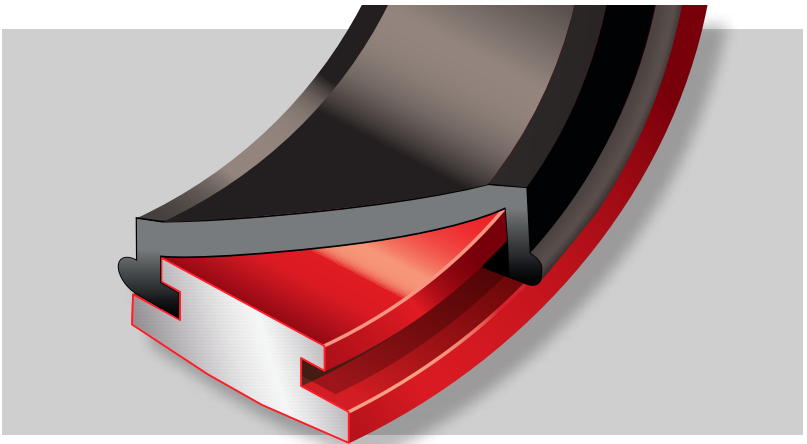
1. Double D: precision machined flats on the stem and in the disc.
Sizes 2"– 20" (50mm–500mm)

2. Spline: male splines in the stem and female in the disc.
Standard Sizes 22"– 48" (550mm–1200mm)
Selected Sizes 54"– 120" (1400mm–3000mm)

3. Double Keyed: keyways machined into disc matching keys in the stem
Selected Sizes 54"– 120" (1400mm–3000mm)

Disassembly of Bray's internal connection is performed by simply pulling the stem out of the disc. Bray's precision machining of the disc and the stem connection minimizes hysteresis and produces maximum strength engagements. All stem designs incorporate a blow-out proof feature.

B. SEAT DESIGN Bray's seat design provides complete isolation of flowing media from the body and stem by a totally encasing design. Designed to seal with slip-on or weld-neck flanges.



Tongue-and-groove

2 INTERNATIONAL COMPATIBILITY

Valve mounting top flanges meet ISO 5211 standards for direct mounting of manual operators and power actuators. All Bray valves have extended necks which allow for at least 2" piping insulation.



3 ACTUATOR MOUNTING

Due to a modular concept of design, all Bray actuators including Handles, Gear Operators, Pneumatic and Electric Actuators mount directly to Bray resilient seated valves. No brackets are required. This allows for simple installation in the field, minimizes possible misalignment and reduces overall height.

EXTERNAL COATING OPTIONS

1 POLYESTER BODY COATING

Bray's standard product offers valve bodies with a polyester coating, providing excellent corrosion and wear resistance to the valve's surface. The Bray polyester coating is a hard, gloss red finish.

Chemical Resistant

Resists a broad range of chemicals including dilute acids and alkalis, petroleum solvents, alcohols, greases and oils. Also offers outstanding resistance to humidity and water.

Weatherability

Resistant to ultra-violet radiation.

Abrasion Resistant

Excellent resistance to abrasion.

Impact Resistant

Withstands impact without chipping or cracking.

2 NYLON 11 COATING:

Nylon 11 also has superior corrosion resistance and has been used successfully in many applications such as water, cement, food and seawater.

Weatherability

Bray's Nylon 11 coating has been salt spray tested in excess of 2000 hours and used in seawater immersion service for over 25 years without any deterioration of the coating resulting in no corrosion to the coated metal components.

Abrasion Resistant

Excellent resistance to abrasion.

Impact Resistant

Excellent - no chipping or cracking.

Other customer specified coating materials are available. Please consult your local Bray representative for your specific application.

3 SEACORR COATING:

FDA Epoxy pigmented with 316L Stainless Steel Flake available for corrosive environments as tested per ASTM B-117 salt spray test for 2000 hours.





SEAT MATERIALS

Seat Temperature Ranges

EPDM	-20°F (-29°C)	250°F (121°C)	FKM	0°F (-18°C)	400°F (204°C)
BUNA-N	0°F (-18°C)	212°F (100°C)	Polyurethane	-20°F (-29°C)	176°F (80°C)

EPDM (Peroxide Cured)

EPDM is the abbreviated name for Ethylene Propylene Diene Monomer. In general industry, one may see other abbreviations or trade names used in lieu of EPDM such as EPT, Nordel, ECD, or EPR. Typically these are the same materials as EPDM.

EPDM is a standard seat material offered in Bray resilient-seated butterfly valves. It is the most universal and economical of seat materials offered by Bray; that is, it may be used in a wider range of applications than BUNA-N. Of important significance also is the fact all EPDM seat materials sold by Bray are Food Grade. Bray's EPDM Food Grade seats are perfectly suitable for sanitary applications as well as standard industrial uses. EPDM is also available as a covering for Series 20 discs.

BUNA-N (Black & White)

BUNA-N is the commonly used name for Nitrile synthetic rubber. Nitrile is a copolymer of acrylonitrile and butadiene. BUNA-N is sometimes referred to as NBR, Nitrile, or Hycar. BUNA-N is an excellent general purpose seat material which is particularly suitable for hydrocarbon service. BUNA-N is a standard Bray seat material and is Food Grade; thus suitable for sanitary applications. Note, BUNA-N is also available as a covering for Series 20 disc stems.

FKM

FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (Fluoroelastomers) such as Viton® (DuPont). FKM has some outstanding characteristics such as improved acid, oil, and temperature resistance over standard seat materials.

POLYURETHANE

Urethane seats are primarily used for their ability to resist abrasive wear. Urethane can be used on a reasonably broad range of services. Urethane will withstand severe impact, recover its original shape after distortion and resist abrasion better than other elastomers such as EPDM and BUNA-N.

Seat material availability depends on valve size & series. Please consult your local Bray representative for your specific application.



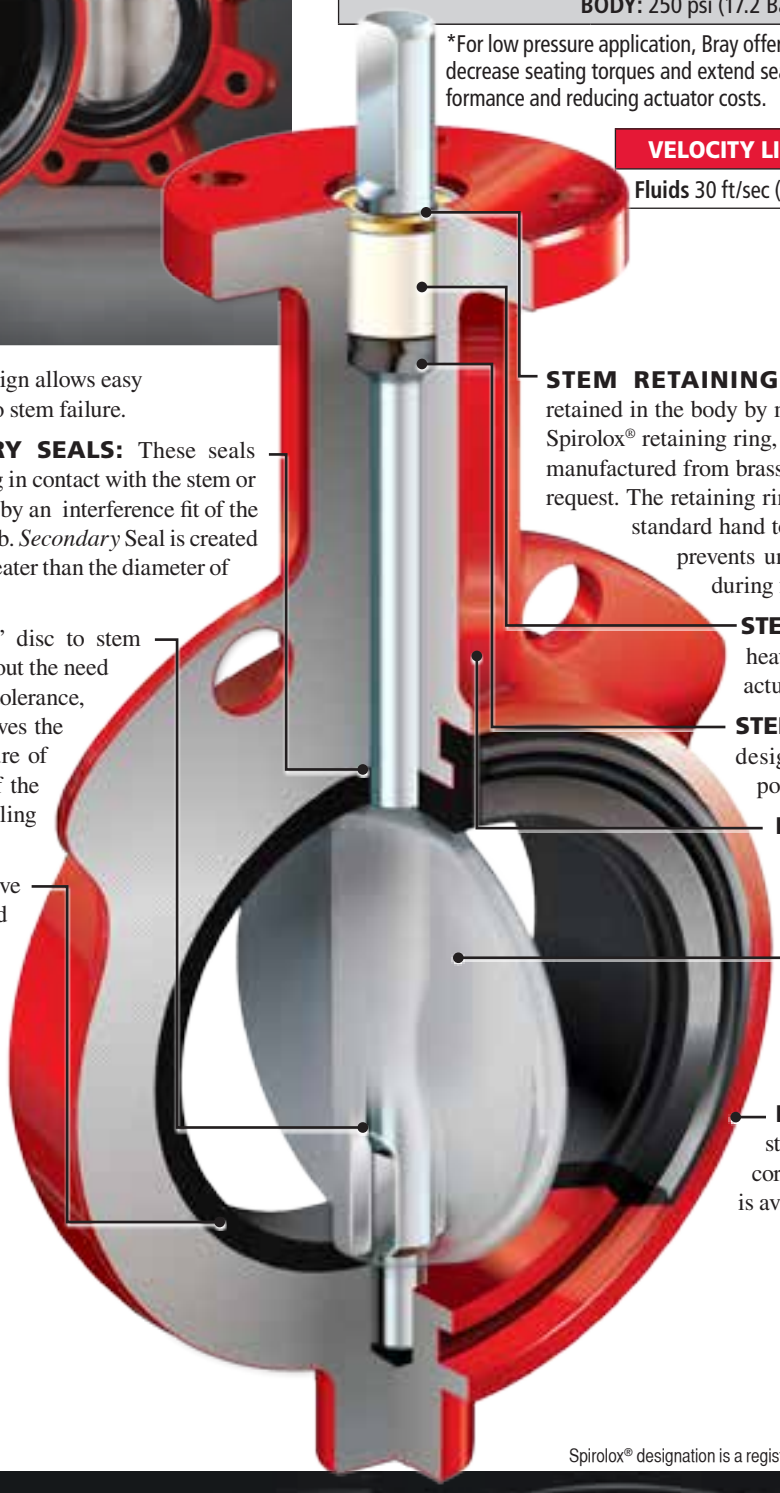


SERIES 30/31 2"-20" (50mm-500mm)

PRESSURE RATINGS		
BIDIRECTIONAL BUBBLE-TIGHT SHUT-OFF – Standard Disc* Downstream Flanges/Disc in Closed Position		
S30/31 Standard Disc*	2-12" (50-300mm)	175 psi (12 Bar)
	14-20" (350-500mm)	150 psi (10.3 Bar)
DEAD-END SERVICE – Lug Bodies/Standard Disc* No Downstream Flanges/Disc in Closed Position		
S31	2-12" (50-300mm)	75 psi (5.2 Bar)
	14-20" (350-500mm)	50 psi (3.4 Bar)
BODY: 250 psi (17.2 Bar) CWP		

*For low pressure application, Bray offers a standard reduced disc diameter to decrease seating torques and extend seat life, thus increasing the valve's performance and reducing actuator costs.

VELOCITY LIMITS For On/Off Services:	
Fluids 30 ft/sec (9 m/s)	**Gases** 175 ft/sec (54 m/s)



High strength through-stem design allows easy disassembly and reduced disc to stem failure.

PRIMARY & SECONDARY SEALS: These seals prevent line media from coming in contact with the stem or body. *Primary* Seal is achieved by an interference fit of the molded seat flat with the disc hub. *Secondary* Seal is created because the stem diameter is greater than the diameter of the seat stem hole.

STEM: Precision double "D" disc to stem connection drives the disc without the need for screws or pins. The close tolerance, double "D" connection that drives the valve disc is an exclusive feature of the Bray valve. Disassembly of the Bray stem is just a matter of pulling the stem out of the disc.

SEAT: Bray's tongue and groove seat design lowers torque and provides complete isolation of flowing media from the body. The seat also features a molded O-ring which eliminates the use of flange gaskets.

STEM RETAINING ASSEMBLY: The stem is retained in the body by means of a unique Stainless Steel Spirolox® retaining ring, a thrust washer and two C-rings, manufactured from brass as standard, stainless steel upon request. The retaining ring may be easily removed with a standard hand tool. The stem retaining assembly prevents unintentional removal of the stem during field service.

STEM BUSHING: Non-corrosive, heavy duty acetal bushing absorbs actuator side thrust.

STEM SEAL: Double "U" cup seal design is self-adjusting and gives positive sealing in both directions.

NECK: Extended neck length allows for 2" of piping insulation and is easily accessible for mounting actuators.

DISC: Casting is spherically machined and hand polished to provide a bubble-tight shut off, minimum torque, and longer seat life.

BODY: One-piece wafer or lug style. Polyester coating for excellent corrosion resistance. Nylon 11 coating is available as an option.

Spirolox® designation is a registered trademark of Kaydon Ring and Seal, Inc.



SERIES 31H

2"-20" (50mm-500mm)

Series 31H Lug valves are drilled and tapped to meet ASME Class 125/150 and PN16 flanges. Series 31H Valves will not be automated.

PRESSURE RATINGS	
BIDIRECTIONAL BUBBLE-TIGHT SHUT OFF & DEAD-END SERVICE	
2-20" (50-500mm)	250 psi (17.2 Bar)
BODY: 250 psi (17.2 Bar) CWP	

VELOCITY LIMITS For On/Off Services:	
Fluids 30 ft/sec (9 m/s)	**Gases** 175 ft/sec (54 m/s)

STANDARD MATERIALS SELECTION 31H	
Body	Cast Iron Ductile Iron
Disc	Aluminum Bronze Nylon 11 Coated Ductile Iron 316 Stainless Steel
Stem	416 Stainless Steel
Seat	Bonded EPDM Bonded BUNA-N

Material availability depends on valve size & series. Other materials are available. Please consult your local Bray representative for your specific application.

STANDARD MATERIALS SELECTION S30/31

NAME	MATERIAL
Body	Cast Iron
	Ductile Iron
	Carbon Steel
	Aluminum
Disc	Aluminum Bronze
	Coated Ductile Iron
	Nylon 11 Coated Ductile Iron
	Halar® Coated Ductile Iron
	304 Stainless Steel
	316 Stainless Steel
	Duplex Stainless Steel
	Super Duplex Stainless Steel
	Hastelloy®
Stem	416 Stainless Steel
	304 Stainless Steel
	316 Stainless Steel
	Monel K500
Seat	BUNA-N – Food Grade
	EPDM – Food Grade
	FKM*
	White BUNA-N – Food Grade
	Bonded EPDM
	Bonded BUNA-N



Material availability depends on valve size & series. Other materials are available. Please consult your local Bray representative for your specific application.

*FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (also called Fluoroelastomers).
Hastelloy® is a registered trademark of Haynes International, Inc.
Halar® is a registered trademark of Ausimont U.S.A., Inc.





SERIES 70 *ELECTRIC*

Torque	300 to 18,000 lb-ins (34-2030 Nm)
Voltage	VAC: 24, 120, 220 VDC: 12, 24
Standard Enclosure	NEMA 4, 4X
Explosion Proof:	NEMA 4, 4X, 7 and 9

The Series 70 is a low profile, compact and powerful actuator with customer-friendly features.

- Manual declutchable handwheel
- Local high visibility position indicator
- Digital interface available
- Optional microprocessor based modulating control



SERIES 73 *ELECTRIC*

Torque	100 to 600 lb-ins (11-70 Nm)
Voltage	VAC: 120, 220 VDC: 12, 24
Standard Enclosure	NEMA 4, 4X, IP65

The Series 73 is a low cost electric actuator for rotary valves.

- Powered by permanent split-capacitor, reversible induction motor
- All AC motors provided with an internal motor brake
- Heavy duty spur gear system
- Heater available to prevent damage to components due to condensation
- LED position indication



SERIES 92/93 *PNEUMATIC*

Bray pneumatic actuators are rack and pinion, opposed-piston actuators available in two versions: double acting and spring return.

- Maximum pressure rating of 140 psi (9.7 bar) and a temperature range of -20°F (-29°C) to +200°F (+95°C)
- Two independently adjustable travel stop screws and a cam on the output shaft to permit precise bidirectional adjustment of movement in both the open and closed positions for quarter turn valves (+5° to -5° limit adjustment)
- Integral porting
- Standard units have anodized aluminum bodies with polyester coated end caps.
- Special coatings and materials available for corrosive environments
- NAMUR accessory compatible



SS ACTUATOR



TRAVEL STOP



SPRING RETURN

ACTUATORS & ACCESSORIES



SERIES 50 - Valve Status Monitors

- 10 amps at 125 or 250 volts AC
- Internal travel switches that are prewired to a terminal block



SERIES 52 - Valve Status Monitors

- ProxSensor provides proximity sensors in one fully sealed, compact enclosure.
- AC, DC, Intrinsically Safe and BUS Network versions are offered



SERIES 63 - 3 & 4 way solenoids

- Waterproof (NEMA 4,4X) and explosion proof (NEMA 7,9) housings are standard
- NPT and IP65 DIN connections are offered with both single and dual coils



SERIES 6A
Electro-Pneumatic Positioners

- Precise, microprocessor driven flow control and advanced communication
- For use with either double or single acting actuators



Serial Bus Communication

- Bray offers several products featuring serial bus communication.
- Multiple protocols available. Consult your local Bray representative.

Manual Operators



SERIES 1 - Handle & Notch Plate

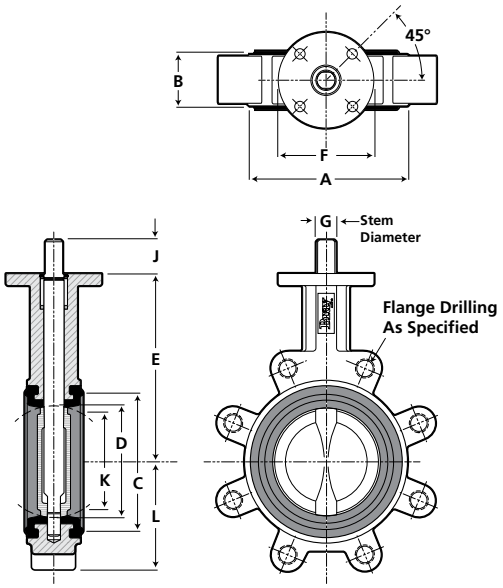


SERIES 4 - Gear Operator

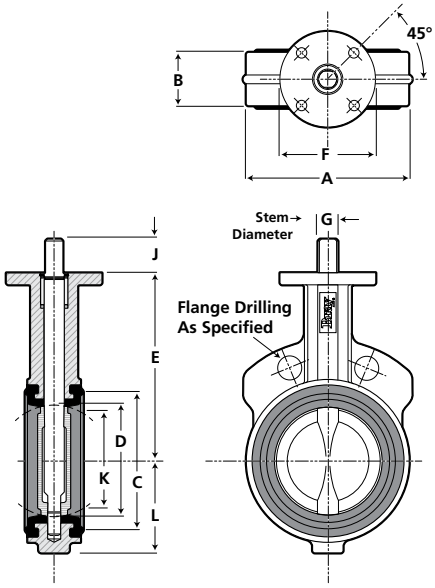


SERIES 5 - Declutchable Gear Operator

Series 31 Lug



Series 30 Wafer





IMPERIAL DIMENSIONS: Inches																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	H	J	K	L		Adapter Code	Weight (lbs.)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
2	3.69	1.62	2.00	2.85	5.50	3.54	2.76	4	.39	.55	39	1.25	1.32	2.22	2.30	A	5.5	7.0	4.75	4	.62-11
2 1/2	4.19	1.75	2.50	3.36	6.00	3.54	2.76	4	.39	.55	.39	1.25	1.91	2.47	2.57	A	7.0	8.0	5.50	4	.62-11
3	4.88	1.75	3.00	4.15	6.25	3.54	2.76	4	.39	.55	.39	1.25	2.55	2.81	2.81	A	7.5	9.0	6.00	4	.62-11
4	6.06	2.00	4.00	5.16	7.00	3.54	2.76	4	.39	.63	.43	1.25	3.57	3.41	4.09	B	11.5	15.0	7.50	8	.62-11
5	7.06	2.12	5.00	6.16	7.50	3.54	2.76	4	.39	.75	.51	1.25	4.63	4.03	4.61	C	14.0	20.0	8.50	8	.75-10
6	8.12	2.12	5.75	7.02	8.00	3.54	2.76	4	.39	.75	.51	1.25	5.45	4.53	5.06	C	17.0	23.0	9.50	8	.75-10
8	10.50	2.50	7.75	9.47	9.50	5.91	4.92	4	.57	.87	.63	1.25	7.45	5.75	6.05	D	34.0	42.0	11.75	12	.75-10
10	12.75	2.50	9.75	11.47	10.72	5.91	4.92	4	.57	1.18	.87	2.00	9.53	7.12	7.69	E	49.0	66.0	14.25	12	.88-9
12	14.88	3.00	11.75	13.47	12.25	5.91	4.92	4	.57	1.18	.87	2.00	11.47	8.12	9.02	E	67.0	88.0	17.00	12	.88-9

Note: K dimension is disc chordal dimension at valve face.

METRIC DIMENSIONS: Millimeters																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	H	J	K	L		Adapter Code	Weight (Kg)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
50	94	43	51	72	140	90	70	4	10	14	10	32	34	56	58	A	2.5	3	121	4	.62-11
65	106	46	64	85	152	90	70	4	10	14	10	32	49	63	65	A	3	3.5	140	4	.62-11
80	124	46	76	102	159	90	70	4	10	14	10	32	65	71	71	A	3.5	4	152	4	.62-11
100	154	52	102	131	178	90	70	4	10	16	11	32	91	87	104	B	5	7	191	8	.62-11
125	181	56	127	156	190	90	70	4	10	19	13	32	118	102	117	C	6	9	216	8	.75-10
150	206	56	146	178	203	90	70	4	10	19	13	32	138	115	129	C	8	10	241	8	.75-10
200	267	60	197	240	241	150	125	4	14	22	16	32	189	146	154	D	15	19	298	12	.75-10
250	324	68	248	291	273	150	125	4	14	30	22	51	242	181	195	E	22	30	362	12	.88-9
300	378	76	298	342	311	150	125	4	14	30	22	51	291	206	229	E	30	40	432	12	.88-9

Note: K dimension is disc chordal dimension at valve face.

Drawings are for reference only. Please refer to Bray ES drawings on the Bray website, www.bray.com. Bray reserves the right to change product dimensions without notice.

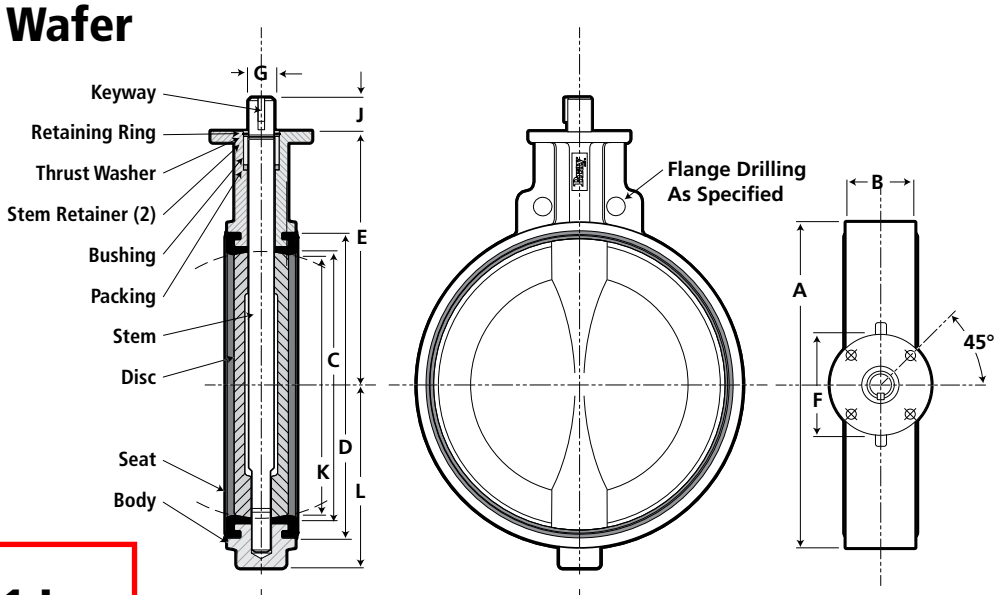
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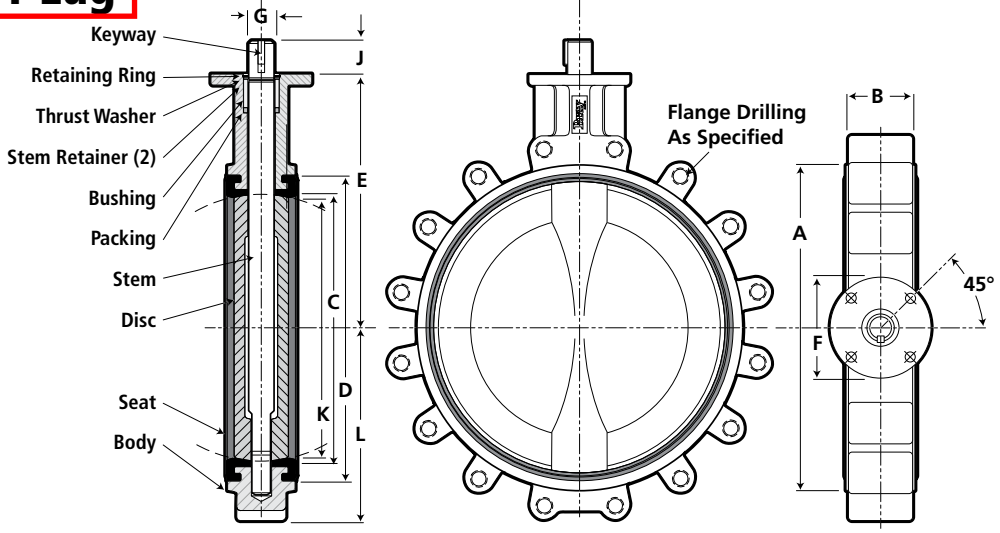
SR Drawing #30/31-2/12-im August 2012- Rev. 0

Customer/Project: _____

Series 30 Wafer



Series 31 Lug



IMPERIAL DIMENSIONS: Inches																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	J	Key Size	K	L		Adapter Code	Weight (lbs.)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
14	17.05	3.00	13.25	15.28	13.62	5.91	4.92	4	.57	1.38	2.00	.39x.39	13.04	9.38	9.93	F	95	114	18.75	12	1.00-8
16	19.21	4.00	15.25	17.14	14.75	5.91	4.92	4	.57	1.38	2.00	.39x.39	14.85	10.75	11.30	F	135	166	21.25	16	1.00-8
18	21.12	4.25	17.25	19.47	16.00	8.27	6.50	4	.81	1.97	2.50	.47x.39	16.85	12.00	12.15	G	200	226	22.75	16	1.12-7
20	23.25	5.00	19.25	21.59	17.25	8.27	6.50	4	.81	1.97	2.50	.47x.39	18.73	14.00	14.00	G	260	305	25.00	20	1.12-7

Note: K dimension is disc chordal dimension at valve face.

METRIC DIMENSIONS: Millimeters																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	J	Key Size	K	L		Adapter Code	Weight (Kg)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
350	433	76	337	388	346	150	125	4	14	35	51	10x10	331	238	252	F	43	52	476	12	1.00-8
400	488	102	387	442	375	150	125	4	14	35	51	10x10	377	273	287	F	61	75	540	16	1.00-8
450	536	108	438	495	406	210	165	4	21	50	64	12x10	428	305	309	G	91	103	578	16	1.12-7
500	591	127	489	548	438	210	165	4	21	50	64	12x10	476	348	358	G	118	138	635	20	1.12-7

Note: K dimension is disc chordal dimension at valve face.

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SR Drawing #30/31-14/20-im August 2012- Rev. 0

Inquire/P.O. No.:_____

Customer/Project: _____

Bray Order No.: _____

RESILIENT SEATED

BUTTERFLY VALVES



Bray®

BRAY.COM

THE HIGH PERFORMANCE COMPANY

	Body Style	Size Range	Pressure Range	Page
Series 20	Wafer	1"-20" (25mm-500mm)	150 psi (10.3 bar)	**6**
Series 21	Lug	1"-20" (25mm-500mm)	150 psi (10.3 bar)	
Series 22	Wafer	2"-20" (50mm-500mm)	150 psi (10.3 bar)	**8**
Series 23	Lug	2"-20" (50mm-500mm)	150 psi (10.3 bar)	
	Double Flanged	24" (600mm)	150 psi (10.3 bar)	
Series 30	Wafer	2"-12" (50mm-300mm)	175 psi (12 bar)	**10**
		14"-20" (350mm-500mm)	150 psi (10.3 bar)	
Series 31	Lug	2"-12" (50mm-300mm)	175 psi (12 bar)	
		14"-20" (350mm-500mm)	150 psi (10.3 bar)	
Series 31H	Lug	2"-20" (50mm-500mm)	250 psi (17.2 bar)	**11**
Series 31U	Lug	2"-12" (50mm-300mm)	285 psi (20 bar)	**12**
Series 3A	Double Flanged	2"-12" (50mm-300mm)	175 psi (12 bar)	**14**
		14"-20" (350mm-500mm)	150 psi (10.3 bar)	
Series 3AH	Double Flanged	2"-20" (50mm-500mm)	250 psi (17.2 bar)	**15**
Series 32	Wafer	22"-36" (550mm-900mm)	75 psi (5.2 bar)	**18**
Series 33	Wafer	22"-36" (550mm-900mm)	150 psi (10.3 bar)	**18**
Series 35	Double Flanged	22"-120" (550mm-3000mm)	75 psi (5.2 bar)	**20**
Series 36	Double Flanged	22"-120" (550mm-3000mm)	150 psi (10.3 bar)	**20**
Series 35F	Double Flanged	32"-60" (800mm-1500mm)	75 psi (5.2 bar)	**21**
Series 36H	Double Flanged	22"-60" (550mm-1500mm)	232 psi (16 bar)	**21**
Actuators & Accessories				**22**

INTERNATIONAL COMPATIBILITY

Valve mounting top flanges meet ISO 5211 bolt circle standards for direct mounting of manual operators and power actuators. All Bray valves have extended necks which allow for at least 2" piping insulation.



ACTUATOR MOUNTING

All Bray actuators including handles, gear operators, pneumatic and electric actuators mount directly to Bray resilient seated valves. No brackets are required. This allows for simple installation in the field, minimizes possible misalignment and reduces overall height.

ISOLATION FROM LINE MEDIA

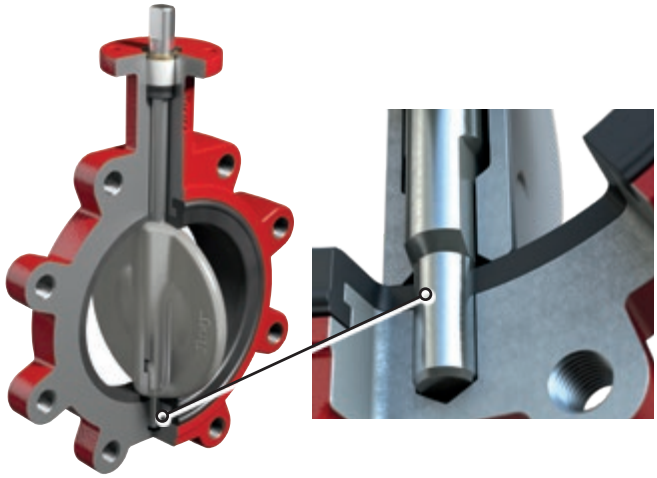
Bray's seat design and internal disc to stem connection isolates the line media from the body and stem.

INTERNAL DISC TO STEM CONNECTION

Series 30/31 Sizes 2"– 20" (50mm–500mm)

Bray offers Double "D" precision machined flats on the stem and in the disc. The Series 30/31 internal, non-wetted connections eliminate exposed external disc to stem connections.

The disc and the stem connection minimizes hysteresis and produces maximum strength engagements. All stem designs incorporate a blowout proof feature.



SEAT DESIGN

The seat is designed to seal with slip-on or weld-neck flanges and the molded o-ring eliminates the need for flange gaskets. The tongue and groove locks the seat in place and makes the valve dead end capable.



Tongue and Groove

POLYESTER COATING



The Bray standard polyester body coating is a hard, gloss red finish. The polyester coating provides excellent corrosion and wear resistance.

Chemical Resistant

Resistant to dilute acids and alkalies, petroleum solvents, alcohols, greases and oils.

Weatherability

Resistant to humidity, water and ultraviolet radiation.

Abrasion and Impact Resistant

NYLON 11 COATING

Nylon 11 has superior corrosion resistance and has been used successfully as a disc coating in many applications

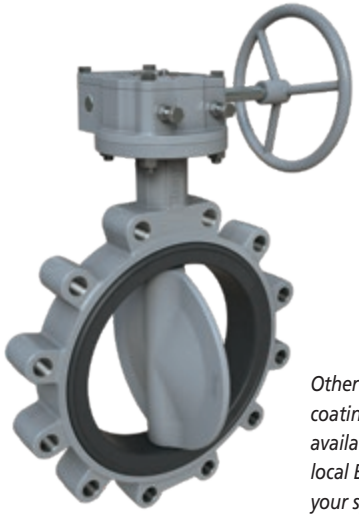
Weatherability

Bray's Nylon 11 coating has been salt spray tested in excess of 2000 hours and used in seawater immersion service for over 30 years without any deterioration of the coating resulting in no corrosion to the coated metal components.

Abrasion and Impact Resistant

SEACORR® COATING

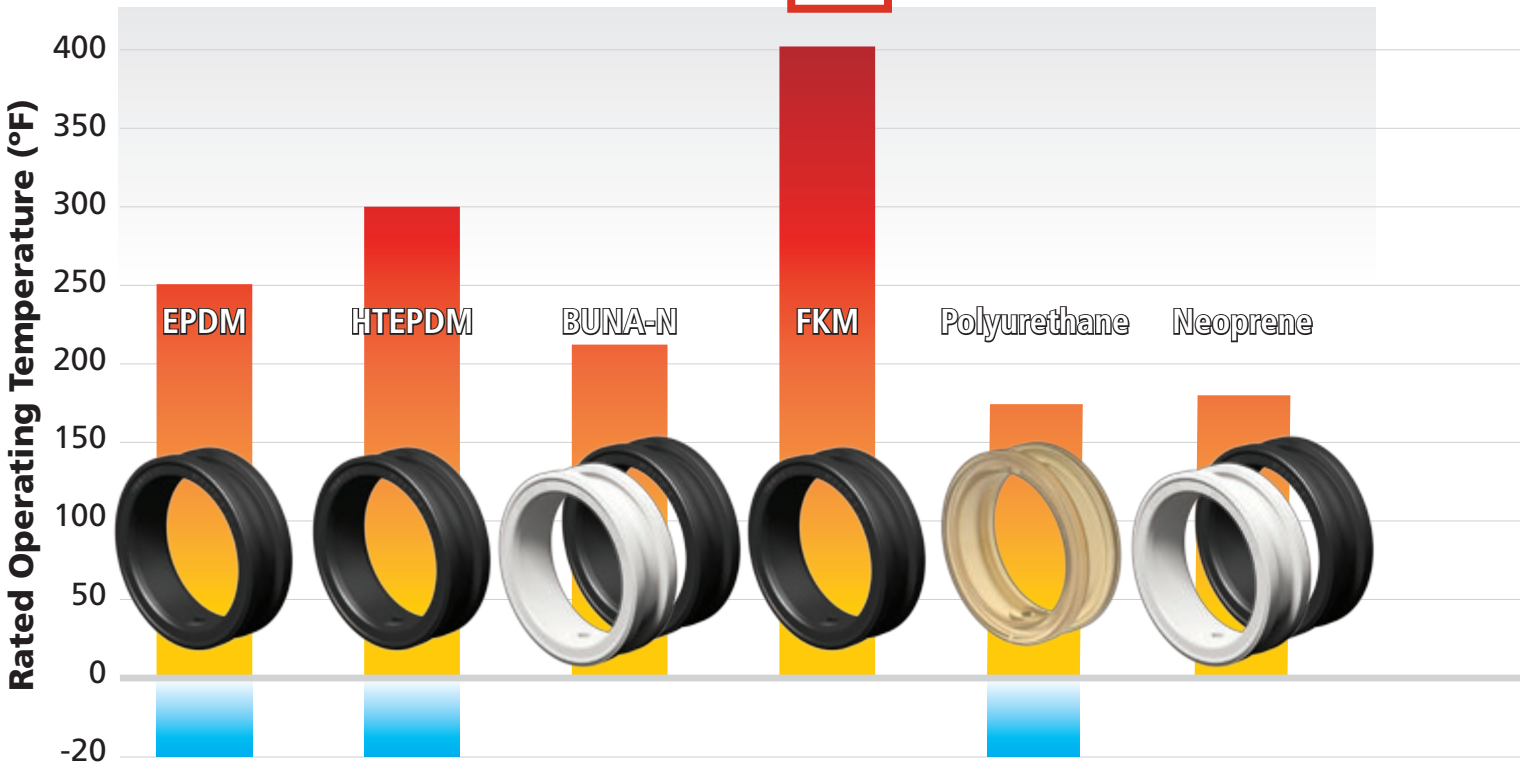
SEACORR coating provides superior protection in corrosive environments. Available as an exterior coating of valves, manual and automated actuators for harsh applications.



Other customer specified coating materials are available. Please consult your local Bray representative for your specific application.

All Bray valves are pressure tested to 110% of rated pressure to assure bubble tight shutoff.

Series 20, 21, 3A, 30, 31, 32, 33, 35, 36



PEROXIDE CURED EPDM

-20°F to 250°F (-29°C to 121°C)

Bray's peroxide cured EPDM (Ethylene Propylene Diene Monomer) seats have a higher resistance to abrasion, lower compression set, and higher temperature capabilities than sulfur cured seats.

As a standard seat offering, Bray's peroxide cured EPDM is the most universal and economical seat material used in our resilient seated butterfly valves. All of Bray's peroxide cured EPDM seats are food grade and can be certified to NSF-61.

HTEPDM

-20°F to 300°F (-29°C to 150°C)

HTEPDM is a proprietary rubber blend offered by Bray to increase the thermal resistance properties of standard EPDM and is formulated to provide long term service at elevated temperatures for hot water. HTEPDM Food Grade seats are suitable for sanitary applications as well as standard industrial uses.

BUNA-N (Black or White)

0°F to 212°F (-18°C to 100°C)

BUNA-N is the commonly used name for Nitrile synthetic rubber. Nitrile is a copolymer of acrylonitrile and butadiene. BUNA-N is sometimes referred to as NBR, Nitrile, or Hycar. BUNA-N is a general purpose seat material particularly suitable for hydrocarbon service. BUNA-N is a standard Bray seat material and food grade is available for sanitary applications.

FKM

0°F to 400°F (-18°C to 204°C)

FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (Fluoroelastomers) such as Viton® (DuPont). FKM has some outstanding characteristics such as improved acid, oil, and temperature resistance over other seat materials.

POLYURETHANE

-20°F to 175°F (-29°C to 80°C)

Polyurethane seats are primarily used because of their resistance to abrasive wear. Polyurethane can be used in a reasonably broad range of services and will withstand severe impact, recover its original shape after distortion and resist abrasion better than other elastomers.

NEOPRENE SEAT (Black or White)

0°F to 180°F (-18°C to 82°C)

Neoprene is an all-purpose polymer with desirable characteristics including high resiliency with low compression, resistance to vegetable and animal oil, and flame resistance. This sealing material is excellent for refrigerants, ammonia and Freon, and is principally used in pulp and (non-bleached) paper lines. Neoprene is not recommended for strong oxidizing acids, chlorinated solvents, esters, ketones, aromatic hydrocarbons or hydraulic fluids. White neoprene is generally used in sanitary applications while the black grade provides better abrasion and oil resistance.

The Bray Series 30/31 features a high strength one piece stem design utilizing an efficient internal disc to stem connection. This resilient seated butterfly valve provides a primary and secondary seal between the disc and seat as well as the stem and seat which ensures the total encapsulation of the line media and zero external leakage.

PRESSURE RATINGS

BIDIRECTIONAL BUBBLE TIGHT SHUT OFF – Standard Disc* Downstream flanges and disc in closed position		
Series 30/31 Standard Disc*	2"-12" (50-300mm)	175 psi (12 bar)
	14"-20" (350-500mm)	150 psi (10.3 bar)
DEAD END SERVICE – Lug Bodies and Standard Disc* No downstream flanges and disc in closed position		
Series 31	2"-12" (50-300mm)	75 psi (5.2 bar)
	14"-20" (350-500mm)	50 psi (3.4 bar)
BODY: 250 psi (17.2 bar)		

*For low pressure (50 psi) applications, Bray offers a standard reduced disc diameter to decrease seating torques and extend seat life, thus increasing the valve's performance and reducing actuator costs.

VELOCITY LIMITS FOR ON/OFF SERVICES

FLUIDS: 30 ft/sec (9 m/s)	**GASES:** 175 ft/sec (54 m/s)



1 – **STEM RETAINING ASSEMBLY:** The stem is retained in the body by means of a unique stainless steel Spirolox® retaining ring, a thrust washer and two C-rings, manufactured from brass as standard, stainless steel upon request.

2 – **STEM BUSHING:** Non-corrosive, heavy duty acetal bushing absorbs actuator side thrust.

3 – **STEM SEAL:** Double "U" cup seal design is self-adjusting and gives positive sealing in both directions.

4 – **PRIMARY AND SECONDARY SEALS:** These seals prevent line media from coming in contact with the stem or body. The primary seal is an interference fit of the molded seat flat with the disc hub. The secondary seal is created because the stem diameter is greater than the diameter of the seat stem hole.

5 – **BODY:** One piece wafer or lug style. Polyester coating for excellent corrosion resistance. Nylon 11 coating is available as an option.

6 – **SEAT:** Bray's tongue and groove seat design provides complete isolation of flowing media from the body. The seat also features a molded o-ring which eliminates the use of flange gaskets.

7 – **DISC:** Casting is spherically machined and hand polished to provide a bubble tight shutoff, minimum torque, and longer seat life. Bray's resilient Nylon 11 coating comes as standard.

8 – **STEM:** Precision double "D" disc to stem connection drives the disc without the need for screws or pins. The close tolerance, double "D" connection that drives the valve disc is an exclusive feature of the Bray valve. Disassembly of the Bray stem is just a matter of pulling the stem out of the disc.



MATERIAL SELECTION OPTIONS

BODY	DISC	STEM	SEAT
Cast Iron✦	Nylon 11 Coated Ductile Iron✦	416 Stainless Steel✦	BUNA-N Food Grade✦
Ductile Iron✦	316 Stainless Steel✦	304 Stainless Steel	EPDM Food Grade✦
Carbon Steel	Nickel Aluminum Bronze	316 Stainless Steel	FKM*
Aluminum	Coated Ductile Iron	Monel® K500	White BUNA-N Food Grade
	Halar® Coated Ductile Iron		Bonded EPDM
	304 Stainless Steel		Bonded BUNA-N
	Duplex Stainless Steel		
	Super Duplex Stainless Steel		
	Hastelloy®		

✦Standard Option

*FKM is the ASTM D1418 designation for fluorinated hydrocarbon elastomers (also called fluoroelastomers).

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Halar® is a registered trademark of Solvay Solexis, Inc.

Hastelloy® is a registered trademark of Haynes International, Inc.



SERIES 31H

2"-20" (50mm-500mm)

Series 31H Lug valves are drilled and tapped to meet ASME Class [illegible]/150 and PN16 flanges. Series 31H valves are designed for manual operation only.

PRESSURE RATINGS

BIDIRECTIONAL BUBBLE [illegible] SHUT-OFF AND DEAD END SERVICE	
2"-20" (50-500mm)	250 psi (17.2 bar)
BODY: [illegible] psi (17.2 bar)	

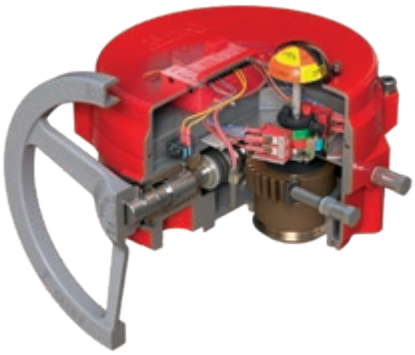
VELOCITY LIMITS FOR ON/OFF SERVICES

FLUIDS: 30 ft/sec (9 m/s)	**GASES:** 175 ft/sec (54 m/s)

STANDARD MATERIAL SELECTIONS

Body	Cast Iron Ductile Iron
Disc	Nickel Aluminum Bronze Nylon 11 Coated Ductile Iron 316 Stainless Steel
Stem	416 [illegible]inless Steel
Seat	Bonded EPDM Bonded BUNA-N

Material availability depends on valve size and series. Other materials are available. Please consult your local Bray representative for your specific application.



SERIES 70 ELECTRIC ACTUATOR

Low profile, compact, high output actuator for quarter turn applications

- On/Off or modulating (Servo NXT)
- Manual declutchable handwheel
- Optional Seacorr® coating for harsh environments
- High visibility dome position indicator
- Network protocols available

Voltages	120, 220, 24VAC 50/60 Hz, 1-phase, 24VDC
Output Torque	300 to 18,000 lb-ins (34 to 2,034 Nm)
Standard Enclosure	NEMA Type 4, 4X
Explosion Proof (Optional)	NEMA Type 4, 4X, 7, 9 Class I, Div 1 & 2, Group C, D Class II, Div 1 & 2, Group E, F, and G





Extreme High Temperature Actuator



Stainless Steel Actuator

SERIES 92/93 PNEUMATIC ACTUATOR

Rack and pinion actuators available in double acting and spring return

- Standard units have anodized aluminum bodies with polyester coated end caps
- SIL 3 capable
- Optional Seacorr® coating for harsh environments
- Integral porting
- Internal bidirectional travel stops

Torque	Double Acting up to: 44,130 lb-in (4,986 Nm) Spring End Torque up to: 14,173 lb-in (1,601 Nm)	
Pressure Range	40 - 140 psi (2.8 - 10 bar)	
Media	Dry Compressed Air/Inert Gas*	
Temperature Range	Standard	-4°F to 200°F (-20°C to 93°C)
	Low	-40°F to 176°F (-40°C to 80°C)
	High	0°F to 300°F (-18°C to 149°C)
	Extreme High Temperature	0°F to 482°F (-18°C to 250°C)



Pneumatic Actuator



Hydraulic Actuator



Self-Contained Electro-Hydraulic Actuator

SERIES 98 SCOTCH YOKE ACTUATORS

For quarter turn rotary operation

- Low Pressure Pneumatic Actuator
- High Pressure Hydraulic Actuator
- Optional Self-Contained Integral Hydraulic Power Pack or Centralized Hydraulic Power Unit to power multiple hydraulic actuators.
- Compact design with a high torque to weight ratio
- Modular design offers easy configuration in the field
- Premium epoxy/polyurethane coating as standard
- SIL 3 capable
- Pressure Equipment Directive (PED) 97/23/EC compliant
- Standardized interfaces: ISO 5211, VDI/VDE 3845 for accessories

Optional

- Manual overrides
- Hydraulic dampener for fast acting operation, lockout/pst device
- Lockout/PST device

Torque	Double Acting: Pneumatic or Hydraulic up to: 885,000 lb-in (100,000 Nm)	
	Spring Return (Spring End): Pneumatic or Hydraulic up to 445,261 lb-in (50,306 Nm)	
Pressure Range	Pneumatic: 40 - 150 psi (2.8 - 10.3 bar) Hydraulic: 500 - 3000 psi (35 - 207 bar)	
Media	Pneumatic: Dry compressed air/inert gas Hydraulic: Hydraulic Fluid (Standard Trim) ISO VG 32/46, ISO-L-HV, flash point >157°C	
Temperature Range	Standard	-4°F to 200°F (-20°C to 93°C)
	High Temperature	Up to 300°F (149°C)
	Low Temperature	Down to -50°F (-46°C)



SERIES 6A ELECTRO-PNEUMATIC POSITIONER

> Precision digital control
> Zero bleed design
> Compatible with rotary or linear actuators for single and double acting applications
> Various housing options available
> Precise, microprocessor driven flow control and advanced communication
> Non-contacting position sensor technology
> Integral volume booster
> Connective and preventative maintenance self-diagnostic checks



SERIES 6P PNEUMATIC POSITIONER

> Pneumatic to pneumatic positioner for single and double acting actuators
> Rugged aluminum diecast housing for harsh environments
> Minimal setup time for zero and span adjustment
> Split range capabilities
> High visibility dome position indicator
> Optional 2 x SPDT mechanical switches



SERIES 5A, 5B AND 5C VALVE STATUS MONITORS

> Discrete status monitor for quarter turn rotary actuators
> NEMA 4, 4X and IP66 and IP67 ingress protection
> Intrinsically safe or explosion-proof options for hazardous locations
> High visibility dome position indicator
> Up to 6 SPDT switches or non-contacting proximity switches
> Switches pre-wired to internal terminal block
> Available in die-cast aluminum housing coated with 2-layers of polyester or fiberglass reinforced PBT housing for highly corrosive environments



SERIES 54 VALVE PROXIMITY SENSOR

> Dual proximity sensors for valve position
> NEMA 4, 4X and IP66, IP67, IP69K ingress protection available
> Available solenoid outputs
> 2 or 3 wire DC, AC/DC, intrinsically safe, and AS-i interface
> Pin connector or conduit versions available



SERIES 63 SOLENOID VALVES

> Weatherproof NEMA 4, 4X and explosion proof housings available
> Flying leads or DIN connectors, single or dual coil
> 5/2 or 3/2 operation
> NAMUR mounted
> High flow up to 1.4 Cv
> Intrinsically safe versions available
> Available voltages: 12, 24 VDC; 24, 110, 220 VAC

SINCE 1986, BRAY HAS PROVIDED FLOW CONTROL SOLUTIONS FOR A VARIETY OF INDUSTRIES AROUND THE WORLD.

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Bray International, Inc.
13333 Westland East Blvd.
Houston, Texas 77041
Tel: +1.281.894.5454

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SERIES 92/93

PNEUMATIC ACTUATORS

TECHNICAL SALES MANUAL



Bray®

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THE HIGH PERFORMANCE COMPANY

RESILIENT SEATED BUTTERFLY VALVES

TECHNICAL SALES MANUAL



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Torques

INTRODUCTION TO TORQUES

There are a number of torques which butterfly valves may experience such as:

- **T_{su} - Seating and Unseating Torque**
- **T_d - Dynamic Torque Resulting from fluid flow**
- **T_{bf} – Bearing Friction Torque**
- **T_{ss} – Stem Seal Friction Torque**
- **T_e – Eccentricity Torque resulting from disc offset from centerline of stem (either single, double or triple offset)**
- **T_h – Hydrostatic Torque**

Factors which influence the butterfly valve torque values shown above are:

- Type of Seat and Seat Material
- Interference of Seat I.D. and Disc O.D.
- Shaft Diameter
- Valve Diameter
- Bearing Coefficient of Friction
- Angle of Opening
- Shut-off Pressure
- Fluid Velocity
- Disc Shape and Configuration
- Piping System and Location/Orientation of Valve in Pipe Line
- System Head Characteristics
- Physical Size of Disc/Shaft Obstructing Flow
- Disc Edge Finish

With respect to Butterfly Valves, the two major conditions for determining total valve operating torque (T_T) exists as follows:

CASE I (Angle = 0° , Disc in Closed Position)

$$T_T = T_h + T_{bf} + T_{ss} + T_{su}$$

Analyzed

Total Torque for Case I using a symmetrical disc butterfly valve is the sum of hydrostatic torque, bearing friction torque, stem seal, friction torque, and seating/unseating torque.

A. Hydrostatic Torque (T_h)

We will ignore discussion of the hydrostatic torque values as they are generally insignificant compared to the seating/unseating, bearing friction and stem seal torque values (the safety factor applied to seating/unseating, stem seal friction and bearing friction torque values more than compensates for the hydrostatic torque which is usually less than 2% of these total torques).

B. Bearing Friction Torque (T_{bf})

Bearing friction torque occurs because pressure forces against the disc are transmitted to the stem. As the stem is forced against the bearing supports, bearing friction torque is created between the stem material and the support material as the stem is turned. Bearing friction torques are normally included in the seating/unseating torque values.

Bearing friction torques can be determined by using the following equation:

$$T_{bf} = .785\ C_f\ D_v^2\ (d/2)\ \Delta P$$

Where:

- T_{bf} = Bearing Friction Torque
- C_f = Coefficient of Friction (approximately .25 for non-corroded stem to cast iron body) (dimensionless).
- D_v = Valve Diameter (Inches)
- d = Diameter of Shaft (Inches)
- ΔP = Pressure Differential (psi)

C. Stem Seal Friction Torque (T_{ss})

For all practical purposes stem seal friction torque values are insignificant when compared to seating/unseating and bearing friction torques. Stem seal friction torques are normally included in the seating/unseating torque values.

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D. Seating/Unseating Torques (T_{su})

The seating/unseating torque value (T_{su}) is a function of the pressure differential, the seat material's coefficient of friction, the finished surface of the disc edge, the amount of interference between the seat I.D. and disc O.D. when flanged in piping, the seat thickness, and the type of service (media) for which the valve is being used. In determining the T_{su} values for Bray resilient seated butterfly valves, Bray has developed Seating/Unseating Torque Charts incorporating all bearing friction and stem seal friction torques for three classes of services for both the valves with standard discs (rated to full pressure) and for valves with reduced diameter discs (rated for 50 psi [3.5 bar]). The three service classes are:

Class A – Non-Corrosive, Lubricating Service

Class B – General Service

Class C – Severe Service

Please review the guidelines for each class in the technical manual when determining which Seating/Unseating Torque Class should be used. Most butterfly valves are used in Class II, General Service applications.

E. Total Torque (T_T)

The total torque values for Bray symmetrical disc valves for Case I applications are shown in the Seating/Unseating Torque Charts within this manual.

CASE II (Disc in Partial To Full Opening Position)

$$T_T = T_{bf} + T_{ss} + T_d$$

The total Torque for Case II using a symmetrical disc butterfly valve is the summation of bearing friction torque, stem seal friction torque and dynamic torque.

A. Bearing Friction Torque (T_{bf})

See Case I discussion. This torque value is normally included in the Dynamic Torque Value.

B. Stem Seal Friction Torque (T_{ss})

See Case I discussion. This torque value is normally included in the Dynamic torque value.

C. Dynamic Torque (T_d)

In a symmetrical disc design, dynamic torque occurs between the closed position, 0° and the full open position, 90°. With the disc in the partially open position, velocity of the fluid passing the leading disc edge is less than the velocity passing the trailing edge. This variance in velocity past the leading disc edge and trailing disc edge results in an unbalanced distribution of pressure forces on the upstream side of the face of the disc. The total pressure forces acting perpendicular to the disc face on the leading edge half of the disc are greater than the total pressure acting perpendicular on the trailing half of the disc. This uneven distribution of pressure on the disc face (exists on both sides of the disc) results in a torsional force which tries to turn the disc to the closed position **(Figure 1)**. This torsional closing force can become greater than the seating/unseating torque value depending on the valve angle of opening and differential pressure.

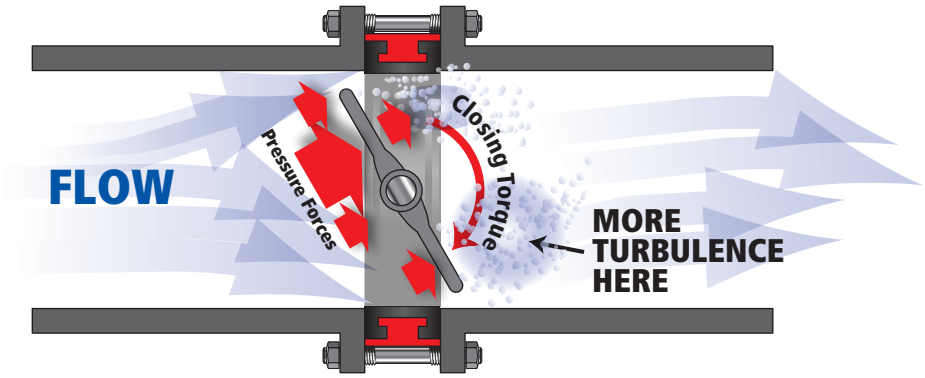
To determine dynamic torque, the following equation is applied:

$$T_d = C_{dt}\, d^3\, \Delta P$$

Where:

- T_d = Dynamic Torque (lbs- in).
- C_{dt} = Coefficient of Dynamic Torque (based on disc shape and angle of opening) (dimensionless)
- d = Diameter of Disc (Inches)
- ΔP = Pressure Differential Across Valve (psi)

Figure 1 - Pressure Distribution



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As shown in **Figure 2**, coefficient of dynamic torque for Bray's symmetrical disc valves is at 0° angle of opening and increases until the angle of opening reaches 75°-80°, where it then decreases to a zero value at full open (90°) (no internal friction factors considered, just dynamic torque only).

One final comment about dynamic torque is that one may minimize the dynamic torque by the orientation of the valve (stem horizontal or vertical) in the pipeline as well as by the location (distance) in the pipeline from elbows, other valves, etc. (See Bray Resilient Seated BFV Operations and Maintenance Manual).

D. Total Torque (T_T)

The total torque required for operating a Bray symmetrical disc butterfly valve at an angle opening between 0° and 90° is shown in the Dynamic Torque section of this manual. Note that the dynamic torque includes all internal friction torque values.

CONCLUSION

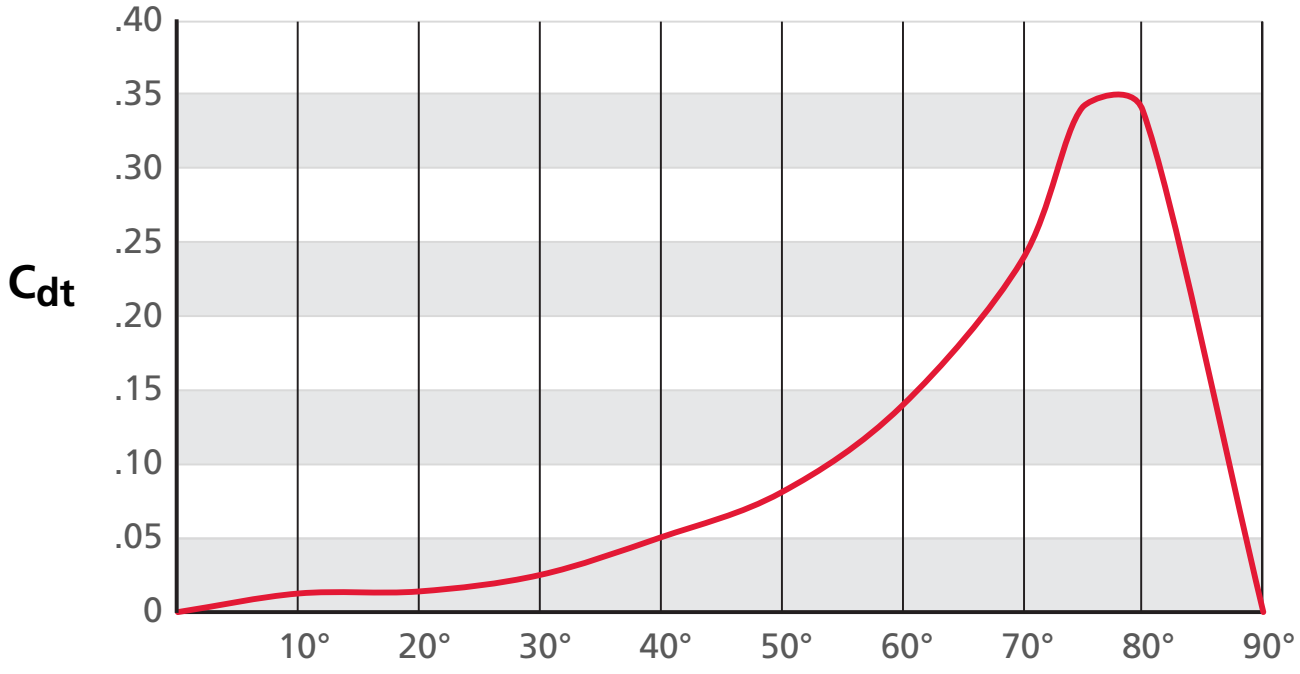
In most applications for butterfly valves, especially 20˝ (DN 500) or smaller, the maximum torque required to operate the valve will be seating/unseating torque. However, dynamic torque should be considered particularly in:

- Control applications using larger valves (24˝ [DN600] and above) where the disc is maintained in the open position
- Applications using larger valves (24˝ [DN 600] and above) where the velocity is high (16 ft./sec [4.9m/sec]).

Figure 2 - Angle of Opening

The C_{dt} value for Bray symmetrical disc valves are approximately:

Angle of Opening	0°	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
C_{dt}	0	0.0126	0.0140	0.0251	0.0505	0.0809	0.1394	0.2384	0.3419	0.3400	0



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REDUCED DISC DIAMETER BRAY SERIES 30/31/3A VALVES

Bray offers a reduced disc diameter for 4"-20" for Series 30, 31 and 3A valves. The purpose of reducing the disc diameter is to decrease the seating/unseating torques and extend the seat life on low pressure applications.

By reducing the disc diameter, the interference between the disc O.D. and seat I.D. is decreased and the valve pressure rating, which is a function of this interference, is reduced to 50 PSI. Less interference between the disc and seat results in reduced seating/unseating torques. Lower seating/unseating torque may allow for the use of a smaller actuator on the valve. In other applications where abrasive dry bulk materials such as cement, sugar, plastic, pellets, flour, etc., are generally pneumatically conveyed at 50 PSI or less, the reduced disc diameter not only reduces the seating/unseating torque but, very importantly, usually significantly increases the service life of the seat.

Bray does the following to differentiate reduced diameter discs from full diameter discs:

Metal Discs: An " R " is stamped above the part number

Nylon 11 Coated Discs: Discs are differentiated by the color of the Nylon 11:

Grey – Full Disc Diameter

White – Reduced Disc Diameter

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SEATING & UNSEATING TORQUES

Bray has developed Seating/Unseating Torque Charts for three Classes of Service for its valves with standard discs (rated for full pressure) and for valves with reduced diameter discs (rated for 50 PSI / 3.5 bar.).

The guidelines for selecting a Class to be used for determining a valve's seating/unseating torque are given below. Each valve application should comply with all five Class characteristics in order to be qualified for that Class.

Characteristics of Application	**Class A** Non-Corrosive, Lubricating Service	**Class B** General Service	**Class C** Severe Service
Media Type	Lubricating hydrocarbons; Aqueous processes and Water (See Note 1)	Water; aqueous processes; all other aqueous liquids including salt water; Lubricating gases	Dry, non-lubricating such as air, dry gas, cement, pneumatic conveying mediums
Corrosion by Media	Insignificant if any	No major corrosion or deposits from media	Can incur significant corrosion such as Ductile Iron disc in water
Chemical Reactions of Media with Seat	Insignificant if any	Only minor or insignificant in nature	Reactions causing swelling and hardness occur
Media Temperature	45º to 160ºF (7º to 71ºC)	Within seat temperature limits, not near limits	Near or at seat temperature limits
Frequency of Valve Cycling	Once weekly or more frequently	Minimum once every 3-6 weeks, or more frequently	Infrequently, sometimes not cycled for long periods

NOTE:

1. For aqueous processes and water, Class A torques may be used only if a Nylon 11 coated disc is selected and all other Class A characteristics apply. Otherwise, Class B torques should be used.
2. All the material trims may be classified into Class A, B, or C except Series 20/21 valves with a PTFE Lined Elastomer seat, PTFE molded disc/stem, or rubber molded disc/stem. These trims must always use Class C Seating/Unseating Torque Values unless they are used only in a throttling application. Valves with bonded seats must always be classified as Class C.
3. If a valve is used strictly in a throttling application, that is, it is never put in the closed position but throttled between 20° and 80°, then Class A torques may be used provided you have checked to see that dynamic torques do not exceed the Class A torque values.
4. With the exception of dry, non-lubricating medias, one is usually safe electing to use Class B torques for sizing actuators for all other valve service applications. Seating/Unseating Torque values shown include friction bearing torques for stated differential pressure.
5. Dynamic Torque values are not considered. See the Dynamic Torque chart in this manual for determination of Dynamic Torque.
6. Do not apply a safety factor to torque values when determining actuator output torque requirement.
7. **For 3-way assemblies where one valve is opening and another is closing, multiply torque by a 1.5 factor.**

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Series 20/21 and 30/31/3A Torques Imperial (Lb-Ins)

	Valve Size Inches	Valve Differential Pressure (PSIG)						
		Full Disc					Reduced Disc	
		0 psi	50 psi	100 psi	150 psi	175 psi	0 psi	50 psi
Class A Non-Corrosive, Lubricating Service	1	54	59	65	70	73	54	59
	1.5	81	86	91	97	100	81	86
	2	109	114	119	123	128	109	114
	2.5	169	178	187	196	200	169	178
	3	220	236	250	264	273	220	236
	4	341	364	387	410	423	225	248
	5	510	560	610	660	687	324	374
	6	632	712	792	872	912	344	488
	8	1,182	1,341	1,500	1,660	1,741	735	894
	10	1,764	2,018	2,272	2,526	2,653	1,204	1,358
	12	2,701	3,110	3,519	3,928	4,132	1,665	2,074
	14	3,818	4,500	5,182	5,864	—	2,318	3,000
	16	4,638	5,819	7,000	8,182	—	2,699	3,880
	18	5,265	7,065	8,865	10,665	—	2,970	4,788
	20	7,000	9,364	11,728	14,091	—	3,356	6,243
Class B General Service	1	59	65	71	77	80	59	65
	1.5	89	95	100	106	110	89	95
	2	120	125	130	135	140	120	125
	2.5	185	195	205	215	220	185	195
	3	245	260	275	290	297	245	260
	4	375	400	425	450	462	252	267
	5	560	615	670	725	755	355	410
	6	695	783	871	953	1,003	427	537
	8	1,300	1,475	1,650	1,825	1,915	808	983
	10	1,960	2,240	2,520	2,800	2,940	1,213	1,493
	12	2,970	3,420	3,870	4,320	4,545	1,830	2,280
	14	4,200	4,950	5,700	6,450	—	2,550	3,300
	16	5,100	6,400	7,700	9,000	—	2,967	4,267
	18	5,850	7,850	9,850	11,850	—	3,267	5,267
	20	7,700	10,300	12,900	15,500	—	4,267	6,867
Class C Severe Service	1	74	82	89	97	100	74	82
	1.5	111	119	125	133	137	111	119
	2	151	157	163	169	175	151	157
	2.5	231	244	257	269	275	231	244
	3	306	325	344	363	375	306	325
	4	468	500	532	563	582	316	348
	5	700	769	838	907	944	444	513
	6	870	980	1,090	1,200	1,255	525	672
	8	1,625	1,844	2,063	2,282	2,394	1,011	1,230
	10	2,450	2,800	3,150	3,500	3,675	1,517	1,867
	12	3,712	4,275	4,838	5,400	5,682	2,287	2,850
	14	5,251	6,188	7,125	8,063	—	3,189	4,126
	16	6,375	8,000	9,625	11,250	—	3,709	5,334
	18	7,315	9,815	12,315	14,815	—	4,084	6,584
	20	9,625	12,875	16,125	19,375	—	5,334	8,584

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Series 20/21 and 30/31/3A Torques Metric (Nm)

	Valve Size mm	Valve Differential Pressure (bar)						
		Full Disc					Reduced Disc	
		0 bar	3.4 bar	7 bar	10.3 bar	12 bar	0 bar	3.4 bar
Class A Non-Corrosive, Lubricating Service	25	6	7	7	8	8	6	7
	40	9	10	10	11	11	9	10
	50	12	13	13	14	14	12	13
	65	19	20	21	22	23	19	20
	80	25	27	28	30	31	25	27
	100	39	41	44	46	48	25	28
	125	58	63	69	75	78	37	42
	150	71	80	89	99	103	39	55
	200	134	152	169	188	197	83	101
	250	199	228	257	285	300	136	153
	300	305	351	398	444	467	188	234
	350	431	508	585	663	—	262	339
	400	524	657	791	924	—	305	438
	450	595	798	1,002	1,205	—	336	541
	500	791	1,058	1,325	1,592	—	379	705
Class B General Service	25	7	7	8	9	9	7	7
	40	10	11	11	12	12	10	11
	50	14	14	15	15	16	14	14
	65	21	22	23	24	25	21	22
	80	28	29	31	33	34	28	29
	100	42	45	48	51	52	28	30
	125	63	69	76	82	85	40	46
	150	79	88	98	108	113	48	61
	200	147	167	186	206	216	91	111
	250	221	253	285	316	332	137	169
	300	336	386	437	488	514	207	258
	350	475	559	644	729	—	288	373
	400	576	723	870	1,017	—	335	482
	450	661	887	1,113	1,339	—	369	595
	500	870	1,164	1,458	1,751	—	482	776
Class C Severe Service	25	8	9	10	11	11	8	9
	40	13	13	14	15	15	13	13
	50	17	18	18	19	20	17	18
	65	26	28	29	30	31	26	28
	80	35	37	39	41	42	35	37
	100	53	56	60	64	66	36	39
	125	79	87	95	102	107	50	58
	150	98	111	123	136	142	59	76
	200	184	208	233	258	270	114	139
	250	277	316	356	395	415	171	211
	300	419	483	547	610	642	258	322
	350	593	699	805	911	—	360	466
	400	720	904	1,087	1,271	—	419	603
	450	826	1,109	1,391	1,674	—	461	744
	500	1,087	1,455	1,822	2,189	—	603	970

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DYNAMIC TORQUE FACTORS (IMPERIAL)

To Use the Torque Chart, note the following:

1. Dynamic Torque values include all bearing friction and stem-seal friction torques.
2. Dynamic Torque values are per 1 PSI ΔP. To determine dynamic torque (lb-in) at a desired angle of opening, multiply the pressure drop ΔP at this angle by the appropriate dynamic torque factor in the charts below.
3. Bray recommends sizing control valves between 20° and 70°, with 60° the preferred angle.
4. Dynamic Torque will tend to close all Bray valves whose disc are symmetrical to the stem.

Series 20/21 and 30/31/3A (Dynamic Torque Factor - lb-in./psi)

Valve Size in.	Angle of Opening									
	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
2″	0.11	0.13	0.23	0.45	0.73	1.25	2.14	3.07	3.05	0.00
2.5″	0.22	0.24	0.43	0.87	1.39	2.39	4.09	5.86	5.83	0.00
3″	0.37	0.41	0.73	1.47	2.36	4.07	6.95	9.97	9.92	0.00
4″	0.86	0.95	1.70	3.43	5.49	9.45	16.17	23.19	23.07	0.00
5″	1.65	1.83	3.29	6.61	10.59	18.25	31.22	44.77	44.53	0.00
6″	2.49	2.77	4.97	10.00	16.01	27.59	47.19	67.68	67.32	0.00
8″	6.60	6.74	12.08	24.30	38.93	67.07	114.71	164.51	163.64	0.00
10″	11.99	13.32	23.89	48.06	76.99	132.65	226.86	325.35	323.64	0.00
12″	20.89	23.21	41.62	83.74	134.14	231.14	395.30	566.91	563.93	0.00
14″	30.04	33.38	59.84	120.40	192.87	332.34	568.37	815.12	810.83	0.00
16″	45.65	50.72	90.94	182.97	293.12	505.07	863.76	1238.76	1232.24	0.00
18″	65.91	73.23	131.30	264.16	423.18	729.18	1247.04	1788.44	1779.02	0.00
20″	91.42	101.57	182.11	366.39	586.95	1011.37	1729.64	2480.55	2467.50	0.00

Example: 4″ Valve; 60° Open with a 10 PSI pressure drop: [Td = (9.454)(10) = 94.54 lb-in]

Series 32/33, 35/36 (Dynamic Torque Factor - lb-in./psi)

Valve Size in.	Angle of Opening									
	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
24″	158.36	175.95	315.46	634.69	1016.76	1751.99	2996.23	4297.03	4274.40	0.00
30″	315.32	350.35	628.13	1263.77	2024.54	3488.51	5966.01	8556.12	8511.07	0.00
36″	551.88	613.21	1099.39	2211.92	3543.45	6105.77	10442.00	14975.33	14896.49	0.00
Larger Size Valves - Consult Factory										

Example: 24″ Valve; 60° Open with a 10 PSI pressure drop: [Td = (1,751.990)(10) = 17,519.90 lb-in]

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DYNAMIC TORQUE FACTORS (METRIC)

To Use the Torque Chart, note the following:

1. Dynamic Torque values include all bearing friction and stem-seal friction torques.
2. Dynamic Torque values are per 1 bar ΔP. To determine dynamic torque (Nm) at a desired angle of opening, multiply the pressure drop ΔP at this angle by the appropriate dynamic torque factor in the charts below.
3. Bray recommends sizing control valves between 20° and 70°, with 60° the preferred angle.
4. Dynamic Torque will tend to close all Bray valves whose disc are symmetrical to the stem.

Series 20/21 and 30/31/3A (Dynamic Torque Factor - Nm/bar)

Valve Size mm.	Angle of Opening									
	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
50	0.19	0.21	0.37	0.74	1.19	2.05	3.51	5.03	5.00	0.00
65	0.35	0.39	0.70	1.42	2.27	3.91	6.69	9.60	9.55	0.00
80	0.60	0.67	1.20	2.41	3.87	6.66	11.39	16.34	16.25	0.00
100	1.40	1.56	2.79	5.61	8.99	15.49	26.49	38.00	37.80	0.00
125	2.70	3.00	5.39	10.84	17.36	29.91	51.16	73.36	72.98	0.00
150	4.09	4.54	8.14	16.38	26.24	45.22	77.33	110.91	110.32	0.00
200	10.82	11.04	19.79	39.82	63.79	109.91	187.97	269.58	268.16	0.00
250	19.65	21.83	39.14	78.75	126.16	217.38	371.76	533.16	530.35	0.00
300	34.24	38.04	68.20	137.22	219.82	378.77	647.77	929.00	924.11	0.00
350	49.23	54.70	98.06	197.29	316.06	544.61	931.38	1335.74	1328.71	0.00
400	74.81	83.12	149.03	299.83	480.33	827.66	1415.46	2029.97	2019.28	0.00
450	108.01	120.01	215.15	432.88	693.46	1194.92	2043.53	2930.72	2915.29	0.00
500	149.80	166.45	298.42	600.40	961.83	1657.34	2834.37	4064.89	4043.50	0.00

Example: 100 mm Valve; 60° Open with a .75 bar pressure drop: [Td = (15.49)(.75) = 11.62 Nm]

Series 32/33, 35/36 (Dynamic Torque Factor - Nm/bar)

Valve Size mm	Angle of Opening									
	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
600	259.50	288.34	516.94	1040.07	1666.17	2871.00	4909.94	7041.56	7004.49	0.00
750	516.71	574.13	1029.33	2070.95	3317.62	5716.65	9776.53	14020.96	13947.15	0.00
900	904.38	1004.86	1801.57	3624.68	5806.67	10005.56	17111.37	24540.17	24410.97	0.00
Larger Size Valves - Consult Factory										

Example: 600 mm Valve; 60° Open with a .75 bar pressure drop: [Td = (2871)(.75) = 2153.25 Nm]

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VALVE SIZING COEFFICIENTS

1. **Valve Sizing Coefficients (Cv)**..... Pages 15-16

1. **Cv** stands for **Valve Sizing Coefficient**, sometimes called the **Flow Rate Coefficient**.
2. **Cv** varies with the valve size, angle of opening and the manufacturer's valve style.
3. **Cv** is defined as the volume of water in USGPM that will flow through a given restriction or valve opening with a pressure drop of one (1) psi at room temperature.

2. **Valve Sizing Coefficients (Kv)**..... Pages 17-18

1. **Kv** stands for **Valve Sizing Coefficient**, sometimes called the **Flow Rate Coefficient**.
2. **Kv** varies with the valve size, angle of opening and the manufacturer's valve style.
3. **Kv** is defined as the volume of water in Cubic Meters/Hour (m^3/hr) that will flow through a given restriction or valve opening with a pressure drop of one (1) bar at room temperature.

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Series 30/31/31H/3A/3AH/31U - Valve Sizing Coefficient (Cv)

Valve Size Inches	Disc Position (Degrees)								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
2	0.8	7	16	27	43	61	84	114	144
2.5	1	11	24	43	67	107	163	223	282
3	2	15	35	61	96	154	267	364	461
4	3	27	62	109	171	274	496	701	841
5	5	43	98	170	268	428	775	1,146	1,376
6	6	56	129	225	354	567	1,025	1,542	1,850
8	12	102	241	421	680	1,081	1,862	2,842	3,316
10	19	162	382	667	1,076	1,710	2,948	4,525	5,430
12	27	235	555	1,005	1,594	2,563	4,393	6,731	8,077
14	34	299	756	1,320	2,149	3,384	5,939	8,874	10,538
16	45	397	1,001	1,749	2,847	4,483	7,867	11,761	13,966
18	58	507	1,281	2,237	3,643	5,736	10,065	14,496	17,214
20	72	632	1,595	2,786	4,536	7,144	12,535	18,812	22,339

Series 32/33/35/36/35F/36H - Valve Sizing Coefficient (Cv)

Valve Size Inches	Disc Position (Degrees)								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
22	103	916	2,070	3,510	5,640	9,036	14,562	22,028	27,168
24	259	1,028	2,387	4,244	6,962	11,040	18,235	27,186	33,154
26	289	1,141	2,752	4,890	7,824	12,496	19,921	29,700	36,220
28	295	1,324	3,133	5,399	8,636	13,838	22,578	34,683	41,619
30	420	1,652	3,986	7,080	11,328	18,090	28,844	43,003	52,443
32	550	2,026	4,636	7,983	12,743	20,410	32,591	48,558	60,658
34	533	2,304	5,210	8,834	14,179	22,741	36,648	55,438	68,374
36	740	2,775	5,936	9,790	15,572	25,053	40,086	59,667	77,089
40	757	2,971	6,925	11,862	19,307	30,636	50,406	73,990	90,175
42	783	3,502	7,879	12,997	21,010	35,016	54,584	83,421	102,989
44	904	4,066	8,698	14,346	22,818	36,712	58,740	87,430	112,960
48	1,023	4,651	10,365	17,010	27,242	43,853	70,431	108,968	132,888
52	Consult Factory								
54	1,299	5,904	13,158	21,594	34,583	55,671	89,411	138,334	168,700
60	1,480	6,400	14,500	24,500	39,400	63,200	102,000	154,000	190,000
66	1,650	7,110	16,100	27,300	43,800	70,200	113,000	171,000	211,000
72	1,900	8,220	18,600	31,500	50,700	81,200	131,000	198,000	244,000
78	2,290	9,910	22,400	38,000	61,000	97,800	158,000	238,000	294,000
84	2,290	11,390	25,800	43,700	70,200	112,400	181,000	274,000	338,000
90	Consult Factory								
96	Consult Factory								

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Series 30/31/31H/3A/3AH/31U - Valve Sizing Coefficient (Kv)

Valve Size mm	Disc Position (Degrees)								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
50	0.692	6.055	13.840	23.355	37.195	52.765	72.660	98.610	124.560
65	0.865	9.515	20.760	37.195	57.955	92.555	140.995	192.895	243.930
80	1.730	12.975	30.275	52.765	83.040	133.210	230.955	314.860	398.765
100	2.595	23.355	53.630	94.285	147.915	237.010	429.040	606.365	727.465
125	4.325	37.195	84.770	147.050	231.820	370.220	670.375	991.290	1,190.240
150	5.190	48.440	111.585	194.625	306.210	490.455	886.625	1,333.830	1,600.250
200	10.380	88.230	208.465	364.165	588.200	935.065	1,610.630	2,458.330	2,868.340
250	16.435	140.130	330.430	576.955	930.740	1,479.150	2,550.020	3,914.125	4,696.950
300	23.355	203.275	480.075	869.325	1,378.810	2,216.995	3,799.945	5,822.315	6,986.605
350	29.410	258.635	653.940	1,141.800	1,858.885	2,927.160	5,137.235	7,676.010	9,115.370
400	38.925	343.405	865.865	1,512.885	2,462.655	3,877.795	6,804.955	10,173.265	12,080.590
450	50.170	438.555	1,108.065	1,935.005	3,151.195	4,961.640	8,706.225	12,539.040	14,890.110
500	62.280	546.680	1,379.675	2,409.890	3,923.640	6,179.560	10,842.775	16,272.380	19,323.235

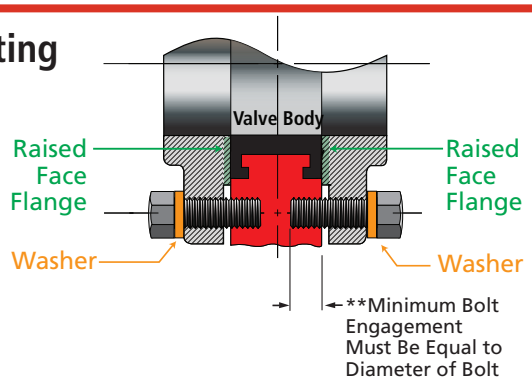
Series 32/33/35/36/35F/36H - Valve Sizing Coefficient (Kv)

Valve Size mm	Disc Position (Degrees)								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
550	89.095	792.340	1,790.550	3,036.150	4,878.600	7,816.140	12,596.130	19,054.220	23,500.320
600	224.035	889.220	2,064.755	3,671.060	6,022.130	9,549.600	15,773.275	23,515.890	28,678.210
650	249.985	986.965	2,380.480	4,229.850	6,767.760	10,809.040	17,231.665	25,690.500	31,330.300
700	255.175	1,145.260	2,710.045	4,670.135	7,470.140	11,969.870	19,529.970	30,000.795	36,000.435
750	363.300	1,428.980	3,447.890	6,124.200	9,798.720	15,647.850	24,950.060	37,197.595	45,363.195
800	475.750	1,752.490	4,010.140	6,905.295	11,022.695	17,654.650	28,191.215	42,002.670	52,469.170
850	461.045	1,992.960	4,506.650	7,641.410	12,264.835	19,670.965	31,700.520	47,953.870	59,143.510
900	640.100	2,400.375	5,134.640	8,468.350	13,469.780	21,670.845	34,674.390	51,611.955	66,681.985
1,000	654.805	2,569.915	5,990.125	10,260.630	16,700.555	26,500.140	43,601.190	64,001.350	78,001.375
1,050	677.295	3,029.230	6,815.335	11,242.405	18,173.650	30,288.840	47,215.160	72,159.165	89,085.485
1,100	781.960	3,517.090	7,523.770	12,409.290	19,737.570	31,755.880	50,810.100	75,626.950	97,710.400
1,200	884.895	4,023.115	8,965.725	14,713.650	23,564.330	37,932.845	60,922.815	94,257.320	114,948.120
1,300	Consult Factory								
1,400	1,123.635	5,106.960	11,381.670	18,678.810	29,914.295	48,155.415	77,340.515	119,658.910	145,925.500
1,500	1,280.200	5,536.000	12,542.500	21,192.500	34,081.000	54,668.000	88,230.000	133,210.000	164,350.000
1,650	1,427.250	6,150.150	13,926.500	23,614.500	37,887.000	60,723.000	97,745.000	147,915.000	182,515.000
1,800	1,643.500	7,110.300	16,089.000	27,247.500	43,855.500	70,238.000	113,315.000	171,270.000	211,060.000
2,000	1,980.850	8,572.150	19,376.000	32,870.000	52,765.000	84,597.000	136,670.000	205,870.000	254,310.000
2,200	1,980.850	9,852.350	22,317.000	37,800.500	60,723.000	97,226.000	156,565.000	237,010.000	292,370.000
2,250	Consult Factory								
2,400	Consult Factory								

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EXAMPLES OF TYPICAL FLANGE TO VALVE BOLTING*

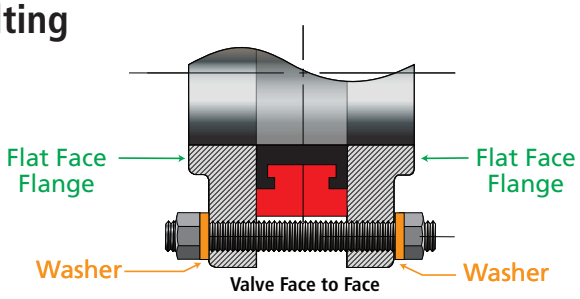
** Lug Style Bolting



Flange Width Including Raise Face If Applicable + Washer Width + Minimum Bolt Engagement Equal to Bolt Diameter = Bolt Length

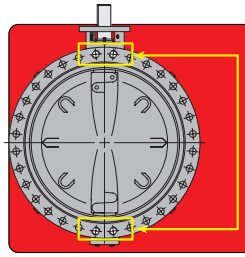


Wafer Style Bolting



Flange Width x2 Including Raise Face If Applicable + Valve Face to Face + Washer Width x2 + Width of Nut x2 + 4 Threads (2 Per Side) = Overall Length





**** Note: Please refer to Appropriate Bray Dimensional Drawings for specific valve drilling information on Wafer and Lug Valves 20" and larger.**

Please refer to ASME B-16.5 or B-16.47 for Flange and Bolt Dimension Information

* Double flange style bolting not shown.
** Lug threads may be tapped from both sides and therefore tap may not be continuous.

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FLANGE BOLT TENSIONING
Bray Butterfly Valves with Metal Mating Flanges

A question frequently asked at Bray is "What torque do I apply to the flange bolts to insure the valve is properly installed?". Initially this seems to be a simple request until all of the factors are analyzed. The installation of a valve requires several components: the valve, mating flanges, nuts, bolts and studs. Each is supplied by different manufacturers and each has different characteristics. The proper torque for one combination may be too much or too little for a second combination. The following is a list of information which needs to be known in order to start calculating the torque requirements.

Valve
- Type
- Size
- Materials of construction (Body)
- Surface finishes / Surface conditions

Flange
- Type
- Size
- Finish / both sides
- Condition of flange / surface contamination

Bolt (or Stud)
- Type
- Materials of Construction
- Surface Conditions

Nut
- Type
- Materials of Construction
- Surface Conditions

Lubrication
- Type
- Coverage

General Factors
- Temperature and relative humidity at the time of installation
- Speed at which bolts are turned

Note: The elastomer valve seat manufactured by Bray also acts as the flange gasket. No additional gaskets are required or recommended. Other valve styles which do not have integral gaskets will need to have this component supplied. The characteristics of this component will also need to be considered.

Complete knowledge of all relevant conditions is almost impossible to obtain. As a result, the computation of the exact torque requirement is not practical. No reputable manufacturer can provide accurate information when so many outside factors are present.

The International Fasteners Institute covers some of the details required to "compute" a torque value. Even with this information the use of a torque wrench is only considered to be 25% accurate. Based on the difficulty and inaccuracy of using this method, Bray recommends the use of the "Turn of the nut" method.

"Turn of the Nut" Tightening
(For ANSI Standard Iron and Steel Flanges)
**For Non-Metallic or non-standard flanges, follow the manufacturers installation procedures.

1. The valve and flange faces must be aligned parallel to each other.

   Note: For rubber seated butterfly valves manufactured by Bray, it is required that the valve be fully opened prior to the tightening of the flange bolts.

2. After aligning the holes in a joint, sufficient bolts shall be placed and brought to a 'snug-tight' condition to ensure that the parts of the joint are *brought into full contact* with each other. 'Snug-Tight' is the tightness attained by the full effort of a man using a spud wrench.

3. Following the initial snugging operation, bolts shall be placed in any remaining holes and brought to snug-tightness. Re-snugging may be necessary in large joints.

4. Tighten opposite bolts in sequence to insure even pressure around the entire flange.

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5. When all bolts are snug-tight, each bolt in the joint then shall be tightened additionally by the applicable amount of nut rotation given in Note 1. During tightening there shall be no rotation of the valve or flange.

Note 1

For bolt lengths **not exceeding** 8 diameters or 8 inches (203.2 mm) = **1/4 turn**
For bolt lengths **exceeding** 8 diameters or 8 inches (203.2 mm) = **1/2 turn**

Disclaimer:
Bray Controls is issuing these recommendations only as a guide to installation. This recommendation is based on the full compliance of all materials supplied to their appropriate specifications. Since many of the components are not manufactured by Bray we can take no responsibility for any damage caused during installation.

Series 20/21 and 30/31 - Flange Bolt Torque Chart

Valve Size		Normal Torque Range	Normal Torque Range
In	mm	Ft-lbs	Nm
2	50	30	40
2.5	65	30	40
3	80	35	50
4	100	35 - 40	50 - 55
5	125	35 - 45	50 - 60
6	150	35 - 50	50 - 65
8	200	45 - 55	60 - 75
10	250	55 - 75	75 - 100
12	300	65 - 110	90 - 150
14	350	75 - 120	100 - 165
16	400	75 - 120	100 - 165
18	450	85 - 130	115 - 175
20	500	85 - 130	115 - 175

Please note that the Nm and Ft-lbs values are based on bolt size in respective metric and ANSI flanges, i.e. these values are not a direct conversion between Nm and Ft-lbs.

The values represent average torques needed to ensure full compression of the resilient valves' seats into the valves' bodies when installed in pipeline flanges. The face of both flanges must come into full contact with the valves' metal bodies.

No additional torque is required for proper functioning of the Bray resilient seated valves.

The torque values are based on using new, coarse-threaded, lubricated fasteners. Up to 25% may be added to the Normal Torque Range values when using non-lubricated fasteners.

Torque Values specified by flange manufacturers ***must not be exceeded.***

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Series 30/31, 31H, 3A/3AH, 31U - Standard Metal Specifications

Part	Material	ASTM No.	UNS No.	30/31	31H	3A/3AH	31U
Body	Cast Iron	A126 Class B		●	●	●	
	Ductile Iron	A536 Gr. 65-45-12	F33100	●	●	●	
	Ductile Iron	A395	F32800				●
	Carbon Steel	A216 WCB	J030002	●		●	●
	Nickel Aluminum Bronze	B148	C95800				●
	Aluminum	B26 Class B		●			
Disc	Aluminum Bronze	B148	C95400	●	●	●	
	Nickel Aluminum Bronze	B148	C95800				●
	Nylon Coated Ductile Iron	A536 Gr. 65-45-12	F33100	●	●	●	
	316 Stainless Steel	A351 CF8M	J92900	●	●	●	●
	304 Stainless Steel	A351 CF8	J92600	●		●	
	Duplex Stainless Steel	A995 Gr 4A	J92205	●		●	
	Super Duplex Stainless Steel	A995 Gr 5A	J93404	●		●	
	Super Austenitic Stainless Steel (254 SMO™)*	A351 Grade CK3MCuN	S31254	●		●	
	Hastelloy® C-276 *	B575	N10276	●		●	
Stem	304 Stainless Steel	A276	S30400	●		●	
	316 Stainless Steel	A276	S31600	●		●	
	416 Stainless Steel	A582	S41600	●	●	●	●
	17-4 ph Stainless Steel	A564 630 Heat Treated	S17400				●
	Monel® *	B865	N05500	●		●	●

* Hastelloy® is a registered trademark of Haynes International, Inc.
Monel® is a registered trademark of International Nickel Company, Inc.
254 SMO™ is a registered trademark of Avesta AB.
AL-6XN® is a registered trademark of ATI Properties, Inc.

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HEADQUARTERS

Bray International, Inc.

13333 Westland East Blvd.
Houston, Texas 77041
Tel: +1.281.894.5454

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Bray Series 92/93 Pneumatic Actuators

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Actuator Installation Notes

These notes apply to the installation of Bray S92/93 pneumatic valve actuators.

- Verify that the valve and the actuator are both in the same position (both open or both closed) before mounting the actuator to the valve.
- Apply a light coating of grease to the inside of the actuator output bore before installing the actuator on the valve. This will allow the actuator to be more easily removed from the valve stem even after years of service.
- If stem adapters are required to match the actuator output bore to the valve stem, apply a light coating of grease to the inside of the stem adapter as well as the inside of the actuator output bore.
- Some stem adapters are kits consisting of multiple components. These kits may contain spacers that look like stem adapters, but are designed to keep the stem adapter in place during operation of the actuator. Verify that all stem adapters and spacers are installed in the proper position and sequence.

Refer to Series 92/93 Operations and Technical Manual (OM_S92-93)

- If keyed stem adapters are used, the key must be held in the keyway so that it will not work loose during operation of the actuator. The key may be retained by any one of several methods:

  If the valve stem height matches the depth of the actuator output bore, use a key that fits the full length of the keyway. Tack weld the key to the adapter before installation in the actuator.

  Upset the end of the keyway after the key has been installed in the shaft by using a punch or chisel.
- If mounting studs are used instead of bolts, thread the studs completely into the actuator before placing the actuator on the valve. This assures that the full strength of the connection is achieved.
- While the mounting bolts are only finger tight, cycle the actuator fully open and fully closed to verify proper alignment on the valve.
- Tighten the mounting bolts or nuts in a diagonal pattern to evenly distribute stress in the bolts.

ACTUATOR MOUNTING CODES FOR S92/93 - IMPERIAL (IN)

Actuator Sizes	Valve Code	Inner Bolt Circle			Outer Bolt Circle			Stem Hole			
		Bolt Circle (+/- .005)	No. Holes	Bolt Size	Bolt Circle (+/- .005)	No. Holes	Bolt Size	Bore Diameter (+/- .004)	Across Flats (+ .002-.0)	Depth	Keyway Width (+ .002-.0)
48	AA	1.42	4	#10-32	1.97	4	1/4-20	0.4	0.32	1.3	NA
63	A	1.969	4	1/4-20	2.756	4	5/16-18	0.552	0.395	1.38	NA
83	C	1.969	4	1/4-20	2.756	4	5/16-18	0.749	0.513	1.46	NA
93	C	1.969	4	1/4-20	2.756	4	5/16-18	0.749	0.513	1.46	NA
119	E	2.756	4	5/16-18	4.921	4	1/2-13	1.182	0.867	2.2	NA
128	E	2.756	4	5/16-18	4.921	4	1/2-13	1.182	0.867	2.2	NA
160A	E	NA	NA	NA	4.921	4	1/2-13	1.182	0.867	2.2	NA
160B	F	NA	NA	NA	4.921	4	1/2-13	1.38	NA	2.38	0.394
210	G	4.921	4	1/2-13	6.496	4	5/8-11	1.97	NA	2.76	0.472
255A	H	6.496	4	M20 x 2.5P	4.724 X 7.874	4	M20 x 2.5P	2.505	NA	4.25	0.625
255B	K	6.496	4	M20 x 2.5P	4.724 X 7.874	4	M20 x 2.5P	3.006	NA	4.25	0.750

ACTUATOR MOUNTING CODES FOR S92/93 - METRIC (MM)

Actuator Sizes	Valve Code	Inner Bolt Circle			Outer Bolt Circle			Stem Hole			
		Bolt Circle (+/- .127)	No. Holes	Bolt Size	Bolt Circle (+/- .127)	No. Holes	Bolt Size	Bore Dia. (+/-.102)	Across Flats (+ .050-.0)	Depth	Keyway Width
48	AA	36	4	M5 x 0.8P	50	4	M6 x 1.0P	10	8	33	NA
63	A	50	4	M6 x 1.0P	70	4	M8 x 1.25P	14	10	35	NA
83	C	50	4	M6 x 1.0P	70	4	M8 x 1.25P	19	13	37	NA
93	C	50	4	M6 x 1.0P	70	4	M8 x 1.25P	19	13	37	NA
119	E	70	4	M8 x 1.25P	125	4	M12 x 1.75P	30	22	56	NA
128	E	70	4	M8 x 1.25P	125	4	M12 x 1.75P	30	22	56	NA
160A	E	NA	NA	NA	125	4	M12 x 1.75P	30	22	56	NA
160B	F	NA	NA	NA	125	4	M12 x 1.75P	35	NA	60	10
210	G	125	4	M12 x 1.75P	165	4	M20 x 2.5P	50	NA	70	12
255A	H	165	4	M20 x 2.5P	120 x 200	4	M20 x 2.5P	64	NA	108	16
255B	K	165	4	M20 x 2.5P	120 x 200	4	M20 x 2.5P	76	NA	108	19

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Pneumatic Actuator Data (Imperial)

Approximate Actuator Speeds (Seconds)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
90° Travel	1/4	1/4	1/4	1/4	1/2	1/2	1	2	2 3/4

Note: Times shown are in seconds at 80 PSIG supply pressure with 6ft. tubing having an internal diameter of not less than approximately 1/4" using a Bray Series 62 or Series 63 solenoid. Bray S92/93 actuation times are very dependent on the flow capacity of their air supply. The use of smaller port solenoids, solenoid manifolds, smaller I.D. air supply tubing and/or extended lengths of tubing can significantly reduce the actuation time and/or initial response to the command signal.

Actuator Weights (lbs)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
Double Acting	2	3.3	6.3	8.5	18	21.5	39	78	171
Spring Return	2.3	3.9	7.3	10.9	24.5	30.6	58.3	124.7	239

Weights are in lbs. Spring Return unit weights are with full set of springs on each piston.

Actuator Volumes (in^3)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
Counter-Clockwise	5.7	9.6	24.8	39.0	81.0	106.5	187.5	360.0	750.0
Clockwise	4.8	13.4	32.6	50.1	102.7	140.6	259.6	450.0	900.0

Counter-clockwise: Air volume in cubic inches required to push pistons apart, full travel.
Clockwise: Air volume in cubic inches required to push pistons together, full travel.

Pneumatic Actuator Data (Metric)

Approximate Actuator Speeds (Seconds)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
90° Travel	1/4	1/4	1/4	1/4	1/2	1/2	1	2	2 3/4

Note: Times shown are in seconds at 5.5 bar supply pressure with 1.8 meter tubing having an internal diameter of not less than approximately (6.35 mm)using a Bray Series 62 or Series 63 solenoid. Bray S92/93 actuation times are very dependent on the flow capacity of their air supply. The use of smaller port solenoids, solenoid manifolds, smaller I.D. air supply tubing and/or extended lengths of tubing can significantly reduce the actuation time and/or initial response to the command signal.

Actuator Weights (kg)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
Double Acting	0.9	1.5	2.9	3.9	8.2	9.8	17.7	35.4	77.6
Spring Return	1.0	1.8	3.3	4.9	11.1	13.9	26.4	56.6	108.4

Weights are in kg Spring Return unit weights are with full set of springs on each piston.

Actuator Volumes (cm^3)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
Counter-Clockwise	93.4	157.3	406.4	638.6	1327.5	1744.5	3072.6	5899.3	12290.3
Clockwise	78.7	219.6	534.2	820.5	1683.1	2303.3	4254.1	7374.2	14748.4

Counter-clockwise: Air volume in cubic centimeters required to push pistons apart, full travel.
Clockwise: Air volume in cubic centimeters required to push pistons together, full travel.

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STANDARD MATERIALS SELECTION	
Name	**Material**
Body	Extruded Aluminum Alloy, Anodized 316 Stainless Steel
End Caps	Die cast Aluminum Alloy with Corrosion Resistant Polyester Coating 316 Stainless Steel
Pistons	Die Cast Aluminum Alloy
Output Shaft/Pinion:	Carbon Steel, Zinc Plated
Travel Stop:	Alloy Steel
Shaft Bearings:	Acetal
Piston Guides:	Acetal
Fasteners:	Stainless Steel
Springs	Spring Steel, Protective Coating
Piston O-Ring Seals:	Buna-N
Options:	Polyester Coated Body Exterior Electroless Nickel Plated Body Exterior Hard Anodized Body Exterior Seacorr Coated Body Exterior Stainless Steel Pinion

OPERATING CONDITIONS	
Pressure Range	40 - 140 psi (2.8 - 10 bar)
Media	Dry Compressed Air/Inert Gas* **Contact Factory for other media.*
Temperature Range	Standard -4° F to 200° F (-20° C to 93° C)
	Low -40° F to 176° F (-40° to 80° C)
	High 0° F to 300° F (-18° C to 149° C)
Note: Cycle life on Low and High temperature seal kits reduced compared to Standard Buna N Seals	
Series 92 Double Acting	Available in 90°, 135°, 180° Rotation
Series 93 Spring Return	Available in 90° Rotation Operating Pressure 140 psig (10 bar) maximum

COMPLIANCES	
Torque Base	Mounting Dimensions as per ISO 5211: 2001(E)
Accessories	Shaft Driven Accessories Mounting per NAMUR-VDE
Ingress Protection	IP66/IP67M per IEC 60529
Safety	ATEX, SIL 3 suitable, PED

Series 92 Torque Data

Series 92 Actuator Torque Data (Lb-in)

Double Acting Pneumatic Operated, Torque Output

Actuator Size	Air Supply Pressure (PSIG)				
	40	**60**	**80**	**100**	**120**
48	75	113	150	188	225
63	145	221	297	373	449
83	351	536	721	906	1091
93	493	753	1013	1272	1532
119	1058	1615	2171	2728	3285
128	1410	2152	2894	3636	4378
160	2797	4270	5742	7214	8687
210	5783	8826	11870	14914	17957
255	14211	21691	29171	36650	44130

Series 92 Actuator Torque Data (N m)

Double Acting Pneumatic Operated, Torque Output

Actuator Size	Air Supply Pressure (Bar)				
	2.8	**4.1**	**5.5**	**6.9**	**8.3**
48	9	13	17	21	25
63	16	25	34	42	51
83	40	61	82	102	123
93	56	85	115	144	173
119	120	183	245	308	371
128	159	243	327	411	495
160	316	482	649	815	982
210	653	997	1341	1685	2029
255	1606	2451	3296	4141	4986

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Series 93 Actuator Torque Data (Lb-In) Air Operated, With Spring Return, Torque Output

Actuator Size	No. Springs per Piston	Air Supply Pressure (PSIG)										Spring	
		40		60		80		100		120		Spring Start	Stroke End
		Start	End	Start	End	Start	End	Start	End	Start	End		
48	1	51	32	89	70	126	107	164	145	201	182	43	24
	2/1	39	10	77	48	114	85	152	123	189	160	65	36
	2			64	27	101	64	139	102	176	139	86	49
	3/2			52	5	89	42	127	80	164	117	108	61
	3					77	21	115	59	152	96	129	73
63	2	91	65	167	141	243	217	319	293	395	369	80	54
	3	64	27	140	103	216	179	292	255	368	331	118	81
	4			113	65	189	141	265	217	341	293	156	108
	5			86	27	162	103	238	179	314	255	194	135
	6					135	65	211	141	287	217	232	162
83	2	210	167	395	352	580	537	765	722	950	907	184	141
	3	156	76	341	261	526	446	711	631	896	816	275	195
	4			281	176	466	361	651	546	836	731	360	255
	5			220	97	405	282	590	467	775	652	439	316
	6					369	185	554	370	739	555	536	352
93	2	310	232	570	492	830	752	1089	1011	1349	1271	261	183
	3	218	101	478	361	738	621	997	880	1257	1140	392	275
	4			386	231	646	491	905	750	1165	1010	522	367
	5			294	94	554	354	813	613	1073	873	659	459
	6					462	229	721	488	981	748	784	551
119	2	692	469	1249	1026	1805	1582	2362	2139	2919	2696	589	366
	3	509	174	1066	731	1622	1287	2179	1844	2736	2401	884	549
	4			883	437	1439	993	1996	1550	2553	2107	1178	732
	5			700	142	1256	698	1813	1255	2370	1812	1473	915
	6					1073	404	1630	961	2187	1518	1767	1098
128	2	880	465	1622	1207	2364	1949	3106	2691	3848	3433	945	530
	3			1357	733	2099	1475	2841	2217	3583	2959	1419	795
	4			1094	261	1836	1003	2578	1745	3320	2487	1891	1058
	5					1568	529	2310	1271	3052	2013	2365	1326
	6					1302	57	2044	799	2786	1541	2837	1592
160	2	1819	1118	3292	2591	4764	4063	6236	5535	7709	7008	1679	978
	3	1399	349	2872	1822	4344	3294	5816	4766	7289	6239	2448	1398
	4			2452	1123	3924	2595	5396	4067	6869	5540	3147	1818
	5			2030	353	3502	1825	4974	3297	6447	4770	3917	2240
	6					3154	1196	4626	2668	6099	4141	4546	2588
210	2	3833	2508	6876	5551	9920	8595	12964	11639	16007	14682	3275	1950
	3	2859	868	5902	3911	8946	6955	11990	9999	15033	13042	4915	2924
	4			4930	2275	7974	5319	11018	8363	14061	11406	6551	3896
	5			3949	638	6993	3682	10037	6726	13080	9769	8188	4877
	6					6022	2031	9066	5075	12109	8118	9839	5848
255	2	9487	6747	16967	14227	24447	21707	31926	29186	39406	36666	7464	4724
	3	7125	3015	14605	10495	22085	17975	29564	25454	37044	32934	11196	7086
	4			12243	6762	19723	14242	27202	21721	34682	29201	14929	9448
	5			9880	3030	17360	10510	24839	17989	32319	25469	18661	11811
	6					14998	6778	22477	14257	29957	21737	22393	14173

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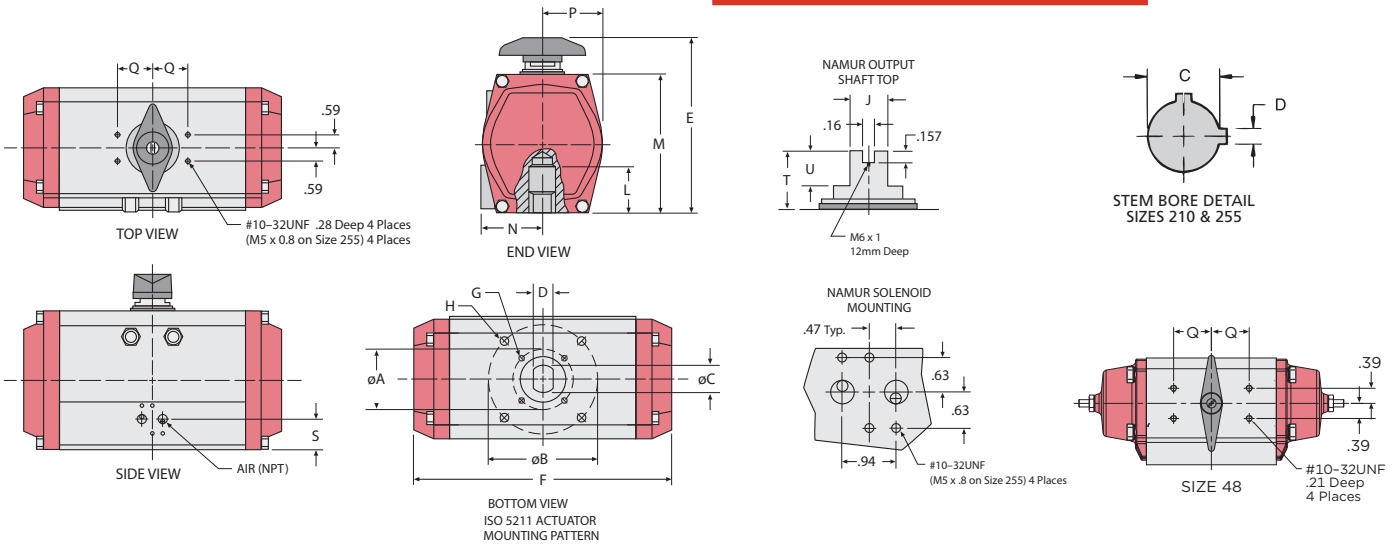
Series 93 Actuator Torque Data (N m)

Air Operated, With Spring Return, Torque Output

Actuator Size	No. Springs per Piston	Air Supply Pressure (Bar)										Spring	
		2.8		4.1		5.5		6.9		8.3		Spring Start	Stroke End
		Start	End	Start	End	Start	End	Start	End	Start	End		
48	1	6	4	10	8	14	12	19	16	23	21	5	3
	2/1	4	1	9	5	13	10	17	14	21	18	7	4
	2			7	3	11	7	16	12	20	16	10	6
	3/2			6	1	10	5	14	9	19	13	12	7
	3					9	2	13	7	17	11	15	8
63	2	10	7	19	16	28	25	36	33	45	42	9	6
	3	7	3	16	12	24	20	33	29	42	37	13	9
	4			13	7	21	16	30	25	39	33	18	12
	5			10	3	18	12	27	20	36	29	22	15
	6					15	7	24	16	32	25	26	18
83	2	24	19	45	40	66	61	86	82	107	103	21	16
	3	18	9	39	30	59	50	80	71	101	92	31	22
	4			32	20	53	41	74	62	95	83	41	29
	5			25	11	46	32	67	53	88	74	50	36
	6					42	21	63	42	84	63	61	40
93	2	35	26	64	56	94	85	123	114	152	144	30	21
	3	25	11	54	41	83	70	113	99	142	129	44	31
	4			44	26	73	56	102	85	132	114	59	42
	5			33	11	63	40	92	69	121	99	75	52
	6					52	26	82	55	111	85	89	62
119	2	78	53	141	116	204	179	267	242	330	305	67	41
	3	58	20	120	83	183	145	246	208	309	271	100	62
	4			100	49	163	112	226	175	289	238	133	83
	5			79	16	142	79	205	142	268	205	166	103
	6					121	46	184	109	247	172	200	124
128	2	99	53	183	136	267	220	351	304	435	388	107	60
	3			153	83	237	167	321	251	405	334	160	90
	4			124	30	207	113	291	197	375	281	214	120
	5					177	60	261	144	345	227	267	150
	6					147	6	231	90	315	174	321	180
160	2	206	126	372	293	538	459	705	625	871	792	190	111
	3	158	39	325	206	491	372	657	539	824	705	277	158
	4			277	127	443	293	610	460	776	626	356	205
	5			229	40	396	206	562	373	728	539	443	253
	6					356	135	523	301	689	468	514	292
210	2	433	283	777	627	1121	971	1465	1315	1809	1659	370	220
	3	323	98	667	442	1011	786	1355	1130	1699	1474	555	330
	4			557	257	901	601	1245	945	1589	1289	740	440
	5			446	72	790	416	1134	760	1478	1104	925	551
	6					680	230	1024	573	1368	917	1112	661
255	2	1072	762	1917	1607	2762	2453	3607	3298	4452	4143	843	534
	3	805	341	1650	1186	2495	2031	3340	2876	4185	3721	1265	801
	4			1383	764	2228	1609	3073	2454	3919	3299	1687	1068
	5			1116	342	1961	1188	2806	2033	3652	2878	2108	1335
	6					1695	766	2540	1611	3385	2456	2530	1601

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S92 Double Acting/S93 Spring Return



IMPERIAL DIMENSIONS - Inches

Size	48	63	83	93	119	128	160*	210	255‡
Air NPT	1/8	1/4	1/4	1/4	1/4	1/4	1/4	1/4	G1/4
A ISO "F"†	1.42 - F 03	1.97-F 05	1.97 - F 05	1.97 - F 05	2.76 - F 07	2.76 - F 07	—	4.92 - F 12	6.50 - F 16
B ISO "F"†	1.97 - F 05	2.76 - F 07	2.76 - F 07	2.76 - F 07	4.92 - F 12	4.92 - F 12	4.92 - F 12	6.50 - F 16	7.87x4.72 Rect.
C	.55	.55	.75	.75	1.18	1.18	1.18	1.97	2.50
D	.40	.40	.51	.51	.87	.87	.87	.47	.62
E	3.88	4.53	5.43	5.78	7.28	8.09	9.36	11.62	13.49
F	4.38	5.58	7.40	9.10	12.40	12.81	15.54	19.57	28.78
G (UNC)	#10-32 x .23	1/4-20 x .32	1/4-20 x .32	1/4-20 x .32	5/16-18 x .46	5/16-18 x .46	—	1/2-13 x .78	M20 x 2.5 x 30mm
H (UNC)	1/4-20 x .25	5/16-18 x .40	5/16-18 x .40	5/16-18 x .40	1/2-13 x .69	1/2-13 x .69	1/2-13 x .75	5/8-11 x 1.11	M20 x2.5 x 30mm
J	.38	.38	.50	.50	1.12	1.12	1.12	1.12	1.12
L	1.38	1.38	1.46	1.46	2.20	2.20	2.20	4.72	6.50
M	2.50	3.46	4.27	4.61	5.52	6.32	7.80	10.16	12.06
N	1.60	1.72	2.28	2.47	2.78	2.88	3.78	4.56	5.40
P	1.18	1.38	1.79	1.97	2.37	2.70	3.39	4.41	5.39
Q	.98**	1.58	1.58	1.58	1.58	1.58	2.56	2.56	2.56
S	1.25	.89	1.26	1.32	1.64	1.64	2.26	2.45	2.48
T	1.10**	.79	.79	.79	.79	.79	1.18	1.18	1.18
U	.47	.47	.47	.47	.47	.47	.75	.75	.75

Note: Double Acting and Spring Return actuators have the same overall dimensions. The double acting unit of the size 48 actuator is optionally available with flat end caps with an F dimension of 4.00
† ISO "F" means mounting flange-drilling pattern.
* Dimensions for Size 160A in table. Size 160B (keyed stem version) has C dimension of 1.38 and D dimension of .39
‡ Dimensions for Size 255A in table. Size 255B actuator has a C dimension of 3.00 and D dimension of .75
** Size 48 has a Q dimension of 1.58 and a T dimension of .79 with use of NAMUR top plate.

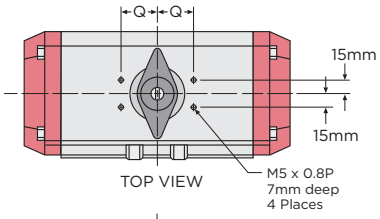
WEIGHTS - lbs - Spring Return unit weights are with full set of springs on each piston.

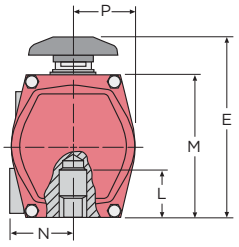
Size	48	63	83	93	119	128	160	210	255
Double Acting	2.0	3.4	6.3	8.5	16.9	21.0	38.8	77.8	167.0
Spring Return	2.4	4.10	8.1	10.8	22.3	27.6	53.2	109.6	210.8

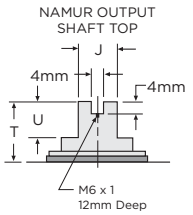
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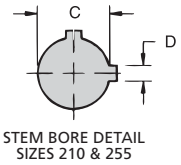
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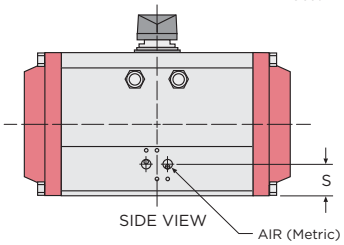
S92 Double Acting/S93 Spring Return

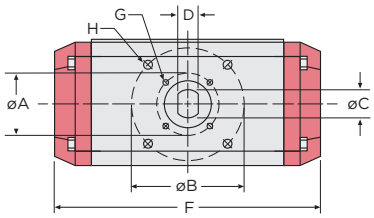


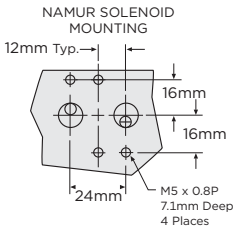


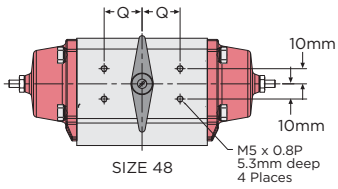












METRIC DIMENSIONS - Millimeters

Size	48	63	83	93	119	128	160*	210	255‡
Air	G1/8	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4
A ISO "F"†	36 - F 03	50 - F 05	50 - F 05	50 - F 05	70 - F 07	70 - F 07	—	125 - F 12	165 - F 16
B ISO "F"†	50 - F 05	70 - F 07	70 - F 07	70 - F 07	125 - F 12	125 - F 12	125 - F 12	165 - F 16	200 x120 Rect.
C	14	14	19	19	30	30	30	50	64
D	10	10	13	13	22	22	22	12	16
E	99	115	138	147	185	205	238	295	343
F	111	142	188	231	315	325	395	497	731
G	M5x0.8 x 5.8mm	M6x1.0 x 8mm	M6x1.0 x 8mm	M6x1.0 x 8mm	M8x1.25P x 12 mm	M8x1.25P x 12 mm	N/A	M12x1.75P x 19m	M20x2.5P x 30mm
H	M6x1.0 x 6.4mm	M8x1.25P x 10mm	M8x1.25P x 10mm	M8x1.25P x 10mm	M12x1.75P x 18mm	M12x1.75P x 18mm	M12x1.75P x 18mm	M20x2.5P x 30mm	M20x2.5P x 30mm
J	10	10	13	13	28	28	28	28	28
L	35	35	37	37	56	56	56	120	165
M	64	88	108	117	140	161	198	258	306
N	41	44	58	63	71	73	96	116	137
P	30	35	45	50	60	69	86	112	137
Q	25**	40	40	40	40	40	65	65	65
S	32	23	32	34	42	42	57	62	63
T	28**	20	20	20	20	20	30	30	30
U	12	12	12	12	12	12	19	19	19

Note: Double Acting and Spring Return actuators have the same overall dimensions. The double acting unit of the size 48 actuator is optionally available with flat end caps with an F dimension of 102mm

† ISO "F" means mounting flange-drilling pattern.

* Dimensions for Size 160A in table. Size 160B (keyed stem version) has C dimension of 35mm and D dimension of 10mm

‡ Dimensions for Size 255A in table. Size 255B actuator has a C dimension of 76mm and D dimension of 19mm

** Size 48 has a Q dimensions of 40mm and a T dimension of 20mm with use of NAMUR top plate.

WEIGHTS - Kilograms - Spring Return unit weights are with full set of springs on each piston.

Size	48	63	83	93	119	128	160	210	255
Double Acting	0.9	1.5	3	4	8	10	18	35	76
Spring Return	1.1	1.9	4	5	10	13	24	50	96

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Bray International, Inc.
13333 Westland East Blvd.
Houston, Texas 77041
Tel: +1.281.894.5454

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THE HIGH PERFORMANCE COMPANY

BRAY.COM

KEY FEATURES

Bray's Series 6A Smart Electro-Pneumatic Positioners offer precise flow control, advanced communication, and enhanced diagnostics for linear and part-turn actuators in industrial applications.

- Simple mounting and automatic commissioning
- Low air consumption of **0.0059 SCFM** in steady state
- Wide stroke range providing high control performance
- Modular design capable of field upgradeable options
- Optional pressure sensor-based diagnostics
- Suitable pneumatic media: natural gas, carbon dioxide, nitrogen, or noble gases



CERTIFICATIONS & APPROVALS

- SIL (Safety Integrity Level) 2
- FM, CSA, ATEX, IECEx, CCC
- INMETRO
- Intrinsically safe, explosion proof
- NEMA 4X/IP66

OPTIONS & ACCESSORIES

- Communications
  - Analog 4-20mA
  - Foundation Fieldbus
  - Profibus PA
  - HART
- Stainless steel, aluminum, and polycarbonate enclosures
- Limit Switches Inductive/Mechanical
- Remote Mounting Kit
- Position feedback, 4-20 mA
- Non-contact sensor (NCS) for extreme vibration environments
- Alarm card module
- Fail Freeze
- Fail to Open
- Volume Boosters



Standard Housing



Stainless Steel Housing



Intrinsically Safe Housing

SELECTABLE FAIL-SAFE MODES

- **Fail Safe:** Valve moves to the safety position; also suitable for SIL2 applications
- **Fail Freeze (Optional):** Valve remains in its last position upon loss of electrical and/or pneumatic power
- **Fail to Open (Optional):** Venting upon loss of electrical power; the valve moves to the preferred position



Explosion-Proof Housing



Stainless Steel Explosion-Proof Housing

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APPLICATIONS

- Suitable for both single and double-acting actuators
- Operational Temperature: -22°F to +176°F (Optional -40°F to +176°F)
- Compatible for rotary and linear valves
- Integrated volume booster designed for pneumatic actuators that require high flow fast stroking times
- Control and On-off applications
- Suitable for emergency shutdown (ESD/SIS) SIL applications



POSITIONER WITH VARIOUS EXTERNAL POSITION DETECTION SYSTEMS

- Ideal for extreme conditions - high temperature, vibration or difficult to reach locations.
- Position detection available as standard solution or integrated in a robust aluminum enclosure
- Distance between positioner and valve can be up to 40 meters

LOCAL USER INTERFACE FUNCTIONS

- Calibration
- Advanced diagnostics checks
- Confirmation of the setpoint and progress to the setpoint
- Operate local position using push buttons
- Potentiometer alignment
- Air pressure monitor
- Maintenance alarms
- Air leakage test
- Live control signal readout

STANDARD DIAGNOSTICS AT A GLANCE

- Valve Performance Test (IEC-61298-2)
- Multi Step Response Test (IEC -61514-2)
- Partial Stroke Test
- Air leakage
- Valve jamming
- Packing wear and tear
- Wear of the valve seat or plug
- Deposits or caking on the valve seat
- Cracking of the valve disk/plug
- Valve position trend diagram
- Stroke counter
- Change in position counter
- Operating hours
- Ambient temperature measurement
- Multiple years of maintenance data storage



Maintenance Alarm set to be signaled



Leak Test Initiated



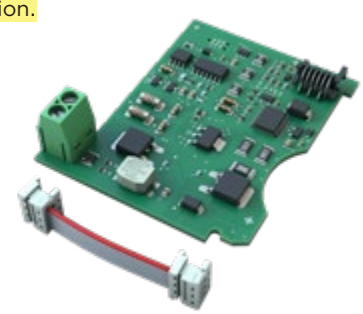
Live Signal Readout

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MODULAR ACCESSORIES

4-20 mA FEEDBACK MODULE

Provides 4-20mA DC output indicating valve position to the control station.



INTERNAL NON-CONTACT SENSOR

Non-contact, solid-state position sensor for high vibration applications.



PROGRAMMABLE ELECTRONIC SWITCHES (ALARM)

Easy to retrofit alarm module comes with two semi conductor switch outputs, one fault output, and one digital input.



MECHANICAL/INDUCTIVE LIMIT SWITCHES

Provides a cam activated indication of actuator travel limits; two output formats are offered:

- Mechanical switches
- Intrinsically safe inductive proximity switches

Both modules also contain an integrated fault indicator.



EXTERNAL NON-CONTACT SENSOR

Ideally suited for the following process conditions:

- Strong vibration and shock loads
- Rough environmental conditions
- Limited space or inaccessible installation location
- Harmful atmospheres (gases, vapors, liquids)



VOLUME BOOSTERS

Integral volume booster paired with a S6A results in a lower profile than a traditional setup and comes with the following benefits:

- Fast adjustment for large drives
- Mounted directly on the positioner, reduces external tubing to a minimum
- The unit reproduces pneumatic signals in a 1:1 ratio and has Cv of 2.0



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EN_SDS-1034_S6A Positioner_20221007

Bray®

THE HIGH PERFORMANCE COMPANY

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EQUIPMENT TECHNICAL DATA SHEETS

PNEUMATIC BUTTERFLY VALVES
OPEN/CLOSE

DAF SEDIMENT PURGE VALVES:
BRAY SERIES 31 BUTTERFLY VALVES W/ PNEUM SPRING RETURN F/C ACTUATOR, SOL, & LIMIT SWITCH

4" BRAY 31/324/A153, LUG BFV (DI BODY, 316SS DISC, 316SS STEM, EPDM SEAT) SUFFIX A153
= MADE IN AMERICA
WITH BRAY SERIES 93/119(3) SPRING RETURN FAIL CLOSED PNEUAMTIC ACTUATOR, SERIES 63 SOL (24VDC, N4, FLYING LEADS) SERIES 5A LIMIT SWITCH (2SPDT, N4) & PREWIRINGKIT FOR SOLENOID TO 5A LIMIT SWITCH
`

DAF FLOATED SLUDGE VALVES
BRAY SERIES 31 BUTTERFLY VALVES W/ PNEUM SPRING RETURN F/O ACTUATOR, SOL, & LIMIT SWITCH

6" BRAY 31/324/A153, LUG BFV (DI BODY, 316SS DISC, 316SS STEM, EPDM SEAT) SUFFIX A153
= MADE IN AMERICA
WITH BRAY SERIES 93/119(5) SPRING RETURN FAIL OPEN PNEUAMTIC ACTUATOR, SERIES 63 SOL (24VDC, N4, FLYING LEADS) SERIES 5A LIMIT SWITCH (2SPDT, N4) & PREWIRINGKIT FOR SOLENOID TO 5A LIMIT SWITCH

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Bray CONTROLS



RESILIENT SEATED

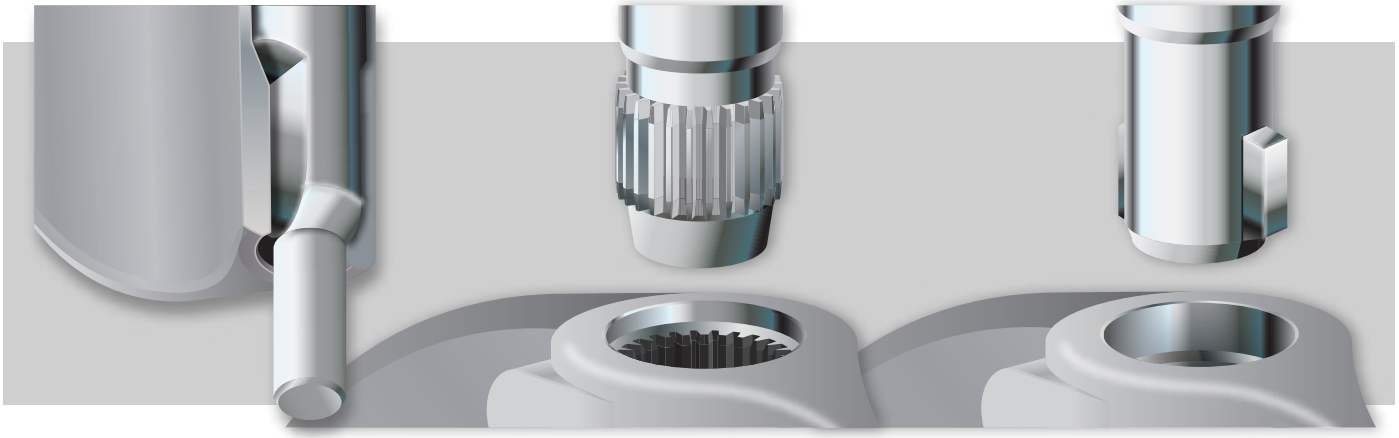
Butterfly Valves

DESIGN BENEFITS

1 ISOLATION FROM LINE MEDIA

achieved in two fundamental design concepts:

A. INTERNAL DISC/STEM CONNECTION Bray offers three disc-to-stem connections: Double 'D', Splined, and Double Key. These internal, non-wetted connections eliminate exposed external disc-to-stem connections such as screws or taper pins.



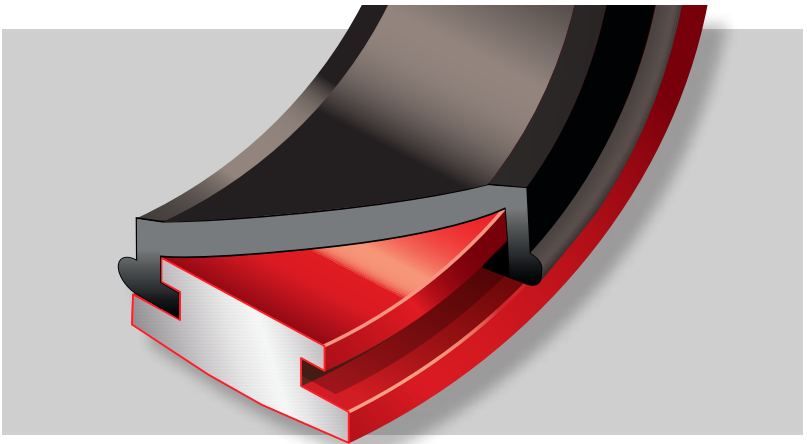
1. Double D: precision machined flats on the stem and in the disc.
Sizes 2"– 20" (50mm–500mm)

2. Spline: male splines in the stem and female in the disc.
Standard Sizes 22"– 48" (550mm–1200mm)
Selected Sizes 54"– 120" (1400mm–3000mm)

3. Double Keyed: keyways machined into disc matching keys in the stem
Selected Sizes 54"– 120" (1400mm–3000mm)

Disassembly of Bray's internal connection is performed by simply pulling the stem out of the disc. Bray's precision machining of the disc and the stem connection minimizes hysteresis and produces maximum strength engagements. All stem designs incorporate a blow-out proof feature.

B. SEAT DESIGN Bray's seat design provides complete isolation of flowing media from the body and stem by a totally encasing design. Designed to seal with slip-on or weld-neck flanges.



Tongue-and-groove

2 INTERNATIONAL COMPATIBILITY

Valve mounting top flanges meet ISO 5211 standards for direct mounting of manual operators and power actuators. All Bray valves have extended necks which allow for at least 2" piping insulation.



3 ACTUATOR MOUNTING

Due to a modular concept of design, all Bray actuators including Handles, Gear Operators, Pneumatic and Electric Actuators mount directly to Bray resilient seated valves. No brackets are required. This allows for simple installation in the field, minimizes possible misalignment and reduces overall height.

EXTERNAL COATING OPTIONS

1 POLYESTER BODY COATING

Bray's standard product offers valve bodies with a polyester coating, providing excellent corrosion and wear resistance to the valve's surface. The Bray polyester coating is a hard, gloss red finish.

Chemical Resistant

Resists a broad range of chemicals including dilute acids and alkalis, petroleum solvents, alcohols, greases and oils. Also offers outstanding resistance to humidity and water.

Weatherability

Resistant to ultra-violet radiation.

Abrasion Resistant

Excellent resistance to abrasion.

Impact Resistant

Withstands impact without chipping or cracking.

2 NYLON 11 COATING:

Nylon 11 also has superior corrosion resistance and has been used successfully in many applications such as water, cement, food and seawater.

Weatherability

Bray's Nylon 11 coating has been salt spray tested in excess of 2000 hours and used in seawater immersion service for over 25 years without any deterioration of the coating resulting in no corrosion to the coated metal components.

Abrasion Resistant

Excellent resistance to abrasion.

Impact Resistant

Excellent - no chipping or cracking.

Other customer specified coating materials are available. Please consult your local Bray representative for your specific application.

3 SEACORR COATING:

FDA Epoxy pigmented with 316L Stainless Steel Flake available for corrosive environments as tested per ASTM B-117 salt spray test for 2000 hours.





SEAT MATERIALS

Seat Temperature Ranges

EPDM	-20°F (-29°C)	250°F (121°C)	FKM	0°F (-18°C)	400°F (204°C)
BUNA-N	0°F (-18°C)	212°F (100°C)	Polyurethane	-20°F (-29°C)	176°F (80°C)

EPDM (Peroxide Cured)

EPDM is the abbreviated name for Ethylene Propylene Diene Monomer. In general industry, one may see other abbreviations or trade names used in lieu of EPDM such as EPT, Nordel, ECD, or EPR. Typically these are the same materials as EPDM.

EPDM is a standard seat material offered in Bray resilient-seated butterfly valves. It is the most universal and economical of seat materials offered by Bray; that is, it may be used in a wider range of applications than BUNA-N. Of important significance also is the fact all EPDM seat materials sold by Bray are Food Grade. Bray's EPDM Food Grade seats are perfectly suitable for sanitary applications as well as standard industrial uses. EPDM is also available as a covering for Series 20 discs.

BUNA-N (Black & White)

BUNA-N is the commonly used name for Nitrile synthetic rubber. Nitrile is a copolymer of acrylonitrile and butadiene. BUNA-N is sometimes referred to as NBR, Nitrile, or Hycar. BUNA-N is an excellent general purpose seat material which is particularly suitable for hydrocarbon service. BUNA-N is a standard Bray seat material and is Food Grade; thus suitable for sanitary applications. Note, BUNA-N is also available as a covering for Series 20 disc stems.

FKM

FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (Fluoroelastomers) such as Viton® (DuPont). FKM has some outstanding characteristics such as improved acid, oil, and temperature resistance over standard seat materials.

POLYURETHANE

Urethane seats are primarily used for their ability to resist abrasive wear. Urethane can be used on a reasonably broad range of services. Urethane will withstand severe impact, recover its original shape after distortion and resist abrasion better than other elastomers such as EPDM and BUNA-N.

Seat material availability depends on valve size & series. Please consult your local Bray representative for your specific application.



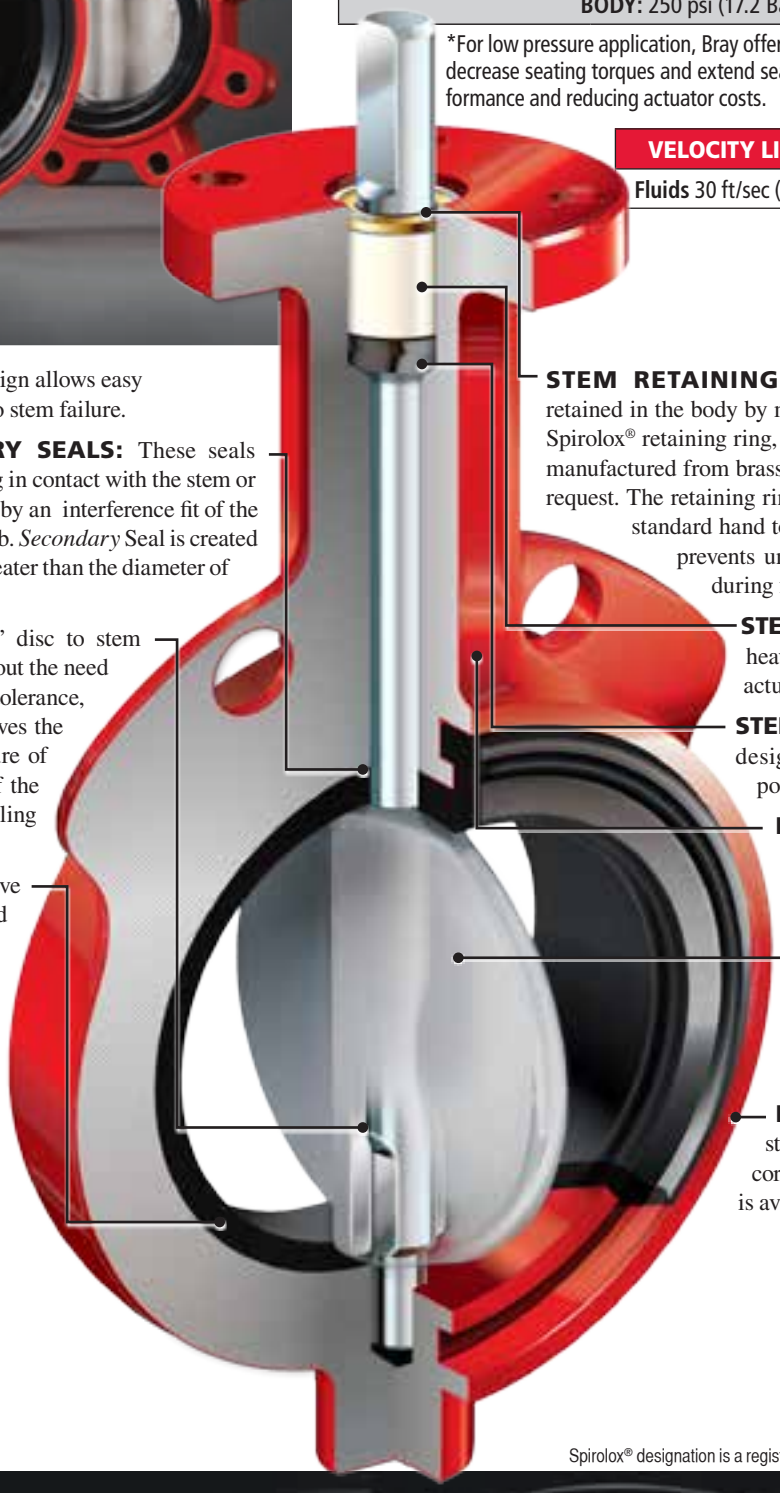


SERIES 30/31 2"-20" (50mm-500mm)

PRESSURE RATINGS		
BIDIRECTIONAL BUBBLE-TIGHT SHUT-OFF – Standard Disc* Downstream Flanges/Disc in Closed Position		
S30/31 Standard Disc*	2-12" (50-300mm)	175 psi (12 Bar)
	14-20" (350-500mm)	150 psi (10.3 Bar)
DEAD-END SERVICE – Lug Bodies/Standard Disc* No Downstream Flanges/Disc in Closed Position		
S31	2-12" (50-300mm)	75 psi (5.2 Bar)
	14-20" (350-500mm)	50 psi (3.4 Bar)
BODY: 250 psi (17.2 Bar) CWP		

*For low pressure application, Bray offers a standard reduced disc diameter to decrease seating torques and extend seat life, thus increasing the valve's performance and reducing actuator costs.

VELOCITY LIMITS For On/Off Services:	
Fluids 30 ft/sec (9 m/s)	**Gases** 175 ft/sec (54 m/s)



High strength through-stem design allows easy disassembly and reduced disc to stem failure.

PRIMARY & SECONDARY SEALS: These seals prevent line media from coming in contact with the stem or body. *Primary* Seal is achieved by an interference fit of the molded seat flat with the disc hub. *Secondary* Seal is created because the stem diameter is greater than the diameter of the seat stem hole.

STEM: Precision double "D" disc to stem connection drives the disc without the need for screws or pins. The close tolerance, double "D" connection that drives the valve disc is an exclusive feature of the Bray valve. Disassembly of the Bray stem is just a matter of pulling the stem out of the disc.

SEAT: Bray's tongue and groove seat design lowers torque and provides complete isolation of flowing media from the body. The seat also features a molded O-ring which eliminates the use of flange gaskets.

STEM RETAINING ASSEMBLY: The stem is retained in the body by means of a unique Stainless Steel Spirolox® retaining ring, a thrust washer and two C-rings, manufactured from brass as standard, stainless steel upon request. The retaining ring may be easily removed with a standard hand tool. The stem retaining assembly prevents unintentional removal of the stem during field service.

STEM BUSHING: Non-corrosive, heavy duty acetal bushing absorbs actuator side thrust.

STEM SEAL: Double "U" cup seal design is self-adjusting and gives positive sealing in both directions.

NECK: Extended neck length allows for 2" of piping insulation and is easily accessible for mounting actuators.

DISC: Casting is spherically machined and hand polished to provide a bubble-tight shut off, minimum torque, and longer seat life.

BODY: One-piece wafer or lug style. Polyester coating for excellent corrosion resistance. Nylon 11 coating is available as an option.

Spirolox® designation is a registered trademark of Kaydon Ring and Seal, Inc.



SERIES 31H

2"-20" (50mm-500mm)

Series 31H Lug valves are drilled and tapped to meet ASME Class 125/150 and PN16 flanges. Series 31H Valves will not be automated.

PRESSURE RATINGS	
BIDIRECTIONAL BUBBLE-TIGHT SHUT OFF & DEAD-END SERVICE	
2-20" (50-500mm)	250 psi (17.2 Bar)
BODY: 250 psi (17.2 Bar) CWP	

VELOCITY LIMITS For On/Off Services:	
Fluids 30 ft/sec (9 m/s)	**Gases** 175 ft/sec (54 m/s)

STANDARD MATERIALS SELECTION 31H	
Body	Cast Iron Ductile Iron
Disc	Aluminum Bronze Nylon 11 Coated Ductile Iron 316 Stainless Steel
Stem	416 Stainless Steel
Seat	Bonded EPDM Bonded BUNA-N

Material availability depends on valve size & series. Other materials are available. Please consult your local Bray representative for your specific application.

STANDARD MATERIALS SELECTION S30/31

NAME	MATERIAL
Body	Cast Iron
	Ductile Iron
	Carbon Steel
	Aluminum
Disc	Aluminum Bronze
	Coated Ductile Iron
	Nylon 11 Coated Ductile Iron
	Halar® Coated Ductile Iron
	304 Stainless Steel
	316 Stainless Steel
	Duplex Stainless Steel
	Super Duplex Stainless Steel
	Hastelloy®
Stem	416 Stainless Steel
	304 Stainless Steel
	316 Stainless Steel
	Monel K500
Seat	BUNA-N – Food Grade
	EPDM – Food Grade
	FKM*
	White BUNA-N – Food Grade
	Bonded EPDM
	Bonded BUNA-N



Material availability depends on valve size & series. Other materials are available. Please consult your local Bray representative for your specific application.

*FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (also called Fluoroelastomers).
Hastelloy® is a registered trademark of Haynes International, Inc.
Halar® is a registered trademark of Ausimont U.S.A., Inc.





SERIES 70 *ELECTRIC*

Torque	300 to 18,000 lb-ins (34-2030 Nm)
Voltage	VAC: 24, 120, 220 VDC: 12, 24
Standard Enclosure	NEMA 4, 4X
Explosion Proof:	NEMA 4, 4X, 7 and 9

The Series 70 is a low profile, compact and powerful actuator with customer-friendly features.

- Manual declutchable handwheel
- Local high visibility position indicator
- Digital interface available
- Optional microprocessor based modulating control



SERIES 73 *ELECTRIC*

Torque	100 to 600 lb-ins (11-70 Nm)
Voltage	VAC: 120, 220 VDC: 12, 24
Standard Enclosure	NEMA 4, 4X, IP65

The Series 73 is a low cost electric actuator for rotary valves.

- Powered by permanent split-capacitor, reversible induction motor
- All AC motors provided with an internal motor brake
- Heavy duty spur gear system
- Heater available to prevent damage to components due to condensation
- LED position indication



SERIES 92/93 *PNEUMATIC*

Bray pneumatic actuators are rack and pinion, opposed-piston actuators available in two versions: double acting and spring return.

- Maximum pressure rating of 140 psi (9.7 bar) and a temperature range of -20°F (-29°C) to +200°F (+95°C)
- Two independently adjustable travel stop screws and a cam on the output shaft to permit precise bidirectional adjustment of movement in both the open and closed positions for quarter turn valves (+5° to -5° limit adjustment)
- Integral porting
- Standard units have anodized aluminum bodies with polyester coated end caps.
- Special coatings and materials available for corrosive environments
- NAMUR accessory compatible



SS ACTUATOR



TRAVEL STOP



SPRING RETURN

ACTUATORS & ACCESSORIES



SERIES 50 - Valve Status Monitors

- 10 amps at 125 or 250 volts AC
- Internal travel switches that are prewired to a terminal block



SERIES 52 - Valve Status Monitors

- ProxSensor provides proximity sensors in one fully sealed, compact enclosure.
- AC, DC, Intrinsically Safe and BUS Network versions are offered



SERIES 63 - 3 & 4 way solenoids

- Waterproof (NEMA 4,4X) and explosion proof (NEMA 7,9) housings are standard
- NPT and IP65 DIN connections are offered with both single and dual coils



SERIES 6A
Electro-Pneumatic Positioners

- Precise, microprocessor driven flow control and advanced communication
- For use with either double or single acting actuators



Serial Bus Communication

- Bray offers several products featuring serial bus communication.
- Multiple protocols available. Consult your local Bray representative.

Manual Operators



SERIES 1 - Handle & Notch Plate

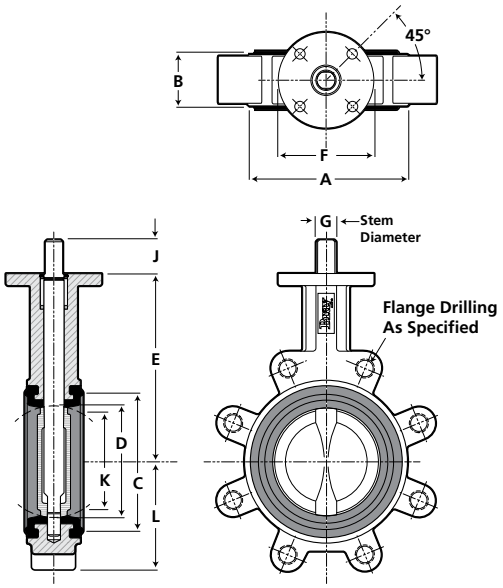


SERIES 4 - Gear Operator

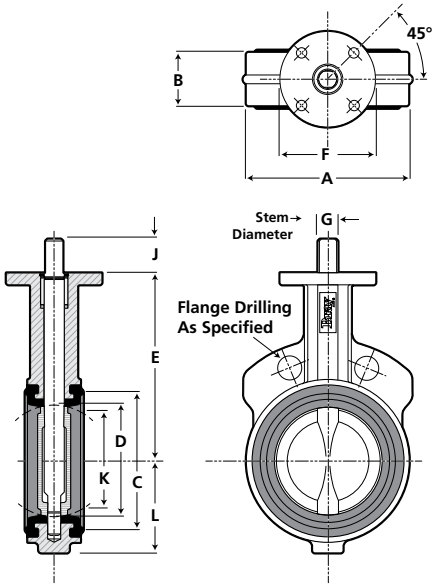


SERIES 5 - Declutchable Gear Operator

Series 31 Lug



Series 30 Wafer





IMPERIAL DIMENSIONS: Inches																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	H	J	K	L		Adapter Code	Weight (lbs.)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
2	3.69	1.62	2.00	2.85	5.50	3.54	2.76	4	.39	.55	39	1.25	1.32	2.22	2.30	A	5.5	7.0	4.75	4	.62-11
2 1/2	4.19	1.75	2.50	3.36	6.00	3.54	2.76	4	.39	.55	.39	1.25	1.91	2.47	2.57	A	7.0	8.0	5.50	4	.62-11
3	4.88	1.75	3.00	4.15	6.25	3.54	2.76	4	.39	.55	.39	1.25	2.55	2.81	2.81	A	7.5	9.0	6.00	4	.62-11
4	6.06	2.00	4.00	5.16	7.00	3.54	2.76	4	.39	.63	.43	1.25	3.57	3.41	4.09	B	11.5	15.0	7.50	8	.62-11
5	7.06	2.12	5.00	6.16	7.50	3.54	2.76	4	.39	.75	.51	1.25	4.63	4.03	4.61	C	14.0	20.0	8.50	8	.75-10
6	8.12	2.12	5.75	7.02	8.00	3.54	2.76	4	.39	.75	.51	1.25	5.45	4.53	5.06	C	17.0	23.0	9.50	8	.75-10
8	10.50	2.50	7.75	9.47	9.50	5.91	4.92	4	.57	.87	.63	1.25	7.45	5.75	6.05	D	34.0	42.0	11.75	12	.75-10
10	12.75	2.50	9.75	11.47	10.72	5.91	4.92	4	.57	1.18	.87	2.00	9.53	7.12	7.69	E	49.0	66.0	14.25	12	.88-9
12	14.88	3.00	11.75	13.47	12.25	5.91	4.92	4	.57	1.18	.87	2.00	11.47	8.12	9.02	E	67.0	88.0	17.00	12	.88-9

Note: K dimension is disc chordal dimension at valve face.

METRIC DIMENSIONS: Millimeters																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	H	J	K	L		Adapter Code	Weight (Kg)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
50	94	43	51	72	140	90	70	4	10	14	10	32	34	56	58	A	2.5	3	121	4	.62-11
65	106	46	64	85	152	90	70	4	10	14	10	32	49	63	65	A	3	3.5	140	4	.62-11
80	124	46	76	102	159	90	70	4	10	14	10	32	65	71	71	A	3.5	4	152	4	.62-11
100	154	52	102	131	178	90	70	4	10	16	11	32	91	87	104	B	5	7	191	8	.62-11
125	181	56	127	156	190	90	70	4	10	19	13	32	118	102	117	C	6	9	216	8	.75-10
150	206	56	146	178	203	90	70	4	10	19	13	32	138	115	129	C	8	10	241	8	.75-10
200	267	60	197	240	241	150	125	4	14	22	16	32	189	146	154	D	15	19	298	12	.75-10
250	324	68	248	291	273	150	125	4	14	30	22	51	242	181	195	E	22	30	362	12	.88-9
300	378	76	298	342	311	150	125	4	14	30	22	51	291	206	229	E	30	40	432	12	.88-9

Note: K dimension is disc chordal dimension at valve face.

Drawings are for reference only. Please refer to Bray ES drawings on the Bray website, www.bray.com. Bray reserves the right to change product dimensions without notice.

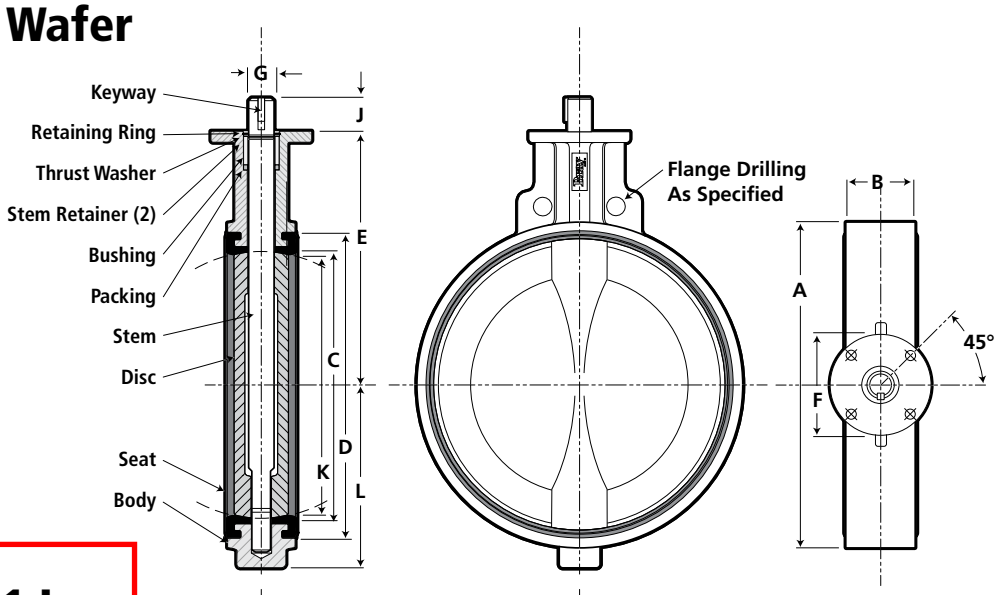
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Bray Order No.: _____

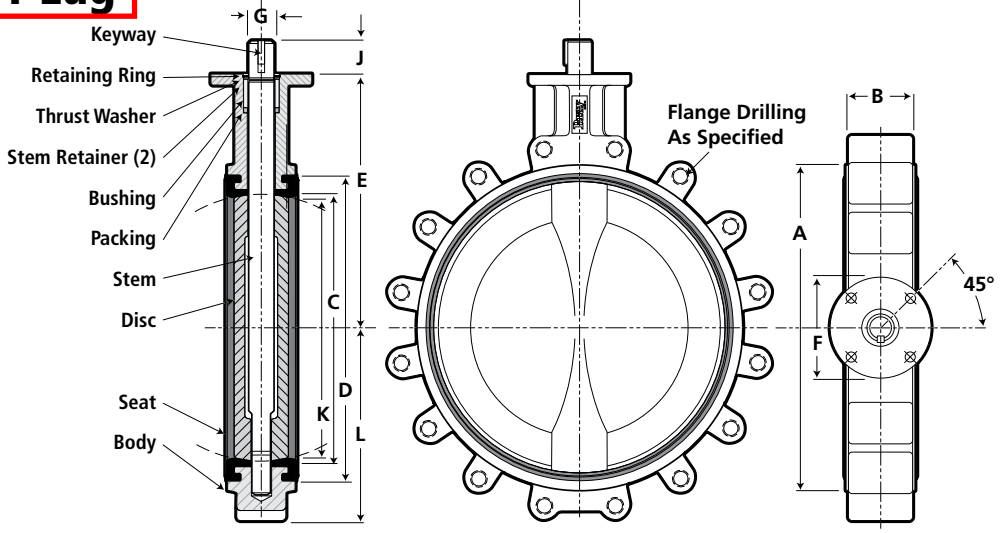
SR Drawing #30/31-2/12-im August 2012- Rev. 0

Customer/Project: _____

Series 30 Wafer



Series 31 Lug



IMPERIAL DIMENSIONS: Inches																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	J	Key Size	K	L		Adapter Code	Weight (lbs.)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
14	17.05	3.00	13.25	15.28	13.62	5.91	4.92	4	.57	1.38	2.00	.39x.39	13.04	9.38	9.93	F	95	114	18.75	12	1.00-8
16	19.21	4.00	15.25	17.14	14.75	5.91	4.92	4	.57	1.38	2.00	.39x.39	14.85	10.75	11.30	F	135	166	21.25	16	1.00-8
18	21.12	4.25	17.25	19.47	16.00	8.27	6.50	4	.81	1.97	2.50	.47x.39	16.85	12.00	12.15	G	200	226	22.75	16	1.12-7
20	23.25	5.00	19.25	21.59	17.25	8.27	6.50	4	.81	1.97	2.50	.47x.39	18.73	14.00	14.00	G	260	305	25.00	20	1.12-7

Note: K dimension is disc chordal dimension at valve face.

METRIC DIMENSIONS: Millimeters																				Lug Bolting Data		
Valve Size	A	B	C	D	E	F	Top Plate Drilling			G	J	Key Size	K	L		Adapter Code	Weight (Kg)		Bolt Circle	No of Holes	Threads ISO Course
							BC	No of Holes	Hole Diameter					Wafer	Lug		Wafer	Lug			
350	433	76	337	388	346	150	125	4	14	35	51	10x10	331	238	252	F	43	52	476	12	1.00-8
400	488	102	387	442	375	150	125	4	14	35	51	10x10	377	273	287	F	61	75	540	16	1.00-8
450	536	108	438	495	406	210	165	4	21	50	64	12x10	428	305	309	G	91	103	578	16	1.12-7
500	591	127	489	548	438	210	165	4	21	50	64	12x10	476	348	358	G	118	138	635	20	1.12-7

Note: K dimension is disc chordal dimension at valve face.

Drawings are for reference only. Please refer to Bray ES drawings on the Bray website, www.bray.com. Bray reserves the right to change product dimensions without notice.

SR Drawing #30/31-14/20-im August 2012- Rev. 0

Inquire/P.O. No.:_____

Customer/Project: _____

Bray Order No.: _____

RESILIENT SEATED

BUTTERFLY VALVES



Bray®

BRAY.COM

THE HIGH PERFORMANCE COMPANY

	Body Style	Size Range	Pressure Range	Page
Series 20	Wafer	1"-20" (25mm-500mm)	150 psi (10.3 bar)	**6**
Series 21	Lug	1"-20" (25mm-500mm)	150 psi (10.3 bar)	
Series 22	Wafer	2"-20" (50mm-500mm)	150 psi (10.3 bar)	**8**
Series 23	Lug	2"-20" (50mm-500mm)	150 psi (10.3 bar)	
	Double Flanged	24" (600mm)	150 psi (10.3 bar)	
Series 30	Wafer	2"-12" (50mm-300mm)	175 psi (12 bar)	**10**
		14"-20" (350mm-500mm)	150 psi (10.3 bar)	
Series 31	Lug	2"-12" (50mm-300mm)	175 psi (12 bar)	
		14"-20" (350mm-500mm)	150 psi (10.3 bar)	
Series 31H	Lug	2"-20" (50mm-500mm)	250 psi (17.2 bar)	**11**
Series 31U	Lug	2"-12" (50mm-300mm)	285 psi (20 bar)	**12**
Series 3A	Double Flanged	2"-12" (50mm-300mm)	175 psi (12 bar)	**14**
		14"-20" (350mm-500mm)	150 psi (10.3 bar)	
Series 3AH	Double Flanged	2"-20" (50mm-500mm)	250 psi (17.2 bar)	**15**
Series 32	Wafer	22"-36" (550mm-900mm)	75 psi (5.2 bar)	**18**
Series 33	Wafer	22"-36" (550mm-900mm)	150 psi (10.3 bar)	**18**
Series 35	Double Flanged	22"-120" (550mm-3000mm)	75 psi (5.2 bar)	**20**
Series 36	Double Flanged	22"-120" (550mm-3000mm)	150 psi (10.3 bar)	**20**
Series 35F	Double Flanged	32"-60" (800mm-1500mm)	75 psi (5.2 bar)	**21**
Series 36H	Double Flanged	22"-60" (550mm-1500mm)	232 psi (16 bar)	**21**
Actuators & Accessories				**22**

INTERNATIONAL COMPATIBILITY

Valve mounting top flanges meet ISO 5211 bolt circle standards for direct mounting of manual operators and power actuators. All Bray valves have extended necks which allow for at least 2" piping insulation.



ACTUATOR MOUNTING

All Bray actuators including handles, gear operators, pneumatic and electric actuators mount directly to Bray resilient seated valves. No brackets are required. This allows for simple installation in the field, minimizes possible misalignment and reduces overall height.

ISOLATION FROM LINE MEDIA

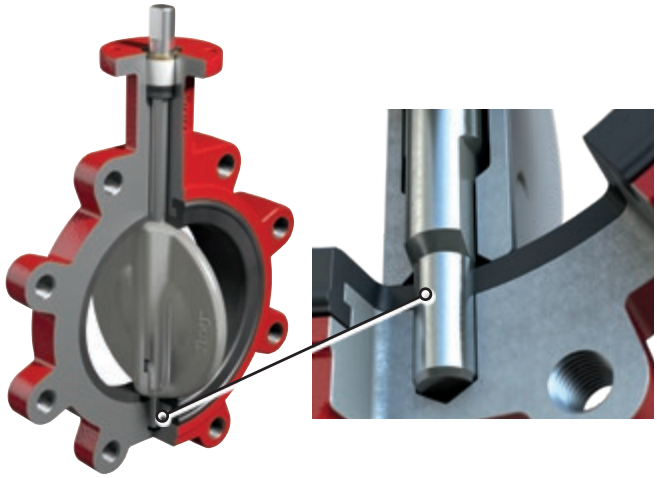
Bray's seat design and internal disc to stem connection isolates the line media from the body and stem.

INTERNAL DISC TO STEM CONNECTION

Series 30/31 Sizes 2"– 20" (50mm–500mm)

Bray offers Double "D" precision machined flats on the stem and in the disc. The Series 30/31 internal, non-wetted connections eliminate exposed external disc to stem connections.

The disc and the stem connection minimizes hysteresis and produces maximum strength engagements. All stem designs incorporate a blowout proof feature.



SEAT DESIGN

The seat is designed to seal with slip-on or weld-neck flanges and the molded o-ring eliminates the need for flange gaskets. The tongue and groove locks the seat in place and makes the valve dead end capable.



Tongue and Groove

POLYESTER COATING



The Bray standard polyester body coating is a hard, gloss red finish. The polyester coating provides excellent corrosion and wear resistance.

Chemical Resistant

Resistant to dilute acids and alkalies, petroleum solvents, alcohols, greases and oils.

Weatherability

Resistant to humidity, water and ultraviolet radiation.

Abrasion and Impact Resistant

NYLON 11 COATING

Nylon 11 has superior corrosion resistance and has been used successfully as a disc coating in many applications

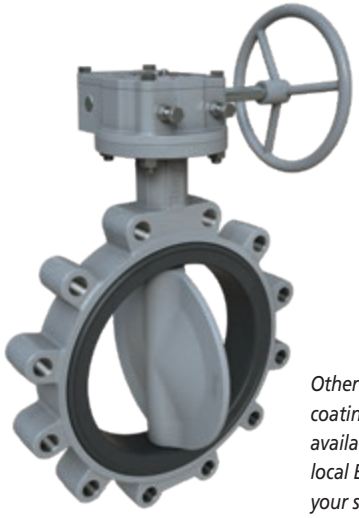
Weatherability

Bray's Nylon 11 coating has been salt spray tested in excess of 2000 hours and used in seawater immersion service for over 30 years without any deterioration of the coating resulting in no corrosion to the coated metal components.

Abrasion and Impact Resistant

SEACORR® COATING

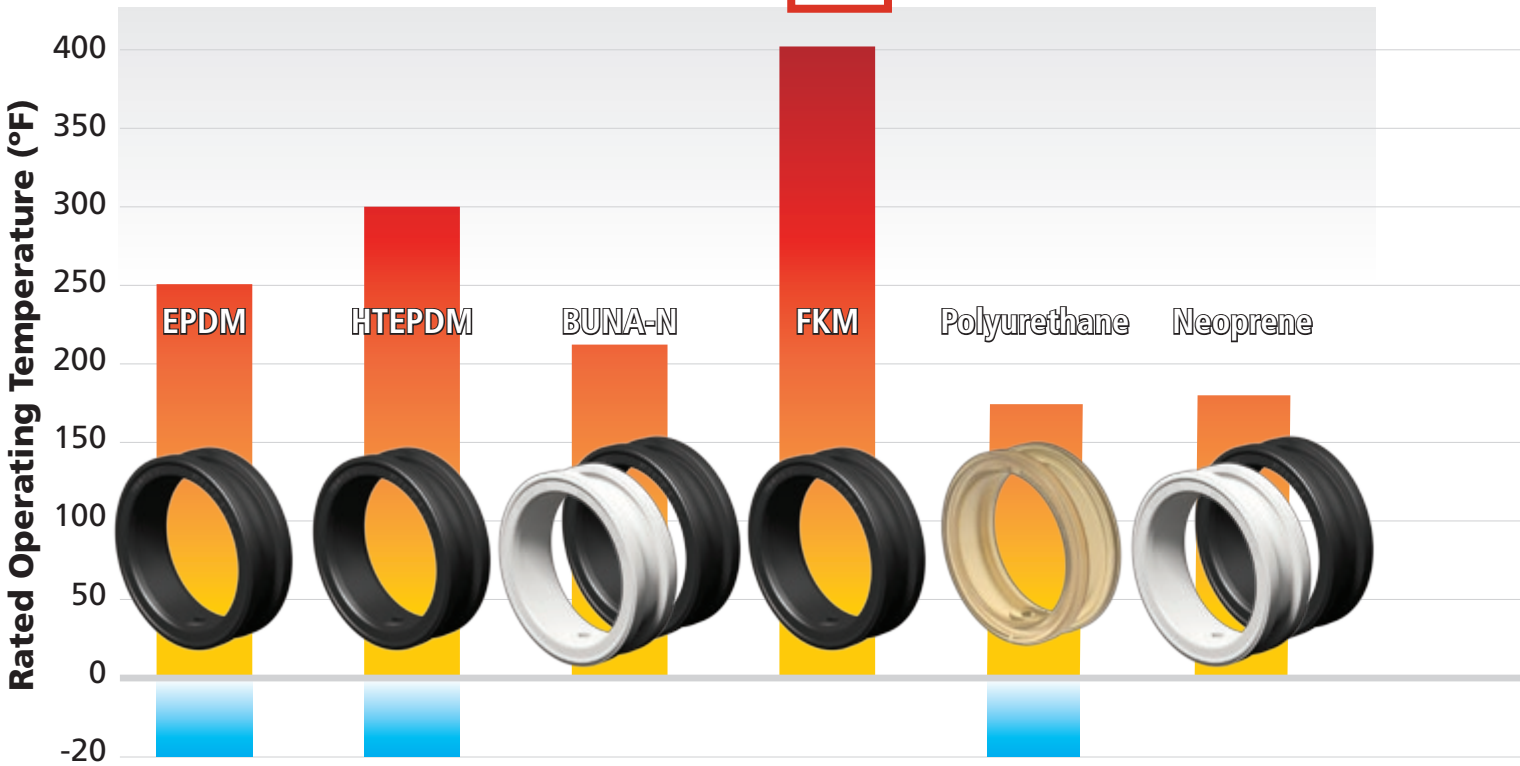
SEACORR coating provides superior protection in corrosive environments. Available as an exterior coating of valves, manual and automated actuators for harsh applications.



Other customer specified coating materials are available. Please consult your local Bray representative for your specific application.

All Bray valves are pressure tested to 110% of rated pressure to assure bubble tight shutoff.

Series 20, 21, 3A, 30, 31, 32, 33, 35, 36



PEROXIDE CURED EPDM

-20°F to 250°F (-29°C to 121°C)

Bray's peroxide cured EPDM (Ethylene Propylene Diene Monomer) seats have a higher resistance to abrasion, lower compression set, and higher temperature capabilities than sulfur cured seats.

As a standard seat offering, Bray's peroxide cured EPDM is the most universal and economical seat material used in our resilient seated butterfly valves. All of Bray's peroxide cured EPDM seats are food grade and can be certified to NSF-61.

HTEPDM

-20°F to 300°F (-29°C to 150°C)

HTEPDM is a proprietary rubber blend offered by Bray to increase the thermal resistance properties of standard EPDM and is formulated to provide long term service at elevated temperatures for hot water. HTEPDM Food Grade seats are suitable for sanitary applications as well as standard industrial uses.

BUNA-N (Black or White)

0°F to 212°F (-18°C to 100°C)

BUNA-N is the commonly used name for Nitrile synthetic rubber. Nitrile is a copolymer of acrylonitrile and butadiene. BUNA-N is sometimes referred to as NBR, Nitrile, or Hycar. BUNA-N is a general purpose seat material particularly suitable for hydrocarbon service. BUNA-N is a standard Bray seat material and food grade is available for sanitary applications.

FKM

0°F to 400°F (-18°C to 204°C)

FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (Fluoroelastomers) such as Viton® (DuPont). FKM has some outstanding characteristics such as improved acid, oil, and temperature resistance over other seat materials.

POLYURETHANE

-20°F to 175°F (-29°C to 80°C)

Polyurethane seats are primarily used because of their resistance to abrasive wear. Polyurethane can be used in a reasonably broad range of services and will withstand severe impact, recover its original shape after distortion and resist abrasion better than other elastomers.

NEOPRENE SEAT (Black or White)

0°F to 180°F (-18°C to 82°C)

Neoprene is an all-purpose polymer with desirable characteristics including high resiliency with low compression, resistance to vegetable and animal oil, and flame resistance. This sealing material is excellent for refrigerants, ammonia and Freon, and is principally used in pulp and (non-bleached) paper lines. Neoprene is not recommended for strong oxidizing acids, chlorinated solvents, esters, ketones, aromatic hydrocarbons or hydraulic fluids. White neoprene is generally used in sanitary applications while the black grade provides better abrasion and oil resistance.

The Bray Series 30/31 features a high strength one piece stem design utilizing an efficient internal disc to stem connection. This resilient seated butterfly valve provides a primary and secondary seal between the disc and seat as well as the stem and seat which ensures the total encapsulation of the line media and zero external leakage.

PRESSURE RATINGS

BIDIRECTIONAL BUBBLE TIGHT SHUT OFF – Standard Disc* Downstream flanges and disc in closed position		
Series 30/31 Standard Disc*	2"-12" (50-300mm)	175 psi (12 bar)
	14"-20" (350-500mm)	150 psi (10.3 bar)
DEAD END SERVICE – Lug Bodies and Standard Disc* No downstream flanges and disc in closed position		
Series 31	2"-12" (50-300mm)	75 psi (5.2 bar)
	14"-20" (350-500mm)	50 psi (3.4 bar)
BODY: 250 psi (17.2 bar)		

*For low pressure (50 psi) applications, Bray offers a standard reduced disc diameter to decrease seating torques and extend seat life, thus increasing the valve's performance and reducing actuator costs.

VELOCITY LIMITS FOR ON/OFF SERVICES

FLUIDS: 30 ft/sec (9 m/s)	**GASES:** 175 ft/sec (54 m/s)



1 – **STEM RETAINING ASSEMBLY:** The stem is retained in the body by means of a unique stainless steel Spirolox® retaining ring, a thrust washer and two C-rings, manufactured from brass as standard, stainless steel upon request.

2 – **STEM BUSHING:** Non-corrosive, heavy duty acetal bushing absorbs actuator side thrust.

3 – **STEM SEAL:** Double "U" cup seal design is self-adjusting and gives positive sealing in both directions.

4 – **PRIMARY AND SECONDARY SEALS:** These seals prevent line media from coming in contact with the stem or body. The primary seal is an interference fit of the molded seat flat with the disc hub. The secondary seal is created because the stem diameter is greater than the diameter of the seat stem hole.

5 – **BODY:** One piece wafer or lug style. Polyester coating for excellent corrosion resistance. Nylon 11 coating is available as an option.

6 – **SEAT:** Bray's tongue and groove seat design provides complete isolation of flowing media from the body. The seat also features a molded o-ring which eliminates the use of flange gaskets.

7 – **DISC:** Casting is spherically machined and hand polished to provide a bubble tight shutoff, minimum torque, and longer seat life. Bray's resilient Nylon 11 coating comes as standard.

8 – **STEM:** Precision double "D" disc to stem connection drives the disc without the need for screws or pins. The close tolerance, double "D" connection that drives the valve disc is an exclusive feature of the Bray valve. Disassembly of the Bray stem is just a matter of pulling the stem out of the disc.



MATERIAL SELECTION OPTIONS

BODY	DISC	STEM	SEAT
Cast Iron✦	Nylon 11 Coated Ductile Iron✦	416 Stainless Steel✦	BUNA-N Food Grade✦
Ductile Iron✦	316 Stainless Steel✦	304 Stainless Steel	EPDM Food Grade✦
Carbon Steel	Nickel Aluminum Bronze	316 Stainless Steel	FKM*
Aluminum	Coated Ductile Iron	Monel® K500	White BUNA-N Food Grade
	Halar® Coated Ductile Iron		Bonded EPDM
	304 Stainless Steel		Bonded BUNA-N
	Duplex Stainless Steel		
	Super Duplex Stainless Steel		
	Hastelloy®		

✦Standard Option

*FKM is the ASTM D1418 designation for fluorinated hydrocarbon elastomers (also called fluoroelastomers).

Monel® is a registered trademark of The International Nickel Company, Inc.

Halar® is a registered trademark of Solvay Solexis, Inc.

Hastelloy® is a registered trademark of Haynes International, Inc.



SERIES 31H

2"-20" (50mm-500mm)

Series 31H Lug valves are drilled and tapped to meet ASME Class [illegible]/150 and PN16 flanges. Series 31H valves are designed for manual operation only.

PRESSURE RATINGS

BIDIRECTIONAL BUBBLE [illegible] SHUT-OFF AND DEAD END SERVICE	
2"-20" (50-500mm)	250 psi (17.2 bar)
BODY: [illegible] psi (17.2 bar)	

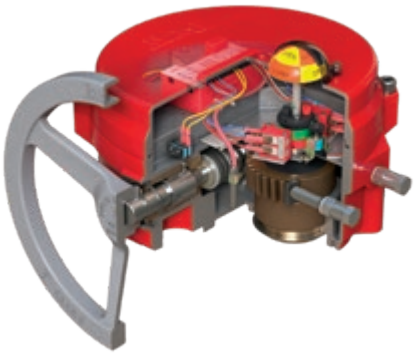
VELOCITY LIMITS FOR ON/OFF SERVICES

FLUIDS: 30 ft/sec (9 m/s)	**GASES:** 175 ft/sec (54 m/s)

STANDARD MATERIAL SELECTIONS

Body	Cast Iron Ductile Iron
Disc	Nickel Aluminum Bronze Nylon 11 Coated Ductile Iron 316 Stainless Steel
Stem	416 [illegible]inless Steel
Seat	Bonded EPDM Bonded BUNA-N

Material availability depends on valve size and series. Other materials are available. Please consult your local Bray representative for your specific application.



SERIES 70 ELECTRIC ACTUATOR

Low profile, compact, high output actuator for quarter turn applications

- On/Off or modulating (Servo NXT)
- Manual declutchable handwheel
- Optional Seacorr® coating for harsh environments
- High visibility dome position indicator
- Network protocols available

Voltages	120, 220, 24VAC 50/60 Hz, 1-phase, 24VDC
Output Torque	300 to 18,000 lb-ins (34 to 2,034 Nm)
Standard Enclosure	NEMA Type 4, 4X
Explosion Proof (Optional)	NEMA Type 4, 4X, 7, 9 Class I, Div 1 & 2, Group C, D Class II, Div 1 & 2, Group E, F, and G





Extreme High Temperature Actuator



Stainless Steel Actuator

SERIES 92/93 PNEUMATIC ACTUATOR

Rack and pinion actuators available in double acting and spring return

- Standard units have anodized aluminum bodies with polyester coated end caps
- SIL 3 capable
- Optional Seacorr® coating for harsh environments
- Integral porting
- Internal bidirectional travel stops

Torque	Double Acting up to: 44,130 lb-in (4,986 Nm) Spring End Torque up to: 14,173 lb-in (1,601 Nm)	
Pressure Range	40 - 140 psi (2.8 - 10 bar)	
Media	Dry Compressed Air/Inert Gas*	
Temperature Range	Standard	-4°F to 200°F (-20°C to 93°C)
	Low	-40°F to 176°F (-40°C to 80°C)
	High	0°F to 300°F (-18°C to 149°C)
	Extreme High Temperature	0°F to 482°F (-18°C to 250°C)



Pneumatic Actuator



Hydraulic Actuator



Self-Contained Electro-Hydraulic Actuator

SERIES 98 SCOTCH YOKE ACTUATORS

For quarter turn rotary operation

- Low Pressure Pneumatic Actuator
- High Pressure Hydraulic Actuator
- Optional Self-Contained Integral Hydraulic Power Pack or Centralized Hydraulic Power Unit to power multiple hydraulic actuators.
- Compact design with a high torque to weight ratio
- Modular design offers easy configuration in the field
- Premium epoxy/polyurethane coating as standard
- SIL 3 capable
- Pressure Equipment Directive (PED) 97/23/EC compliant
- Standardized interfaces: ISO 5211, VDI/VDE 3845 for accessories

Optional

- Manual overrides
- Hydraulic dampener for fast acting operation, lockout/pst device
- Lockout/PST device

Torque	Double Acting: Pneumatic or Hydraulic up to: 885,000 lb-in (100,000 Nm)	
	Spring Return (Spring End): Pneumatic or Hydraulic up to 445,261 lb-in (50,306 Nm)	
Pressure Range	Pneumatic: 40 - 150 psi (2.8 - 10.3 bar) Hydraulic: 500 - 3000 psi (35 - 207 bar)	
Media	Pneumatic: Dry compressed air/inert gas Hydraulic: Hydraulic Fluid (Standard Trim) ISO VG 32/46, ISO-L-HV, flash point >157°C	
Temperature Range	Standard	-4°F to 200°F (-20°C to 93°C)
	High Temperature	Up to 300°F (149°C)
	Low Temperature	Down to -50°F (-46°C)



SERIES 6A ELECTRO-PNEUMATIC POSITIONER

> Precision digital control
> Zero bleed design
> Compatible with rotary or linear actuators for single and double acting applications
> Various housing options available
> Precise, microprocessor driven flow control and advanced communication
> Non-contacting position sensor technology
> Integral volume booster
> Connective and preventative maintenance self-diagnostic checks



SERIES 6P PNEUMATIC POSITIONER

> Pneumatic to pneumatic positioner for single and double acting actuators
> Rugged aluminum diecast housing for harsh environments
> Minimal setup time for zero and span adjustment
> Split range capabilities
> High visibility dome position indicator
> Optional 2 x SPDT mechanical switches



SERIES 5A, 5B AND 5C VALVE STATUS MONITORS

> Discrete status monitor for quarter turn rotary actuators
> NEMA 4, 4X and IP66 and IP67 ingress protection
> Intrinsically safe or explosion-proof options for hazardous locations
> High visibility dome position indicator
> Up to 6 SPDT switches or non-contacting proximity switches
> Switches pre-wired to internal terminal block
> Available in die-cast aluminum housing coated with 2-layers of polyester or fiberglass reinforced PBT housing for highly corrosive environments



SERIES 54 VALVE PROXIMITY SENSOR

> Dual proximity sensors for valve position
> NEMA 4, 4X and IP66, IP67, IP69K ingress protection available
> Available solenoid outputs
> 2 or 3 wire DC, AC/DC, intrinsically safe, and AS-i interface
> Pin connector or conduit versions available



SERIES 63 SOLENOID VALVES

> Weatherproof NEMA 4, 4X and explosion proof housings available
> Flying leads or DIN connectors, single or dual coil
> 5/2 or 3/2 operation
> NAMUR mounted
> High flow up to 1.4 Cv
> Intrinsically safe versions available
> Available voltages: 12, 24 VDC; 24, 110, 220 VAC

SINCE 1986, BRAY HAS PROVIDED FLOW CONTROL SOLUTIONS FOR A VARIETY OF INDUSTRIES AROUND THE WORLD.

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Bray International, Inc.
13333 Westland East Blvd.
Houston, Texas 77041
Tel: +1.281.894.5454

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THE HIGH PERFORMANCE COMPANY

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RESILIENT SEATED BUTTERFLY VALVES

TECHNICAL SALES MANUAL



Bray®

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Torques

INTRODUCTION TO TORQUES

There are a number of torques which butterfly valves may experience such as:

- **T_{su} - Seating and Unseating Torque**
- **T_d - Dynamic Torque Resulting from fluid flow**
- **T_{bf} – Bearing Friction Torque**
- **T_{ss} – Stem Seal Friction Torque**
- **T_e – Eccentricity Torque resulting from disc offset from centerline of stem (either single, double or triple offset)**
- **T_h – Hydrostatic Torque**

Factors which influence the butterfly valve torque values shown above are:

- Type of Seat and Seat Material
- Interference of Seat I.D. and Disc O.D.
- Shaft Diameter
- Valve Diameter
- Bearing Coefficient of Friction
- Angle of Opening
- Shut-off Pressure
- Fluid Velocity
- Disc Shape and Configuration
- Piping System and Location/Orientation of Valve in Pipe Line
- System Head Characteristics
- Physical Size of Disc/Shaft Obstructing Flow
- Disc Edge Finish

With respect to Butterfly Valves, the two major conditions for determining total valve operating torque (T_T) exists as follows:

CASE I (Angle = 0° , Disc in Closed Position)

$$T_T = T_h + T_{bf} + T_{ss} + T_{su}$$

Analyzed

Total Torque for Case I using a symmetrical disc butterfly valve is the sum of hydrostatic torque, bearing friction torque, stem seal, friction torque, and seating/unseating torque.

A. Hydrostatic Torque (T_h)

We will ignore discussion of the hydrostatic torque values as they are generally insignificant compared to the seating/unseating, bearing friction and stem seal torque values (the safety factor applied to seating/unseating, stem seal friction and bearing friction torque values more than compensates for the hydrostatic torque which is usually less than 2% of these total torques).

B. Bearing Friction Torque (T_{bf})

Bearing friction torque occurs because pressure forces against the disc are transmitted to the stem. As the stem is forced against the bearing supports, bearing friction torque is created between the stem material and the support material as the stem is turned. Bearing friction torques are normally included in the seating/unseating torque values.

Bearing friction torques can be determined by using the following equation:

$$T_{bf} = .785\ C_f\ D_v^2\ (d/2)\ \Delta P$$

Where:

- T_{bf} = Bearing Friction Torque
- C_f = Coefficient of Friction (approximately .25 for non-corroded stem to cast iron body) (dimensionless).
- D_v = Valve Diameter (Inches)
- d = Diameter of Shaft (Inches)
- ΔP = Pressure Differential (psi)

C. Stem Seal Friction Torque (T_{ss})

For all practical purposes stem seal friction torque values are insignificant when compared to seating/unseating and bearing friction torques. Stem seal friction torques are normally included in the seating/unseating torque values.

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D. Seating/Unseating Torques (T_{su})

The seating/unseating torque value (T_{su}) is a function of the pressure differential, the seat material's coefficient of friction, the finished surface of the disc edge, the amount of interference between the seat I.D. and disc O.D. when flanged in piping, the seat thickness, and the type of service (media) for which the valve is being used. In determining the T_{su} values for Bray resilient seated butterfly valves, Bray has developed Seating/Unseating Torque Charts incorporating all bearing friction and stem seal friction torques for three classes of services for both the valves with standard discs (rated to full pressure) and for valves with reduced diameter discs (rated for 50 psi [3.5 bar]). The three service classes are:

Class A – Non-Corrosive, Lubricating Service

Class B – General Service

Class C – Severe Service

Please review the guidelines for each class in the technical manual when determining which Seating/Unseating Torque Class should be used. Most butterfly valves are used in Class II, General Service applications.

E. Total Torque (T_T)

The total torque values for Bray symmetrical disc valves for Case I applications are shown in the Seating/Unseating Torque Charts within this manual.

CASE II (Disc in Partial To Full Opening Position)

$$T_T = T_{bf} + T_{ss} + T_d$$

The total Torque for Case II using a symmetrical disc butterfly valve is the summation of bearing friction torque, stem seal friction torque and dynamic torque.

A. Bearing Friction Torque (T_{bf})

See Case I discussion. This torque value is normally included in the Dynamic Torque Value.

B. Stem Seal Friction Torque (T_{ss})

See Case I discussion. This torque value is normally included in the Dynamic torque value.

C. Dynamic Torque (T_d)

In a symmetrical disc design, dynamic torque occurs between the closed position, 0° and the full open position, 90°. With the disc in the partially open position, velocity of the fluid passing the leading disc edge is less than the velocity passing the trailing edge. This variance in velocity past the leading disc edge and trailing disc edge results in an unbalanced distribution of pressure forces on the upstream side of the face of the disc. The total pressure forces acting perpendicular to the disc face on the leading edge half of the disc are greater than the total pressure acting perpendicular on the trailing half of the disc. This uneven distribution of pressure on the disc face (exists on both sides of the disc) results in a torsional force which tries to turn the disc to the closed position **(Figure 1)**. This torsional closing force can become greater than the seating/unseating torque value depending on the valve angle of opening and differential pressure.

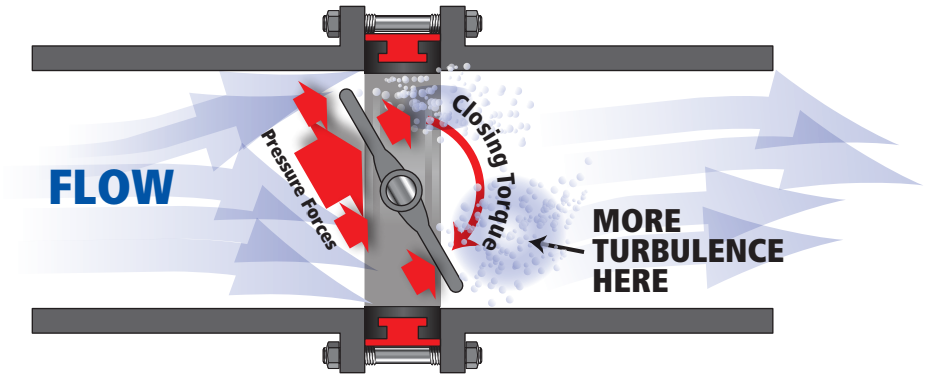
To determine dynamic torque, the following equation is applied:

$$T_d = C_{dt}\, d^3\, \Delta P$$

Where:

- T_d = Dynamic Torque (lbs- in).
- C_{dt} = Coefficient of Dynamic Torque (based on disc shape and angle of opening) (dimensionless)
- d = Diameter of Disc (Inches)
- ΔP = Pressure Differential Across Valve (psi)

Figure 1 - Pressure Distribution



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As shown in **Figure 2**, coefficient of dynamic torque for Bray's symmetrical disc valves is at 0° angle of opening and increases until the angle of opening reaches 75°-80°, where it then decreases to a zero value at full open (90°) (no internal friction factors considered, just dynamic torque only).

One final comment about dynamic torque is that one may minimize the dynamic torque by the orientation of the valve (stem horizontal or vertical) in the pipeline as well as by the location (distance) in the pipeline from elbows, other valves, etc. (See Bray Resilient Seated BFV Operations and Maintenance Manual).

D. Total Torque (T_T)

The total torque required for operating a Bray symmetrical disc butterfly valve at an angle opening between 0° and 90° is shown in the Dynamic Torque section of this manual. Note that the dynamic torque includes all internal friction torque values.

CONCLUSION

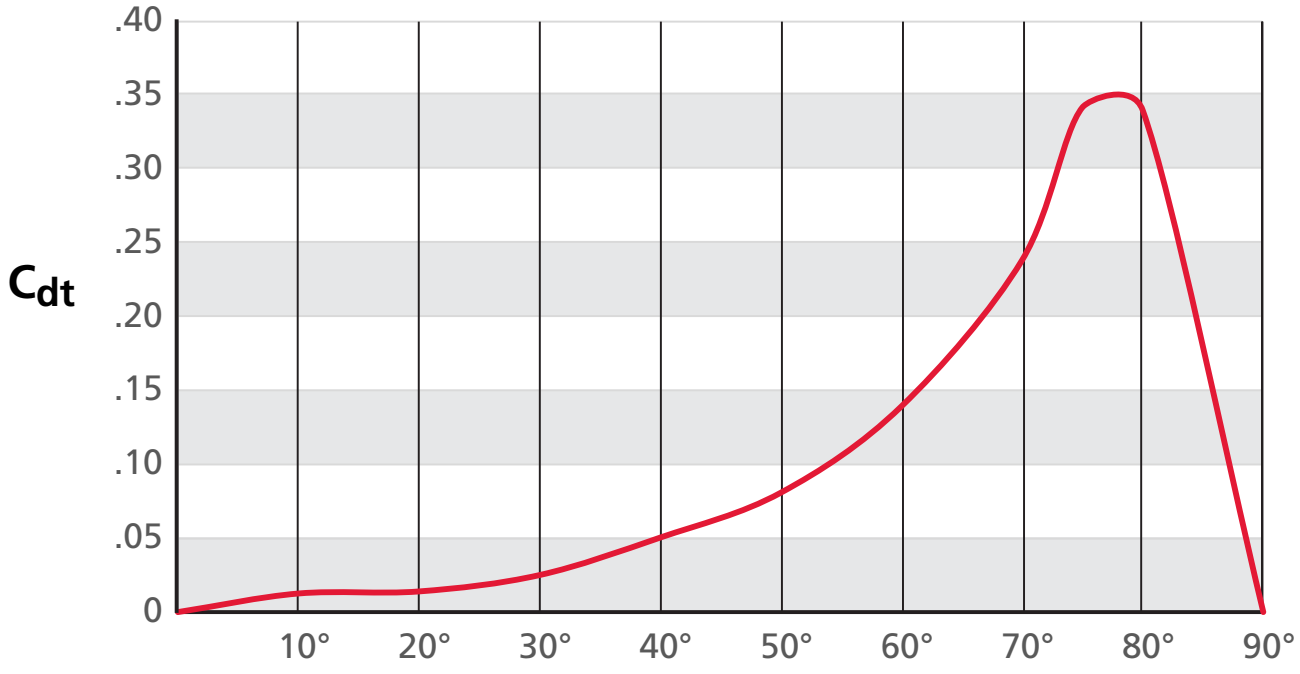
In most applications for butterfly valves, especially 20˝ (DN 500) or smaller, the maximum torque required to operate the valve will be seating/unseating torque. However, dynamic torque should be considered particularly in:

- Control applications using larger valves (24˝ [DN600] and above) where the disc is maintained in the open position
- Applications using larger valves (24˝ [DN 600] and above) where the velocity is high (16 ft./sec [4.9m/sec]).

Figure 2 - Angle of Opening

The C_{dt} value for Bray symmetrical disc valves are approximately:

Angle of Opening	0°	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
C_{dt}	0	0.0126	0.0140	0.0251	0.0505	0.0809	0.1394	0.2384	0.3419	0.3400	0



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REDUCED DISC DIAMETER BRAY SERIES 30/31/3A VALVES

Bray offers a reduced disc diameter for 4"-20" for Series 30, 31 and 3A valves. The purpose of reducing the disc diameter is to decrease the seating/unseating torques and extend the seat life on low pressure applications.

By reducing the disc diameter, the interference between the disc O.D. and seat I.D. is decreased and the valve pressure rating, which is a function of this interference, is reduced to 50 PSI. Less interference between the disc and seat results in reduced seating/unseating torques. Lower seating/unseating torque may allow for the use of a smaller actuator on the valve. In other applications where abrasive dry bulk materials such as cement, sugar, plastic, pellets, flour, etc., are generally pneumatically conveyed at 50 PSI or less, the reduced disc diameter not only reduces the seating/unseating torque but, very importantly, usually significantly increases the service life of the seat.

Bray does the following to differentiate reduced diameter discs from full diameter discs:

Metal Discs: An " R " is stamped above the part number

Nylon 11 Coated Discs: Discs are differentiated by the color of the Nylon 11:

Grey – Full Disc Diameter

White – Reduced Disc Diameter

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SEATING & UNSEATING TORQUES

Bray has developed Seating/Unseating Torque Charts for three Classes of Service for its valves with standard discs (rated for full pressure) and for valves with reduced diameter discs (rated for 50 PSI / 3.5 bar.).

The guidelines for selecting a Class to be used for determining a valve's seating/unseating torque are given below. Each valve application should comply with all five Class characteristics in order to be qualified for that Class.

Characteristics of Application	**Class A** Non-Corrosive, Lubricating Service	**Class B** General Service	**Class C** Severe Service
Media Type	Lubricating hydrocarbons; Aqueous processes and Water (See Note 1)	Water; aqueous processes; all other aqueous liquids including salt water; Lubricating gases	Dry, non-lubricating such as air, dry gas, cement, pneumatic conveying mediums
Corrosion by Media	Insignificant if any	No major corrosion or deposits from media	Can incur significant corrosion such as Ductile Iron disc in water
Chemical Reactions of Media with Seat	Insignificant if any	Only minor or insignificant in nature	Reactions causing swelling and hardness occur
Media Temperature	45º to 160ºF (7º to 71ºC)	Within seat temperature limits, not near limits	Near or at seat temperature limits
Frequency of Valve Cycling	Once weekly or more frequently	Minimum once every 3-6 weeks, or more frequently	Infrequently, sometimes not cycled for long periods

NOTE:

1. For aqueous processes and water, Class A torques may be used only if a Nylon 11 coated disc is selected and all other Class A characteristics apply. Otherwise, Class B torques should be used.
2. All the material trims may be classified into Class A, B, or C except Series 20/21 valves with a PTFE Lined Elastomer seat, PTFE molded disc/stem, or rubber molded disc/stem. These trims must always use Class C Seating/Unseating Torque Values unless they are used only in a throttling application. Valves with bonded seats must always be classified as Class C.
3. If a valve is used strictly in a throttling application, that is, it is never put in the closed position but throttled between 20° and 80°, then Class A torques may be used provided you have checked to see that dynamic torques do not exceed the Class A torque values.
4. With the exception of dry, non-lubricating medias, one is usually safe electing to use Class B torques for sizing actuators for all other valve service applications. Seating/Unseating Torque values shown include friction bearing torques for stated differential pressure.
5. Dynamic Torque values are not considered. See the Dynamic Torque chart in this manual for determination of Dynamic Torque.
6. Do not apply a safety factor to torque values when determining actuator output torque requirement.
7. **For 3-way assemblies where one valve is opening and another is closing, multiply torque by a 1.5 factor.**

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Series 20/21 and 30/31/3A Torques Imperial (Lb-Ins)

	Valve Size Inches	Valve Differential Pressure (PSIG)						
		Full Disc					Reduced Disc	
		0 psi	50 psi	100 psi	150 psi	175 psi	0 psi	50 psi
Class A Non-Corrosive, Lubricating Service	1	54	59	65	70	73	54	59
	1.5	81	86	91	97	100	81	86
	2	109	114	119	123	128	109	114
	2.5	169	178	187	196	200	169	178
	3	220	236	250	264	273	220	236
	4	341	364	387	410	423	225	248
	5	510	560	610	660	687	324	374
	6	632	712	792	872	912	344	488
	8	1,182	1,341	1,500	1,660	1,741	735	894
	10	1,764	2,018	2,272	2,526	2,653	1,204	1,358
	12	2,701	3,110	3,519	3,928	4,132	1,665	2,074
	14	3,818	4,500	5,182	5,864	—	2,318	3,000
	16	4,638	5,819	7,000	8,182	—	2,699	3,880
	18	5,265	7,065	8,865	10,665	—	2,970	4,788
	20	7,000	9,364	11,728	14,091	—	3,356	6,243
Class B General Service	1	59	65	71	77	80	59	65
	1.5	89	95	100	106	110	89	95
	2	120	125	130	135	140	120	125
	2.5	185	195	205	215	220	185	195
	3	245	260	275	290	297	245	260
	4	375	400	425	450	462	252	267
	5	560	615	670	725	755	355	410
	6	695	783	871	953	1,003	427	537
	8	1,300	1,475	1,650	1,825	1,915	808	983
	10	1,960	2,240	2,520	2,800	2,940	1,213	1,493
	12	2,970	3,420	3,870	4,320	4,545	1,830	2,280
	14	4,200	4,950	5,700	6,450	—	2,550	3,300
	16	5,100	6,400	7,700	9,000	—	2,967	4,267
	18	5,850	7,850	9,850	11,850	—	3,267	5,267
	20	7,700	10,300	12,900	15,500	—	4,267	6,867
Class C Severe Service	1	74	82	89	97	100	74	82
	1.5	111	119	125	133	137	111	119
	2	151	157	163	169	175	151	157
	2.5	231	244	257	269	275	231	244
	3	306	325	344	363	375	306	325
	4	468	500	532	563	582	316	348
	5	700	769	838	907	944	444	513
	6	870	980	1,090	1,200	1,255	525	672
	8	1,625	1,844	2,063	2,282	2,394	1,011	1,230
	10	2,450	2,800	3,150	3,500	3,675	1,517	1,867
	12	3,712	4,275	4,838	5,400	5,682	2,287	2,850
	14	5,251	6,188	7,125	8,063	—	3,189	4,126
	16	6,375	8,000	9,625	11,250	—	3,709	5,334
	18	7,315	9,815	12,315	14,815	—	4,084	6,584
	20	9,625	12,875	16,125	19,375	—	5,334	8,584

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Series 20/21 and 30/31/3A Torques Metric (Nm)

	Valve Size mm	Valve Differential Pressure (bar)						
		Full Disc					Reduced Disc	
		0 bar	3.4 bar	7 bar	10.3 bar	12 bar	0 bar	3.4 bar
Class A Non-Corrosive, Lubricating Service	25	6	7	7	8	8	6	7
	40	9	10	10	11	11	9	10
	50	12	13	13	14	14	12	13
	65	19	20	21	22	23	19	20
	80	25	27	28	30	31	25	27
	100	39	41	44	46	48	25	28
	125	58	63	69	75	78	37	42
	150	71	80	89	99	103	39	55
	200	134	152	169	188	197	83	101
	250	199	228	257	285	300	136	153
	300	305	351	398	444	467	188	234
	350	431	508	585	663	—	262	339
	400	524	657	791	924	—	305	438
	450	595	798	1,002	1,205	—	336	541
	500	791	1,058	1,325	1,592	—	379	705
Class B General Service	25	7	7	8	9	9	7	7
	40	10	11	11	12	12	10	11
	50	14	14	15	15	16	14	14
	65	21	22	23	24	25	21	22
	80	28	29	31	33	34	28	29
	100	42	45	48	51	52	28	30
	125	63	69	76	82	85	40	46
	150	79	88	98	108	113	48	61
	200	147	167	186	206	216	91	111
	250	221	253	285	316	332	137	169
	300	336	386	437	488	514	207	258
	350	475	559	644	729	—	288	373
	400	576	723	870	1,017	—	335	482
	450	661	887	1,113	1,339	—	369	595
	500	870	1,164	1,458	1,751	—	482	776
Class C Severe Service	25	8	9	10	11	11	8	9
	40	13	13	14	15	15	13	13
	50	17	18	18	19	20	17	18
	65	26	28	29	30	31	26	28
	80	35	37	39	41	42	35	37
	100	53	56	60	64	66	36	39
	125	79	87	95	102	107	50	58
	150	98	111	123	136	142	59	76
	200	184	208	233	258	270	114	139
	250	277	316	356	395	415	171	211
	300	419	483	547	610	642	258	322
	350	593	699	805	911	—	360	466
	400	720	904	1,087	1,271	—	419	603
	450	826	1,109	1,391	1,674	—	461	744
	500	1,087	1,455	1,822	2,189	—	603	970

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DYNAMIC TORQUE FACTORS (IMPERIAL)

To Use the Torque Chart, note the following:

1. Dynamic Torque values include all bearing friction and stem-seal friction torques.
2. Dynamic Torque values are per 1 PSI ΔP. To determine dynamic torque (lb-in) at a desired angle of opening, multiply the pressure drop ΔP at this angle by the appropriate dynamic torque factor in the charts below.
3. Bray recommends sizing control valves between 20° and 70°, with 60° the preferred angle.
4. Dynamic Torque will tend to close all Bray valves whose disc are symmetrical to the stem.

Series 20/21 and 30/31/3A (Dynamic Torque Factor - lb-in./psi)

Valve Size in.	Angle of Opening									
	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
2″	0.11	0.13	0.23	0.45	0.73	1.25	2.14	3.07	3.05	0.00
2.5″	0.22	0.24	0.43	0.87	1.39	2.39	4.09	5.86	5.83	0.00
3″	0.37	0.41	0.73	1.47	2.36	4.07	6.95	9.97	9.92	0.00
4″	0.86	0.95	1.70	3.43	5.49	9.45	16.17	23.19	23.07	0.00
5″	1.65	1.83	3.29	6.61	10.59	18.25	31.22	44.77	44.53	0.00
6″	2.49	2.77	4.97	10.00	16.01	27.59	47.19	67.68	67.32	0.00
8″	6.60	6.74	12.08	24.30	38.93	67.07	114.71	164.51	163.64	0.00
10″	11.99	13.32	23.89	48.06	76.99	132.65	226.86	325.35	323.64	0.00
12″	20.89	23.21	41.62	83.74	134.14	231.14	395.30	566.91	563.93	0.00
14″	30.04	33.38	59.84	120.40	192.87	332.34	568.37	815.12	810.83	0.00
16″	45.65	50.72	90.94	182.97	293.12	505.07	863.76	1238.76	1232.24	0.00
18″	65.91	73.23	131.30	264.16	423.18	729.18	1247.04	1788.44	1779.02	0.00
20″	91.42	101.57	182.11	366.39	586.95	1011.37	1729.64	2480.55	2467.50	0.00

Example: 4″ Valve; 60° Open with a 10 PSI pressure drop: [Td = (9.454)(10) = 94.54 lb-in]

Series 32/33, 35/36 (Dynamic Torque Factor - lb-in./psi)

Valve Size in.	Angle of Opening									
	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
24″	158.36	175.95	315.46	634.69	1016.76	1751.99	2996.23	4297.03	4274.40	0.00
30″	315.32	350.35	628.13	1263.77	2024.54	3488.51	5966.01	8556.12	8511.07	0.00
36″	551.88	613.21	1099.39	2211.92	3543.45	6105.77	10442.00	14975.33	14896.49	0.00
Larger Size Valves - Consult Factory										

Example: 24″ Valve; 60° Open with a 10 PSI pressure drop: [Td = (1,751.990)(10) = 17,519.90 lb-in]

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DYNAMIC TORQUE FACTORS (METRIC)

To Use the Torque Chart, note the following:

1. Dynamic Torque values include all bearing friction and stem-seal friction torques.
2. Dynamic Torque values are per 1 bar ΔP. To determine dynamic torque (Nm) at a desired angle of opening, multiply the pressure drop ΔP at this angle by the appropriate dynamic torque factor in the charts below.
3. Bray recommends sizing control valves between 20° and 70°, with 60° the preferred angle.
4. Dynamic Torque will tend to close all Bray valves whose disc are symmetrical to the stem.

Series 20/21 and 30/31/3A (Dynamic Torque Factor - Nm/bar)

Valve Size mm.	Angle of Opening									
	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
50	0.19	0.21	0.37	0.74	1.19	2.05	3.51	5.03	5.00	0.00
65	0.35	0.39	0.70	1.42	2.27	3.91	6.69	9.60	9.55	0.00
80	0.60	0.67	1.20	2.41	3.87	6.66	11.39	16.34	16.25	0.00
100	1.40	1.56	2.79	5.61	8.99	15.49	26.49	38.00	37.80	0.00
125	2.70	3.00	5.39	10.84	17.36	29.91	51.16	73.36	72.98	0.00
150	4.09	4.54	8.14	16.38	26.24	45.22	77.33	110.91	110.32	0.00
200	10.82	11.04	19.79	39.82	63.79	109.91	187.97	269.58	268.16	0.00
250	19.65	21.83	39.14	78.75	126.16	217.38	371.76	533.16	530.35	0.00
300	34.24	38.04	68.20	137.22	219.82	378.77	647.77	929.00	924.11	0.00
350	49.23	54.70	98.06	197.29	316.06	544.61	931.38	1335.74	1328.71	0.00
400	74.81	83.12	149.03	299.83	480.33	827.66	1415.46	2029.97	2019.28	0.00
450	108.01	120.01	215.15	432.88	693.46	1194.92	2043.53	2930.72	2915.29	0.00
500	149.80	166.45	298.42	600.40	961.83	1657.34	2834.37	4064.89	4043.50	0.00

Example: 100 mm Valve; 60° Open with a .75 bar pressure drop: [Td = (15.49)(.75) = 11.62 Nm]

Series 32/33, 35/36 (Dynamic Torque Factor - Nm/bar)

Valve Size mm	Angle of Opening									
	10°	20°	30°	40°	50°	60°	70°	75°	80°	90°
600	259.50	288.34	516.94	1040.07	1666.17	2871.00	4909.94	7041.56	7004.49	0.00
750	516.71	574.13	1029.33	2070.95	3317.62	5716.65	9776.53	14020.96	13947.15	0.00
900	904.38	1004.86	1801.57	3624.68	5806.67	10005.56	17111.37	24540.17	24410.97	0.00
Larger Size Valves - Consult Factory										

Example: 600 mm Valve; 60° Open with a .75 bar pressure drop: [Td = (2871)(.75) = 2153.25 Nm]

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VALVE SIZING COEFFICIENTS

1. **Valve Sizing Coefficients (Cv)**..... Pages 15-16

1. **Cv** stands for **Valve Sizing Coefficient**, sometimes called the **Flow Rate Coefficient**.
2. **Cv** varies with the valve size, angle of opening and the manufacturer's valve style.
3. **Cv** is defined as the volume of water in USGPM that will flow through a given restriction or valve opening with a pressure drop of one (1) psi at room temperature.

2. **Valve Sizing Coefficients (Kv)**..... Pages 17-18

1. **Kv** stands for **Valve Sizing Coefficient**, sometimes called the **Flow Rate Coefficient**.
2. **Kv** varies with the valve size, angle of opening and the manufacturer's valve style.
3. **Kv** is defined as the volume of water in Cubic Meters/Hour (m^3/hr) that will flow through a given restriction or valve opening with a pressure drop of one (1) bar at room temperature.

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Series 30/31/31H/3A/3AH/31U - Valve Sizing Coefficient (Cv)

Valve Size Inches	Disc Position (Degrees)								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
2	0.8	7	16	27	43	61	84	114	144
2.5	1	11	24	43	67	107	163	223	282
3	2	15	35	61	96	154	267	364	461
4	3	27	62	109	171	274	496	701	841
5	5	43	98	170	268	428	775	1,146	1,376
6	6	56	129	225	354	567	1,025	1,542	1,850
8	12	102	241	421	680	1,081	1,862	2,842	3,316
10	19	162	382	667	1,076	1,710	2,948	4,525	5,430
12	27	235	555	1,005	1,594	2,563	4,393	6,731	8,077
14	34	299	756	1,320	2,149	3,384	5,939	8,874	10,538
16	45	397	1,001	1,749	2,847	4,483	7,867	11,761	13,966
18	58	507	1,281	2,237	3,643	5,736	10,065	14,496	17,214
20	72	632	1,595	2,786	4,536	7,144	12,535	18,812	22,339

Series 32/33/35/36/35F/36H - Valve Sizing Coefficient (Cv)

Valve Size Inches	Disc Position (Degrees)								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
22	103	916	2,070	3,510	5,640	9,036	14,562	22,028	27,168
24	259	1,028	2,387	4,244	6,962	11,040	18,235	27,186	33,154
26	289	1,141	2,752	4,890	7,824	12,496	19,921	29,700	36,220
28	295	1,324	3,133	5,399	8,636	13,838	22,578	34,683	41,619
30	420	1,652	3,986	7,080	11,328	18,090	28,844	43,003	52,443
32	550	2,026	4,636	7,983	12,743	20,410	32,591	48,558	60,658
34	533	2,304	5,210	8,834	14,179	22,741	36,648	55,438	68,374
36	740	2,775	5,936	9,790	15,572	25,053	40,086	59,667	77,089
40	757	2,971	6,925	11,862	19,307	30,636	50,406	73,990	90,175
42	783	3,502	7,879	12,997	21,010	35,016	54,584	83,421	102,989
44	904	4,066	8,698	14,346	22,818	36,712	58,740	87,430	112,960
48	1,023	4,651	10,365	17,010	27,242	43,853	70,431	108,968	132,888
52	Consult Factory								
54	1,299	5,904	13,158	21,594	34,583	55,671	89,411	138,334	168,700
60	1,480	6,400	14,500	24,500	39,400	63,200	102,000	154,000	190,000
66	1,650	7,110	16,100	27,300	43,800	70,200	113,000	171,000	211,000
72	1,900	8,220	18,600	31,500	50,700	81,200	131,000	198,000	244,000
78	2,290	9,910	22,400	38,000	61,000	97,800	158,000	238,000	294,000
84	2,290	11,390	25,800	43,700	70,200	112,400	181,000	274,000	338,000
90	Consult Factory								
96	Consult Factory								

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Series 30/31/31H/3A/3AH/31U - Valve Sizing Coefficient (Kv)

Valve Size mm	Disc Position (Degrees)								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
50	0.692	6.055	13.840	23.355	37.195	52.765	72.660	98.610	124.560
65	0.865	9.515	20.760	37.195	57.955	92.555	140.995	192.895	243.930
80	1.730	12.975	30.275	52.765	83.040	133.210	230.955	314.860	398.765
100	2.595	23.355	53.630	94.285	147.915	237.010	429.040	606.365	727.465
125	4.325	37.195	84.770	147.050	231.820	370.220	670.375	991.290	1,190.240
150	5.190	48.440	111.585	194.625	306.210	490.455	886.625	1,333.830	1,600.250
200	10.380	88.230	208.465	364.165	588.200	935.065	1,610.630	2,458.330	2,868.340
250	16.435	140.130	330.430	576.955	930.740	1,479.150	2,550.020	3,914.125	4,696.950
300	23.355	203.275	480.075	869.325	1,378.810	2,216.995	3,799.945	5,822.315	6,986.605
350	29.410	258.635	653.940	1,141.800	1,858.885	2,927.160	5,137.235	7,676.010	9,115.370
400	38.925	343.405	865.865	1,512.885	2,462.655	3,877.795	6,804.955	10,173.265	12,080.590
450	50.170	438.555	1,108.065	1,935.005	3,151.195	4,961.640	8,706.225	12,539.040	14,890.110
500	62.280	546.680	1,379.675	2,409.890	3,923.640	6,179.560	10,842.775	16,272.380	19,323.235

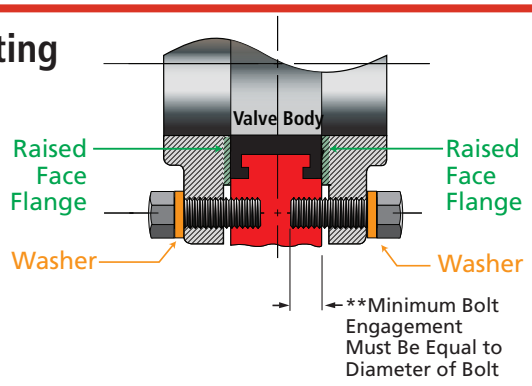
Series 32/33/35/36/35F/36H - Valve Sizing Coefficient (Kv)

Valve Size mm	Disc Position (Degrees)								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
550	89.095	792.340	1,790.550	3,036.150	4,878.600	7,816.140	12,596.130	19,054.220	23,500.320
600	224.035	889.220	2,064.755	3,671.060	6,022.130	9,549.600	15,773.275	23,515.890	28,678.210
650	249.985	986.965	2,380.480	4,229.850	6,767.760	10,809.040	17,231.665	25,690.500	31,330.300
700	255.175	1,145.260	2,710.045	4,670.135	7,470.140	11,969.870	19,529.970	30,000.795	36,000.435
750	363.300	1,428.980	3,447.890	6,124.200	9,798.720	15,647.850	24,950.060	37,197.595	45,363.195
800	475.750	1,752.490	4,010.140	6,905.295	11,022.695	17,654.650	28,191.215	42,002.670	52,469.170
850	461.045	1,992.960	4,506.650	7,641.410	12,264.835	19,670.965	31,700.520	47,953.870	59,143.510
900	640.100	2,400.375	5,134.640	8,468.350	13,469.780	21,670.845	34,674.390	51,611.955	66,681.985
1,000	654.805	2,569.915	5,990.125	10,260.630	16,700.555	26,500.140	43,601.190	64,001.350	78,001.375
1,050	677.295	3,029.230	6,815.335	11,242.405	18,173.650	30,288.840	47,215.160	72,159.165	89,085.485
1,100	781.960	3,517.090	7,523.770	12,409.290	19,737.570	31,755.880	50,810.100	75,626.950	97,710.400
1,200	884.895	4,023.115	8,965.725	14,713.650	23,564.330	37,932.845	60,922.815	94,257.320	114,948.120
1,300	Consult Factory								
1,400	1,123.635	5,106.960	11,381.670	18,678.810	29,914.295	48,155.415	77,340.515	119,658.910	145,925.500
1,500	1,280.200	5,536.000	12,542.500	21,192.500	34,081.000	54,668.000	88,230.000	133,210.000	164,350.000
1,650	1,427.250	6,150.150	13,926.500	23,614.500	37,887.000	60,723.000	97,745.000	147,915.000	182,515.000
1,800	1,643.500	7,110.300	16,089.000	27,247.500	43,855.500	70,238.000	113,315.000	171,270.000	211,060.000
2,000	1,980.850	8,572.150	19,376.000	32,870.000	52,765.000	84,597.000	136,670.000	205,870.000	254,310.000
2,200	1,980.850	9,852.350	22,317.000	37,800.500	60,723.000	97,226.000	156,565.000	237,010.000	292,370.000
2,250	Consult Factory								
2,400	Consult Factory								

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EXAMPLES OF TYPICAL FLANGE TO VALVE BOLTING*

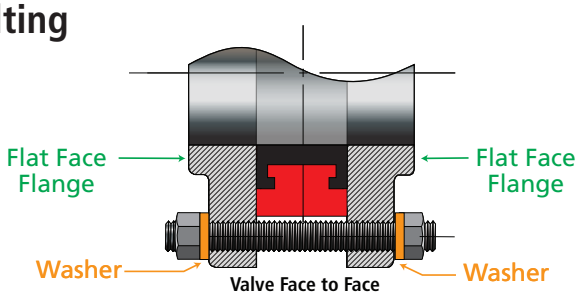
** Lug Style Bolting



Flange Width Including Raise Face If Applicable + Washer Width + Minimum Bolt Engagement Equal to Bolt Diameter = Bolt Length

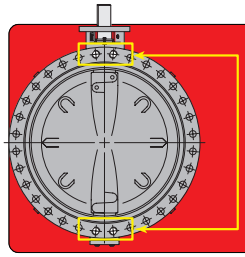


Wafer Style Bolting



Flange Width x2 Including Raise Face If Applicable + Valve Face to Face + Washer Width x2 + Width of Nut x2 + 4 Threads (2 Per Side) = Overall Length





**** Note: Please refer to Appropriate Bray Dimensional Drawings for specific valve drilling information on Wafer and Lug Valves 20" and larger.**

Please refer to ASME B-16.5 or B-16.47 for Flange and Bolt Dimension Information

* Double flange style bolting not shown.
** Lug threads may be tapped from both sides and therefore tap may not be continuous.

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FLANGE BOLT TENSIONING
Bray Butterfly Valves with Metal Mating Flanges

A question frequently asked at Bray is "What torque do I apply to the flange bolts to insure the valve is properly installed?". Initially this seems to be a simple request until all of the factors are analyzed. The installation of a valve requires several components: the valve, mating flanges, nuts, bolts and studs. Each is supplied by different manufacturers and each has different characteristics. The proper torque for one combination may be too much or too little for a second combination. The following is a list of information which needs to be known in order to start calculating the torque requirements.

Valve
- Type
- Size
- Materials of construction (Body)
- Surface finishes / Surface conditions

Flange
- Type
- Size
- Finish / both sides
- Condition of flange / surface contamination

Bolt (or Stud)
- Type
- Materials of Construction
- Surface Conditions

Nut
- Type
- Materials of Construction
- Surface Conditions

Lubrication
- Type
- Coverage

General Factors
- Temperature and relative humidity at the time of installation
- Speed at which bolts are turned

Note: The elastomer valve seat manufactured by Bray also acts as the flange gasket. No additional gaskets are required or recommended. Other valve styles which do not have integral gaskets will need to have this component supplied. The characteristics of this component will also need to be considered.

Complete knowledge of all relevant conditions is almost impossible to obtain. As a result, the computation of the exact torque requirement is not practical. No reputable manufacturer can provide accurate information when so many outside factors are present.

The International Fasteners Institute covers some of the details required to "compute" a torque value. Even with this information the use of a torque wrench is only considered to be 25% accurate. Based on the difficulty and inaccuracy of using this method, Bray recommends the use of the "Turn of the nut" method.

"Turn of the Nut" Tightening
(For ANSI Standard Iron and Steel Flanges)
**For Non-Metallic or non-standard flanges, follow the manufacturers installation procedures.

1. The valve and flange faces must be aligned parallel to each other.

   Note: For rubber seated butterfly valves manufactured by Bray, it is required that the valve be fully opened prior to the tightening of the flange bolts.

2. After aligning the holes in a joint, sufficient bolts shall be placed and brought to a 'snug-tight' condition to ensure that the parts of the joint are *brought into full contact* with each other. 'Snug-Tight' is the tightness attained by the full effort of a man using a spud wrench.

3. Following the initial snugging operation, bolts shall be placed in any remaining holes and brought to snug-tightness. Re-snugging may be necessary in large joints.

4. Tighten opposite bolts in sequence to insure even pressure around the entire flange.

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5. When all bolts are snug-tight, each bolt in the joint then shall be tightened additionally by the applicable amount of nut rotation given in Note 1. During tightening there shall be no rotation of the valve or flange.

Note 1

For bolt lengths **not exceeding** 8 diameters or 8 inches (203.2 mm) = **1/4 turn**
For bolt lengths **exceeding** 8 diameters or 8 inches (203.2 mm) = **1/2 turn**

Disclaimer:
Bray Controls is issuing these recommendations only as a guide to installation. This recommendation is based on the full compliance of all materials supplied to their appropriate specifications. Since many of the components are not manufactured by Bray we can take no responsibility for any damage caused during installation.

Series 20/21 and 30/31 - Flange Bolt Torque Chart

Valve Size		Normal Torque Range	Normal Torque Range
In	mm	Ft-lbs	Nm
2	50	30	40
2.5	65	30	40
3	80	35	50
4	100	35 - 40	50 - 55
5	125	35 - 45	50 - 60
6	150	35 - 50	50 - 65
8	200	45 - 55	60 - 75
10	250	55 - 75	75 - 100
12	300	65 - 110	90 - 150
14	350	75 - 120	100 - 165
16	400	75 - 120	100 - 165
18	450	85 - 130	115 - 175
20	500	85 - 130	115 - 175

Please note that the Nm and Ft-lbs values are based on bolt size in respective metric and ANSI flanges, i.e. these values are not a direct conversion between Nm and Ft-lbs.

The values represent average torques needed to ensure full compression of the resilient valves' seats into the valves' bodies when installed in pipeline flanges. The face of both flanges must come into full contact with the valves' metal bodies.

No additional torque is required for proper functioning of the Bray resilient seated valves.

The torque values are based on using new, coarse-threaded, lubricated fasteners. Up to 25% may be added to the Normal Torque Range values when using non-lubricated fasteners.

Torque Values specified by flange manufacturers ***must not be exceeded.***

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Series 30/31, 31H, 3A/3AH, 31U - Standard Metal Specifications

Part	Material	ASTM No.	UNS No.	30/31	31H	3A/3AH	31U
Body	Cast Iron	A126 Class B		●	●	●	
	Ductile Iron	A536 Gr. 65-45-12	F33100	●	●	●	
	Ductile Iron	A395	F32800				●
	Carbon Steel	A216 WCB	J030002	●		●	●
	Nickel Aluminum Bronze	B148	C95800				●
	Aluminum	B26 Class B		●			
Disc	Aluminum Bronze	B148	C95400	●	●	●	
	Nickel Aluminum Bronze	B148	C95800				●
	Nylon Coated Ductile Iron	A536 Gr. 65-45-12	F33100	●	●	●	
	316 Stainless Steel	A351 CF8M	J92900	●	●	●	●
	304 Stainless Steel	A351 CF8	J92600	●		●	
	Duplex Stainless Steel	A995 Gr 4A	J92205	●		●	
	Super Duplex Stainless Steel	A995 Gr 5A	J93404	●		●	
	Super Austenitic Stainless Steel (254 SMO™)*	A351 Grade CK3MCuN	S31254	●		●	
	Hastelloy® C-276 *	B575	N10276	●		●	
Stem	304 Stainless Steel	A276	S30400	●		●	
	316 Stainless Steel	A276	S31600	●		●	
	416 Stainless Steel	A582	S41600	●	●	●	●
	17-4 ph Stainless Steel	A564 630 Heat Treated	S17400				●
	Monel® *	B865	N05500	●		●	●

* Hastelloy® is a registered trademark of Haynes International, Inc.
Monel® is a registered trademark of International Nickel Company, Inc.
254 SMO™ is a registered trademark of Avesta AB.
AL-6XN® is a registered trademark of ATI Properties, Inc.

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HEADQUARTERS

Bray International, Inc.

13333 Westland East Blvd.
Houston, Texas 77041
Tel: +1.281.894.5454

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THE HIGH PERFORMANCE COMPANY

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SERIES 92/93

PNEUMATIC ACTUATORS

TECHNICAL SALES MANUAL



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Bray Series 92/93 Pneumatic Actuators

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Actuator Installation Notes

These notes apply to the installation of Bray S92/93 pneumatic valve actuators.

- Verify that the valve and the actuator are both in the same position (both open or both closed) before mounting the actuator to the valve.
- Apply a light coating of grease to the inside of the actuator output bore before installing the actuator on the valve. This will allow the actuator to be more easily removed from the valve stem even after years of service.
- If stem adapters are required to match the actuator output bore to the valve stem, apply a light coating of grease to the inside of the stem adapter as well as the inside of the actuator output bore.
- Some stem adapters are kits consisting of multiple components. These kits may contain spacers that look like stem adapters, but are designed to keep the stem adapter in place during operation of the actuator. Verify that all stem adapters and spacers are installed in the proper position and sequence.

Refer to Series 92/93 Operations and Technical Manual (OM_S92-93)

- If keyed stem adapters are used, the key must be held in the keyway so that it will not work loose during operation of the actuator. The key may be retained by any one of several methods:

  If the valve stem height matches the depth of the actuator output bore, use a key that fits the full length of the keyway. Tack weld the key to the adapter before installation in the actuator.

  Upset the end of the keyway after the key has been installed in the shaft by using a punch or chisel.
- If mounting studs are used instead of bolts, thread the studs completely into the actuator before placing the actuator on the valve. This assures that the full strength of the connection is achieved.
- While the mounting bolts are only finger tight, cycle the actuator fully open and fully closed to verify proper alignment on the valve.
- Tighten the mounting bolts or nuts in a diagonal pattern to evenly distribute stress in the bolts.

ACTUATOR MOUNTING CODES FOR S92/93 - IMPERIAL (IN)

Actuator Sizes	Valve Code	Inner Bolt Circle			Outer Bolt Circle			Stem Hole			
		Bolt Circle (+/- .005)	No. Holes	Bolt Size	Bolt Circle (+/- .005)	No. Holes	Bolt Size	Bore Diameter (+/- .004)	Across Flats (+ .002-.0)	Depth	Keyway Width (+ .002-.0)
48	AA	1.42	4	#10-32	1.97	4	1/4-20	0.4	0.32	1.3	NA
63	A	1.969	4	1/4-20	2.756	4	5/16-18	0.552	0.395	1.38	NA
83	C	1.969	4	1/4-20	2.756	4	5/16-18	0.749	0.513	1.46	NA
93	C	1.969	4	1/4-20	2.756	4	5/16-18	0.749	0.513	1.46	NA
119	E	2.756	4	5/16-18	4.921	4	1/2-13	1.182	0.867	2.2	NA
128	E	2.756	4	5/16-18	4.921	4	1/2-13	1.182	0.867	2.2	NA
160A	E	NA	NA	NA	4.921	4	1/2-13	1.182	0.867	2.2	NA
160B	F	NA	NA	NA	4.921	4	1/2-13	1.38	NA	2.38	0.394
210	G	4.921	4	1/2-13	6.496	4	5/8-11	1.97	NA	2.76	0.472
255A	H	6.496	4	M20 x 2.5P	4.724 X 7.874	4	M20 x 2.5P	2.505	NA	4.25	0.625
255B	K	6.496	4	M20 x 2.5P	4.724 X 7.874	4	M20 x 2.5P	3.006	NA	4.25	0.750

ACTUATOR MOUNTING CODES FOR S92/93 - METRIC (MM)

Actuator Sizes	Valve Code	Inner Bolt Circle			Outer Bolt Circle			Stem Hole			
		Bolt Circle (+/- .127)	No. Holes	Bolt Size	Bolt Circle (+/- .127)	No. Holes	Bolt Size	Bore Dia. (+/-.102)	Across Flats (+ .050-.0)	Depth	Keyway Width
48	AA	36	4	M5 x 0.8P	50	4	M6 x 1.0P	10	8	33	NA
63	A	50	4	M6 x 1.0P	70	4	M8 x 1.25P	14	10	35	NA
83	C	50	4	M6 x 1.0P	70	4	M8 x 1.25P	19	13	37	NA
93	C	50	4	M6 x 1.0P	70	4	M8 x 1.25P	19	13	37	NA
119	E	70	4	M8 x 1.25P	125	4	M12 x 1.75P	30	22	56	NA
128	E	70	4	M8 x 1.25P	125	4	M12 x 1.75P	30	22	56	NA
160A	E	NA	NA	NA	125	4	M12 x 1.75P	30	22	56	NA
160B	F	NA	NA	NA	125	4	M12 x 1.75P	35	NA	60	10
210	G	125	4	M12 x 1.75P	165	4	M20 x 2.5P	50	NA	70	12
255A	H	165	4	M20 x 2.5P	120 x 200	4	M20 x 2.5P	64	NA	108	16
255B	K	165	4	M20 x 2.5P	120 x 200	4	M20 x 2.5P	76	NA	108	19

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Pneumatic Actuator Data (Imperial)

Approximate Actuator Speeds (Seconds)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
90° Travel	1/4	1/4	1/4	1/4	1/2	1/2	1	2	2 3/4

Note: Times shown are in seconds at 80 PSIG supply pressure with 6ft. tubing having an internal diameter of not less than approximately 1/4" using a Bray Series 62 or Series 63 solenoid. Bray S92/93 actuation times are very dependent on the flow capacity of their air supply. The use of smaller port solenoids, solenoid manifolds, smaller I.D. air supply tubing and/or extended lengths of tubing can significantly reduce the actuation time and/or initial response to the command signal.

Actuator Weights (lbs)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
Double Acting	2	3.3	6.3	8.5	18	21.5	39	78	171
Spring Return	2.3	3.9	7.3	10.9	24.5	30.6	58.3	124.7	239

Weights are in lbs. Spring Return unit weights are with full set of springs on each piston.

Actuator Volumes (in^3)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
Counter-Clockwise	5.7	9.6	24.8	39.0	81.0	106.5	187.5	360.0	750.0
Clockwise	4.8	13.4	32.6	50.1	102.7	140.6	259.6	450.0	900.0

Counter-clockwise: Air volume in cubic inches required to push pistons apart, full travel.
Clockwise: Air volume in cubic inches required to push pistons together, full travel.

Pneumatic Actuator Data (Metric)

Approximate Actuator Speeds (Seconds)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
90° Travel	1/4	1/4	1/4	1/4	1/2	1/2	1	2	2 3/4

Note: Times shown are in seconds at 5.5 bar supply pressure with 1.8 meter tubing having an internal diameter of not less than approximately (6.35 mm)using a Bray Series 62 or Series 63 solenoid. Bray S92/93 actuation times are very dependent on the flow capacity of their air supply. The use of smaller port solenoids, solenoid manifolds, smaller I.D. air supply tubing and/or extended lengths of tubing can significantly reduce the actuation time and/or initial response to the command signal.

Actuator Weights (kg)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
Double Acting	0.9	1.5	2.9	3.9	8.2	9.8	17.7	35.4	77.6
Spring Return	1.0	1.8	3.3	4.9	11.1	13.9	26.4	56.6	108.4

Weights are in kg Spring Return unit weights are with full set of springs on each piston.

Actuator Volumes (cm^3)									
Size	**48**	**63**	**83**	**93**	**119**	**128**	**160**	**210**	**255**
Counter-Clockwise	93.4	157.3	406.4	638.6	1327.5	1744.5	3072.6	5899.3	12290.3
Clockwise	78.7	219.6	534.2	820.5	1683.1	2303.3	4254.1	7374.2	14748.4

Counter-clockwise: Air volume in cubic centimeters required to push pistons apart, full travel.
Clockwise: Air volume in cubic centimeters required to push pistons together, full travel.

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STANDARD MATERIALS SELECTION	
Name	**Material**
Body	Extruded Aluminum Alloy, Anodized 316 Stainless Steel
End Caps	Die cast Aluminum Alloy with Corrosion Resistant Polyester Coating 316 Stainless Steel
Pistons	Die Cast Aluminum Alloy
Output Shaft/Pinion:	Carbon Steel, Zinc Plated
Travel Stop:	Alloy Steel
Shaft Bearings:	Acetal
Piston Guides:	Acetal
Fasteners:	Stainless Steel
Springs	Spring Steel, Protective Coating
Piston O-Ring Seals:	Buna-N
Options:	Polyester Coated Body Exterior Electroless Nickel Plated Body Exterior Hard Anodized Body Exterior Seacorr Coated Body Exterior Stainless Steel Pinion

OPERATING CONDITIONS	
Pressure Range	40 - 140 psi (2.8 - 10 bar)
Media	Dry Compressed Air/Inert Gas* **Contact Factory for other media.*
Temperature Range	Standard -4° F to 200° F (-20° C to 93° C)
	Low -40° F to 176° F (-40° to 80° C)
	High 0° F to 300° F (-18° C to 149° C)
Note: Cycle life on Low and High temperature seal kits reduced compared to Standard Buna N Seals	
Series 92 Double Acting	Available in 90°, 135°, 180° Rotation
Series 93 Spring Return	Available in 90° Rotation Operating Pressure 140 psig (10 bar) maximum

COMPLIANCES	
Torque Base	Mounting Dimensions as per ISO 5211: 2001(E)
Accessories	Shaft Driven Accessories Mounting per NAMUR-VDE
Ingress Protection	IP66/IP67M per IEC 60529
Safety	ATEX, SIL 3 suitable, PED

Series 92 Torque Data

Series 92 Actuator Torque Data (Lb-in)

Double Acting Pneumatic Operated, Torque Output

Actuator Size	Air Supply Pressure (PSIG)				
	40	**60**	**80**	**100**	**120**
48	75	113	150	188	225
63	145	221	297	373	449
83	351	536	721	906	1091
93	493	753	1013	1272	1532
119	1058	1615	2171	2728	3285
128	1410	2152	2894	3636	4378
160	2797	4270	5742	7214	8687
210	5783	8826	11870	14914	17957
255	14211	21691	29171	36650	44130

Series 92 Actuator Torque Data (N m)

Double Acting Pneumatic Operated, Torque Output

Actuator Size	Air Supply Pressure (Bar)				
	2.8	**4.1**	**5.5**	**6.9**	**8.3**
48	9	13	17	21	25
63	16	25	34	42	51
83	40	61	82	102	123
93	56	85	115	144	173
119	120	183	245	308	371
128	159	243	327	411	495
160	316	482	649	815	982
210	653	997	1341	1685	2029
255	1606	2451	3296	4141	4986

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Series 93 Actuator Torque Data (Lb-In) Air Operated, With Spring Return, Torque Output

Actuator Size	No. Springs per Piston	Air Supply Pressure (PSIG)										Spring	
		40		60		80		100		120		Spring Start	Stroke End
		Start	End	Start	End	Start	End	Start	End	Start	End		
48	1	51	32	89	70	126	107	164	145	201	182	43	24
	2/1	39	10	77	48	114	85	152	123	189	160	65	36
	2			64	27	101	64	139	102	176	139	86	49
	3/2			52	5	89	42	127	80	164	117	108	61
	3					77	21	115	59	152	96	129	73
63	2	91	65	167	141	243	217	319	293	395	369	80	54
	3	64	27	140	103	216	179	292	255	368	331	118	81
	4			113	65	189	141	265	217	341	293	156	108
	5			86	27	162	103	238	179	314	255	194	135
	6					135	65	211	141	287	217	232	162
83	2	210	167	395	352	580	537	765	722	950	907	184	141
	3	156	76	341	261	526	446	711	631	896	816	275	195
	4			281	176	466	361	651	546	836	731	360	255
	5			220	97	405	282	590	467	775	652	439	316
	6					369	185	554	370	739	555	536	352
93	2	310	232	570	492	830	752	1089	1011	1349	1271	261	183
	3	218	101	478	361	738	621	997	880	1257	1140	392	275
	4			386	231	646	491	905	750	1165	1010	522	367
	5			294	94	554	354	813	613	1073	873	659	459
	6					462	229	721	488	981	748	784	551
119	2	692	469	1249	1026	1805	1582	2362	2139	2919	2696	589	366
	3	509	174	1066	731	1622	1287	2179	1844	2736	2401	884	549
	4			883	437	1439	993	1996	1550	2553	2107	1178	732
	5			700	142	1256	698	1813	1255	2370	1812	1473	915
	6					1073	404	1630	961	2187	1518	1767	1098
128	2	880	465	1622	1207	2364	1949	3106	2691	3848	3433	945	530
	3			1357	733	2099	1475	2841	2217	3583	2959	1419	795
	4			1094	261	1836	1003	2578	1745	3320	2487	1891	1058
	5					1568	529	2310	1271	3052	2013	2365	1326
	6					1302	57	2044	799	2786	1541	2837	1592
160	2	1819	1118	3292	2591	4764	4063	6236	5535	7709	7008	1679	978
	3	1399	349	2872	1822	4344	3294	5816	4766	7289	6239	2448	1398
	4			2452	1123	3924	2595	5396	4067	6869	5540	3147	1818
	5			2030	353	3502	1825	4974	3297	6447	4770	3917	2240
	6					3154	1196	4626	2668	6099	4141	4546	2588
210	2	3833	2508	6876	5551	9920	8595	12964	11639	16007	14682	3275	1950
	3	2859	868	5902	3911	8946	6955	11990	9999	15033	13042	4915	2924
	4			4930	2275	7974	5319	11018	8363	14061	11406	6551	3896
	5			3949	638	6993	3682	10037	6726	13080	9769	8188	4877
	6					6022	2031	9066	5075	12109	8118	9839	5848
255	2	9487	6747	16967	14227	24447	21707	31926	29186	39406	36666	7464	4724
	3	7125	3015	14605	10495	22085	17975	29564	25454	37044	32934	11196	7086
	4			12243	6762	19723	14242	27202	21721	34682	29201	14929	9448
	5			9880	3030	17360	10510	24839	17989	32319	25469	18661	11811
	6					14998	6778	22477	14257	29957	21737	22393	14173

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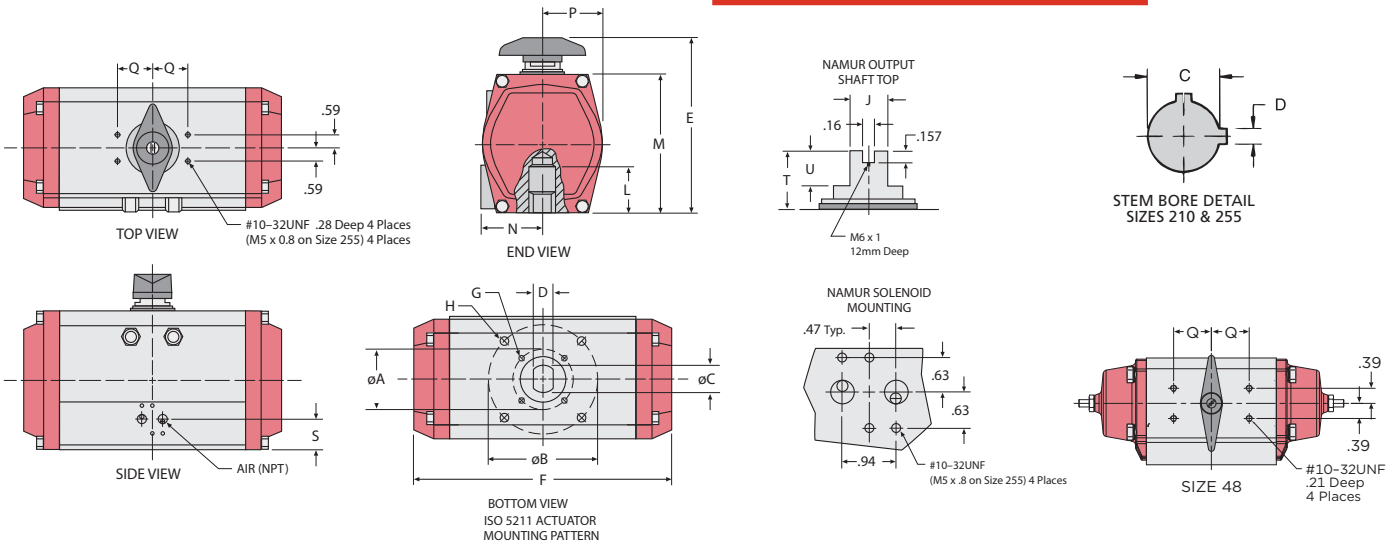
Series 93 Actuator Torque Data (N m)

Air Operated, With Spring Return, Torque Output

Actuator Size	No. Springs per Piston	Air Supply Pressure (Bar)										Spring	
		2.8		4.1		5.5		6.9		8.3		Spring Start	Stroke End
		Start	End	Start	End	Start	End	Start	End	Start	End		
48	1	6	4	10	8	14	12	19	16	23	21	5	3
	2/1	4	1	9	5	13	10	17	14	21	18	7	4
	2			7	3	11	7	16	12	20	16	10	6
	3/2			6	1	10	5	14	9	19	13	12	7
	3					9	2	13	7	17	11	15	8
63	2	10	7	19	16	28	25	36	33	45	42	9	6
	3	7	3	16	12	24	20	33	29	42	37	13	9
	4			13	7	21	16	30	25	39	33	18	12
	5			10	3	18	12	27	20	36	29	22	15
	6					15	7	24	16	32	25	26	18
83	2	24	19	45	40	66	61	86	82	107	103	21	16
	3	18	9	39	30	59	50	80	71	101	92	31	22
	4			32	20	53	41	74	62	95	83	41	29
	5			25	11	46	32	67	53	88	74	50	36
	6					42	21	63	42	84	63	61	40
93	2	35	26	64	56	94	85	123	114	152	144	30	21
	3	25	11	54	41	83	70	113	99	142	129	44	31
	4			44	26	73	56	102	85	132	114	59	42
	5			33	11	63	40	92	69	121	99	75	52
	6					52	26	82	55	111	85	89	62
119	2	78	53	141	116	204	179	267	242	330	305	67	41
	3	58	20	120	83	183	145	246	208	309	271	100	62
	4			100	49	163	112	226	175	289	238	133	83
	5			79	16	142	79	205	142	268	205	166	103
	6					121	46	184	109	247	172	200	124
128	2	99	53	183	136	267	220	351	304	435	388	107	60
	3			153	83	237	167	321	251	405	334	160	90
	4			124	30	207	113	291	197	375	281	214	120
	5					177	60	261	144	345	227	267	150
	6					147	6	231	90	315	174	321	180
160	2	206	126	372	293	538	459	705	625	871	792	190	111
	3	158	39	325	206	491	372	657	539	824	705	277	158
	4			277	127	443	293	610	460	776	626	356	205
	5			229	40	396	206	562	373	728	539	443	253
	6					356	135	523	301	689	468	514	292
210	2	433	283	777	627	1121	971	1465	1315	1809	1659	370	220
	3	323	98	667	442	1011	786	1355	1130	1699	1474	555	330
	4			557	257	901	601	1245	945	1589	1289	740	440
	5			446	72	790	416	1134	760	1478	1104	925	551
	6					680	230	1024	573	1368	917	1112	661
255	2	1072	762	1917	1607	2762	2453	3607	3298	4452	4143	843	534
	3	805	341	1650	1186	2495	2031	3340	2876	4185	3721	1265	801
	4			1383	764	2228	1609	3073	2454	3919	3299	1687	1068
	5			1116	342	1961	1188	2806	2033	3652	2878	2108	1335
	6					1695	766	2540	1611	3385	2456	2530	1601

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S92 Double Acting/S93 Spring Return



IMPERIAL DIMENSIONS - Inches

Size	48	63	83	93	119	128	160*	210	255‡
Air NPT	1/8	1/4	1/4	1/4	1/4	1/4	1/4	1/4	G1/4
A ISO "F"†	1.42 - F 03	1.97-F 05	1.97 - F 05	1.97 - F 05	2.76 - F 07	2.76 - F 07	—	4.92 - F 12	6.50 - F 16
B ISO "F"†	1.97 - F 05	2.76 - F 07	2.76 - F 07	2.76 - F 07	4.92 - F 12	4.92 - F 12	4.92 - F 12	6.50 - F 16	7.87x4.72 Rect.
C	.55	.55	.75	.75	1.18	1.18	1.18	1.97	2.50
D	.40	.40	.51	.51	.87	.87	.87	.47	.62
E	3.88	4.53	5.43	5.78	7.28	8.09	9.36	11.62	13.49
F	4.38	5.58	7.40	9.10	12.40	12.81	15.54	19.57	28.78
G (UNC)	#10-32 x .23	1/4-20 x .32	1/4-20 x .32	1/4-20 x .32	5/16-18 x .46	5/16-18 x .46	—	1/2-13 x .78	M20 x 2.5 x 30mm
H (UNC)	1/4-20 x .25	5/16-18 x .40	5/16-18 x .40	5/16-18 x .40	1/2-13 x .69	1/2-13 x .69	1/2-13 x .75	5/8-11 x 1.11	M20 x2.5 x 30mm
J	.38	.38	.50	.50	1.12	1.12	1.12	1.12	1.12
L	1.38	1.38	1.46	1.46	2.20	2.20	2.20	4.72	6.50
M	2.50	3.46	4.27	4.61	5.52	6.32	7.80	10.16	12.06
N	1.60	1.72	2.28	2.47	2.78	2.88	3.78	4.56	5.40
P	1.18	1.38	1.79	1.97	2.37	2.70	3.39	4.41	5.39
Q	.98**	1.58	1.58	1.58	1.58	1.58	2.56	2.56	2.56
S	1.25	.89	1.26	1.32	1.64	1.64	2.26	2.45	2.48
T	1.10**	.79	.79	.79	.79	.79	1.18	1.18	1.18
U	.47	.47	.47	.47	.47	.47	.75	.75	.75

Note: Double Acting and Spring Return actuators have the same overall dimensions. The double acting unit of the size 48 actuator is optionally available with flat end caps with an F dimension of 4.00
† ISO "F" means mounting flange-drilling pattern.
* Dimensions for Size 160A in table. Size 160B (keyed stem version) has C dimension of 1.38 and D dimension of .39
‡ Dimensions for Size 255A in table. Size 255B actuator has a C dimension of 3.00 and D dimension of .75
** Size 48 has a Q dimension of 1.58 and a T dimension of .79 with use of NAMUR top plate.

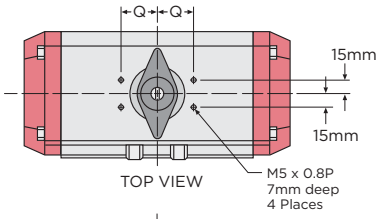
WEIGHTS - lbs - Spring Return unit weights are with full set of springs on each piston.

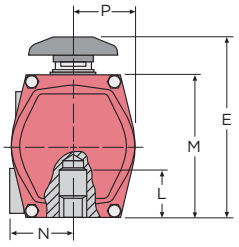
Size	48	63	83	93	119	128	160	210	255
Double Acting	2.0	3.4	6.3	8.5	16.9	21.0	38.8	77.8	167.0
Spring Return	2.4	4.10	8.1	10.8	22.3	27.6	53.2	109.6	210.8

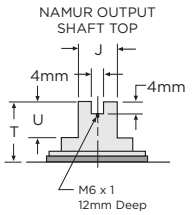
Drawings are for reference only. Please refer to Bray ES drawings on the Bray website, www.bray.com. Bray reserves the right to change product dimensions without notice.

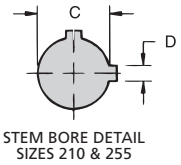
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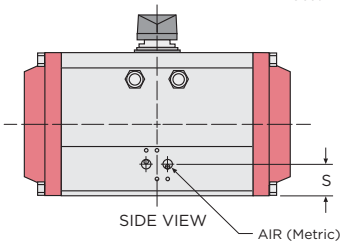
S92 Double Acting/S93 Spring Return

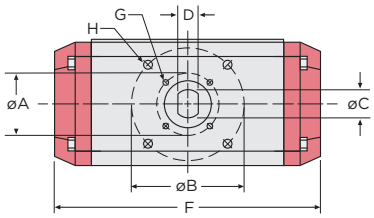


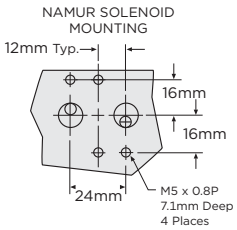


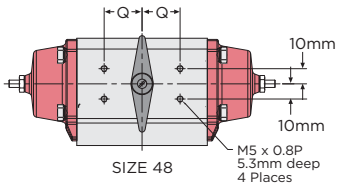












METRIC DIMENSIONS - Millimeters

Size	48	63	83	93	119	128	160*	210	255‡
Air	G1/8	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4	G1/4
A ISO "F"†	36 - F 03	50 - F 05	50 - F 05	50 - F 05	70 - F 07	70 - F 07	—	125 - F 12	165 - F 16
B ISO "F"†	50 - F 05	70 - F 07	70 - F 07	70 - F 07	125 - F 12	125 - F 12	125 - F 12	165 - F 16	200 x120 Rect.
C	14	14	19	19	30	30	30	50	64
D	10	10	13	13	22	22	22	12	16
E	99	115	138	147	185	205	238	295	343
F	111	142	188	231	315	325	395	497	731
G	M5x0.8 x 5.8mm	M6x1.0 x 8mm	M6x1.0 x 8mm	M6x1.0 x 8mm	M8x1.25P x 12 mm	M8x1.25P x 12 mm	N/A	M12x1.75P x 19m	M20x2.5P x 30mm
H	M6x1.0 x 6.4mm	M8x1.25P x 10mm	M8x1.25P x 10mm	M8x1.25P x 10mm	M12x1.75P x 18mm	M12x1.75P x 18mm	M12x1.75P x 18mm	M20x2.5P x 30mm	M20x2.5P x 30mm
J	10	10	13	13	28	28	28	28	28
L	35	35	37	37	56	56	56	120	165
M	64	88	108	117	140	161	198	258	306
N	41	44	58	63	71	73	96	116	137
P	30	35	45	50	60	69	86	112	137
Q	25**	40	40	40	40	40	65	65	65
S	32	23	32	34	42	42	57	62	63
T	28**	20	20	20	20	20	30	30	30
U	12	12	12	12	12	12	19	19	19

Note: Double Acting and Spring Return actuators have the same overall dimensions. The double acting unit of the size 48 actuator is optionally available with flat end caps with an F dimension of 102mm

† ISO "F" means mounting flange-drilling pattern.

* Dimensions for Size 160A in table. Size 160B (keyed stem version) has C dimension of 35mm and D dimension of 10mm

‡ Dimensions for Size 255A in table. Size 255B actuator has a C dimension of 76mm and D dimension of 19mm

** Size 48 has a Q dimensions of 40mm and a T dimension of 20mm with use of NAMUR top plate.

WEIGHTS - Kilograms - Spring Return unit weights are with full set of springs on each piston.

Size	48	63	83	93	119	128	160	210	255
Double Acting	0.9	1.5	3	4	8	10	18	35	76
Spring Return	1.1	1.9	4	5	10	13	24	50	96

Drawings are for reference only. Please refer to Bray ES drawings on the Bray website, www.bray.com. Bray reserves the right to change product dimensions without notice.

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SINCE 1986, BRAY HAS PROVIDED FLOW CONTROL SOLUTIONS FOR A VARIETY OF INDUSTRIES AROUND THE WORLD.

VISIT **BRAY.COM** TO LEARN MORE ABOUT BRAY PRODUCTS AND LOCATIONS NEAR YOU.

HEADQUARTERS
Bray International, Inc.
13333 Westland East Blvd.
Houston, Texas 77041
Tel: +1.281.894.5454

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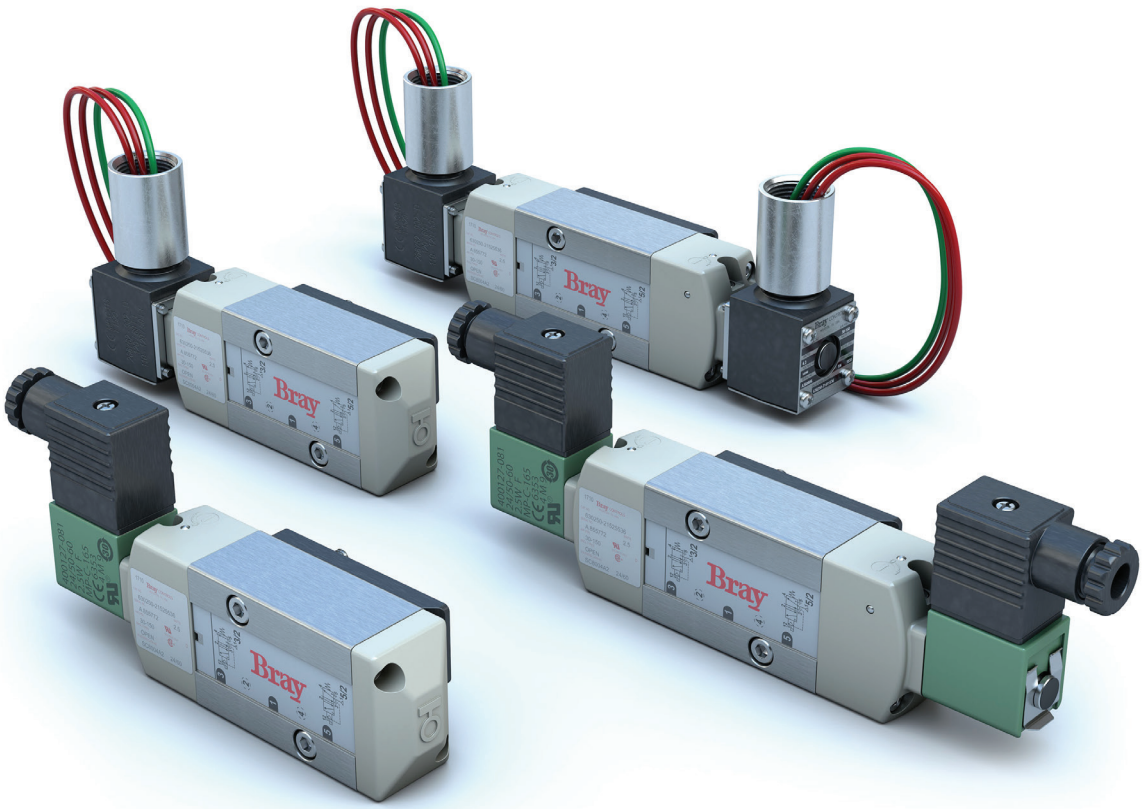
THE HIGH PERFORMANCE COMPANY

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SERIES 63

SOLENOID VALVES

TECHNICAL SALES MANUAL



Bray®

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THE HIGH PERFORMANCE COMPANY

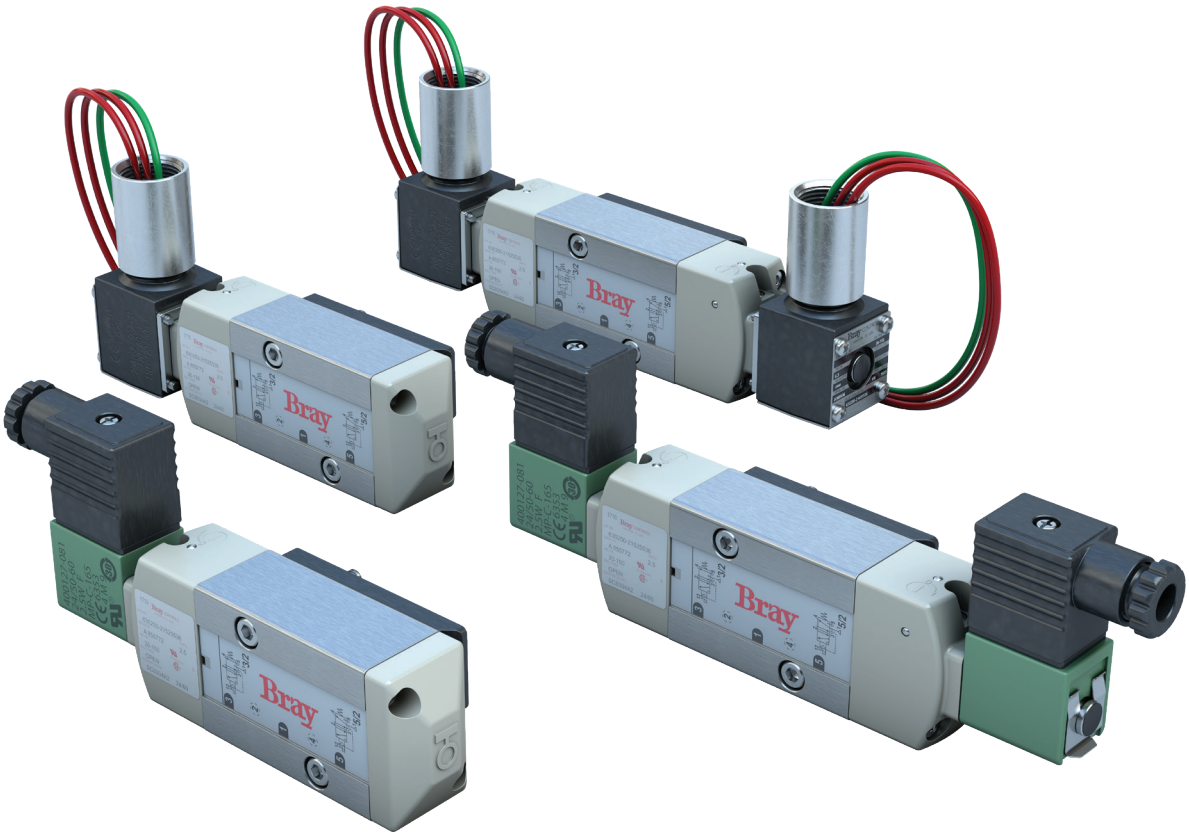
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Pilot-Operated Spool Control

Bray Series 63 solenoid valves are used to control the flow of air to pneumatic actuators. The S63 is designed to be direct mounted to pneumatic actuators providing the optimal flow path and actuator speed. Units are watertight and explosion-proof units are also available. All series 63 solenoid valves carry the CE mark.



FEATURES

- Compact & modular design
- Pilot operated spool control valve
- Convertible from 3-way (3/2) to 4-way (5/2)
- Mechanical manual override
- NAMUR mounting design
- Low-powered units available

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GENERAL SPECIFICATIONS

Mounting	NAMUR VDI/VDE 3845, hardware included
Pneumatic Ports	1/4" NPT
	G1/4 available for DIN Models
Media	Filtered Air or Inert Gas
Connections	NPT flying leads or DIN Form B Type I connections offered, both available with single and dual coils
Electrical Connection	NEMA Housings: 1/2" NPT connection and flying leads
	DIN Housing: Cable Gland PG9 and M15 threaded connector
Coil Temperature Rating	Insulation Class "F", Max. 311°F [155°C]
General Purpose (watertight)	NEMA 4, 4X (Flying Leads)
	IP65 (DIN coil)

MATERIALS OF CONSTRUCTION

Body	Anodized Aluminum
Spring	Phosphate treated black steel
Shading Coil	Copper
Seals	NBR + PUR
Core / Tube	Stainless / Brass
End Covers & Plate	6/6 glass filled polyamide (PA/FV)
Spool	Aluminum
Internal Parts	Zamak, Steel, Acetal

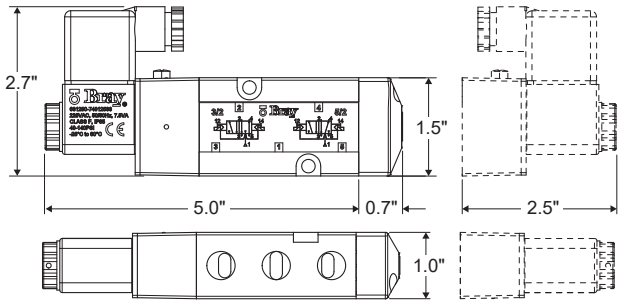
MODEL SPECIFICATIONS

	High-Flow	**UL-Recognized**
Hazardous Locations (Optional)	-	NEMA 7, 9 Class I, Division 1 (Groups A-D) Class II, Division 1 (Groups E-G)
Temperature Range	-13°F to +140°F [-25°C to +60°C]	AC: -13°F to +140°F [-25°C to +60°C]
		DC: -13°F to +77°F [-25°C to +25°C]
Coil Voltage	Flying Leads & DIN 24, 110, 220 VAC, 50-60 HZ; 12, 24 VDC	Flying Leads: 24, 120, 240 VAC, 50-60 HZ; 12, 24 VDC
		DIN: 24, 120, 240 VAC, 50-60 HZ; 24 VDC
Nominal Power	4.5 VA (24 VAC); 6 VA (110 VAC); 7.5 VA (220 VAC); 4.5 W (12 VDC); 3W (24 VDC)	Flying Leads: 6.3 VA (AC); 6.9W (DC)
		DIN: 3.5 VA (AC); 3.0W (DC)
Flow Coefficient (1/4" pipe)	Cv=1.4	Cv=0.7
Operating Pressure	Min. 22 psi [1.5 bar] Max. 130 psi [9 bar	Min. 30 psi [2 bar] Max. 130 psi [9 bar]
Operating Pressure	5 cycles per minute	10 cycles per minute
Certifications	cCSAus (Flying Leads), CE (DIN coil)	UL, CSA, CE (DIN coil)

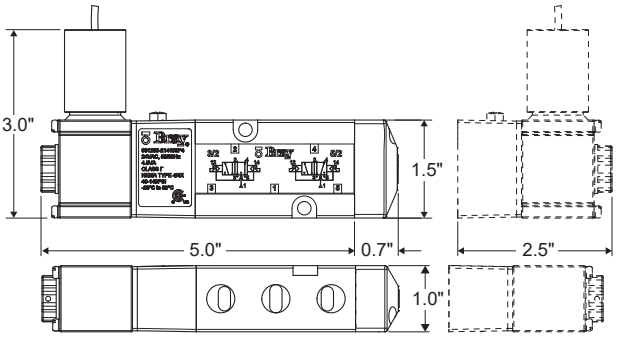
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DIMENSIONS

DIN SOLENOID

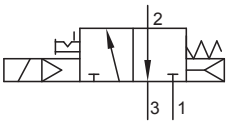
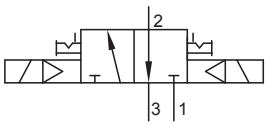
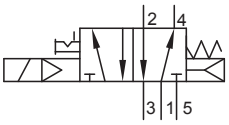
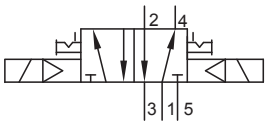


NEMA SOLENOID



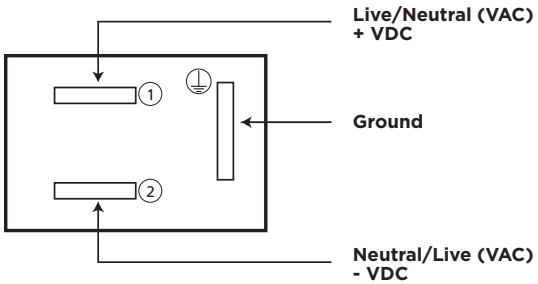
NOTES
1 : Some dimensions may vary depending on model

PNEUMATIC SCHEMATICS

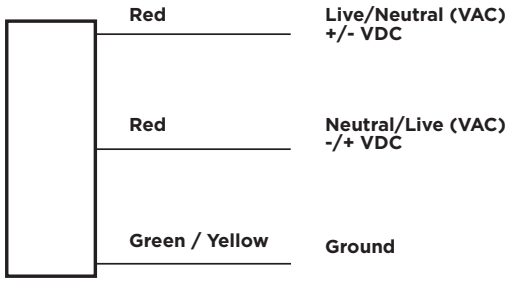
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3/2 Operation		
5/2 Operation		

ELECTRICAL CONNECTIONS

DIN 43650B



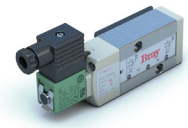
Flying Leads

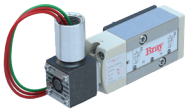


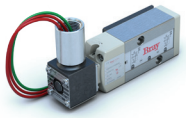
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SINGLE COIL

Type	Voltage	Watt/ VA	Enclosure	CV	Certification	Integral Re-Breather	Manual Override	Part Number
DIN "I" Type	12 VDC				CONSULT FACTORY			
	24 VDC	3 W	IP65	0.7	UL, CSA, CE	YES	YES	630250-21524536
	24 VAC	2.5 VA	IP65	0.7	UL, CSA, CE	YES	YES	630250-21525536
	120 VAC	2.5 VA	IP65	0.7	UL, CSA, CE	YES	YES	630250-21520536
	240 VAC	2.5 VA	IP65	0.7	UL, CSA, CE	YES	YES	630250-21522536
Flying Leads	12 VDC	6.9 W	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21400536
	24 VDC	6.9 W	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21401536
	24 VAC	6.3 VA	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21440536
	120 VAC	6.3 VA	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21410536
	240 VAC	6.3 VA	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21430536
Exp. Proof Flying Leads	12 VDC	6.9 W	NEMA 4, 7 & 9	0.7	UL, CSA	YES	YES	630250-21402536
	24 VDC	6.9 W	NEMA 4, 7 & 9	0.7	UL, CSA	YES	YES	630250-21403536
	24 VAC				CONSULT FACTORY			
	120 VAC	6.3 VA	NEMA 4, 7 & 9	0.7	UL, CSA	YES	YES	630250-21411536
	240 VAC	6.3 VA	NEMA 4, 7 & 9	0.7	UL, CSA	YES	YES	630250-21431536

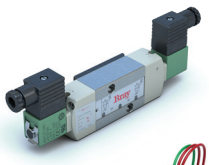


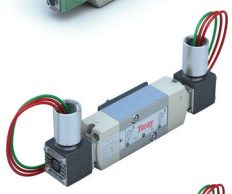


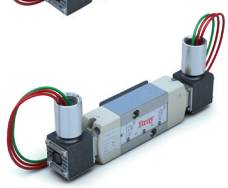


DUAL COIL[1]

Type	Voltage	Watt/ VA	Enclosure	CV	Certification	Integral Re-Breather	Manual Override	Part Number
DIN "I" Type	12 VDC				CONSULT FACTORY			
	24 VDC				CONSULT FACTORY			
	24 VAC				CONSULT FACTORY			
	120 VAC				CONSULT FACTORY			
	240 VAC	2.5 VA	IP65	0.7	UL, CSA, CE	YES	YES	630250-21532536
Flying Leads	12 VDC	6.9 W	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21422536
	24 VDC	6.9 W	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21423536
	24 VAC	6.3 VA	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21428536
	120 VAC	6.3 VA	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21420536
	240 VAC	6.3 VA	NEMA 2, 3, 3S, 4 & 4X	0.7	UL, CSA	YES	YES	630250-21421536
Exp. Proof Flying Leads	12 VDC	6.9 W	NEMA 4, 7 & 9	0.7	UL, CSA	YES	YES	630250-21426536
	24 VDC	6.9 W	NEMA 4, 7 & 9	0.7	UL, CSA	YES	YES	630250-21427536
	24 VAC	6.3 VA	NEMA 4, 7 & 9	0.7	UL, CSA	YES	YES	630250-21436536
	120 VAC	6.3 VA	NEMA 4, 7 & 9	0.7	UL, CSA	YES	YES	630250-21424536
	240 VAC	6.3 VA	NEMA 4, 7 & 9	0.7	UL, CSA	YES	YES	630250-21425536







NOTES
1 For dual coil, Watt/VA is provided per coil.

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Series 5A Aluminum Valve Status Monitor



FEATURES

- IP66 / 67
- NEMA 4, 4x
- High Visibility Indicator Dome
- Compact Design
- SIL 3 Capable Option

TECHNICAL DATA

General Specifications				
Body Material	Die cast aluminum			
Indicator Dome	Polycarbonate			
Coating	Grey polyester			
Conduit Thread	1/2" NPT or M20			
Conduit Quantity	2			
Temperature Range	-13°F to 149°F (-25°C to 65°C)			
Approx. Weight with 2 x SPDT	1.2 lbs / 0.5 kg			
Mounting Pattern	VDI/VDE 3845			
Terminal	4 or 8 Pole configurations			
O-Rings	EPDM			
Indicator Options	Open (yellow) Closed (red) Open (green) Closed (red)	Open (black) Closed (yellow) Open (red) Closed (green)		
Ratings	IP66/67 & NEMA 4, 4x			
Certification	cULus on most models. CE Declaration			
Hazardous Locations (Optional)	ATEX, IECEx, cULus for intrinsic safety			

Mechanical Switches			Reed Switches
Switch Type	SPDT	SPDT Low Power	SPDT
Switch Ratings	10A, 250V AC 1/2 HP, 250V AC 0.25A, 250V DC 0.5A, 125V DC	0.1A, 125V AC 0.1A, 30V DC 1mA, 4V AC/DC min	180 mA, 110V AC 830 mA, 24V DC 20W max.
Max Number of Switches	2	2	2
Approvals	cULus, SIL 3 Capable	cULus, SIL 3 Capable	SIL 3 Capable

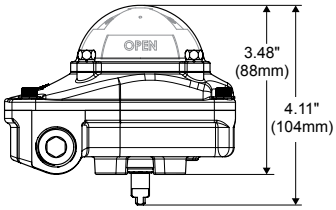
3-Wire DC Proximity Switches	PNP N.O.	PNP N.C.	NPN N.O.	NPN N.C.
Power Supply	Class 2	Class 2	Class 2	Class 2
Operating Voltage	10-30V DC	10-30V DC	10-30V DC	10-30V DC
Load Current	≤ 100 mA	≤ 100 mA	≤ 100 mA	≤ 100 mA
Current Consumption	≤ 15 mA	≤ 15 mA	≤ 15 mA	≤ 15 mA
Leakage Current	≤ 0.5 mA	≤ 0.5 mA	≤ 0.5 mA	≤ 0.5 mA
Voltage Drop	≤ 3V	≤ 3V	≤ 3V	≤ 3V
Max Number of Switches	2	2	2	2
Approvals	cULus	cULus	cULus	N/A

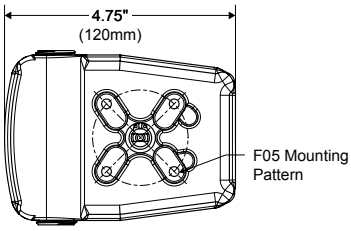
2-Wire Proximity Switches	140V N.O.	250V N.O.
Operating Voltage	20-140V AC 10-140V DC	20-250V AC 10-300V DC
Load Current	5-200 mA	≤ 100 mA
Leakage Current	≤ 0.8 mA	≤ 1.7 mA
Voltage Drop	≤ 7V	≤ 6V
Max Number of Switches	2	2
Approvals	N/A	N/A

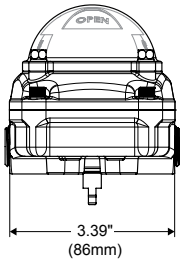
NAMUR I.S. Switches	N.C.
Current Consumption	≥ 3 mA (deactivated) ≤ 1 mA (activated)
Max Power	64 mW
Max Voltage	16 V
Max Current	25 mA
Switch	P+F NJ2-V3-N
Effective Capacitance (C_i)	≤ 40 nF
Effective Inductance (L_i)	≤ 50 µH
Max Number of Switches	2
Approval	cULus, ATEX, IECEx, SIL 3 Capable

UL/cUL	Class I, Division 1, Groups A, B, C, & D, T6 Class II, Division 1, Groups E, F, & G, T85°C Class III
	Class I, Zone 0, AEx ia IIC T6 Class I, Zone 1, AEx ia IIC T6
	Ex ia IIC Gb T6
ATEX	II 1G Ex ia IIC Ga T6 II 2G Ex ia IIC Gb T6
IECEx	Ex ia IIC Ga T6 Ex ia IIC Gb T6
Ambient	Zone 0 or 1G: -25°C ≤ Ta ≤ +49°C Zone 1 or 2G: -25°C ≤ Ta ≤ +65°C

DIMENSIONS







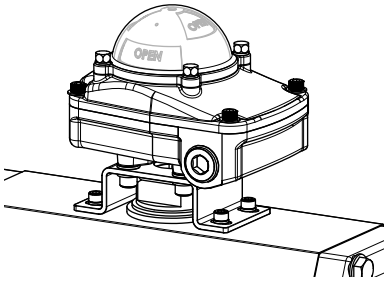
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The technical data herein is for general information only. Product suitability should be based solely upon customer's detailed knowledge and experience with their application.

Series 5A Aluminum Valve Status Monitor

BRACKET

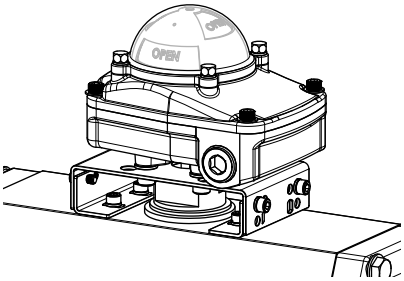
Bracket Type	NAMUR Pattern	Actuator Series	Actuator Size	VSM / Actuator	Std. Part No.
Single Piece	30 x 80	92 / 93	063 - 128	Imperial / Imperial	5B0000-22600534
				Imperial / Metric	5B0000-22630534
				Metric / Metric	5B0000-22650534
		98	All	Imperial / Metric	5B0000-22630534
				Metric / Metric	5B0000-22650534
Adjustable	30 x 80 or 30 x 130	92 / 93	063 - 210	Imperial / Imperial	5B0000-22601534
			063 - 255	Imperial / Metric	5B0000-22631534
				Metric / Metric	5B0000-22651534
		98	All	Imperial / Metric	5B0000-22631534
				Metric / Metric	5B0000-22651534

Single Piece Bracket

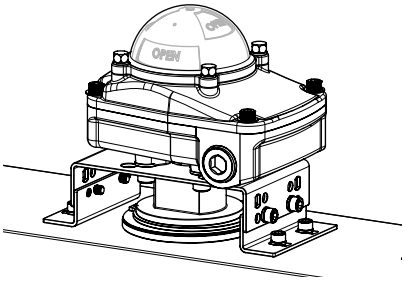


30mm x 80mm

Adjustable Bracket for both 30x80 and 30x130 NAMUR mounting pads (fits all S92/93/98 actuators)



30mm x 80mm



30mm x 130mm

PART NUMBERING SYSTEM

5A000X-126X X XXX / E X

Thread Type

0	Imperial
5	Metric

Switch Option

A	SPDT Mechanical Switch
B	SPDT Mechanical Gold Plated Switch (Low Power)
C	PNP N.O., 3-Wire Switch
D	NPN N.O., 3-Wire Switch
E	PNP N.C., 3-Wire Switch
F	140V, 2-Wire Switch
G	250V, 2-Wire Switch
H	NAMUR Intrinsically Safe Switch
K	SPDT Reed Switch
R	NPN N.C., 3-Wire Switch

Switch Configuration

2	2 Switches

Body Material

536	Polyester coated die-cast aluminum

No Additional Characters

Standard English
Red Closed/Yellow Open

Indicator Language

E	English

Indicator Color

2	Red Closed/ Green Open
3	Yellow Closed/ Black Open
4	Green Closed/ Red Open

HEADQUARTERS
Bray International, Inc.
13333 Westland East Blvd.
Houston, Texas 77041
Tel: 281.894.5454
bray.com

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EQUIPMENT TECHNICAL DATA SHEETS

NEEDLE VALVE

FOR:
AIR DIAPHRAGM SLUDGE PUMP AIR INLET

NEEDLE – MANUAL FLOW ADJUSTMENT VALVE:

Materials: Brass Body, Fluoroelastomer Rubber Seal, Brass Needle
Type: NPT(F) Connections, w/ Manual Flow Adjustment Knob Operator

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Valve Function	Flow Adjustment
Valve Type	Needle
Actuation	Manual
Valve Operation	Handle
Handle Style	Knob
Handle Type	Standard
Fitting Type	Connector
Shape	Straight
For Use With	Water, Oil, Air, Argon, Helium, Krypton, Neon, Xenon
Connection Type	Pipe
Connection Style	Threaded
Pipe Size	1/2
Gender	Female
Thread Type	NPTF
Flow Coefficient (Cv)	1.2
Maximum Pressure	2000 psi @ 400° F
Temperature Range	-15° to 400° F
Seat Type	Metal-to-Metal
Body Material	Brass
Seal Material	Fluoroelastomer Rubber
Needle Material	Brass
End-to-End Length	2 1/2"
Overall	
Height	3 1/8"
Length	2 1/2"
Chemical Resistance (Excellent)	Air, Argon, Helium, Krypton, Neon, Oil, Water, Xenon
Warning Message	Chemical compatibility must be determined by the customer based on the conditions in which the product is being used, including the presence of other chemicals, temperature, and consistency.
RoHS	RoHS 3 (2015/863/EU) compliant with exemption 6(c) - Lead in copper alloy
REACH	Not Compliant

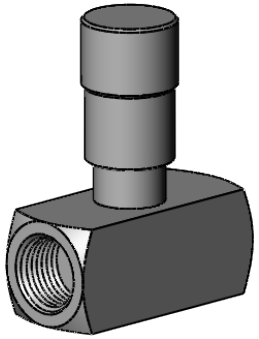
KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

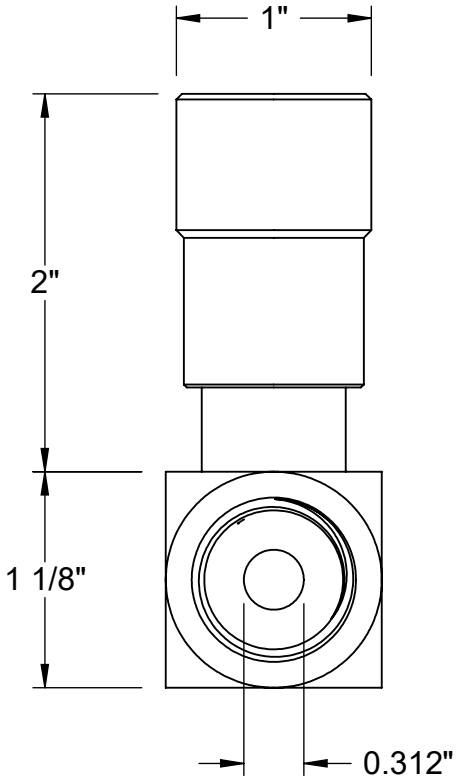
DFARS	Specialty Metals COTS-Exempt
Country of Origin	United States
USMCA Qualifying	No
Schedule B	848120.0040
ECCN	EAR99

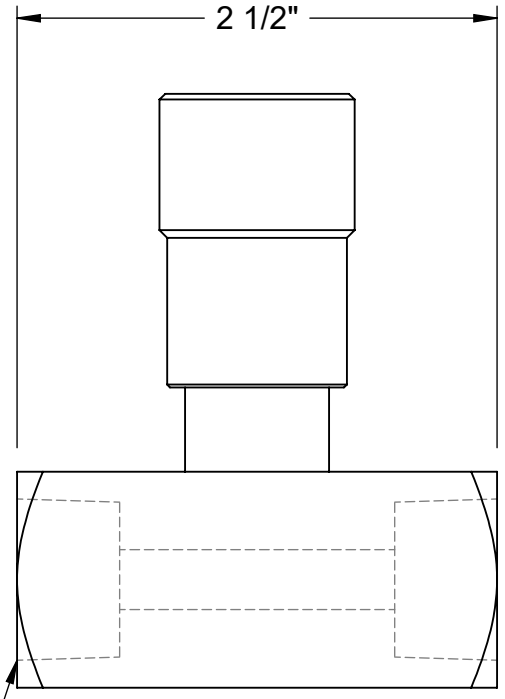
The color-coded threads and numerical markings on these valves ensure consistent and repeatable settings. One full revolution of the handle reveals a new color to indicate the set point. Turn the handle to adjust flow in small increments for metering, sampling, and other applications requiring fine flow control. Valves have metal-to-metal seats that resist temperature fluctuations.

Flow coefficient (Cv) is the amount of water (in gallons per minute) at 60° F that will flow through a fully open valve with a difference of 1 psi between the inlet and the outlet.

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917







1/2 NPTF Pipe Size, 14 Threads Per Inch,
0.53" Thread Engagement

McMASTER-CARR® CAD http://www.mcmaster.com	PART NUMBER **46425K14**
© 2021 McMaster-Carr Supply Company Information in this drawing is provided for reference only.	Easy-Set Precision Flow-Adjustment Valve

EQUIPMENT TECHNICAL DATA SHEETS

SOLENOID VALVE – 2-WAY

KROFTA AIR DISSOLVING TUBE (ADT) AIR FEED SOLENOID VALVE:

ASCO Brass Solenoid Model 8210G001, 2-way, N/C, 3/8" NPT inlet/outlet, 24VDC, Nema 4X rated.

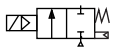
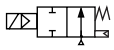
SLUDGE TRANSFER PUMP AIR FEED SOLENOID VALVE:

ASCO Brass Solenoid Model 8210G009, 2-way, N/C, 3/4" NPT inlet/outlet, 24VDC, Nema 4X rated.

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

ASCO® Red-Hat®

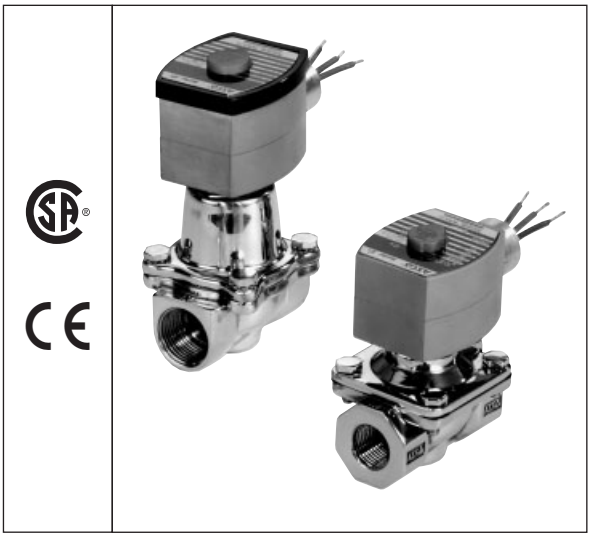
Pilot Operated
General Service Solenoid Valves
Brass or Stainless Steel Bodies
3/8" to 2 1/2" NPT

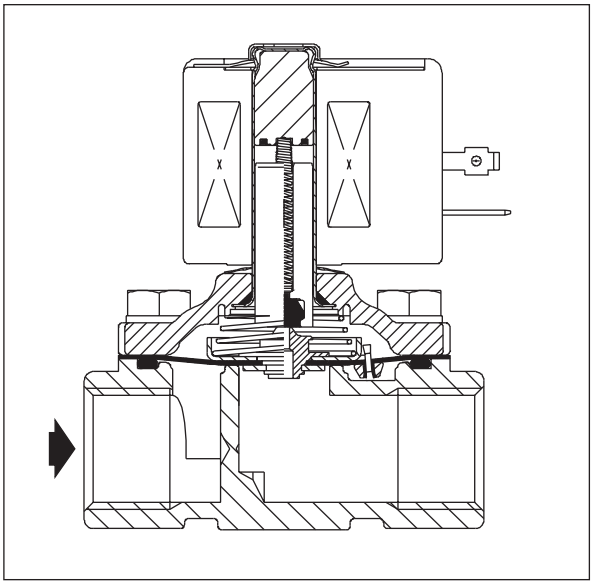
NC 
NO 

2/2
SERIES
8210

Features

- Wide range of pressure ratings, sizes, and resilient materials provide long service life and low internal leakage.
- High Flow Valves for liquid, corrosive, and air/inert gas service.
- Industrial applications include:
  - Car wash
  - Laundry equipment
  - Air compressors
  - Industrial water control
  - Pumps





Construction

Valve Parts in Contact with Fluids		
Body	Brass	304 Stainless Steel
Seals and Discs	NBR or PTFE	
Disc-Holder	PA	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
F	16.8	16.1	35	180	272610	97617	272614	97617
F	-	17.1	40	93	238610	-	238614	-
F	-	20	43	240	99257	-	99257	-
F	-	20.1	48	240	272610	-	272614	-
H	30.6	-	-	-	-	74073	-	74073
H	40.6	-	-	-	-	238910		238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages available when required.

Solenoid Enclosures

Standard: Red-Hat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; Red-Hat - Type I.
Optional: Red-Hat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; Red-Hat - Explosionproof and Watertight, Types 3, 4, 4X, 7, and 9.
(To order, add prefix "EF" to catalog number, except Catalog Numbers 8210B57, 8210B58, and 8210B59. Valves not available with Explosionproof enclosures.)
See Optional Features Section for other available options.

Nominal Ambient Temperature Ranges:

Red-Hat II/
Red-Hat AC: 32˚F to 125˚F (0˚C to 52˚C)
Red-Hat II DC: 32˚F to 104˚F (0˚C to 40˚C)
Red-Hat DC: 32˚F to 77˚F (0˚C to 25˚C)
(104˚F/40˚C occasionally)
Refer to Engineering Section for details.

Approvals:

CSA certified. Red-Hat II meets applicable CE directives.
Refer to Engineering Section for details.

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)							Max. Fluid Temp. °F		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	3/8	1.5	①	150	125	-	40	40	-	180	150	8210G73 ③	1P	●	8210G36 ③	1P	●	6.1/F	11.6/F
3/8	5/8	3	0	150	150	-	40	40	-	180	150	8210G93	5D	❍	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G1	6D	❍	-	-	-	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	-	-	-	175	-	8210G6	5D	❍	-	-	-	17.1/F	-
1/2	7/16	2.2	①	150	125	-	40	40	-	180	150	8210G15 ③	2P	●	8210G37 ③	2P	●	6.1/F	11.6/F
1/2	5/8	4	0	150	150	-	40	40	-	180	150	8210G94	5D	❍	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	-	175	150	-	-	-	8210G87	7D	●	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G2	6D	❍	-	-	-	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G7	5D	❍	-	-	-	17.1/F	-
1/2	3/4	4	5	-	300	-	-	300	-	180	125	8210G227	5D	❍	-	-	-	17.1/F	40.6/H
3/4	5/8	4.5	0	150	150	125	40	40	-	175	150	-	-	-	8210G88	7D	●	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G9	9D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	5	0	150	150	-	40	40	-	180	150	8210G95	8D	❍	-	-	-	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G3	11D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	6	0	-	-	-	200	180	180	-	77	8210B26 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G26 ② ‡	40P	●	-	-	-	16.1F	-
1	1	13	0	-	-	-	100	100	80	-	77	8210B54 ‡	31D	-	8210D89	15D	-	-	30.6/H
1	1	13	0	150	125	125	-	-	-	180	-	8210G54	41D	●	8210G89	45D	●	16.1/F	-
1	1	13	5	150	150	100	125	125	125	180	150	8210G4	12D	❍	-	-	-	6.1/F	11.6/F
1	1	13.5	0	300	225	115	-	-	-	200	-	8210G27 ‡	42P	●	-	-	-	20.1/F	-
1	1	13.5	10	300	300	300	-	-	-	175	-	8210G78 ②	13P	-	-	-	-	17.1/F	-
1 1/4	1 1/8	15	0	-	-	-	100	100	80	-	77	8210B55 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	1 1/8	15	0	150	125	125	-	-	-	180	-	8210G55	43D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	5	150	150	100	125	125	125	180	150	8210G8	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	1 1/4	22.5	0	-	-	-	100	100	80	-	77	8210B56 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G56 ‡	44D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	5	150	150	100	125	125	125	180	150	8210G22	18D	●	-	-	-	6.1/F	11.6/F
2	1 3/4	43	5	150	125	90	50	50	50	180	150	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	1 3/4	45	5	150	125	90	50	50	50	180	150	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	125	125	80	180	150	8210G33	23D	●	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	250	200	200	250	200	200	180	180	8210G11 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	125	125	80	180	150	8210G34	23D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G30	37D	●	10.1/F	11.6/F
1/2	5/8	4	5	250	200	200	250	200	200	180	180	8210G12 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	3/4	5.5	0	150	150	125	125	125	80	180	150	8210G35	25D	●	-	-	-	10.1/F	11.6/F
3/4	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G38	38D	●	10.1/F	11.6/F
3/4	3/4	6.5	5	-	-	-	250	200	200	-	180	8210C13	24D	●	-	-	-	-	16.8/F
3/4	3/4	6.5	5	250	200	200	-	-	-	180	-	8210G13	46D	●	-	-	-	16.1/F	-
1	1	13	0	125	125	125	-	-	-	180	-	8210B57 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	1	13	5	-	-	-	125	125	125	-	180	8210D14	26D	●	-	-	-	-	16.8/F
1	1	13	5	150	150	125	-	-	-	180	-	8210G14	47D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	0	125	125	125	-	-	-	180	-	8210B58 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	1 1/8	15	5	-	-	-	125	125	125	-	180	8210D18	28D	●	-	-	-	-	16.8/F
1 1/4	1 1/8	15	5	150	150	125	-	-	-	180	-	8210G18	48D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	0	125	125	125	-	-	-	180	-	8210B59 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	1 1/4	22.5	5	-	-	-	125	125	125	-	180	8210D32	29D	●	-	-	-	-	16.8/F
1 1/2	1 1/4	22.5	5	150	150	125	-	-	-	180	-	8210G32	49D	●	-	-	-	16.1/F	-
2	1 3/4	43	5	-	-	-	125	125	125	-	150	8210103	30P	●	-	-	-	-	16.8/F
2	1 3/4	43	5	125	125	125	-	-	-	180	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	1 3/4	45	5	-	-	-	125	125	125	-	150	8210104	27P	●	-	-	-	-	16.8/F
2 1/2	1 3/4	45	5	125	125	125	-	-	-	180	-	8210G104	51P	●	-			16.1/F	-

Notes: ① 5 psi on Air; 1 psi on Water.
② Valve provided with PTFE main disc.
③ Valve includes Ultem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve.
Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless Steel disc-holder.
‡ Must have solenoid mounted vertical and upright.

Specifications (Metric units)

Pipe Size (ins.)	Orifice Size (mm)	Kv Flow Factor (m3/h)	Operating Pressure Differential (bar)							Max.Fluid Temp. °C		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	Catalog Number	Constr. Ref. No. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	10	1.29	①	10	9	-	3	3	-	81	65	8210G73 ③	1P	●	8210G36 ③	1P	●	6.1/F	11.6/F
3/8	16	2.57	0	10	10	-	3	3	-	81	65	8210G93	5D	❍	-	-	-	10.1/F	11.6/F
3/8	16	2.57	0.3	14	10	9	9	7	7	81	65	8210G1	6D	❍	-	-	-	6.1/F	11.6/F
3/8	16	2.57	0.3	21	21	21	-	-	-	79	-	8210G6	5D	❍	-	-	-	17.1/F	-
1/2	11	1.89	①	10	9	-	3	3	-	81	65	8210G15 ③	2P	●	8210G37 ③	2P	●	6.1/F	11.6/F
1/2	16	3.43	0	10	10	-	3	3	-	81	65	8210G94	5D	❍	-	-	-	10.1/F	11.6/F
1/2	16	3.43	0	10	10	9	3	3	-	79	65	-	-	-	8210G87	7D	●	17.1/F	11.6/F
1/2	16	3.43	0.3	14	10	9	9	7	7	81	65	8210G2	6D	❍	-	-	-	6.1/F	11.6/F
1/2	16	3.43	0.3	21	21	21	-	-	-	79	-	8210G7	5D	❍	-	-	-	17.1/F	-
1/2	19	3.43	0.3	-	21	-	-	21	-	81	52	8210G227	5D	❍	-	-	-	17.1/F	40.6F
3/4	16	3.86	0	10	10	9	3	3	-	79	65	-	-	-	8210G88	7D	●	17.1/F	11.6/F
3/4	19	4.29	0.3	9	9	9	7	6	5	81	65	8210G9	9D	❍	-	-	-	6.1/F	11.6/F
3/4	19	4.29	0	10	10	-	3	3	-	81	65	8210G95	8D	❍	-	-	-	10.1/F	11.6/F
3/4	19	5.57	0.3	17	10	7	9	9	9	81	65	8210G3	11D	❍	-	-	-	6.1/F	11.6/F
3/4	19	5.14	0	-	-	-	14	12	12	-	25	8210B26 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	19	5.14	0	24	21	14	-	-	-	92	-	8210G26 ② ‡	40P	●	-	-	-	16.1F	-
1	25	11.14	0	-	-	-	7	7	6	-	25	8210B54 ‡	31D	-	8210D89	15D	-	-	30.6/H
1	25	11.14	0	10	9	9	-	-	-	81	-	8210G54	41D	●	8210G89	45D	●	16.1/F	-
1	25	11.14	0.3	10	10	7	9	9	9	81	65	8210G4	12D	❍	-	-	-	6.1/F	11.6/F
1	25	11.57	0	21	16	8	-	-	-	92	-	8210G27 ‡	42P	●	-	-	-	20.1/F	-
1	25	11.57	0.7	21	21	21	-	-	-	79	-	8210G78 ②	13P	-	-	-	-	17.1/F	-
1 1/4	29	12.86	0	-	-	-	7	7	6	-	25	8210B55 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	29	12.86	0	10	9	9	-	-	-	81	-	8210G55	43D	●	-	-	-	16.1/F	-
1 1/4	29	12.86	0.3	10	10	7	9	9	9	81	65	8210G8	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	32	19.29	0	-	-	-	7	7	6	-	25	8210B56 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	32	19.29	0	10	9	9	-	-	-	81	-	8210G56 ‡	44D	●	-	-	-	16.1/F	-
1 1/2	32	19.29	0.3	10	10	7	9	9	9	81	65	8210G22	18D	●	-	-	-	6.1/F	11.6/F
2	44	36.86	0.3	10	9	6	3	3	3	81	65	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	44	38.57	0.3	10	9	6	3	3	3	81	65	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	16	2.57	0.0	10	10	9	9	9	6	81	65	8210G33	23D	●	-	-	-	10.1/F	11.6/F
3/8	16	2.57	0.3	17	14	14	17	14	14	81	81	8210G11 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	16	3.43	0	10	10	9	9	9	6	81	65	8210G34	23D	●	-	-	-	10.1/F	11.6/F
1/2	16	2.57	0	10	10	7	9	9	6	81	65	-	-	-	8210G30	37D	●	10.1/F	11.6/F
1/2	16	3.43	0.3	17	14	14	17	14	14	81	81	8210G12 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	19	4.71	0	10	10	9	9	9	6	81	65	8210G35	25D	●	-	-	-	10.1/F	11.6/F
3/4	16	2.57	0	10	10	7	9	9	6	81	65	-	-	-	8210G38	38D	●	10.1/F	11.6/F
3/4	19	5.57	0.3	-	-	-	17	14	14	-	81	8210C13	24D	●	-	-	-	-	16.8/F
3/4	19	5.57	0.3	17	14	14	-	-	-	81	-	8210G13	46D	●	-	-	-	16.1/F	-
1	25	11.14	0	9	9	9	-	-	-	81	-	8210B57 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	25	11.14	0.3	-	-	-	9	9	9	-	81	8210D14	26D	●	-	-	-	-	16.8/F
1	25	11.14	0.3	10	10	9	-	-	-	81	-	8210G14	47D	●	-	-	-	16.1/F	-
1 1/4	29	12.86	0	9	9	9	-	-	-	81	-	8210B58 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	29	12.86	0.3	-	-	-	9	9	9	-	81	8210D18	28D	●	-	-	-	-	16.8/F
1 1/4	29	12.86	0.3	10	10	9	-	-	-	81	-	8210G18	48D	●	-	-	-	16.1/F	-
1 1/2	32	19.29	0	9	9	9	-	-	-	81	-	8210B59 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	32	19.29	0.3	-	-	-	9	9	9	-	81	8210D32	29D	●	-	-	-	-	16.8/F
1 1/2	32	19.29	0.3	10	10	9	-	-	-	81	-	8210G32	49D	●	-	-	-	16.1/F	-
2	44	36.86	0.3	-	-	-	9	9	9	-	65	8210103	30P	●	-	-	-	-	16.8/F
2	44	36.86	0.3	9	9	9	-	-	-	81	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	44	38.57	0.3	-	-	-	9	9	9	-	65	8210104	27P	●	-	-	-	-	16.8/F
2 1/2	44	38.57	0.3	9	9	9	-	-	-	81	-	8210G104	51P	●	-	-	-	16.1/F	-

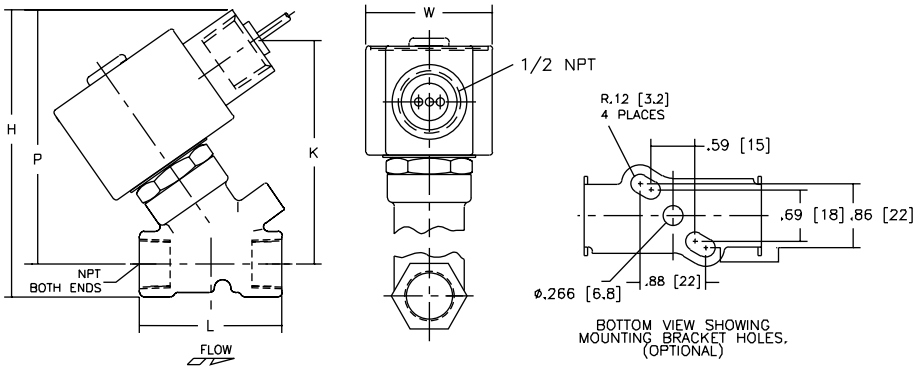
Notes:
① 0.3 bar on Air; 0.0 bar on Water.
② Valve provided with PTFE main disc.
③ Valve includes UItem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve. Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless Steel disc-holder.
‡ Must have solenoid mounted vertical and upright.

Dimensions: inches (mm)

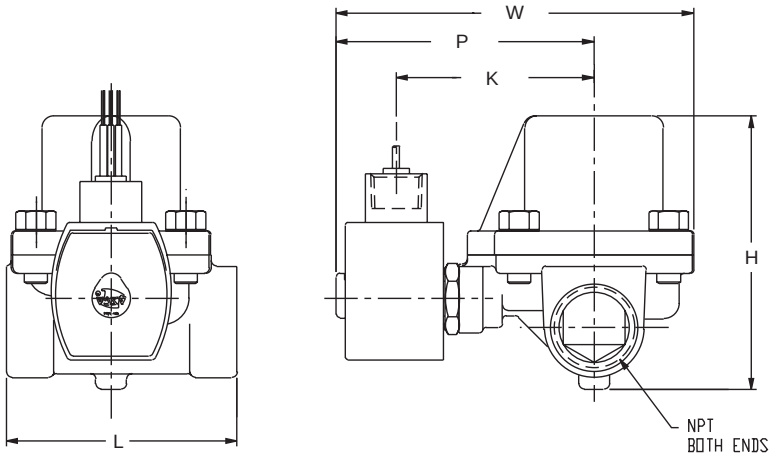
Constr. Ref. No.		H	K	L	P	W
1*	ins.	3.85	3.00	1.91	3.41	1.69
	mm	98	76	49	87	43
2*	ins.	4.17	3.25	2.28	3.63	1.69
	mm	106	83	58	92	43
13	ins.	4.44	3.22	3.75	4.19	5.81
	mm	113	82	95	106	147
5	ins.	3.84	2.31	2.75	3.28	2.28
	mm	98	59	70	83	58
6*	ins.	3.38	1.94	2.75	2.80	2.28
	mm	86	49	70	71	58
7	ins.	4.19	2.50	2.81	3.47	2.39
	mm	106	64	71	88	61
8	ins.	4.13	2.47	2.81	3.44	2.29
	mm	105	63	71	87	58
9*	ins.	3.66	2.10	2.81	2.96	2.28
	mm	93	53	71	75	58
10*①	ins.	5.25	X	2.81	4.59	2.31
	mm	133	X	71	117	59
11*	ins.	4.16	2.66	3.84	3.52	2.75
	mm	106	68	98	89	70
12	ins.	5.64	3.15	3.75	4.01	3.36
	mm	143	80	95	102	85
15*	ins.	5.34	X	3.75	4.47	3.84
	mm	136	X	95	114	98
16	ins.	5.64	3.15	3.66	4.01	3.56
	mm	143	80	93	102	90
18	ins.	6.11	3.30	4.38	4.16	3.92
	mm	155	84	111	106	100
20*	ins.	7.33	3.71	5.06	4.57	4.87
	mm	186	94	129	116	124
21*	ins.	7.33	3.71	5.50	4.57	4.87
	mm	186	94	140	116	124
23	ins.	4.35	2.65	2.75	3.79	2.28
	mm	110	67	70	96	58
24	ins.	5.06	X	3.78	4.44	2.75
	mm	129	X	96	113	70
25	ins.	4.64	2.81	2.81	3.94	2.28
	mm	118	71	71	100	58
26	ins.	6.53	X	3.75	4.91	3.19
	mm	166	X	95	125	81
27	ins.	8.22	X	5.50	5.47	4.87
	mm	209	X	140	139	124
28	ins.	6.53	X	3.66	4.91	3.19
	mm	166	X	93	125	81
29	ins.	7.03	X	4.38	5.06	4.40
	mm	179	X	111	129	112

① Valves must be mounted with solenoid vertical and upright.
* DC dimensions slightly larger.

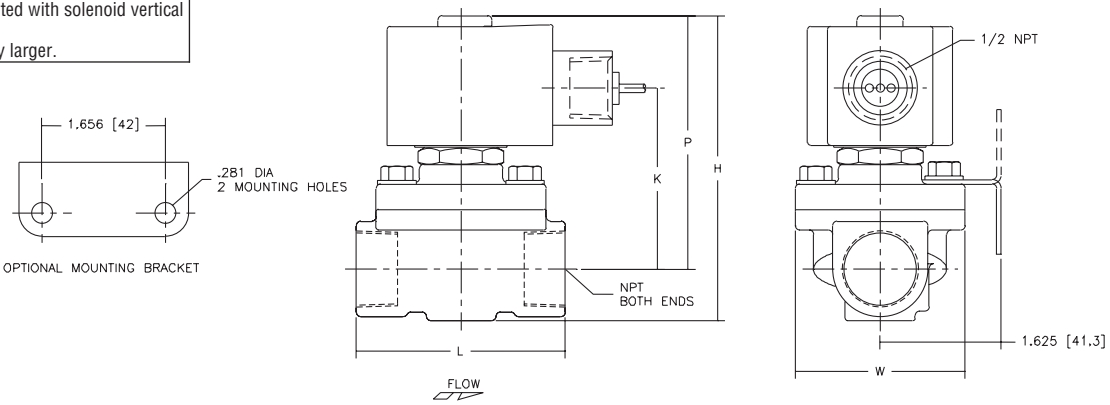
Constr. Refs. 1, 2



Constr. Ref. 13



Constr. Refs. 5-9, 11, 20, 21, 23 , 25, 37,38

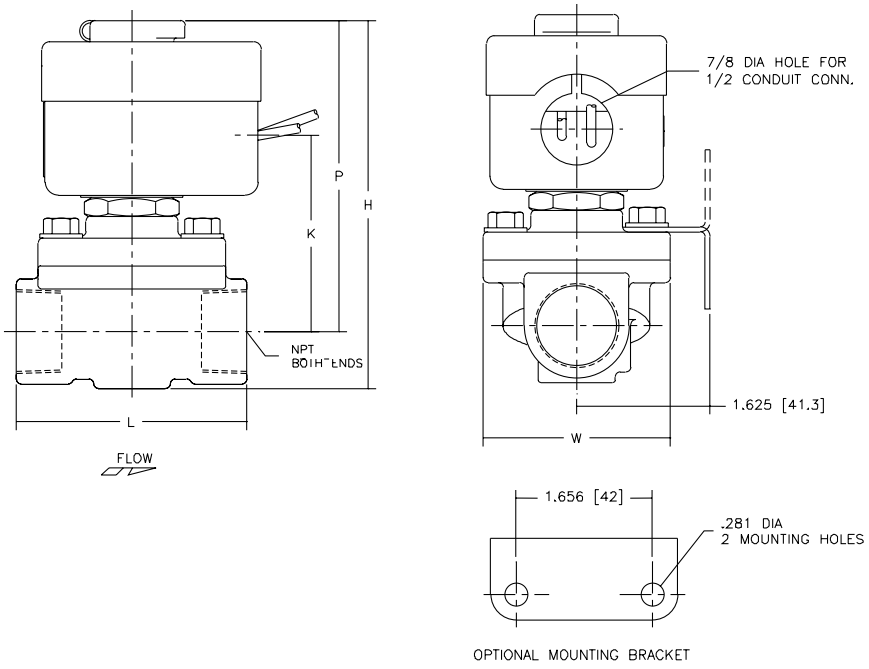


Dimensions: inches (mm)

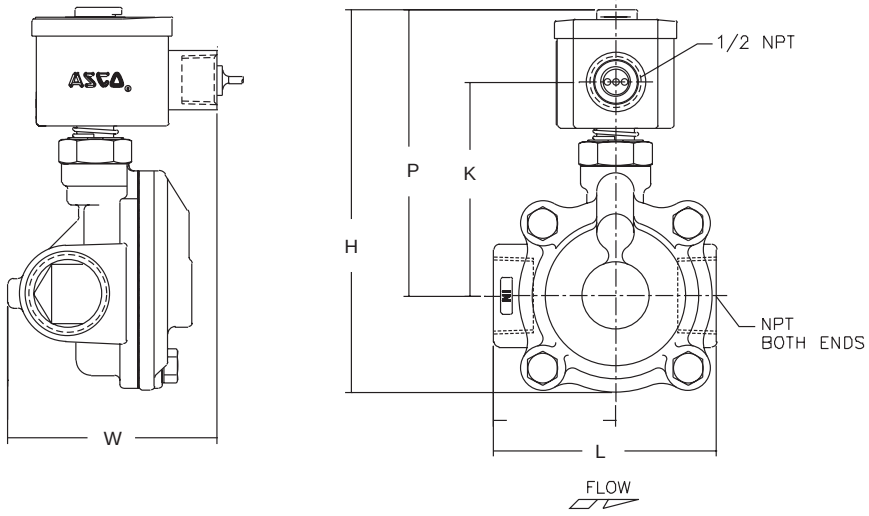
Constr. Ref. No.		H	K	L	P	W
30	ins.	8.22	X	5.06	5.47	4.87
	mm	209	X	129	139	124
31	ins.	5.25	X	3.75	4.44	3.25
	mm	133	X	95	113	83
32	ins.	5.69	X	3.66	4.69	3.25
	mm	145	X	93	119	83
33	ins.	6.06	X	4.38	4.94	3.91
	mm	154	X	111	125	99
34	ins.	6.91	X	3.75	6.09	3.25
	mm	176	X	95	155	83
35	ins.	7.34	X	3.66	6.34	3.25
	mm	186	X	93	161	83
36	ins.	7.66	X	4.38	6.56	3.91
	mm	1.95	X	111	167	99
37	ins.	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
38	ins.	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
39	ins.	5.42	2.31	2.75	4.86	3.80
	mm	138	59	70	123	97
40	ins.	5.20	3.29	2.81	4.50	2.28
	mm	132	83	71	114	58
41	ins.	5.13	3.10	3.75	4.32	3.25
	mm	130	79	95	110	83
42	ins.	6.43	4.40	3.93	5.62	3.25
	mm	163	112	100	143	83
43	ins.	5.57	3.35	3.66	4.57	3.25
	mm	142	85	93	116	83
44	ins.	5.90	3.57	4.38	4.79	3.91
	mm	150	91	111	122	99
45	ins.	5.26	3.17	3.75	4.38	3.84
	mm	134	81	95	111	98
46	ins.	4.95	3.10	3.84	4.31	2.75
	mm	126	79	98	110	70
47	ins.	6.43	3.59	3.75	4.81	3.52
	mm	163	91	95	122	90
48	ins.	6.43	3.59	3.66	4.81	3.73
	mm	163	91	93	122	95
49	ins.	6.91	3.75	4.38	4.96	4.40
	mm	176	95	111	126	112
50	ins.	8.13	4.15	5.06	5.37	4.87
	mm	207	105	129	136	124
51	ins.	8.13	4.15	5.50	5.37	5.18
	mm	207	105	140	136	132

IMPORTANT: Valves may be mounted in any position, except as noted in specifications table.

Constr. Refs. 10, 15, 24, 26-36

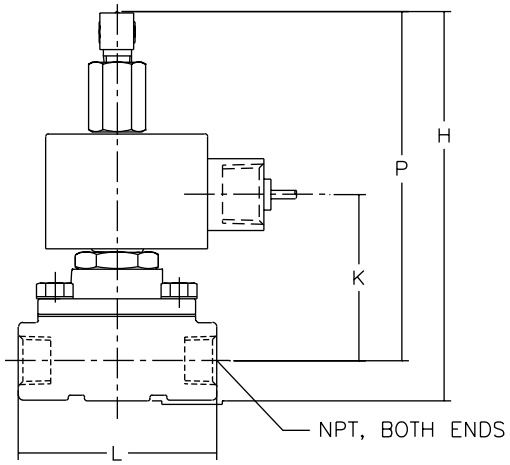


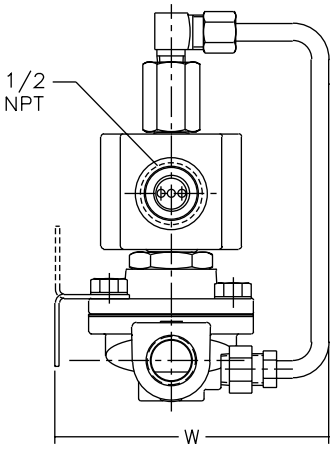
Constr. Refs. 12, 16, 18



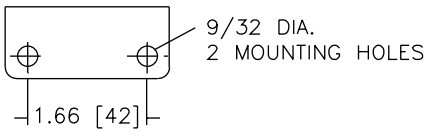
Dimensions: inches (mm)

Constr. Refs. 39



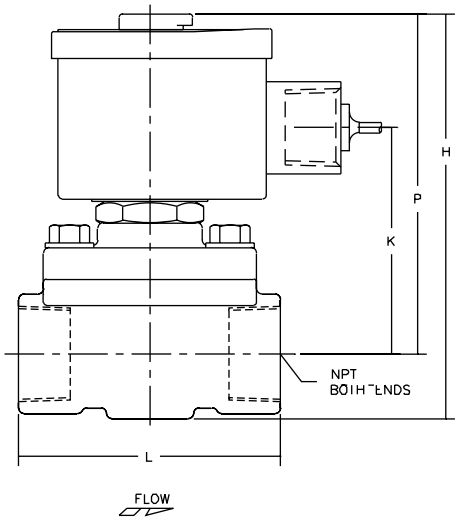


FLOW

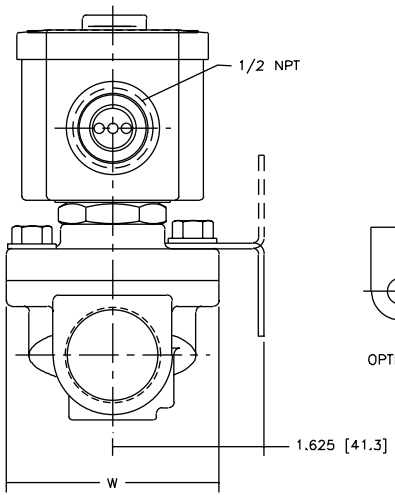


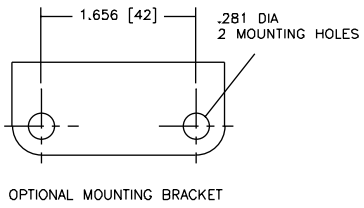
SHOWING MOUNTING
BRACKET ONLY

Constr. Refs. 40-51



FLOW





OPTIONAL MOUNTING BRACKET

EQUIPMENT TECHNICAL DATA SHEETS

SOLENOID VALVE – 3-WAY

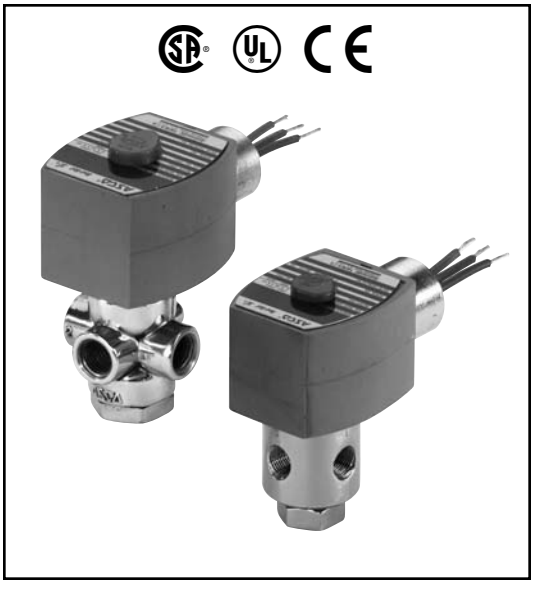
KROFTA AUTO AIR PRESSURE RELEASE GLOBE VALVE (APGV) SOLENOID VALVE:

ASCO Brass Solenoid Model 8210G184, 3-way, N/C, 1/4" NPT inlet/outlet, 24VDC, Nema 4X rated.

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

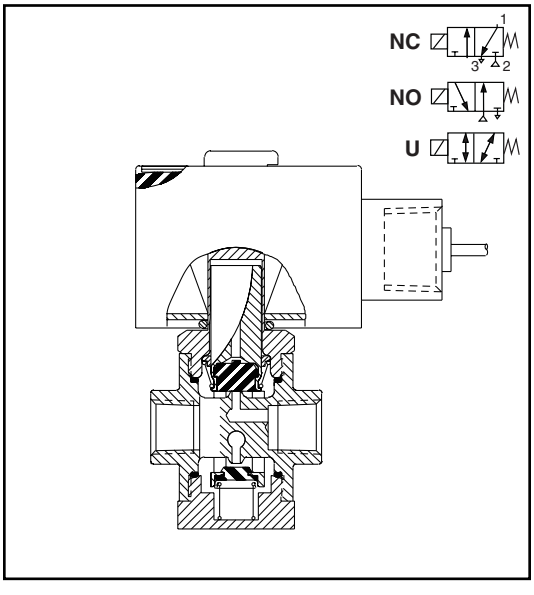
Features

- All NPT connections are in the valve body to allow in-line piping
- No Minimum Operating Pressure Differential required
- Broadest range of applications
- Mountable in any position



Construction

Valve Parts in Contact with Fluids		
Body	Brass	303 Stainless Steel
Seals and Disc	NBR or Cast UR, as Listed	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Core Springs	302 Stainless Steel	
Shading Coil	Copper	Silver
Disc-Holder	CA	
Core Guide	CA (10.1 and 17.1 Watt only)	



Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	10.6	6.1	16	30	238210	238310	238214	238314
F	-	9.1	25	40	238210	-	238214	-
F	11.6	10.1	25	50	238610	238710	238614	238714
F	22.6	17.1	40	70	238610	238710	238614	238714

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages are available when required.

Solenoid Enclosures

Standard: Watertight, Types 1, 2, 3, 3S, 4, and 4X.

Optional: Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9. (To order, add prefix "EF" to the catalog number.)

See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

AC: 32˚F to 125˚F (0˚C to 52˚C)
DC: 32˚F to 104˚F (0˚C to 40˚C)

Note: Some stainless steel constructions are rated -40˚F (-40˚C). See note ④ in specifications table.

Refer to Engineering Section for details.

Approvals

CSA certified. UL listed General Purpose Valves.
Meets applicable CE directives.

SIL 3 capable per IEC 61508 on normally closed const.
Third party certification provided by EXIDA.

Refer to Engineering Section for details.

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi) Max. AC Air-Inert Gas	Max. AC Water	Max. AC Lt. Oil @ 300 SSU	Max. DC Air-Inert Gas	Max. DC Water	Max. DC Lt. Oil @ 300 SSU	Max. Fluid Temp. °F AC	Max. Fluid Temp. °F DC	Brass Body Catalog Number	Brass Body Const. Ref.	Stainless Steel Body Catalog Number	Stainless Steel Body Const. Ref.	Watt Rating/ Class of Coil Insulation ② AC	Watt Rating/ Class of Coil Insulation ② DC
UNIVERSAL OPERATION (Pressure at any port)																
1/8	3/64	0.06	175	175	175	125	125	125	140	120	8320G130 ①	1	8320G140 ①	1	9.1F	10.6F
1/8	1/16	0.09	100	100	100	65	65	65	180	120	8320G001	1	8320G041 ③	1	9.1F	10.6F
1/8	1/16	0.09	175	175	175	125	125	125	200	150	8320G212	4	8320G221 ④	4	17.1/F	22.6/F
1/8	3/32	0.12	50	50	50	50	50	50	180	120	8320G083	1	8320G087 ③	1	6.1/F	10.6/F
1/8	3/32	0.12	100	100	100	60	60	60	200	150	8320G213	4	8320G222 ④	4	17.1/F	11.6/F
1/8	1/8	0.21	30	30	30	20	20	20	180	120	8320G003	1	8320G043 ③	1	9.1/F	10.6/F
1/8	1/8	0.21	50	50	50	25	25	25	200	150	8320G214	4	8320G223 ④	4	17.1/F	11.6/F
1/4	1/16	0.09	125	130	130	75	75	75	200	150	8320G172	2	-	-	10.1/F	11.6/F
1/4	1/16	0.09	175	175	175	125	125	125	200	150	-	-	8320G230 ④	3	17.1/F	22.6/F
1/4	3/32	0.12	100	100	100	60	60	60	200	150	8320G174	2	8320G200 ③④	3	17.1/F	11.6/F
1/4	1/8	0.25	50	50	50	25	25	25	200	150	8320G176	2	8320G201 ③④	3	17.1/F	11.6/F
1/4	11/64	0.35	20	20	20	12	12	12	200	150	8320G178	2	-	-	10.1/F	11.6/F
NORMALLY CLOSED (Closed when de-energized) – PFD_{AVG} = 6.81 x 10^{-4}																
1/8	3/64	0.06	200	200	200	200	200	200	180	120	8320G132	1	8320G142 ③	1	6.1F	10.6/F
1/8	1/16	0.09	150	125	125	125	125	125	180	120	8230G013	1	8320G045 ③	1	6.1F	10.6/F
1/8	1/16	0.09	210	225	225	160	160	160	200	150	8320G215	4	8320G224 ④	4	17.1/F	11.6/F
1/8	3/32	0.12	100	100	100	100	100	100	180	120	8320G015	1	8320G047 ③	1	6.1F	10.6/F
1/8	3/32	0.12	150	150	150	115	115	115	200	150	8320G216	4	8320G225 ④	4	10.1/F	11.6/F
1/8	1/8	0.21	40	40	40	40	40	40	180	120	8320G017	1	8320G049 ③	1	6.1F	10.6/F
1/8	1/8	0.21	85	85	85	60	60	60	200	150	8320G217	4	8320G226 ④	4	10.1/F	11.6/F
1/4	1/16	0.09	210	225	225	160	160	160	200	150	8320G182	2	8320G231 ④	3	17.1/F	11.6/F
1/4	3/32	0.12	150	150	150	115	115	115	200	150	8320G184	2	8320G202 ③④	3	10.1/F	11.6/F
1/4	1/8	0.25	85	85	85	60	60	60	200	150	8320G186	2	8320G203 ③④	3	10.1/F	11.6/F
1/4	11/64	0.35	45	45	45	25	25	25	200	150	8320G188	2	-	-	10.1/F	11.6/F
NORMALLY OPEN (Open when de-energized)																
1/8	3/64	0.06	200	200	200	200	200	200	180	120	8320G136	1	8320G146 ③	1	6.1F	10.6/F
1/8	1/16	0.09	150	125	125	125	125	125	180	120	8320G027	1	8320G051 ③	1	6.1F	10.6/F
1/8	1/16	0.09	235	250	250	160	160	160	200	150	8320G218	4	8320G227 ④	4	17.1/F	11.6/F
1/8	3/32	0.12	100	100	100	100	100	100	180	120	8320G029	1	8320G053 ③	1	6.1F	10.6/F
1/8	3/32	0.12	150	140	140	100	100	100	200	150	8320G219	4	8320G228 ④	4	10.1/F	11.6/F
1/8	1/8	0.21	40	40	40	40	40	40	180	120	8320G031	1	8320G055 ③	1	6.1F	10.6/F
1/8	1/8	0.21	70	70	70	55	55	55	200	150	8320G220	4	8320G229 ④	4	10.1/F	11.6/F
1/4	1/16	0.09	235	250	250	160	160	160	200	150	8320G192	2	8320G232 ④	3	17.1/F	11.6/F
1/4	3/32	0.12	150	140	140	100	100	100	200	150	8320G194	2	8320G204 ③④	3	10.1/F	11.6/F
1/4	1/8	0.25	70	70	70	55	55	55	200	150	8320G196	2	8320G205 ③④	3	10.1/F	11.6/F
1/4	11/64	0.35	40	40	40	30	30	30	200	150	8320G198	2	-	-	10.1/F	11.6/F

① Supplied with cast UR disc.
② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts; the watt rating for the 9.1/F solenoid is 11.1 watts.
③ Can be used for ***dry*** natural gas service with the EF prefix.
④ Constructions standard rated -40˚F (-40˚C) ambient temperature. EFX prefix and TPL # not required.

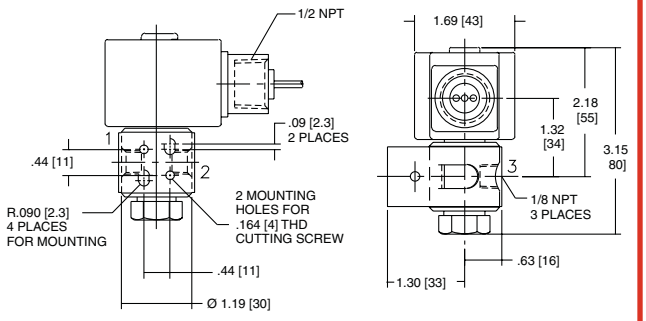
Specifications (Metric units)

Pipe Size (ins.)	Orifice Size (mm)	Kv Flow Factor (m3/h)	Operating Pressure Differential (bar) Max. AC Air-Inert Gas	Max. AC Water	Max. AC Lt. Oil @ 300 SSU	Max. DC Air-Inert Gas	Max. DC Water	Max. DC Lt. Oil @ 300 SSU	Max. Fluid Temp. °C AC	Max. Fluid Temp. °C DC	Brass Body Catalog Number	Brass Body Const. Ref.	Stainless Steel Body Catalog Number	Stainless Steel Body Const. Ref.	Watt Rating/ Class of Coil Insulation② AC	Watt Rating/ Class of Coil Insulation② DC
UNIVERSAL OPERATION (Pressure at any port)																
1/8	1.2	0.05	12	12	12	9	9	9	60	49	8320G130 ①	1	8320G140 ①	1	9.1F	10.6F
1/8	1.6	0.08	7	7	7	4	4	4	82	49	8320G001	1	8320G041 ③	1	9.1F	10.6F
1/8	1.6	0.08	12	12	12	9	9	9	93	66	8320G212	4	8320G221 ④	4	17.1/F	22.6/F
1/8	2.4	0.10	3	3	3	3	3	3	82	49	8320G083	1	8320G087 ③	1	6.1/F	10.6/F
1/8	2.4	0.10	7	7	7	4	4	4	93	66	8320G213	4	8320G222 ④	4	17.1/F	11.6/F
1/8	3.2	0.18	2	2	2	1	1	1	82	49	8320G003	1	8320G043 ③	1	9.1/F	10.6/F
1/8	3.2	0.18	3	3	3	2	2	2	93	66	8320G214	4	8320G223 ④	4	17.1/F	11.6/F
1/4	1.6	0.08	9	9	9	5	5	5	93	66	8320G172	2	-	-	10.1/F	11.6/F
1/4	1.6	0.08	12	12	12	9	9	9	93	66	-	-	8320G230 ④	3	17.1/F	22.6/F
1/4	2.4	0.10	7	7	7	4	4	4	93	66	8320G174	2	8320G200 ③④	3	17.1/F	11.6/F
1/4	3.2	0.21	3	3	3	2	2	2	93	66	8320G176	2	8320G201 ③④	3	17.1/F	11.6/F
1/4	4.4	0.30	1	1	1	1	1	1	93	66	8320G178	2	-	-	10.1/F	11.6/F
NORMALLY CLOSED (Closed when de-energized) – PFD_{AVG} = 6.81 x 10^{-4}																
1/8	1.2	0.05	14	14	14	14	14	14	82	49	8320G132	1	8320G142 ③	1	6.1F	10.6/F
1/8	1.6	0.08	10	9	9	9	9	9	82	49	8230G013	1	8320G045 ③	1	6.1F	10.6/F
1/8	1.6	0.08	14	15	15	11	11	11	93	66	8320G215	4	8320G224 ④	4	17.1/F	11.6/F
1/8	2.4	0.10	7	7	7	7	7	7	82	49	8320G015	1	8320G047 ③	1	6.1F	10.6/F
1/8	2.4	0.10	10	10	10	8	8	8	93	66	8320G216	4	8320G225 ④	4	10.1/F	11.6/F
1/8	3.2	0.18	3	3	3	3	3	3	82	49	8320G017	1	8320G049 ③	1	6.1F	10.6/F
1/8	3.2	0.18	6	6	6	4	4	4	93	66	8320G217	4	8320G226 ④	4	10.1/F	11.6/F
1/4	1.6	0.08	14	15	15	11	11	11	93	66	8320G182	2	8320G231 ④	3	17.1/F	11.6/F
1/4	2.4	0.10	10	10	10	8	8	8	93	66	8320G184	2	8320G202 ③④	3	10.1/F	11.6/F
1/4	3.2	0.21	6	6	6	4	4	4	93	66	8320G186	2	8320G203 ③④	3	10.1/F	11.6/F
1/4	4.4	0.30	3	3	3	2	2	2	93	66	8320G188	2	-	-	10.1/F	11.6/F
NORMALLY OPEN (Open when de-energized)																
1/8	1.2	0.05	14	14	14	14	14	14	82	49	8320G136	1	8320G146 ③	1	6.1F	10.6/F
1/8	1.6	0.08	10	9	9	9	9	9	82	49	8320G027	1	8320G051 ③	1	6.1F	10.6/F
1/8	1.6	0.08	16	17	17	11	11	11	93	66	8320G218	4	8320G227 ④	4	17.1/F	11.6/F
1/8	2.4	0.10	7	7	7	7	7	7	82	49	8320G029	1	8320G053 ③	1	6.1F	10.6/F
1/8	2.4	0.10	10	10	10	7	7	7	93	66	8320G219	4	8320G228 ④	4	10.1/F	11.6/F
1/8	3.2	0.18	3	3	3	3	3	3	82	49	8320G031	1	8320G055 ③	1	6.1F	10.6/F
1/8	3.2	0.18	5	5	5	4	4	4	93	66	8320G220	4	8320G229 ④	4	10.1/F	11.6/F
1/4	1.6	0.08	16	17	17	11	11	11	93	66	8320G192	2	8320G232 ④	3	17.1/F	11.6/F
1/4	2.4	0.10	10	10	10	7	7	7	93	66	8320G194	2	8320G204 ③④	3	10.1/F	11.6/F
1/4	3.2	0.21	5	5	5	4	4	4	93	66	8320G196	2	8320G205 ③④	3	10.1/F	11.6/F
1/4	4.4	0.30	3	3	3	2	2	2	93	66	8320G198	2	-	-	10.1/F	11.6/F

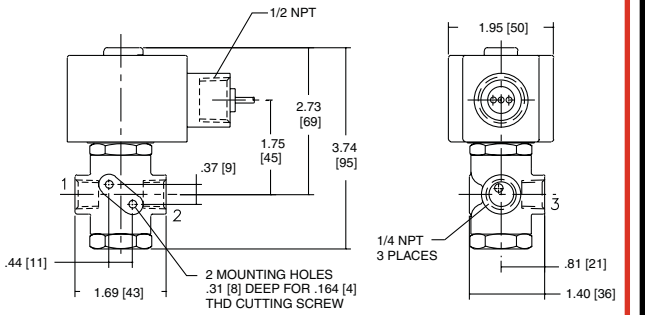
① Supplied with cast UR disc.
② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts; the watt rating for the 9.1/F solenoid is 11.1 watts.
③ Can be used for ***dry*** natural gas service with the EF prefix.
④ Constructions standard rated -40˚F (-40˚C) ambient temperature. EFX prefix and TPL # not required.

Dimensions: inches (mm)

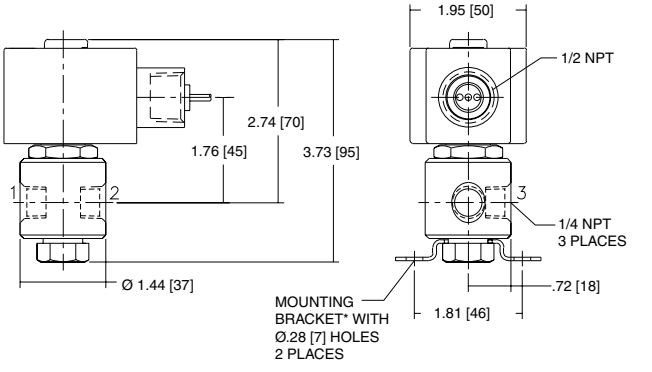
Const. Ref. 1



Const. Ref. 2

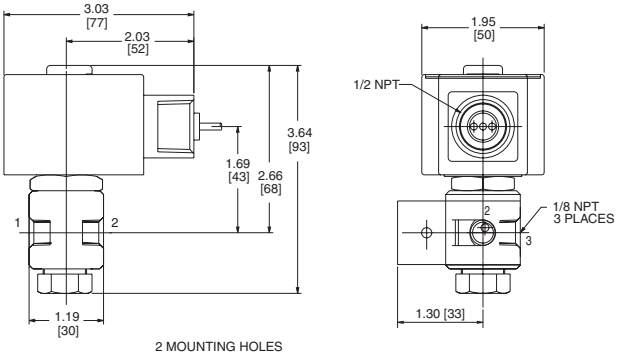


Const. Ref. 3



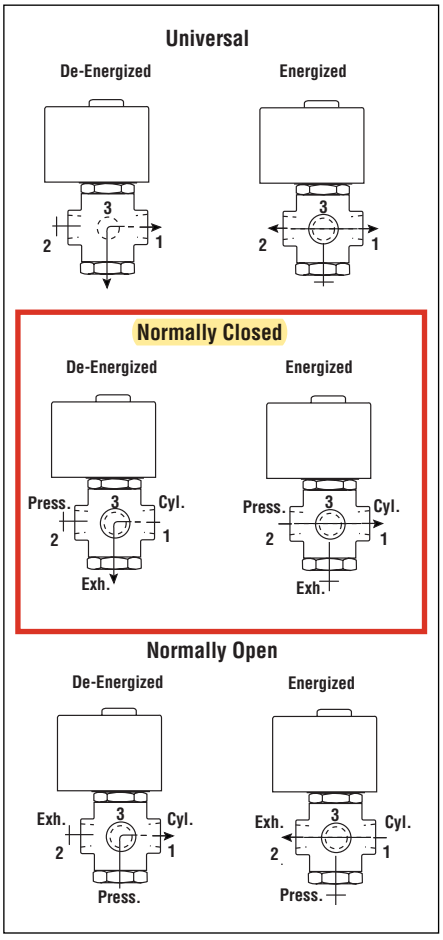
* MOUNTING BRACKET
IS STANDARD ON THIS
CONSTRUCTION

Const. Ref. 4



SHOWING MOUNTING BRACKET ONLY
212299-001

FLOW DIAGRAMS



EQUIPMENT TECHNICAL DATA SHEETS

COAGULANT INJECTION
STATIC MIXER

WESTFALL STATIC MIXER - 2800 SERIES

- SIZE: 6" w/ 0.8 Beta Mixing Plate
- MATERIALS:
  - Mounting Ring: PVC
  - Mixing Plate: PVC
  - Gaskets: 1/8" EPDM
- INCLUDES: (2) 1/2" PVC Injection Quills w/ Built-In Check Valves

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

WESTFALL MANUFACTURING CO.

HEADLOSS CHART

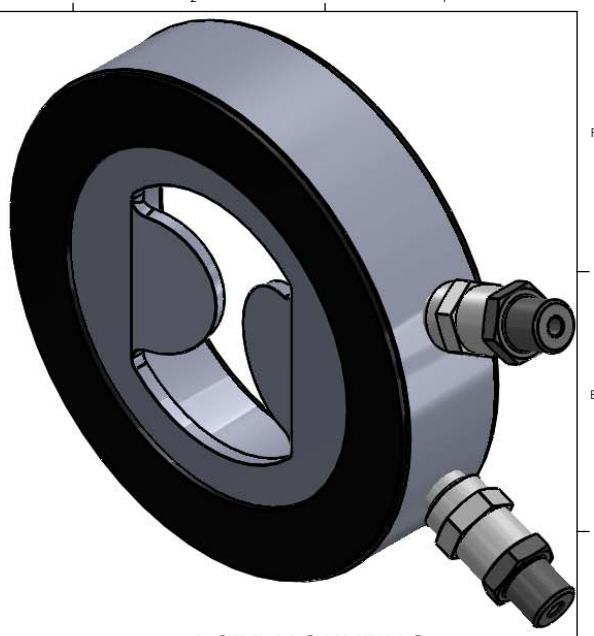
pipe ID 6.07 inches

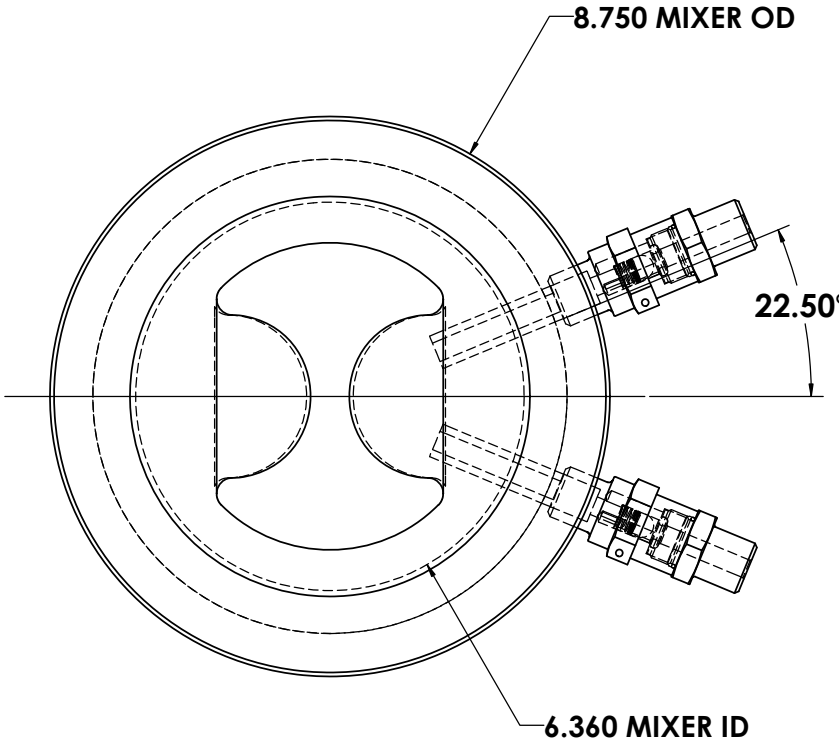
Pipe Area 0.2010 ft2

GPM	ft/s	MODEL 2800 0.7 BETA psi Head loss	MODEL 2800 0.8 BETA psi Head loss	MODEL 2800 0.9 BETA psi Head loss	MODEL 3050 SINGLE psi Head loss	MODEL 3050 DOUBLE psi Head loss	MODEL 3050 TRIPLE psi Head loss	MODEL 6000 psi Head loss
90.2	1.00	**0.22**	0.09	0.05	0.004	0.008	0.011	0.008
180.4	2.00	**0.88**	0.37	0.18	0.015	0.030	0.044	0.034
270.6	3.00	**1.97**	**0.82**	0.41	0.034	0.068	0.099	0.076
360.8	4.00	3.51	**1.47**	0.73	0.060	0.122	0.176	0.136
451.0	5.00	5.48	**2.29**	1.14	0.094	0.190	0.276	0.212
541.2	6.00	7.89	**3.30**	1.64	0.135	0.274	0.397	0.305
631.4	7.00	10.74	**4.49**	2.24	0.184	0.372	0.540	0.415
721.6	8.00	14.03	**5.87**	**2.92**	0.240	0.486	0.706	0.542
811.8	9.00	17.75	7.42	**3.69**	0.303	0.616	0.893	0.686
902.0	10.00	21.92	9.17	**4.56**	0.375	0.760	1.103	0.847
992.2	11.00	26.52	11.09	**5.52**	0.453	0.920	1.335	1.025
1082.4	12.00	31.56	13.20	**6.57**	0.539	1.094	1.588	1.220

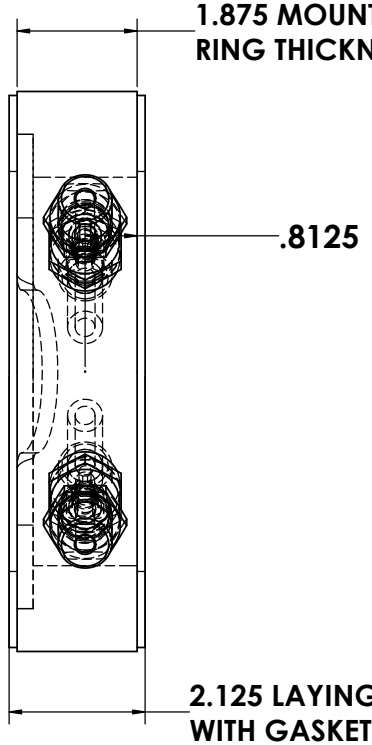
6" WESTFALL STATIC MIXER MODEL 2800
PVC MOUNTING RING
(1) .8 BETA PVC MIXING PLATE
(2) 1/2" NPT INJECTION PORTS
(2) 1/8" EPDM GASKETS

SHOWN WITH:
(2) 1/2" PVC QUILLS WITH BUILT IN CHECK VALVES





FLOW
------>



CLIENT APPROVAL:
APPROVED BY: DATE:

PRINT NAME: TITLE:

COMPANY:

WESTFALL

WESTFALL MANUFACTURING COMPANY
15 BROAD COMMON ROAD, BRISTOL RI 02809 U.S.A
P: 401-253-3799 F: 401-253-6530 www.westfallmfg.com

WESTFALL STATIC MIXER
MODEL 2800 - 6"

DIMENSIONS ARE IN INCHES (UNLESS OTHERWISE NOTED)

SCALE	DATE	PROJECT
	2.16.2024	EQUIPMENT
DRAWN BY MGP	CHECKED BY	PLANT
	APPROVED BY	SHEET
		DWG. NO. 6-2800-B

EQUIPMENT TECHNICAL DATA SHEETS

CHEMICAL FEED – COAGULANT DOSING

DESCRIPTION

PROMINENT GAMMA/X CHEMICAL DOSING PUMP

- Part # GMXA1009PPB2M000UD01300EN - gamma/X
  - The ProMinent gamma/X is a microprocessor-based solenoid-driven diaphragm programmable pump. Continuous electronic stroke length adjustment from 0 - 100% (recommended 30 - 100%). Stroke rate adjustment in 1 stroke/hour increments from 0 to 12,000 strokes/h.
  - Standard features include:
    - Remote on/off and external contact input 1:1 with pulse control.
    - Backlit dot matrix display with 3-LED indicators
    - Fiberglass-reinforced, PPE plastic housing rated to IP65.

      ** (ProMinent Control Cable is required for external control)

  - Capacity:
    - * 2.38GPH; 9.0L/H
    - * 145PSI; 10BAR

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

gamma/ X Series

X-tremely clever!



Capacity range 0.24 to 11.9 gph (0.74 - 32 l/h) and pressures up to 363 psig (25 bar)

The gamma/ X is the first metering pump with predictive intelligence. Thanks to its controlled solenoid drive with sensor-free pressure measurement, it detects hydraulic faults even in the case of minimal deviations – immediately and optimally matching its output to the pressure conditions and properties of the medium while protecting the pump and piping systems from overload situations.

Features & Benefits

- Electronic stroke length adjustment
- Volume adjustment in gph
- Analog, Contact and Batch modes optional
- Integrated system pressure measurement
- Bus interfaces such as Profibus and CANbus
- Bluetooth technology available
- Improved visibility of LED-indicator lights
- Large, illuminated display
- Analog output for stroke length and stroke rate transmission
- Removable base for quick and easy installation
- Auto compensates programmed feed rates during back pressure fluctuations
- As low as 1mL/hr continuous feed rate with regulated solenoid drive
- Turn down ratio up to 40,000:1
- Integrated pressure measurement and display
- Available diaphragm rupture indicator
- Integrated 7-day timer
- Detects Overpressure/ No Pressure (broken discharge line)
- Automatically sets optimal speed and stroke based on GPH settings
- Certified to NSF/ANSI 50 and 61 (Acrylic and PVDF liquid ends only)

Field of application

- Can be integrated into automated processes and used in all industries

gamma/ X Series

Technical Data

Capacity Data												
Pump Version	**Capacity at Maximum Backpressure**					**Max. Stroking Rate**	**Tubing Connectors O.D. x I.**	**Suction Lift ****		**SS Liquid end connections FNPT**	**Shipping Weight lbs**	
	psig	**(bar)**	**gph***	**(l/h)**	**ml/stroke**	**strokes/ min**	**in**	**ft**	**(m)**	**in**	**lbs**	**(kg)**
gamma/ X with standard liquid ends												
1602	232	(16)	0.61	(2.3)	0.19	200	1/4 x 3/16	19.6	(6)	1/4	7.9	9
1604	232	(16)	0.95	(3.6)	0.30	200	1/4 x 3/16	16.4	(5)	1/4	7.9	9
0708	102	(7)	2.0	(7.6)	0.63	200	1/2 x 3/8	13.1	(4)	1/4	8.1	11
0414	58	(4)	3.56	(13.5)	1.13	200	1/2 x 3/8	9.8	(3)	1/4	8.1	11
0220	29	(2)	5.2	(19.7)	1.64	200	1/2 x 3/8	6.5	(2)	3/8	8.1	11
2504	363	(25)	1.0	(3.8)	0.32	200	(8 x 4mm)	13.1	(4)	1/4	10.8	12.1
1009	145	(10)	2.38	(9.0)	0.75	200	1/2 x 3/8	9.8	(3)	1/4	11.2	14.3
0715	102	(7)	3.83	(14.5)	1.21	200	1/2 x 3/8	9.8	(3)	1/4	11.2	14.3
0424	58	(4)	6.34	(24)	2.00	200	1/2 x 3/8	9.8	(3)	3/8	11.2	14.3
0245	29	(2)	11.9	(45)	3.70	200	1/2 x 3/8	6.5	(2)	3/8	11.5	15.4
gamma/ X with auto-degassing liquid ends, 3-port (NPB9/ NPE9)												
1602	232	(16)	0.34	(1.30)	0.11	200	1/4 x 3/16	6.9	(2.1)	-	7.9	-
1604	232	(16)	0.63	(2.40)	0.21	200	1/4 x 3/16	8.8	(2.7)	-	7.9	-
0708	101	(7)	1.8	(6.80)	0.57	200	1/2 x 3/8	6.5	(2)	-	8.1	-
0414	58	(4)	3.17	(12)	1.00	200	1/2 x 3/8	6.5	(2)	-	8.1	-
0220	29	(2)	4.75	(18)	1.5	200	1/2 x 3/8	6.5	(2)	-	8.1	-
1009	145	(10)	2.11	(8)	0.67	200	1/2 x 3/8	9.8	(3)	-	11.2	-
0715	101	(7)	3.56	(13.5)	1.00	200	1/2 x 3/8	8.2	(2.5)	-	11.2	-
0424	58	(4)	5.28	(20)	1.67	200	1/2 x 3/8	8.2	(2.5)	-	11.2	-
gamma/ X with self-bleeding liquid ends, 2-port without bypass (PVT7)												
1604	145	(10)	0.42	(1.60)	0.13	200	1/4 x 3/16	6	(1.8)	-	7.9	-
0708	101	(7)	1.50	(5.7)	0.48	200	1/2 x 3/8	6	(1.8)	-	8.1	-
0414	58	(4)	3.17	(12)	1.00	200	1/2 x 3/8	6	(1.8)	-	8.1	-
0220	29	(2)	4.60	(17.4)	1.45	200	1/2 x 3/8	6	(1.8)	-	8.1	-
1009	145	(10)	1.58	(6.0)	0.50	200	1/2 x 3/8	6	(1.8)	-	11.2	-
0715	101	(7)	3.40	(12.9)	1.08	200	1/2 x 3/8	6	(1.8)	-	11.2	-
0424	58	(4)	5.07	(19.2)	1.60	200	1/2 x 3/8	6	(1.8)	-	11.2	-

Positive suction is recommended on pumps with 1/2" MNPT connections.
gamma/ X metering pumps with high viscosity liquid ends (PVT 4) have a 10 – 20 % lower capacity rating and are not self-priming.
Permissible ambient temperature: 14 °F to 113 °F | Average power consumption: 78 W | Degree of protection: IP 66
Repeatability ± 2% when utilized and installed per operating instructions
* Capacity data represents minimum values, tested using water at 68 ºF (room temperature)
** Suction lift with pre-primed suction line and liquid end

ProMinent Fluid Controls, Inc. (USA)
136 Industry Drive • Pittsburgh, PA 15275
Ph: (412) 787-2484 • email: prominentcsd-us@prominent.com
www.prominent.us

ProMinent Fluid Controls, Ltd. (Canada)
490 Southgate Drive • Guelph, N1G 4P5
Ph: (519) 836-5226 • Toll Free: 1-888-709-9933
email: sales@prominent.ca
www.prominent.com

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2 Identity code



Product identification

This identity code serves to identify the product.

Use the identity code from the Product Catalogue for orders.

Product range gamma/ X											
GMXa	Type										
	- - - -	Performance data and type - see nameplate									
		Dosing head material									
		PP	Polypropylene								
		NP	Clear acrylic								
		PV	PVDF								
		TT	PTFE + carbon								
		SS	Stainless steel								
			Seal material								
			B	FPM							
			E	EPDM							
			T	PTFE							
			F	PTFE, FDA-compliant							
				Dosing head design							
				0	without bleed valve, without valve spring						
				1	without bleed valve, with valve spring						
				2	with bleed valve, without valve spring						
				3	with bleed valve, with valve spring						
				4	without bleed valve, with valve spring for higher-viscosity media						
				7	self-bleeding with groove (SEK)						
				9	self-bleeding with bypass (SEK)						
					Hydraulic connector						
					0	Standard connection in line with technical data					
					5	Connector for 12/6 hose, suction side standard					
					9	Connector for 10/4 hose, discharge side only, suction side standard					
						Diaphragm rupture indicator					
						0	without diaphragm rupture indicator				
						1	with diaphragm rupture indicator, optical sensor, electrical signal				
							Design				
							0	Hous. RAL5003 / Hood RAL2003			
							M	modified			

Product range gamma/ X																
								Logo								
								0	with ProMinent logo							
									Electrical connection							
									U	100-230 V ± 10%, 50/60 Hz						
										Cable and plug						
										A	2 m European					
										B	2 m Swiss					
										C	2 m Australian					
										D	2 m USA / 115 V					
										E	2 m Great Britain					
										1	2 m open end					
										. .	...					
											Relay, pre-set to ...					
											0	no relay	-			
											1	1 x changeover contact 230 V AC – 6 A	Fault indicating relay (N/C)			
											4	1 x N/O 24 V DC – 1 A 1 x N/O 24 V DC – 100 mA	as 1 + pacing relay			
											C	1 x N/O 24 V DC – 100 mA, and 1 x 4-20 mA output	As 1 + 4-20 mA output			
											F	with automatic bleed valve	230 V AC			
											G	with automatic bleed valve and relay output	24 V DC			
											. .	...				
												Accessories				
												0	no accessories			
												1	with foot and injection valve, 2 m suction line, 5 m metering line			
												4	Multifunctional valve and accessories			
													Control version			
													0	Manual + external contact with pulse control		
													3	Manual + external contact with pulse control + analogue 0/4-20mA		
													C	As 3 + CANopen		
													E	As 3 + PROFINET®		
													M	As 3 + Modbus RTU		
													R	As 3 + PROFIBUS® interface, M12		
														Metering monitor		

Product range gamma/ X		
0	Dynamic metering monitor	
	Remote stop / Remote control	
0	without Bluetooth	
B	with Bluetooth	
	Language	
	DE	Deutsch
	EN	English
	ES	Spanish
	FR	French
	...	...

EQUIPMENT TECHNICAL DATA SHEETS

PVC ISOLATION BALL VALVES

COAGULANT METERING SKID ISOLATION VALVES:

- Spears PVC Compact Isolation Ball Valves
    - 1/2" Type 21 PVC Ball Valve w/ FKM O-Ring

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917



Features – PVC, CPVC

This industrial grade, quarter turn shutoff valve is popular where maintenance-free installations are desired for a variety of chemical processing, industrial and OEM applications. IPS Sizes 1/2" - 4" available with socket, threaded or flanged end connectors, 6" size available with socket or flanged end connectors. 6" valve uses high-efficiency lever style handle for easier operation.

- Chemical & Corrosion Resistant PVC or CPVC Construction
- Maintenance-Free Sealed Unit
- Schedule 80 Full-Bore Design
- High Impact Polypropylene Handle
- Spears® Single O-ring Safe-T-Shear® Stem Design
- EPDM or FKM O-rings
- Self Adjusting PTFE Floating Seat Design
- Sizes 1/2" - 2" Pressure Rated to 235 psi @ 73°F, Sizes 3" - 6" and all Flanged Pressure Rated to 150 psi @ 73°F
- EPDM valves NSF® Certified for Potable Water use
- Suitable for Vacuum Service
- Assembled with Silicone-Free, Water Soluble Lubricant
- Manufactured to ASTM F 1970

Note: Valve size 6" uses Lever Handle (not shown)

Sample Engineering Specification

All thermoplastic ball valves shall be Compact sealed unit type constructed from PVC Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, Cell Classification 23447. All O-rings shall be EPDM or FKM. All valves shall have Safe-T-Shear® stem and Polypropylene handle. All EPDM valves shall be certified by NSF® International for use in potable water service. All 1/2" - 2" valves shall be pressure rated at 235 psi, all 3" - 6" and all flanged valves shall be pressure rated at 150 psi for water at 73°F, as manufactured by Spears® Manufacturing Company.

Quick-View Valve Selection Chart

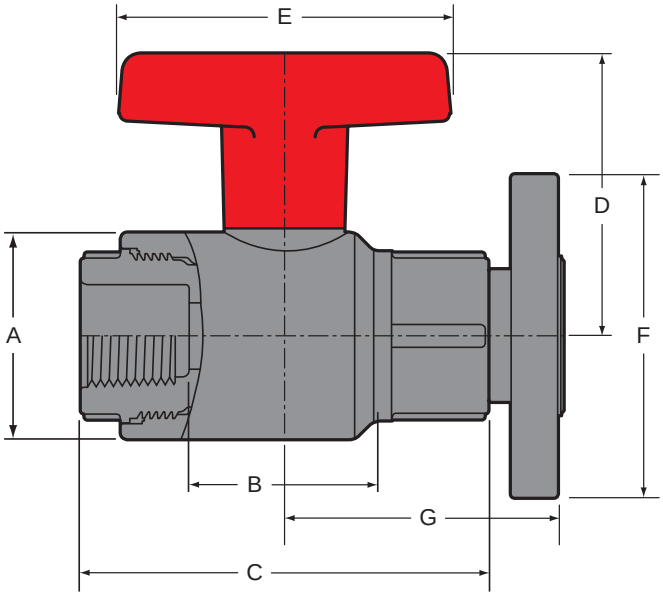
Valve Size	O-ring Material	PVC Part Numbers[1]			Pressure Rating
		Socket	Threaded	Flanged	
1/2	EPDM	2122-005	2121-005	2123-005	235 psi Non-Shock Water @ 73°F (Flanged 150 psi Non-Shock) Water @ 73°F
	FKM	2132-005	2131-005	2133-005	
3/4	EPDM	2122-007	2121-007	2123-007	
	FKM	2132-007	2131-007	2133-007	
1	EPDM	2122-010	2121-010	2123-010	
	FKM	2132-010	2131-010	2133-010	
1-1/4	EPDM	2122-012	2121-012	2123-012	
	FKM	2132-012	2131-012	2133-012	
1-1/2	EPDM	2122-015	2121-015	2123-015	
	FKM	2132-015	2131-015	2133-015	
2	EPDM	2122-020	2121-020	2123-020	
	FKM	2132-020	2131-020	2133-020	
3	EPDM	2122-030	2121-030	2123-030	150 psi Non-Shock Water @ 73°F
	FKM	2132-030	2131-030	2133-030	
4	EPDM	2122-040	2121-040	2123-040	
	FKM	2132-040	2131-040	2133-040	
6	EPDM	2122-060	---	2123-060	
	FKM	2132-060	---	2133-060	

1: For CPVC valves, add the letter "C" to the part numbers listed (e.g., 2131-005**C**).

Optional Accessories*

- Round Safety Handle
- Stem Extension Kit
- Mini-Mount Actuation Mounting Kit
- 2" Square/T-Style Operator Nut

*See ***"BALL VALVE ACCESSORIES"*** section for details of individual products.



Dimensions, Weights, Operating Torque & C_V Values

Nominal Size	Dimension Reference (inches, ± 1/16)								Approx. Wt. (Lbs.)		Oper.[2] Torque (in.-lb.)	Cv^3 Values	
	A	B[1]		C	D	E[4]	F	G	PVC	CPVC		Soc/Thd	Flanged
		Socket	Threaded										
1/2	1-11/16	1-5/8	1-7/8	3-3/8	2-5/16	2-3/4	3-1/2	2-17/32	.31	.32	20	36	20
3/4	2-1/8	1-15/16	2-7/16	4-1/16	2-11/16	3-1/4	3-7/8	2-27/32	.49	.52	30	74	42
1	2-7/16	2-1/16	2-3/8	4-7/16	2-7/8	3-3/4	4-1/4	3-1/16	.64	.69	40	141	80
1-1/4	2-13/16	2-3/8	3	4-15/16	3-5/16	4-1/8	4-5/8	3-13/32	.93	.98	60	284	163
1-1/2	3-1/4	2-13/16	3-1/2	5-5/8	3-11/16	4-1/2	5	4	1.39	1.45	80	402	229
2	4-1/16	3-3/8	4-7/16	6-1/2	4-3/8	5-1/4	5-7/8	4-13/32	2.33	2.45	90	706	429
3	5-5/16	4-9/16	5-1/2	8-5/16	5-1/2	7-21/32	7-1/2	5-7/16	4.49	5.02	300	1660	1079
4	7-3/8	6-3/16	7-3/16	10-5/32	6-5/8	10-27/32	9-1/16	6-7/8	9.50	10.24	400	3104	2028
6[4]	10-3/16	8	10-3/4	14-1/8	8-1/16	14-5/16	11-1/4	8-21/32	21.48	23.41	900	7942	5268

1: Valve Lay Length
2: Torque required at valve maximum internal pressure rating, 5 ft./sec. flow velocity.
3: Gallons per minutes at 1 psi pressure loss. Values calculated from valve laying length, based on derivative of Hazen-Williams equation with surface roughness factor of C =150.
4: 6" valve has lever handle, dimension is from valve centerline (not illustrated)

Temperature Pressure Rating

System Operating Temperature °F (°C)			100 (38)	110 (43)	120 (49)	130 (54)	140 (60)	150 (66)	160 (71)	170 (77)	180 (82)	190 (88)	200 (93)	210 (99)
Valve Pressure Rating psi (MPa)	1/2" - 2"	PVC	235 (1.62)	211 (1.45)	150 (1.03)	75 (.52)	50 (.34)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)
		CPVC	235 (1.62)	219 (1.51)	170 (1.17)	145 (1.00)	130 (.90)	110 (.76)	90 (.62)	80 (.55)	70 (.48)	60 (.41)	50 (.34)	-0- (-0-)
	3" - 6"	PVC	150 (1.03)	135 (.93)	110 (.76)	75 (.52)	50 (.34)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)
		CPVC	150 (1.03)	140 (.97)	130 (.90)	120 (.83)	110 (.76)	100 (.70)	90 (.62)	80 (.55)	70 (.48)	60 (.41)	50 (.34)	-0- (-0-)

NOT FOR DISTRIBUTION OF COMPRESSED AIR OR GASES

EQUIPMENT TECHNICAL DATA SHEETS

CALIBRATION COLUMN

CALIBRATION COLUMN FOR COAGULANT METERING PUMP:
- CC0200-E : 1/2 NPT 2000ml PVC Calibration Column w/ E Clean Cap w/ FKM O-Ring

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Griffco Valve Inc.
188 Creekside Dr
Amherst, NY 14228 USA
Phone: +1 716 835-0891
Fax: +1 716 835-0893

PVC CALIBRATION COLUMNS



Griffco calibration cylinders are designed to enhance the performance of chemical feed systems by providing a verification of the flow rate of the chemical feed pump. Robust construction of clear PVC with an easy to read graduation in mL and gph. Available in three models: EZ-Clean, Vented, and Open Top; and in 15 sizes: 100 mL through 40,000 mL as detailed here.

Features:

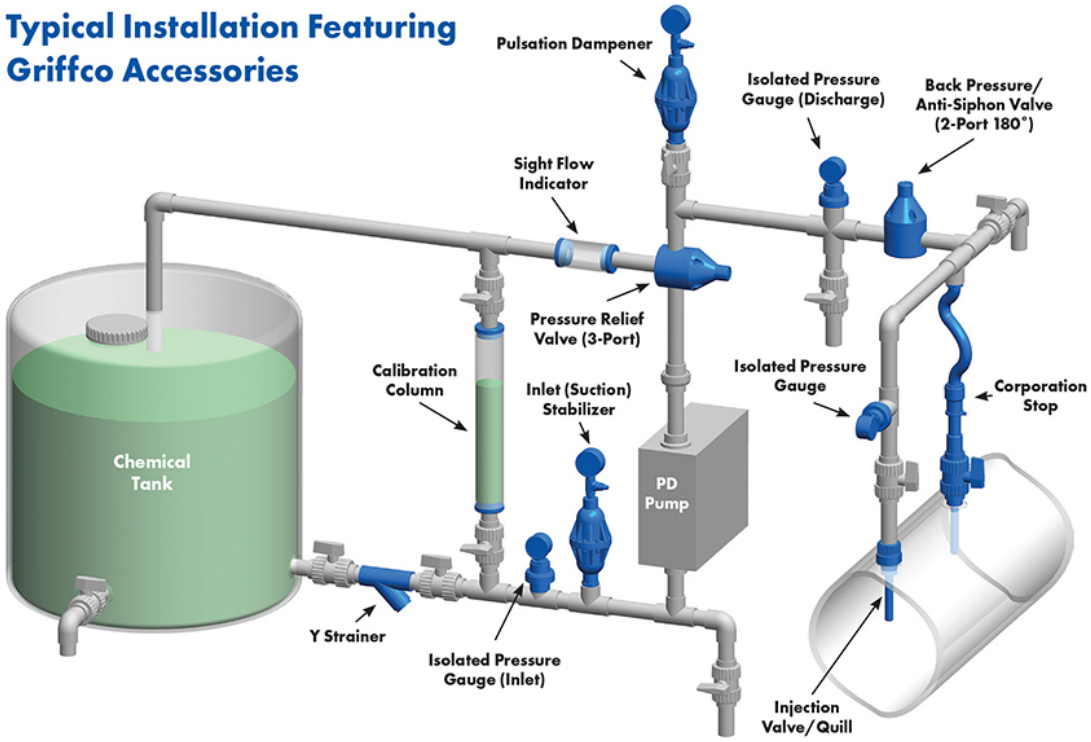
- **High Reliability / Affordable**
- **High Contrast Graduation Markings**
- **Clear Easy-View Tube**
- **Robust Schedule 40 Pipe Construction**
- **Direct mL / GPH Readout**
- **Sealed Top with Overflow Connection**
- **Optional EZ-Clean Model**
- **Optional Open Top with Dust Cap**

Operation:

Griffco calibration cylinders are installed in the suction line to the chemical metering pump. Two isolating valves, (not supplied) must be installed in the suction line as per the drawing below. The top of the cylinder should be vented back to the storage tank or to drain.
Fill the cylinder to the top mark then close the valve from the chemical tank. Switch on the chemical feed pump and draw down the chemical in the cylinder for 30 seconds. Switch the pump off. The reading on the right side of the cylinder is a direct readout of USgph.
Alternatively, observe the volume withdrawn on the mL scale. To convert to LPH or GPH use this formula:

LPH = 3.6 x [mL] ÷ Time (sec)
GPH = 0.951 x [mL] ÷ Time (sec)

Note: Max. cylinder pressure is 15 psi.



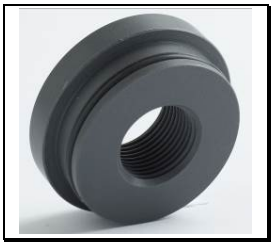
Description of models:



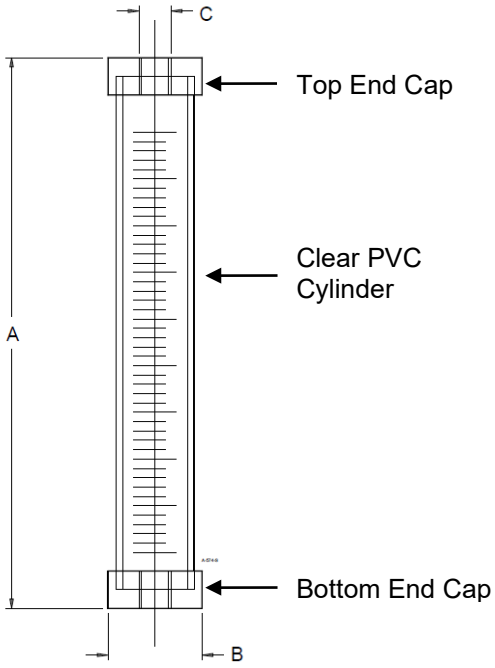
Sealed:
Top is glued to cylinder and contains a vent or overflow connection. (FNPT). Used in applications where there is a positive suction head, and a permanent installation is desired.



Loose Cap: (Avail. up to 20,000 mL)
Top is loose and does not have a connection in the top. Dust cover only. Used in applications where there is no positive suction head, and the cylinder must be filled from the top.



EZ-Clean: (Avail. 100 – 7000 mL only)
Top is sealed with an O-ring and has a vent connection, but removable for easy cleaning. Used in applications where frequent cleaning is required such as polymer, alum, ferric chloride or chlorine.



Capacity (mL) ◊	Max Flow ▲ (USgph)	(lph)	Scale (mL)	Scale ▲ (gph)	A (in)	B (in)	C (in)
100	3.17	12	1	.1	11	1.5	1/2
200	6.34	24	1	.1	19	1.5	1/2
300	9.51	36	5	.2	13	2.2	1/2
500	15.85	60	5	.2	13	2.5	3/4
1000	31.70	120	5	.2	22	2.5	3/4
2000	63.40	240	10	1	20	3.7	1
3000	95.10	360	10	1	17	4.9	1 1/2
4000	126.8	480	10	1	37	3.7	1
W4000*	126.8	480	10	1	22.5	4.9	1 1/2
5000	158.5	600	10	1	28	4.9	1 1/2
7000	221.9	840	10	1	38	4.9	1 1/2
10,000	317.0	1200	100	5	25	6.95	2
15,000	475.5	1800	100	5	36	6.95	2
20,000	634.0	2400	100	5	47	6.95	2
30,000	952.0	3600	200	10	65*	9.5**	4
40,000	1,268.0	4800	200	10	77.5*	9.5**	4

▲ Max Flow and gph scale are based on 30 second drawdown
◊ For 60 sec draw down, double capacity in mL or flow size
*W4000 is shorter, wider version of 4000 model
**Reference only

Codes for Ordering PVC Calibration Columns:

CC ☐☐☐☐ ☐ ☐ ☐
1 **2** **3** **4**

1 = Size

0100 – 100 mL
0200 – 200 mL
0300 – 300 mL
0500 – 500 mL
1000 – 1000 mL
2000 – 2000 mL
3000 – 3000 mL
4000 – 4000 mL
W4000 – 4000 mL
5000 – 5000 mL
7000 – 7000 mL
10000 – 10000 mL
15000 – 15000 mL
20000 – 20000 mL
30000 – 30000 mL
40000 – 40000 mL

2 = Top End Cap Style
(Top Cap Only)

S – Sealed
L – Loose (up to 20000mL)
EZ – EZ Clean (up to 7000mL)

3 = Connections

Blank – Threaded
S – Socket
F – Flanged
U – Union

4 = Oring Material
(For EZ Clean and Union Connections Only)

Blank – FKM (Viton®)
E - EPDM

Available O-ring Options:
PTFE Encapsulated
or FFKM are available upon request

Website: www.griffcovalve.com email: sales@griffcovalve.com

EQUIPMENT TECHNICAL DATA SHEETS

PRESSURE GAUGE
COAGULANT PUMP DISCHARGE

Griffco Pressure Gauge with Gauge Guard
- GC050-P31-T: 1/2" NPT Gauge Guard - PVC Premium Gauge - 160 psi

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

Griffco Valve Inc.
188 Creekside Dr
Amherst, NY 14228 USA
Phone: +1 716 835-0891
Fax: +1 716 835-0893

Gauge and Instrument Guards



Griffco diaphragm gauge and instrument isolators are designed to enhance the performance of chemical feed systems. The addition of gauges to the system ensure optimal pressures are maintained. Diaphragm isolators protect instruments against chemical attack.

Features:

- **Reliable Instrument Protection**
- **Will Perform in Any Position**
- **Molded Noryl Top**
- **316 SS Gauge Connection**
- **Wide Range of Materials**
- **Calibration Screw for Zeroing**
- **Multiple Diaphragm Options**
- **Available With or Without Gauge**
- **No Metal Fasteners**

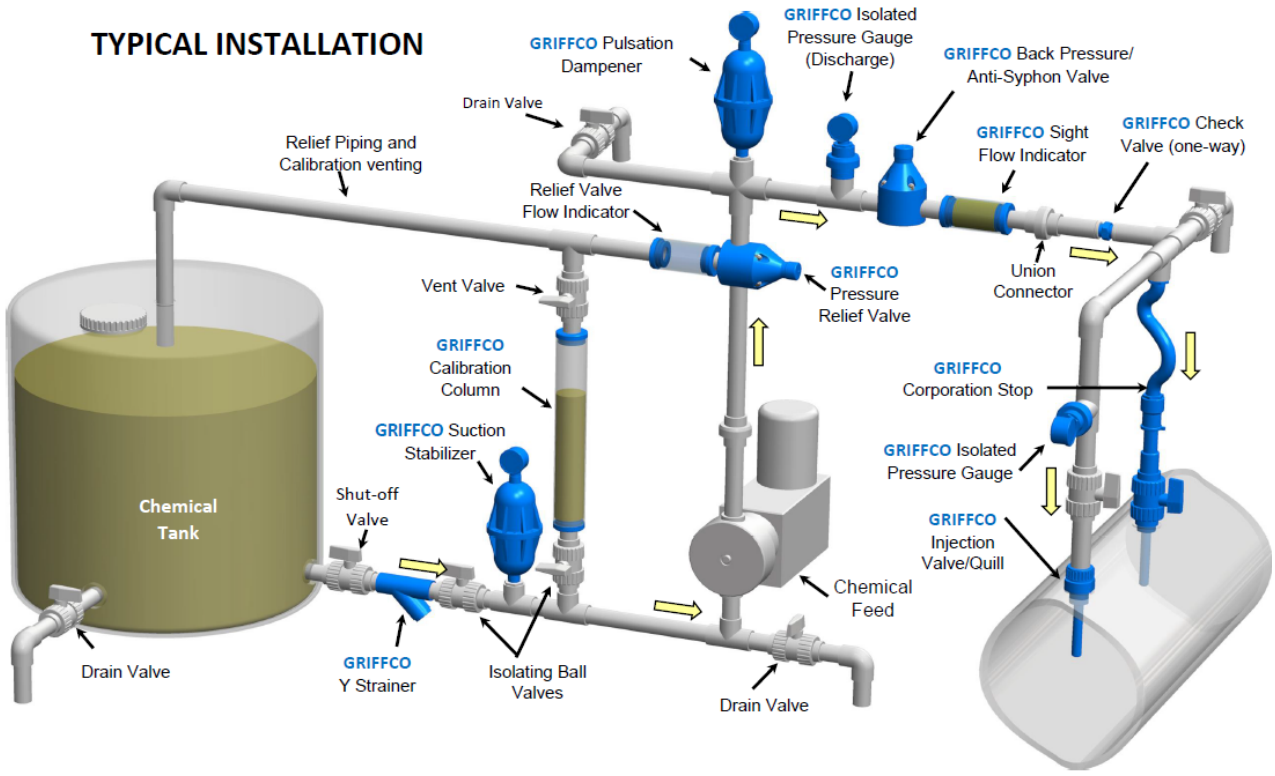
Principles of Operation:

1 – A Griffco Valve gauge guard assembled with a vacuum mechanism must be filled with a proper fill fluid. (e.g. glycerine).

2 – The gauge guard diaphragm is an elastic wall that precludes the process fluid from entering the gauge or pressure device.

3 – Pressure on the process side of the diaphragm pushes against the fill liquid transferring the pressure to the device.

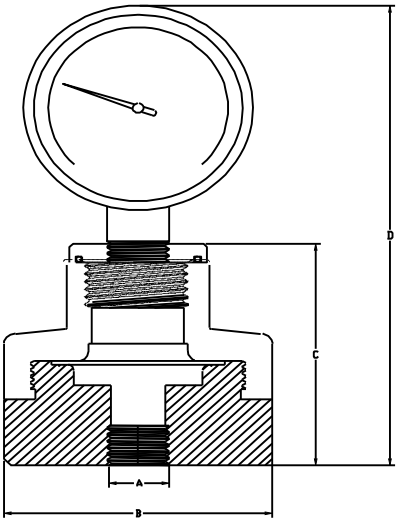
4 – Conversely, vacuum causes the diaphragm to flex in the reverse direction, producing a vacuum in the fill liquid, which triggers the device.



TECHNICAL DATA:

Materials of Construction:	**Body: PVC, CPVC, PP, PVDF, 316 SS. Top: Noryl**
Connection Sizes:	**1/4", 3/8" and 1/2"**
Connections:	**NPT, BSPT, Flange, Union**
Gauge Port Sizes	**1/4" Standard, Optional (Only available with No Gauge): 1/8", 1/2"**
Max Temperature:	**PVC: 140°F (60°C) ; CPVC & PP 190° (87°C); PVDF: 300° (150°C)**
Max Operating Pressure(psi) @ 70 Deg. F	**250 psi**
O-Ring Material	**Viton**
Diaphragm Material	**Standard: Viton. Optional: PTFE, Hypalon**
Gauge Accuracy	**± 2%**
Optional Gauges	**0 – 160 psi, 0 – 60 psi, 0 – 100 psi, 0 – 200 psi, 0 – 300 psi**

DIMENSIONS:



Size (A)	B (in)	C (in)	D (in)
1/4"	2.35	2.15	4.75
3/8″	2.35	2.15	4.75
1/2"	2.35	2.15	4.75





Product Codes for Ordering:

GG ☐☐☐ ☐ ☐ ☐ ☐

GGU with Union Connections ☐☐☐ ☐ ☐ ☐ ☐

GGS with Pressure Switch ☐☐☐ ☐ ☐ ☐ ☐

1 2 3 4 5

1 - Size	2 - Material	3 - Gauge Class	4 - Pressure Range	5 - Options
025 - 1/4"	P - PVC	0 - No Gauge	1 - 0 - 160 psi*	T - PTFE Diaphragm
038 - 3/8"	CP - CPVC	1 - Economy	2 - 0 - 60 psi	H - Hypalon Diaphragm
050 - 1/2"	PP - Polypro	2 - Mid- Range	3 - 0 - 100 psi	B - BSP Connections
	K - Kynar	3 - Premium	4 - 0 - 200 psi	F - Flanged
	S - 316SS	4 - Compound**	5 - 0 - 300 psi	D - Metric Union Connection
	A - Alloy 20	5 - Std Pressure Switch	6 - 0 - 30 psi	Z - Threaded Union Connection
	C - Hast C	6 - SS Pressure Switch	7 - 40 - 150 psi***	M – Back Mount
			8 - 0 - 15 psi	R – Rubber Boot for Gauge
				G8 - 1/8" Gauge Port – No Gauge
				G5 - 1/2" Gauge Port – No Gauge
				XL - 4 or 4 1/2" Gauge****

*Pressure Range on Compound Gauge Option 1 is 150 psi instead of 160 psi

**Compound Gauge Pressure Ranges: 30-0-XXX

***Pressure Range Option 7 only available for Pressure Switch

**Pressure Switches available with Pressure Range Option 2 (0-60 psi) or 7 (40-150 psi) Only

****Economy XL are 4 ½",
Mid-Range & Premium are 4"

Website: www.griffcovalve.com **Email: Sales@griffcovalve.com**

EQUIPMENT TECHNICAL DATA SHEETS

PRESSURE RELIEF VALVE
COAGULANT METERING PUMP DISCHARGE

GRIFFCO Back Pressure Valve - BPM050P

- 1/2" NPT; 10-150 psi Spring
- Materials
    - Diaphragm: PTFE/EPDM
    - Valve Top: Noryl
    - Valve Body: PVC

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

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M-SERIES
BACK PRESSURE VALVES



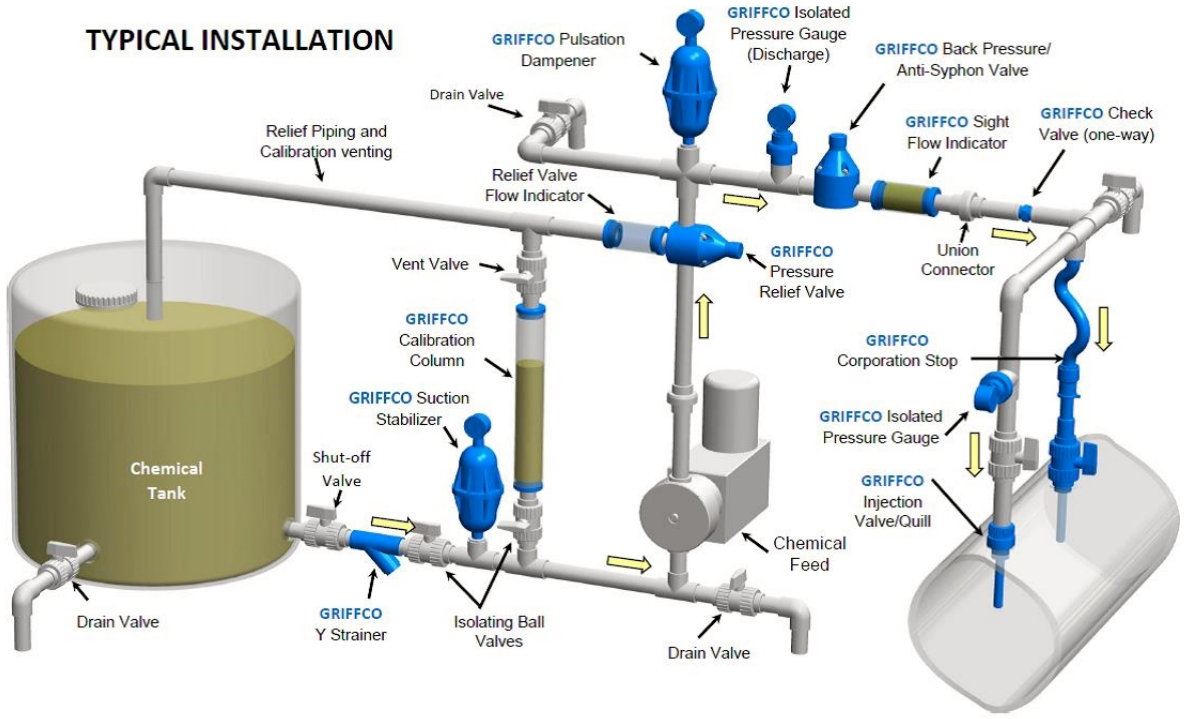
Griffco's new molded Noryl top extends the temperature and pressure rating of the standard valves. New valve designs continue to enhance the performance of chemical feed systems by applying a continuous back pressure to the chemical feed pump, while also acting as an anti-siphon valve. New construction ensures increased reliability in the rigorous service of municipal and industrial applications. Wetted materials include: **PVC, CPVC, PP, PVDF, PTFE, 316 SS, A 20 and Hast. C**. Available sizes: 1/4", 3/8",& 1/2".

Features:

- **Molded Noryl Top**
- **High Reliability / Low Cost**
- **Compact Size for OEM Applications**
- **Adjustable Pressure Settings**
- **Optional 350 PSI Rated Valve**
- **Anti-Siphon Function**
- **Robust, Machined Body Construction**
- **Vulcanised PTFE/EPDM Diaphragm**
- **Wide Range of Materials**

Operation:

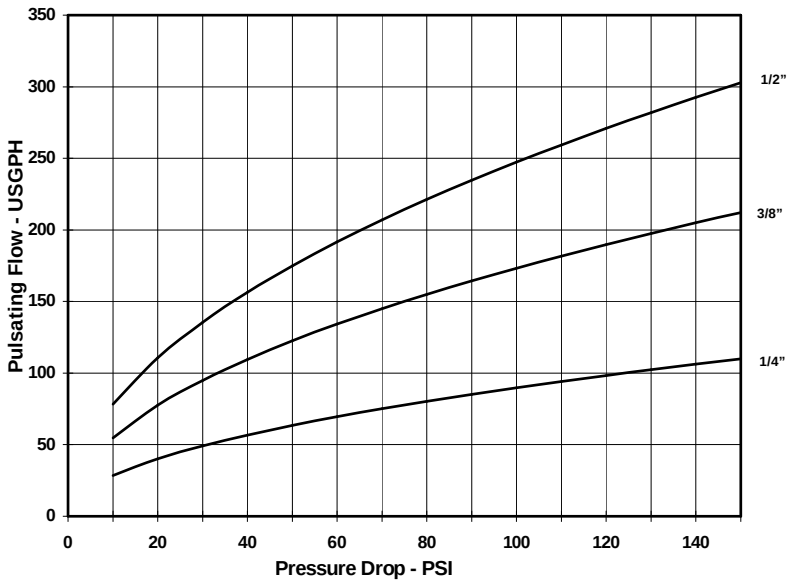
Griffco diaphragm back pressure valves apply positive discharge pressure to a metering pump system to prevent siphoning and eliminate varying dosage rates caused by fluctuating downstream pressure. The diaphragm is held against the valve seat by an internal spring. When the preset pressure is exceeded, the diaphragm is forced up and chemical flows through the valve to the injection point. The valves are preset for 50 psi, however they are field adjustable from 10 - 150 psi via the adjustment screw. Installation should be as close to the injection point as possible to prevent chemical line drainage, and it is most important that all chemical system equipment such as pulsation dampeners and pressure gauges are between the pump and back pressure valve.



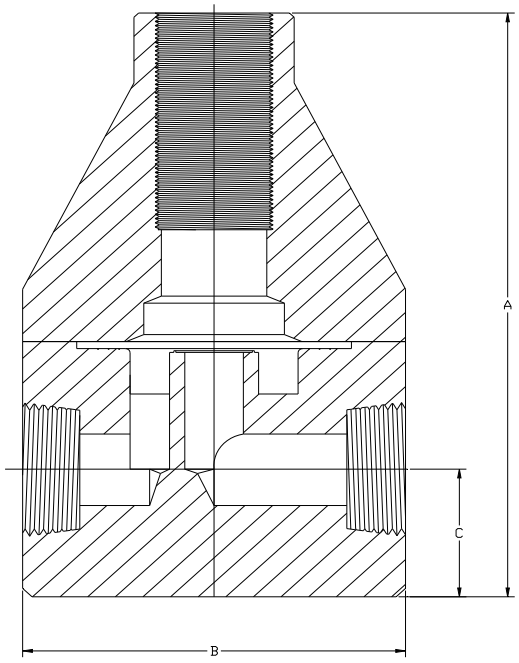
Technical Data:

Sizes: **Model BPM**			**1/4", 3/8", 1/2"**		
Connections:			**NPT, Socket, Union, Flanged**		
Pressure Adjustment			**Standard: 10 - 150 psi, Optional: 0 - 50 psi, 10 - 250 psi, 50 – 350 psi**		
Flow Rates @ 150 psi			**Shipping Weight: lbs**		
Size	**Pulsating**	**Continuous**	**Plastic**	**Metal / Plastic Top**	**Metal / Metal Top**
1/4" 3/8" 1/2"	100 USgph 200 USgph 300 USgph	5 USgpm 10 USgpm 15 USgpm	1.0 1.0 1.0	2.5 2.5 3.0	3.0 3.0 3.5
Max Temperature: (°F)			**PVC: 140°; CPVC & PP: 195°; PTFE & PVDF & Metal: 300°, (Peak 390°)**		
Max Operating Pressure @ 70°F: (psi)			**Plastic/Noryl: 375 psi, Metal /Metal: 2000 psi**		
Materials of Construction:					
Diaphragm			**PTFE / EPDM, Optional: Viton, Hypalon, Nitrile, PTFE / Viton**		
Valve Top			**Standard: Noryl, Optional: 316 SS L**		
Valve Body			**PVC, CPVC, PP, PTFE, PVDF, 316 SS L, A 20, Hast. C, Others on Request**		

Performance Curves:



Dimensions:



Product Codes For Ordering:

BPM ☐☐☐ ☐ ☐ ☐

1 **2** **3** **4**

1 = Size	2 = Material	3 = Spring Opt	4 = Options
025 – 1/4"	P - PVC	Blank - 10-150 psi	Blank – NPT & PTFE/EPDM
038 – 3/8"	CP - CPVC	1 - 0 - 50 psi	V - Viton Diaphragm
050 – 1/2"	PP - Polypro	2 - 10 - 250 psi	TV – PTFE/Viton Diaph.
	T - PTFE		S - Socket Connection
	K - PVDF	*For 50 - 350 psi*	F - Flange Connection
	H - Halar	*spring use option*	U - Union Connection
	S - 316 SS	*code "MSS"*	OSS - 316 SS L Top
	A - Alloy 20		MSS - 50-350 psi 316SSL Top
	C - Hastelloy C		AR - Priming Valve
			90 - 90° Configuration

DIMENSIONS: BPM - Series			
All Materials (Orifice size = 0.312)			
Size	A (in.)	B (in.)	C (in.)
1/4"	3.550	2.350	0.750
3/8"	3.550	2.350	0.750
1/2"	4.250	2.350	1.080

Note: Option MSS is only for use on 316SS, A20, & Hast C Valves.

Website: www.griffcovalve.com Email: sales@griffcovalve.com

EQUIPMENT TECHNICAL DATA SHEETS

PRESSURE RELIEF VALVE
COAGULANT METERING PUMP DISCHARGE

GRIFFCO Pressure Relief Valve - PRM050P

- 1/2" NPT; 10-150 psi Spring Pressure Relief
- Materials
    - Diaphragm: PTFE/EPDM
    - Valve Top: Noryl
    - Valve Body: PVC

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

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www.griffcovalve.com

M-SERIES
PRESSURE RELIEF VALVES



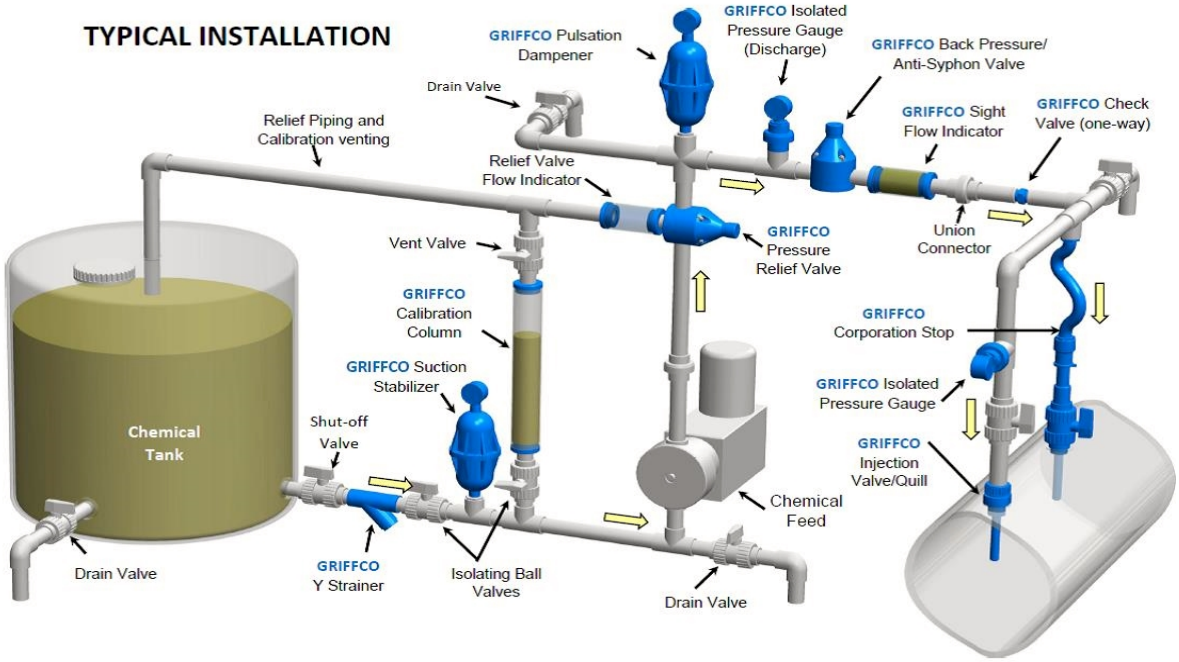
Griffco M-Series diaphragm pressure relief valves are designed to protect chemical feed systems from over pressure damage caused by defective equipment or a blockage in the chemical feed line. Robust construction ensures reliability in the rigorous service of municipal and industrial applications. Wetted materials include: **PVC, CPVC, PP, PVDF, PTFE, Halar, 316 SS, A20 and Hastelloy C**. Available sizes: 1/4", 3/8", and 1/2".

Features:

- **Molded Noryl Top**
- **High Reliability / Low Cost**
- **Compact Size for OEM Applications**
- **Adjustable Pressure Settings**
- **Optional 350 PSI Rated Valve**
- **3 Port, 2 Port, & 90° Configuration**
- **Robust, Machined Body Construction**
- **Multiple Diaphragm Materials**
- **Wide Range of Valve Materials**

Operation:

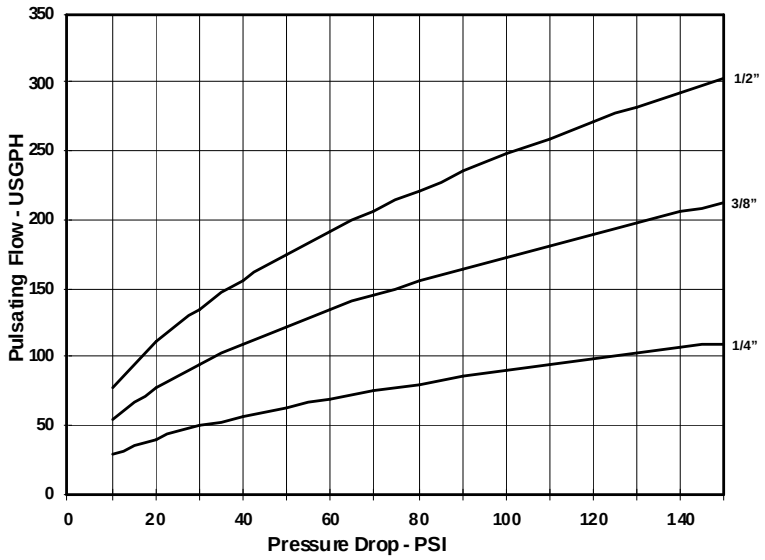
Griffco diaphragm pressure relief valves operate when the pressure in the chemical system exceeds the preset pressure of the valve. The diaphragm is held against the valve seat by an internal spring. When the preset pressure is exceeded the diaphragm is forced up and the chemical flows out the relief port, back to the chemical tank or to the suction side of the pump. The valves are pre-set at 50 psi, however they are field adjustable from 10 - 150 psi, via the adjustment screw. The relief valve should be set approximately 15 psi higher than the system pressure. Installation should be made as close to the pump as possible, without any valves or accessories between the relief valve and the pump. Consult your pump manufacturer for their recommendations.



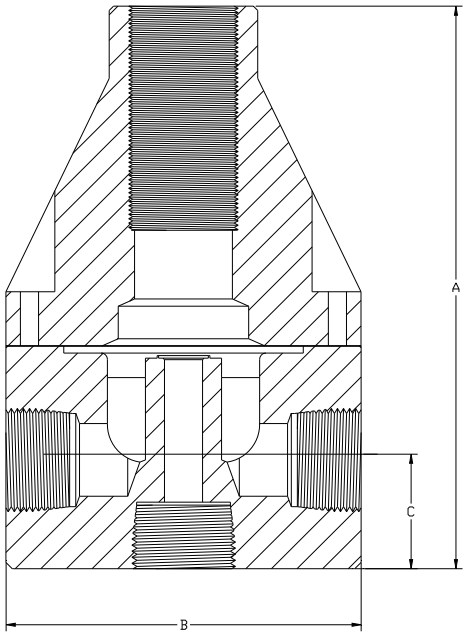
Technical Data:

Sizes: PRM			**1/4", 3/8", 1/2"**		
Connections:			**NPT, Socket, Union, Flanged**		
Pressure Adjustment			**Standard 10 - 150 psi, Optional: 0 – 50 psi, 10 - 250 psi, 50 – 350 psi**		
Flow Rates @ 150 psi			**Shipping Weight: lbs**		
Size	**Pulsating**	**Continuous**	**Plastic**	**Metal / Plastic Top**	**Metal / Metal Top**
1/4" 3/8" 1/2"	100 USgph 200 USgph 300 USgph	5 USgpm 10 USgpm 15 USgpm	1.0 1.0 1.0	2.5 2.5 3.0	3.0 3.0 3.5
Max Temperature: (°F)			**PVC: 140°; CPVC & PP: 195°; PTFE & PVDF & Metal: 300°, (Peak 390°)**		
Max Operating Pressure @ 70°F: (psi)			**Plastic/Noryl: 375 psi, Metal /Metal: 2000 psi**		
Materials of Construction:					
Diaphragm			**PTFE / EPDM, Optional: Viton, Hypalon, Nitrile, PTFE / Viton**		
Valve Top			**Standard: Noryl, Optional: 316 SS L**		
Valve Body			**PVC, CPVC, PP, PTFE, PVDF, 316 SS L, A 20, Hast. C, Others on Request**		

Performance Curves:



Standard PRM Dimensions:



***PRM2 and PRM3 Dimensions available upon request**

Product Codes For Ordering:

PRM ☐☐☐ ☐ ☐ ☐

PRM2 (Optional 2 port) 1 2 3 4

PRM3 (Relief port is on the side of the valve instead of at the bottom)

1 = Size
025 – 1/4"
038 – 3/8"
050 – 1/2"

2 = Material
P - PVC
CP - CPVC
PP - Polypro
T - PTFE
K - PVDF
H - Halar
S - 316 SS
A - Alloy 20
C - Hastelloy C

3 = Spring Opt
Blank - 10-150 psi
1 - 0 - 50 psi
2 - 10 - 250 psi

For 50 - 350 psi spring use option code "MSS"

4 = Options
Blank – NPT & PTFE/EPDM
V - Viton Diaphragm
TV – PTFE/Viton Diaph.
S - Socket Connection
F - Flange Connection
U - Union Connection
OSS - 316 SS L Top
MSS - 50-350 psi 316SSL Top
AR - Priming Valve
90 - 90° Configuration

Note: Option MSS is only for use on 316SS, A20, & Hast C Valves.

DIMENSIONS: PRM - Series			
All Materials	(Orifice size = 0.312)		
Size	A (in.)	B (in.)	C (in.)
1/4"	3.550	2.350	0.750
3/8"	3.550	2.350	0.750
1/2"	4.250	2.350	1.080

Operating instructions

Solenoid Metering Pump
gamma/ X, GMXa

EN



Please carefully read these operating instructions before use. · Do not discard.
The operator shall be liable for any damage caused by installation or operating errors.
The latest version of the operating instructions are available on our homepage.

Part no. 984586 **Original operating instructions (2006/42/EC)** BA G 062 09/20 EN

Supplementary information



Fig. 1: Please read!

Read the following supplementary information in its entirety! You will benefit more from the operating instructions should you already know this information.

The following are highlighted separately in the document:

- Enumerated lists

→ Instructions

⇨ Outcome of the instructions

↳ *'State the identity code and serial number' on page 2*: Links to points in this chapter

- refer to ... : References to points in this document or another document

[Keys]

'Menu level 1 ➔ *Menu level 2* ➔ *Menu level ...*': Menu paths

'Software interface texts'

Information

This provides important information relating to the correct operation of the unit or is intended to make your work easier.

Safety information

Safety information is identified by pictograms - see "Safety Chapter".

State the identity code and serial number

Please state the identity code and serial number, which you can find on the nameplate or in the menu under *'Setting / Menu* ➔ *Information'* when you contact us or order spare parts. This enables us to clearly identify the unit type and material version.

General non-discriminatory approach

In order to make it easier to read, this document uses the male form in grammatical structures but with an implied neutral sense. It is aimed equally at both men and women. We kindly ask female readers for their understanding in this simplification of the text.

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1 Identity code



Product identification

This identity code serves to identify the product.

Use the identity code from the Product Catalogue for orders.

| Product range gamma/ X | | |

| Product range gamma/ X | | |

Product range gamma/ X		
	EN	English
	ES	Spanish
	FR	French
	...	...

2 About this pump

About this pump

Pumps in the gamma/ X product range are microprocessor-controlled solenoid metering pumps with the following characteristics:

- Simple adjustment of the capacity directly in l/h
- Available material combinations: PP, PVDF, clear acrylic, PTFE and stainless steel
- Special dosing head designs for gaseous and high-viscosity media
- Illuminated LC display and 3-LED display for operating, warning and error messages, visible from all sides
- Factor with external contact control 99:1 ... 1:99
- Batch operation with max. 99,999 strokes/start pulse
- Input of concentration for simple adjustment with volume-proportional metering tasks
- Stroke rate adjustment in 1 stroke/hour increments from 0 ... 12,000 strokes/h
- Electronic stroke length adjustment, continuous from 0 ... 100% (recommended 30 ... 100%)
- Connector for 2-stage level switch
- External control via 0/4-20 mA standard signal with adjustable assignment of signal value to stroke rate
- Optional 4-20 mA output for remote transmission of stroke length and stroke rate
- Universal power supply unit 100 V - 230 V, 50/60 Hz
- Optional 230 V relay module, can also be retrofitted easily and securely
- Optional 24 V combined relay, can also be retrofitted easily and securely

The hydraulic parts of the gamma/ X are identical to those of the Beta® (not with types 0220, 0424 and 0245).

3 Safety chapter

Identification of safety notes

The following signal words are used in these operating instructions to denote different severities of danger:

Signal word	Meaning
WARNING	Denotes a possibly dangerous situation. If this is disregarded, you are in a life-threatening situation and this can result in serious injuries.
CAUTION	Denotes a possibly dangerous situation. If this is disregarded, it could result in slight or minor injuries or material damage.

Warning signs denoting different types of danger

The following warning signs are used in these operating instructions to denote different types of danger:

Warning signs	Type of danger
	Warning – automatic start-up.
	Warning – high-voltage.
	Warning – danger zone.

Intended use

- Only use the pump to meter liquid feed chemicals.
- Only start up the pump once it has been correctly installed and started up in accordance with the technical data and specifications contained in the operating instructions.
- Observe the general limitations with regard to viscosity limits, chemical resistance and density - see also ProMinent Resistance List in the Product Catalogue or at www.prominent.com!
- All other uses or modifications are prohibited.
- The pump is not intended for the metering of gaseous media and solids.
- The pump is not intended for the metering of flammable media.
- The pump is not intended for the metering of explosive media.
- The pump is not intended for operation in areas at risk from explosion.
- The pump is not intended for use outdoors without appropriate protective measures.
- Only allow the pump to be operated by trained and authorised personnel - see the following "Qualifications" table.
- You have a duty to observe the information contained in the operating instructions during the different phases of the unit's service life.

Safety information



WARNING!

Warning about personal and material damage

The pump can start to pump, as soon as it is connected to the mains voltage.

– Install an emergency cut-off switch in the pump power supply line or integrate the pump in the emergency cut-off management of the system.



WARNING!

Warning of personal injury and material damage

The pump can start pumping as soon as it has cooled down after the error *'temperature'*.

– Take this into account with the pump and your installation.



WARNING!

Danger of electric shock

A mains voltage may exist inside the pump housing.

– If the pump housing has been damaged, you must disconnect it from the mains immediately. It may only be returned to service after an authorised repair.



WARNING!

Warning of hazardous feed chemical

Should a dangerous feed chemical be used: it may escape from the hydraulic components when working on the pump, material failure or incorrect handling of the pump.

– Take appropriate protective measures before working on the pump (e.g. safety glasses, safety gloves, ...). Adhere to the material safety data sheet for the feed chemical.
– Drain and flush the liquid end before working on the pump.



WARNING!

Danger from hazardous substances!

Possible consequence: Fatal or very serious injuries.

Please ensure when handling hazardous substances that you have read the latest safety data sheets provided by the manufacture of the hazardous substance. The actions required are described in the safety data sheet. Check the safety data sheet regularly and replace, if necessary, as the hazard potential of a substance can be re-evaluated at any time based on new findings.

The system operator is responsible for ensuring that these safety data sheets are available and that they are kept up to date, as well as for producing an associated hazard assessment for the workstations affected.



CAUTION!

Warning of feed chemical spraying around

Feed chemical may spray out of the hydraulic components if they are tampered with or opened due to pressure in the liquid end and adjacent parts of the system.

- Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
- Ensure that the system is at atmospheric pressure before commencing any work on hydraulic parts of the system.



CAUTION!

Warning of feed chemical spraying around

The metering pump may generate a multiple of its nominal pressure. Hydraulic parts may rupture if a discharge line is blocked.

- Correctly install a relief valve in the discharge line downstream of the metering pump.



CAUTION!

Warning of feed chemical spraying around

An unsuitable feed chemical can damage the parts of the pump that come into contact with the chemical.

- Take into account the resistance of the wetted materials and the ProMinent Resistance List when selecting the feed chemical - see the ProMinent Product Catalogue or visit ProMinent.



CAUTION!

Danger of injury to personnel and material damage

The use of untested third party components can result in injury to personnel and material damage.

- Only fit parts to metering pumps that have been tested and recommended by ProMinent.



CAUTION!

Danger from incorrectly operated or inadequately maintained pumps

Danger can arise from a poorly accessible pump due to incorrect operation and poor maintenance.

- Ensure that the pump is accessible at all times.
- Adhere to the maintenance intervals.



CAUTION!

Danger from incorrect dosing

The metering behaviour of the pump changes if a different liquid end size is fitted.

- Reprogram the pump in the *'Menu / Information ➔ Settings ➔ System ➔ Replace head type'* menu.



CAUTION!

Warning against illegal operation

Observe the regulations that apply where the device is installed.

Isolating protective equipment

- Cover of the slot for relays and optional modules - see the chapter entitled "Overview of equipment and control elements"

Customers should only remove the cover of the slot for relays and optional modules and/or a relay or optional module in line with the supplementary instructions for the relays and optional modules.

Customers should only remove the dosing head in accordance with the "Repair" chapter.

Only the ProMinent service department is authorised to open the housing and hood (housing the control elements).

Information in the event of an emergency

In an emergency, either disconnect the mains plug, press *[Start/Stop]* or press the Emergency Stop switch installed on the customer's side or disconnect the pump from the mains/power supply in line with the Emergency Stop management guidelines for your system.

If feed chemical escapes, ensure that the pump's hydraulic environment is also at atmospheric pressure. Adhere to the material safety data sheet for the feed chemical.

Qualification of personnel

Task	Qualification
Storage, transport, unpacking	Instructed person
Assembly	Technical personnel, service
Planning the hydraulic installation	Qualified personnel who have a thorough knowledge of metering pumps
Hydraulic installation	Technical personnel, service
Installation, electrical	Electrical technician
Operation	Instructed person
Maintenance, repair	Technical personnel, service
Decommissioning, disposal	Technical personnel, service
Troubleshooting	Technical personnel, electrical technician, instructed person, service

Explanation of the table:

Qualified personnel

A qualified employee is deemed to be a person who is able to assess the tasks assigned to him and recognise possible dangers based on his/her technical training, knowledge and experience, as well as knowledge of pertinent regulations.

Note:

A qualification of equal validity to a technical qualification can also be gained by several years of employment in the relevant field of work.

Electrical technician

An electrical technician is able to complete work on electrical systems and recognise and avoid possible dangers independently based on his/her technical training and experience, as well as knowledge of pertinent standards and regulations.

The electrical technician should be specifically trained for the working environment in which he is employed and know the relevant standards and regulations.

An electrical technician must comply with the provisions of the applicable statutory directives on accident prevention.

Instructed person

An instructed person is deemed to be a person who has been instructed and, if required, trained in the tasks assigned to him/her and possible dangers that could result from improper behaviour, as well as having been instructed in the required protective equipment and protective measures.

Service

The Service department refers to service technicians, who have received proven training and have been authorised by ProMinent to work on the system.

Sound pressure level

Sound pressure level LpA < 70 dB according to EN ISO 20361

at maximum stroke length, maximum stroke rate, maximum back pressure (water)

4 Storage, Transport and Unpacking

Safety Information



WARNING!

Only return metering pumps for repair in a cleaned state and with a flushed liquid end - refer to "Decommissioning!

Only return metering pumps with a completed Decontamination Declaration form. The Decontamination Declaration constitutes an integral part of an inspection / repair order. A unit can only be inspected or repaired when a Declaration of Decontamination Form is submitted that has been completed correctly and in full by an authorised and qualified person on behalf of the pump operator.

The "Decontamination Declaration Form" can be found on our homepage.



CAUTION!

Danger of material damage

The device can be damaged by incorrect or improper storage or transportation!

- The unit should only be stored or transported in a well packaged state - preferably in its original packaging.
- The packaged unit should also only be stored or transported in accordance with the stipulated storage conditions.
- The packaged unit should be protected from moisture and the ingress of chemicals.

Ambient conditions

Ambient conditions - refer to "Technical Data" chapter.

Scope of delivery

Compare the delivery note with the scope of delivery:

- Metering pump with mains cable
- Connector kit for hose/pipe connection (optional)
- Product-specific operating instructions with EC Declaration of Conformity
- Optional accessories

5 Overview of equipment and control elements

5.1 Overview of equipment

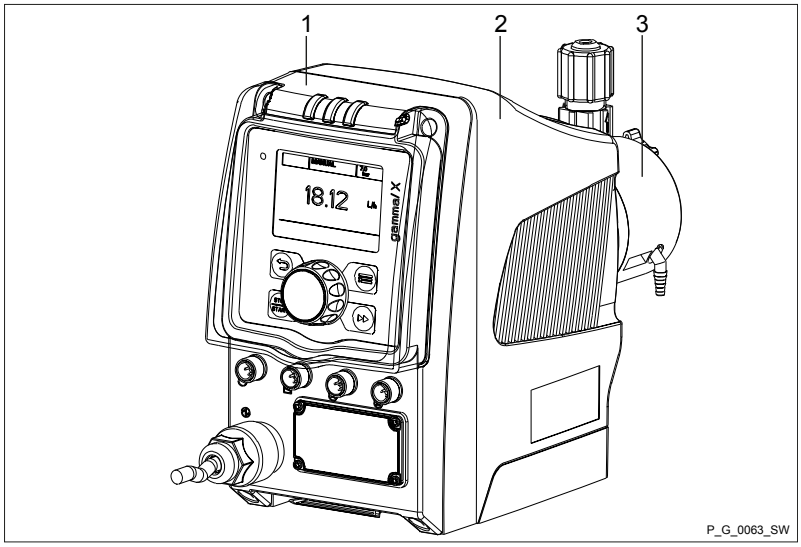


Fig. 2: Overview of equipment, complete

1 Control unit
2 Drive unit
3 Liquid end

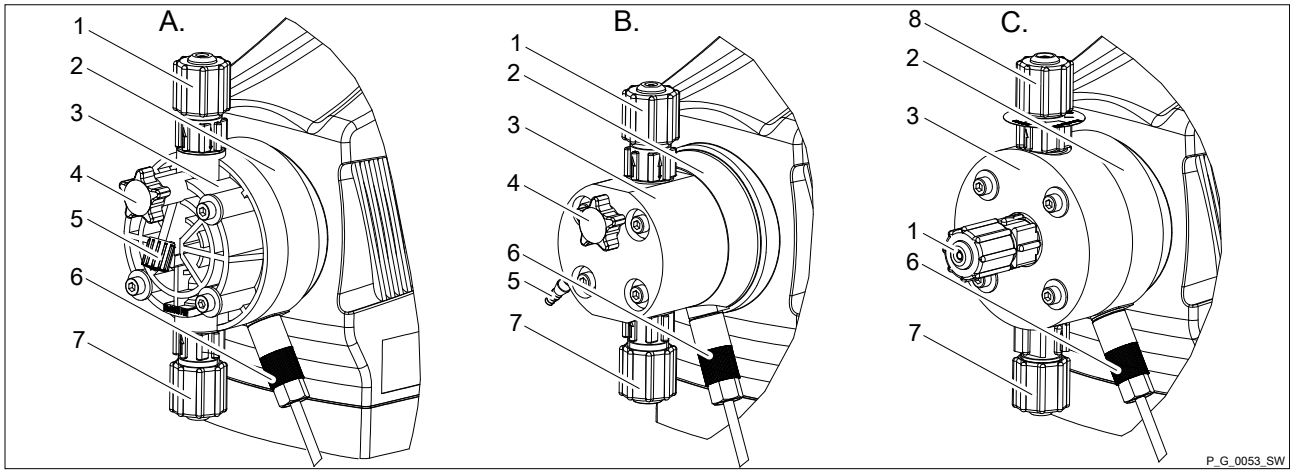


Fig. 3: A. Liquid end with PV bleed valve; B. Liquid end with NP bleed valve; C. Self-bleeding liquid end (SEK)

1 Discharge valve
2 Backplate
3 Dosing head
4 Bleed valve
5 Bypass hose sleeve
6 Diaphragm rupture indicator (optional)
7 Suction valve
8 Bleed valve, self-bleeding

Self-bleeding liquid ends (SER)

Externally self-bleeding liquid ends with groove (SER) look identical to liquid ends with bleed valve.

The SER valve is only approved up to a pressure of 10 bar. We recommend operating a pump with a SER valve of between 1 ... 7 bar.

5.2 Control elements

Control elements, overview

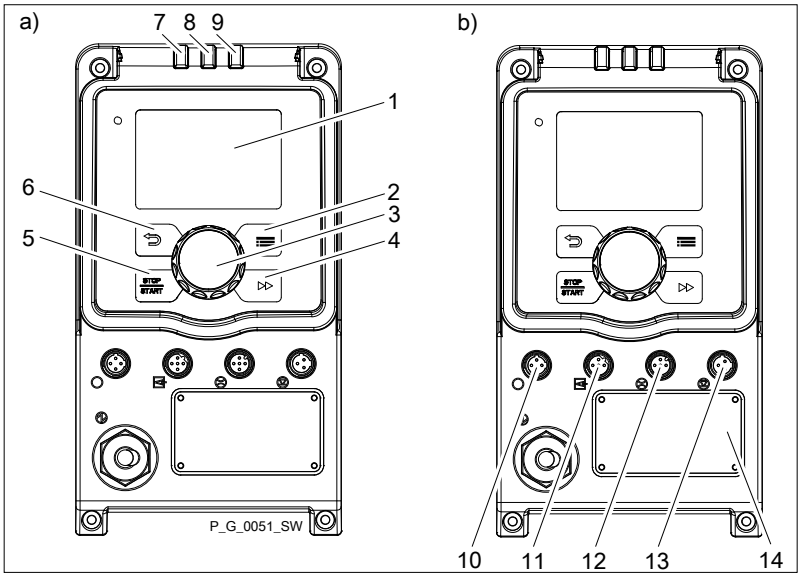


Fig. 4: Control elements

1 LCD screen
2 *[Menu]* key
3 Clickwheel
4 *[Priming]* key
5 *[STOP/START]* key
6 *[Back]* key
7 Fault indicator (red)
8 Warning indicator (yellow)
9 Operating indicator (green)
10 "Diaphragm rupture indicator" terminal
11 "External control" terminal
12 "Metering monitor" terminal
13 "Level switch" terminal
14 Slot for relays and optional modules

5.2.1 Control elements

Use this overview to familiarise yourself with the keys and other control elements on the pump!

Pressure display, identifier and fault displays on the LCD screen

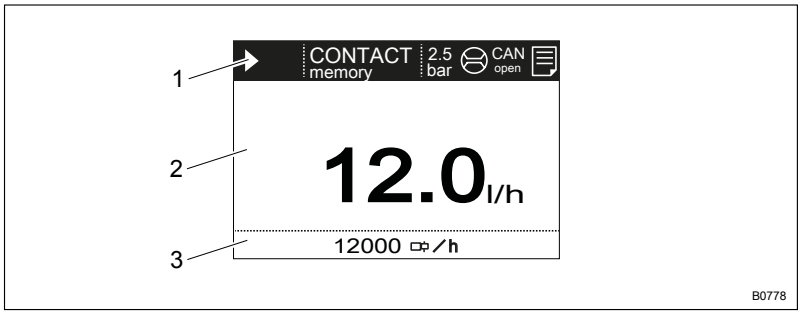


Fig. 5: Construction of the continuous display

1 Status bar
2 Continuous display, central area
3 Secondary display

Refer to the chapter entitled "Main displays and secondary displays" in the Appendix for the different main displays and secondary displays.

The LCD screen supports the operation and adjustment of the pump using different information and various identifiers:

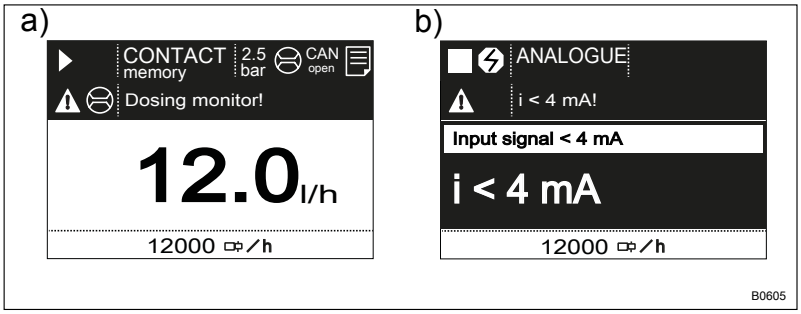


Fig. 6: a) Continuous display with warning message; b) Continuous display with fault message. Explanation of the symbols in the following tables.

The above Figure, Part a) shows that:

- the pump is in operation
- it is in *'Contact'* operating mode with "memory" stroke memory
- the average system pressure is 2.5 bar
- a metering monitor is connected
- a CAN module is being used
- a log entry has been made
- a warning message for the *'Dosing monitor'* is pending
- the capacity of 12.0 l/h has been set
- the stroke rate is 12,000 strokes / h

Tab. 1: Pressure display

Display	Meaning
2.5 bar	Displays the average system pressure.

Tab. 2: Identifiers and error displays:

Identifier	Meaning
	The pump is working or waiting for a starting signal.
	The pump was manually stopped using the [STOP/START] key.
	The pump was remotely stopped (Pause) - via the "External" socket.
	The pump was stopped by an error.
	Only with cyclical batch metering: the pump is waiting for the next cycle.

Identifier	Meaning
	Only with *'Access protection'*: the pump software is locked.
'AUX'	The pump is currently pumping at auxiliary capacity and/or auxiliary frequency.
'memory'	Only in *'CONTACT'* and *'BATCH'* operating modes: The "Stroke memory" auxiliary function has been set.
	The pump is in *'ANALOG'* operating mode. The *'Curve ➔ linear'* type of processing is set.
	The pump is in *'ANALOG'* operating mode. The *'Curve ➔ Upper side band'* type of processing is set.
	*'Metering ➔ Discharge stroke ➔ optimum'* metering profile has been set.
	*'Metering ➔ Discharge stroke ➔ fast'* metering profile has been set.
	*'Metering ➔ Discharge stroke ➔ sine mode'* metering profile has been set.
	*'Metering ➔ Discharge stroke ➔ continuous'* metering profile has been set.
	*'Metering ➔ Discharge stroke ➔ DFMa'* metering profile has been set.
	*'Metering ➔ Discharge stroke ➔ normal'* metering profile has been set.
	*'Metering ➔ Suction stroke ➔ HV1'* metering profile has been set.
	*'Metering ➔ Suction stroke ➔ HV2'* metering profile has been set.
	*'Metering ➔ Suction stroke ➔ HV3'* metering profile has been set.
	A "Flow Control" metering monitor is connected.
	A diaphragm rupture indicator is connected.
	The pump has created a log about the operation.

Identifier	Meaning
	The pump is in the *'Menu'* (Set up).

Further explanations can be found in the "Trouble-shooting" chapter.

The pump only shows the metering volume and the capacity in the calibrated status in l or l/h or in gal or gal/h.

5.2.2 Key functions

Key	Application	In the continuous displays	In the menu
[Back]	press	-	Go back to the previous menu item (or a continuous display) - without saving
[STOP/ START]	press	Stop pump,	Stop pump,
		Start pump	Start pump
[Menu]	press	Go to the menu	Go back to a continuous display
[Priming]	press	Priming *	Priming *
[Clickwheel]	press	Start batch (only in *'Batch'* operating mode), Acknowledge errors	Go to next menu item (or a continuous display) Confirm entry and save
[Clickwheel]	turn	Switch between the continuous displays	Change figure or change selection

** When priming the pump does not run at maximum stroke rate.*

If [Priming] is pressed in 'Stop' status, then [Priming] has top priority as long as the button is pressed.

Refer to the "Set-up basics" chapter for information on how to adjust figures

6 Functional description

6.1 Liquid End

The dosing process is performed as follows: The diaphragm is pressed into the dosing head; the pressure in the dosing head closes the suction valve and the feed chemical flows through the discharge valve out of the dosing head. The diaphragm is now drawn out of the dosing head; the discharge valve closes due to the negative pressure in the dosing head and fresh feed chemical flows through the suction valve into the dosing head. One cycle is completed.

6.2 Drive unit

The metering diaphragm is driven by an electromagnet, controlled by an electronic controller.

Drive technology

The drive technology on the gamma/ X enables the timed progress of the flow to be precisely matched to the requirements of the particular application.

This ensures that the user can set the optimum **discharge stroke** for his application, as required:

Pos.*	Discharge stroke	Application
A.	*'optimum'*	For maximum precision when metering and the very best results with internal pressure measurement and special functions.
B.	*'fast'*	For as fast a discharge stroke as possible - the duration of the discharge stroke is dependent on the stroke rate.
C.	*'s fast'*	For as fast a discharge stroke as possible - the duration of the discharge stroke is dependent on the stroke rate.
D.	*'sine mode'*	The duration of the discharge stroke is dependent on the stroke rate for a long, sine-shaped pressure stroke.
E.	*'continuous'*	For a continuous discharge stroke e.g. for bottling processes. The duration of the discharge stroke is dependent on the stroke rate.
F.	*'DFMa'*	For optimum operation with a flow meter DulcoFlow® DFMa.

* see following drawing.

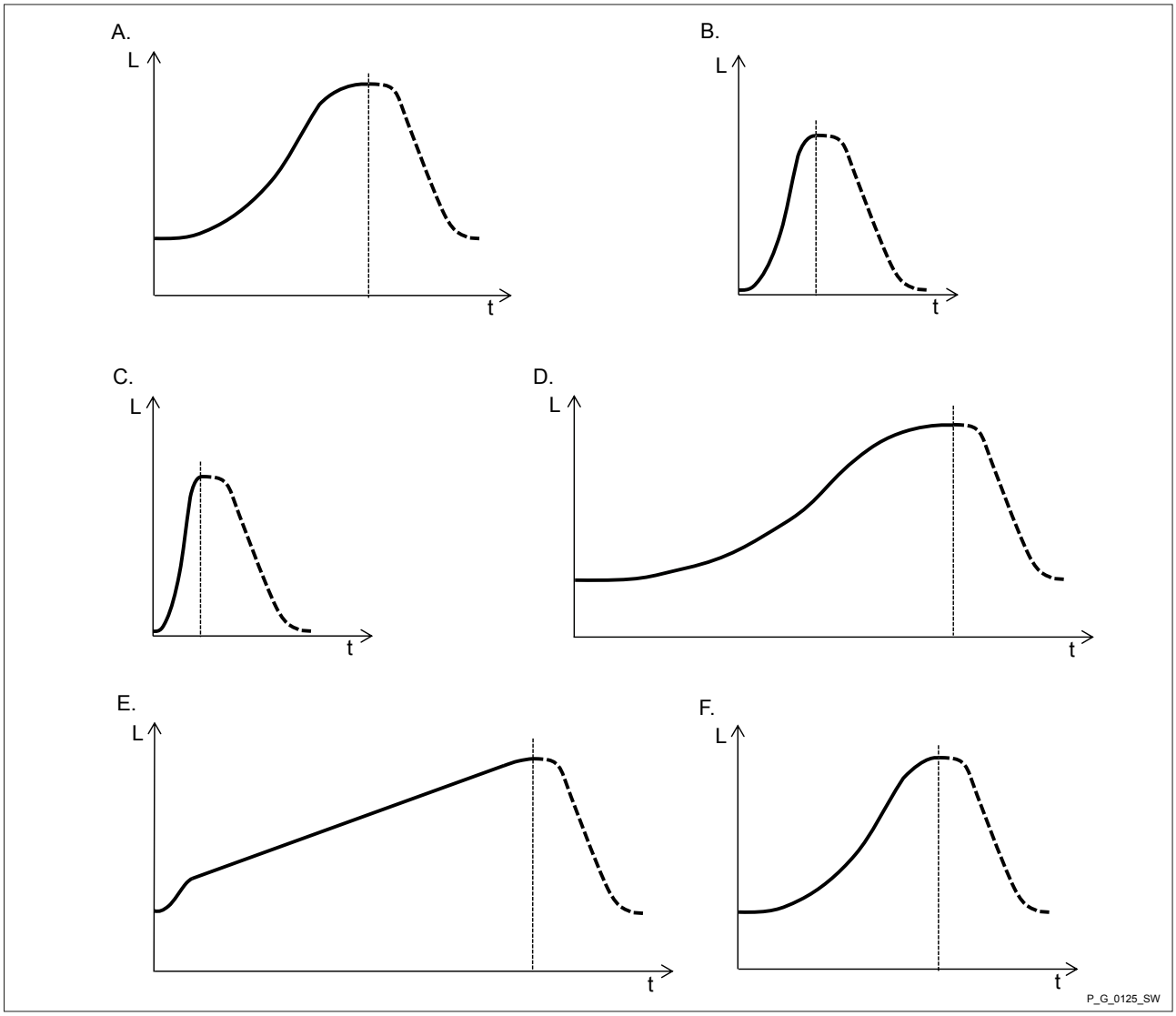


Fig. 7: Discharge stroke metering profiles with stroke L and time t (suction stroke shown as a dotted line)

It is possible to selectively also slow the **suction stroke** with all these metering profiles for the discharge stroke - see . In this way, it is possible to prevent the main cause of inaccurate metering with high viscosity feed chemicals, namely the incomplete filling of the liquid end. With gaseous feed chemicals, the slow suction stroke prevents cavitation and consequently increases dosing precision.

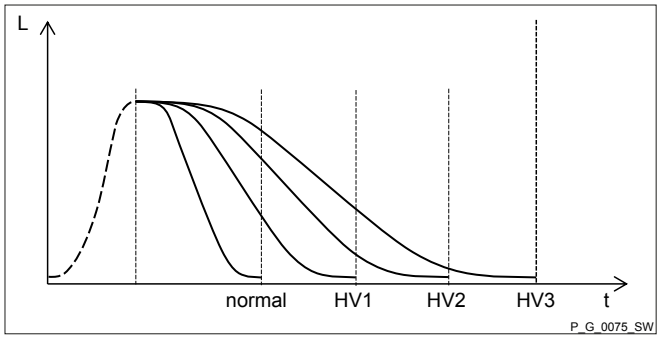


Fig. 8: Suction stroke metering profiles with stroke L and time t

Normal	Normal suction stroke
HV1	Suction stroke for viscous feed chemical
HV2	Suction stroke for average viscosity feed chemical
HV3	Suction stroke for high-viscosity feed chemical

Oscillations in the back pressure in the metering line, which could lead to undesirable variations in the metering volume, are automatically compensated for by the power end/drive. This results in **dosing precision**, which otherwise could only be achieved with complex control circuits.

6.3 Capacity

The capacity set regulates the pump even in *'Automatic'* mode (not with SEK dosing heads).

By contrast, in conventional mode, the stroke length and stroke rate determine the capacity. The stroke length can be adjusted between 0 and 100% via the continuous display or the menu. A metering volume of between 30 to 100% is reproduced as being technically sensible (SEK type: 50 - 100%)! The stroke rate can be set via the menu (not in "Analogue" operating mode) within a range of 0 - 12,000 strokes/h.

6.4 Self-Bleeding

SER types

Self-bleeding liquid ends without bypass are capable of independent priming when a discharge line is connected and diverting any air pockets present into the discharge line. During operation they are also capable of conveying away gases which are produced, independently of the operating pressure in the system.

SEK types

Self-bleeding liquid ends with ball are capable of independent priming when a discharge line is connected and diverting any air pockets present via a bypass. During operation they are also capable of conveying away gases which are produced, independently of the operating pressure in the system. It is also possible to meter precisely under atmospheric pressure due to the integral back pressure valve.

6.5 Operating modes

Operating modes are selected via the "Operating modes" menu.

Refer to the "Hierarchy of Operating Modes, Functions and Fault Statuses" for the order of the various operating modes, functions and fault statuses.

"Manual" operating mode

'Manual' operating mode permits you to operate the pump manually.

"Contact" operating mode

This operating mode provides the option of controlling the pump externally by means of potential-free contacts (e.g. by means of a contact water meter). The "Pulse Control" option enables you to preselect the number of strokes (a scaling or transfer factor of 0.01 to 99.99) in the *'Settings'* menu.

"Batch" operating mode

This operating mode provides the option of working with large transfer factors (up to 99,999). Metering can be triggered either by pressing the *[Clickwheel]* or by a pulse received via the "External control" terminal or via a contact or a semiconductor switching element. It is possible to preselect a metering volume (batch) or a number of strokes using the *[Clickwheel]* in the *'Settings'* menu.

"Analogue" operating mode

The capacity and/or stroke rate is controlled via an analogue current signal via the "External control" socket. The processing of the current signal can be preselected using the control unit.

6.6 Functions

Refer to the "Hierarchy of Operating Modes, Functions and Fault Statuses" for the order of the various operating modes, functions and fault statuses.

The following functions can be selected using the *'Settings'* menu:

"Calibrate" function

The pump can also be operated in a calibrated state in all operating modes if it is to meter extremely precisely. This can be useful with high-viscosity feed chemicals but less so with feed chemicals with a similar consistency to water. Calibration is retained over the entire stroke rate range and over a stroke length range from 0 - 100%.

"Auxiliary capacity" / "Auxiliary frequency" function

This facilitates the switch-over to a fixed adjustable capacity / stroke rate in the *'menu'* via the "External control" terminal.

"Bleed " function

This permits simple bleeding - without the need for an additional bleed valve. The pump works at maximum stroke rate based on the selected signal to transport gas bubbles out of the liquid end.

"Timer" function

This permits a simple timer program to be set up without the need for an additional timer module.

The following functions are available as standard:

"Flow" function

It monitors the flow after every single stroke, if a dosing monitor is connected and if *'Fast'* is set under *'Settings* ➔ *Metering* ➔ *Discharge stroke'* or *'DFMa'* (for the DulcoFlow®). The number of defective strokes, after which the pump is switched off, can be set in the *'Settings'* menu.

"Level switch" function

Information about the liquid level in the dosing tank is reported to the pump. A two-stage level switch has to be fitted for this purpose, which is connected to the "Level switch" terminal. It is possible to connect a suction lance with continuous level measurement to pumps from 2019 onwards.

"Pause" function

The pump can be remotely stopped via the "External control" terminal.

"Stop" function

The pump can be stopped without disconnecting it from the mains/power supply by pressing *[STOP/START]*.

"Priming" function

Priming can be triggered by pressing *[Priming]*.

6.7 Relay (Options)

The pump has several connecting options available:

"Fault indicating relay" option

The relay can close a connected power circuit (e.g. for an alarm horn) in the event of warnings or fault messages (e.g. *'Warning level'*).

The relay can be retrofitted through the slot in the front of the pump – refer to the installation instructions for "Retrofitting relays".

"Fault indicating and pacing relay" option

This combined relay can generate a contact with each stroke via its pacing relay in addition to functioning as a fault indicating relay.

The relay can be retrofitted through the slot in the front of the pump.

"Automatic bleed" option

The "Automatic bleed" option is used for controlled bleeding of the liquid end, if the pump has the "Automatic bleed" option. This option can be retrofitted through the slot in the front of the pump and conversion of the dosing head.

There are two versions:

- Version with only 1 relay – to control the electric bleed valve in the dosing head.
- Version with only 2 relays – one relay to control the electric bleed valve in the dosing head and one relay free for other uses.

“mA output" option

The current output I signal indicates the pump's actual calculated metering volume. The relay can be retrofitted through the slot in the front of the pump.

The option also always includes a fault indicating relay or a pacing relay.

6.8 LED displays

Fault indicator (red)

LED display	Colour	lit	briefly goes out	flashes
Fault indicator	red	A fault message is pending	-	undefined operating status
Warning indicator	yellow	A warning message is pending	-	-
Operating display	green	The pump is ready for operation	At each stroke	Stroke rate below 30 strokes / min

6.9 Hierarchy of operating modes, functions and fault statuses

The different operating modes, functions and fault statuses have a different impact on whether and how the pump reacts.

The following list shows the order:

1. - Priming
2. - Stop
3. - Error, Pause
4. - Auxiliary capacity / Auxiliary frequency
5. - Manual, Analogue, Contact, Batch, Fieldbus

Comments:

re 1. - “Priming" can take place in any pump mode (providing it is working).

re 2. - "Stop" stops everything.

re 3. - "Error", and "Pause" stop everything apart from "Priming".

re 4. - "Auxiliary capacity" and/or "Auxiliary frequency" always have priority over the capacity / stroke rate specified by an operating mode listed under 5.

7 Assembly

Please refer to the online version of the operating instructions on our website for the right dimensional drawings for the pump and mounting plate.

Compare the dimensions on the dimensional drawing with those of the pump and/or mounting plate.

CAUTION!

Danger from incorrectly operated or inadequately maintained pumps

Danger can arise from a poorly accessible pump due to incorrect operation and poor maintenance.

– Ensure that the pump is accessible at all times.
– Adhere to the maintenance intervals.

Capacity too low

The liquid end valves can be disturbed by vibrations.

– *Secure the metering pump so that no vibrations can occur.*

Capacity too low

If the valves of the liquid end are not vertical, they cannot close correctly.

– *Ensure that the suction and discharge valves are upright (with self-bleeding liquid ends: the bleed valve).*

Several metering pumps can be arranged closely together as required.

1. To remove the mounting plate, press down the black flap below the front of the pump a little and press the mounting plate backwards.
2. Assemble the mounting plate on a **level** and load-bearing base surface (with a minimum of 2 bolts and 2 washers!).

   You can also assemble the mounting plate on a **vertical**, level and load-bearing base surface (using 3 bolts and 3 washers!). You then need to rotate the liquid end (vertical valve position!)

   You can also assemble the mounting plate on a **wall bracket** (accessories). 3 alignments are possible.
3. Lock the foot of the metering pump into the mounting plate – see Fig. 9.

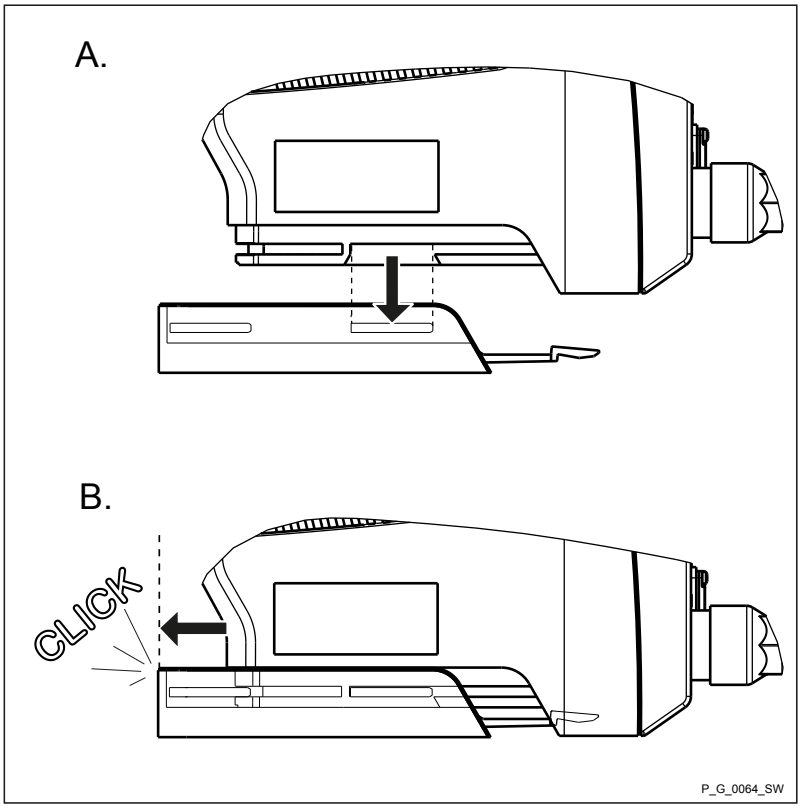
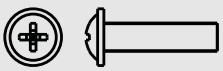


Fig. 9

Tab. 3: Suggested bolts and washers for fixing the assembly foot

Bolt	Type	Size	Washer
	DELTA-PT bolt	50 (WN5412/5452)	A5.3 (DIN 125)
	PT bolt	50 (WN1441/1411 KA/B)	-
	Flat-head bolt	M5 (DIN EN ISO 7045)	A5.3 (DIN 125)
	Allen bolt/	M5 (DIN EN ISO 4762)	A5.3 (DIN 125)

8 Installation, hydraulic

Safety information



CAUTION!

Warning of feed chemical spraying around

An unsuitable feed chemical can damage the parts of the pump that come into contact with the chemical.

– Take into account the resistance of the wetted materials and the ProMinent Resistance List when selecting the feed chemical - see the ProMinent Product Catalogue or visit ProMinent.



CAUTION!

Warning of feed chemical spraying around

Pumps which are not fully installed hydraulically can eject feed chemicals from the outlet openings of the discharge valves as soon as they are connected to the mains.

– The pump must first be hydraulically installed and then electrically.
– In the event that you have failed to do so, press the *[STOP/START]* button or press the emergency-stop switch.



CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

– Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
– Depressurise the system before commencing any work on hydraulic parts.



CAUTION!

Danger from rupturing hydraulic components

Peak loads during the dosing stroke can cause the maximum permissible operating pressure of the system and pump to be exceeded.

– The discharge lines are to be properly designed.



CAUTION!

Danger of injury to personnel and material damage

The use of untested third party components can result in injury to personnel and material damage.

– Only fit parts to metering pumps that have been tested and recommended by ProMinent.

8.1 Installing hose lines

8.1.1 Installation of Metering Pumps Without Bleed Valve

Safety information



CAUTION!

Warning of feed chemical spraying around

The pipes can loosen or rupture if they are not installed correctly.

- Route all hose lines so they are free from mechanical stresses and kinks.
- Only use original hoses with the specified hose dimensions and wall thicknesses.
- Only use clamp rings and hose nozzles that are intended for the hose diameter in question to ensure the long service life of the connections.



CAUTION!

Danger from rupturing hydraulic components

Hydraulic components can rupture if the maximum permissible operating pressure is exceeded.

- Always adhere to the maximum permissible operating pressure of all hydraulic components - please refer to the product-specific operating instructions and system documentation.
- Never allow the metering pump to run against a closed shut-off device.
- Install a relief valve.



CAUTION!

Hazardous feed chemicals can escape

Hazardous or extremely aggressive feed chemicals can leak out when using conventional bleeding procedures with metering pumps.

- Install a bleed line with return line into the storage tank.



CAUTION!

Hazardous feed chemicals can escape

Hazardous or extremely aggressive feed chemicals can leak out in the event that the metering pump is removed from the installation.

- Install a shut-off valve on the metering pump's pressure and discharge sides.



CAUTION!

Uncontrolled flow of feed chemical

Feed chemical can press through a stopped metering pump if there is back pressure.

- Use an injection valve or a vacuum breaker.

CAUTION!

Uncontrolled flow of feed chemical

Feed chemicals can leak through the metering pump in an uncontrolled manner in the event of excessive priming pressure.

– Do not exceed the maximum permissible priming pressure for the metering pump.

Align the pipes so that the metering pump and the liquid end can simply be removed from the side if necessary.

Installing hose lines - PP, NP, PV, TT designs

1. Cut off the ends of the hoses at right angles.
2. Pull the union nut (2) and clamp ring (3) over the hose (1) - see figure Fig. 10.
3. Push the hose end (1) up to the stop over the nozzle (4) and widen, if necessary.

Ensure that the O-ring and flat seal (5) is properly fitted to the valve (6).

Never re-use used PTFE seals.

An installation sealed in this way is not watertight. This type of seal is permanently distorted when subjected to pressure.

In order to enable it to be distinguished from the EPDM flat seal, the FPM flat seal PV design has a dot.

4. Place the hose (1) with the nozzle (4) onto the valve (6).
5. Clamp the hose connector: Tighten the union nut (2) while simultaneously pressing on the hose (1).
6. Re-tighten the hose connector: Pull on the hose line (1) briefly, which is fastened to the dosing head and then re-tighten the union nut (2).

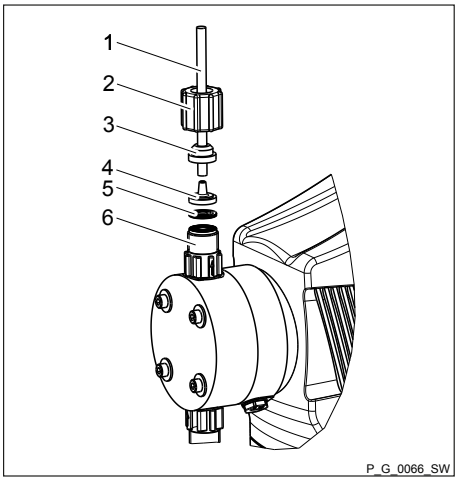


Fig. 10: PP, NP, PV and TT designs

1 Hose
2 Union nut
3 Clamp ring
4 Nozzle
5 O-ring or flat seal
6 Valve

Installing stainless steel pipe - SS design

1. Pull the union nut (2) and clamp rings (3, 4) over the pipe (1) with approx. 10 mm overhang - see Fig. 11.
2. Insert the pipe (1) up to the stop in the valve (5) and then withdraw 1...2 mm.
3. Tighten the union nut (2).

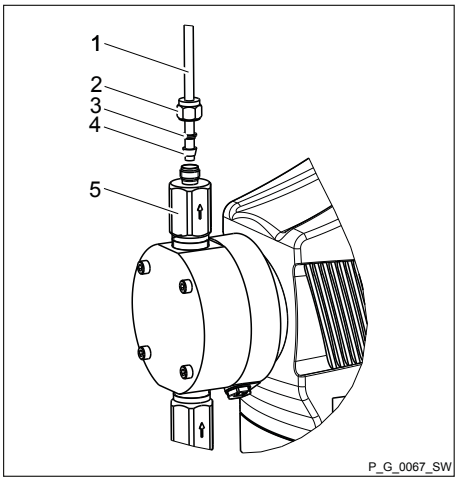


Fig. 11: SS design with pipe

1 pipe
2 Union nut
3 Rear clamp ring
4 Front clamp ring
5 Valve

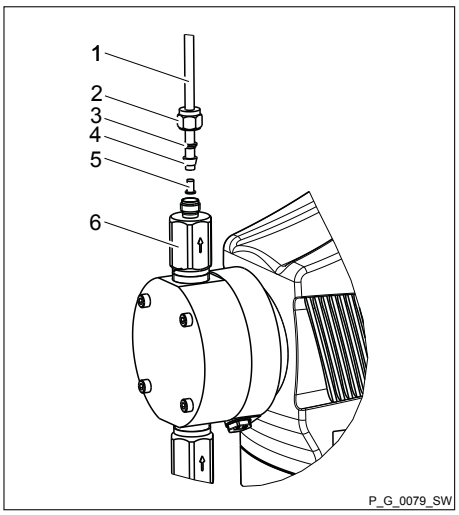
Installing hose lines - SS design

CAUTION!

Warning of feed chemical spraying around

Connections can come loose in the event that hose lines are installed incorrectly on stainless steel valves.

– Only use PE or PTFE hose lines.
– In addition, insert a stainless steel support insert into the hose line.



1 Hose
2 Union nut
3 Rear clamp ring
4 Front clamp ring
5 Support insert
6 Valve

Fig. 12: SS design with hose

8.1.2 Installation of Metering Pumps With Bleed Valve

Safety information

CAUTION!

– All the installation and safety notes for metering pumps without bleed valves also apply.

Installation of the return line

A return line is also connected in addition to the suction and discharge line.

1. Attach the hose line to the return hose nozzle or to the liquid end bleed valve. PVC hose, soft, 6x4 mm is recommended.
2. Feed the free end of the return line back to the storage tank.
3. Shorten the return line so that it is not immersed in the feed chemical in the storage tank.

8.1.3 Installation of Metering Pumps With Self-bleeding (SEK Type)

Safety information

CAUTION!

– All of the installation and safety notes for metering pumps without self-bleeding also apply.
– Do not exceed the maximum values for priming lift, priming pressure and viscosity of the feed chemical.
– Do not allow the suction side line cross-section to exceed the line cross-section on the suction valve.

Information about priming pressure

- *Make sure that the priming pressure on the suction end is at least equal to the return line pressure.*
- *Back pressure in the return line restricts the bleeding function.*
- *In contrast, it is possible to operate the pump with back pressure in the return line and atmospheric pressure on the suction side.*

Installation of the return line

A return line is also connected in addition to the suction and discharge line.

- *The return line is connected to the vertical valve on the upper side of the liquid end. It is factory-labelled with a red sleeve - see Fig. 10.*
- *The discharge line is connected to the horizontal valve.*

1. Attach the hose line to the return hose nozzle or to the liquid end bleed valve. PVC hose, soft, 6x4 mm is recommended.
2. Feed the free end of the return line back to the storage tank.
3. SEK only: Insert the return line into the anti-kink device on the bleed valve and screw it in place until the anti-kink device engages.

The anti-kink device prevents the return line from kinking, avoiding the risk of self-bleeding failure.

4. Shorten the return line so that it is not immersed in the feed chemical in the storage tank.

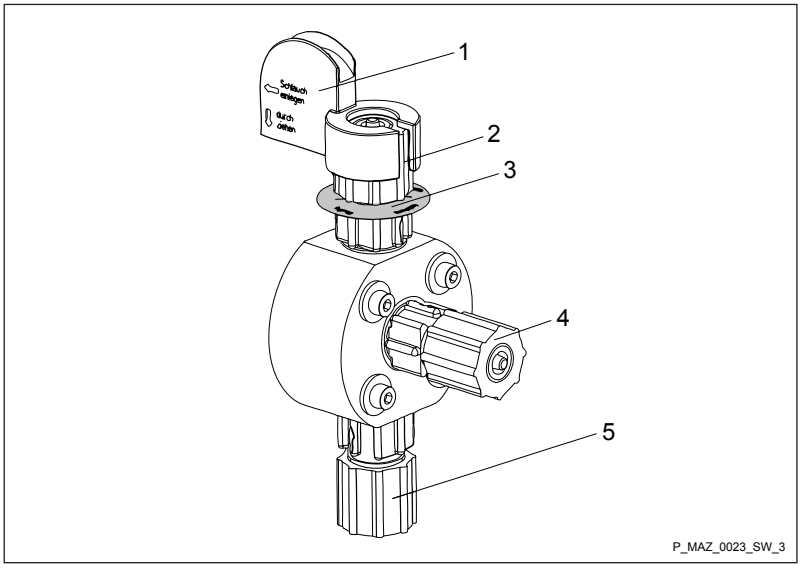


Fig. 13: SEK liquid end

1 Anti-kink device
2 Bleed valve for the return line into the storage tank, 6/4 mm
3 Red sleeve
4 Discharge valve for discharge line to the injection point, 6/4 - 12/9 mm
5 Suction valve for suction line in the storage tank, 6/4 - 12/9 mm

8.2 Basic installation notes

Safety notes

CAUTION!

Danger resulting from rupturing hydraulic components

Hydraulic components can rupture if the maximum permissible operating pressure is exceeded.

- Never allow the metering pump to run against a closed shut-off device.
- With metering pumps without integral relief valve: Install a relief valve in the discharge line.

CAUTION!

Hazardous feed chemicals can escape

With hazardous feed chemicals: Hazardous feed chemical can leak out when using conventional bleeding procedures with metering pumps.

- Install a bleed line with a return into the storage tank.

→ Shorten the return line so that it does not dip into the feed chemical in the storage tank.

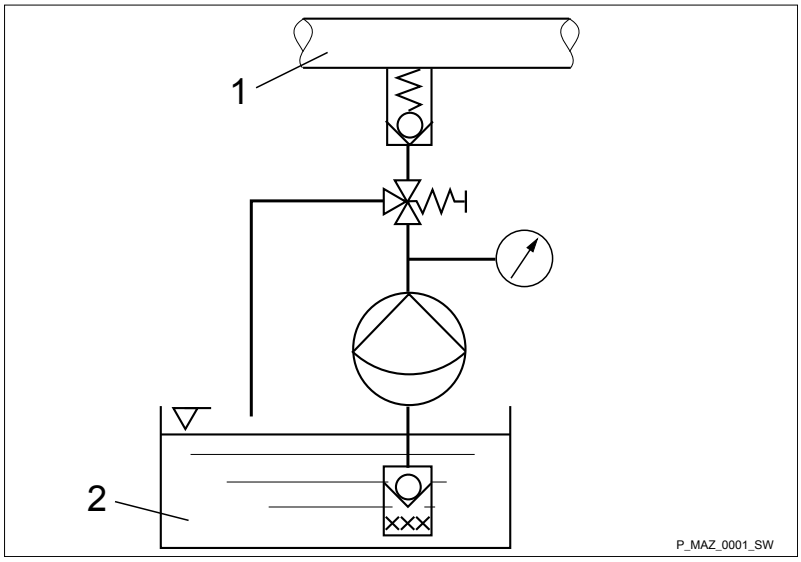


Fig. 14: Standard installation

1 Main line
2 Storage tank

Legend for hydraulic diagram

Symbol	Explanation	Symbol	Explanation
	Metering pump		Foot valve with filter meshes
	Injection valve		Level switch
	Multifunctional valve		Manometer

9 Installation, electrical



WARNING!

Danger of electric shock

A mains voltage may exist inside the device.

– Before any work, disconnect the device's mains cable from the mains.



WARNING!

Risk of electric shock

This pump is supplied with a grounding conductor and a grounding-type attachment plug.

– To reduce the risk of electric shock, ensure that it is connected only to a proper grounding-type receptacle.



WARNING!

Risk of electric shock

In the event of an electrical accident, the pump must be quickly disconnected from the mains.

– Install an emergency cut-off switch in the pump power supply line or
– Integrate the pump in the emergency cut-off management of the system and inform personnel of the isolating option.



WARNING!

Danger of electric shock

Incompletely installed electrical options can allow moisture into the inside of the housing.

– Fit appropriate modules into the slot on the front of the pump or use the original blank cover to seal it in a leak-tight manner.



WARNING!

Danger of electric shock

A mains voltage may exist inside the pump housing.

– If the pump housing has been damaged, you must disconnect it from the mains immediately. It may only be returned to service after an authorised repair.



CAUTION!

Risk of short circuiting caused by moist pins

No moisture must reach the pins of the PROFIBUS® jack.

– A suitable PROFIBUS® plug or protective cap must be screwed onto the PROFIBUS® jack.



CAUTION!

Material damage possible due to power surges

Should the pump be connected to the mains power supply in parallel to inductive consumers (such as solenoid valves, motors), inductive power surges can damage the control when it is switched off.

- Provide the pump with its own contacts (Phase) and supply with voltage via a contactor relay or relay.
- Should this not be possible, then switch a varistor (part no. 710912) or an RC gate (0.22 µF/220 Ω, part no. 710802) in parallel.



CAUTION!

Bonding of the contacts of your switching relay

The high starting current can cause the contacts of the on-site switching relay to bond together if the mains voltage switches a solenoid metering pump on and off in a process.

- Use the switching options offered by the external socket to control the pump (functions: Pause, Auxiliary frequency or Operating modes: Contact, Batch, Analogue).
- Use a starting current limiter if it is impossible to avoid switching the pump on and off via a relay.

→ Install the pump in line with best working practice and in accordance with the operating instructions and applicable regulations.

9.1 Supply voltage connector - power supply



WARNING!

Unexpected start-up is possible

The pump can start pumping and consequently feed chemical may escape as soon as the pump is connected to the mains/power supply.

- Avoid the escape of feed chemical.
- If you have not done so, immediately press *[STOP/START]* or disconnect the pump from the mains voltage e.g. using an Emergency Stop switch.
- Refer to the material safety data sheet for your feed chemical.



CAUTION!

If the pump is integrated into a system: Design the system so that potential hazardous situations are avoided by pumps starting up automatically subsequent to unintended power interruptions.

Connect the pump to the power supply using the mains cable.

9.2 HMI operating unit

Connect the HMI to the CAN socket above the LEDs of the pump base if the pump is operated with HMI.

If the pump is operated without HMI, then plug the sealing cap supplied into the CAN socket above the LEDs of the pump base.

CAUTION!

Risk of short circuiting

A short circuit may occur in the pump if liquid penetrates into the CAN socket.

– Always plug a CAN plug or the sealing cap supplied into the CAN socket.

CAUTION!

Danger of malfunction

Incorrect operation via the CAN bus will lead to malfunctions.

– Do not connect any other control (e.g. DXCa) to the CAN socket when operating with HMI connected.

9.3 Description of the terminals

9.3.1 "External control" terminal

The "External control" terminal is a 5-pin panel terminal. It is compatible with 2- and 4-pin cables.

Only use a 5-pin cable with the "Auxiliary capacity" / "Auxiliary frequency" functions.

Only use a 4-pin or a 5-pin cable with the "mA input" function.

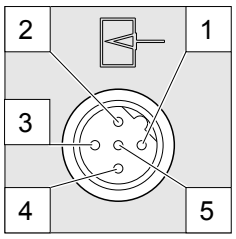


Fig. 15: Assignment on the pump

Electrical interface for pin 1 "Pause" - pin 2 "External contact" - pin 5 "Auxiliary capacity / Auxiliary frequency"

Data	Value	Unit
Voltage with open contacts	5	V
Input resistance	10	kΩ
Max. pulse frequency	25	pulse/s
Min. pulse duration	20	ms

Control via:

- potential-free contact (load: 0.5 mA at 5 V) or
- semiconductor switch (residual voltage < 0.7 V)

Electrical interface for pin 3 "mA input" (with identity code characteristic "Control version": 2 and 3)[1]

Data	Value	Unit
Input load, approx.	120	Ω

[1] At 0.0 .. 0.4 mA (4.4 mA) the metering pump performs its first metering stroke and at 19.6 ... 20.0 mA the pump reaches maximum frequency.

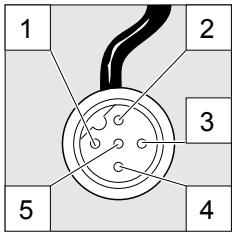


Fig. 16: Assignment on the cable

Pin	Function	5-wire cable	2-wire cable
1	Pause	brown	bridged at pin 4
2	External contact	white	brown
3	mA input*	blue	-
4	Earth GND	black	white
5	Auxiliary capacity / Auxiliary frequency	grey	-

* with identity code characteristic "Control version": 3

Refer to the functional description for the sequence of functions and operating modes.

"Pause" function

The pump works if:

- pin 1 and pin 4 are connected to each other and the cable is connected.
- no cable is connected.

The pump does not work if:

- pin 1 and pin 4 are open and the cable is connected.

Acknowledge fault with 'Pause'

Certain errors requiring acknowledgement can also be acknowledged using 'Pause' instead of using the [P] key. These are errors like: 'Flow', 'Air lock', 'p-' (as soon as the conditions are in order).

"External contact" operating mode

The pump performs one or more strokes if:

- Pin 2 and pin 4 are connected to each other for at least 20 ms. At the same time, pin 1 and pin 4 must also be connected to each other.

"Analog" operating mode

The pump capacity and/or stroke rate can be controlled by a current signal. The current signal is connected between pin 3 and pin 4.

Pin 1 and pin 4 must also be connected.

"Auxiliary capacity" / "Auxiliary frequency" operating mode

The pump works at a pre-set capacity / stroke rate if:

- Pin 5 and pin 4 are connected to each other. At the same time, pin 1 and pin 4 must also be connected to each other. The auxiliary capacity / auxiliary frequency is factory-preset to maximum capacity / stroke rate.

9.3.2 "Level switch" terminal

There is a connecting option for a 2-stage level switch with pre-warning and limit stop or a suction lance with continuous level measurement.

9.3.2.1 Suction lance with 2-stage level switch

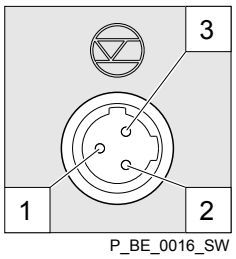


Fig. 17: Assignment on the pump

Electrical interface

Data	Value	Unit
Voltage with open contacts	5	V
Input resistance	10	kΩ

Control via:

- potential-free contact (load: 0.5 mA at 5 V) or
- semiconductor switch (residual voltage < 0.7 V)

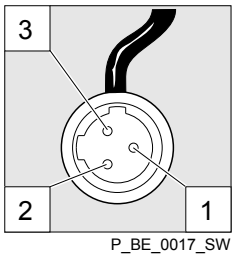


Fig. 18: Assignment on the cable

Pin	Function	3-wire cable
1	Earth GND	black
2	Minimum pre-warning	blue
3	Minimum limit stop	brown

9.3.3 "Metering monitor" terminal

There is a connecting option for a metering monitor.

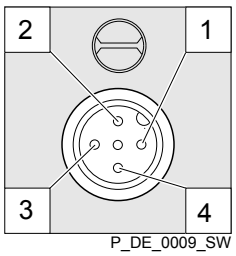


Fig. 19: Assignment on the pump

Electrical interface

Data	Value	Unit
Voltage with open contacts	5	V
Input resistance	10	kΩ

Control via:

- potential-free contact (load: 0.5 mA at 5 V) or

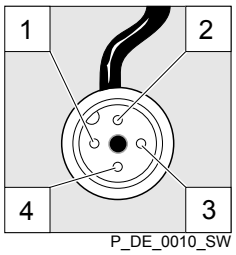


Fig. 20: Assignment on the cable

Pin	Function	4-wire cable
1	Power supply (5 V)	brown
2	Coding	white
3	Feedback	blue
4	Earth GND	black

9.3.4 "Diaphragm rupture indicator" terminal

There is a connecting options for a diaphragm rupture indicator.

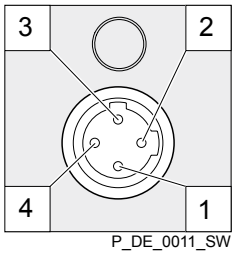


Fig. 21: Assignment on the pump

Electrical interface

Specification	Value
Supply voltage, approx.:	+5 V, can be loaded to 20 mA (current limitation 150 mA)
Power consumption:	min. 10 mA, max. 20 mA (sensor presence detection)
Sensor signal:	potential-free contact (load: 0.5 mA at +5 V) or semiconductor switch (residual voltage < 0.3 V)

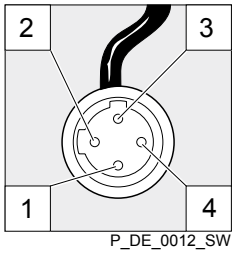


Fig. 22: Assignment on the cable

Pin	Function	4-wire cable
1	Power supply (5 V)	brown
2	not assigned	white
3	Sensor signal	blue
4	Earth GND	black

9.3.5 Relay

9.3.5.1 Relay functions

Tab. 4: gamma/ X GMXa

Identity code	Designation	Type	Maximum voltage	Maximum current	Operational lifetime Min. switching operations
0	no relay	-	-	-	-
1	Fault indicating relay, N/C	Changeover contact	230 V AC	6 A	50 000
4	Fault indicating relay, N/C	N/C	24 V DC	1 A	50 000
	Pacing relay, normally open	N/O	24 V DC	100 mA	unlimited
C	4-20 mA current output	-	-	-	-
	Fault indicating relay, N/C	N/C	24 V DC	100 mA	unlimited
F	Automatic bleeding	Changeover contact	230 V AC	6 A	50 000
G	Automatic bleeding	N/O	24 V DC	1 A	50 000
	Fault indicating relay, N/C	N/C	24 V DC	100 mA	unlimited

Relay type

You can reprogram the relays to these types:

Menu setting	Effect
Timer	The relay switches when requested by the timer.
Fault	The relay switches in the event of an error message (red LED*).

Menu setting	Effect
Warning	The relay switches in the event of a warning message (yellow LED*).
Warning + error (fault indicating relay)	The relay switches in the event of a warning message (yellow LED*) or an error message (red LED*).
Warning + error + stop	The relay switches in the event of a warning message (yellow LED*), when stopped by *[Start/Stop]* or in the event of a fault message (red LED*).
Pump active	The relay switches as soon as the pump is in standby and not stopped and not in a state like *'Pause'* or if an error is pending. In the opposite case, the relay switches back again.
Stroke rate** (pacing relay)	The relay switches with every stroke.
Cycle quantity** (pacing relay)	The relay always switches when the set cycle quantity has been reached.
Metering / Batch	The relay changes its state as soon as a batch has been processed.
Degassing***	The relay opens an optionally installed bleed valve as soon as the control activates it.

* see the "Troubleshooting" chapter

** only use *'Relay 2'* for this relay type (semiconductor relay).

*** only use *'Relay 1'* for this relay type.

Relay polarity

You can set here how a relay is to switch.

Menu setting	Effect
N/C	The relay is closed in normal mode and opens with a triggering event. (N/C)
N/O	The relay is open in normal mode and closes with a triggering event. (N/O)

9.3.5.2 "Fault indicating relay" output (identity code 1)

A fault indicating relay can be ordered as an option - refer to ordering information in the appendix. It is used to emit a signal when there is a fault with the pump and for the "Liquid level low, 1st stage" warning message and "Liquid level low 2nd stage" fault message.

The fault indicating relay can be retrofitted and is operational once attached to the relay board - refer to "Retrofitting relays" supplementary operating instructions.

The behaviour is factory-programmed. If another switching function is wished, the pump can be reprogrammed in the *'Relay'* menu.

The relay can be retrofitted and is operational once it has been plugged into the relay board.

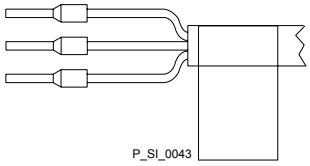
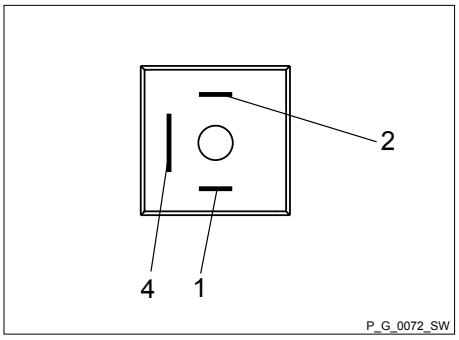


Fig. 23: Assignment on the cable

Identity code 1



To pin	VDE cable	Contact	CSA cable
1	white	N/O (normally open)	white
2	Green	N/C (normally closed)	red
4	brown	C (common)	black

Fig. 24: Assignment on the pump

9.3.5.3 Output for other relays (identity code 4)

A fault indicating and a pacing relay can be ordered as options - refer to ordering information in the appendix. The pacing output is electrically isolated by means of an optocoupler with a semiconductor switch. The second switch is a relay (also electrically isolated).

The behaviour is factory-programmed. If another switching function is wished, the pump can be reprogrammed in the *'Relay'* menu.

The fault indicating/pacing relay can be retrofitted and is operational once attached to the relay board - refer to the "Retrofitting relays" supplementary instructions.

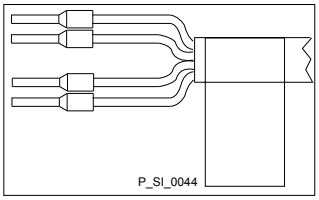


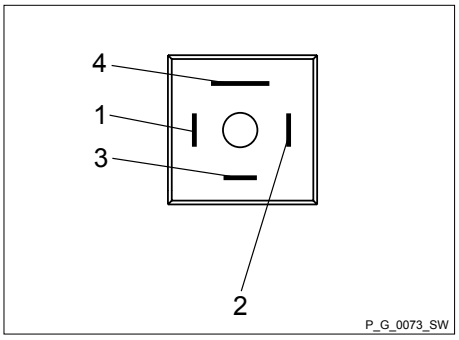
Fig. 25: Assignment on the cable

Electrical interface

for semiconductor switch pacing relay:

Data	Value	Unit
Max. residual voltage at $I_{off\ max}$ = 1 µA	0.4	V
Pacing pulse duration, approx.	100	ms

Identity code 4



To pin	VDE cable	Contact	Relay
1	yellow	N/O (normally open)	Relay 1
4	Green	C (common)	Relay 1
3	white	N/O (normally open)	Relay 2
2	brown	C (common)	Relay 2

Fig. 26: Assignment on the pump

9.3.5.4 "Current output plus relay" output (identity code C)

A relay combined with a current output can be ordered as an option. The relay either switches as a fault indicating relay in the event of a fault on the pump and with "Liquid level low 1st stage" warning message and "Liquid level low 2nd stage" fault messages or is used as a pacing relay.

The behaviour is factory-programmed. If another switching function is wished, the pump can be reprogrammed in the *'Relay'* menu.

The variable to be signalled for the current output can be selected in the *'ANALOGUE OUTPUT'* menu.

The current output plus relay can be retrofitted and operates once it is plugged into the board.

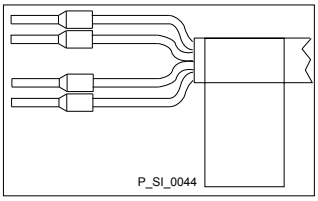


Fig. 27: Assignment on the cable

Electrical interface

for current output

Data	Value	Unit
Open circuit voltage:	8	V
Current range:	4 ... 20	mA
Ripple, max.:	80	µA ss
Load, max.:	250	Ω

for semiconductor switch ("relay"):

Data	Value	Unit
Max. residual voltage at $I_{off\ max}$ = 1 µA	0.4	V
Pacing pulse duration, approx.	100	ms

Identity code c

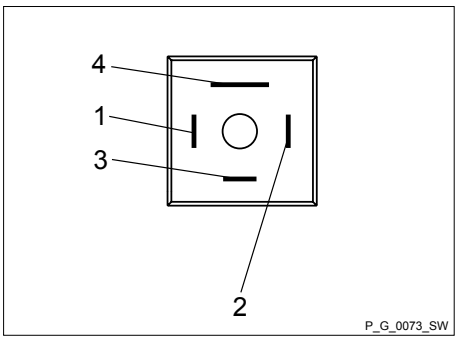


Fig. 28: Assignment on the pump

To pin	VDE cable	Contact	Relay
1	yellow	"+"	Current output
4	Green	“-"	Current output
3	white	N/C (normally closed) or N/O (normally open)	Relay
2	brown	C (common)	Relay

10 Basic set-up principles

– *Please also refer to all the overviews covering "Operating/set-up overview" and "Operating menu for gamma/ X, complete" in the appendix and the "Overview of equipment and control elements" and "Control elements" chapters.*
– *The pump exits the menu and returns to a continuous display if [Menu] is pressed or no key is pressed for 60 seconds.*

10.1 Basic principles for setting up the control



Fig. 29: Please read

Fig. 30 shows using the "Language" example how to set up something - in turn:

- Sequence of displays
- The path derived from this
- The path as presented in the operating instructions

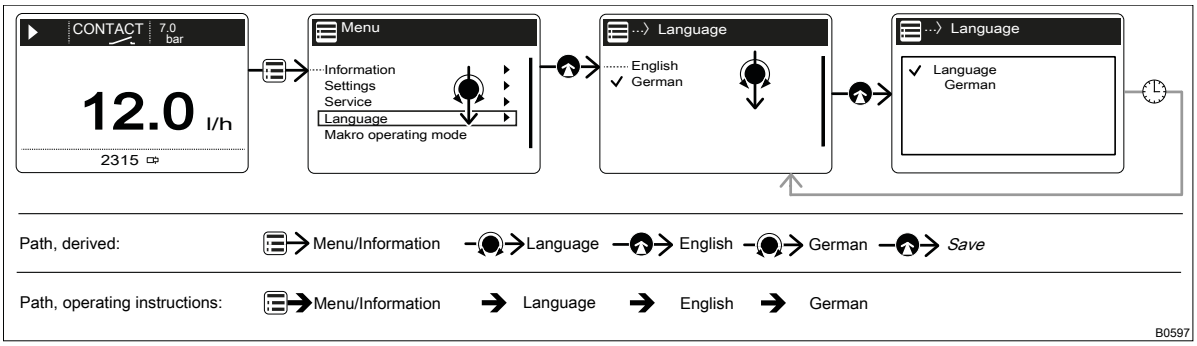


Fig. 30: "Setting up the language": As an example of set-up and path displays

Tab. 5: Legend:

Symbol	Explanation
	Press *[Menu]*
	Turn the *[Clickwheel]*
	Press the *[Clickwheel]*

"Setting up the language" in detail

1. To access the *'Menu'*: press the *[Menu]* key.
   ⇨ The cursor immediately points to *'Information'*.
2. To switch from *'Information'* to *'Language'*: turn the *[Clickwheel]*.
3. To return to the *'Language'* menu: press the *[Clickwheel]*.
   ⇨ The cursor points to a language.
4. To switch to *'Deutsch'*: turn the *[Clickwheel]*.
5. To save: press the *[Clickwheel]*.
   ⇨ The software shows a display by way of confirmation.
   After 2 seconds, it returns to the higher-level *'Menu'*.
6. To complete the setting: press *[]* Menu.
   Alternatively: wait 60 seconds or exit the *'Menu'* via the *[Menu]* key or using *'End'*.

Confirming an entry

Briefly press the *[Clickwheel]*.

⇨ The software switches to the next menu point or back to the menu and saves the entry.

Exiting a menu option without confirming it

Press *[Back]*.

⇨ The software switches to the next menu point or back to the menu without saving anything.

Returning to a continuous display

Press *[Menu]*.

⇨ The software cancels the entry and switches to a continuous display without saving anything.

Changing adjustable variables

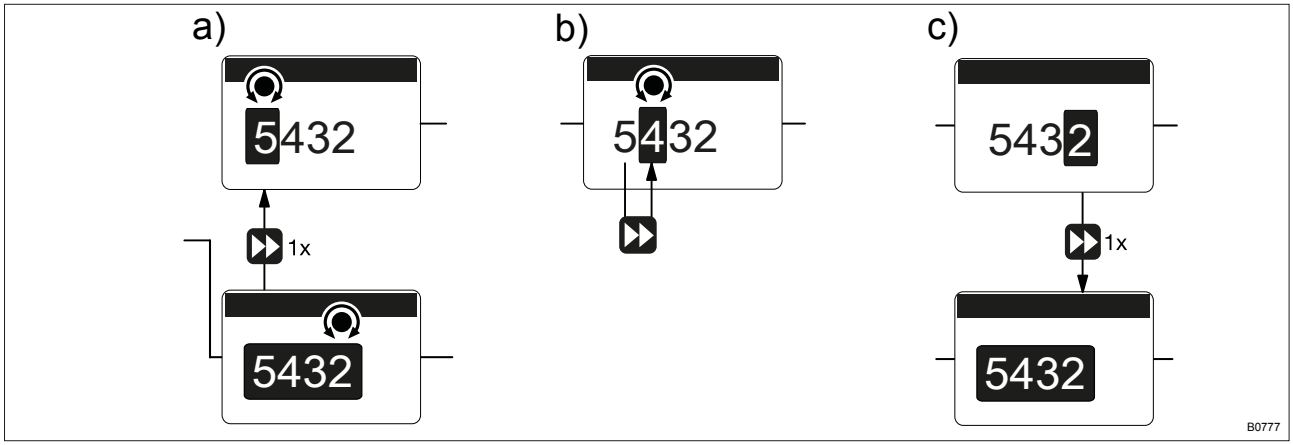


Fig. 31: a) Changing from one figure to its initial figures; b) Changing the figure; c) Returning from the last figure to the (complete) figure (to correct a wrong figure, for example).

Changing a (complete) number

Turn the *[Clickwheel]*.

⇨ The value of the figure highlighted is raised or lowered.

Changing figures

1. To adjust the value of a figure digit-by-digit, press *[Priming]*.

   ⇨ The first figure is highlighted - see Figure above, point a)

2. To adjust the value of a figure, turn the *[Clickwheel]*.
3. To move to the next figure, press *[Priming]* - see above Figure, point b).
4. To run through the figures again, if necessary (possibly because of an incorrect figure), when you get to the last figure press *[Priming]* again - see above Figure, point c).

   ⇨ Now you can start from the beginning again.

Confirming adjustable variables

→ Press the *[Clickwheel]* 1x.

⇨ The software saves the entry.

10.2 Checking adjustable variables

Continuous displays

Before adjusting the pump, you can check the current settings of the adjustable variables:

→ Simply turn the *[Clickwheel]* if the pump is showing a continuous display.

⇨ Each time the *[Clickwheel]* engages when you turn it, you will see a different continuous display.



The number of continuous displays depends on the identity code, the selected operating mode and the connected additional devices – see overview of "Continuous displays" in the appendix.

Secondary displays

The lowest line of a continuous display shows different information (which cannot be adjusted in the secondary display) - see "Continuous displays and secondary displays" overview in the appendix.

You can access secondary displays via any continuous display as follows:

1. → Press the *[Clickwheel]* for 3 seconds.

⇨ A frame appears around the secondary display.

2. → Providing there is a frame, you will see a different secondary display each time the *[Clickwheel]* engages when turned.

When you reach the secondary display you wish, leave the *[Clickwheel]* and wait briefly.

10.3 Changing to Setting mode

In a continuous display, if you press *'Menu'*, the pump in Setting mode changes to *'Menu'*. For more information refer to the following chapter entitled "Set up / Menu".

If under *'Access protect.'* only *'Menu'* or *'All'* has been set up (top right lock symbol), then after pressing the *[Clickwheel]*, first enter the *'Password'*.

11 Set up / *'Menu'*



- *Refer to the overviews covering "Operating/set up overview" and "Operating menu gamma/ X, complete" in the appendix and in the "Overview of equipment" and "Control elements" chapters.*
- *The pump exits the menu and returns to a continuous display if [Menu] is pressed or if no key is pressed for 60 seconds.*

The *'Menu'* is sub-divided as follows:

1 - *'Information'*

2 - *'Settings'*

3 - *'Timer'*

4 - *'Service'*

5 - *'Language'*

11.1 *'Information'*

→ *'Menu / Information → ...'*

The *'Information'* provides information on your pump and certain parameters and counters. The number and type can depend on the pump settings.

11.2 *'Settings'*

→ *'Menu / Information → Settings → ...'*

The *'Settings'* menu generally includes these setting menus:

1 - *'Operating mode'*

2 - *'Automatic'*

3 - *'Stroke length'*

4 - *'Metering'*

5 - *'Concentration'*

6 - *'Calibrate'*

7 - *'System'*

8 - *'Inputs/outputs'*

9 - *'Config I/O'*

10 - *'Bleeding'*

11 - *'Priming time'*

12 - *'Set time'*

13 - *'Date'*

11.2.1 *'Operating mode'*

→ *'Menu / Information → Settings → Operating mode → ...'*

11.2.1.1 *'Manual'*

→ *'Menu / Information* → *Settings* → *Operating mode* → *Manual'*

'Manual' operating mode allows you to operate the pump manually.

The capacity and/or stroke rate and stroke length can be set in the continuous displays in this operating mode.

11.2.1.2 *'Contact'*

→ *'Menu / Information* → *Settings* → *Operating mode* → *Contact* → *...'*

'Contact' operating mode allows you to trigger individual strokes or a series of strokes.

You can trigger the strokes via a pulse sent via the "External control" terminal.

The purpose of this operating mode is to convert the incoming pulses into strokes with a step-down (fractions) or small step-up or also 1:1.

CAUTION!

The pump maintains the stroke rate when changing over from *'Manual'* operating mode to *'Contact'* operating mode.

The maximum stroke rate can be set in 'Contact' operating mode. It should normally be set to 12,000 strokes/hour.

Contact - adaptive

If the gaps between the pulses (e.g. from contact water meter) slowly change, you can set the pump to *'Adaptive* → *On'* - the pump will then meter more evenly.

Memory - Pulses not yet processed

You can also activate the *'Memory'* function extension ("memory" identifier). When *'Memory'* is activated, the pump adds up the remaining strokes , which could not be processed, up to the maximum capacity of the stroke memory of 999,999 strokes. If this maximum capacity is exceeded, the pump goes into fault mode.

CAUTION!

– Only with *'Memory'* - *'off'*: If you press *[STOP/START]* or empty the contact memory (*'Menu / Information* → *Service* → *Clear counters'*) or the "Pause" function is activated, the *'Memory'* is cleared.

(*'Automatic'* *'Off'*) factor

The number of strokes per pulse depends on the factor which you can input. By using a factor you can multiply incoming pulses by a factor between 1.01 to 99.99 or reduce them by a factor of 0.01 to 0.99:

```
Number of strokes executed = factor x number of
incoming pulses
```

Table of examples

	Factor	Pulse (sequence)	Number of strokes (sequence)
Step-up*			
	1	1	1
	2	1	2
	25	1	25
	99.99	1	99.99
	1.50	1	1.50 (1 / 2)
	1.25	1	1.25 (1 / 1 / 1 / 2)
Step-down**			
	1	1	1
	0.50	2	1
	0.10	10	1
	0.01	100	1
	0.25	4	1
	0.40	2.5 (3 / 2)	(1 / 1)
	0.75	1.33 (2 / 1 / 1)	(1 / 1 / 1)

*Tab. 6: * Explanation of the conversion ratio*

With a factor of 1	... 1 stroke is executed per 1 pulse
With a factor of 2	... 2 strokes are executed per 1 pulse
With a factor of 25	... 25 strokes are executed per 1 pulse

*Tab. 7: ** Explanation of step-down*

With a factor of 1	... 1 stroke is executed per 1 pulse.
With a factor of 0.5	...1 stroke is executed after 2 pulses.
With a factor of 0.1	...1 stroke is executed after 10 pulses.
With a factor of 0.75	...1 stroke is executed once after 2 pulses, then 1 stroke is executed twice after 1 pulse, and then again 1 stroke after 2 pulses etc.

If a remainder is obtained when dividing by the factor, then the unit adds the remainders together. As soon as this sum reaches or exceeds "1", the pump executes an additional stroke. Therefore on average during the metering operation, the resultant number of strokes precisely matches the factor.

Metering volume (*'Automatic' 'On'*)

Analogue applies to the *'Metering volume'* and to the *'Factor'*.

Contact water meter

Using "Pulse control" you can ideally adapt the pump to the relevant process, for example in conjunction with contact water meters.

11.2.1.3 *'Batch'*

→ *'Menu / Information* → *Settings* → *Operating mode* → *Batch* → *...'*

The *'Batch'* operating mode enables you to pre-select large metering volumes.

You can only select whole numbers but no fractions as the number of strokes (figures 1 to 99,999).

You can trigger the strokes using the *[Clickwheel]* if you have already switched to the *'Push'* continuous display. You can also trigger them via a pulse using the "External control" terminal.

The stroke rate can be set in 'Batch' operating mode. It should normally be set to 12,000 strokes/hour.

Memory - remaining strokes not yet processed

You can also activate the *'Memory'* function extension ("memory" identifier). When *'Memory'* is activated, the pump adds up the remaining strokes , which could not be processed, up to the maximum capacity of the stroke memory of 999,999 strokes. If this maximum capacity is exceeded, the pump goes into fault mode.

CAUTION!

– The pump maintains its stroke rate when changing over from *'Manual'* operating mode to *'Batch'* operating mode.
– When you press *[STOP/START]* or the "Pause" function is activated, the *'Memory'* is cleared.

In operation, the batch size can be changed more easily by using the "Batch size" continuous display.

11.2.1.4 *'Analogue'* (optional)

→ *'Menu / Information* → *Settings* → *Operating mode* → *Analogue* → *...'*

The secondary display "Signal current" indicates the incoming current.

You can select 5 types of current signal processing:

- *'0 - 20 mA'*
- *'4 - 20 mA'*
- *'Linear curve '*
- *'Lower side band'*
- *'Upper side band'*

'0 - 20 mA'

At 0 mA the pump is stationary –

At 20 mA the pump works at maximum stroke rate.

'4 - 20 mA'

At 4 mA the pump is stationary –

At 20 mA the pump works at maximum stroke rate.

With current signals of less than 3.8 mA, an error message appears and the pump stops (e.g. if a cable has broken).

'Linear curve'

The symbol "Linear curve" appears on the LCD screen. You can enter any pump stroke rate behaviour proportional to the current signal. For this purpose, enter any two points P1 (I1, F1) and P2 (I2, F2) (F1 is the stroke rate at which the pump is to operate at current I1, F2 is the stroke rate at which the pump is to operate at current I2...); this defines a straight line and thus the behaviour is specified:

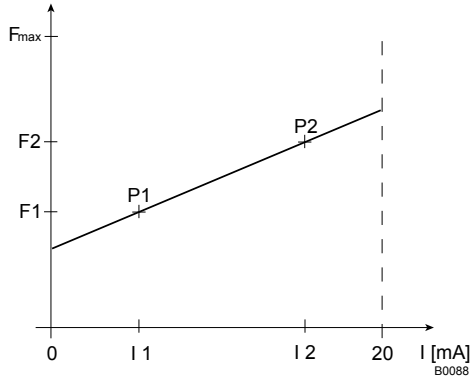


Fig. 32: Frequency-current diagram for "Linear curve"

Plot a diagram similar to the one above – with values for (I1, F1) and (I2, F2) – so that you can set the pump as desired!

The smallest processable difference between I1 and I2 is 4 mA (|| I1-I2 || ≥4 mA).

Error processing

In the *'Error message'* menu item, you can activate an error process for these types of processing.

'Lower side band'

Using this type of processing, you can control a metering pump using the current signal as shown in the diagram below.

However, you can also control two metering pumps for different feed chemicals via a current signal (e.g. one acid pump and one alkali pump using the signal of a pH sensor). To do this, connect the pumps electrically in series.

Error processing

In the *'Error message'* menu item, you can activate an error process for these types of processing.

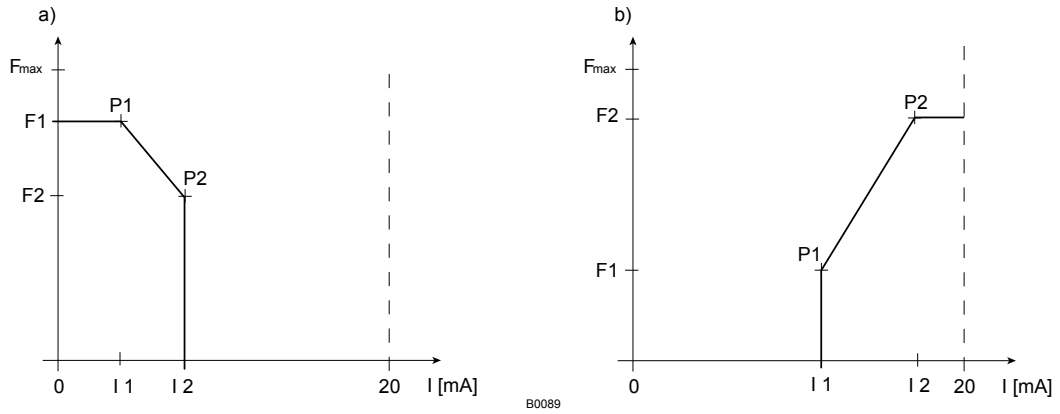


Fig. 33: Frequency-current diagram for a) Lower side band, b) Upper side band

'Upper side band'

Using this processing type, you can control a metering pump using the current signal as shown in the diagram above.

Everything functions according to the *'Lower side band'* type of the processing.

11.2.2 *'Automatic'*

☰ ➔ *'Menu / Information ➔ Settings ➔ Automatic ➔ ...'*

The *'Automatic'* menu lets you set whether the unit is to meter automatically or conventionally.

'Automatic' - 'on' lets you set direct values, such as capacity, metering volume or dosing time, instead of stroke length and stroke rate. Other selection points then appear in the operating menu - refer to the chapter "Operating menu gamma/ X, complete" (in the appendix) for the selection points highlighted with a "*1".

In *'Automatic' - 'on'* metering mode, the gamma/ X specifies the stroke length and the stroke rate according to the conditions determined in order to meter the set capacity.

'Automatic' - 'on' and 'Automatic' - 'off' metering modes are completely independent of each other. That is to say that 'Automatic' - 'off' metering mode does not carry over settings from 'Automatic' - 'on'.

Tab. 8: Setting ranges

	'Automatic' - 'on'	***'Automatic' - 'off'***
Manual, continuous	1:2,000	1:2,000
Manual, discontinuous	1:40,000	1:40,000

11.2.3 *'Stroke length'*

☰ ➔ *'Menu / Information ➔ Settings ➔ Stroke length ➔ ...'*

The menu does not appear with *'Automatic' 'on'*!

In the *'Stroke length'* menu, you can enter the stroke length manually.

In operation, the stroke length can be changed more easily via the "Stroke length" continuous display:

- *Turn the [Clickwheel] to return to the "Stroke length" continuous display.*
- *Press the [Clickwheel] and then turn it to set the stroke length.*
- *Press the [Clickwheel] to save the stroke length.*

11.2.4 Dosing

➔ *'Menu / Information ➔ Settings ➔ Metering ➔ ...'*

11.2.4.1 *'Discharge stroke'*

➔ *'Menu / Information ➔ Settings ➔ Metering ➔ Discharge stroke ➔ ...'*

In the *'Settings'* - *'Discharge stroke'* sub-menu, you can precisely match the pump metering flow over time to the requirements of the particular application.

This ensures that the user can set the optimum **discharge stroke** for his application, as required:

Pos.*	Discharge stroke	Application
A.	*'optimum'*	For maximum precision when metering and the very best results with internal pressure measurement and special functions.
B.	*'fast'*	For as fast a discharge stroke as possible - the duration of the discharge stroke is dependent on the stroke rate.
C.	*'s fast'*	For as fast a discharge stroke as possible - the duration of the discharge stroke is dependent on the stroke rate.
D.	*'sine mode'*	The duration of the discharge stroke is dependent on the stroke rate for a long, sine-shaped pressure stroke.
E.	*'continuous'*	For a continuous discharge stroke e.g. for bottling processes. The duration of the discharge stroke is dependent on the stroke rate.
F.	*'DFMa'*	For optimum operation with a flow meter DulcoFlow® DFMa.

* see following drawing.

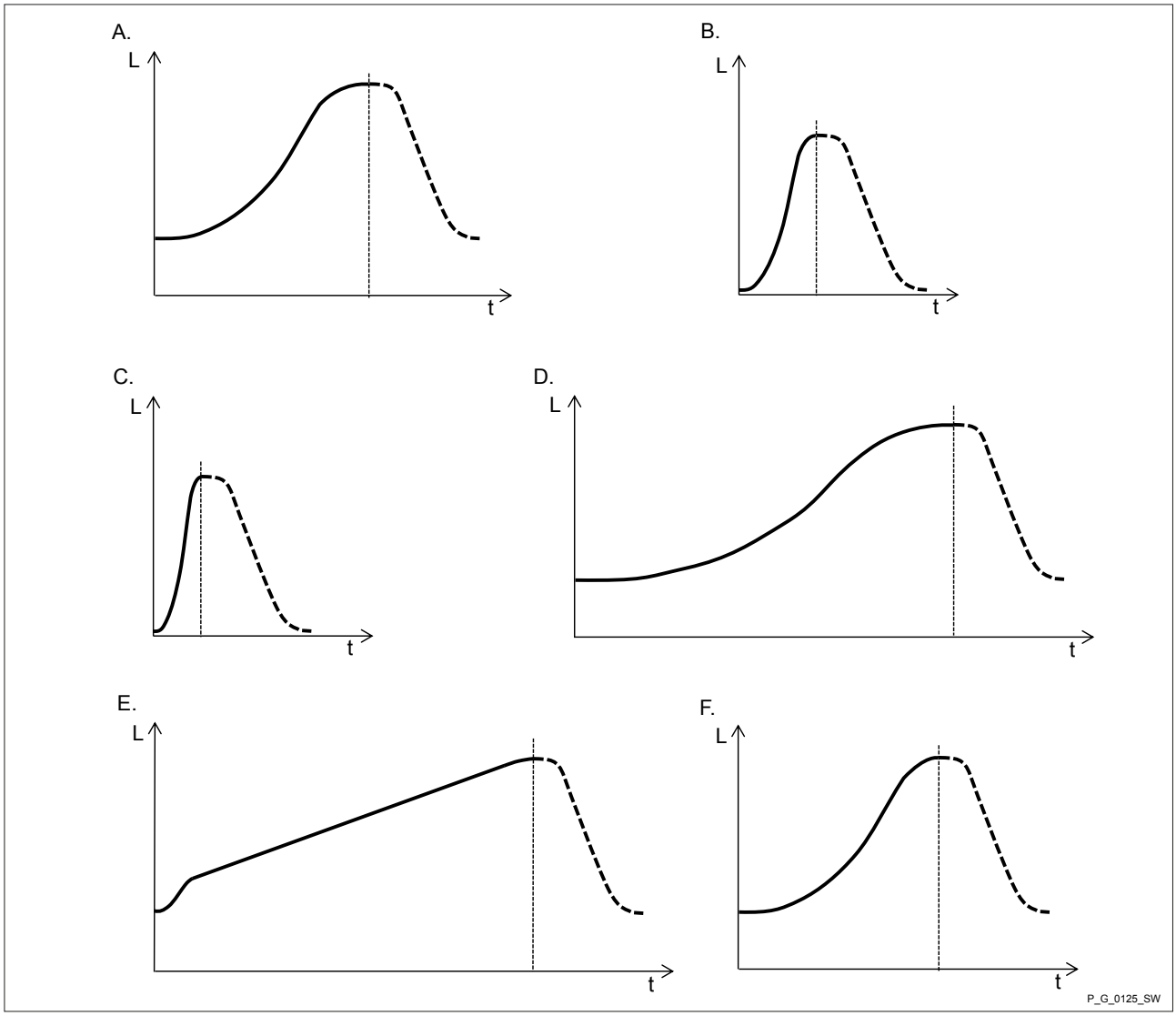


Fig. 34: Discharge stroke metering profiles with stroke L and time t (suction stroke shown as a dotted line)

11.2.4.2 *'Suction stroke'*

☰ ➔ *'Menu / Information ➔ Settings ➔ Metering ➔ Suction stroke ➔ ...'*

It is possible to selectively also slow the **suction stroke** with all these metering profiles for the discharge stroke - see . In this way, it is possible to prevent the main cause of inaccurate metering with high viscosity feed chemicals, namely the incomplete filling of the liquid end. With gaseous feed chemicals, the slow suction stroke prevents cavitation and consequently increases dosing precision.

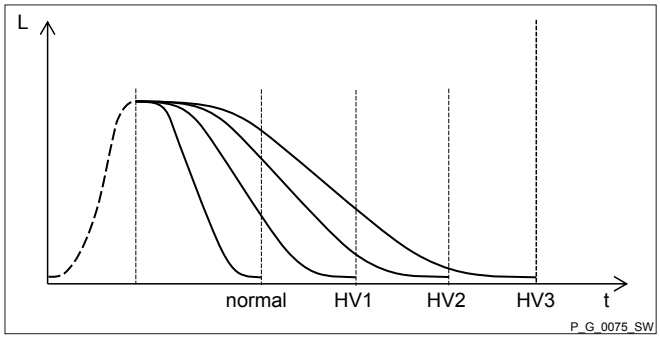


Fig. 35: Suction stroke metering profiles with stroke L and time t

Normal	Normal suction stroke
HV1	Suction stroke for viscous feed chemical
HV2	Suction stroke for average viscosity feed chemical
HV3	Suction stroke for high-viscosity feed chemical

– *Slowing down the suction stroke leads to a lower stroke rate and thus to a lower capacity.*

'Suction stroke' setting	Maximum stroke rate Strokes/min
Normal	200
HV1	160
HV2	120
HV3	80

11.2.4.3 *'Pressure stage'*

➔ *'Menu / Information ➔ Settings ➔ Metering ➔ Pressure stage ➔ ...'*

You can use the programmable *'Pressure stage'* function to reduce the nominal pressure of the pump, thereby minimising the risk of lines rupturing.

The switch-off pressure of the permanently active overpressure monitoring falls at the same time as the pressure stage - see .

Tab. 9: Nominal pressures depending on the size of the liquid ends and the pressure stages

Pressure stage /	4	7	10	16	20	25
Size of liquid end						
1602	X	X	X	X	-	-
2002	X	X	X	-	X	-
1604	X	X	X	X	-	-
2504	X	X	X	-	-	X

Pressure stage /	4	7	10	16	20	25
Size of liquid end						
1009	X	X	X	-	-	-
708	X	X	-	-	-	-
715	X	X	-	-	-	-
414	X	-	-	-	-	-
424	X	-	-	-	-	-

Switch-off pressure

Switch-off pressure: Pressure above which the unit is switched off for the medium term in the event of excess pressure = Pressure state plus 10 ... 20 %.

11.2.4.4 *'Monitoring'*

☰ ➔ *'Menu / Information ➔ Settings ➔ Metering ➔ Monitoring ➔ ...'*

11.2.4.4.1 *'Air lock'*

☰ ➔ *'Menu / Information ➔ Settings ➔ Metering ➔ Monitoring ➔ Air lock ➔ ...'*

Should a message and the "Air lock" symbol appear, this may mean that there is gas in the liquid end (if *'Warning'* or *'Error'* was set in the *'Air lock'* sub-menu).

11.2.4.4.2 *'Air sensitivity'*

☰ ➔ *'Menu / Information ➔ Settings ➔ Metering ➔ Monitoring ➔ Air sensitivity ➔ ...'*

Using the *'Air sensitivity'* programmable function, you can adjust the sensitivity of air detection a little to receive as few incorrect alarms as possible.

Tab. 10: There are 3 levels of sensitivity:

normal	maximum sensitivity
average	average sensitivity
weak	lowest sensitivity. Only use at pressures of < 2 bar.

11.2.4.4.3 Message with overpressure

You can have the pump output a message in the event of overpressure using the programmable *'Message with overpressure'* function.

11.2.4.4.4 Message when no pressure

You can have the pump output a message in the event of no pressure using the programmable *'Message with no pressure'* function.

11.2.4.4.5 Cavitation

You can have the pump output a message in the event that it identifies cavitation using the programmable *'Cavitation'* function.

11.2.4.5 Compensation

Only with *'Automatic'* OFF operating mode: Using the *'Compensation'* programmable function, you can minimise the influence of back pressure oscillations and thus achieve a high level of dosing precision.

With difficult hydraulic conditions, it may be better to switch off the 'Compensation' function.

11.2.5 Concentration

➔ *'Menu / Information* ➔ *Settings* ➔ *Concentration* ➔ *...'*

The desired mass concentration of feed chemical that will subsequently be required in the dissolving medium (e.g. the main flow) can be entered directly in the "Concentration" continuous display.

The principle of entering the concentration:

1. Select the operating mode.
2. Set the data for the feed chemical and dissolving medium in the *'Set up'- 'Concentration'* menu.
3. Set the desired concentration in the "Concentration" continuous display.

- *The "Concentration" continuous display only appears, if:*
  - *the pump is calibrated.*
  - *the 'Concentration' menu was run through in the operating mode used.*
  - *and 'Concentration control' was switched to 'active' - in the operating mode being used.*
- *The "Concentration" continuous display switches to the display mode "%" at concentrations above 999.99 ppm.*
- *When changing between operating modes, the pump saves the settings for each operating mode - providing it is connected to supply voltage.*
- *If the pump is to display the concentration as a volume concentration, enter "1.00" kg/l for the density of the feed chemical.*

11.2.5.1 *'Manual'* operating mode (settings for the *'Concentration'* function)

☰ ➔ *'Menu / Information* ➔ *Settings* ➔ *Concentration* ➔ *Concentration control* ➔ *Flow of main medium* ➔ *...'*

The "Concentration input" in *'Manual'* operating mode is intended for metering a substance into pipework containing a medium flowing at a constant rate (*'main flow'*) in such a way that it has a specific mass concentration in the flow.

CAUTION!
Danger of too high concentrations
The metering pump can continue to meter if the flow falls or stops entirely.

– Take system-based precautions to prevent the metering pump from continuing to meter in these circumstances.

The prerequisites are that:

- the flowing medium has the same density as water (1 kg/l ≙ g/cm³)
- the mass concentration of the feed chemical is known - see the feed chemical safety data sheet (e.g. with 35% sulphuric acid: 35 %)
- the density of the feed chemical is known - see the feed chemical safety data sheet (e.g. with 35% sulphuric acid: 1.26 kg/l ≙ g/cm³)
- The measurement unit for the liquid volume is set in the *'System* ➔ *Volume unit'* menu.

Procedure

CAUTION!
The precision of the concentration is strongly dependent on:

– the precision of the metering pump calibration.
– the precision of the inputs.

1. Calibrate the metering pump if it is not yet calibrated - see chapter *'Settings'*- *'Calibration'* chapter.
2. Check whether the metering pump is set to *'Automatic'* - *'on'* metering mode.
3. Select *'Manual'* - *'Operating mode'* (possible settings from other operating modes remain saved.).
4. Select *'Concentration'* in the *'Set up'* menu.
5. Set *'active'* in the *'Concentration control'* menu item and press the *[Clickwheel]*.
6. Set the *'Main medium flow'* (in the pipework) and then press the *[Clickwheel]*.
7. Set the *'Feed chemical mass concentration'* and press the *[Clickwheel]*.
8. Set the (mass) *'Feed chemical density'* and press the *[Clickwheel]*.
   ⇨ The *'Concentration'* menu appears.
9. Press *[Menu]* ☰.
   ⇨ A continuous display appears.
10. Press the *[Clickwheel]* to go to the "Concentration" continuous display (ppm or %).
11. Enter the required mass concentration of the feed chemical in the main flow by pressing and turning the *[Clickwheel]*.

Tab. 11: Possible values of adjustable variables

Adjustable variable	Lower value	Upper value	Increment
Flow in m^3/h	0000.1	9999.9	0000.1
Mass concentration in %	000.01	100.00	000.01
Mass density in kg/l	0.50	2.00	0.01

11.2.5.2 *'Contact'* operating mode (settings on the *'Concentration'* function)

☰ ➔ *'Menu / Information* ➔ *Settings* ➔ *Concentration* ➔ *Concentration control* ➔ *Contact gap* ➔ *...'*

The "Concentration input" in *'CONTACT'* operating mode is intended for metering a substance into pipework containing a medium flowing at a variable rate in such a way that it has a specific mass concentration in the flow.

CAUTION!
Danger of too high concentrations
The metering pump can continue to meter if the flow falls or stops entirely.

– Take system-based precautions to prevent the metering pump from continuing to meter in these circumstances.

The prerequisites are that:

- the flowing medium has the same density as water (1 kg/l ≙ g/cm^3)
- the mass concentration of the feed chemical is known - see the feed chemical safety data sheet (e.g. with 35% sulphuric acid: 35 %)
- the density of the feed chemical is known - see the feed chemical safety data sheet (e.g. with 35% sulphuric acid: 1.26 kg/l ≙ g/cm^3)
- a contact water meter is hydraulically installed and connected to the external input of the metering pump.
- The measurement unit for the liquid volume is set in the *'System* ➔ *Volume unit'* menu.

Procedure

CAUTION!
The precision of the concentration is strongly dependent on:

– the precision of the metering pump calibration.
– the precision of the inputs.

1. Calibrate the metering pump if it is not yet calibrated - see chapter *'Settings'*- *'Calibration'* chapter.
2. Check whether the metering pump is set to *'Automatic'* - *'on'* metering mode.
3. Select *'Contact'* - *'Operating mode'* and simply confirm the associated menu items with the *[Clickwheel]* (possible settings from other operating modes remain saved.)
4. Select *'Concentration'* in the *'Set up'* menu.
5. Set *'active'* in the *'Concentration control'* menu item and press the *[Clickwheel]*.
6. Set the *'Contact gap'* and press the *[Clickwheel]*.
7. Set the (mass) *'Feed chemical concentration'* and press the *[Clickwheel]*.

8. Set the (mass) *'Feed chemical density'* and press the *[Clickwheel]*.
   ⇨ The *'Concentration'* menu appears.
9. Press *[Menu]*.
   ⇨ A continuous display appears.
10. Press the *[Clickwheel]* to go to the "Concentration" continuous display (ppm or %).
11. You can enter the desired mass concentration using the *[Clickwheel]*.

Tab. 12: Possible values of adjustable variables

Adjustable variable	Lower value	Upper value	Increment
Contact gap in l/contact	000.10	999.99	000.01
Mass concentration in %	000.01	100.00	000.01
Mass density in kg/l	0.50	2.00	0.01

11.2.5.3 *'Batch'* operating mode (settings for the *'Concentration'* function)

'Menu / Information ➔ *Settings* ➔ *Concentration* ➔ *Concentration control* ➔ *Volume of main medium* ➔ *...'*

The "Concentration input" in *'Batch'* operating mode, is intended for metering a substance into the medium in a storage tank so that it then has a defined mass concentration in the storage tank (when batching a solution – do not forget to stir!).

The prerequisites are that:

- the medium in the storage tank has the same mass density as water (1 kg/l ≙ g/cm³)
- the mass concentration of the feed chemical is known - see the feed chemical safety data sheet (e.g. with 35% sulphuric acid: 35 %)
- the density of the feed chemical is known - see the feed chemical safety data sheet (e.g. with 35% sulphuric acid: 1.26 kg/l ≙ g/cm³)
- The measurement unit for the liquid volume is set in the *'System* ➔ *Volume unit'* menu.

Procedure

CAUTION!
The precision of the concentration is strongly dependent on:
– the precision of the metering pump calibration.
– the precision of the inputs.

1. Calibrate the metering pump if it is not yet calibrated - see *'Set up'* - *'Calibration'* chapter.
2. Check whether the metering pump is set to *'Automatic'* - *'on'* metering mode.
3. Select *'Batch'* - *'Operating mode'* and simply confirm the associated menu items with the *[Clickwheel]* (possible settings from other operating modes remain saved.)
4. Select *'Concentration'* in the *'Set up'* menu.
5. Set *'active'* in the *'Concentration control'* menu item and press the *[Clickwheel]*.
6. Set the *'Main medium volume'* of the medium in the storage tank and press the *[Clickwheel]*.

7. Set the (mass) *'Feed chemical concentration'* and press the *[Clickwheel]*.
8. Set the (mass) *'Feed chemical density'* and press the *[Clickwheel]*.
   ⇨ The *'Concentration'* menu appears.
9. Press *[Menu]*.
   ⇨ A continuous display appears.
10. Press the *[Clickwheel]* to go to the "Concentration" continuous display (ppm or %).
11. You can enter the desired mass concentration using the *[Clickwheel]*.

Tab. 13: Possible values of adjustable variables

Adjustable variable	Lower value	Upper value	Increment
Volume in l	0000.1	9999.9	0000.1
Mass concentration in %	000.01	100.00	000.01
Mass density in kg/l	0.50	2.00	0.01

11.2.5.4 *'Analogue'* operating mode (settings on the *'Concentration'* function)

'Menu / Information ➔ *Settings* ➔ *Concentration* ➔ *Concentration control* ➔ *Max. flow of main medium* ➔ *...'*

The "Concentration input" in *'Analogue'* operating mode is intended for metering a substance into pipework containing a medium flowing at a variable rate in such a way that it has a specific mass concentration in the flow.

CAUTION!
Risk of incorrect concentrations
– After adjusting, check whether the concentration at various flows corresponds to the required result.

The prerequisites are that:

- the flowing medium has the same density as water (1 kg/l ≙ g/cm³)
- the mass concentration of the feed chemical is known - see the feed chemical safety data sheet (e.g. with 35% sulphuric acid: 35 %)
- the density of the feed chemical is known - see the feed chemical safety data sheet (e.g. with 35% sulphuric acid: 1.26 kg/l ≙ g/cm³)
- a flow meter with analogue output is hydraulically installed and connected to the external input of the metering pump.
- The measurement unit for the liquid volume is set in the *'System* ➔ *Volume unit'* menu.

Procedure

CAUTION!
The precision of the concentration is strongly dependent on:
– the precision of the metering pump calibration.
– the precision of the inputs.

1. Calibrate the metering pump if it is not yet calibrated - see chapter *'Settings'- 'Calibration'* chapter.
2. Check whether the metering pump is set to *'Automatic'* - *'on'* metering mode.
3. Select *'Analogue'* operating mode and confirm with the *[Clickwheel]*.
4. Set *'0...20 mA'* or *'4..20 mA'* in the *'Select analogue'* menu item and press the *[Clickwheel]*.
5. Select *'Concentration'* in the *'Set up'* menu.
6. Set *'active'* in the *'Concentration control'* menu item and press the *[Clickwheel]*.
7. Set the *'Max. main medium flow'* (in the pipework) and press the *[Clickwheel]*. (It is then assigned to the current value of 20 mA).
8. Set the (mass) *'Feed chemical concentration'* and press the *[Clickwheel]*.
9. Set the (mass) *'Feed chemical density'* and press the *[Clickwheel]*.

   ⇨ The *'Concentration'* menu appears.
10. Press *[Menu]*.

    ⇨ A continuous display appears.
11. Press the *[Clickwheel]* to go to the "Concentration" continuous display (ppm or %).
12. You can enter the desired mass concentration using the *[Clickwheel]*.

CAUTION!

- Note the decimal point.
- The mass concentration is affected by changes in the stroke rate and the stroke length.
- The pump limits the upper value of the mass concentration, because otherwise the incremental jumps when adjusting would be unacceptably large. Adjust the stroke length as necessary - do not set it under 30%.

The least significant figures of the value in the continuous display cannot be changed at will using the [Arrow keys], rather only in incremental jumps resulting from the input data.

As necessary, change the stroke length and adjust the concentration; in doing so the pump compensates via the stroke rate.

Tab. 14: Possible values of adjustable variables

Adjustable variable	Lower value	Upper value	Increment
Max. flow in m^3/h	0000.1	9999.9	0000.1
Mass concentration in %	000.01	100.00	000.01
Mass density in kg/l	0.50	2.00	0.01

11.2.6 Calibration

'Menu / Information ➔ *Settings* ➔ *Calibration* ➔ *...'*

Calibration - precision

Normally the pump does not have to be calibrated.

However, the pump should be calibrated for precise metering.

With individual pumps in the product range, the capacity can systematically deviate by -5% to +10% from the specified capacity. A reproducibility of ±2 % from the specified capacity remains as a deviation after calibration.

Calibration influences the menu

In 'Auto' - 'off' dosing mode: Some menus only appear if the pump has been calibrated.

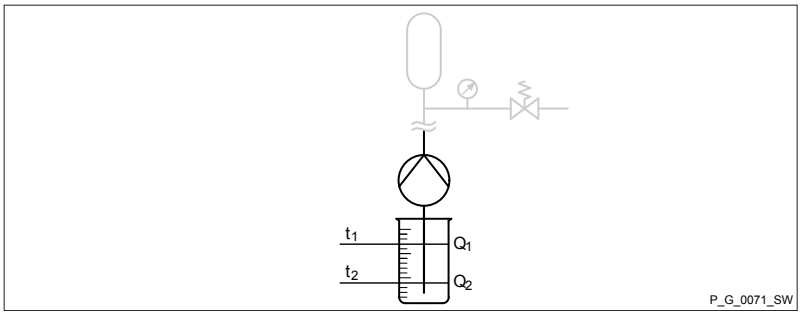
Calibration using a calibration factor

1. Select the *'Menu / Information* ➔ *Settings* ➔ *Calibration* ➔ *Calibration factor'* menu and press the *[Clickwheel]*.
   ⇨ The *'Calibration factor'* menu item appears.
2. Use the *[Clickwheel]* to enter the required *'Calibration factor'*.
   ⇨ The *'Calibration factor'* menu item appears for confirmation.

'Calibr. factory' = Actual value (measured) / Setpoint (required)

Calibration

WARNING!
If the feed chemical is hazardous, take appropriate safety precautions when performing the following calibration instructions. Observe the material safety data sheet for the feed chemical!



Preparation

1. Use the *[Clickwheel]* to scroll through the continuous display to check whether litres or gallons have been selected.
2. If the incorrect volume unit has been selected, correct it in the *'Menu / Information* ➔ *Settings* ➔ *System* ➔ *Volume unit'* menu.
3. Check whether the capacity or stroke rate in the continuous display is not too low for calibration.
4. Lead the suction hose into a measuring cylinder containing the feed chemical – make sure that the discharge hose is installed permanently (operating pressure, ...!).

5. Prime the feed chemical (press ⏭) *[Priming]*) if the suction hose is empty.

Calibration process

1. Record the level in the measuring cylinder.
2. Select the *'Menu / Information* ➔ *Settings* ➔ *Calibration* ➔ *Calibration'* menu and press the *[Clickwheel]*.
   ⇨ The *'Start calibration'* (PUSH) menu item appears.
3. To start calibration, press the *[Clickwheel]*.
   ⇨ The *'Calibrate ...'* menu item appears, the pump starts to pump and indicates the number of strokes.
4. After a reasonable number of strokes (a minimum of 200), use the *[Clickwheel]* to stop the pump.
   ⇨ The *'Calibration ended'* menu item appears. It requests you to enter the calibration volume.
5. Determine the required metering volume (difference between initial volume - remaining volume in the measuring cylinder).
6. Use the *[Clickwheel]* to enter this volume in the *'Calibration ended'* menu item and close.
   ⇨ The pump switches to the *'Calibration result'* menu item - the pump is calibrated.
7. Press the *[Clickwheel]*.
   ⇨ The pump returns to the *'Menu / Information* ➔ *Settings'* menu.

11.2.7 System

☰ ➔ *'Menu / Information* ➔ *Settings* ➔ *System* ➔ *...'*

The *'System'* menu splits into the following sub-menus:

1 - *'Dosing head'*
2 - *'Volume unit'*
3 - *'Pressure unit'*
4 - *'Pressure adjustment'*
5 - *'Start behaviour'*

11.2.7.1 *'Dosing head '*

☰ ➔ *'Menu / Information* ➔ *Settings* ➔ *System* ➔ *Dosing head* ➔ *...'*

CAUTION!
- Should a different liquid end size be fitted, then the pump must be reprogrammed in the *'Dosing head'* sub-menu.
- Reprogram the pump to *'No dosing head'* for demonstration purposes or if operating without feed chemical.

11.2.7.2 Volume unit

☰ ➔ *'Menu / Information* ➔ *Settings* ➔ *System* ➔ *Volume unit* ➔ *...'*

You can select another unit for the volume in the *'Volume unit'* sub-menu.

11.2.7.3 Pressure unit

➔ *'Menu / Information ➔ Settings ➔ System ➔ Pressure unit ➔ ...'*

In the *'Pressure unit'* sub-menu, you can select another unit for the pressure.

11.2.7.4 Pressure adjustment

➔ *'Menu / Information ➔ Settings ➔ System ➔ Pressure adjustment ➔ ...'*

You can adjust the pressure value, which the pump displays in the *'Pressure adjustment'* sub-menu, if it is to differ from the pressure in the discharge line.



There is no 'Pressure adjustment' sub-menu with pumps with SER dosing heads.

Requirements:

- A manometer is installed in the discharge line.
- Everything is set on the pump.

1. Shift to the *'Pressure adjustment'* sub-menu.
   ⇨ The *'Start pump'* menu item appears.
2. Use the *[Clickwheel]* to confirm *'Yes'*.
   ⇨ The pump starts up.
   The *'Calibration pressure'* menu item appears.
3. The *'Calibration pressure'* menu item shows at the top the pressure value that the pump is missing. Below that it displays an adjustable pressure value.
4. Use the *[Clickwheel]* to enter the pressure value from the manometer as soon as the pressure value is stable.
5. Use the *[Clickwheel]* to confirm this pressure value.
   ⇨ The pump stops.
   'Pressure adjustment' is now complete.

11.2.7.5 Start behaviour

➔ *'Menu / Information ➔ Settings ➔ System ➔ Start behaviour ➔ ...'*

You can specify the start behaviour of the pump once the supply voltage has been switched on in the *'Start behaviour'* sub-menu.

Start behaviour	Description
'always STOP'	The pump always wakes up in “Manual stop via the [STOP/START] key" mode. It can only be started by pressing [STOP/START].
'always on'	The pump always starts immediately.
'last status'	The pump always adopts the last status it had before the supply voltage was switched off.

11.2.8 Inputs/outputs

➔ *'Menu / Information ➔ Settings ➔ Inputs/outputs ➔ ...'*

The *'Inputs/outputs'* menu is split into the following sub-menus:

1 - *'Auxiliary capacity' | 'Auxiliary frequency'*

2 - *'Relay1'* (optional)

3 - *'Relay2'* (optional)

4 - *'Flow monitor'* (only if connected)

5 - *'Diaphragm rupture'* (only if connected)

6 - *'Pause input'* (optional)

7 - *'Niveau monitoring'*

11.2.8.1 *'Auxiliary capacity' | 'Auxiliary frequency'*

➔ *'Menu / Information ➔ Settings ➔ Inputs/Outputs ➔ Auxiliary capacity / Auxiliary frequency ➔ ...'*

The programmable *'Auxiliary capacity' | 'Auxiliary frequency'* function enables switch-over to an additional capacity / stroke rate that can be fixed in the *'Auxiliary capacity' | 'Auxiliary frequency'* menu.

It can be activated via the "External control” terminal. If *'Auxiliary capacity' | 'Auxiliary frequency'* is being used, then the identifier "AUX” appears on the LCD screen.

Refer to the "Hierarchy of operating modes, functions and fault statuses" for the order of the various operating modes, functions and fault statuses.

11.2.8.2 *'Relay1 (optional)'*

➔ *'Menu / Information ➔ Settings ➔ Inputs/outputs ➔ Relay1 ➔ ...'*

The setting options for the 'Relay' function are only available if a relay is fitted.

gamma/ X, GMXa

Tab. 15: Relay, physical and pre-set to ...

Identity code specification	Relay, physical	Pre-set to ...
1	1 x changeover contact 230 V – 8 A	Fault indicating relay, N/C
4	2 x N/O 24 V – 100 mA	Fault indicating relay, N/C, and pacing relay

Relay type

You can reprogram the relays to these types:

Menu setting	Effect
Timer	The relay switches when requested by the timer.
Error	The relay switches in the event of a fault message (red LED*).
Warning	The relay switches in the event of a warning message (yellow LED*).
Warning + error	The relay switches in the event of a warning message (yellow LED*) or a fault message (red LED*).
Warning, error + stop	The relay switches in the event of a warning message (yellow LED*), when stopped by [Start/Stop] or in the event of a fault message (red LED*).
Pump active	The relay switches as soon as the pump is in standby and not stopped and not in a status like *'Pause'* or if an error is pending. In the opposite case, the relay switches back again.
Stroke rate**	The relay switches with every stroke.
Cycle quantity	The relay always switches when the set metering volume is exceeded.
Metering / Batch	The relay changes its status as soon as a batch has been processed.
Bleeding	The relay opens an optionally installed bleed valve as soon as the control activates it.

* see the "Troubleshooting" chapter

** only use *'Relay 2'* for this relay type (semiconductor relay).

You can set in the associated menu for certain events whether they are to be signalled as an error or warning (or not) (level, metering stroke, cavitation, ...).

The relays can also switch with programmed errors - refer to the "Troubleshooting" chapter.

Relay polarity

You can set here how a relay is to switch.

Menu setting	Effect
N/C	The relay is closed in normal mode and opens with a triggering event. (N/C)
N/O	The relay is open in normal mode and closes with a triggering event. (N/O)

11.2.8.3 *'Relay2 (optional)'*

☰ ➔ *'Menu / Information ➔ Settings ➔ Inputs/outputs ➔ Relay2 ➔ ...'*

Relay cycle quantity

You can set the metering volume for which the pacing relay is to switch once here.

For more information on *'Relay2'* - see *Chapter 11.2.8 'Inputs/outputs' on page 68*.

11.2.8.4 mA output

➔ *'Menu / Information* ➔ *Settings* ➔ *Inputs/outputs* ➔ *mA-Output* ➔ *...'*

You can enter here which signal is to be output similar to the pump capacity and as an mA signal and how the pump is to respond. The following can be selected one after the other - Table display:

1. *'mA-Output'*	2. *'Select the analogue signal'*	3. *'Capacity at 20 mA'*	4. *'Behaviour, mA output'*	5. *'Behaviour 23 mA'*	6. *'Behaviour 3.6 mA '*
'0...20 mA' *'4...20 mA'*	*'Strokes / hour'*	-	*'No change'*	-	-
			'Behaviour, mA output'	*'Passive'* *'Error'* *'Warning'* *'Warning + error '* *'Warning + error + stop'* *'Bleeding'*	*'Passive'* *'Error'* *'Warning'* *'Warning + error '* *'Warning + error + stop'* *'Bleeding'*
	'Litre / hour at 20 mA'	*'xx.xx l/h'*			

The following can be selected one after the other - Displayed as instructions:

1. Select the current range in the *'mA-Output'* display.
2. In the *'Select the analogue signal'* display, select which of the pump's capacity parameters is to be signalled by the mA output.
3. Only with *'Liter/Hour at 20mA'*: Select the capacity (Litre / hour) in the *'Capacity at 20 mA'* display, which is to be used for 20 mA (thereby scaling your mA range).
4. In the *'Behavior mA output'* display, select whether the mA output is to signal something or not (*'No change'*).
5. In the *'Behavior 23 mA'* display, select which pump behaviour the mA output is to signal by 23 mA. *'Behavior 3.6 mA'* acts in a similar way.



The behaviour selected under 'Behavior 23 mA' has a higher priority when signalling than the one selected under 'Behavior 3.6 mA'.

11.2.8.5 *'Flow control'*

➔ *'Menu / Information* ➔ *Settings* ➔ *Inputs/outputs* ➔ *Flow control* ➔ *...'*

The setting options for the 'Flow control' function are only available if a flow control is electrically installed. The symbol for flow control appears: .

A metering monitor, such as a Flow Control (also DulcoFlow®), can register the individual pressure impacts of the pump and report them back to the pump.

The pump switches to fault mode if this feedback is missing in a sequence, as set under *'Error tolerance'*.

It is possible to switch the function on and off under *'Activation'*.

Under *'at Auxiliary'*, it is possible to set whether the function is to be deactivated with auxiliary frequency.

11.2.8.6 *'Diaphragm rupture'*

→ *'Menu / Information* → *Settings* → *Inputs/outputs* → *Diaphragm rupture* → *...'*

The setting options for the 'Diaphragm rupture' function are only available if a diaphragm rupture indicator is electrically installed. The symbol for diaphragm appears .

In the *'Diaphragm rupture'* sub-menu you can select whether the pump generates a warning message or an error message in the event of a diaphragm rupture.

11.2.8.7 *'Pause input'*

→ *'Settings* → *Inputs/outputs* → *Pause* → *...'*

In the *'Pause'* menu you can select whether the pump switches to *'Pause'* with an "Energizing (N/O)" or "Releasing (N/C)" input contact signal.

11.2.8.8 *'Niveau monitoring'*

→ *'Settings* → *Inputs/outputs* → *Niveau monitoring* → *...'*

Select in the which measuring principle is to be used for level monitoring in the *'Niveau monitoring'* menu:

- *'2-stage'*
- *'continuous'*

11.2.8.8.1 2-stage

In the *'Level warning'* sub-menu, you can select for a two-stage level switch whether the pump switches to *'Level warning'* with a *'Break contact'* or *'Make contact'* input contact signal.

In the *'Level error'* sub-menu, you can select for a two-stage level switch whether the pump switches to *'Error'* with a *'Break contact'* or *'Make contact'* input contact signal.

11.2.8.8.2 Continuous

Calibrate

The ProMinent suction lance with continuous level measurement can measure the liquid level in a 30-litre canister with 5 % precision. The relevant secondary display of the gamma/ X indicates the liquid level, or the liquid level can be reported to the control panel by bus.

You can calibrate continuous level measurement in the *'Calibrate'* sub-menu.

Electrodes

You can calibrate the *'electrodes'* in this sub-menu – this is a step that is not normally necessary. If the feed chemical has a dielectric constant ε_r below 30, you can try to get level measurement running.

1. Select *'Electrodes'* under *'Calibrate'*.
   ⇨ The *'Calibration "Air"'* display appears.
2. Remove the level gauge from the feed chemical.
3. Press the *[dial]*.
   ⇨ The *'Calibration "Medium"'* display appears.
4. Immerse the level measurement in the feed chemical up to the holding claws.
5. Press the *[dial]*.
   ⇨ The calibration process is completed.
6. Check whether the level measurement is working as expected.

Perc. liquid level

Use *'Percent level'* in this sub-menu to recalibrate the level measurement if you wish to work with another maximum liquid level.

1. Select *'Percent level'* under *'Calibrate'*.
   ⇨ The *'Calib. "Liquid level"'* display appears.
2. Immerse the level measurement in the feed chemical.
3. Use the *[dial]* to set the required percentage for this level and press the *[dial]*.
   ⇨ The application switches back to the Start menu.
4. Check whether the level measurement is working as expected.

Configuration

You need to enter the warning thresholds for continuous level measurement and the required unit in the *'Configure'* sub-menu.

1. Enter the *'Warning Level Niveau'* as a % and press the *[dial]*.
2. Enter the *'Fault Level Niveau'* as a % and press the *[dial]*.
3. Select the *'Unit Level'* for the "continuous level" secondary display: select *'Percent'* or *'Liter'* and press the *[dial]*.

11.2.9 Bleeding

☰ ➔ *'Menu / Information ➔ Settings ➔ Bleeding ➔ ...'*

The *'Bleeding'* function is used for controlled bleeding of the liquid end.

The software solution is always in the pump control. The pump calls up the *'Priming'* function for bleeding. The pump can therefore pump the gas bubbles out of the liquid end even without a bleed valve (solenoid valve) – depending on the back pressure.

If the pump has "Automatic bleed" via the "relay identity code option (retro-fittable), the pump can be bled via a bleed relay.

There are 2 hardware options for automatically bleeding the discharge side:

- via ProMinent's bleed module in the liquid end.
- via a customer implemented bleed facility in the discharge line.



The relay - "Relay" – "with automatic bleed" - changes its switching status for the period during which the pump is priming.

The *'Bleed'* function can be triggered in 4 ways:

1 - Not (*'Off'*).

2 - *'Periodically'* by an internal signal - defined by *'Cycle'* and *'Duration'*.

3 - By the *'Air lock'* internal signal

4 - If one of the two signals occurs (*'Both'*).

Detailed explanation:

1 - If *'Off'* has been selected in the menu, this function is deactivated.

2 - If *'Periodic'* was selected in the menu, then the control unit periodically triggers the bleed procedure with an adjustable *'cycle'* (10 ... 1440 min = 24 h) and an adjustable *'duration'* (5 ... 300 s = 5 min).

Bleeding is always triggered at the start of a period. A bleed process is also started by  *[STOP/START]* or by connecting the pump to mains voltage.

3 - If *'Air lock'* has been selected in the menu, the *'Air lock'* internal signal triggers the bleed procedure.

If the signal appears again within 8 minutes of the bleed procedure being carried out, the control unit repeats the bleed procedure up to a maximum of 3 times. However if the signal still appears, then an error message is generated, which has to be acknowledged via the *[dial]*.

In the event of an *'Air lock'* the option of a direct error or warning message disappears for the *'Air lock'* signal. The corresponding menu branch in the *'Settings'* menu is also hidden. The signal is only available for the *'Bleed'* function.

4 - If *'Both'* has been selected in the menu, then each trigger can trigger a bleed process.

Sequence of the bleed procedure (automatic):

1. The pump control stops the normal metering operation - the "Stop Pause" symbol appears on the LCD screen.
2. Only with bleed relay: After 1 s, the pump control opens the bleed valve on the liquid end (via the bleed relay and the solenoid valve).
3. 1 s later, the pump starts to run at a high stroke rate (like during priming) - the "Air lock" symbol  appears on the LCD screen instead of the "Stop Pause" symbol.
4. The pump operates in this way for the total set time.
5. Once the set time has elapsed, the pump stops – the "Stop Pause" symbol  appears on the LCD screen again.
6. Only with bleed relay: After 1 s the pump control closes the liquid end bleed valve.
7. After 1 s the "Stop Pause" symbol disappears and the pump recommences normal operation.

If the pump was in the "Stop" state at the time of triggering ( ) *[STOP/START]*, Pause, Error), the start of the bleed procedure is delayed - until this state has been cleared.

If the pump switched to "Stop" state during the bleed procedure, the pump control jumps immediately to phases 5 and 6. - see above. This definitely cancels the bleed procedure. As soon as the "Stop" state is cleared, the bleed procedure starts from the beginning.

11.2.10 *'Priming time'*

→ *'Menu / Information* → *Settings* → *Priming time* → *...'*

In the *'Priming time'* menu, you can select how long the metering pump is to prime once *[Priming]* has been pressed.

In operation, the stroke length can be changed more easily using the "Priming time" display:

- *Press [Priming] - the pump starts to prime.*
- *Turn the [Clickwheel] to set the priming time.*
- *Press the [Clickwheel] to save the priming time.*

11.2.11 *'Set time'*

→ *'Menu / Information* → *Settings* → *Set time* → *...'*

You can set the time in the *'Set time'* menu.

1. Use the dial to adjust a figure.
2. Use) *[Priming]* to move to the next figure.

Under *'Auto. Summertime'* you can select whether you wish to change over to *'Summertime'*.

You can also state when the pump is to change to and from *'Summertime'*.

Check under *'Location'* whether the pump is also set to your *'hemisphere'* of the world.

11.2.12 *'Date'*

→ *'Menu / Information* → *Settings* → *Date* → *...'*

You can set the date in the *'Date'* menu.

11.3 Timer

→ *'Menu / Information* → *Timer* → *...'*

- *Please first read this chapter completely to gain an overview. You will then understand the timer better when working through the chapter.*

The timer gamma/ X can do the following at predefined times and intervals or event-dependent:

- open / close the relays
- switch the level of a Config I/O output
- be triggered by the level at a Config I/O input
- start a delayer
- switch operating mode
- operate the pump work at a defined capacity or stroke rate / stroke length
- stop / start the pump
- trigger a batch (*'Batch (time)'*)

11.3.1 Activation / deactivation

☰ ➔ *'Menu / Information ➔ Timer ➔ Activation ➔ ...'*

You can only program the timer when 'Activation' is set to 'inactive'.

To program the timer, set *'Activation'* to *'inactive'*.

⇨ The first line of the timer menu *'Timer state'* then shows *'Inactive'*.

To activate the timer, set *'Activation'* to *'active'*.

⇨ The first line of the timer menu *'Timer state'* then displays *'active'*.

The timer starts working - the timer identifier ◷ is visible in the continuous display.

When 'Activation' is set to 'active', the timer software generates the status of the pump which the pump would have precisely had at this time if it had been set to 'active' without any interruption.

Delayed, linked actions are unaffected by this.

11.3.2 Setting the timer

☰ ➔ *'Menu / Information ➔ Timer ➔ Set Timer ➔ ...'*

You can create commands (also known as “program lines”) for a timer program in the *'Set Timer'* menu.

You can create up to 99 commands (program lines).

Create the command as follows:

1 - Create a *'new'* command (program line)

2 - Select the *'Triggering event'* (trigger) and the time and/or interval if necessary

3 - Select *'Action'* and a value, if necessary

4 - Check the command

5 - Create the next command – if necessary

The following administration functions are available to manage the commands (program lines):

1 - Reprogram program line (*'New'*)

2 - Check program line (*'Show'*)

3 - Change program line (*'Change'*)

4 - Clear individual program line (*'Clear'*)

(5 - Clear the entire program (*'Clear all'* one level higher))

CAUTION!
The pump does not perform any plausibility check.

Please ensure before using that the timer actually does what you expect of it. Please consider the consequences for your system.

CAUTION!
A program set up in *'Automatic'* - *'on'* metering mode will not function in *'Automatic'* - *'off'* metering mode and vice versa.

CAUTION!
If you wish to use automatic summer time adjustment (*'Settings'* - *'Time'*) avoid any triggering events between 02:00 a.m. and 03:00 a.m.

Restriction with day numbers
If you wish to start an action on a certain day of each month, note that the timer only permits days 01 - 28.

Using Config I/Os
If you wish to use Config I/Os as inputs or outputs, you first need to configure them as a 'Timer input' or 'Timer output' under 'Menu / Information ➔ Settings ➔ Config I/Os ➔ ...'.

11.3.2.1 Reprogramming program line (*'new'*)

CAUTION!
If the *'Timer state'* is set to *'active'*, the pump can neither be set nor programmed!

To do so, set the *'Timer state'* under *'Activation'* to *'inactive'*.

11.3.2.1.1 Principle construction of a program line

In principle, an (imaginary) program line / instruction is set up as follows:

Time event (trigger)		Action	
Workdays 1 (Mo-Fr)	Time of day 12:00	Manual	20.00 l/h

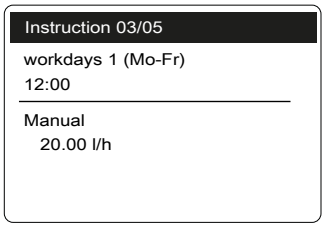
This corresponds to the following instruction:

`WHEN triggering event, THEN action`

The **time event (trigger)** defines what action or at what time an action is to take place.

The **action** defines which type of action is to take place.

The finished program line/ instruction looks like this:



B1106

Example

Time event (trigger)		Action	
Workdays 1 (Mo-Fr)	Time of day 12:00	Manual	20.00 l/h

The example means:

When it is 12:00 on a workday, then the pump is to work in *'Manual'* operating mode at 20.00 l/h.

Tab. 16: Time events (triggers)

Time events (triggers)	Description	Remark
Time	Switching time reached	For more information - see ↳ *Chapter 11.3.2.1.3 'Selecting cyclic time events and switching point' on page 78*
'Init'	Thus declared is started at the beginning of the program process	Defines starting conditions - see ↳ *Chapter 11.3.2.1.2 ''Init' Initial conditions' on page 78*

You can select an action and also a value:

Tab. 17: Action

Action	Description	Value
'Manual'	Switch over in this operating mode	Litre/h (*'Dos. capacity'*)
'Manual'	Switch over in this operating mode	Litre/h *1 (*'Dos. capacity'*)
		Strokes/h *2 (*'Metering rate'*) + *'Stroke length'*
'Halt'	Stop pump	--
*'Relay1 **'*	Have the relay switch to status ...	open closed
*'Relay2 **'*	Have the relay switch to status ...	open closed
'Contact'	Switch over in this operating mode	--

Action	Description	Value
'Batch (input)'	Switch over in this operating mode	--
'Analogue'	Switch over in this operating mode	--
*'Frequency *2'*	The pump runs at this stroke rate	Strokes/h (*'Metering rate'*)

*1: only available in *'Automatic'* operating mode - see chapter *'Settings'* - *'Automatic'*

*2: only available, if metering is done traditionally/conventionally - see chapter *'Settings'* - *'Automatic'*

** Option; needs to be assigned to the *'Timer'* (under *'Settings* ➔ *Inputs/Outputs* ➔ *Relay* ➔ *Relay type'* - refer to this chapter of the operating instructions under *'Settings'*)

Tab. 18: Selected value ranges

Designation	Value range
Line numbers	01 ... 99
Day (date)	01 ... 28
Time of day (hours)	00 ... 23
Seconds	0001 ... 9999

11.3.2.1.2 *'Init'* Initial conditions

The triggering event *'Init'* can be used to set initial conditions at the beginning of a program sequence.

Example

triggering event (trigger)		Action	
Init	-	Relay 2	closed
Init	-	Contact	-

The example means:

As soon as the programme is started (via *'Timer* ➔ *Activation* ➔ *active'* or power supply on), *'Init'* sets *'Relay 2'* to *'closed'* and the *'Operating mode'* to *'Contact'*.

11.3.2.1.3 Selecting cyclic time events and switching point

The cyclic time events periodically trigger actions. That is why a program line consists of a cycle and a switching point:

The **cycle** specifies after which time the action is to be repeated.

The **switching time** specifies when the action is to take place.

Example

Time events (triggers)		Action
Cycle	Switching time	
Workdays 1 (Mo-Fr)	Time of day 12:00	Manual

Tab. 19: Cyclic time events

Cycle	Time
'hourly'	hourly at mm. Minute
'daily'	daily at the time mm.ss, Monday to Sunday
'Workdays 1 (Mo-Fr)'	daily at the time mm.ss, Monday to Friday
'workdays 2 (Mo-Sa)'	daily at the time mm.ss, Monday to Saturday
'Weekend (Sa+Su)'	daily at the time mm.ss, Saturday and Sunday
'weekly'	weekly at the time mm.ss on day xxxxxx.
'monthly'	monthly at the time mm.ss on the day dd. Day* of the month

* Value range is restricted to day 01 – 28

CAUTION!
If you wish to use automatic summer time adjustment (*'Settings'* - *'Time'*) avoid in principle any time events between 02:00 and 03:00.

A time event lets you trigger an action precisely to the minute.

If the action is to be triggered precisely to the second, then you need to set up your programming on a delayer.

11.3.2.2 1 time event - several actions

You can assign 1 time event to several actions. To do so, always use the same cycle and the same switching time! :

Example

No.	Time event (trigger)		Action	
01	Workdays 1 (Mo-Fr)	Time of day 12:00	Halt	-
02	Workdays 1 (Mo-Fr)	Time of day 12:00	Batch (input)	50 strokes
03	Workdays 1 (Mo-Fr)	Time of day 12:00	Relay 1	-closed
04	-	-	...	.

- *For details on the sorting sequence of the program lines see 'Sorting sequence' on page 80.*
- *The timer program can have a maximum of 99 program lines.*

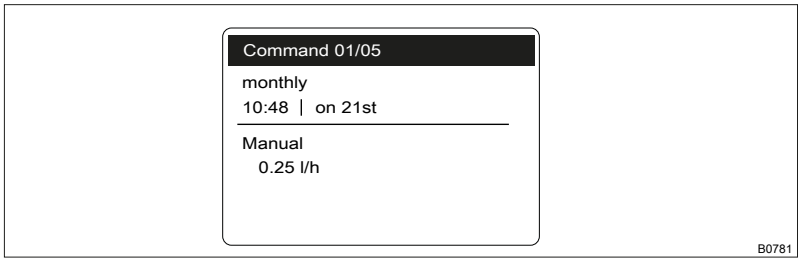
11.3.2.3 Check program lines (*'Show'*)

☰ ➔ *'Menu / Information ➔ Timer ➔ Set timer ➔ Show'*

'Show' lets you check individual program lines / instructions.

1. Press the *[Clickwheel]* on a program line / instruction.

   ⇨ This display appears:



Above the line Time event (trigger) and possible value
Below the line Action and value, if required

2. Turn the *[Clickwheel]*.

   ⇨ Scroll from instruction to instruction.

   The number of the program line or instruction (and the number of the last program line or instruction) appears at the top in the dark bar.

3. Pressing the *[Clickwheel]* returns you to *'Set timer'*.

As the timer software automatically sorts the program lines, the numbers of the program lines can change if you change something.

Sorting sequence

The timer software automatically sorts every newly programmed program line / instruction after completing it (press the *[Clickwheel]*) below the other program lines.

The 1st sorting criterion is the type of **time event (trigger)** (for the sequence refer to *Further information on page 77* and *Further information on page 78*).

Time-dependent program lines are ordered below each other initially after the **Switching point** (2nd sorting criterion)

then after the length of the **Cycle** (3rd sorting criterion).

The 4th sorting criterion is the type of **action** (see also the programming examples at the end of these instructions).

A purely time-controlled timer program will also run in this sequence.

11.3.2.4 Change program lines (*'Change'*)

'Menu / Information ➔ Timer ➔ Set timer ➔ Change'

1. Use the *[Clickwheel]* to select the required program line / instruction according to its number and press the *[Clickwheel]*.

2. Click through the instruction and change it.

   ⇨ The timer software sorts a changed program line / instruction after completion with the *[Clickwheel]* possibly differently in between the other program lines (Rules - see *'Sorting sequence' on page 80*).

11.3.2.5 Clear individual program lines (*'Clear'*)

'Menu / Information ➔ Timer ➔ Set timer ➔ Clear'

1. Use the *[Clickwheel]* to select the required program line / instruction according to its number.
2. The program line will be cleared as soon as you press the *[Clickwheel]*.
   ⇨ The timer software re-sorts the remaining programme lines (Rules - see *'Sorting sequence' on page 80*).



Clear all program lines

The option to clear all program lines is to be found one level higher in the menu:

☰ ➔ *'Menu / Information ➔ Timer ➔ Clear all'*

11.3.3 Clear all

☰ ➔ *'Menu / Information ➔ Timer ➔ Clear all ➔ ...'*

Use the *'Clear all'* menu to clear all instructions (the entire program).

11.3.4 Examples

Requirements:

- You have already worked with the pump type
- The time has been set (possibly set under *'Settings ➔ Set time ➔ Time'*. Only possible with *'Timer state'- 'Inactive'*).

Example of "Weekday metering"

Task:

The pump is to meter 2 litres every half hour every weekday (Mon-Fri) between 8:00 and 11:00.

Solution:

As you define switching times with the timer, you need to first define the switching points at 08:30, 09:30 and 10:30.

To meter 2 litres, the pump needs to work in *'Manual' 'Mode'* for 10 min at a *'Dos. capacity'* of 12,000 l/h. A *'Dos. capacity'* of 12,000 l/h is thereby added to the switching points.

You also need to define the switching times to stop the pump at 08:40, 09:40 and 10:40 - paired with the *'Halt'* action.

Tab. 20: Program as program lines / instructions

No.	Time event		Action		Comment
		Switching time		Capacity	
01	Workdays 1 (Mo-Fr)	08:30	Manual	12,000 l/h	Meter at 12,000 l/h
02	Workdays 1 (Mo-Fr)	08:40	Halt	-	Halt
03	Workdays 1 (Mo-Fr)	09:30	Manual	12,000 l/h	Meter at 12,000 l/h
04	Workdays 1 (Mo-Fr)	09:40	Halt	-	Halt
05	Workdays 1 (Mo-Fr)	10:30	Manual	12,000 l/h	Meter at 12,000 l/h
06	Workdays 1 (Mo-Fr)	10:40	Halt	-	Halt

How to enter the program lines / instructions:

1. To program the timer, set ☰ ➔ *'Menu / Information* ➔ *Timer* ➔ *Activation'* to *'inactive'*.

   ⇨ The first line of the timer menu *'Timer state'* then shows *'Inactive'*.

2. Always enter the program / instructions from the table, above, into the newly created instruction under *'Timer* ➔ *Set timer* ➔ *new* ➔ *...'* (Do not get irritated: the timer program automatically sorts the instructions).

3. To activate the timer, set *'Activation'* to *'active'*.

   ⇨ The first line of the timer menu *'Timer state'* then displays *'active'*.

   The timer starts working - the timer identifier ◷ is visible in the continuous display.

4. Test your programming!

   The secondary display “Timer” can help with this as it shows the next instruction and the remaining time. (To access this secondary display, press the *[Clickwheel]* in a continuous display until a long series of small circles appears below - immediately turn the *[Clickwheel]* to navigate to the last circle and press the *[Clickwheel]*.)

   The continuous display itself shows information on the current status of the pump in the dark bar.

If something has been entered incorrectly:

- *Either press ⮌ in the current program line and enter the correct values*
- *or search for the program line in 'CHANGE' (automatic sorting!). Now press the [Clickwheel], allow the program to run through the program lines again and enter the values correctly*
- *or use 'Clear' to select the program line and clear*
- *or clear everything using 'Clear all' (one level higher).*

11.3.5 Timer information

Status as soon as the programmed pump is connected to the power supply:

The timer software now generates the status of the pump which the pump would have precisely had at this time if it had not been disconnected from the power supply.

Effective settings after switching between Timer *'active'* and *'inactive'*:

The timer settings are saved and become effective again when *'inactive'* switches to *'active'*.

The operating mode settings are saved and become effective again when *'active'* is switched to *'inactive'*.

Storage period of your programming:

The pump stores your programming for up to 20 years.

(The calibration and timer data is maintained for up to 100 years).

The time is retained without power supply for approx. 2 years.

11.3.6 Typical pitfalls Timer functional faults

Problem	Possible cause of fault	Remedy
The pump starts pumping unexpectedly.	The timer clears every "Manual" stop when activated - see "Timer behaviour on start"	Enter an *'Init'* instruction with *'Halt'* action.
The timer does not react to a contact signal at the corresponding pin of the "Config I/O" socket.	Config I/O was not configured as "Config I/O" - "Input" in the *'Menu / Information ➔ Settings ➔ Inputs/Outputs ➔ ...'* menu.	Configure Config I/O as "Config I/O" - "Input" in the *'Menu / Information ➔ Settings ➔ Inputs/Outputs ➔ ...'* menu.
The timer does not set a Config I/O output.	Config I/O was not configured as "Timer" - "Input" in the *'Menu / Information ➔ Settings ➔ Inputs/Outputs ➔ ...'* menu.	Configure Config I/O as a "Timer" - "Input" in the *'Menu / Information ➔ Settings ➔ Inputs/Outputs ➔ ...'* menu.
A *'Delayer'* does not trigger an *'Action'*.	Different delay times have been defined for the same *'Delayer'* but this delayer is stopped and becomes inactive after the shortest delay time.	Create a further *'Delayer'* for the longer delay time.

11.3.7 Brief explanation of selected functions

Time event (trigger)

An event can be triggered either time-dependent or event-controlled.

1 - Time events (really time-dependent) are processed precisely to the minute.

2 - Initialisation (*'Init'*) is executed at the start of the program (*'Timer* ➔ *Activation* ➔ *active'* or when the power supply is connected) to obtain a defined status of the system.

3 - "Config I/O" inputs can trigger something if the input potential changes from 1 to 0 or with a falling edge or if the potential-free contact is closed.

4 - Delayers can trigger an action as soon as their time has expired - precisely to the second.

Actions

These are the *'Actions'* which the timer executes as soon as a *'time event'* has occurred.

Initialisation

When *'Activation'* is set to *'active'*, the timer software generates the status of the pump which the pump would have precisely had at this time if it had been set to *'active'* without any interruption.

This does not relate to delayed, linked actions.

The initial commands (*'Init'*) can be used to program a defined switch-on status. Initial commands have priority over time commands.

Outputs

Those relays which were connected with the relay option are designated as outputs. There can be up to 2 relays.

Pins 1 - 3 of the "Config I/O" socket can be inputs and outputs. That can be programmed.

Inputs

Pins 1 - 3 of the "Config I/O" socket can be inputs and outputs. That can be programmed.

Delayer

Delayers are started event- or time-controlled. On expiry of the delay time, the delayer itself can trigger any actions.

11.4 *'Service'*

☰ ➔ *'Menu / Information* ➔ *Service* ➔ *...'*

11.4.1 *'Access protection'*

☰ ➔ *'Menu / Information* ➔ *Service* ➔ *Access protect* ➔ *...'*

You can lock parts of the setting options here.

The following locking options are available:

Selection	Point ①	Point ②
'none'	-	-
' Lock menu'	X	-
'Lock all'	X	X

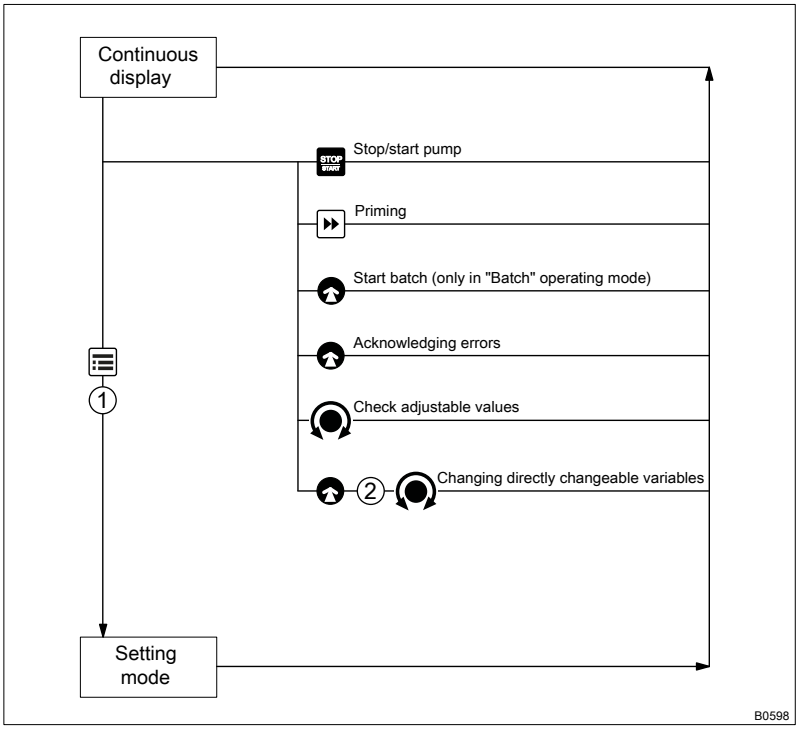


Fig. 36

If you have set a *'Password'* - see below, then the identifier will appear after 1 minute in the top left and the specified areas will be locked, if no key has been pressed in the meantime.

Both locks use the same *'Password'*.

11.4.2 *'Password '*

→ *'Menu / Information → Service → Password → ...'*

You can enter a password of your choice in the *'Change password'* menu.

11.4.3 *'Clear counter'*

→ *'Menu / Information → Service → Clear counter → ...'*

You can reset the counter to "0" in the *'Clear counter'* menu:

- *'Stroke counter'* (total number of strokes)
- *'Volume counter'* (total litres)
- *'Contact memory'*
- *'All'*

→ To clear: exit the menu by briefly pressing the *[Clickwheel]*.

The values have increased since commissioning of the pump, the last calibration or the last deletion.

11.4.4 *'Error log book'*

'Menu / Information ➔ Service ➔ Error log book ➔ ...'

You can view the list of *'Log book entries'* here.

A *'Filter'* helps with the overview.

If you need more detailed log book entries:

The metering pump gamma/ X with Bluetooth functionality can display a more extensive log file with pump-related events and e-mail it using a Bluetooth-compatible Android smart device and the "gamma/ X" app.

11.4.4.1 Log book entry - Detailed view

Press the *[Clickwheel]* to obtain more information about a log book entry.

Tab. 21: Information on the detailed view

Line	Information
1	Date/time
2	Type of entry (fault, warning ...)
3	Total operating time, total number of strokes
4	Switching-on duration, stroke rate since switching on
5	Room temperature, status information on the error (for developers)

11.4.5 *'Diaphragm replacement'*

'Menu / Information ➔ Service ➔ Diaphragm replacement ➔ ...'

You can move the slide rod into the "replacement position" here with *'To replacement position'* to enable the diaphragm to be replaced more easily.

11.4.6 *'Display'*

'Menu / Information ➔ Service ➔ Display ➔ ...'

You can set the *'Contrast'* and the *'Brightness'* of the LCD screen here.

11.4.7 *'Factory setting'*

'Menu / Information ➔ Service ➔ Factory setting ➔ ...'

You can reset the pump to its factory settings here with *'Yes'*

The password is 1812.

11.4.8 Diaphragm part number: XXXXXXX

➔ *'Menu / Information* ➔ *Service*
➔ *Diaphragm part number: XXXXXXX* ➔ *...'*

You can read off the part number (order number) of the correct diaphragm here.

11.4.9 Spare parts kit part number: XXXXXXX

➔ *'Menu / Information* ➔ *Service*
➔ *Spare parts kit part number: XXXXXXX* ➔ *...'*

You can read off the part number (order number) of the correct spare parts kit here.

11.5 *'Language'*

➔ *'Menu / Information* ➔ *Language* ➔ *...'*

You can select the desired operating language in the *'Language'* menu.

12 Operation

WARNING!

Fire hazard with flammable media

Only with combustible media: These may start to burn when combined with oxygen.

– During filling and draining of the liquid end, an expert must ensure that feed chemical does not come into contact with oxygen.

This chapter describes all the operating options in a continuous display (several symbols and the pressure display appear at the top in the black bar) for the trained person at the pump.

– *Please also refer to the "Operating/Setting Overview" and "Continuous Displays and Secondary Displays" overviews at the end of the operating instructions and also the "Overview of Equipment and Control Elements" chapter.*

12.1 Manual operation

Stop/start pump

Stop the pump: Press) *[STOP/START]*.

Start the pump: Press) *[STOP/START]* again.

Priming

Press) *[Priming]*.

Turn the *[Clickwheel]* to extend of shorten the priming time during priming.

Starting a batch

In *'Batch'* operating mode: Press the *[Clickwheel]* in the *'Push'* continuous display.

Acknowledging errors

Press the *[Clickwheel]* to acknowledge error messages that require acknowledgement.

Checking adjustable variables

In a continuous display: Another continuous display will appear each time the *[Clickwheel]* engages when turned. (The number depends on the configuration).

Changing directly changeable variables

Changing a variable in the relevant continuous display:

1. Press the *[Clickwheel]*.
   ⇨ The variable can be changed (highlighted).
2. Turn the *[Clickwheel]*.
   ⇨ The variable is changed.
3. Press the *[Clickwheel]*.
   ⇨ The variable is saved (the highlighting disappears).

If the "lock" - "lock all" has been set - see *'Set Up Overview of the gamma/ X' on page 89*, first enter the *'Password'* after pressing the *[Clickwheel]*.

List of directly changeable variables:

- Capacity
- Stroke rate
- Stroke length
- Factor
- Contact volume
- Batch dosing time
- Concentration

Set Up Overview of the gamma/ X

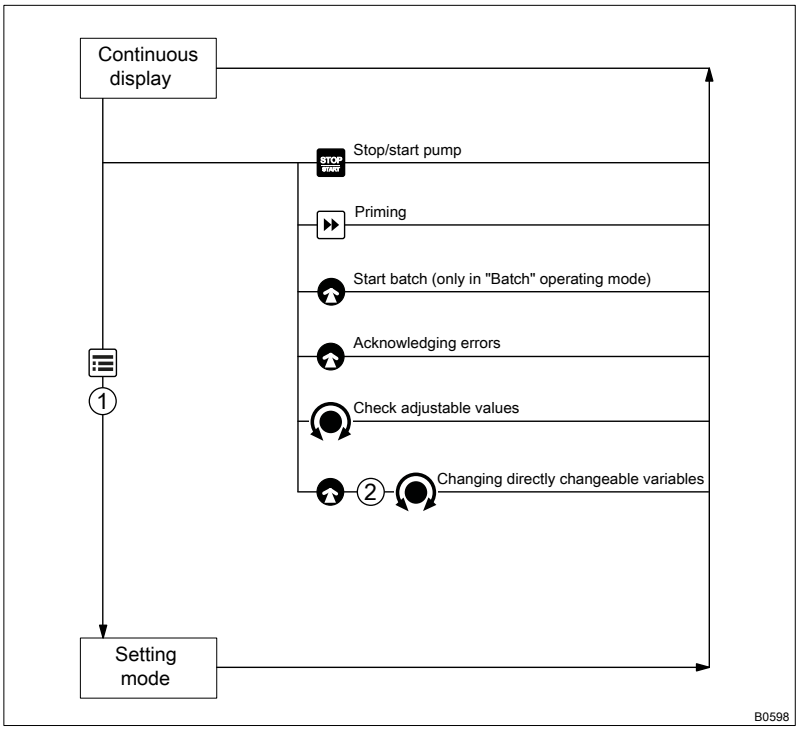


Fig. 37: Control options using keys and locking options

Press *[Clickwheel]*
Turn *[Clickwheel]*
① "Lock menu"
② "Lock all"

13 Maintenance

WARNING!

It is mandatory that you read the safety information and specifications in the "Storage, Transport and Unpacking" chapter prior to shipping the pump.

WARNING!

Fire hazard with flammable media

Only with flammable media: They can be ignited by oxygen.

– The pump may not work if there is a mixture of feed chemical with oxygen in the liquid end. A specialist may need to take appropriate actions (using inert gas, ...).

CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

– Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
– Depressurise the system before commencing any work on hydraulic parts.

Third-party spare parts for the pumps may result in problems when pumping.

– *Only use original spare parts.*
– *Use the correct spare parts kits. In the event of doubt, refer to the exploded views and ordering information in the appendix.*

Standard liquid ends:

Interval	Maintenance work	Personnel
Quarterly*	■ Check the metering diaphragm for damage** - refer to "Repair". ■ Check that the hydraulic lines are fixed firmly to the liquid end. ■ Check that the discharge valve and suction valve are fitted tightly. ■ Check that the entire liquid end is leak-tight - particularly around the leakage hole - refer to Fig. 38. ■ Check that the flow is correct: Press ⏭ *[Priming]* to allow the pump to prime briefly. ■ Check that the electrical connectors are intact. ■ Check the integrity of the housing. ■ Check that the dosing head screws are tight.	Technical personnel

* Under normal loading (approx. 30% of continuous operation).

Under heavy loading (e.g. continuous operation): Shorter intervals.

** Check the metering diaphragm frequently with feed chemicals that put particular pressure on the diaphragm, e.g. those containing abrasive additives.

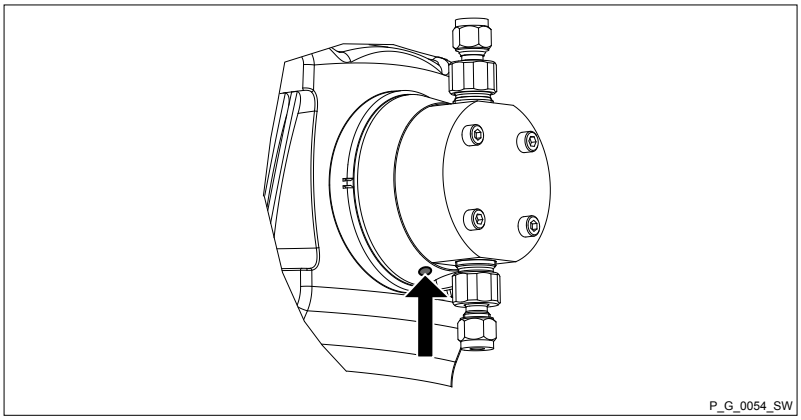


Fig. 38: The leakage hole

Liquid ends with bleed valve:

Interval	Maintenance work
Quarterly*	In addition: ■ Check that the bypass line is fixed firmly to the liquid end. ■ Check that the bleed valve is tight. ■ Check the discharge and bypass line for kinks. ■ Check that the bleed valve is operating correctly.

* Under normal loading (approx. 30% of continuous operation).

Under heavy loading (e.g. continuous operation): Shorter intervals.

Tightening torque

Data	Value	Unit
Tightening torque for screws:	4.5 ... 5.0	Nm

14 Carrying out repairs

Safety information



WARNING!

Danger of electric shock

Unauthorised repairs inside the pump can result in an electric shock.

For this reason, only allow a ProMinentbranch or representative to perform repairs inside the pump, in particular the following:

- Replacement of damaged mains connection lines
- Replacement of fuses
- Replacement of electronic control



WARNING!

It is mandatory that you read the safety information and specifications in the "Storage, Transport and Unpacking" chapter prior to shipping the pump.



WARNING!

Contact with the feed chemical

Parts that come into contact with the feed chemical are exposed and touched during repair work.

- Protect yourself against the feed chemical in case it is hazardous. Read the safety data sheet on the feed chemical.



CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

- Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
- Depressurise the system before commencing any work on hydraulic parts.



WARNING!

Fire hazard with flammable media

Only with flammable media: They can be ignited by oxygen.

- The pump may not work if there is a mixture of feed chemical with oxygen in the liquid end. A specialist may need to take appropriate actions (using inert gas, ...).

14.1 Replacing the diaphragm

The order no. (part number) of the appropriate diaphragm or the spare parts kit can be found at the end of the 'Service' menu.

- If necessary take protective measures.
- Adhere to the material safety data sheet for the feed chemical.
- Prevent the escape of feed chemical.
- Ensure that the system is at atmospheric pressure.

1. Empty the liquid end (turn the liquid end upside down and allow the feed chemical to run out; flush out with a suitable medium; flush the liquid end thoroughly when using hazardous feed chemicals!)
2. Set up ➔ *'Service* ➔ *Diaphragm replacement* ➔ *To replacement position'*

   ⇨ The pump moves the diaphragm away from the backplate.

Now leave the pump connected to the mains/ power supply so that this state is maintained.

3. Unscrew the hydraulic connectors on the discharge and suction side.
4. With types with coarse/fine bleed valve: Firstly remove the coarse/ fine bleed valve (grip), then lift off the cover of the liquid end with a screw driver.

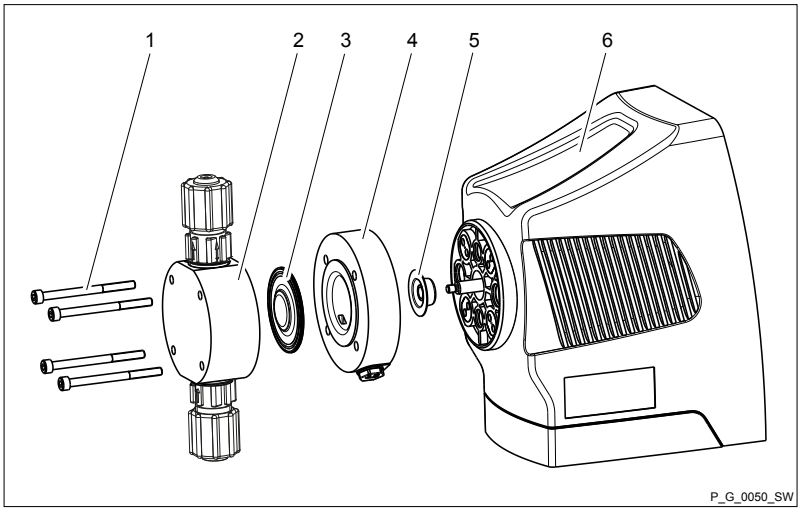


Fig. 39: Partially exploded view of liquid end

1 Screws
2 Dosing head
3 Diaphragm

4 Backplate
5 Safety diaphragm
6 Pump housing

5. Remove the screws (1).
6. Remove the dosing head (2) plus screws (1) from the pump - see figure
7. Loosen the diaphragm (3) from the drive axle with a gentle backwards turn in an anticlockwise direction.
8. Unscrew the diaphragm (3) completely from the drive axle.
9. Remove the backplate (4) from the pump housing (6).
10. Check the condition of the safety diaphragm (5) and replace if necessary.
11. Push the safety diaphragm (5) onto the drive axle only until it lies flush with the pump housing (6) and no further!
12. Tentatively screw the new diaphragm (3) onto the drive axle up to the stop - ensure that this is successful, otherwise the pump will subsequently not meter correctly!
13. Unscrew the diaphragm (3) again.
14. Place the backplate (4) on the pump housing (6).



CAUTION!

– Make sure that the leakage hole points downwards when the pump is subsequently fitted - see figure in the "Maintenance" chapter!
– Place the backplate (4) immediately into the correct position on the pump housing (6)! Do not twist the backplate on the pump housing to prevent the safety diaphragm (5) becoming warped!

15. Place the diaphragm (3) into the backplate (4).



CAUTION!

– Do not over-tighten the diaphragm (3) in the following step!
– Ensure that the backplate (4) remains in its position so that the safety diaphragm does not become warped!

16. Hold the backplate (4) firmly and screw the diaphragm (3) in a clockwise direction until it is sitting tightly.
17. Place the dosing head (2) with the screws (1) onto the diaphragm (3) and the backplate (4) - ensure that the suction connector points downwards when the pump is in its subsequent fitting position.
18. Set up ☰ ➔ *'Service ➔ Diaphragm replacement ➔ Back'*

    ⇨ The pump moves the diaphragm back to the backplate.
19. Gently tighten the screws (1) and then tighten them diagonally. See below for the tightening torque.
20. With types with coarse/fine bleed valve: Allow the cover of the liquid end to rest in the dosing head, then press the grip of the bleed valve into the coarse/fine bleed valve.



Check the tightening torque of the screws after 24 hours of operation!

Tightening torque

Data	Value	Unit
Tightening torque for screws:	4.5 ... 5.0	Nm

14.2 Cleaning the Diaphragm Rupture Indicator

WARNING!
Warning of unnoticed escape of feed chemical
After the diaphragm rupture indicator has been triggered, any residue of feed chemical residues can interfere with it.

– After the diaphragm rupture indicator has been triggered, clean and test it.

1. First replace the liquid end diaphragm - see above!
2. Unscrew the diaphragm rupture indicator using an SW 14 open-ended spanner.
3. Clean the diaphragm rupture indicator with suitable liquid - if possible using water (polysulphone material).
4. Test the connected diaphragm rupture indicator: fully immerse the tapered section at the front in water.
   ⇨ The continuous display indicates a diaphragm rupture.
5. Thoroughly dry the diaphragm rupture indicator.
   ⇨ The continuous display no longer indicates a diaphragm rupture.
6. Screw the clean and dry diaphragm rupture indicator into the hole until hand-tight and liquid-tight - without using tools!

14.3 Cleaning valves

Warning of faulty operation
Refer to the exploded drawings in the appendix when working on the unit.

The order no. (part number) of the appropriate spare parts kit can be found at the end of the 'Service' menu.

15 Troubleshooting

Safety information



WARNING!

Warning of hazardous feed chemical

Should a dangerous feed chemical be used: it may escape from the hydraulic components when working on the pump, material failure or incorrect handling of the pump.

– Take appropriate protective measures before working on the pump (e.g. safety glasses, safety gloves, ...). Adhere to the material safety data sheet for the feed chemical.
– Drain and flush the liquid end before working on the pump.



CAUTION!

Warning of feed chemical spraying around

Feed chemical may spray out of the hydraulic components if they are tampered with or opened due to pressure in the liquid end and adjacent parts of the system.

– Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
– Ensure that the system is at atmospheric pressure before commencing any work on hydraulic parts of the system.



WARNING!

Fire hazard with flammable media

Only with flammable media: They can be ignited by oxygen.

– The pump may not work if there is a mixture of feed chemical with oxygen in the liquid end. A specialist may need to take appropriate actions (using inert gas, ...).

15.1 Faults without a fault message

Faults without a fault message

Fault description	Cause	Remedy	Personnel
Pump does not prime in spite of full stroke motion and bleeding.	Minor crystalline deposits on the ball seat due to the valves drying out.	Take the suction hose out of the storage tank and thoroughly flush out the liquid end.	Technical personnel
	Serious crystalline deposits on the ball seat due to the valves drying out.	Dismantle the valves and clean them - refer to the "Repair" chapter.	Technical personnel
Fluid escapes from the backplate.	The screws in the dosing head are too loose.	Tighten the screws in the dosing head crosswise - refer to the "Repair" chapter for the tightening torque.	Instructed personnel
	The metering diaphragm is not leak-tight.	Replace the diaphragm - refer to the "Repair" chapter. If a diaphragm rupture has been indicated, clean the diaphragm rupture indicator - refer to the "Repair" chapter.	Technical personnel

Fault description	Cause	Remedy	Personnel
Green LED display (operating indicator) not lighting up.	The wrong power supply or no power supply is connected.	The specified power supply as per the voltage specification can be found on the nameplate.	Electrician

15.2 Faults with error message

15.2.1 Fault messages on the LCD screen

In the event of a fault:

- the red LED display lights up.
- an identifier and a message appear on the LCD screen.
- the pump stops.

Fault description	Cause	Remedy	Personnel
No. 0: The identifier appears followed by the message *'System error'*.	System or EPRom error	Return the pump to ProMinent.	
No. 1: The identifier I < 4 mA appears followed by the message *'Input signal < 4 mA'*.	The pump is in *'Analog'* operating mode, a fault behaviour has been programmed in the *'Analog'* menu and the control current has fallen below 4 mA.	Eliminate the cause of the low control current or Switch the programming of the fault behaviour to *'off'* - see chapter "Set up"-"Settings"-"Operating mode"-"Analog".	Technical personnel
No. 2: The identifier I > 20 mA appears followed by the message *'Input signal > 20 mA'*.	The pump is in *'Analog'* operating mode, a fault behaviour has been programmed in the *'Analog'* menu and the control current has risen above 20 mA.	Eliminate the cause of the high control current or Switch the programming of the fault behaviour to *'off'* - see chapter "Set up"-"Settings"-"Operating mode"-"Analog".	Technical personnel
No. 3: The identifier appears followed by the message *'Level error!'*.	The fluid level in the storage tank has reached "Liquid level low 2nd stage".	Top up the storage tank.	Technical personnel
No. 4: The identifier appears followed by the message *'Diaphragm rupture'*.	The diaphragm is broken.	Replace the diaphragm and clean the diaphragm rupture indicator, refer to the "Repair" chapter.	Technical personnel
No. 5: The identifier appears followed by the message *'Defective stroke met.'*.	The metering monitor reported more defective strokes than was set in the *'Inputs/Outputs'* menu.	Press the *[Clickwheel]*. Investigate and clear the cause.	Technical personnel
No. 6: The identifier appears followed by the message *'Sensor error'*.	Sensor faulty	Return the pump to ProMinent.	
No. 7: The identifier "Temperature" appears followed by the message *'Temperature'* and the pump remains idle.	The ambient temperature is too high or too low.	Change the ambient temperature. The pump starts up automatically.	Technical personnel
	The temperature is too high.	Rectify the cause. The pump starts up automatically.	Technical personnel
No. 8: No identifier appears but the message *'Initialisation'* appears.	Pump restart, initialisations incomplete.	Pump restart.	
No. 9: The identifier appears followed by the message *'Solenoid not connected'*.	The solenoid is not connected.	Return the pump to ProMinent.	
No. 10: The identifier appears followed by the message *'Parameter wrong!'*.	An incorrect parameter has been entered.	Correct the parameter.	Technical personnel

Fault description	Cause	Remedy	Personnel
No. 11: The identifier p+ and the message *'Overload'* appear.	The pump has detected too high a back pressure.	Rectify the cause and acknowledge the error.	Technical personnel
No. 12: The identifier and the message *'Overload'* appear.	The current is too high.	Rectify the cause and acknowledge the error.	Technical personnel
No. 13: The identifier and the message *'Power supply'* appear.	The power supply is too high or too low or not connected.	Rectify the cause.	Technical personnel
No. 14: The identifier appears followed by the message *'Air in dosinghead'*.	Gas bubbles in the liquid end (leaks, gaseous medium, cavitation).	Bleed the liquid end and rectify the cause. Acknowledge the error. Seal the system or slow the suction stroke.	Technical personnel
No. 15: The identifier appears followed by the message *'Degassing unsuccessful!'*.	Automatic bleeding was unsuccessful	Rectify the causes and acknowledge the error.	Technical personnel
No. 16: The identifier and the message *'Memory overflow'* appear.	The stroke tank has overflowed.	Remedy the cause (such as too low a factor, too high a contact frequency ...), then: Press the *[Clickwheel]* (think of the consequences for the process!).	Technical personnel
No. 17: The identifier I<Imin and the message *'Control signal < Imin'* appear.	The pump is in *'Analog'*-"xx. side band" operating mode, a fault behaviour has been programmed in the *'Analog'* menu and the control current has fallen below 4 mA (limit can be adjusted).	Eliminate the cause of the low control current or Switch the programming of the fault behaviour to *'off'* - see chapter "Set up"-"Settings"-"Operating mode"-"Analog".	Technical personnel
No. 18: The identifier I>Imax and the message *'Control signal > Imax'* appear.	The pump is in *'Analog'*-"xx. side band" operating mode, a fault behaviour has been programmed in the *'Analog'* menu and the control current has risen above 20 mA (limit can be adjusted).	Eliminate the cause of the high control current or Switch the programming of the fault behaviour to *'off'* - see chapter "Set up"-"Settings"-"Operating mode"-"Analog".	Technical personnel
No. 19: The identifier p- appears followed by the message *'Negative pressure '*.	The pump has detected too low a back pressure.	Rectify the cause and acknowledge the error.	Technical personnel
No. 20: The identifier and the message *'Module missing'* appear.	The optional module is missing.	Insert the optional module.	Technical personnel
	Communication between the optional module and pump electronics is not working.	Return the pump to ProMinent.	
No. 21: The identifier and the message *'Module communication'* appear.	The bus contact between the optional module and control room has been disconnected.	Rectify the cause (cable, control room ...)	Technical personnel

15.2.2 Warning messages on the LCD screen

In the event of a warning:

- the yellow LED display lights up!
- an identifier and a message appear on the LCD screen.

Fault description	Cause	Remedy	Personnel
No. 0: *'Level'* and the identifier appear.	The fluid level in the storage tank has reached "Liquid level low 1st stage".	Top up the storage tank.	Instructed personnel

Fault description	Cause	Remedy	Personnel
No. 1: The identifier appears followed by the message *'Diaphragm rupture'*.	The diaphragm is broken.	Replace the diaphragm and clean the diaphragm rupture indicator, refer to the "Repair" chapter.	Technical personnel
No. 2: The identifier appears followed by the message *'Defective stroke met.'*.	The metering monitor reported more defective strokes than was set in the *'Inputs/Outputs'* menu.	Press the *[Clickwheel]*. Investigate and clear the cause.	Technical personnel
No. 3: The identifier and the message *'Invalid metering volume'* appear.	The set metering volume in concentration mode cannot be metered.	Adjust the metering parameters.	Technical personnel
No. 4: The identifier and the message *'Invalid parameter'* appear.	A set parameter is invalid.	Adjust the parameter.	Technical personnel
No. 5: The identifier and the message *'Fan warning'* appear.	The fan is faulty or not connected.	Return the pump to ProMinent.	
No. 6: The identifier appears followed by the message *'System warning'*.	An internal system warning or an incorrect solenoid assignment has been detected.	Return the pump to ProMinent.	
No. 7: The identifier appears followed by the message *'Air in dosinghead'*.	Gas bubbles in the liquid end (leaks, gaseous medium, ...)	Bleed the liquid end and rectify the cause. Seal the system or slow the suction stroke.	Technical personnel
No. 8: The identifier and the message *'Overload'* appear.	The pump has detected too high a back pressure.	Rectify the cause.	Technical personnel
No. 9: The identifier and the message *'Dos. capacity too low'* appear.	The pump cannot meter the capacity it has calculated from the settings.	Modify the settings.	Technical personnel
No. 10: The identifier and the message *'Negative pressure'* appear.	The pump has detected too low a back pressure.	Rectify the cause.	Technical personnel
No. 11: The identifier appears followed by the message *'Cavitation'*.	Cavitation in the liquid end.	Adjust the metering parameters.	Technical personnel

15.2.3 All other faults

Please contact the responsible ProMinent branch or representative!

15.3 Log book

15.3.1 Fault messages in the log book



For more information on the 'ERROR' messages - refer to the chapter "Fault messages on the LCD screen".

Tab. 22: Errors

Log book no.	Description	Acknowledge?
0	System, EEProm error *	X
1	The pump is in *'Analog'* operating mode, a fault behaviour has been programmed in the *'Analog'* menu and the control current has risen above 20 mA.	-
2	The pump is in *'Analog'* operating mode, a fault behaviour has been programmed in the *'Analog'* menu and the control current has fallen below 4 mA.	-
3	The fluid level in the storage tank has reached "Liquid level low 2nd stage".	-
4	The diaphragm is broken.	-
5	The metering monitor reports more defective strokes than were set in the *'Inputs/Outputs'* menu.	X
6	Fault on the sensor for the stroke length.*	-
7	The ambient temperature is too high or too low.	-
8	Fault during initialisation.	-
9	Fault on the solenoid. *	-
10	Fault with the stroke parameters.	-
11	The pump has detected too high a back pressure.	X
12	The power supply is too high.	X
13	The power supply is too low or not connected.	-
14	Gas bubbles in the liquid end (leaks, gaseous medium, cavitation).	X
15	Fault during bleeding.	X
16	The stroke tank has overflowed.	X
17	The pump is in *'Analog'*-"xx. side band" operating mode, a fault behaviour has been programmed in the *'Analog'* menu and the control current has fallen below 4 mA.	-
18	The pump is in *'Analog'*-"xx. side band" operating mode, a fault behaviour has been programmed in the *'Analog'* menu and the control current has risen above 20 mA.	-
19	The pump has detected too low a back pressure.	X
20	No connection between the optional module and the bus.	-
21	An optional module is no longer found.	-

* Please get in touch with the ProMinent head office should this fault occur.

15.3.2 Warning messages in the log book



For more information on the 'WARNING' messages - refer to the chapter "Warning messages on the LCD screen".

Tab. 23: Warnings

Log book no.	Description
0	The fluid level in the storage tank has reached "Liquid level low 1st stage".
1	The diaphragm is broken.
2	The metering monitor reports more defective strokes than were set in the *'Inputs/Outputs'* menu.
3	The metering volume cannot be metered.
4	A set parameter is invalid.
5	The fan is faulty or not connected.
6	An internal system warning or an incorrect solenoid assignment has been detected.
7	Gas bubbles in the liquid end (leaks, gaseous medium, cavitation).
8	The pump has detected too high a back pressure.
9	The pump cannot meter the capacity it has calculated from the settings.
10	The pump has detected too low a back pressure.
11	Cavitation in the liquid end.

15.3.3 Event messages in the log book

Tab. 24: Events

Log book no.	Description
0	Head change is active – dongle was inserted.
1	Parameter menu called up – dongle was inserted.
2	Air gap measured – dongle was inserted.
3	Too high current was detected but no fault message generated.
4	The controller data was not plausible.
5	Automatic bleed was active.
6	The pump status has changed.
7	The pump was reset to factory settings.
8	The pump was calibrated.
9	*[START/STOP]* was pressed.
10	*[Priming]* was pressed.
11	The *[Clickwheel]* was pressed.
12	The diaphragm was replaced.
13	The timer performed an action.
14	A relay has triggered.
15	Solenoid identification was performed.

Log book no.	Description
16	CRC error has been detected in the EEProm data. *Log book:* [hh ll 00 00] hh – MSB address ll – LSB address [00 00 rr ss] ss – Struct rr – Result
17	Overloading has been detected. *Log book:* [00 PP zz ii] PP – Solenoid power [W] zz – Uzk [V] ii – Solenoid current [* 100 mA]
18	The metering volume cannot be metered. In *'Contact'* operating mode, e.g. by too fast a contact sequence.
19	The pump has been booted and is operational.

15.3.4 Log book entry - Detailed view

Press the *[Clickwheel]* to obtain more information about a log book entry.

Tab. 25: Information on the detailed view

Line	Information
1	Date/time
2	Type of entry (fault, warning ...)
3	Total operating time, total number of strokes
4	Switching-on duration, stroke rate since switching on
5	Room temperature, status information on the error (for developers)

16 Decommissioning and disposal

Decommissioning

WARNING!

Danger from chemical residue

There is normally chemical residue in the liquid end and on the housing after operation. This chemical residue could be hazardous to people.

- It is mandatory that the safety information in the "Storage, transport and unpacking" chapter are read before shipping or transport.
- Thoroughly clean the liquid end and the housing of chemicals and dirt. Adhere to the material safety data sheet for the feed chemical.

WARNING!

Warning of hazardous feed chemical

Should a dangerous feed chemical be used: it may escape from the hydraulic components when working on the pump, material failure or incorrect handling of the pump.

- Take appropriate protective measures before working on the pump (e.g. safety glasses, safety gloves, ...). Adhere to the material safety data sheet for the feed chemical.
- Drain and flush the liquid end before working on the pump.

WARNING!

Fire hazard with flammable media

Only with flammable media: They can be ignited by oxygen.

- The pump may not work if there is a mixture of feed chemical with oxygen in the liquid end. A specialist may need to take appropriate actions (using inert gas, ...).

CAUTION!

Warning of feed chemical spraying around

Feed chemical can spray out of the hydraulic components if they are manipulated or opened due to pressure in the liquid end and adjacent parts of the system.

- Disconnect the pump from the mains power supply and ensure that it cannot be switched on again by unauthorised persons.
- Depressurise the system before commencing any work on hydraulic parts.

Danger of damage to the device

Take into account the information in the "Storage, transport and unpacking" chapter if the system is decommissioned for a temporary period.

1. Disconnect the pump from the mains.
2. Drain the liquid end by turning the pump upside down and allowing the feed chemical to run out.

3. Flush the liquid end with a suitable medium; flush the dosing head thoroughly when using hazardous feed chemicals!

Disposal

WARNING!

Eye injury from compression spring

A compression spring is fitted in the pump in the drive magnet, which could cause eye injuries when opened.

– Do not dismantle the pump to dispose of it.

CAUTION!

Risk to the environment from the battery

There is a battery in the pump, which can have a toxic effect on the environment.

– Separate the battery from the remaining parts.
– Note the pertinent regulations currently applicable in your country!

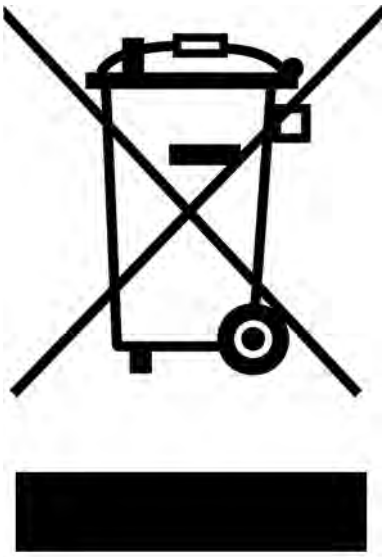
CAUTION!

Environmental hazard due to electronic waste

There are components in the pump, which can have a toxic effect on the environment.

– Note the pertinent regulations currently applicable in your country!

Sign indicating EU collection system



In accordance with the European Directive 2012/19/EU on waste electrical and electronic equipment, this device features the symbol showing a waste bin with a line through it. The device must not be disposed of along with domestic waste. To return the device, use the return and collection systems available and observe the local legal requirements.

17 Technical data

17.1 Performance data

gamma/ X operating at 200 strokes/minute and 100 % stroke length

Type	Pump capacity			Connector size Outside ∅ x inside ∅	Suction lift[1]	Priming lift[2]	Max. priming pressure on the suction side
	bar	l/h	ml/stroke	mm	m water column	m water column	bar
gamma/ X							
2002	20	2.05	0.17	6x3	6.0	2.5	5.5
1602	16	2.3	0.20	6x4	6.0	2.5	5.5
1604	16	3.6	0.30	6x4[4]	5.0	3.0	3
0708	7	7.6	0.63	8x5[4]	4.0	2.0	2
0414	4	13.5	1.13	8x5[4, ****]	3.0	2.5	1.5
0220	2	19.7	1.64	12x9[4]	2.0	2.0	1
2504	25	3.8	0.32	8x4[4, ***]	4.0	3.0	3
1009	10	9.0	0.75	8x5[4]	3.0	3.0	2
0715	7	14.5	1.21	8x5[4, ****]	3.0	3.0	1.5
0424	4	24.0	2.00	12x9[4]	3.0	3.0	1
0245	2	45.0	3.70	12x9	2.0	2.0	0.8
gamma/ X metering pumps with self-bleeding dosing head SER[3]*****							
1602	10	0.9*	0.08	6x4	1.8	1.2	0.5
1604	10	2.4*	0.13	6x4	1.8	1.2	0.5
0708	7	5.7	0.48	8x5	1.8	1.0	0.5
0414	4	12.0	1.00	8x5	1.8	1.4	0.5
0220	2	17.4	1.45	12x9	1.8	1.7	0.5
1009	10	6.0	0.50	8x5	1.8	1.0	0.5
0715	7	12.9	1.08	8x5	1.8	1.4	0.5
0424	4	19.2	1.60	12x9	1.8	1.7	0.5
gamma/ X metering pumps with self-bleeding dosing head SEK[3]							
1602	10	1.3*	0.11	6x4	2.1	-	0.5
1604	10	2.4*	0.21	6x4	2.7	-	0.5
0708	7	6.8	0.57	8x5	2.0	-	0.5
0414	4	12.0	1.00	8x5	2.0	-	0.5
0220	2	18.0	1.50	12x9	2.0	-	0.5
1009	10	8.0	0.67	8x5	3.0	-	0.5
0715	7	13.5	1.12	8x5	2.5	-	0.5
0424	4	20.0	1.67	12x9	2.5	-	0.5

* - The capacity can significantly fall at pressures above the nominal pressure.

1 - Suction lift with a filled suction line and filled liquid end. With self-bleeding dosing head with air in the suction line.

2 - Priming lift with clean and moist valves. Priming lift at 100 % stroke length and free outlet or opened bleed valve.

3 - The given performance data represents guaranteed minimum values calculated using water as the medium at room temperature. The bypass connection with a self-bleeding dosing head SEK is 6x4 mm.

4 - These pump types are also available with dosing heads for higher-viscosity media (HV). The pump types have a 10 ... 20 % lower capacity and are not self-priming.

*** - with stainless steel design 6 mm connector width

**** - with stainless steel design 12 mm connector width

***** - The SER valve is only approved up to a pressure of 10 bar. We recommend operating a pump with a SER valve of between 1 ... 7 bar.

All data calculated with water at 20 °C.

17.2 Accuracy

17.2.1 Standard Liquid End

Data	Value	Unit
Capacity range of the series	-5 ... +10	% *
Reproducibility	±2	% **

* - at max. stroke length and max. operating pressure for all material versions

** - at constant conditions and min. 30 % stroke length

17.2.2 Self-Bleeding Liquid End

As the self-bleeding liquid end is used with outgassing media and when operating with air bubbles, no dosing accuracy or reproducibility can be provided.

The recommended minimum stroke length with self-bleeding dosing pumps is 50 %.

17.3 Viscosity

The liquid ends are suitable for the following viscosity ranges:

Design	Range	Unit
Standard	0 ... 200	mPas
With valve springs	200 ... 500	mPas
With HV head	500 ... 3000*	mPas
Self-bleeding (SEK)	0 ... 50	mPas

* Even significantly higher with corrected adjusted installation. Contact Technical; Support in Heidelberg.

17.4 Material specifications

Standard liquid ends

Design	Dosing head	Valves	Seals	Balls
PPT	Polypropylene	PVDF	PTFE	Ceramic
NPT	Clear acrylic	PVDF	PTFE	Ceramic
PVT	PVDF	PVDF	PTFE	Ceramic
PPE	Polypropylene	EPDM	EPDM	Ceramic
PPB	Polypropylene	FKM	FKM	Ceramic
NPE	Clear acrylic	EPDM	EPDM	Ceramic
NPB	Clear acrylic	FKM	FKM	Ceramic
TTT	PTFE	PTFE	PTFE	Ceramic
SST	Stainless steel 1.4404	Stainless steel 1.4404/1.4571	PTFE	Ceramic

Diaphragm: with PTFE coating.

FKM = fluorine rubber.

Drive unit

Housing parts: Polyphenylene ether (PPE with fibreglass)

17.5 Electrical data

Design: 100 - 230 V ±10 %, 50/60 Hz, gamma/ X GMXa

Parameter	M70	M85
Nominal power**, approx.	25 W	30 W
Current I eff	0.25 ... 0.10 A	0.30 ... 0.12 A
Switch on peak current (for 3 ...5 ms)	20 A	20 A
Fuse*	2.5 slow blow	2.5 slow blow

** With relay closed: The nominal power rises by 1 W.

* Fuses must have VDE, UL and CSA certification. e.g. type 19195 manufactured by Wickmann in compliance with IEC Publ. 127 - 2/3

17.6 Temperatures

Pump, fully assembled

Data	Value	Unit
Storage and transport temperature:	-20 ... +50	°C
Ambient temperature in operation (power end/drive and control):	-10 ... +45	°C
Medium temperature:	-10 °C ... see following table	

Liquid ends

Material version	Long term	Temporary *
PP	50 °C	100 °C
NP	45 °C	60 °C
PV	50 °C	120 °C
SS	50 °C	120 °C
TT	50 °C	120 °C

* Max. temp., for 15 min at max. 2 bar, depending on the ambient temperature

17.7 Climate

Data	Value	Unit
Maximum air humidity*:	95	% relative humidity

* Non-condensing

Test: Humid heat, cyclical,

in accordance with EN 680068-2-30: 2005

17.8 Altitude of site

Data	Value	Unit
Altitude of site , max.:	2000	m above NHN

17.9 Degree of Protection and Safety Requirements

Degree of protection

Protection against contact and humidity:

IP 66 according to DIN EN 60529 with contamination level 2

NEMA 4X / indoor as per NEMA 250

Safety Requirements

Degree of protection:

1 - mains power connection with protective earth conductor

17.10 Compatibility

Compatibility to the gamma/ L product range is guaranteed with the following components:

- Control cable Beta® 5-wire for "External" function.
- Control cable gamma/Vario 2-, 4- and 5-wire for the "External" function
- Level switch 2-stage (gamma / Beta® / delta®)
- Dosing line cross-sections for gamma / Beta®
- Standard connector kit for gamma / Beta®
- Wall brackets for gamma / Beta®
- Dosing tanks and fixing plates

- Distance between suction and pressure connector
- Distance between the connectors and the pump fixing holes
- Distance between the pump fixing holes
- Identical use of accessories, such as back pressure valves, multifunctional valves and flushing assembly
- Compatibility of resistance by the equivalence of the material used for the liquid ends

Compatibility to the gamma/ L product range is not guaranteed for the following points:

- External dimensions of the pump
- Distance between the support surface for the mounting foot and the centre of the dosing head
- Metering monitor

17.11 Shipping weight

Shipping weight of gamma/ X types - in kg

Material	Types	
	2002, 1602, 1604, 0708, 0414, 0220	2504, 1009, 0715, 0424, 0245
PP, NP, PV, TT	3.6 .. 3.7	4.9 ... 5.2
SS	4.1 ... 5.0	5.5 ... 7.0

17.12 Sound pressure level

Sound pressure level

Sound pressure level LpA < 70 dB according to EN ISO 20361

at maximum stroke length, maximum stroke rate, maximum back pressure (water)

18 Exploded drawings and ordering information

18.1 Exploded drawings

Liquid end gamma/ X 1602 - 1604 PP_2

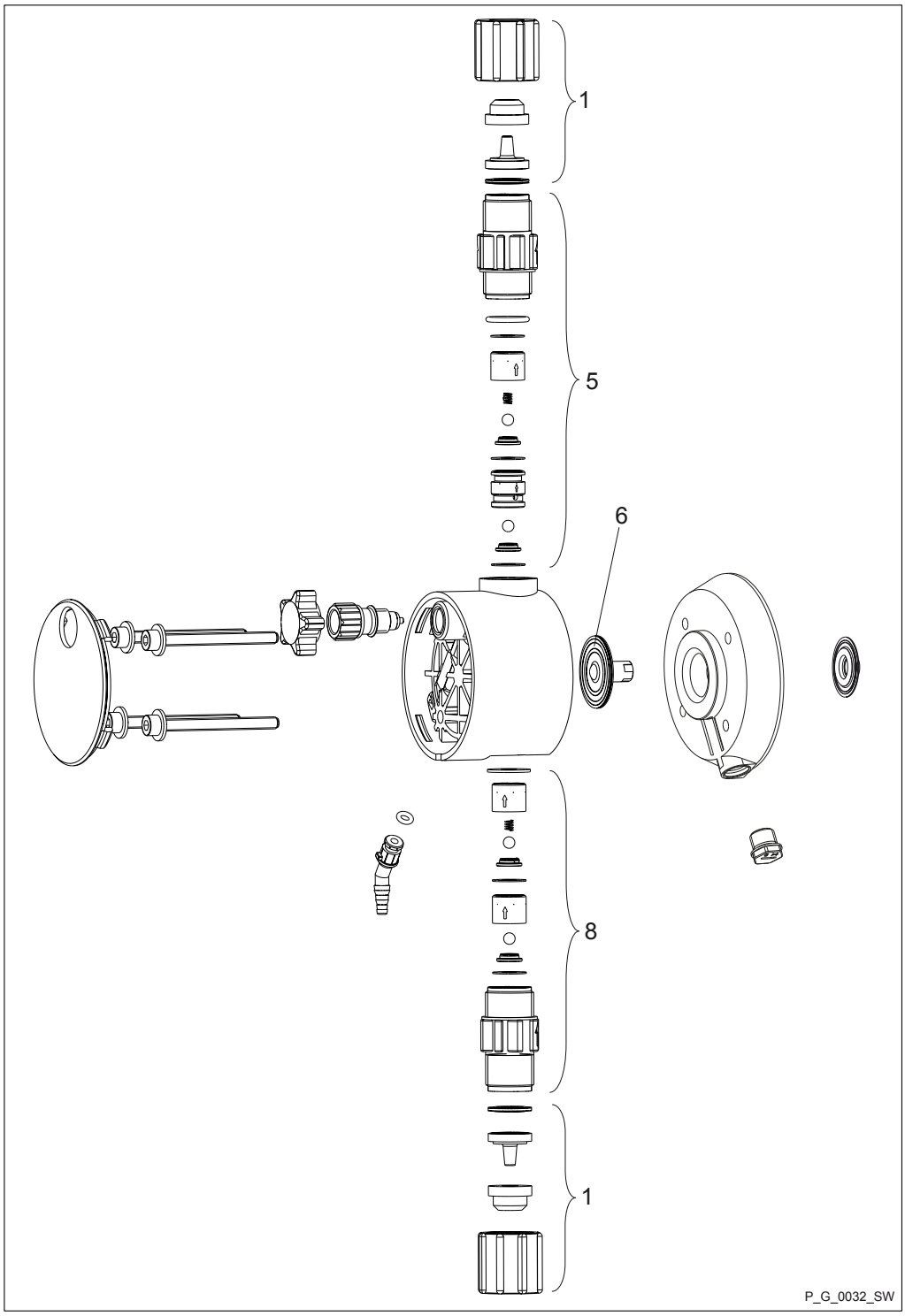


Fig. 40

Tab. 26: Spare parts for liquid end gamma/ X 1602 - 1604 PP_2

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 1602 PP_2

	PPE2	PPB2	PPT2
Liquid end	1050931	1050900	1050942
Spare parts kit	1001646	1001654	1023109
Diaphragm	1000246	1000246	1000246

Liquid end gamma/ X 1604 PP_2

	PPE2	PPB2	PPT2
Liquid end	1050932	1050901	1050943
Spare parts kit	1039989	1039987	1035332
Diaphragm	1034612	1034612	1034612

Liquid end gamma/ X 0708 (1009) - 0220 (0424) PP_2

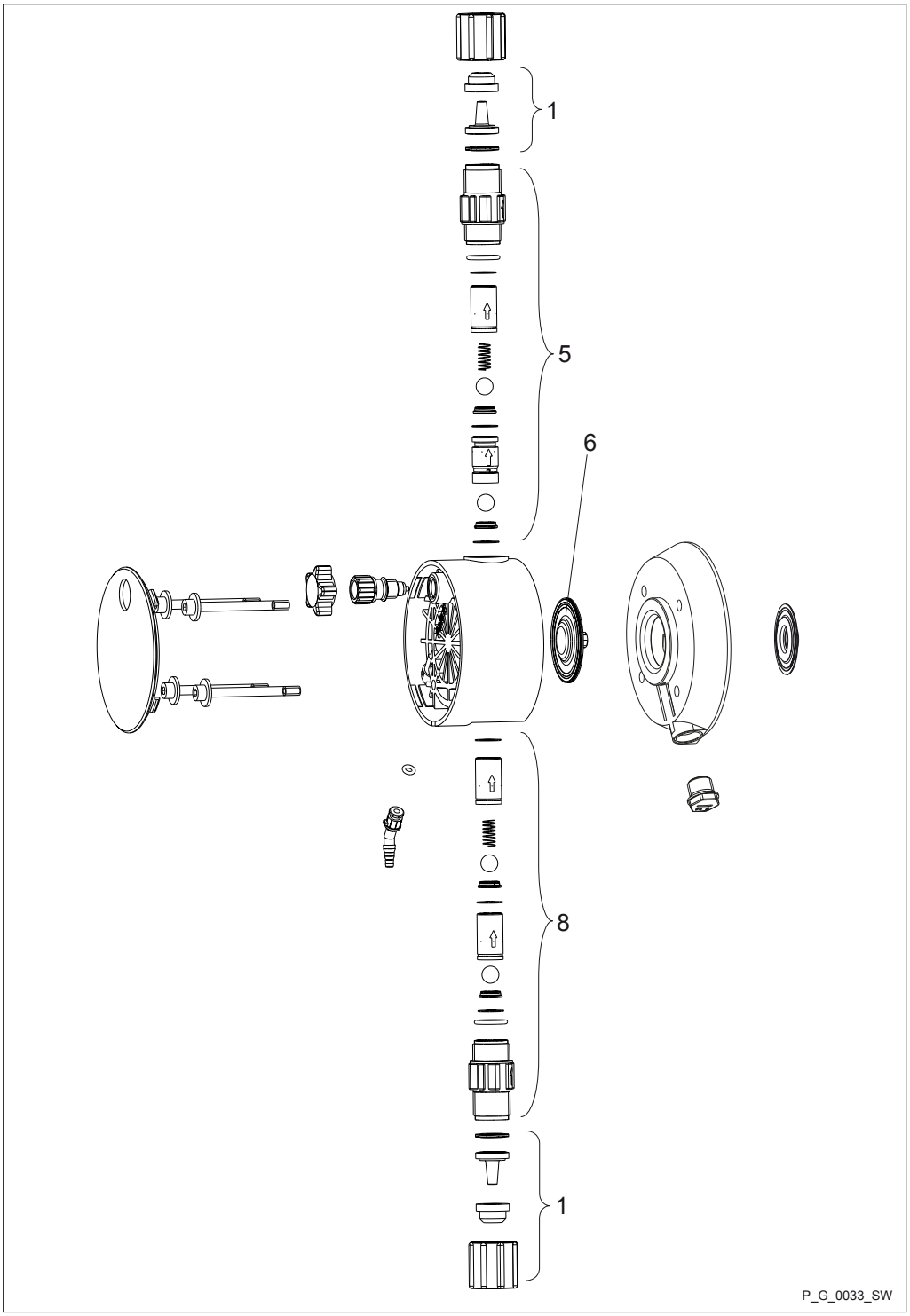


Fig. 41

Tab. 27: Spare parts for liquid end gamma/ X 0708 (1009) - 0220 (0424) PP_2

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0708 (1009) PP_2

	PPE2	PPB2	PPT2
Liquid end	1050933	1050902	1050944
Spare parts kit	1001648	1001656	1023111
Diaphragm	1000248	1000248	1000248

Liquid end gamma/ X 0414 (0715) PP_2

	PPE2	PPB2	PPT2
Liquid end	1050934	1050903	1050945
Spare parts kit	1001649	1001657	1023112
Diaphragm	1000249	1000249	1000249

Liquid end gamma/ X 0220 (0424) PP_2

	PPE2	PPB2	PPT2
Liquid end	1050935	1050924	1050946
Spare parts kit	1051096	1051085	1051129
Diaphragm	1045456	1045456	1045456

Liquid end gamma/ X 0245 PP_0

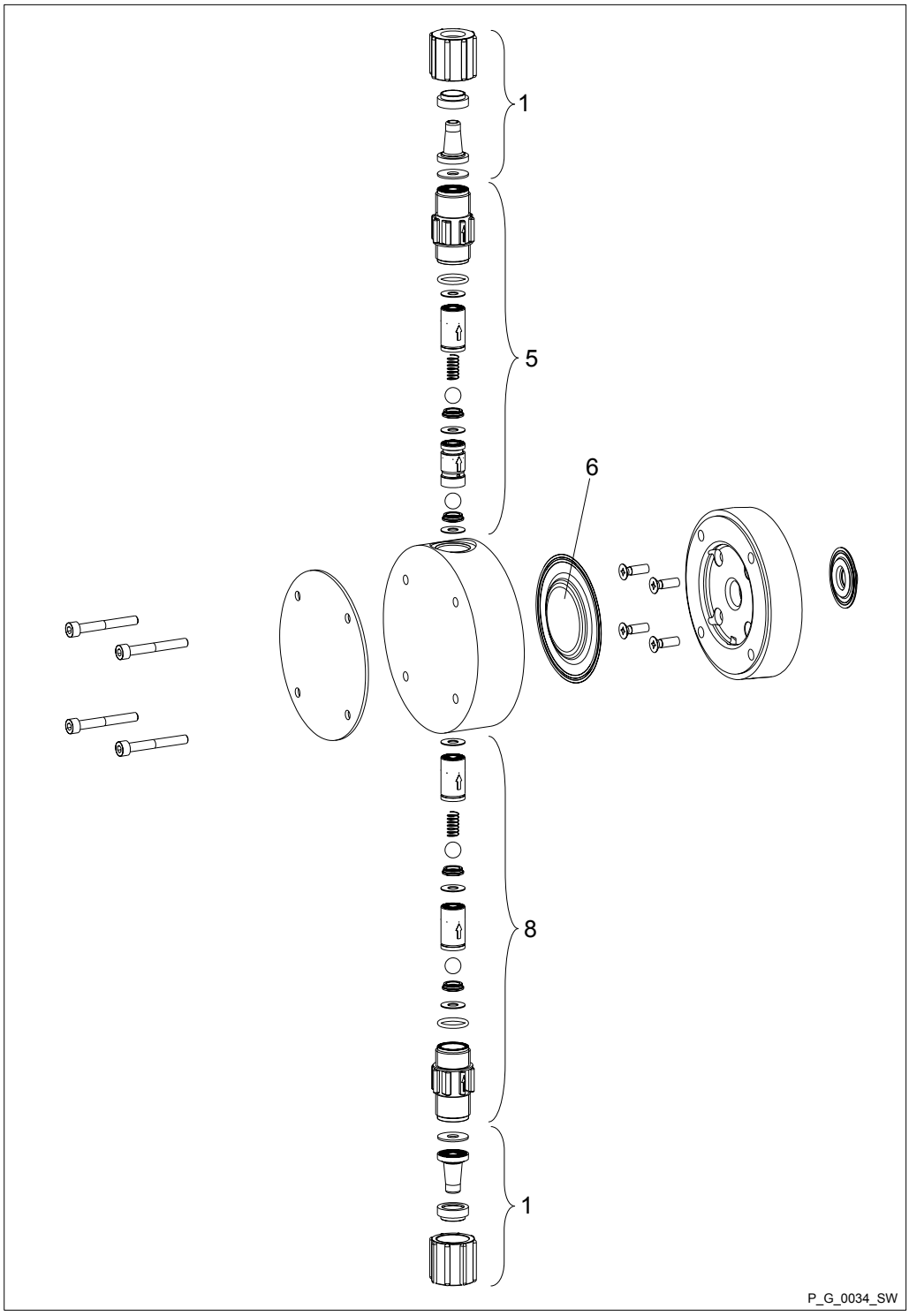


Fig. 42

Tab. 28: Spare parts kit for liquid end gamma/ X 0245 PP_0

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0245

	PPE0	PPB0	PPT0
Liquid end	1050936	1050925	1050947
Spare parts kit	1051097	1051086	1051130
Diaphragm	1045443	1045443	1045443

Liquid end gamma/ X 1602 - 2504 NP_0 and NP_2

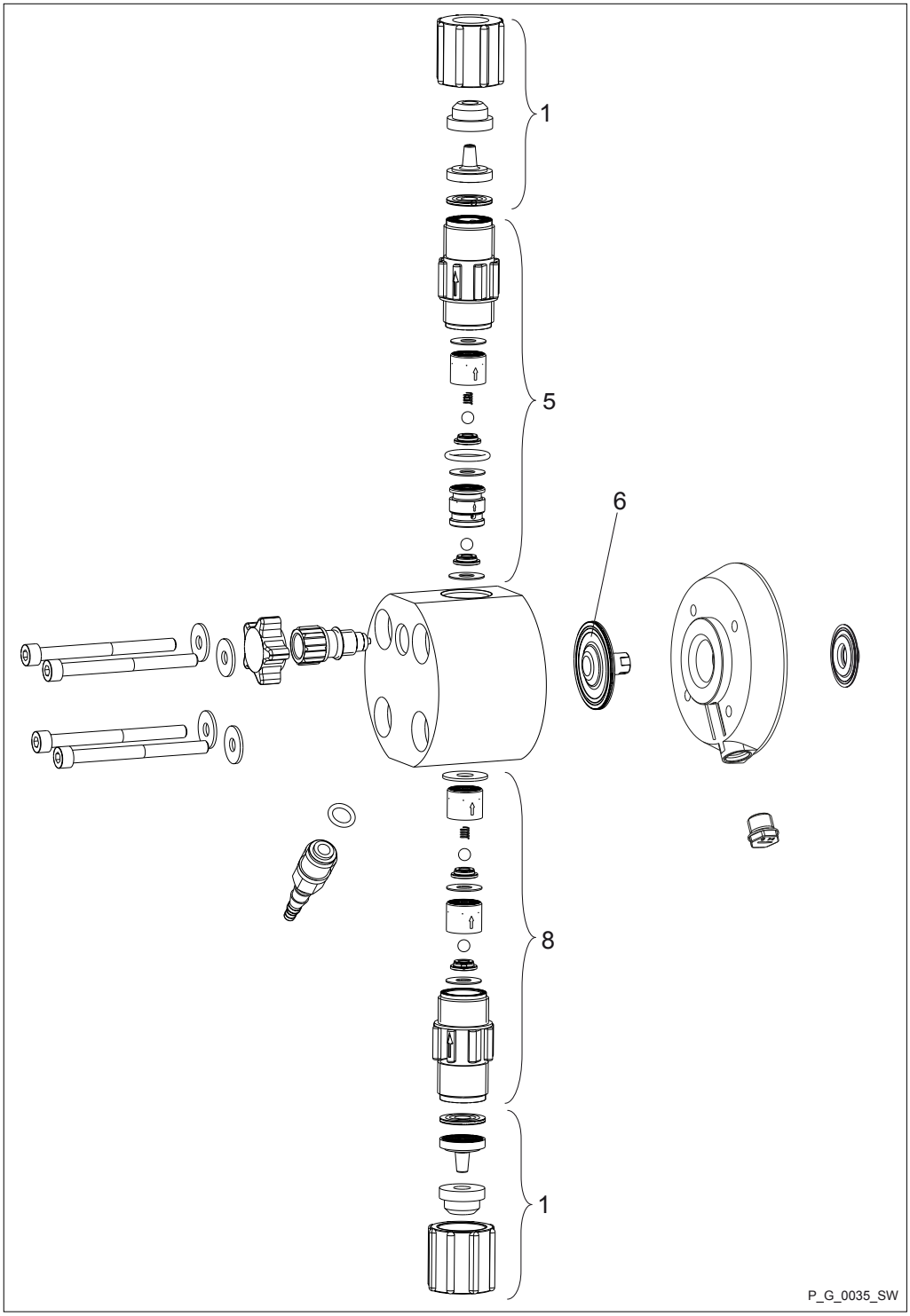


Fig. 43

Tab. 29: Spare parts for liquid end gamma/ X 1602 - 2504 NP NP_0 and NP_2

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 2002

	NPE_	NPB_	NPT_
Liquid end with bleed valve, _2	1050965	1050948	1050982
Liquid end without bleed valve, _0	1050971	1050954	1050988
Spare parts kit	1001715	1001723	1023109
Diaphragm	1000246	1000246	1000246

Liquid end gamma/ X 1602

	NPE_	NPB_	NPT_
Liquid end with bleed valve_2	1051073	1051071	1051087
Liquid end without bleed valve, _0	1051084	1051072	1051088
Spare parts kit	1001715	1001723	1023109
Diaphragm	1000246	1000246	1000246

Liquid end gamma/ X 2504

	NPE_	NPB_	NPT_
Liquid end with bleed valve, _2	1051175	1051163	1051179
Liquid end without bleed valve, _0	1051176	1051174	1051180
Spare parts kit	1039988	1039986	1035332
Diaphragm	1034612	1034612	1034612

Liquid end gamma/ X 1604

	NPE_	NPB_	NPT_
Liquid end with bleed valve, _2	1050966	1050949	1050983
Liquid end without bleed valve, _0	1050972	1050955	1050989
Spare parts kit	1039988	1039986	1035332
Diaphragm	1034612	1034612	1034612

Liquid end gamma/ X 0708 (1009) - 0220 (0424) NP_0 and NP_2

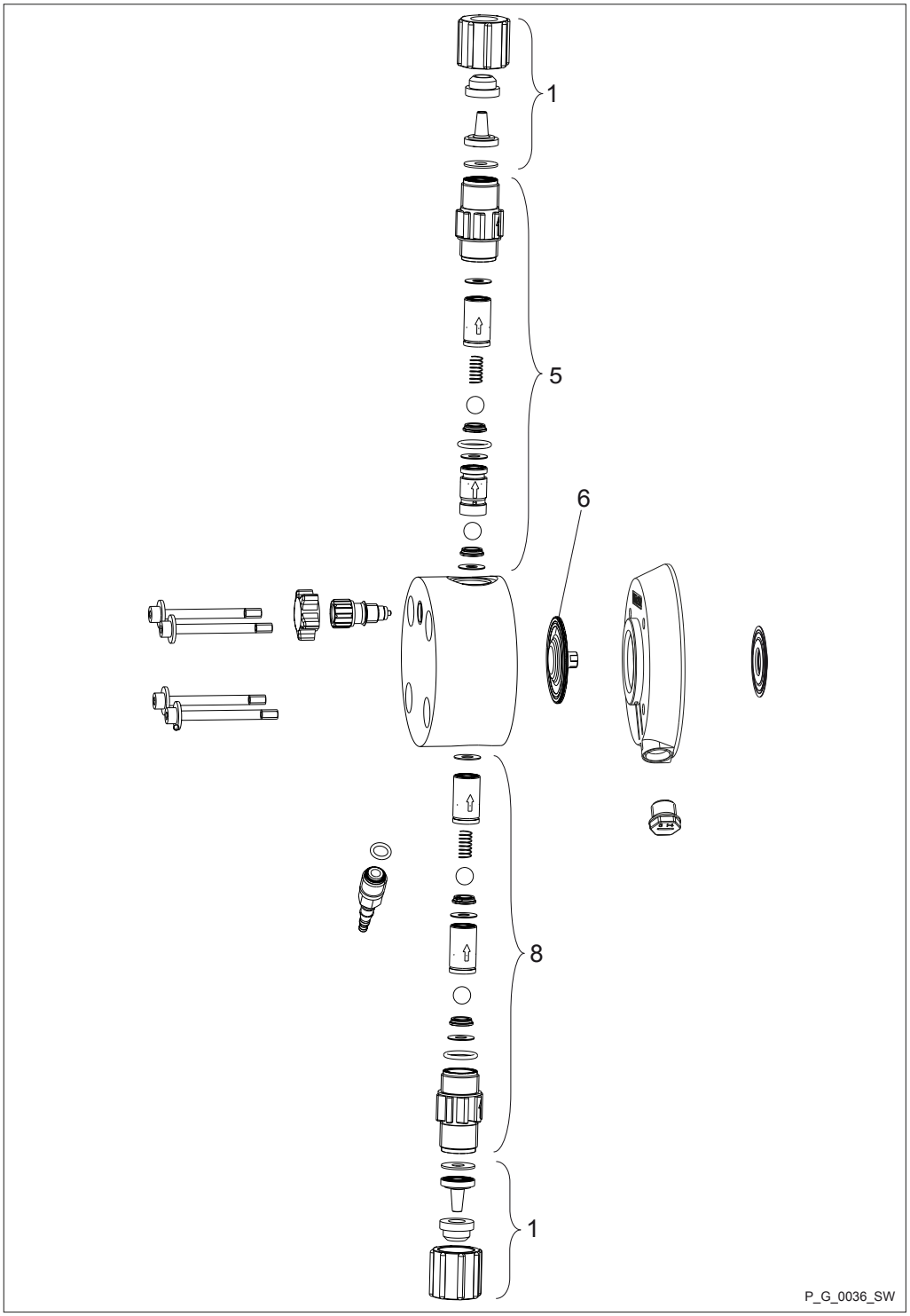


Fig. 44

Tab. 30: Spare parts for liquid end gamma/ X 0708 (1009) - 0220 (0424) NP_0 and NP_2

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0708 (1009)

	NPE_	NPB_	NPT_
Liquid end with bleed valve, _2	1050967	1050950	1050984
Liquid end without bleed valve, _0	1050973	1050956	1050990
Spare parts kit	1001717	1001725	1023111
Diaphragm	1000248	1000248	1000248

Liquid end gamma/ X 0414 (0715)

	NPE_	NPB_	NPT_
Liquid end with bleed valve, _2	1050968	1050951	1050985
Liquid end without bleed valve, _0	1050974	1050957	1050991
Spare parts kit	1001718	1001726	1023112
Diaphragm	1000249	1000249	1000249

Liquid end gamma/ X 0220 (0424)

	NPE_	NPB_	NPT_
Liquid end with bleed valve, _2	1050969	1050952	1050986
Liquid end without bleed valve, _0	1050975	1050958	1050992
Spare parts kit	1051118	1051107	1051129
Diaphragm	1045456	1045456	1045456

Liquid end gamma/ X 0245 NP_0 and NP_2

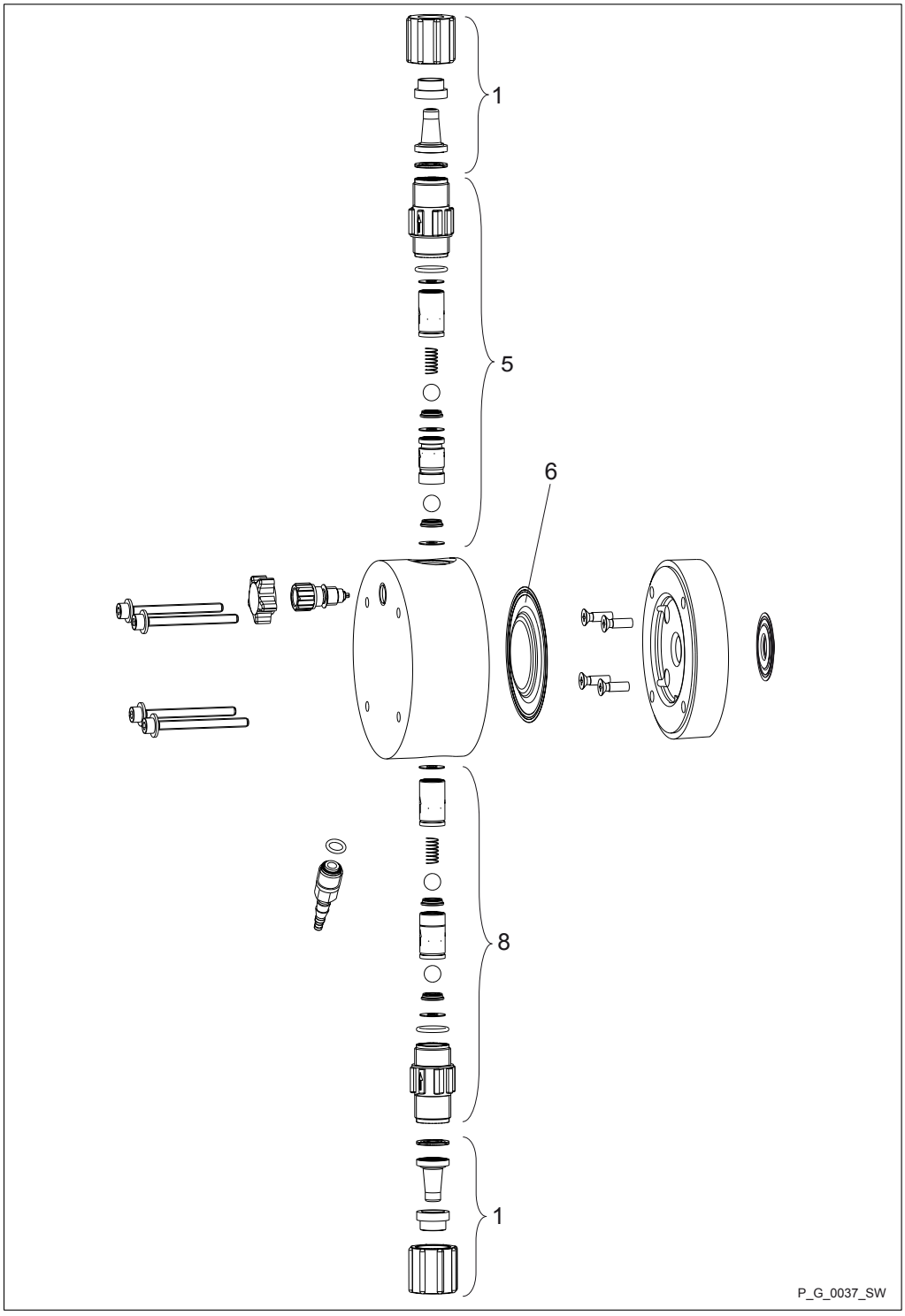


Fig. 45

Tab. 31: Spare parts for liquid end gamma/ X 0245 NPT0 and NPT2

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0245

	NPE_	NPB_	NPT_
Liquid end with bleed valve, _2	1050970	1050953	1050987
Liquid end without bleed valve, _0	1050976	1050959	1050993
Spare parts kit	1051119	1051108	1051130
Diaphragm	1045443	1045443	1045443

Liquid end gamma/ X 1602 - 1604 PVT2

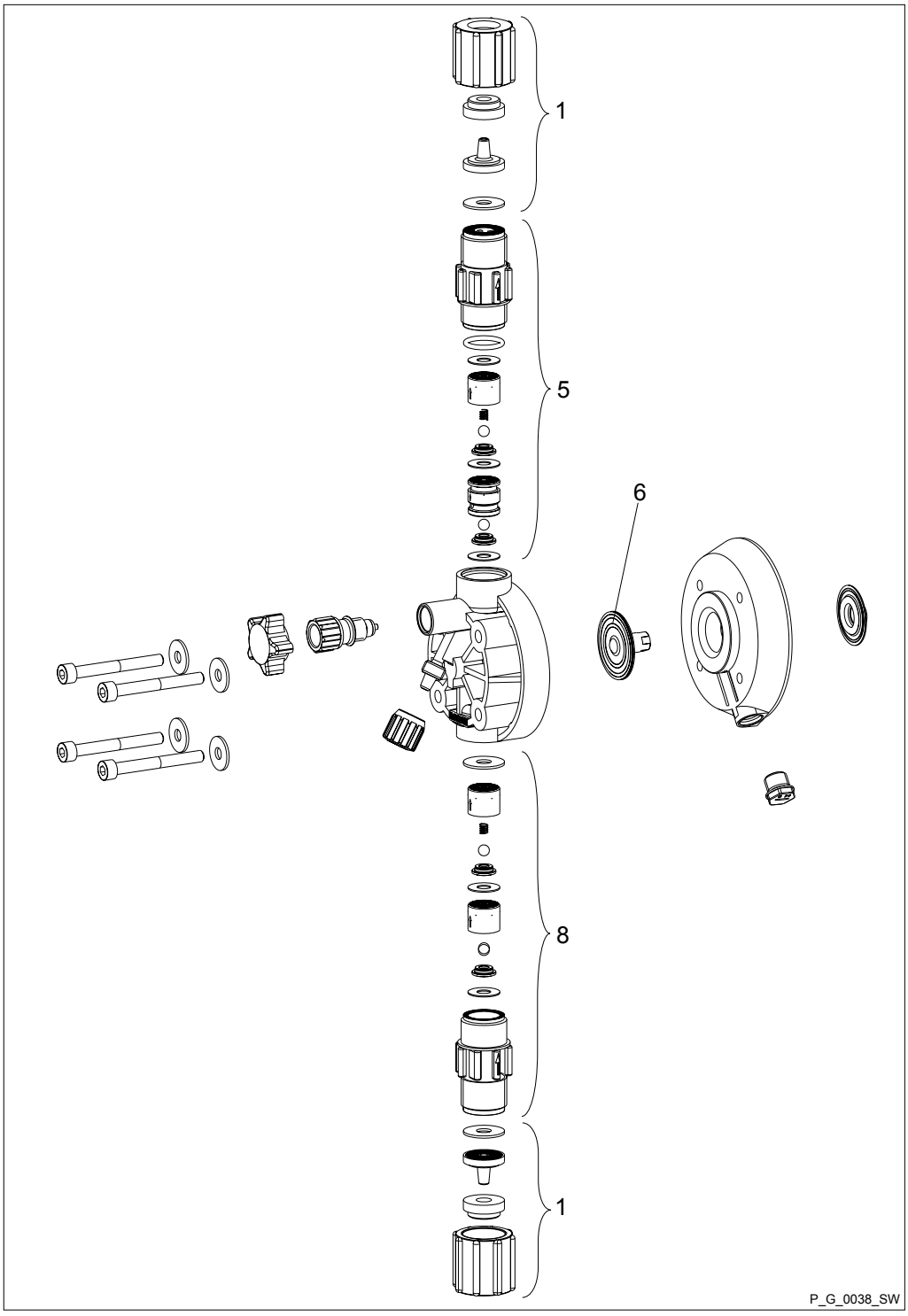


Fig. 46

Tab. 32: Spare parts for liquid end gamma/ X 1602 - 1604 PVT2

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 1602

	PVT2
Liquid end	1050994
Spare parts kit	1023109
Diaphragm	1000246

Liquid end gamma/ X 1604

	PVT2
Liquid end	1050995
Spare parts kit	1035332
Diaphragm	1034612

Liquid end gamma/ X 0708 (1009) - 0220 (0424) PVT2

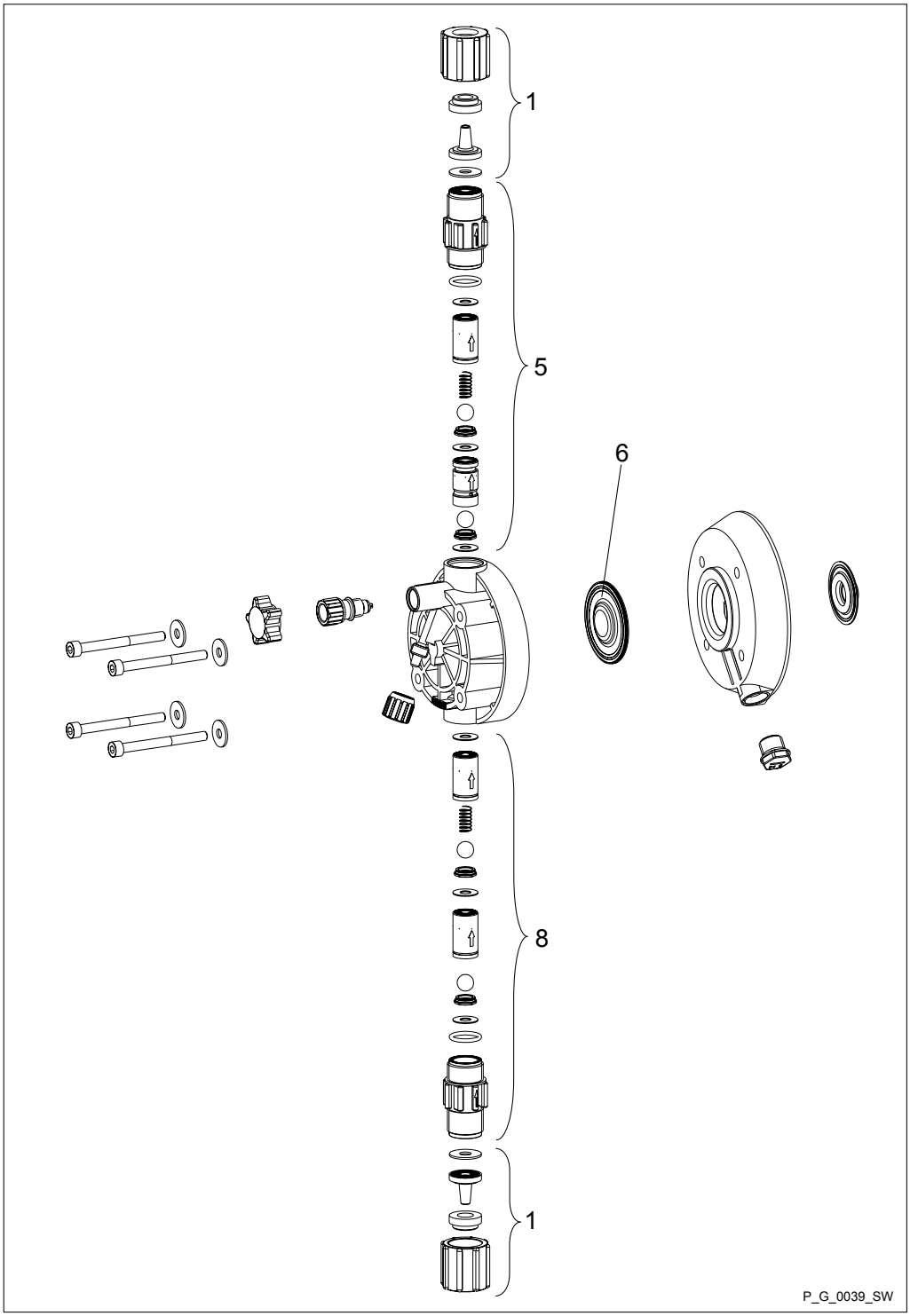


Fig. 47

Tab. 33: Spare parts kit for liquid end gamma/ X 0708 (1009) - 0220 (0424) PVT2

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0708 (1009)

	PVT2
Liquid end	1050996
Spare parts kit	1023111
Diaphragm	1000248

Liquid end gamma/ X 0414 (0715)

	PVT2
Liquid end	1050997
Spare parts kit	1023112
Diaphragm	1000249

Liquid end gamma/ X 0220 (0424)

	PVT2
Liquid end	1050998
Spare parts kit	1051129
Diaphragm	1045456

Liquid end gamma/ X 0245 PVT0

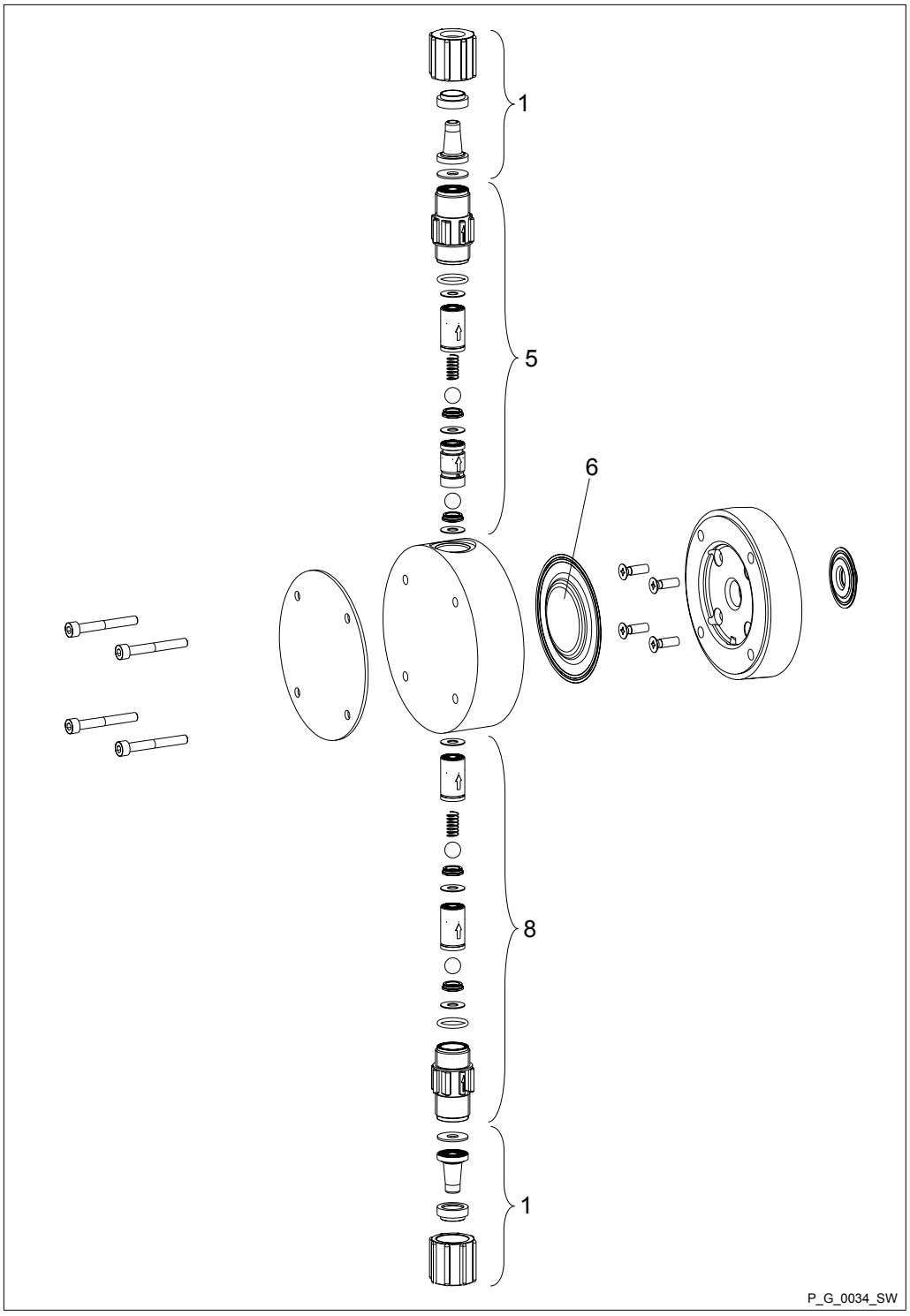


Fig. 48

Tab. 34: Spare parts kit for liquid end gamma/ X 0245 PVT0

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0245

	PVT0
Liquid end	1050999
Spare parts kit	1051130
Diaphragm	1045443

Liquid end gamma/ X 1604 - 0220 (0424)
PV_4

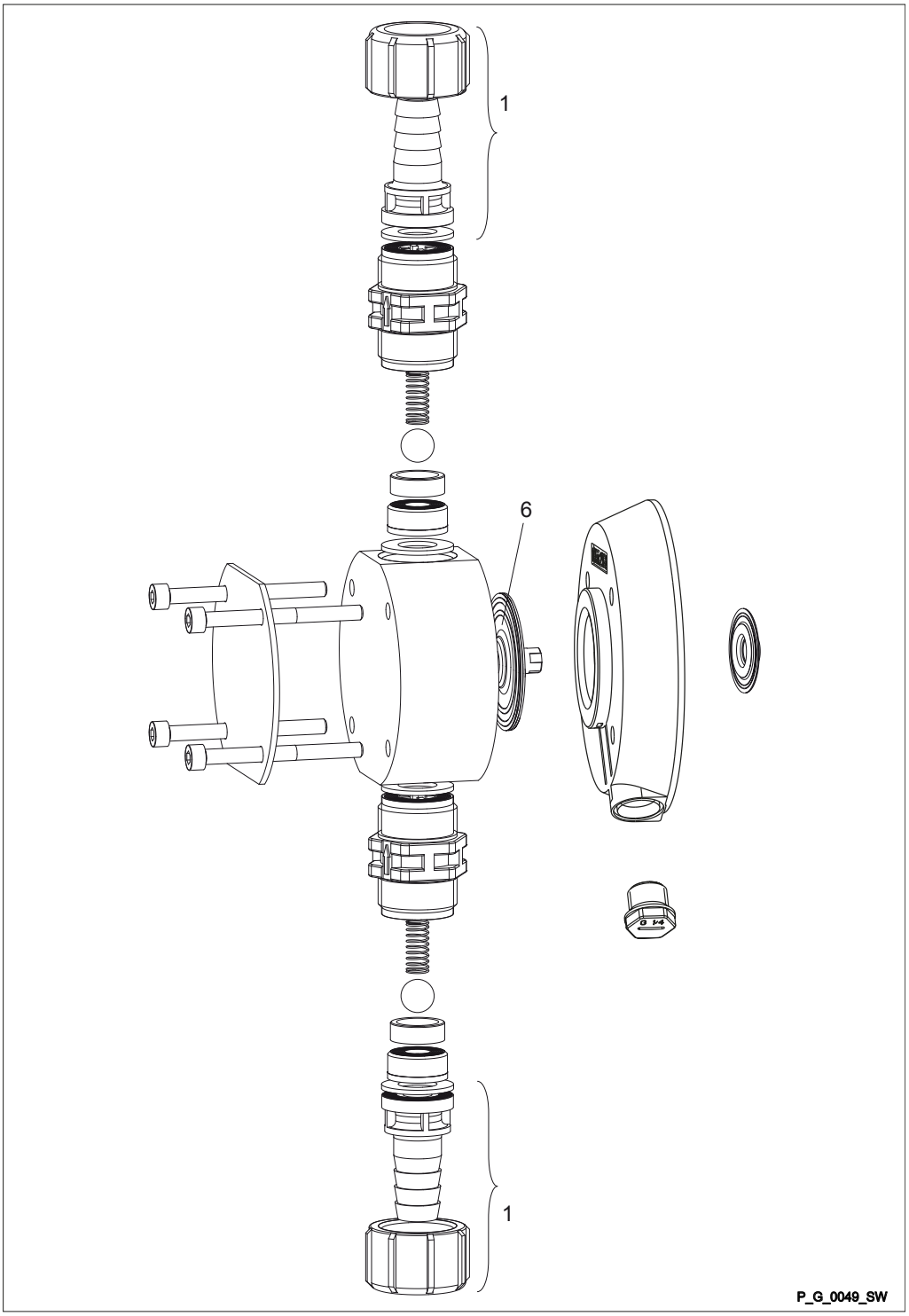


Fig. 49

Tab. 35: Spare parts kit for liquid end gamma/ X 1604 - 0220 (0424) PV_4

Pos.	Description
1	Connector kit with hose nozzle
6	Diaphragm

Liquid end gamma/ X 1604

	PV_4
Liquid end	1051000
Spare parts kit	1035342
Diaphragm	1034612

Liquid end gamma/ X 0708 (1009)

	PV_4
Liquid end	1051001
Spare parts kit	1019067
Diaphragm	1000248

Liquid end gamma/ X 0414 (0715)

	PV_4
Liquid end	1051002
Spare parts kit	1019069
Diaphragm	1000249

Liquid end gamma/ X 0220 (0424)

	PV_4
Liquid end	1051003
Spare parts kit	1051134
Diaphragm	1045456

Liquid end gamma/ X 1602 - 1604 TTT0

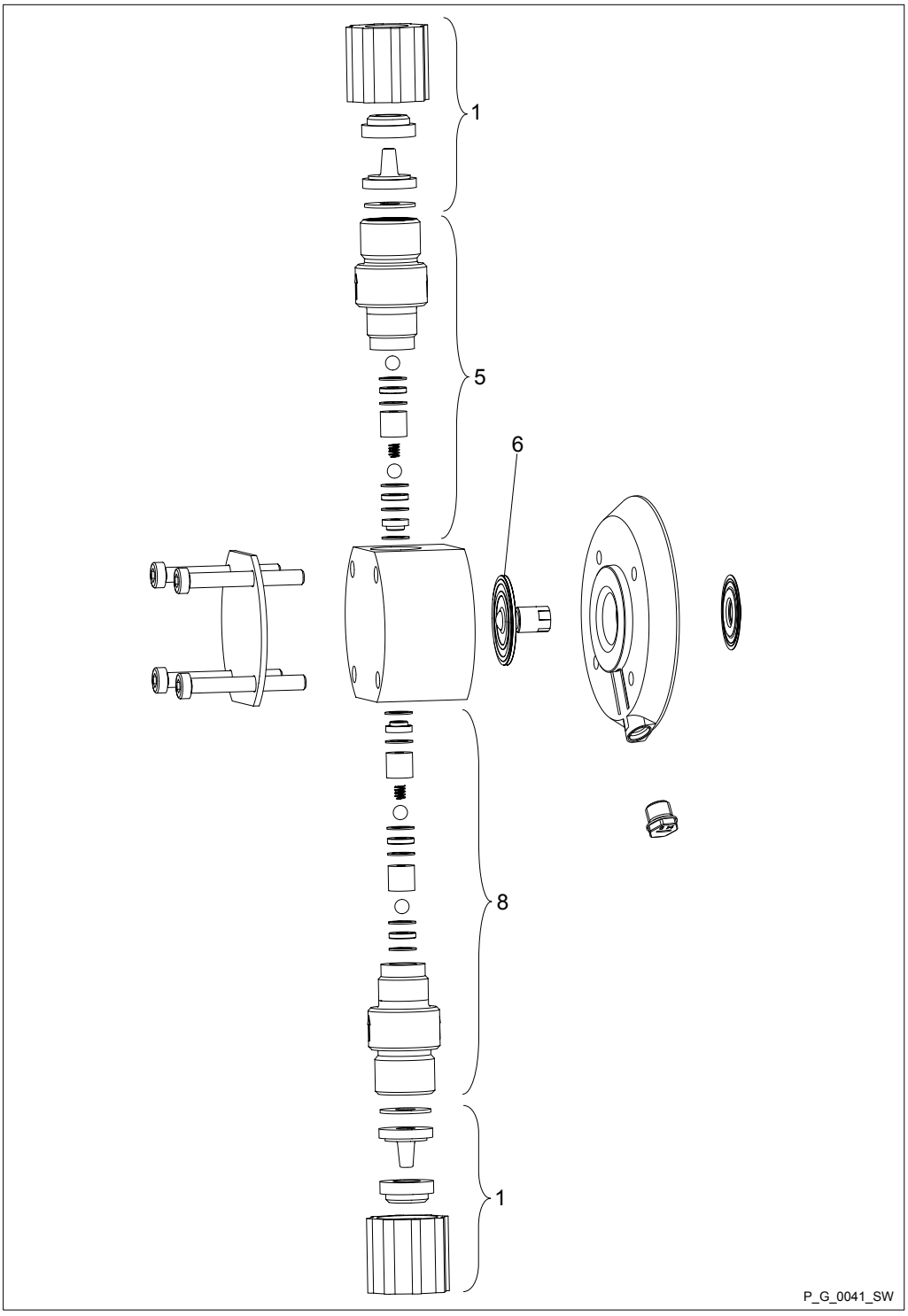


Fig. 50

Tab. 36: Spare parts for liquid end gamma/ X 1602 - 1604 TTT0

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 1602

	TTT0
Liquid end	1051016
Spare parts kit	1001739
Diaphragm	1000246

Liquid end gamma/ X 1604

	TTT0
Liquid end	1051017
Spare parts kit	1035331
Diaphragm	1034612

Liquid end gamma/ X 0708 (1009) - 0220 (0424) TTT0

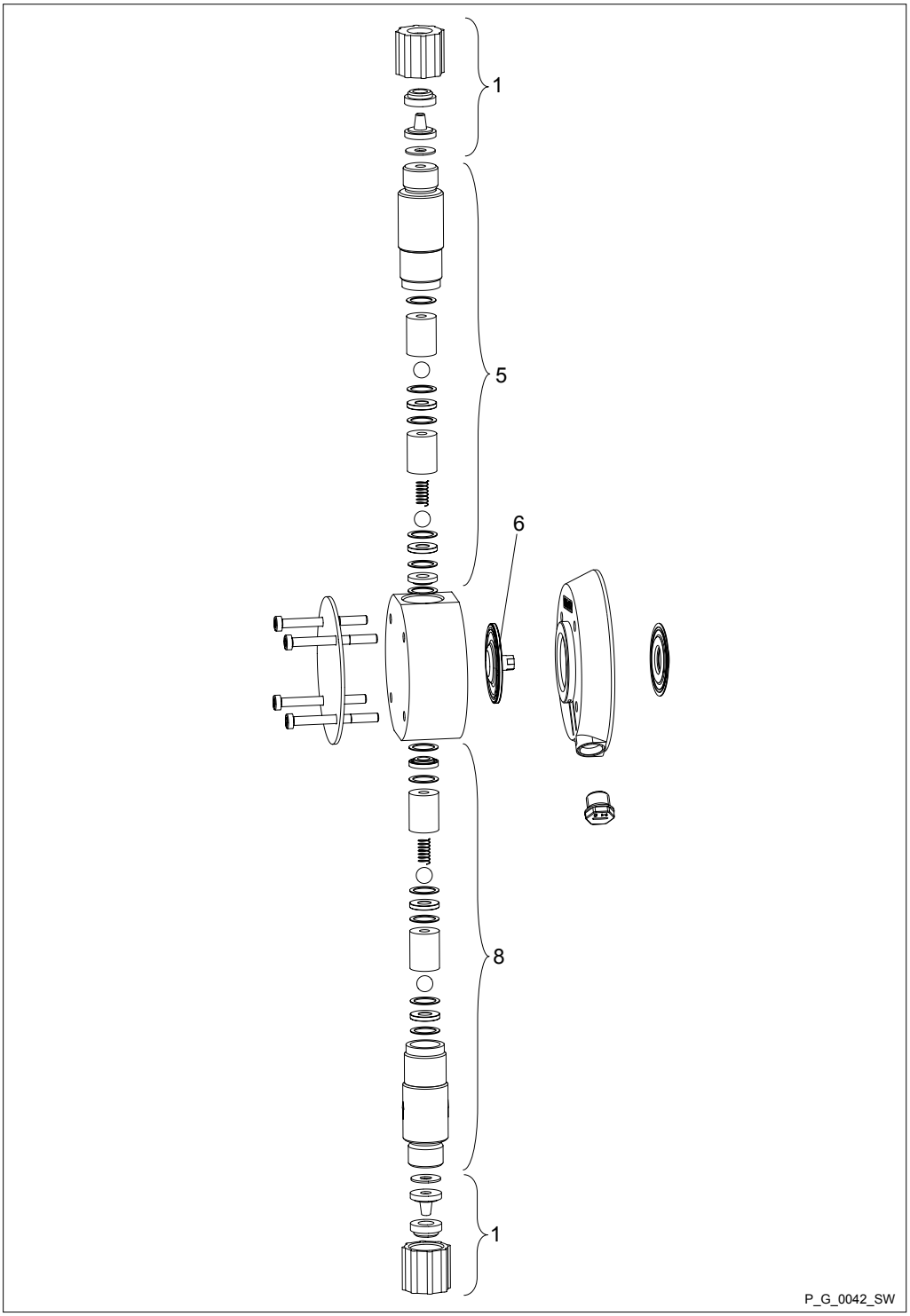


Fig. 51

Tab. 37: Liquid end gamma/ X 0708 (1009) - 0220 (0424) TTT0

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0708 (1009)

	TTT0
Liquid end	1051018
Spare parts kit	1001741
Diaphragm	1000248

Liquid end gamma/ X 0414 (0715)

	TTT0
Liquid end	1051019
Spare parts kit	1001742
Diaphragm	1000249

Liquid end gamma/ X 0220 (0424)

	TTT0
Liquid end	1051020
Spare parts kit	1051151
Diaphragm	1045456

Liquid end gamma/ X 0245 TTT0

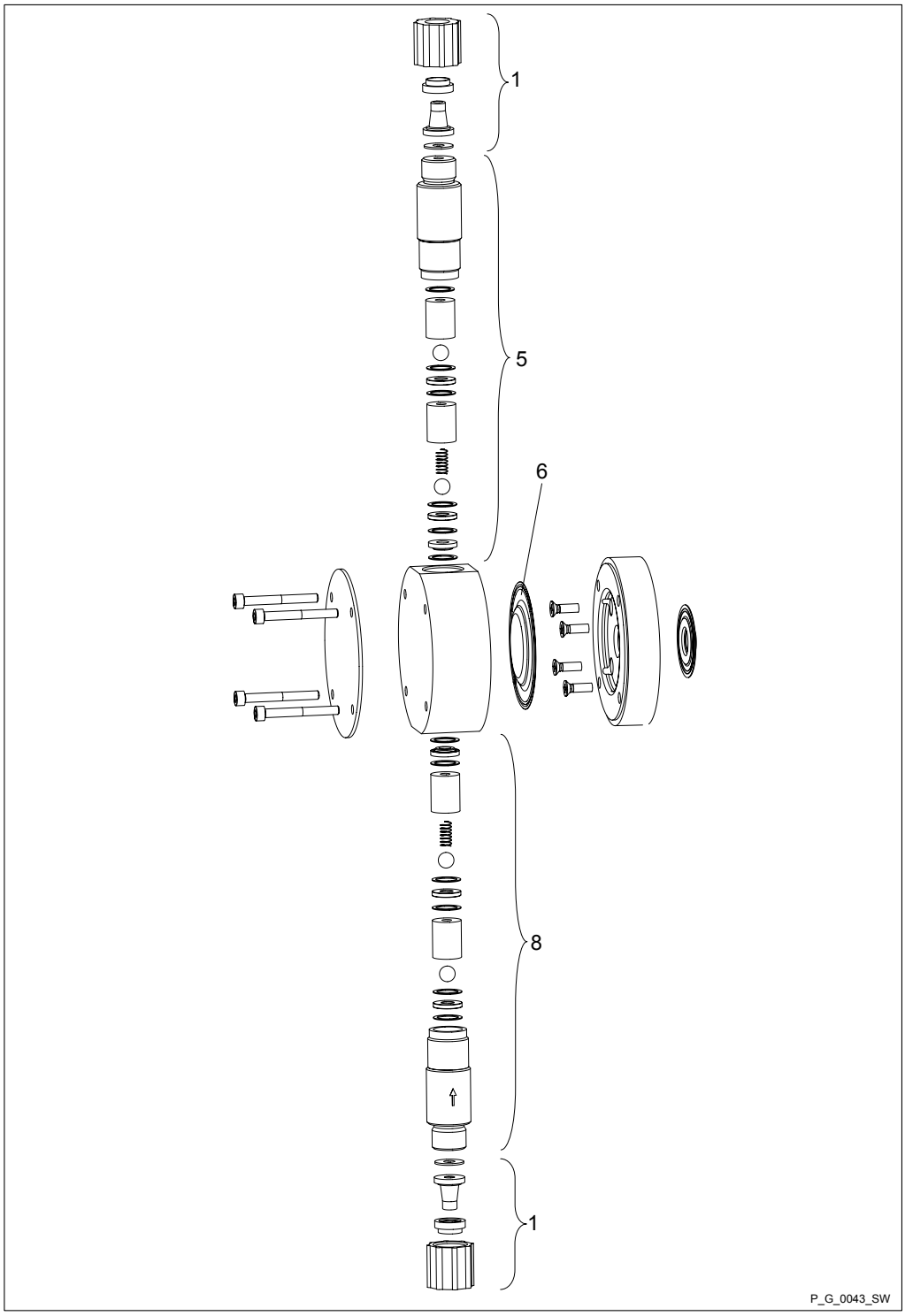


Fig. 52

Tab. 38: Spare parts kit for liquid end gamma/ X 0245 TTT0

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0245

	TTT0
Liquid end	1051021
Spare parts kit	1051152
Diaphragm	1045443

Liquid end gamma/ X 1602 - 2504 SST0

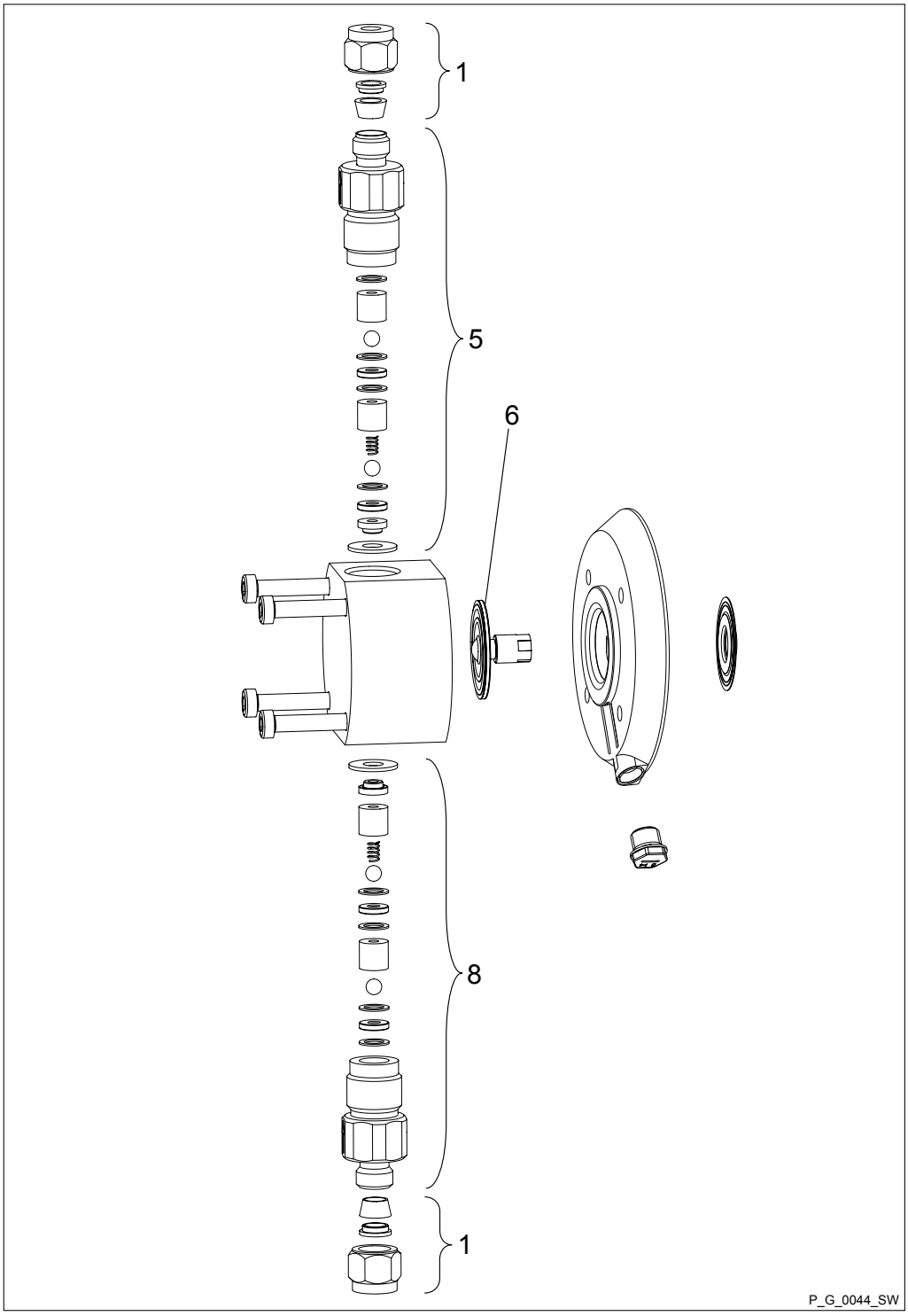


Fig. 53

Tab. 39: Spare parts for liquid end gamma/ X 1602 - 2504 SST0

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 1602 (2002)

	SST0
Liquid end	1051004
Spare parts kit	1001731
Diaphragm	1000246

Liquid end gamma/ X 1604 (2504)

	SST0
Liquid end	1051005
Spare parts kit	1035331
Diaphragm	1034612

Liquid end gamma/ X 0708 (1009) - 0220 (0424) SST0

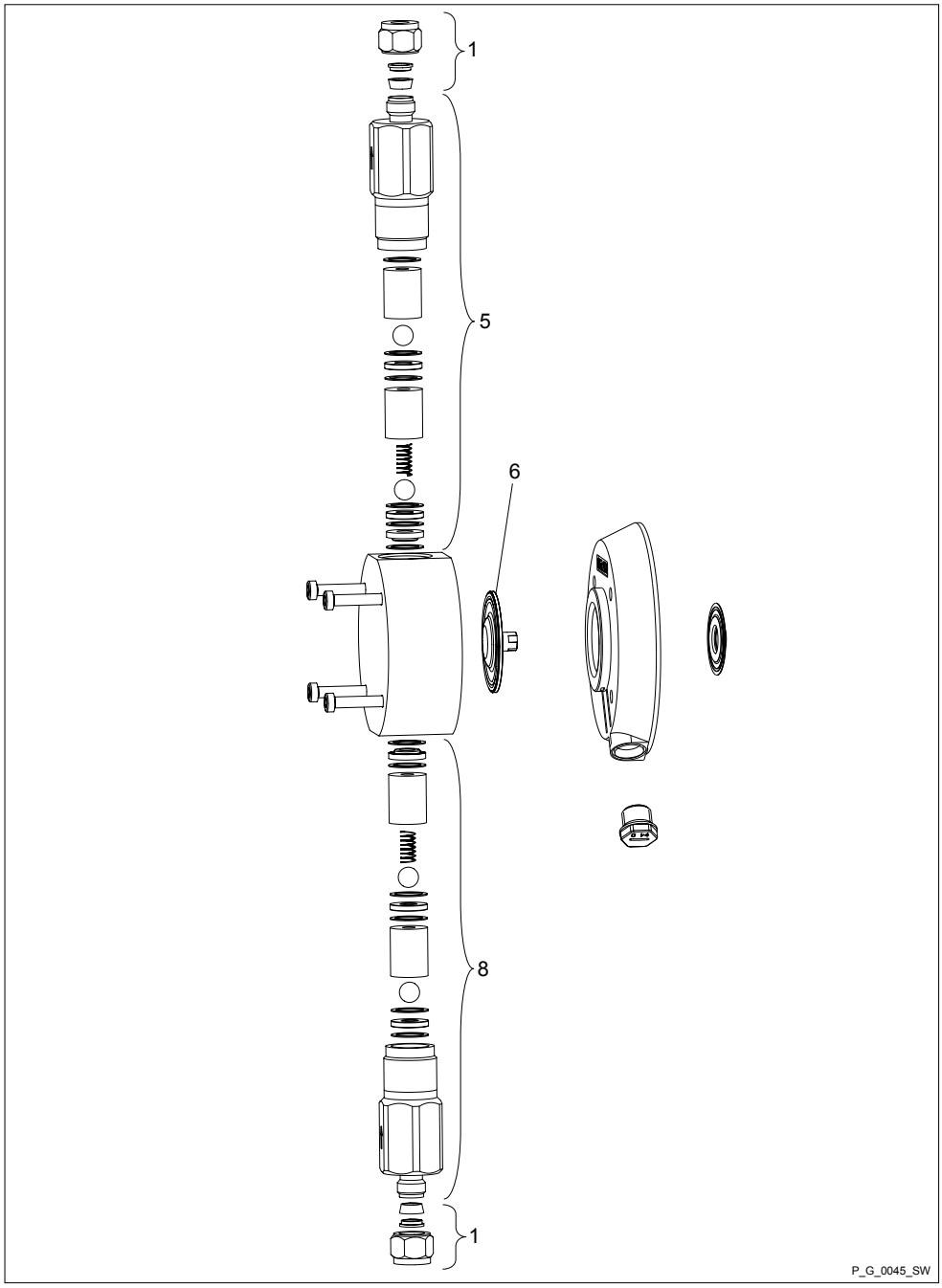


Fig. 54

Tab. 40: Spare parts kit for liquid end gamma/ X 0708 (1009) - 0220 (0424) SST0

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0708 (1009)

	SST0
Liquid end	1051006
Spare parts kit	1001733
Diaphragm	1000248

Liquid end gamma/ X 0414 (0715)

	SST0
Liquid end	1051007
Spare parts kit	1001734
Diaphragm	1000249

Liquid end gamma/ X 0220 (0424)

	SST0
Liquid end	1051008
Spare parts kit	1051139
Diaphragm	1045456

Liquid end gamma/ X 0245 SST0

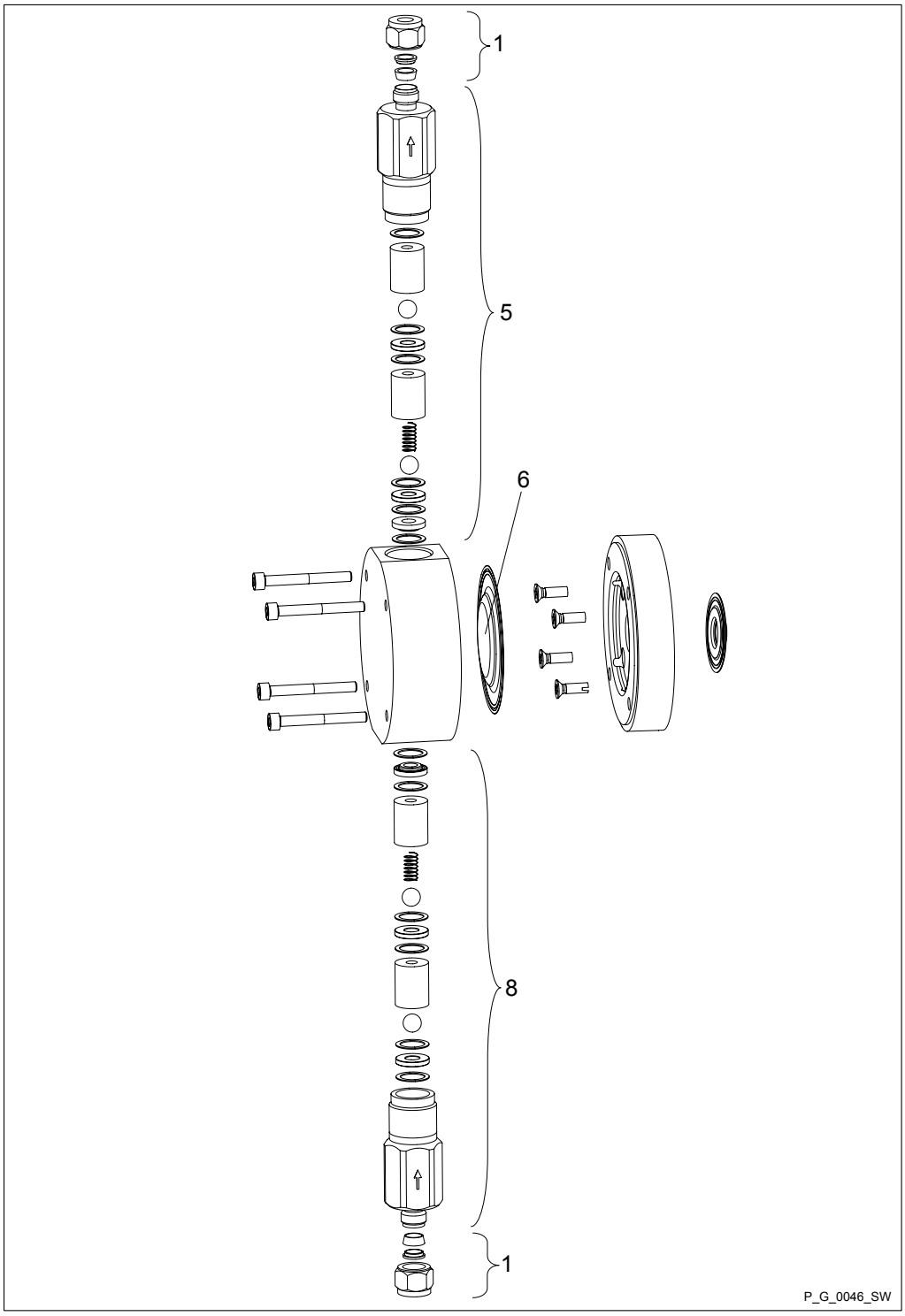


Fig. 55

Tab. 41: Spare parts kit for liquid end gamma/ X 0245 SST0

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0245

	SST0
Liquid end	1051009
Spare parts kit	1051140
Diaphragm	1045443

Liquid end gamma/ X 1602 -2504 SER, self-bleeding without bypass, NPT7

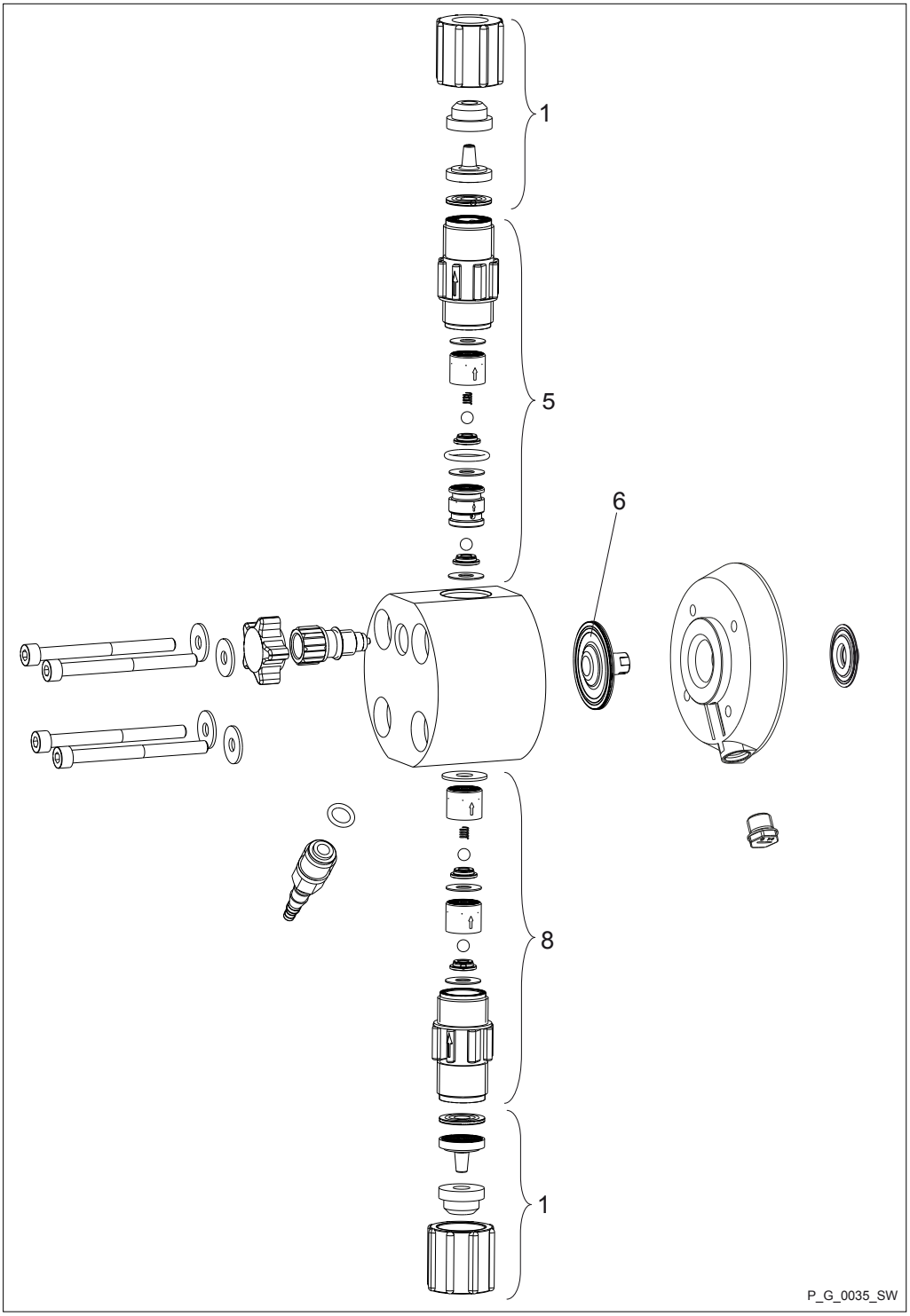


Fig. 56

Tab. 42: Spare parts for liquid end gamma/ X 1602 - 2504 SER, self-bleeding without bypass, NPT7

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 1602

	NPT7
Liquid end SER, self-bleeding without bypass	1051092
Spare parts kit	1047830
Diaphragm	1000246

Liquid end gamma/ X 1604

	NPT7
Liquid end SER, self-bleeding without bypass	1051093
Spare parts kit	1047858
Diaphragm	1034612

Liquid end gamma/ X 0708 (1009) - 0220 (0424) SER, self-bleeding without bypass, NPT7

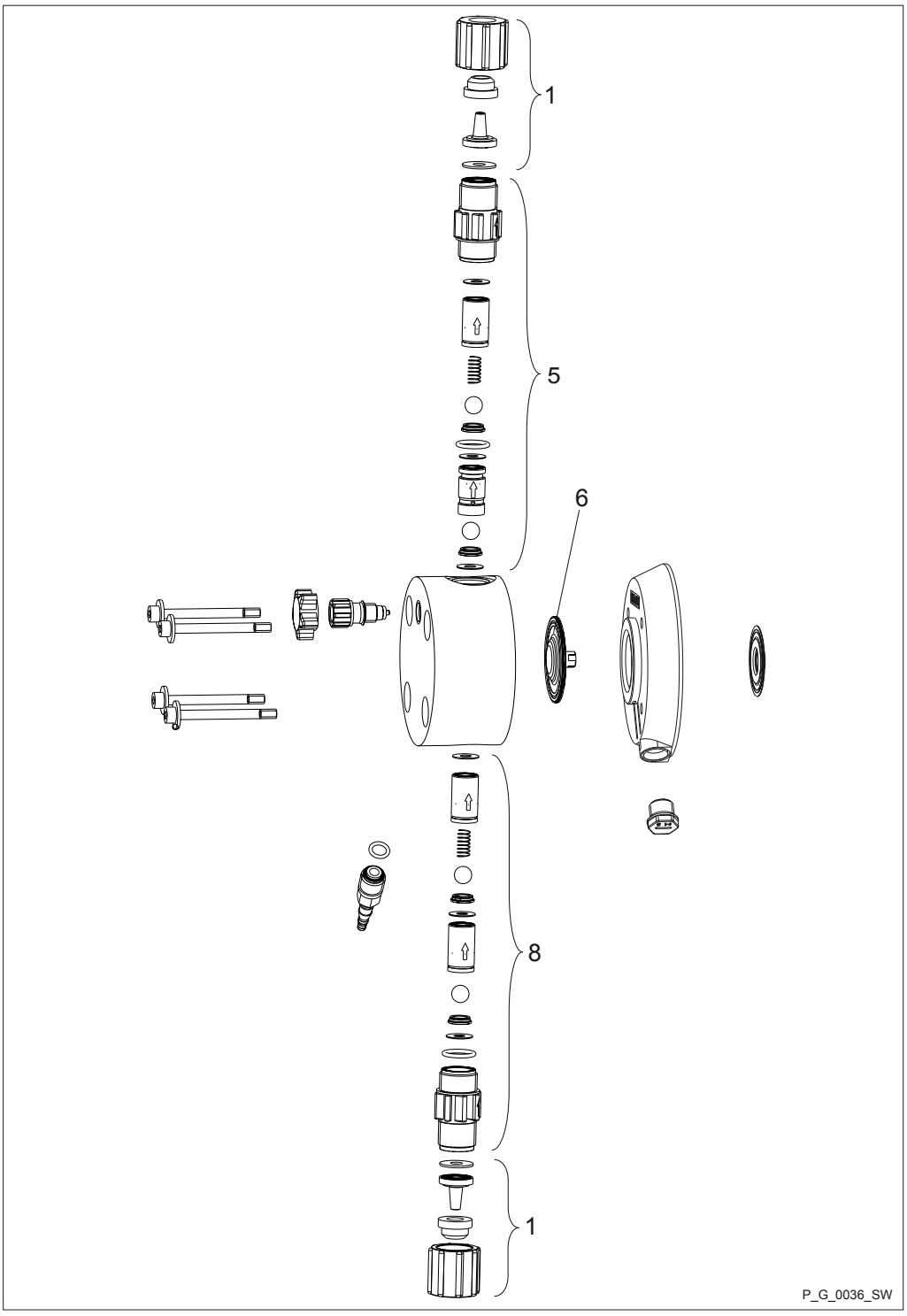


Fig. 57

Tab. 43: Spare parts for liquid end gamma/ X 0708 (1009) - 0220 (0424) SER, self-bleeding without bypass, NPT7

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0708 (1009)

	NPT7
Liquid end SER, self-bleeding without bypass	1051094
Spare parts kit	1047832
Diaphragm	1000248

Liquid end gamma/ X 0414 (0715)

	NPT7
Liquid end SER, self-bleeding without bypass	1051095
Spare parts kit	1047833
Diaphragm	1000249

Liquid end gamma/ X 0220 (0424)

	NPT7
Liquid end SER, self-bleeding without bypass	1051098
Spare parts kit	1047837
Diaphragm	1045456

**Liquid end gamma/ X 1602 - 1604 SER,
self-bleeding without bypass, PVT7**

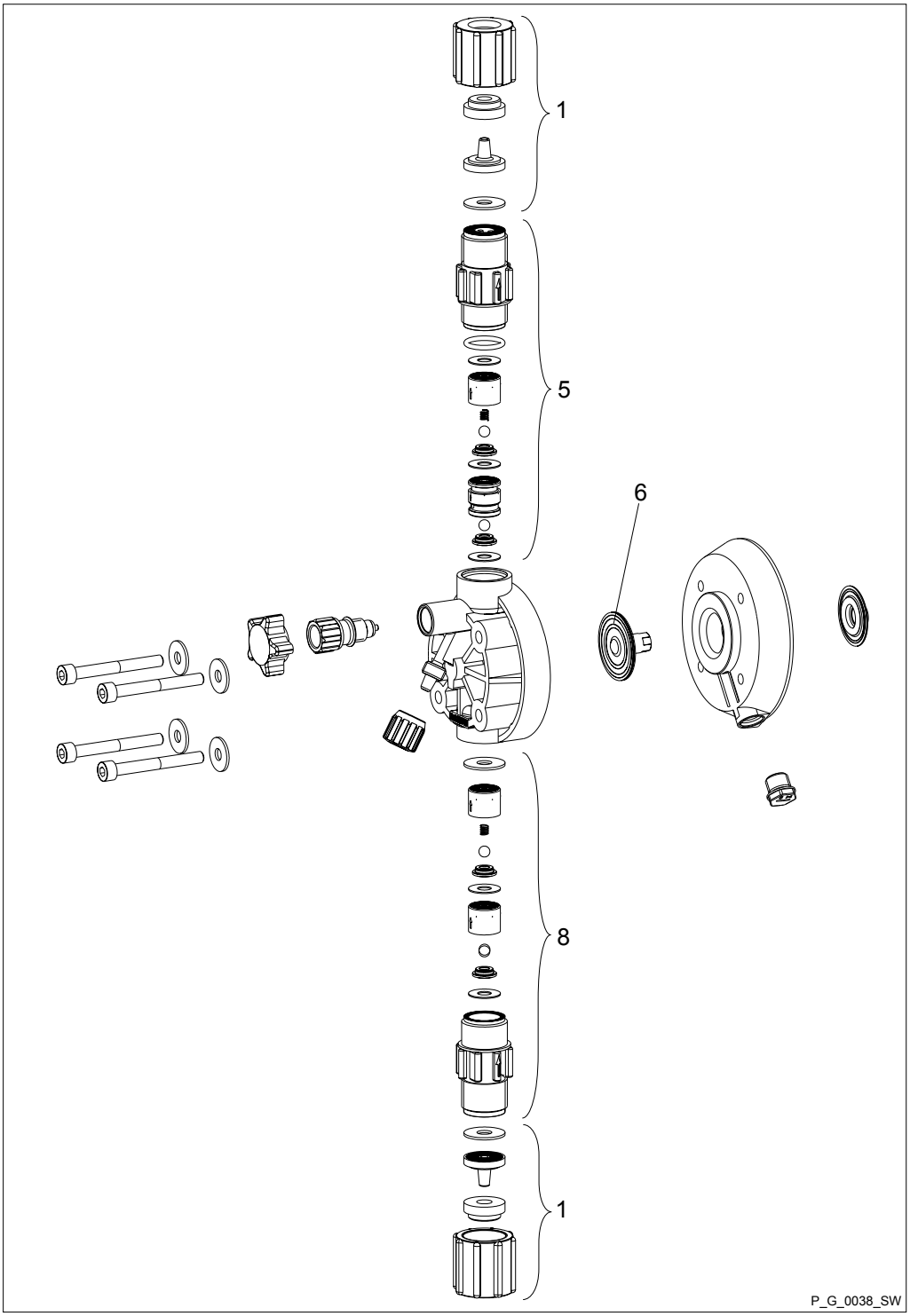


Fig. 58

Tab. 44: Spare parts for liquid end gamma/ X 1602 - 1604 SER, self-bleeding without bypass, PVT7

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 1602

	PVT7
Liquid end SER, self-bleeding without bypass	1051099
Spare parts kit	1047830
Diaphragm	1000246

Liquid end gamma/ X 1604

	PVT7
Liquid end SER, self-bleeding without bypass,	1051100
Spare parts kit	1047858
Diaphragm	1034612

Liquid end gamma/ X 0708 (1009) - 0220 (0424) SER, self-bleeding without bypass, PVT7

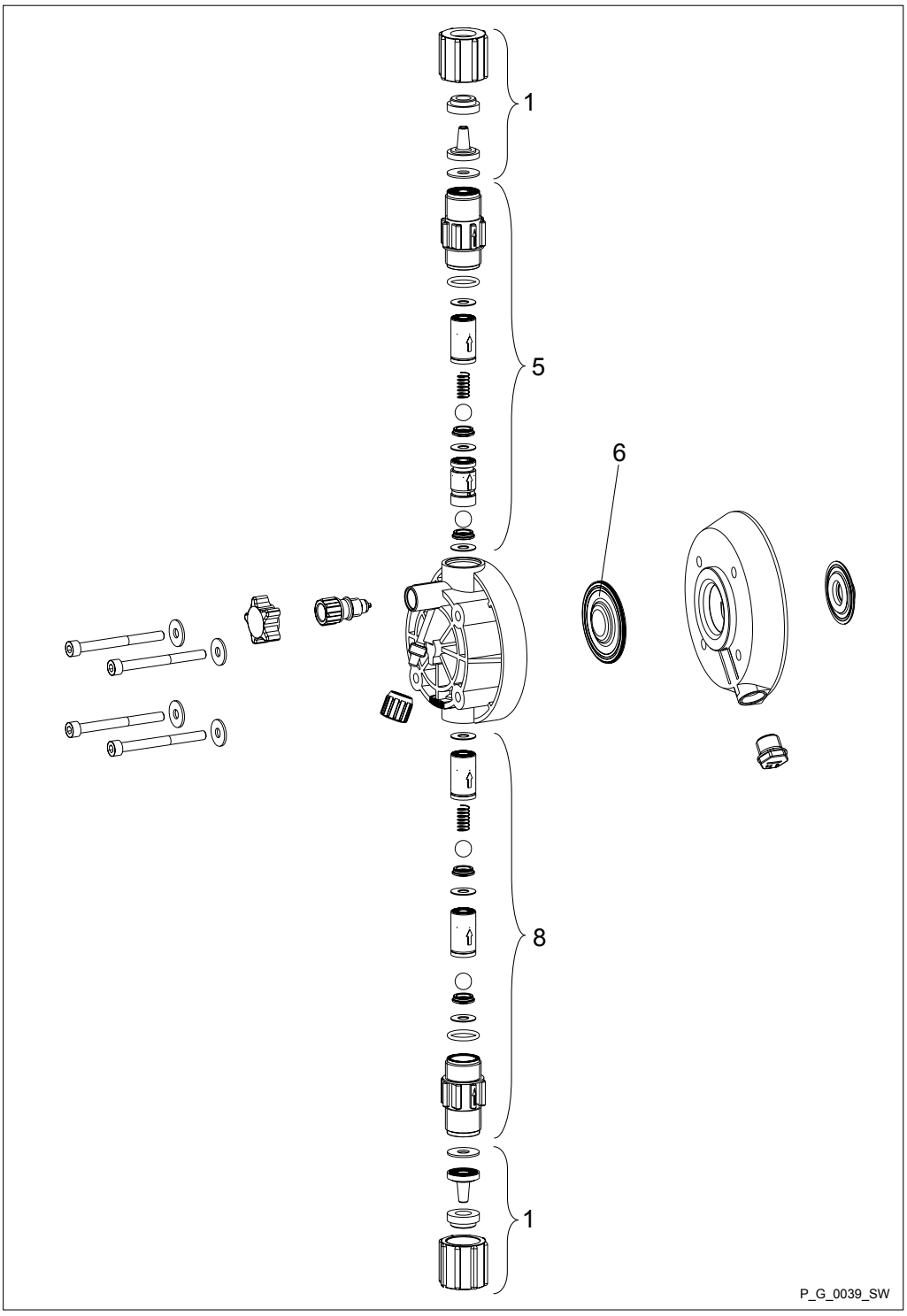


Fig. 59

Tab. 45: Spare parts for liquid end gamma/ X 0708 (1009) - 0220 (0424) SER, self-bleeding without bypass, PVT7

Pos.	Description
1	Connector kit
5	Discharge valve
6	Diaphragm
8	Suction valve

Liquid end gamma/ X 0708 (1009)

	PVT7
Liquid end SER, self-bleeding without bypass	1051101
Spare parts kit	1047832
Diaphragm	1000248

Liquid end gamma/ X 0414 (0715)

	PVT7
Liquid end SER, self-bleeding without bypass	1051103
Spare parts kit	1047833
Diaphragm	1000249

Liquid end gamma/ X 0220 (0424)

	PVT7
Liquid end SER, self-bleeding without bypass	1051104
Spare parts kit	1047837
Diaphragm	1045456

Liquid end gamma/ X 1602 - 1604 PP_9 and NP_9

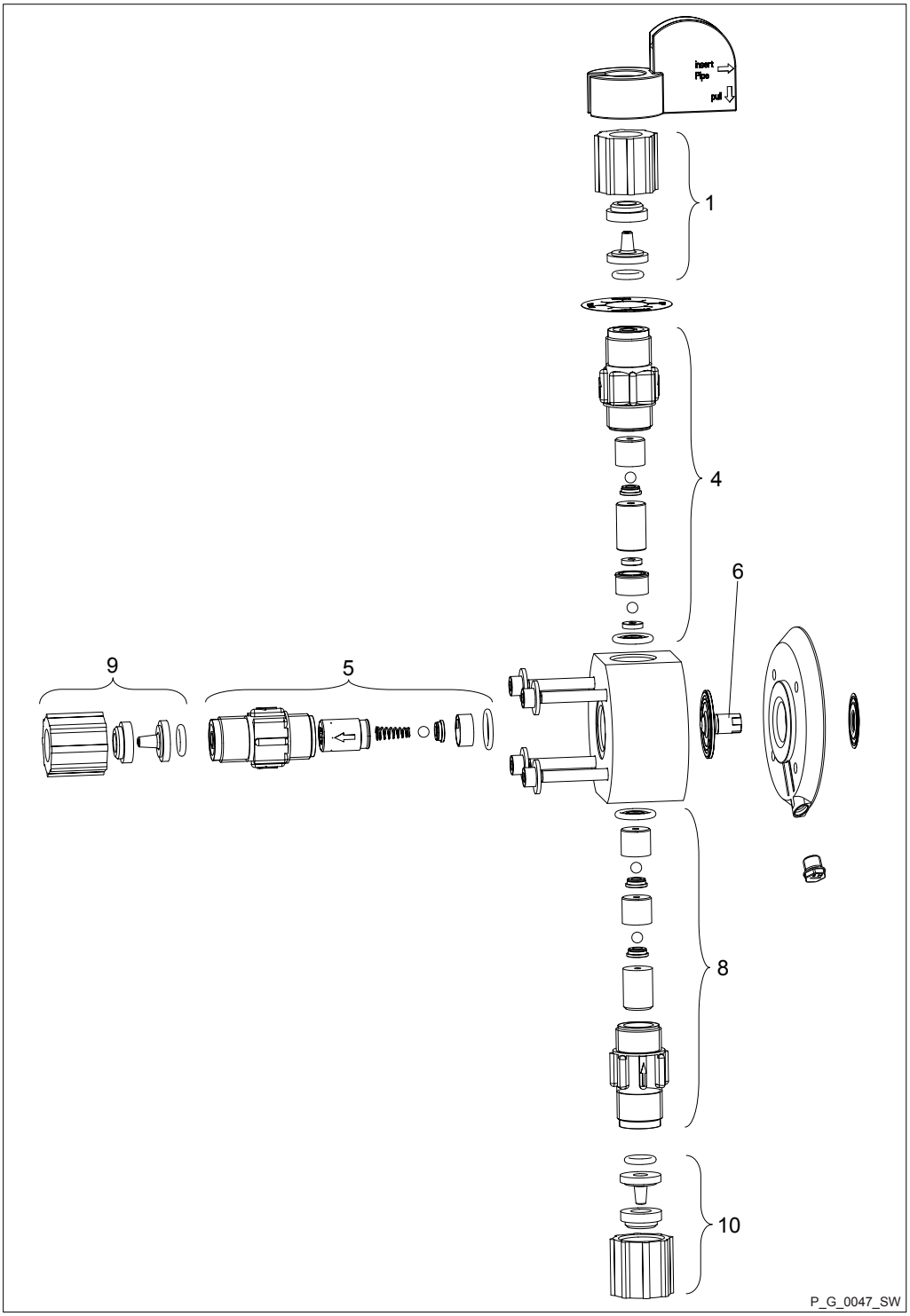


Fig. 60

Pos.	Part
1, 9, 10	Connector kit
4	Bleed valve
5	Discharge valve
6	Diaphragm
8	Suction valve

Tab. 46: Liquid ends

Type	Order No.
PPE_9	-
1602	1050937
1604	1050938
PPB_9	-
1602	1050926
1604	1050927

Tab. 47: Liquid ends

Type	Order No.
NPE_9	-
1602	1050977
1604	1050978
NPB_9	-
1602	1050960
1604	1050961

Spare parts kits for type:	Material version	Order No.
1602 with spring	PPE	1001757
1604 with spring	PPE	1035335
1602 with spring	PPB	1001763
1604 with spring	PPB	1035336
1602 with spring	NPE	1001661
1604 with spring	NPE	1035333
1602 with spring	NPB	1001667
1604 with spring	NPB	1035334

Diaphragm for type:	Order No.
1602	1000246
1604	1034612

Liquid end gamma/ X 0708 (1008) - 0220 (0420) PP_9 and NP_9

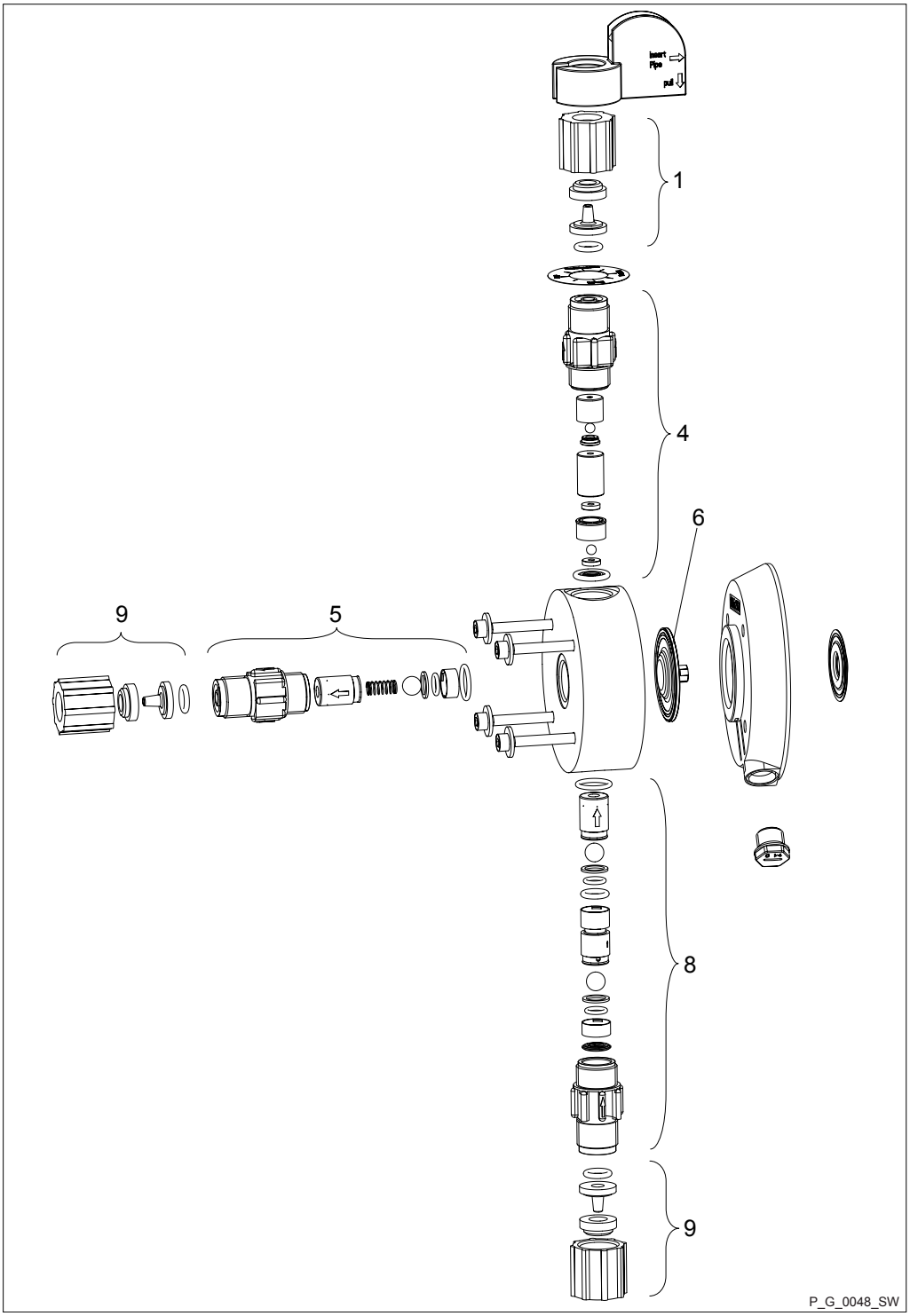


Fig. 61

Pos.	Part
1, 9, 10	Connector kit
4	Bleed valve
5	Discharge valve
6	Diaphragm
8	Suction valve

Tab. 48: Liquid ends

Type	Order No.
PPE9	-
0708 / 1009	1050939
0414 / 0715	1050940
0220 / 0424	1050941
PPB9	-
0708 / 1009	1050928
0414 / 0715	1050929
0220 / 0424	1050930

Tab. 49: Liquid ends

Type	Order No.
NPE9	-
0708 / 1009	1050979
0414 / 0715	1050980
0220 / 0424	1050981
NPB9	-
0708 / 1009	1050962
0414 / 0715	1050963
0220 / 0424	1050964

Spare parts kits for type:	Material version	Order No.
0708 (1008)	PPE	1001759
0413 (0713)	PPE	1001760
0220 (0420)	PPE	1051102
0708 (1008)	PPB	1001765
0413 (0713)	PPB	1001766
0220 (0420)	PPB	1051091
0708 (1008)	NPE	1001663
0413 (0713)	NPE	1001664
0220 (0420)	NPE	1051124
0708 (1008)	NPB	1001669
0413 (0713)	NPB	1001670
0220 (0420)	NPB	1051113

Diaphragm for type:	Order No.
0708	1000248
0413	1000249
0220	1045456

18.2 Ordering information

Retrofit kits

Retrofit kit	Part no.
Fault indicating relay:	1050643
Fault indicating/pacing relay:	1050654
Current output:	1050655
Bleed valve 4-p. 24 V PVF:	1061480
Retrofit kit for bleed valve 3-p. 230 V PVF:	1061481

Further sources of information

Further information on spare parts, accessories and options can be found in:

- the exploded drawings
- the identity code
- in www.prominent.com
- the ProMinent product catalogue

19 Dimensional drawings

- *Compare the dimensions on the dimensional drawing with those of the pump and mounting foot.*
- *All dimensions are in mm.*

Dimensional drawing of gamma/ X mounting foot

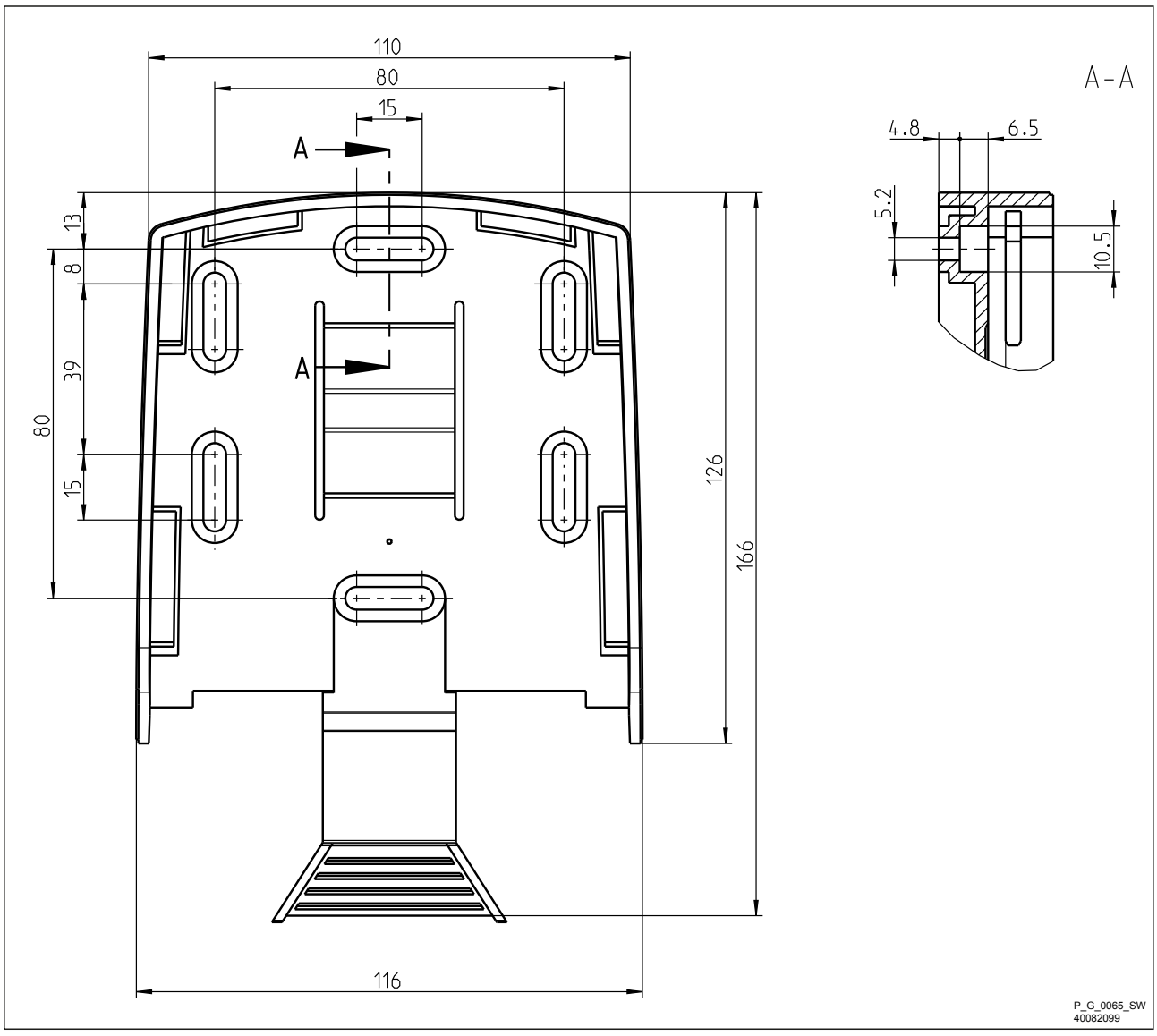


Fig. 62

Dimensional drawing gamma/ X, material versions PP_2

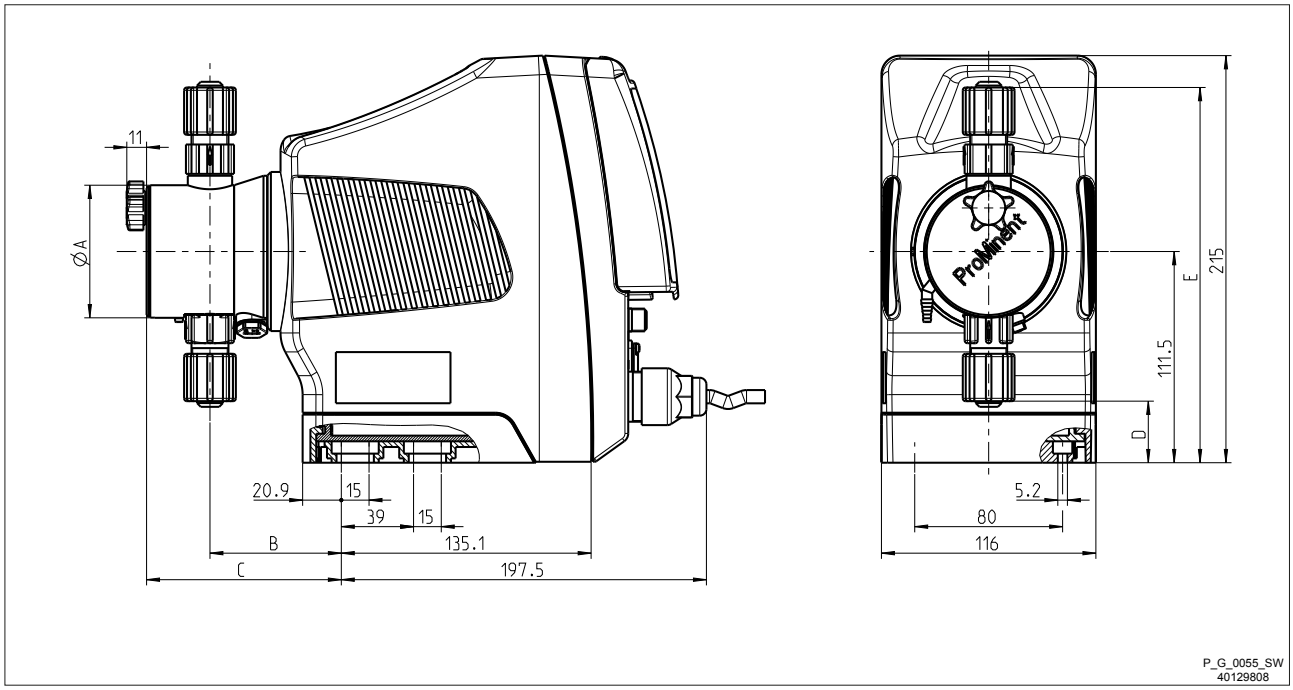


Fig. 63

	gamma/ X M70					gamma/ X M85			
	1602	1604	0708	0414	0220	1009	0715	0424	0245
ØA	70	70	90	90	90	90	90	90	110
B	71	71	74	74	76	74	74	76	76
C (with bleed valve)	106	106	108	107	110	108	107	110	-
C (without bleed valve)	-	-	-	-	-	-	-	-	93
D	32	32	24	24	24	24	24	24	14
E	198	198	202	202	202	202	202	202	209

Dimensional drawing gamma/ X, material versions NP_2

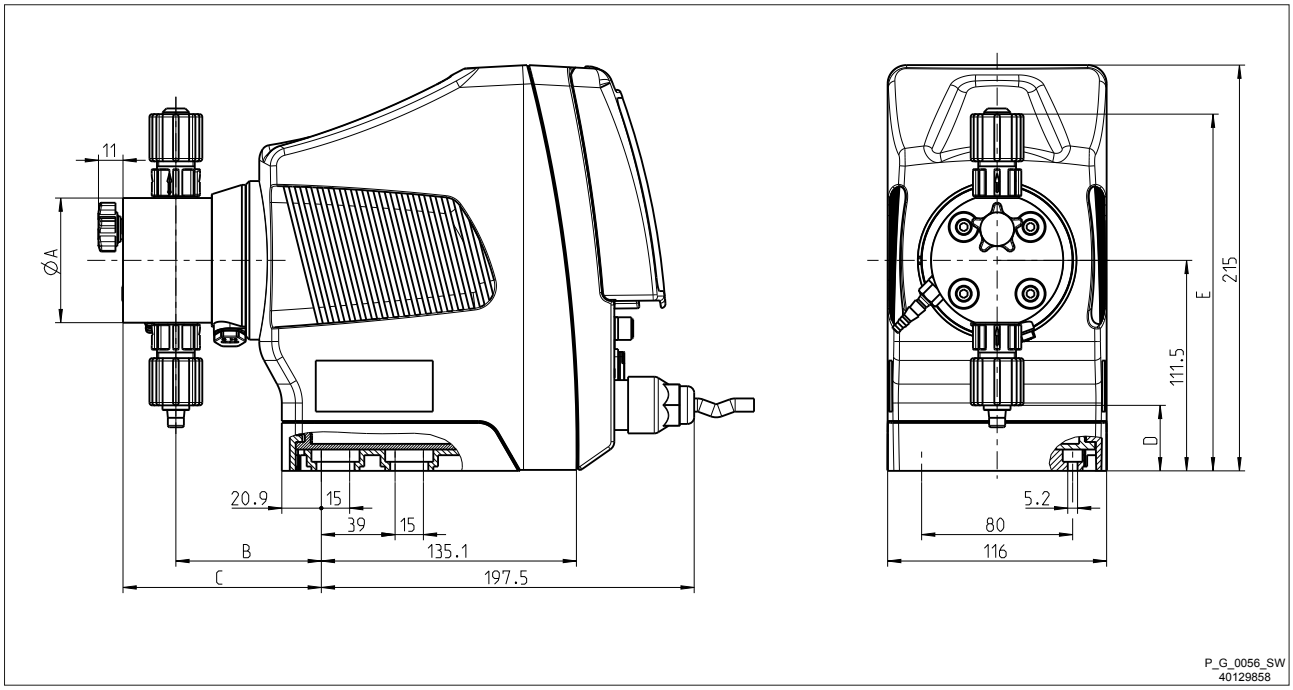


Fig. 64

	gamma/ X M70					gamma/ X M85				
	1602	**1604**	**0708**	**0414**	**0220**	**2504**	**1009**	**0715**	**0424**	**0245**
ØA	70	70	90	90	90	70	90	90	90	110
B	77	77	74	76	76	77	74	76	76	76
C (with bleed valve)	105	105	102	104	104	105	102	104	104	105
C (without bleed valve)	92	92	91	91	91	92	91	91	91	91
D	33	33	23	23	23	33	23	23	23	14
E	191	191	200	200	200	191	200	200	200	210

Dimensional drawing gamma/ X, material version PVT2

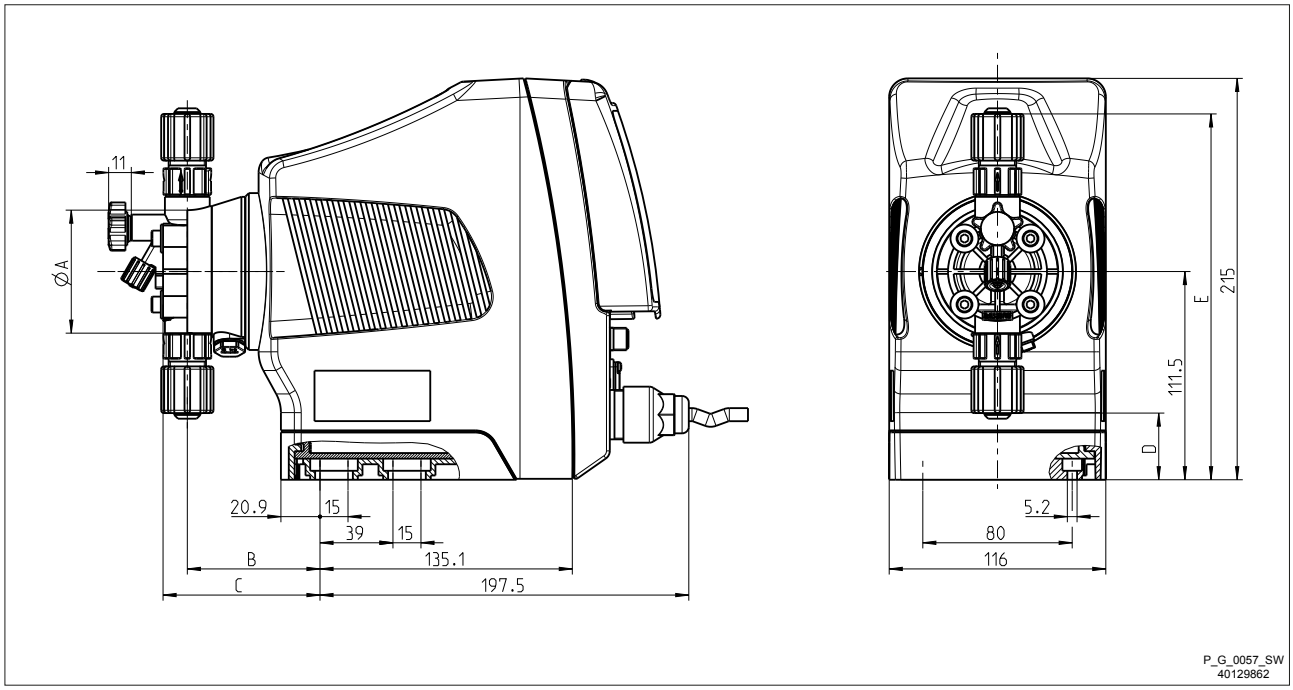


Fig. 65

	gamma/ X M70					gamma/ X M85			
	1602	**1604**	**0708**	**0414**	**0220**	**1009**	**0715**	**0424**	**0245**
ØA	70	70	90	90	90	90	90	90	110
B	71	71	75	73	79	75	73	79	76
C (with bleed valve)	84	84	92	90	90	92	90	90	-
C (without bleed valve)	-	-	-	-	-	-	-	-	93
D	36	36	25	25	25	25	25	25	14
E	196	196	203	203	203	203	203	203	209

Dimensional drawing gamma/ X, material version PVT4

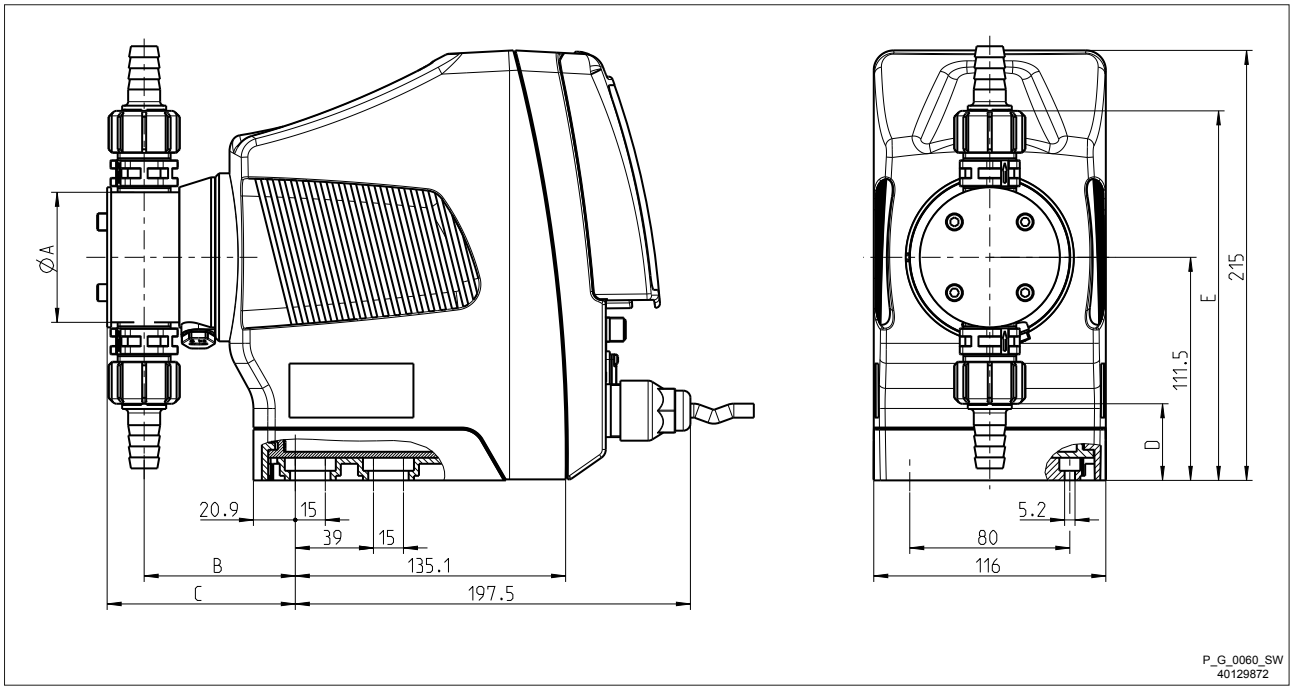


Fig. 66

	gamma/ X M70				gamma/ X M85		
	1604	0708	0414	0220	1009	0715	0424
ØA	70	80	80	85	80	80	85
B	76	78	78	79	78	78	79
C	94	96	96	97	96	96	97
D	38	33	33	30	33	33	30
E	185	190	190	193	190	190	193

Dimensional drawing gamma/ X, material version TTT0

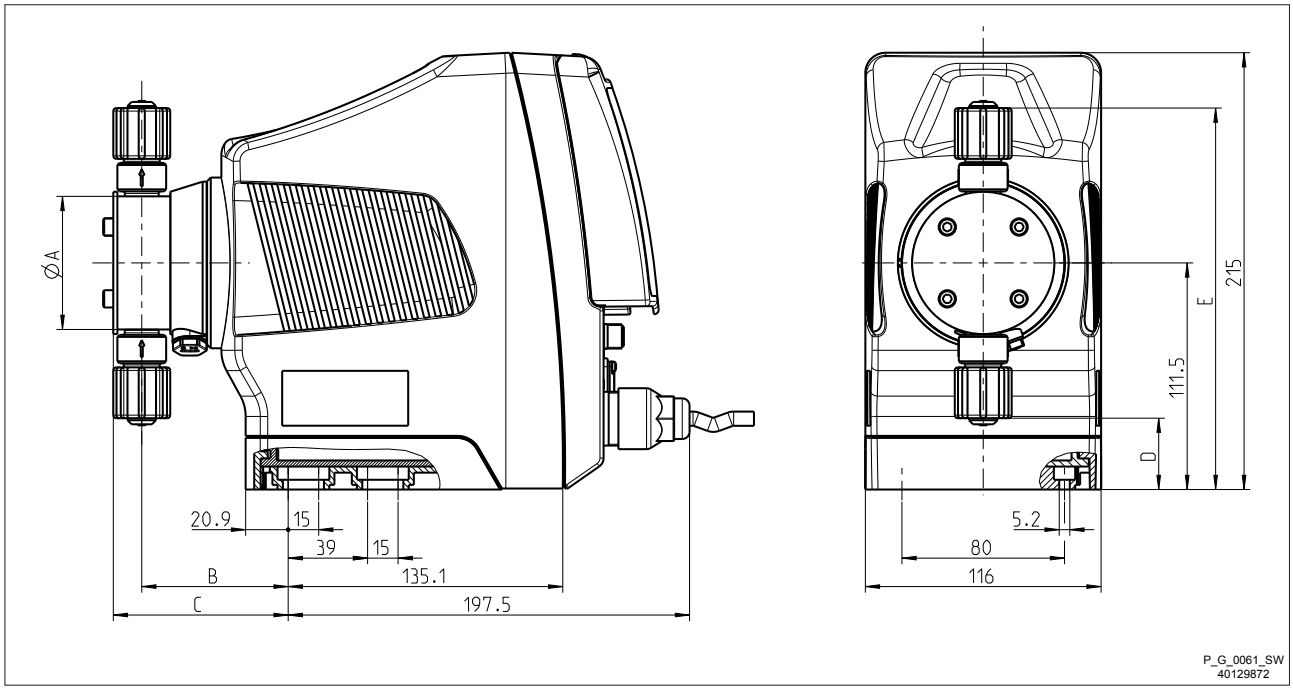


Fig. 67

	gamma/ X M70					gamma/ X M85			
	1602	1604	0708	0414	0220	1009	0715	0424	0245
ØA	70	70	85	85	85	85	85	85	100
B	72	72	79	77	77	79	77	77	78
C	86	86	96	96	96	96	96	96	97
D	35	35	3	3	3	3	3	3	-5
E	188	188	220	220	202	220	220	202	227

Dimensional drawing gamma/ X, material version SST0

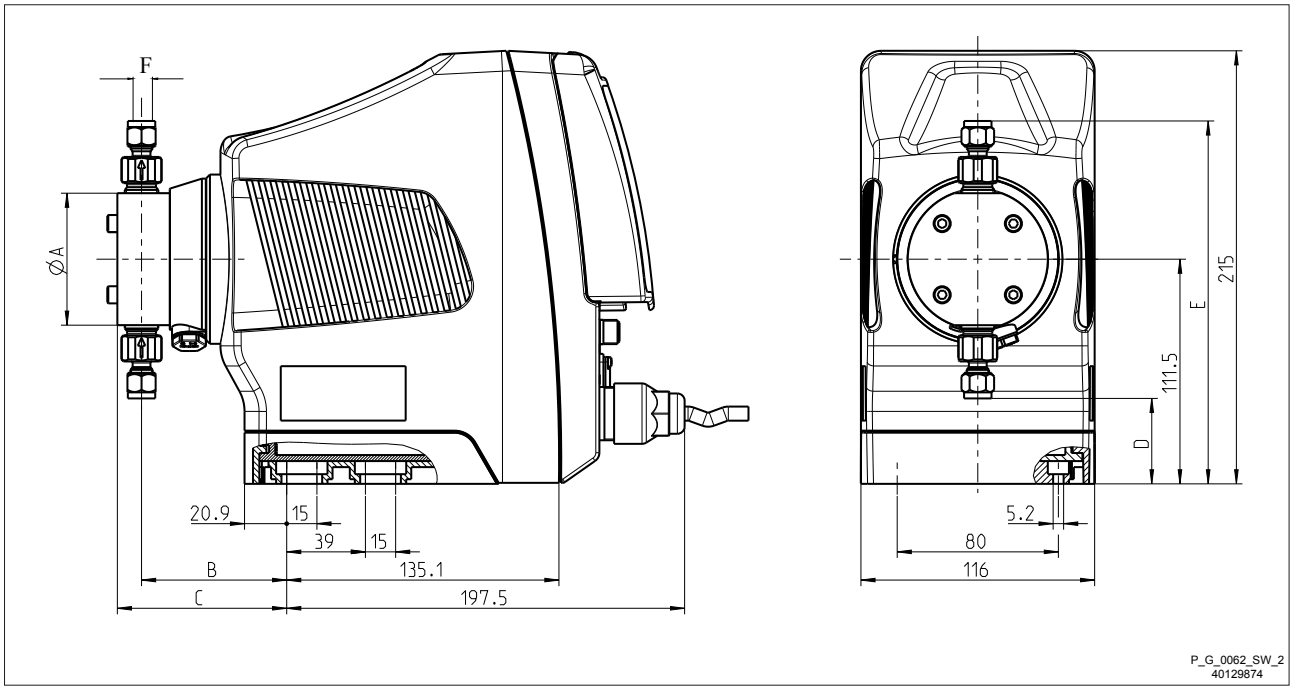


Fig. 68

	gamma/ X M70					gamma/ X M85				
	1602 2002	1604	0708	0414	0220	2504	1009	0715	0424	0245
ØA	70	70	85	85	85	70	85	85	85	100
B	72	72	79	77	77	72	79	77	77	79
C	84	84	94	94	94	84	94	94	94	95
D	42	42	11	11	11	42	11	11	11	15.8
E	180	180	211	211	211	180	211	211	211	207.3
F	6	6	8	12	12	6	8	12	12	ISO - Rp 3/8

Dimensional drawing gamma/ X, material version PPB9

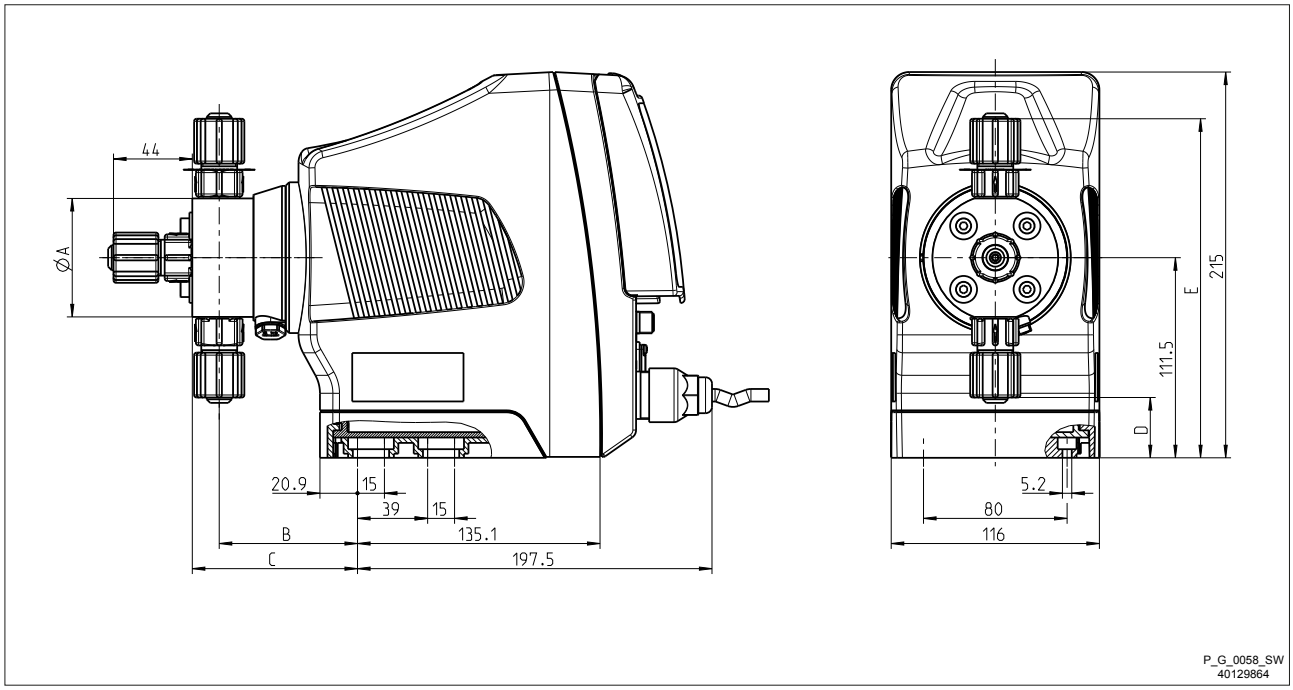


Fig. 69

	gamma/ X M70					gamma/ X M85		
	1602	**1604**	**0708**	**0414**	**0220**	**1009**	**0715**	**0424**
ØA	70	70	90	90	90	90	90	90
B	77	77	74	76	76	74	76	76
C	92	92	89	91	91	89	91	91
D	33	33	24	24	24	24	24	24
E	189	189	199	199	199	199	199	199

Dimensional drawing gamma/ X, material version NPB9

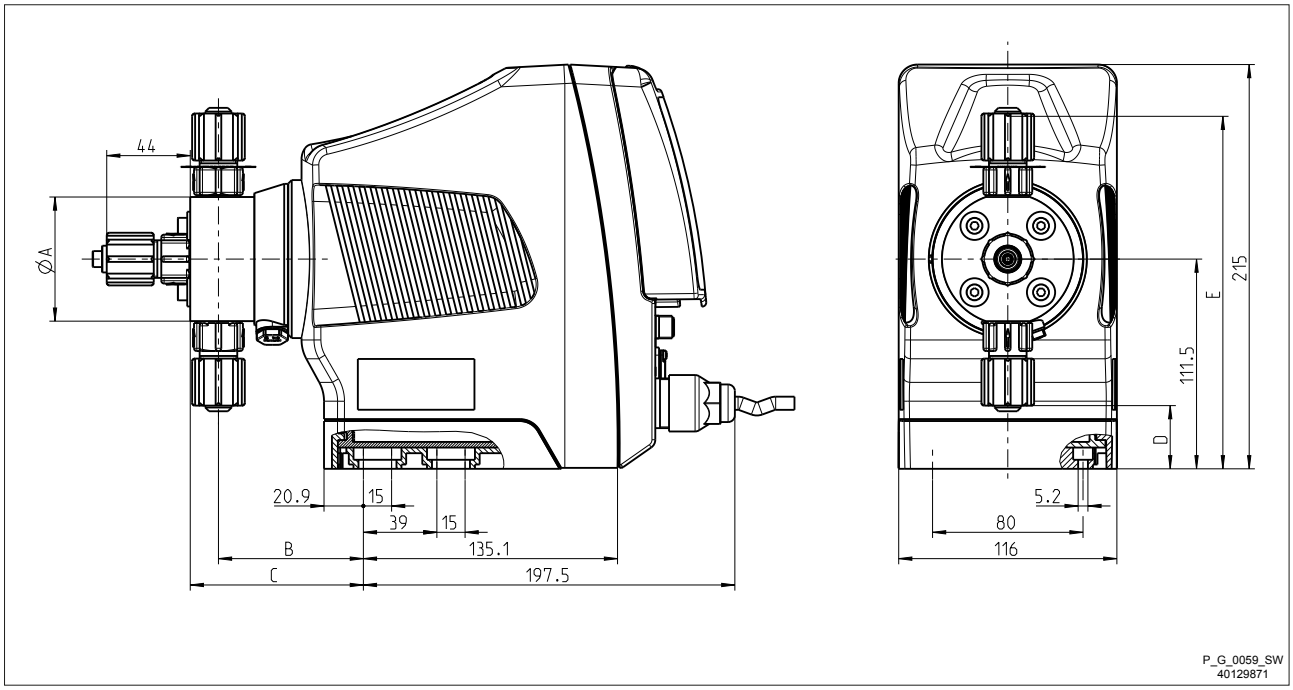


Fig. 70

	gamma/ X M70					gamma/ X M85		
	1602	1604	0708	0414	0220	1009	0715	0424
ØA	70	70	90	90	90	90	90	90
B	77	77	76	76	76	76	76	76
C	92	92	91	91	91	91	91	91
D	33	33	24	24	24	24	24	24
E	189	189	199	199	199	199	199	199

20 Diagrams for Setting the Capacity

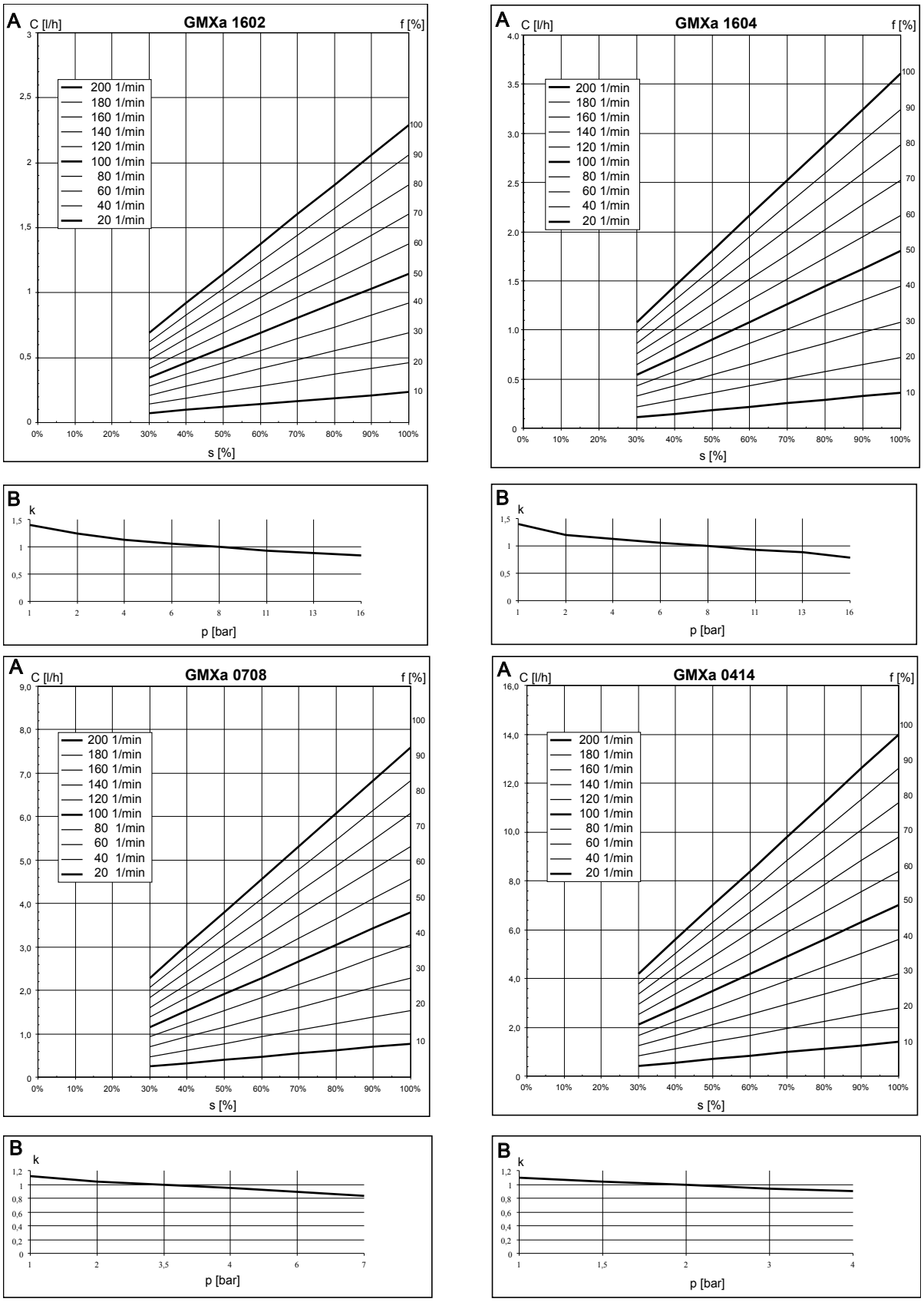


Fig. 71: A) Capacity C at maximum back pressure depending on the stroke length s for different stroke rates f. - B) Corresponding correction factors k dependent on back pressure p - at 70 % strokelength, "Automatic"-"Off" and "Compensation"-"Off".

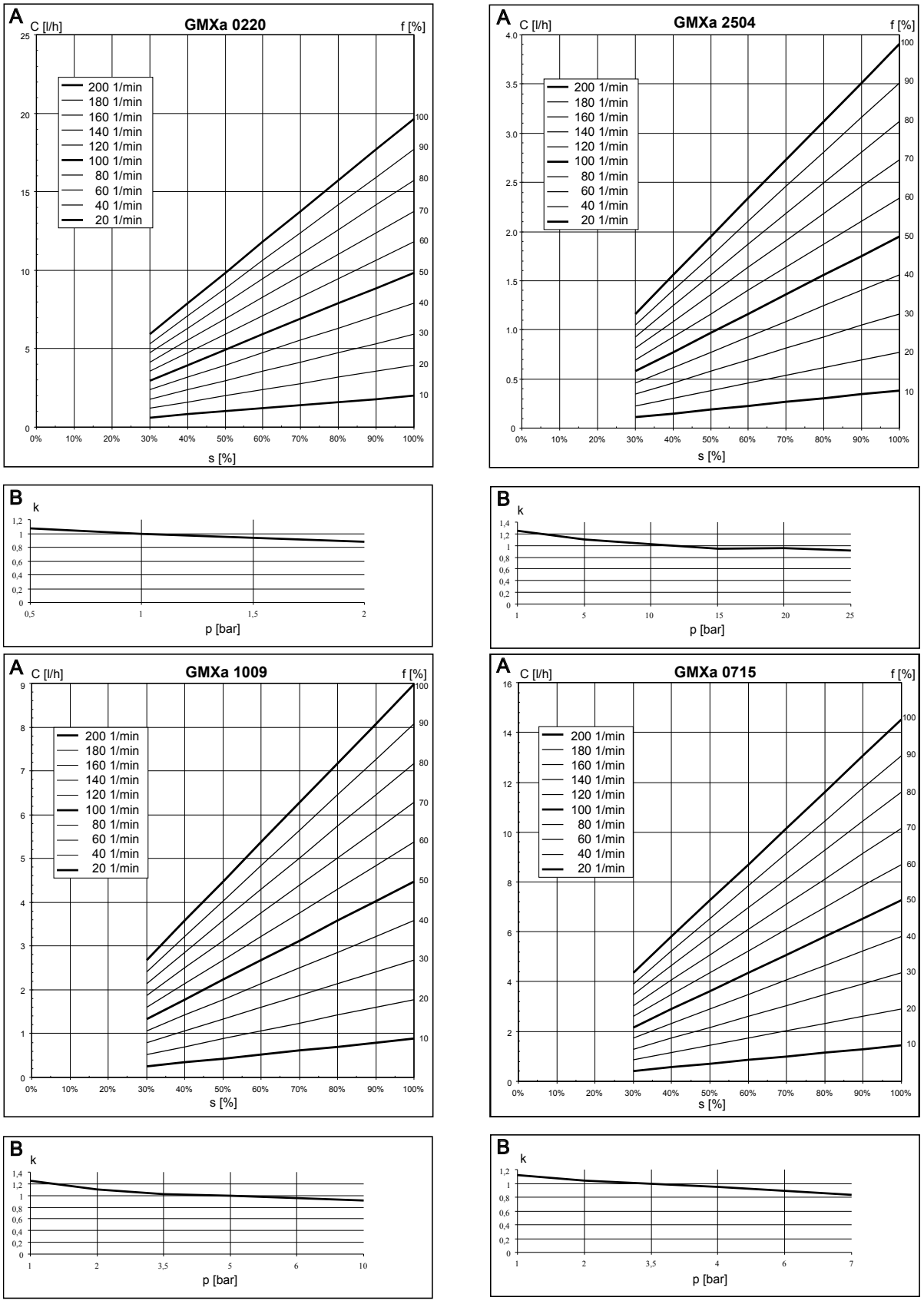


Fig. 72: A) Capacity C at maximum back pressure depending on the stroke length s for different stroke rates f. - B) Corresponding correction factors k dependent on back pressure p - at 70 % strokelength, "Automatic"-"Off" and "Compensation"-"Off".

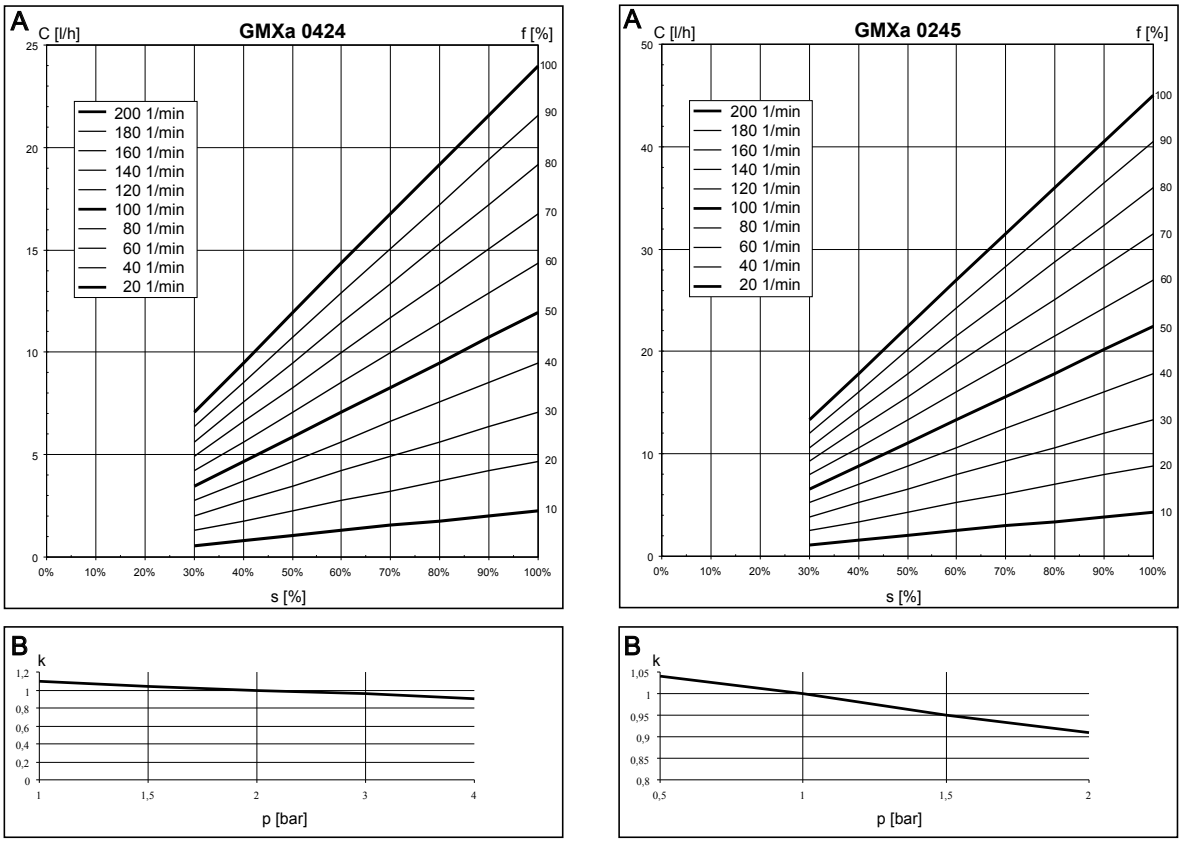


Fig. 73: A) Capacity C at maximum back pressure depending on the stroke length s for different stroke rates f. - B) Corresponding correction factors k dependent on back pressure p - at 70 % strokelength, "Automatic"-"Off" and "Compensation"-"Off".

21 Declaration of Conformity for Machinery

For mains voltage pumps:

In accordance with DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, Appendix I, BASIC HEALTH AND SAFETY REQUIREMENTS, section 1.7.4.2. C.

We,

- ProMinent GmbH
- Im Schuhmachergewann 5 - 11
- D - 69123 Heidelberg, Germany,

hereby declare that the product specified in the following, complies with the relevant basic health and safety requirements of the EC Directive, on the basis of its functional concept and design and in the version distributed by us.

Any modification to the product not approved by us will invalidate this declaration.

Tab. 50: Extract from the Declaration of Conformity

Designation of the product:	Metering pump, gamma/ X product range
Product type:	GMXa _ _ _ _ _ _ _ _ _ _ _ _ U _ _ _ Y _ 0 Y = 0, 3, 4, 5
Serial number:	see nameplate on the device
Relevant EC directives:	Machinery Directive (2006/42/EC) Compliance with the protection targets of the Low Voltage Directive according to Appendix I, No. 1.5.1 of the Machinery Directive RoHS Directive (2011/65/EU) EMC Directive (2014/30/EU)
Harmonised standards applied, in particular:	EN ISO 12100: 2010 EN 809:1998 + A1:2009 + AC:2010 EN 61010-1:2010 EN 50581:2012 EN 61000-6-2:2005 + AC:2005 EN 61000-6-3:2007 + A1:2011 +AC:2012
Date:	20/04/2016

You will find the EC Declaration of Conformity to download on our homepage.

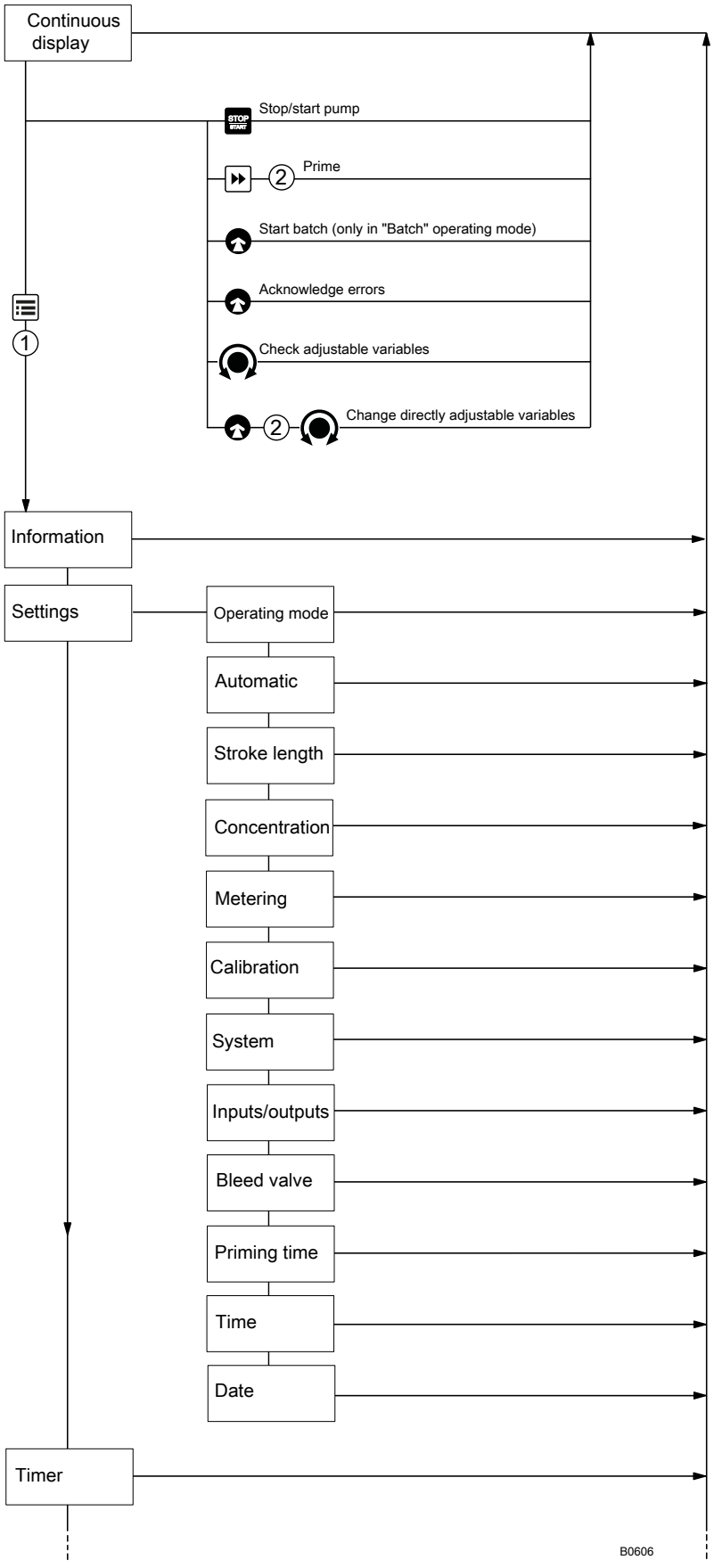
22 Approvals

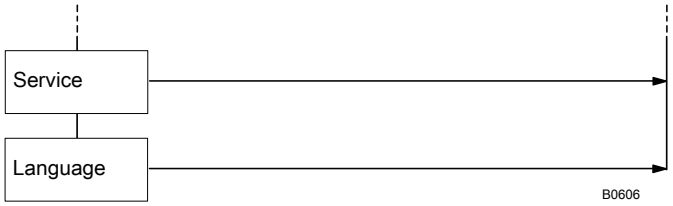
Other certifications

The pump has CE approval and the following certifications:

Certification	Certificate no.
EAC	TC N RU D-DE.IA58.B.03108
$_{C}$ MET $_{US}$	-
NSF61	-

23 Operating/Set-up overview of the gamma/ X




Service
Language
B0606

24 gamma/ X operating menu, overall

1st level	2nd	3rd	4th	5th	xth
Information	Versions	Hardware			
		Software			
		HMI version			
	Time				
	Date				
	Max. capacity *1 Max. capacity *2				
	Serial number				
	Identity code				
	Switch-on counter				
	Total operating time				
	Total metering volume				
	Total number of strokes				
	Total metering volume				
	Current stroke volume				
	Part name				
	Part device address				
Settings	Operating mode	Manual			
		Contact	*Adaptive* On Off	*Memory* On Off	Metering volume *1
					Factor *2
		Batch	*Memory* On Off	Metering volume *1	
				Factor *2	...
		Analogue	0...20 mA		
			4...20 mA		
			Linear curve Lower side band Upper side band	Curve point 1 (I1,F1)	...
	Automatic	On Off			
	Stroke length *2	1 ... 100%			

1st level	2nd	3rd	4th	5th	xth
	Dosing	Discharge stroke	optimum fast sine mode continuous DFMa		
		Suction stroke	normal HV1 HV2 HV3		
		Pressure stage	x bar		
		Monitoring	Air lock	Inactive Warning Fault	
			Air sensitivity	normal average weak	
			Message with over-pressure	Inactive Error+warning Warning Fault	
			Message when no pressure	Inactive Warning Fault Error+warning	
			Cavitation	Inactive Warning	
		Compensation	Inactive Active		
		Adaptive control	Inactive Adaptive Save param. Restore old values		
	Concentration	Concentration con-trol active inactive	Flow of main medium (for Manual)	Concentration of feed chemical	...
			Contact gap (for Contact)	Concentration of feed chemical	...
			Volume of main medium (for Batch)	Concentration of feed chemical	...
			Max. flow of main medium (for Ana-logue)	Concentration of feed chemical	...
	Calibrate	Calibration factor	Calibration factor		

1st level	2nd	3rd	4th	5th	xth
		Calibrate	Start calibration	Calibration ended	Calibration result
	System	Bluetooth	active inactive		
		Dosing head	No dosing head ... 0245		
		Volume unit	Litres Gallons		
		Pressure unit	bar psi		
		Pressure adjustment	... bar		
		Start behaviour	always STOP always on last status		
	Inputs/outputs	Auxiliary capacity *1 Auxiliary frequency *2 Auxiliary stroke length *2	...		
		Relay 1	Relay1 type	Timer Fault Warning Warning + error Warning, error + manual stop Pump active Cycle quantity Stroke rate Metering / Batch Bleeding	
			Relay 1 polarity	energizing (N/O) releasing (N/C)	
			Relay cycle quantity	01.000 l	

1st level	2nd	3rd	4th	5th	xth
		Relay 2	Relay type	Inactive Fault Warning Warning + error Warning, error + manual stop Pump active Metering volume Stroke rate Metering / Batch Bleeding External	
			Polarity	energizing (N/O) releasing (N/C)	
		mA output	0...20 mA 4...20 mA	Strokes / hour Litre / hour at 20 mA	...
		Flow control	Flow Control	Tolerance / strokes	...
				Activation	...
				if auxiliary	...
		diaphragm rupture	Inactive Warning Fault		
		Pause input	N/C N/O		
		Level warning	N/C N/O		
		Level error	N/C N/O		
	Bleeding	Off			
		Periodic	Bleed cycle	Bleed metering time	...
		Air lock	Bleed metering time		
		both	Bleed cycle	Bleed metering time	...
	Priming time	0 ... 60 s			
	Set time	Time	Setting	hh.mm.ss	
		Auto. summer time	Yes No		
		Summer time begins in	February March April		

1st level	2nd	3rd	4th	5th	xth
		Sunday the	1st, 2nd, 3rd, 4th, 5th		
		Summer time ends in	August September October November		
		Sunday the	1st, 2nd, 3rd, 4th, 5th		
		Location	Northern Hemi-sphere Southern Hemi-sphere		
	Date	dd.mm.yyyy			
Timer	Timer status				
	Activation	Active Inactive			
	Setting the timer	New Displays Change Clear	Command 01 Anweisung2 …	Init Hourly Daily (Mon-Sun) Weekdays1 (Mo-Fr) Weekdays2 (Mo-Sa) Weekend (Sa+Su) Weekly Monthly	...
	Clear all	No Yes			
Service	Access protection	*Password?*	None Lock menu Lock all		
	Password	*Password?*	0000		
	Clear counter	Stroke counter Quantity counter All			
	Error log book	Error log book	...		
		Filter	None Warn.+error only Error only Warnings only Events only		
	Diaphragm replace-ment	Back To change position			
	Display	Brightness			
		Contrast			

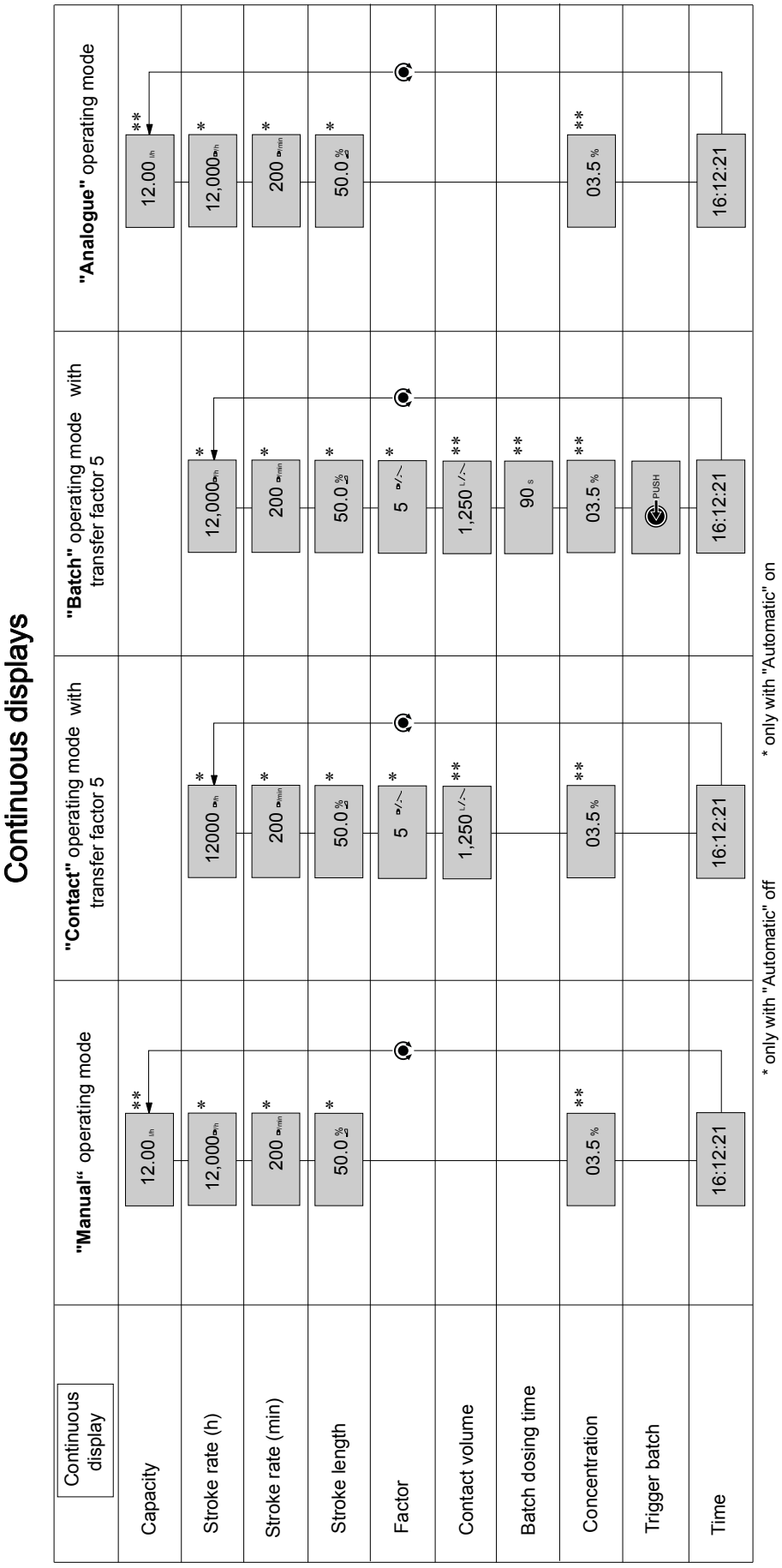
1st level	2nd	3rd	4th	5th	xth
	Factory setting	*Password?*	Yes No		
	Diaphragm part number: XXXXXXX				
	Spare parts kit part number: XXXXXXX				
Language	English German Frenchç Spanishñ ...				

*1 with *'Automatic'* - *'on'* - see Chap. *'Set Up'* - *'Settings'* - *'Automatic'*

*2 with *'Automatic'* - *'off'* / with conventional operating mode

Menus may be missing or added depending on the design and equipment on the pump.

25 Continuous Displays and Secondary Displays



Auxiliary displays in the continuous display

Auxiliary display	Mode **"Manual"**	Mode **"Batch"** with transfer factor 5	Mode **"Contact"** with transfer factor 5	Mode **"Analogue"**
Capacity	12.00 L / h			12.00 L / h
Stroke rate	12000 / h	12000 / h	12000 / h	12000 / h
Factor		5 /	5 /	
Remaining strokes			25,00 ↓ [1]	
Remaining litres			000,833 ↓ L [1]	
Total number of strokes	86500	86500	86500	86500
Stroke length	50 %	50 %	50 %	50 %
Signal current (at the input)				12,7 mA [2]
Dosing mode	slow HV1	slow HV1	slow HV1	slow HV1
Pressure display	12.5 bar	12.5 bar	12.5 bar	12.5 bar
Time	16:12:21	16:12:21	16:12:21	16:12:21
Date	2015 - 03 - 27	2015 - 03 - 27	2015 - 03 - 27	2015 - 03 - 27

1 = only with "Storage tank" function extension
2 = only with current output

26 Installation instructions: Retrofitting Relays

These installation instructions apply to:

	Order No.
Fault indicating relay GMXa	1050643
Fault indicating and pacing relay GMXa	1050654

WARNING!
Danger of electrocution.
Live parts can be accessed if the slot for the relay has been opened.

- Disconnect the pump from the mains/power supply prior to commencing work.
- Only operate the pump with a liquid-tight screwed slot for the relay and connector for the relay cable.

Scope of delivery

1 - Relay board, fully ass.

1 - Relay cable, fully assembled, with connector

1 - Seal

Materials

Torx spanner T 25

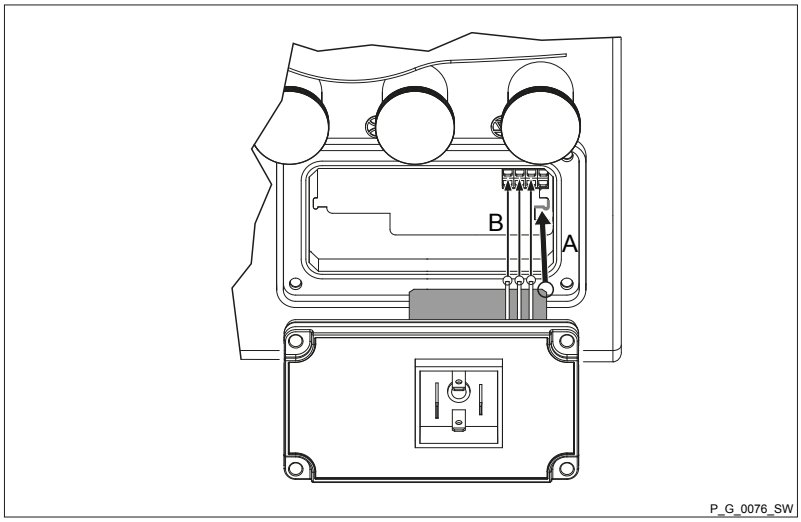
A small bright pocket torch can help to find the 4x2 contact in the slot for the relays more easily.

Personnel: ■ Electrician

Prerequisite:

The pump is electrically disconnected.

1. Remove the cover of the slot.
2. Hold the relay board by the edge of the relay cover.
3. Carefully insert the relay board into the slot for the relay - the opening in the board in the slot will help with this (A); at the same time make sure that the 3x2 pins on the relay board are sitting correctly and on the left contacts of the 4x2 contact in the slot (B) - see Figure
4. Push the relay board with gentle pressure into the slot.
5. Use the screws to screw the relay cover until liquid-tight with the housing.
6. Insert the seal of the connector of the relay cable into the relay cover.
7. Push the connector onto the pins of the relay cover and then tighten the screw into the connector until liquid-tight.


B
A
P_G_0076_SW

27 Supplementary instructions for GMXa with vPTFE diaphragm

27.1 Replacing the vPTFE diaphragm

Spare part vPTFE diaphragm

The vPTFE diaphragm (full PTFE diaphragm) is replaced in the same way as the standard diaphragm - see “Repair” chapter.



A fitted vPTFE diaphragm needs to be replaced once the dosing head screws have been loosened – the pump can no longer be tight.

Part no.	Pump types
1105385	GMXa 1604
1107566	GMXa 0220 / 0424
1107567	GMXa 0414 / 0715
1107568	GMXa 1602
1107569	GMXa 0708 / 1009
1109192	GMXa 0245

27.2 Performance data - GMXa with vPTFE diaphragm

gamma/ X operating at 200 strokes/minute and 100 % stroke length

Type ... PVT	Minimum pump capacity * at maximum back pressure			Connector size Outside ∅ x inside ∅	Suction lift**	Priming lift***	Max. priming pressure on the suction side
	bar	l/h	ml/stroke	mm	m water column	m water column	mbar
gamma X							
1602 ...	10	2.04	0.17	6x4	5	2	5.5
1604 ...	10	3.42	0.28	6x4	5	2	3
0708 ...	7	7.6	0.63	8x5	4	2	2
1009 ...	10	9.3	0.77	8x5	3	2	2
0414 ...	4	11.5	0.96	8x5	3	2	1.5
0715 ...	7	11.6	0.96	8x5	3	2	1.5
0220 ...	2	16.6	1.38	12x9	2	2	1
0424 ...	4	20.7	1.73	12x9	3	2.5	1
0245 ...	2	35.7	2.97	12x9	2	2	0.8

* - The given performance data represents guaranteed minimum values calculated using water as the medium at 20 °C.

** - Suction lift with a filled suction line and filled liquid end.

*** - Priming lift with clean and moist valves. Priming lift at 100 % stroke length and free outlet or opened bleed valve.

All data calculated with water at 20 °C.

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ProMinent GmbH
Im Schuhmachergewann 5-11
69123 Heidelberg,
Germany
Telephone: +49 6221 842-0
Fax: +49 6221 842-419
Email: info@prominent.com
Internet: www.prominent.com

984586, 7, en_GB

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EQUIPMENT TECHNICAL DATA SHEETS

PVC CHECK VALVE
POLYMER INJECTION

POLYMER INJECTION CHECK VALVE:

- PLASTOMATIC PVC Diaphragm Check Valve - Model: CKM050V-PV
  - 1/2" NPT
  - PVC Body
  - FKM Seals

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

PLAST-O-MATIC

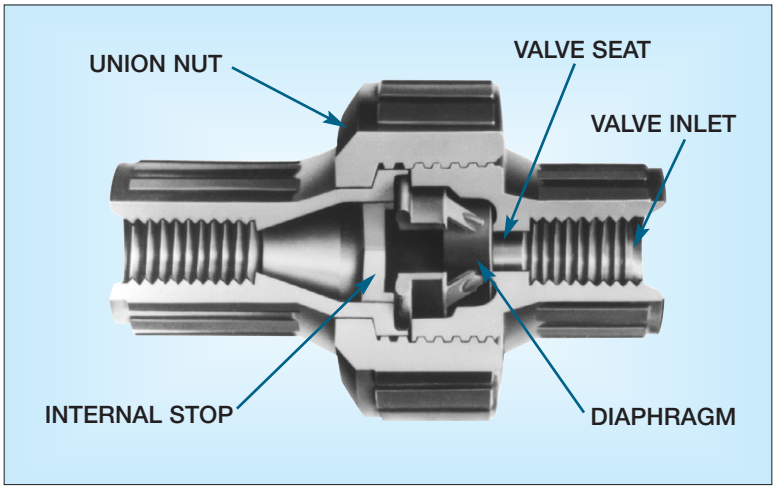
PRODUCT DATA

CATALOG CKL
(Series CKM & CK)

Self-Closing Thermoplastic Check Valves...

Patented Diaphragm Design Assures Dependable, Repetitive, Bubble-Tight Sealing... and They Can Be Mounted in Any Position!

Sizes: 1/2", 3/4" and 1"



Features/Benefits:

- **Patented Design:** Self-sealing - are not dependent upon gravity, mounting position or reverse flow, a significant improvement over ball check valves.
- **Silent Operation:** No internal sliding or loose parts to slam or vibrate - chattering is eliminated!
- **Dependability:** Leak-free sealing protects against the potential hazards created by reverse flow of corrosive liquids such as acids, caustics and chlorine solutions.
- **Repetitive Long Term Sealing:** Diaphragm automatically positions itself against seat in the identical location. Superior to ball check valves which often leak at lower pressures.
- **Convenience:** Union nut on Series CKM simplifies valve inspection/removal with minimum piping breakdown.
- **Minimal Cracking Pressure:** Diaphragm begins to open at approximately 1.0 to 1.5 PSI.
- **Cost Efficient:** Designed to improve system performance and competitively priced.

Materials of Construction:

Plast-O-Matic Series CKM Check Valves are molded of Type 1, Grade 1, PVC (Polyvinyl Chloride), Glass-filled Polypropylene, Corzan® CPVC, and Kynar® PVDF in sizes 1/2", 3/4" and 1". A machined version, Series CK is available in PTFE in sizes 3/4" and 1". Diaphragms are of EPDM or FKM (Viton®). Threaded connections are standard on all models. Socket end connectors are available on all Series CKM models.

Note: For information on 1½", 2" and 3" models, refer to Catalog CKS.

PLAST-O-MATIC VALVES, INC.

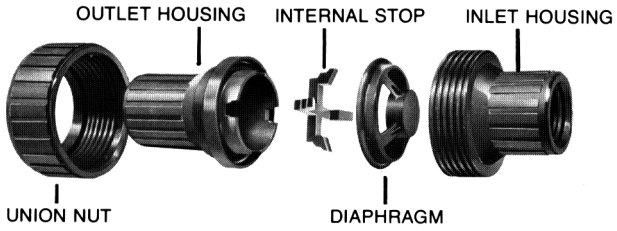
1384 Pompton Avenue, Cedar Grove, New Jersey 07009
(973) 256-3000 • Fax: (973) 256-4745 • www.plastomatic.com

Series CKM & CK Diaphragm Check Valves 1/2", 3/4" & 1"

Design

Series CKM & CK Check Valves, normally closed in design, feature a patented diaphragm seal that will neither stick nor chatter and is automatic in action. The valves are not dependent upon gravity so they can be mounted in any position. Even in the absence of reverse flow or pressure, the diaphragm will automatically reposition itself to seal against the valve seat. This is achieved with or without the presence of reverse flow. The unique and patented diaphragm will seal in the identical location every time producing a more reliable and repetitive seal.

The molded Series CKM models have only one moving part – the diaphragm. This provides both design simplicity and maximum operating dependability.

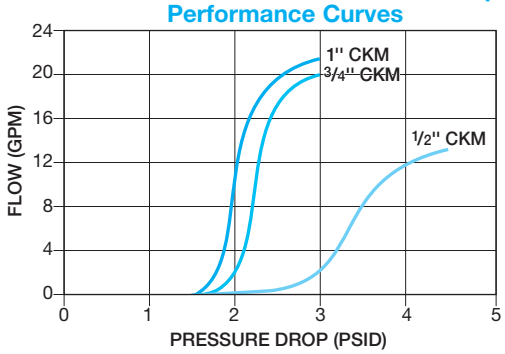


Operation

Flow entering the valve inlet will open the valve by pushing the diaphragm off the valve seat until it comes to rest on the internal stop. This supports the diaphragm and eliminates force or stress under high flow condition. In this position both the diaphragm and valve seat are kept clean by the flushing action of the internal flow, keeping the entire sealing area free of particles which could cause leakage.

If the inlet flow is either stopped, or if a backflow of a higher pressure is sensed, the diaphragm will automatically reposition itself, closing off the valve seat. Reverse flow or pressure is not required to close the valve when the inlet flow stops. If reverse pressure is present it simply creates a tighter seal.

Series CKM – Flow vs. Pressure Drop Performance Curves



Series CKM is a normally-closed design requiring 1.5 PSI or less to open

Installation

Because of its normally closed design the Plast-O-Matic CKM and CK Check Valves can be installed in any position; concern over the valve seat closing due to gravity (as with ball check designs) is of no consequence. Caution should be exercised to make certain that the direction of flow is correct. Threaded connections should never be made to metal piping and should always be wrapped with PTFE or other acceptable pipe sealant to effect a seal. The assembly need only be made hand tight followed by a one-quarter turn more with a strap wrench. *DO NOT* overtighten and *DO NOT* use a pipe wrench as a future valve fracture could result.

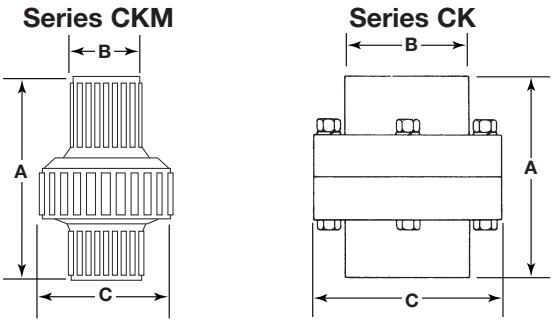
Dimensions and Material Availability

Series CKM – Molded Models: PVC, CPVC, GPP & PVDF

Pipe Size (NPT)	A		B		C	
	in.	mm	in.	mm	in.	mm
1/2"	3.8	97	1.3	33	2.4	62
3/4"	4.1	105	1.6	39	2.8	72
1"	4.7	120	1.9	48	2.8	72

Series CK – Machined Models: PTFE

3/4"	3.6	92	1.9	48	3.0	76
1"	4.3	110	1.9	48	3.0	76



Pressure Temperature Ratings

Series CKM – Molded Models: PVC, CPVC, GPP & PVDF

Valve Body Material	Valve Diaphragm Material	Maximum Working Pressure							
		77°F (25°C)		140°F (60°C)		180°F (82°C)		280°F (138°C)	
		Inlet	Back	Inlet	Back	Inlet	Back	Inlet	Back
PVC	EPDM	150	100	150	100	NR	NR	NR	NR
	FKM	150	100	150	100	NR	NR	NR	NR
GPP 20% Glass Filled	EPDM	100	100	100	100	100	100	NR	NR
	FKM	100	100	100	100	100	100	NR	NR
PVDF	EPDM	150	100	150	100	150	100	NR	NR
	FKM	150	100	150	100	150	100	60	60
CPVC	EPDM	150	100	150	100	150	100	NR	NR
	FKM	150	100	150	100	150	100	NR	NR

Series CK – Machined PTFE Models

PTFE	EPDM	40	40	40	40	40	40	5	5
	FKM	40	40	40	40	40	40	5	5

Ordering Information For Series CKM & CK

Pipe Size	CKM - PVC FKM Seals	CKM - PP FKM Seals	CKM-PF FKM Seals	CKM-CPVC FKM Seals	CK-TF FKM Seals
1/2"	CKM050V-PV	CKM050V-PP	CKM050V-PF	CKM050V-CP	N.A.
3/4"	CKM075V-PV	CKM075V-PP	CKM075V-PF	CKM075V-CP	CK075V-TF
1"	CKM100V-PV	CKM100V-PP	CKM100V-PF	CKM100V-CP	CK100V-TF

Note: Threads are standard. For socket ends add "S" after seal material. (ex. CKM050VS-PV). For other body materials consult factory. Above shown with FKM (Viton®) Seals. For EPDM seals change "V" to "EP". N.A. = Not Available.

AUTHORIZED PLAST-O-MATIC DISTRIBUTOR

PLAST-O-MATIC VALVES, INC.
1384 Pompton Ave., Cedar Grove, NJ 07009 • (973) 256-3000 • Fax: (973) 256-4745 • www.plastomatic.com
5/06

EQUIPMENT TECHNICAL DATA SHEETS

CHEMICAL FEED – POLYMER MAKE-UP SYSTEM

DESCRIPTION

PROMINENT PROMIX POLYMER MAKE-UP SYSTEM

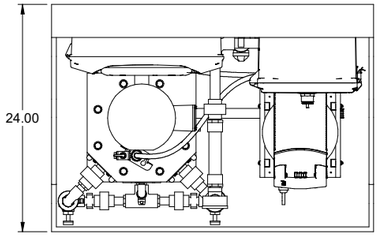
- Part # 1136590 - PROMIX S_diaLog X_60x2-0.60TA peristaltic neat polymer metering pump, primary flow meter and post-dilution rotameter with control valves, dilution solenoid valve, Dialog X controller and polypropylene base.

  System Connections:
  Water Inlet: 3/4" FNPT
  Pump Inlet: 1/2" FNPT
  Solution Discharge: 3/4" FNPT

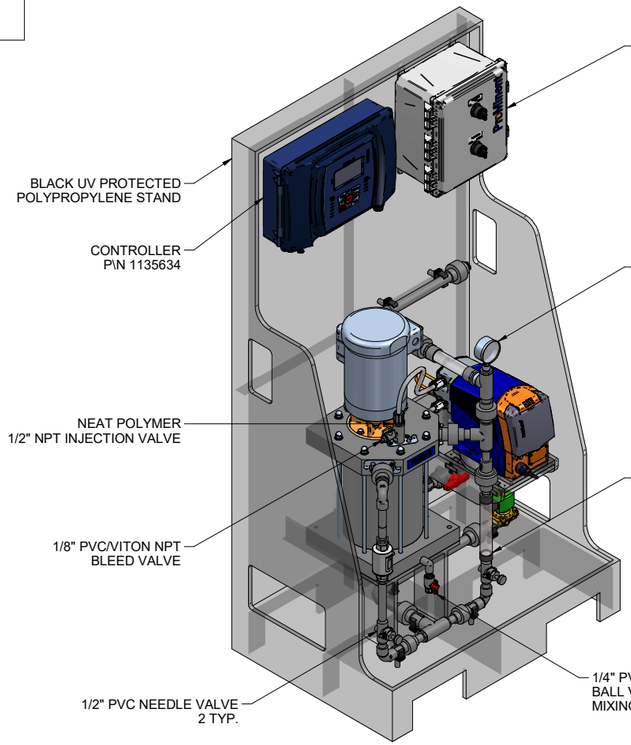
  Primary Dilution: 60 gph
  Post Dilution: 60 gph
  Pump Capacity: 0.72 gph
  System Voltage: 120/1/60

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

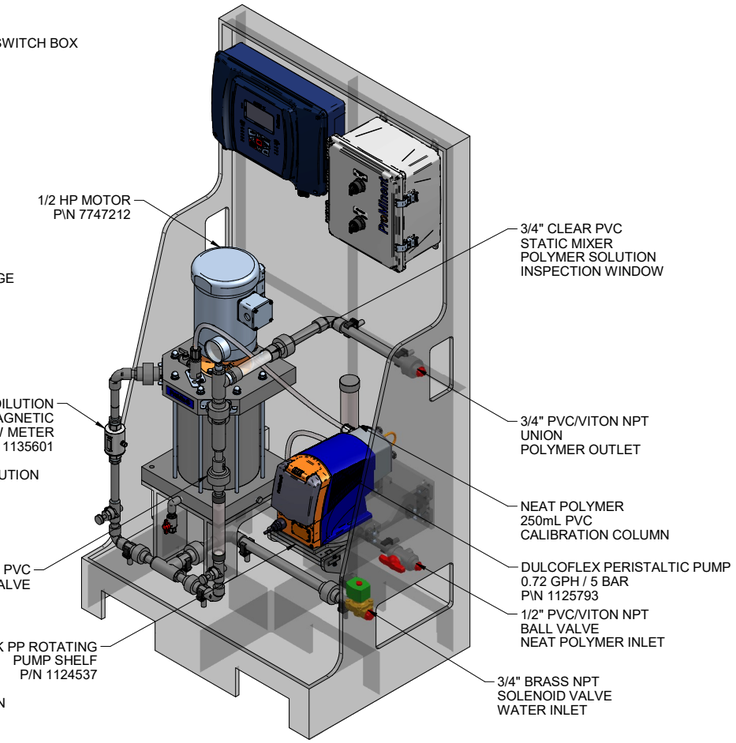
DWG No	REV
1136590-200	0



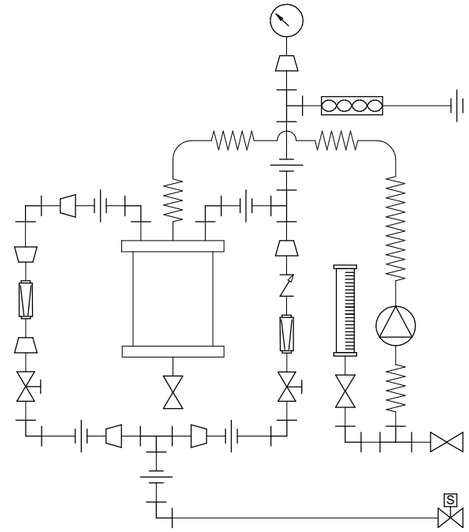
PLAN VIEW



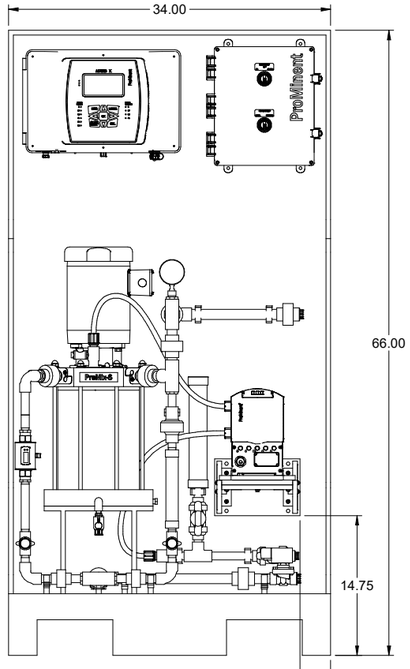
LEFT ISOMETRIC VIEW



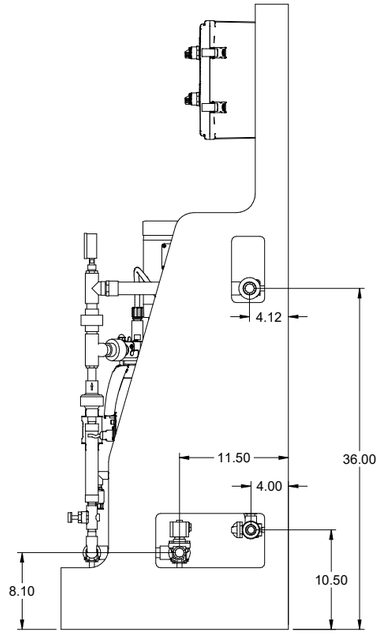
RIGHT ISOMETRIC VIEW



PIPING SCHEMATIC



FRONT VIEW



SIDE VIEW

NOTES:

1. ALL PIPING AND FITTINGS SHALL BE 1/2" AND 3/4" SCH. 80 PVC SOCKET WELD WITH VITON SEALS UNLESS OTHERWISE NOTED.
2. PUMP MAXIMUM CAPACITY RATES BASED UPON PUMPING WATER.
3. POLYMER BLENDING SYSTEM WITH THREE ZONE PVC MIXING CHAMBER.
4. REQUIRED INCOMING POWER:

   120VAC, 1 PHASE, 60Hz, 15 AMP CURRENT RATING AT 120 VAC

5. ALL DIMENSIONS ARE IN INCHES AND ARE SHOWN FOR REFERENCE ONLY.

0	04/19/24	FIRST ISSUE	GJS		
REV	DATE	DESCRIPTION	BY	APPD	REVD

REVISIONS

MAXIMUM TESTING PRESSURE =	100 PSI
MAXIMUM OPERATING PRESSURE =	100 PSI
MAXIMUM NEAT POLYMER PUMP DISCHARGE PRESSURE =	73 PSI
CHEMICAL SERVICE =	WATER SOLUBLE POLYMER

CUSTOMER: PROMINENT FLUID CONTROLS INC. (PROMIX S AEGIS X SYSTEM)

JOB No: 1136590 | PURCHASE ORDER No: N\A

TITLE: PROMIX S_AGIX 60X2-0.60TA SYSTEM SKID GENERAL ARRANGEMENT

THIS DRAWING IS THE PROPERTY OF PROMINENT FLUID CONTROLS INC. AND SHALL NOT BE COPIED OR TRANSFERRED WITHOUT THE WRITTEN CONSENT OF PROMINENT FLUID CONTROLS INC.

ENGINEERS SEAL

ProMinent®
THE PROMINENT GROUP OF COMPANIES

PITTSBURGH, PA USA WWW.PROMINENT.US

PROMINENT FLUID CONTROLS LTD.
490 SOUTHGATE DRIVE.
GUELPH, ONTARIO, CANADA
N1H 6J3
TEL. 519 836 5692 FAX. 519 836 5226

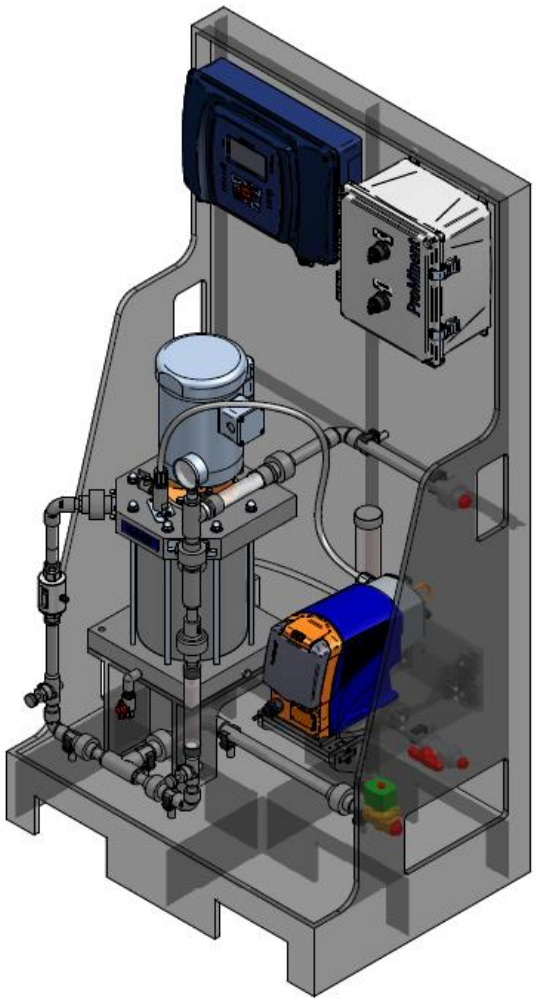
PROMINENT FLUID CONTROLS INC.
RIDC PARK WEST
136 INDUSTRY DRIVE,
PITTSBURGH P.A., USA. 15275
TEL. 412 787 2484 FAX. 412 787 0704

DESIGNED	KP\JM	APPROVED	KP\JM
DRAWN	GJS	SCALE	N.T.S.
CHECKED	KP\JM	DATE	04/19/24

DWG No	REV	PAGE
1136590-200	0	1/1

ProMinent ProMix Inline Polymer Feeder

Operating Instructions
ProMinent® ProMix S
Polymer Blending Systems



Please completely read through these operating instructions first! Do not discard!

The warranty shall be invalidated by damage caused by operating errors!

ProMix_S _IOM (3/20/24): – P/N: 1135600-(Rev-0)

ProMinent Fluid Controls, Inc. (USA) 136 Industry Drive, Pittsburgh, PA 15275

Tel: (412) 787-2484 www.prominent.com Fax: (412) 787-0704

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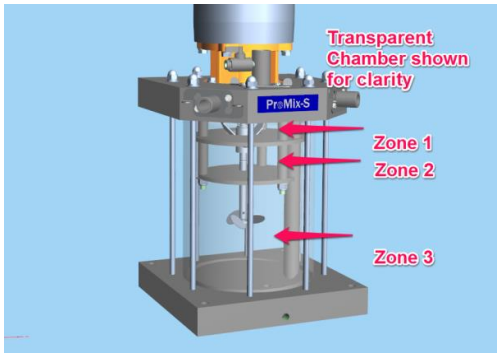
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1 Overview

The ProMix Inline Polymer Feeder is a skid system designed to control feed water and polymer and combine them to produce a high-quality solution. The system is designed to receive liquid neat polymer while mixing it with feed water to produce and discharge a quality solution from the system.

Research in the science of polymer activation indicates that the activation energy must decrease as the polymeric chain is uncoiled to prevent rupture and hence decrease the performance of the product.

The mixing by the Polymer Feeder is accomplished mechanically with three distinct mixing zones separated by baffles. The first zone consists of a fast-mixing blade that delivers high shear at the precise point of polymer injection, creating an immediate dispersion before agglomeration takes place. The second mixing zone induces a vortex and draws solution down through the center of the chamber from zone one and forces the solution outward to the sides and then down into the third zone. Finally, the third zone mixing blade gently agitates/blends the active polymer solution before it exits the chamber via the discharge tube.



The ProMix Inline Polymer Feeder controller offers several operating options. These options are selected using various combinations of the controller door switch positions and polymer type selections via the controller menu. The controller allows the polymer pump speed to be controlled either locally via the keypad or remotely via a customer supplied 4-20 mA signal over a 0 to 100% speed range. The polymer dosage rate must be calculated, and the pump adjusted for the desired ratio concentration of polymer to dilution water leaving the feeder by volume. Different maximum concentrations are possible based upon the type of polymer. Emulsion polymers should be limited to a maximum of 1% concentration in the mixing chamber and Mannich polymers should not exceed 10% in the mixing chamber.

The System Start switch on the controller door has three positions: ON, OFF and REMOTE. ON enables the controller locally and REMOTE allows the controller to be enabled via a customer supplied dry contact. The Polymer Pump switch has two positions: LOCAL and EXTERNAL. Placing the System Start switch in the OFF position after having first been in either of the other two positions will initiate a flush cycle for the system before shutting down.

The Polymer Pump switch on the controller front door has two positions to choose the source of the pump control signal. In the LOCAL position, the controller uses the keypad entry for polymer pump speed. In the EXTERNAL position, a user supplied 4-20 mA signal representing 0 – 100% pump speed controls the pump. The user must manually adjust the primary and post dilution valves for the desired dilution water flow rate and must calculate the required pump speed to attain the desired concentration. A flow meter and rotameter are provided to monitor the dilution and post-dilution water flow rates, respectively.

The ProMix Polymer Feeder is equipped with all the necessary components for easy installation, reliable performance, and safe operation. The design incorporates an electric solenoid valve (water inlet), flow meter, manually adjustable rotameter for secondary dilution flow, either a peristaltic, progressive cavity or diaphragm type neat polymer pump (depending on model), Dialog X controller, manual ball valves, pump calibration column, PVC piping and components, and polymer mixing chamber mounted on a skid to facilitate proper mixing and deliver.

2 Installation & Quick Start Guide

2.1 Safety

Utilize appropriate protective safety gear when operating or maintaining this equipment. Recommended safety gear is as follows:

Personal Protective Equipment (PPE):

- Hard Hats (Where overhead hazards exist)
- Safety Glasses with side shields
- PVC Apron
- PVC Gloves
- Safety-Toed Work Boots

2.2 Delivery & Storage Checklist

1. Check packing list for completeness and note any missing items immediately.
2. Inspect equipment and shipping container for damages before accepting delivery. Make note of the carrier's bill-of-lading, the extent of the damage, if any, and notify the carrier.
3. Store the equipment on firm level surface in original packing container. Do not store the equipment where it may be exposed to extreme temperatures, precipitation, humidity, or dust. Avoid direct sunlight that could overheat and damage equipment.

Ambient Conditions for storage and transport:
Temperature: 14°F to 120°F
Air Humidity: ≤ 92% relative humidity, non-condensing

2.3 Installation Considerations

- Required Polymer System Voltage
- Available Water Pressure
- Available Water Quality (Flowmeter requires water conductivity higher than 20 µS/cm)
- Injection Point Pressure
- Number of Injection Points
- Polymer Solution Discharge: For example (Length of Piping Run and Pipe Size)
- Neat Polymer Suction: Flooded or Lift
- Type of Application / Dewatering Device
- Type of Polymer: Emulsion, Dispersion, Solution

2.4 Installation

NOTE: ProMix systems are a flow through design. Incoming water pressure must be adequate to overcome pressure losses in the system and the pressures in the downstream system.

1. Unpack and position equipment on sturdy level surface. Fasten to prevent movement.
2. Do not install equipment in areas of extreme heat, cold, dust or humidity. Avoid areas where objects or fluids can drop from overhead.
3. Units are to be installed as close to the point of application as possible.
4. Inlet pressure is not to exceed the working pressure of the neat polymer pump.
5. System pressure at the discharge is not to exceed 80% of inlet pressure.
6. Piping Internal to the System:
    a. Inspect the piping for breakage. The system may have been jarred during shipping.
    b. Check the tightness on all unions. Hand tighten only – no tools. Unions incorporate an o-ring seal. Ensure that the o-ring is seated properly prior to tightening.
7. Piping External to the System (Reference Appendix A for connection location):
    a. Install piping so that connections properly meet system termination points. Do not “stretch” field installed piping to meet system termination points. Stressed piping will fail.
    b. Piping should be at a minimum ¾” to and from the piping on the system.
    c. Avoid getting dirt and debris inside the piping during installation. Plug ends of piping with rags if construction activities are underway. All debris must be flushed from piping before system start-up.
    d. Connect to outlet piping ¾” FNPT from static mixer to associated customer application point.
    e. Connect to make-up water inlet piping ¾” FNPT.
    f. Connect to Neat Polymer pump inlet piping ½” FNPT.
    g. Install ¾” pressure regulator and ¾” y-strainer / basket strainer on the clean make-up water line if equipment is currently not installed. (Recommended)
    h. Allow provisions for draining the system piping. Skid components will require maintenance. Ensure that chemicals can be evacuated from the skid piping and components for servicing.
8. Electrical Supply Needed for the System:
    a. Review local Electrical Code and follow accordingly.
    b. Connect incoming power to skid mounted control panel *(120VAC, Single Phase, 15 Amp, 60 Hz).* Ensure panel is properly grounded.
    c. Check electrical connections to be sure proper voltage is supplied to the system.
    d. Power the unit using a dedicated, separate breaker in the local lighting distribution panel.
    e. Do not route the AC power in common conduit with variable frequency pump drives.
    f. Do not put conduit entries in the top of the control panel. Resulting conduit condensation and failure to seal may damage controller circuit boards.
9. The Overload relay should be set to the Motor Nameplate Full Load Amps. Setting this to a higher value will result in possible damage to the motor and associated wiring. Overload conditions should be investigated, and possible process changes may need to be made to prevent overload conditions.
10. Connect Digital Remote Start Functions (note wiring termination points in Appendix B) for remote start permissive. Default jumpers should remain in place for any input not available.

2.5 Quick Start Guide

1. Check unit thoroughly to be sure all fittings and wire connections are tight.
2. Before powering the system on:
   a. Be sure “System Start” switch on the gray control box door is in the “OFF” position and the “Polymer Pump” switch is in the “Local” position.

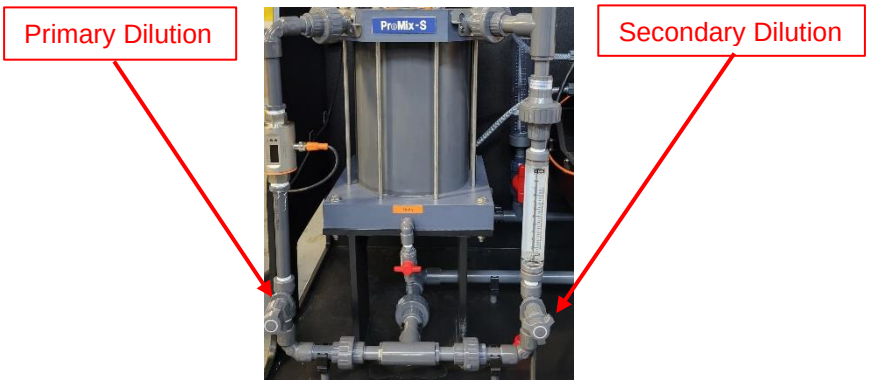


- Switching to "ON" starts the unit locally.
- Switching to "Remote" the unit waits for a dry contact at terminals TB-2 15 and 16.



- Switching to "LOCAL" the % speed from the Polymer Calc. is entered on the Dialog X Web HMI in the "Polymer Pump Speed" input.
- Switching to "External" the % speed is controlled via 4-20 mA signal from terminals TB-3 2 (-) and 3(+) for passive and TB-3 1(-) and 2 (+) for active.

   b. Open ball valve on the suction of the pump to allow chemical to flow into the system by gravity. If the application is suction lift, then ensure liquid is present in pump suction.
   c. Fully open the needle valve that controls the water going into the mixing chamber (Primary Dilution), while fully closing the needle valve that controls the water flow after the mixing chamber (Secondary/Post Dilution).



3. Power on both the breaker and motor overload rotary switch inside the gray control box.

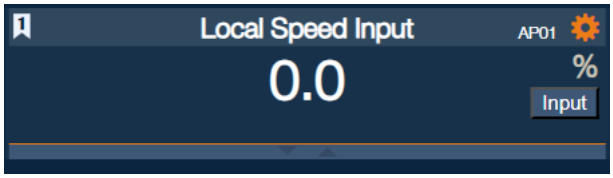


- The breaker is in the down position, signifying it is off.
- The motor overload switch is pointed at the 9 o'clock position, signifying it is off.
- Current trip point should be 10% above the FLA of the motor at maximum.

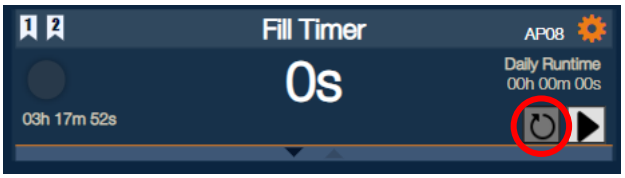


- The breaker is in the up position, signifying it is on.
- The motor overload switch is pointed at the 12 o'clock position, signifying it is on.

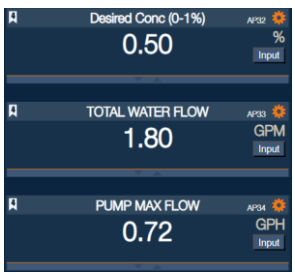
4. Startup pump at maximum output to purge all air and prime the system. To prime the pump, press and hold the PRIME button ⏩ on the pump keypad until chemical is visible in the discharge line.
5. Connect to the controller via WiFi with either smartphone, tablet or computer.
   a. Select Dialog_X_nnnn from the device WiFi settings and enter 1234567890 as the password.
   b. Open device browser and enter 192.168.1.1 in address bar.
   c. Login as Administrator with the password 3356 to make changes to the process settings.
   d. For instructions running the system via the keypad, see **Section 3.3.2** of the manual.
6. Verify that the “Local Speed Input” (AP01) value is set to 0%. For more information refer to Section 3.2.2.



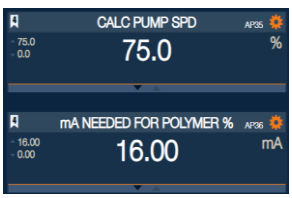
7. Turn “System Start” switch to “ON” to begin filling the chamber. This step will ensure that the mixing chamber motor does not run dry, which will result in damage to mechanical seal.
   a. Ensure that air has been purged from the chamber by verifying that water coming through the static mixer is no longer aerated within the fill timer limit.
      i. If aerated water continues and the fill cycle needs reset, turn “System Start” switch to the “OFF” position. Then reset the “Fill Timer” AP08 by selecting the reset button and repeat step 7. For more information refer to Section 3.2.2.



8. Adjust the Primary Dilution flow control valve to obtain the desired flow rate. If additional dilution water is needed, adjust the secondary accordingly.
9. Perform and verify pump calibration using drawdown calibration cylinder. When finished, switch back to bulk supply. To perform pump calibration, refer to the pump name plate data.
10. Perform calculations by utilizing the calculator apps in the controller to obtain pump speed based on desired concentration, set flow rate and maximum output of the polymer pump.



- AP32 - Input desired final polymer concentration, not to exceed 1%.
- AP33 - Input total water flow obtained in step 8.
- AP34 - Input the maximum flow of the polymer pump.



- AP35 - The calculated pump speed value obtained is the value to be entered in the Local Speed Input AP01 while polymer pump switch is in local.
- AP36 - mA Needed for Polymer % is the signal required while the Polymer pump switch is in external.

11. Enter in the calculated pump speed value from AP35 into AP01 or apply calculated input signal from AP36 (if polymer pump switch is external selected).
12. Observe system and check for leaks.
13. This completes the quick start guide. For further information consult operation manual.

3 Controller

The ProMinent ProMix Polymer Feeder utilizes the ProMinent Dialog X controller to deliver the operation required to operate the feeder.

3.1 Communication

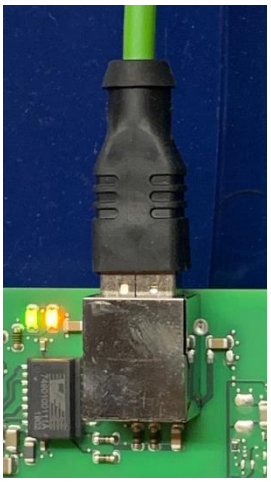
The Dialog X supports multiple types of communication with the unit. The two that will be discussed are LAN and WiFi connection. Refer to the Dialog X manual for further communication settings.

3.1.1 LAN Connection

The most common connection is a physical Local Area Network (LAN) connection. This requires an Ethernet cable (provided), and you will need to set up the Ethernet port address on your device to be compatible with the address of the controller.
Use the included **green Ethernet cable** to attach to the LAN port on your PC and to the LAN port on the door of the controller. A green light should be seen on your PC next to the connection. The amber light will blink with each packet that passes by in either direction.



Round 4 pin M12 connector



Open the controller and note that the LAN green and amber lights are lit on the back of the door next to the RJ45 port.

NOTICE

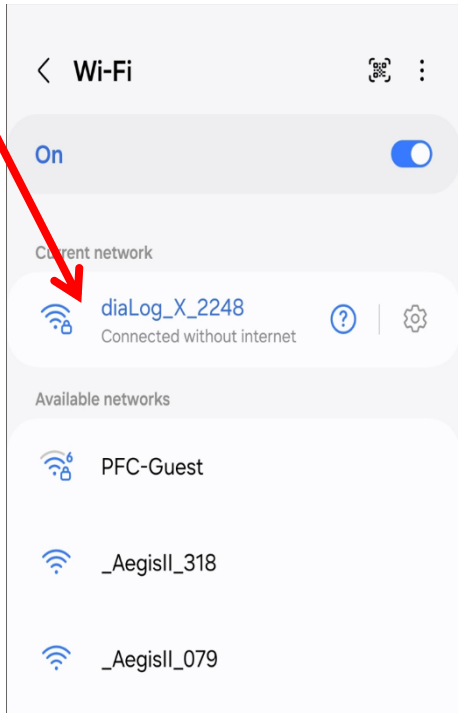
The Ethernet cable no longer needs to be a ‘crossover’ type cable. However, please note that the **Dialog X controllers require a <u>recent version</u> of whichever Browser you choose to use.**

Next, you need to open a web browser session (Remote HMI) to be able to communicate with the controller. This step requires you to enter the LAN IP address of the Dialog X controller where **10.10.6.106** is the controller default.

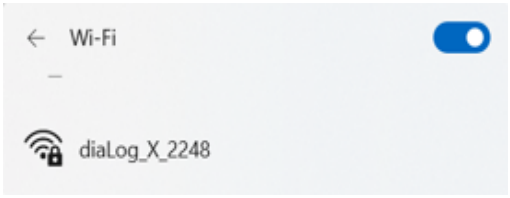
NOTE: In order to access the Remote HMI, you will need to configure your device’s IP settings. For step-by-step instructions, please refer to the Dialog X manual.

3.1.2 WiFi Connection

Click on the **Wi-Fi** icon on your device to see a list of available Wi-Fi devices.
Click on the **Dialog_X_nnnn** choice and press the Connect button. You will be prompted to enter the password where the default is 1234567890.
The numbers **nnnn** are taken from the last 4 digits of the controller serial number. The serial number is located on a sticker on the outside of the Dialog X. This unique name allows you to differentiate between controllers when more than one is within the **Wi-Fi** range of your device. In the example here, the controller SN ends in 2248.
Further simplify identifying nearby controllers by changing the Wi-Fi name. **Dialog X 2248** could become **Dialog X ProMix** for example.



You are now on the Dialog X **Wi-Fi** network. You have established a path between the two devices.

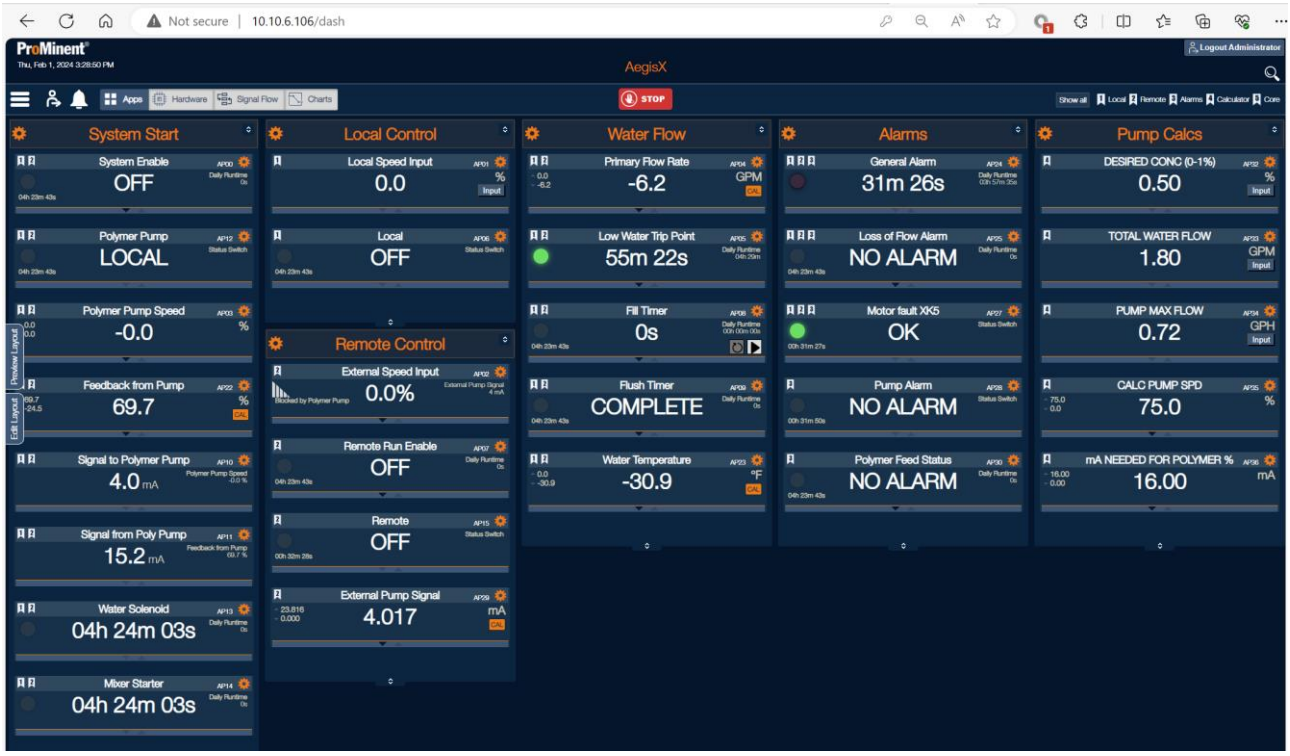


Next, you need to open a web browser session (Remote HMI) to be able to communicate with the controller. This step requires you to enter the WiFi IP address of the Dialog X controller where **192.168.1.1** is the controller address.

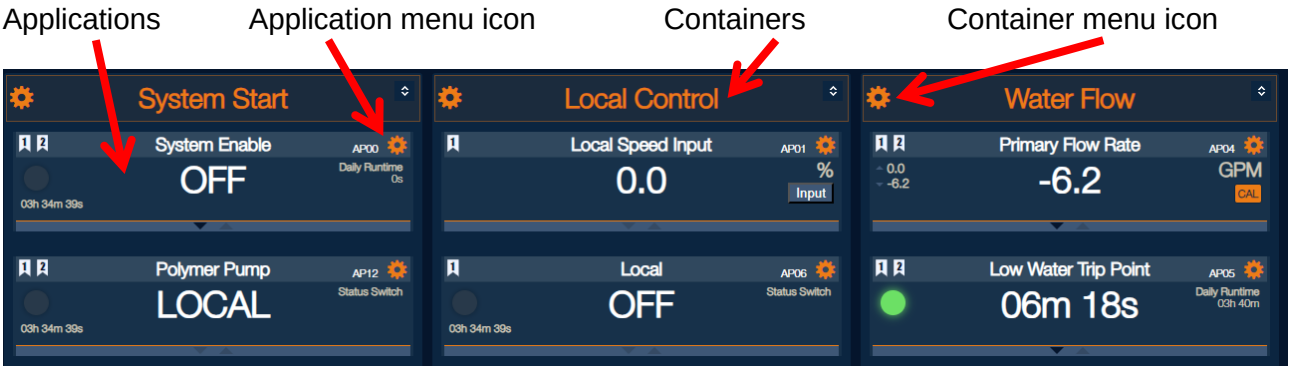
3.2 Remote HMI

The Remote HMI (Human Machine Interface) is accessed by typing the controller IP address into the address bar in a web browser. Again, when connected to the controller via LAN connection the default address to type in the address bar is **10.10.6.106** whereas **192.168.1.1** is utilized when connected via WiFi.

When first connecting to the controller via the web browser, the Remote HMI application page will appear after the initializing and loading screen has finished. The initial view of the Remote HMI is defaulted to the Administrator view.



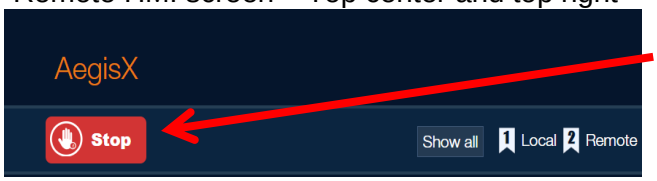
The Application Page is where the logic of the controller is programmed. Use the Remote HMI to easily change setpoints, alarm and warning limits, input and output scales, and create graphs.



Applications are the logic of the controller's programming. To make changes to the application, use the Application Menu icon. Applications are organized into containers. To add or duplicate applications in the container, use the container menu icon.

The Remote HMI can also stop the I/O of the controller without being at the physical controller.

Remote HMI screen – Top center and top right



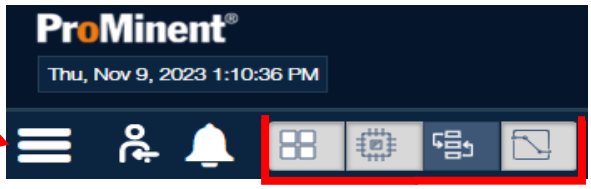
Remote start/stop button.

System buttons. For more information please refer to the Dialog X manual.

Systems group applications are on the controller level as opposed to containers for the user level. For the ProMix the applications are grouped into systems based on how the application affects the ProMix.

Remote HMI screen – Top left

The Controller settings menu handles system maintenance issues like time and date, adding new users, creating and describing the purpose of new containers on the application page, firmware versions, and more.



Login Alarms Pages

The page buttons allow the user to view the application, hardware, signal flow, and charting pages. For more information on the different pages, please refer to the Dialog X manual.

3.2.1 Login Information

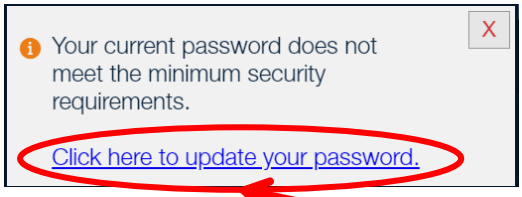
To log into the Administrator or Operator level user by selecting the login button located in the top left corner.

When logging into the Administrator user account, type “administrator” into the Username field.

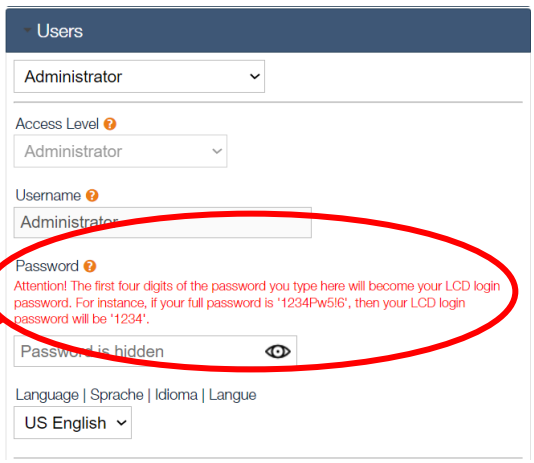
When entering the Administrator account, the default password is “3356”.



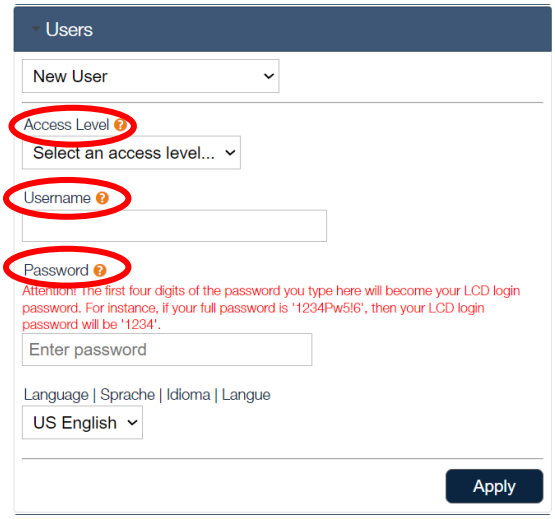
The user will be prompted to change the password for the administrator account. **It is suggested to change the password and keep it on file.**



By selecting the link in the prompt above, the Users tab of the Setup section in the Controller Settings menu will appear. From here, you can change the password by following the red dialog.



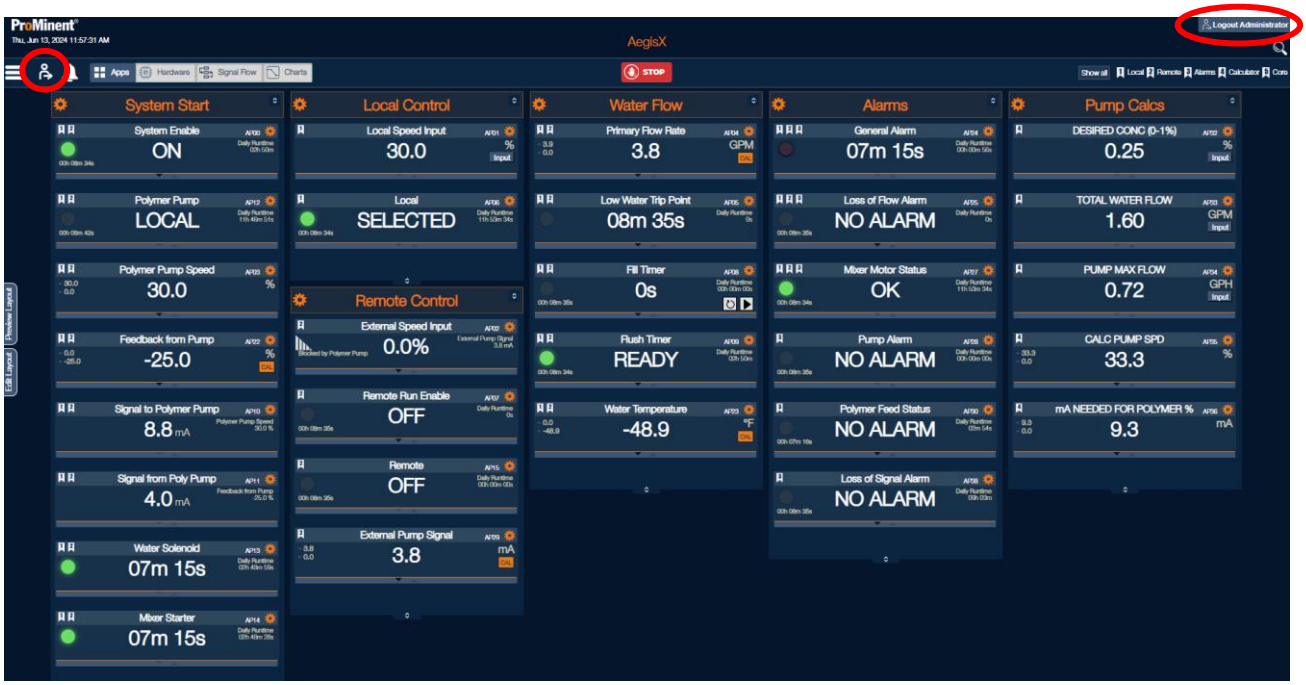
From the same Users tab, while logged in as the Administrator, the user can create other administrator level and operator level users. To do so, the Administrator will select the Access level drop-down and choose either an administrator or operator, assign the username in the username box, and enter in a password for that user, following the red dialog.



With the ProMix, a default operator level user has been created. The username **OP1** accompanied with the password **3356ProOp!**. The username and password can both be changed. **It is suggested to keep on file all usernames and passwords after creation.**

3.2.2 Remote HMI Operation

As explained in **Section 3.2.1**, when logging in as the administrator, the administrator view is similar to the default view but with two exceptions. These exceptions are the Logout button in the top left corner and the Logout Administrator button in the top right corner as depicted below.



Most applications are not able to be modified by the administrator or operator users. This is to prevent accidental changes from occurring causing a malfunction with the equipment.

The administrator view shows 30 apps which are organized into 6 containers. The default organization of the containers and applications was designed to help the user determine where specific applications would be corresponding to function. The container layout and naming can both be changed by the user at their discretion.

3.2.2.1 System Containers

As explained in **Section 3.2**, the logic blocks (applications) are stored in containers. The default containers are arranged by how the applications operate the system.

Container Name	Description	App IDs
System Start	Applications stored in the System Start container processes the logic of the controller and establishes operation of the system.	AP00 – System Enable
		AP12 – Polymer Pump
		AP03 – Polymer Pump Speed
		AP22 – Feedback from Pump
		AP10 – Signal to Polymer Pump
		AP11 – Signal from polymer Pump
		AP13 – Water Solenoid
		AP14 – Mixer Status
Local Control	Applications stored in the Local Control container run the system when in local.	AP01 – Local Speed Input
		AP06 – Local
Remote Control	Applications stored in the Remote Control container run the system when in external and remote.	AP02 – External Speed Input
		AP07 – Remote Run Enable
		AP15 – Remote
		AP29 – External Pump Signal
Water Flow	Applications stored in the Water Flow container manage operations concerning the water flow.	AP04 – Primary Flow Rate
		AP05 – Low Water Trip Point
		AP08 – Fill Timer
		AP09 – Flush Timer
		AP23 – Water Temperature
Alarms	Applications stored in the Alarms container manage the alarm state and individual alarms of the system.	AP24 – General Alarm
		AP25 – Loss of Flow Alarm
		AP27 – Mixer Motor Status
		AP28 – Pump Alarm
		AP30 (Optional) – Polymer Feed Status
Pump Calcs	Applications stored in the Pump Calcs container setup the calculation of the polymer pump speed for a desired concentration at a given flow rate.	AP32 – Desired Conc (0-1%)
		AP33 – Total Water Flow
		AP34 – Pump Max Flow
		AP35 – Calc Pump Spd
		AP36 – mA Needed for Polymer %

Further explanations of the applications and their operation are discussed in later sections of the manual.

3.2.2.2 System Start Container

The **System Start** container contains the applications that sequence through the logic to begin operation of the equipment. The applications stored in this container cannot be modified.

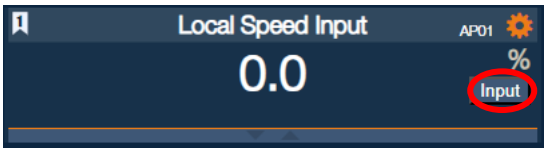
System Start		
App Number	**App Name**	**Description**
AP00	System Enable	Indicates the on/off status of the system.
AP12	Polymer Pump	Indicates the control state of the polymer pump (local or external).
AP03	Polymer Pump Speed	Speed percentage sent to the polymer pump from the controller.
AP22	Feedback from Pump	Speed verification sent back from the polymer pump. *Should be the same value as AP03.
AP10	Signal to Polymer Pump	Indicates the mA signal being sent to the polymer pump.
AP11	Signal from Polymer Pump	Verification mA signal being sent to the controller from the pump. *Should be the same value as AP10.
AP13	Water Solenoid	Indicates the status of the water solenoid. *Green indicator light means open.
AP14	Mixer Starter	Indicates the status of the mixer. *Green indicator light means on.

3.2.2.3 Local Control Container

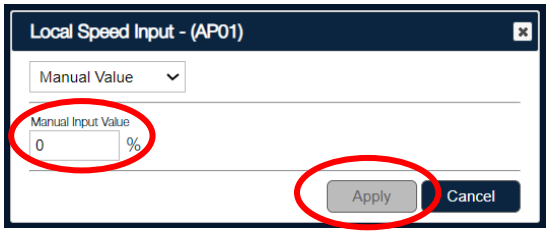
The **Local Control** container contains the applications utilized when the polymer pump control switch is set in local. AP06 is unable to be modified.

Local Control		
AP01	Local Speed Input	Speed percentage input from the user to run the polymer pump while in local.
AP06	Local	Indicates if the system is on locally.

AP01 (Local Speed Input) is the application that is utilized by the user to control the speed percentage of the pump manually.



By selecting the “Input” button, the Manual Value menu will appear where the change in pump speed percentage can be made. After making a change in the “Manual Input Value”, be sure to use the “Apply” button to save the change.



3.2.2.4 Remote Control Container

The **Remote Control** container contains the applications utilized when polymer pump control switch is set to “external”. The applications stored in this container cannot be modified.

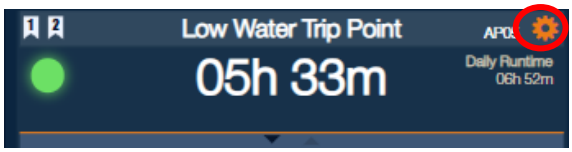
Remote Control		
AP02	External Speed Input	Takes the signal from AP29 and converts it to polymer pump speed percentage.
AP07	Remote Run Enable	Indicates that the system is on locally and has been given a remote contact to run.
AP15	Remote	Indicates if the system is on remotely.
AP29	External Pump Signal	Indicates the mA signal sent to the controller, from an external source, for running the polymer pump.

3.2.2.5 Water Flow Container

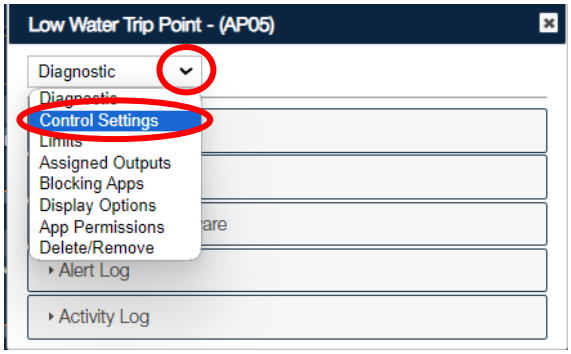
The **Water Flow** container contains the applications that manage the primary dilution water flow. Applications AP04 and AP23 cannot be modified by user.

Water Flow		
AP04	Primary Flow Rate	Displays the flowrate produced from the flowmeter on the primary dilution line.
AP05	Low Water Trip Point	Indicates if the primary water flow has not met the minimum flowrate. *Trip point to be set by user
AP08	Fill Timer	Indicates the system is going through a fill cycle. *Green indicator light means the chamber is filling. Fill time to be set by user (default 30s).
AP09	Flush Timer	Indicates the system is going through a flush cycle. *Yellow indicator light means flushing. Flush time to be set by user (default 30s).
AP23	Water Temperature	Displays the water temperature measurement from the flowmeter on the primary dilution line.

AP05 (Low Water Trip Point) sets the minimum flow rate that the system must see to remain operating while maintaining less than or equal to 1% in the mixing chamber. It is crucial to not exceed 1% due to the risk of tripping the motor starter.



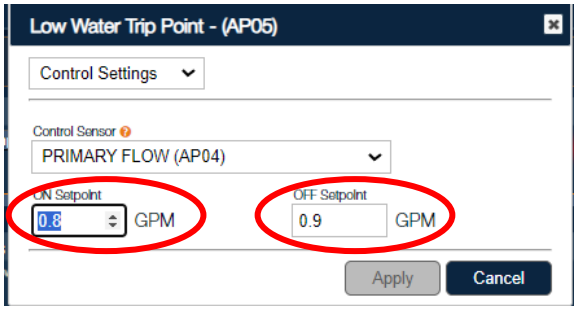
Adjust the setpoints by first selecting the application menu icon.



Then, select the application control settings drop-down menu. Then select the “Control Settings” option to gain access to the “Control Settings” setpoints.

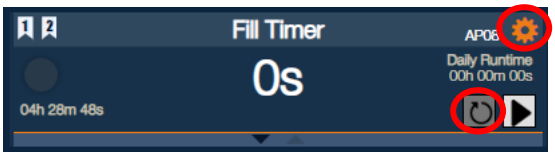
Adjust the “On Setpoint” to the minimum allowable flow rate that will not exceed a 1% concentration.

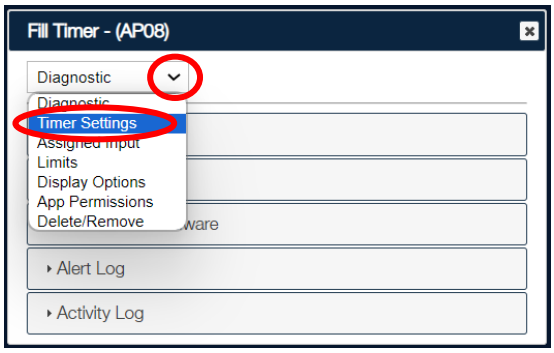
Adjust the “Off Setpoint” slightly above the on setpoint. If the flow does not exceed the “Off Setpoint” in a set time (AP25), an alarm condition will occur, and the water solenoid will close.



AP08 (Fill Timer) sets the time required to fill the mixing chamber (default 30s) before the mixer motor and polymer pump start. Depending on the operational flow rate, this time will need to be changed (chamber capacity is two gallons). **It is critical that the mixing chamber is full prior to the mixer motor turning on to prevent the shaft seals from sustaining damage.**

The Fill Timer is set to run after the system has been enabled and is set to run only once. Reset the timer by either selecting the reset button or by power cycling the unit. To adjust fill time, select the application menu icon.



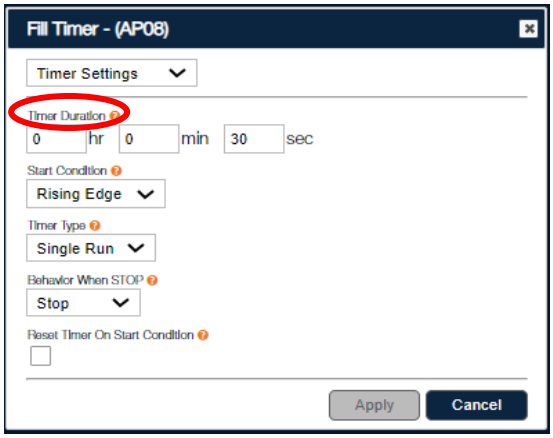


Then, select the application control settings drop-down menu. Then select the “Timer Settings” option to gain access to the “Timer Duration” setpoint.

Set the “Timer Duration” in accordance with the operational flow rate and the mixing chamber capacity.

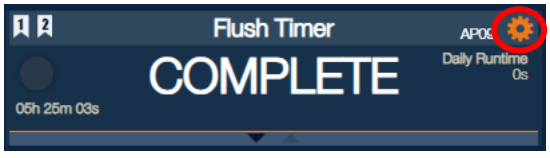
Once the chamber is filled, you can elect to set the “Timer Duration” to zero. This option is if the facility power fluctuates routinely.

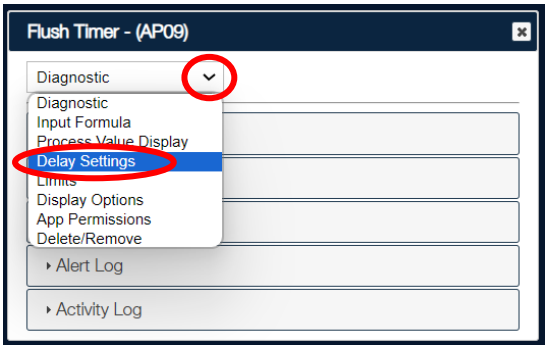
If maintenance on the mixing chamber requires the chamber to be drained and the timer has been set to zero, be sure to restore the “Timer Duration” to the previous time.



AP09 (Flush Timer) sets the time required (default 30s) to flush the polymer out of the mixing chamber leaving the mixing chamber with water only. Depending on the operational flow rate and process, this time will need to be changed.

The Flush Timer is set to run after the system has been disabled through setting the Enable Switch to OFF or when certain fault conditions happen. To adjust flush time, select the application menu icon.

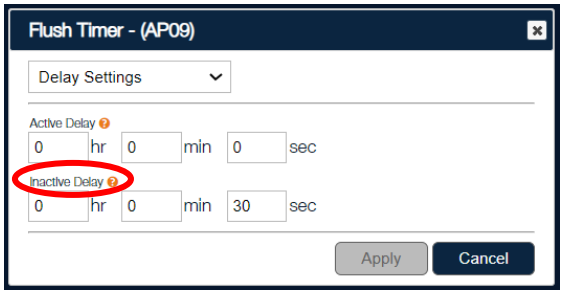




Then, select the application control settings drop-down menu. Then select the “Delay Settings” option to gain access to the “Inactive Delay” setpoint.

Set the “Inactive Delay” in accordance with the operational flow rate and the mixing chamber capacity.

Once the chamber is mixed, you can elect to set the “Inactive Delay” to zero. This option is if the process starts and stops routinely and if flush water cannot be tolerated downstream.



When the unit is to be shut down and requires flushing, be sure to restore the “Inactive Delay” to the previous time.

Note: When the controller is put into STOP during a flush, the system will pause the flush. The system will continue flushing when the STOP has been lifted.

3.2.2.6 Alarms Container

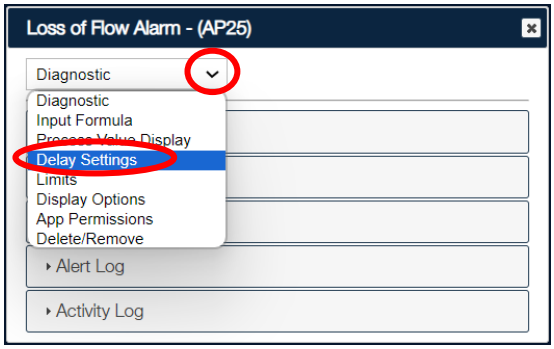
The **Alarms** container contains the applications that indicate faults with the major components of the system. AP24 and AP27-AP30 cannot be modified by the user.

Alarms		
AP24	General Alarm	Indicates if the system has triggered an alarm. *Red indicator light means the system is in an alarm state.
AP25	Loss of Flow Alarm	Indicates if AP05 has been active long enough where flow could not be reestablished. (Default Time 20s)
AP27	Mixer Motor Status	Indicates if the mixer motor has gone into a fault. *Green indicator light means the motor is NOT in a fault.
AP28	Pump Alarm	Indicates if the polymer pump has gone into an alarm state.
AP30 (optional)	Polymer Feed Status	Indicates if the polymer feed sensor is verifying polymer flow. *This app is only added if the polymer feed verification option is installed.
AP38	Loss of Signal Alarm	Indicates if the system is receiving <3.8mA signal for the polymer pump.

AP25 (Loss of Flow Alarm) activates in the event the Low Water Trip Point activates due to flowrate not exceeding the required minimum flowrate. AP25 has a delay to restore flow before the solenoid valve closes from lack of flow.

To change the delay time, first select the application menu icon.

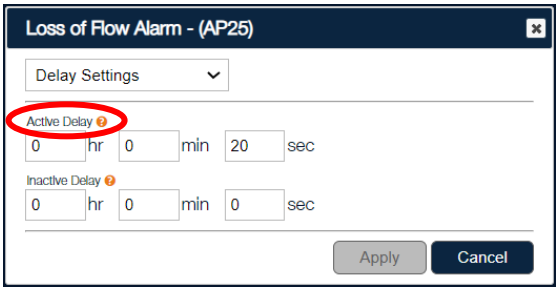




Then, select the application control settings drop-down menu. Then select the “Delay Settings” option to gain access to the “Active Delay” setpoint.

Set the “Active Delay” in accordance with the maximum time allowed for solenoid valve to stay open to restore flow dependent on inlet flow needs.

Note: This app is only available to be changed by the administrator user. Leaving the solenoid valve open without flow for extended period can result in damage to the solenoid valve.



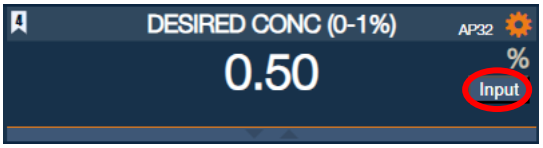
3.2.2.7 Pump Calcs Container

The **Pump Calcs** container displays the applications associated with calculating the polymer pump speed percentage and the signal needed to operate the polymer pump at the calculated speed percentage. Both AP35 and AP36 cannot be modified by the user.

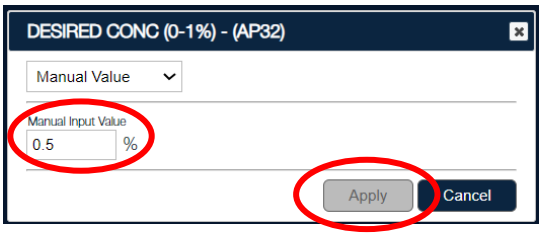
Pump Calcs		
AP32	Desired Conc (0-1%)	Input for the polymer percent concentration the user wishes to make down. *Utilized only in pump speed calculation.
AP33	Total Water Flow	Input for the total water flow the user anticipates running the system at. *Utilized only in pump speed calculation.
AP34	Pump Max Flow	Input for the maximum flowrate of the polymer pump. *Utilized only in pump speed calculation.
AP35	Calc Pump Spd	Polymer pump speed percentage calculated from the inputs of AP32-AP34. *To be entered into AP01
AP36	mA Needed for Polymer %	mA signal calculated from the inputs of AP32-AP34 for verifying the signal sent to the pump. *Use with AP10

AP32 (Desired Conc (0-1%)) sets the user’s desired polymer concentration for calculating the appropriate polymer pump speed.

To change the desired concentration for pump speed percentage calculation, first select the “Input” button.

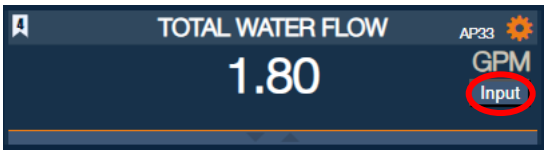


The Manual Value menu will appear where the change in polymer concentration can be made. After making a change in the “Manual Input Value”, be sure to use the “Apply” button to save the change.

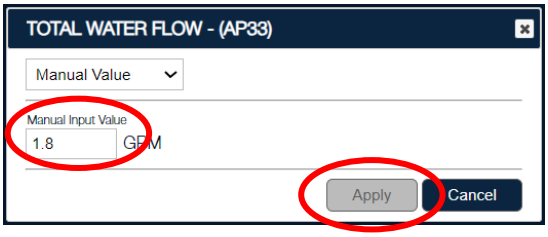


AP33 (Total Water Flow) is where the planned operating flowrate is entered for calculating the appropriate polymer pump speed.

To change the flowrate for pump speed percentage calculation, first select the “Input” button.

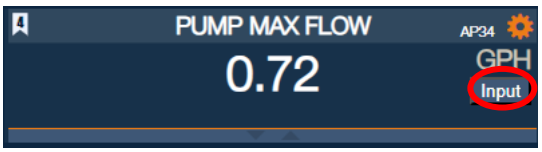


The Manual Value menu will appear where the change in water flowrate can be made. After making a change in the “Manual Input Value”, be sure to use the “Apply” button to save the change.

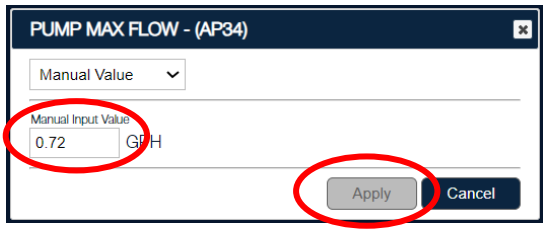


AP34 (Pump Max Flow) is where the maximum flowrate of the polymer pump is entered for calculating the appropriate polymer pump speed (refer to model information for max rate). Once the original polymer pump max flowrate has been entered, the value entered should only change if the polymer pump is replaced with a pump that has a different max flowrate.

To change the pump max flowrate for pump speed percentage calculation, first select the “Input” button.



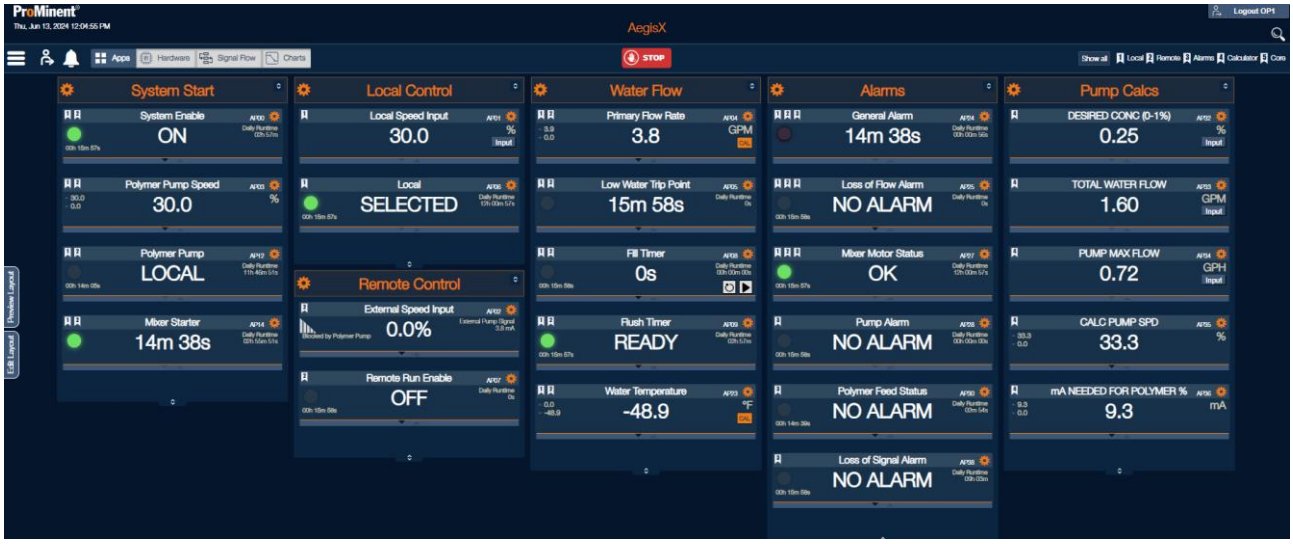
The Manual Value menu will appear where the change for the maximum pump flowrate can be made. After making a change in the “Manual Input Value”, be sure to use the “Apply” button to save the change.



After calculations are made, use the value obtained from AP35 as the input for the AP01. The value obtained from AP36 can be used to verify the signal being sent to the pump as seen in AP10.

3.2.2.8 Default Operator View

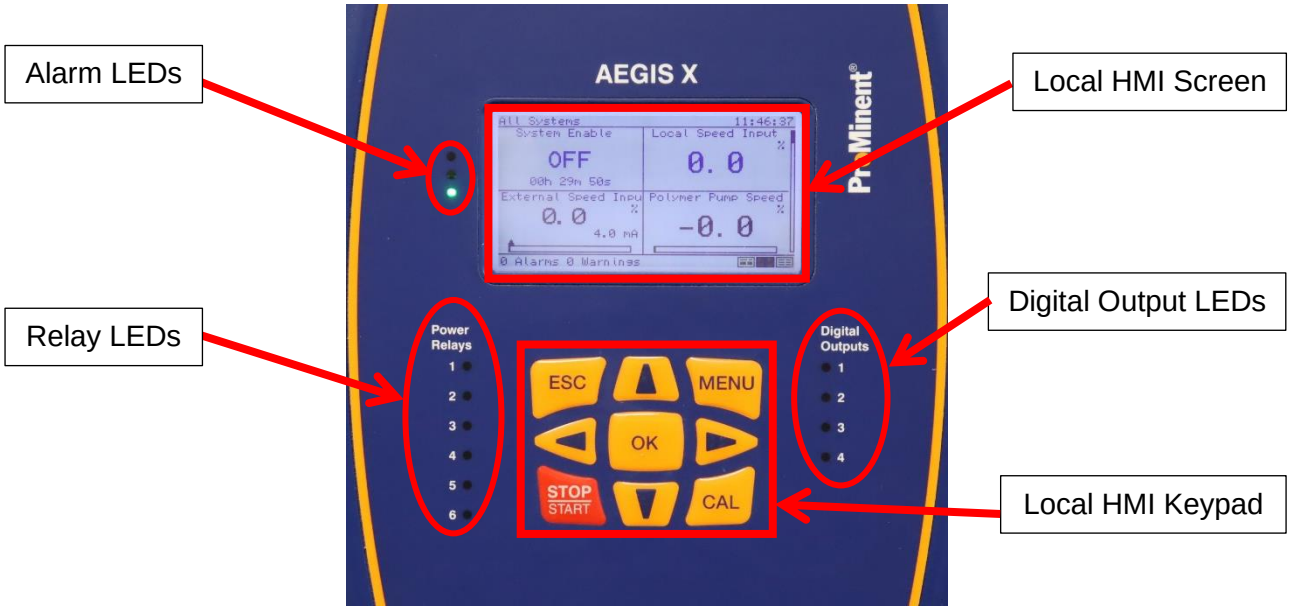
When logging into the operator user that is preprogrammed into the controller, the following view will show.



The operator view is condensed from the administrator to focus on normal operation. The applications in the operator view are highlighted earlier in this section.

3.3 Local HMI

The controller Local HMI (Keypad) indicates real time I/O values and programming information. The front cover LEDs provide relay and digital output status as well as alarms for immediate attention. The keypad allows for local operator interface. Altering of most applications is not available to keyboard users.



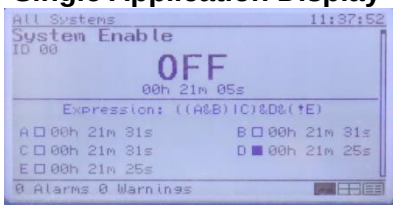
The basic understanding of the keypad is shown in this chart.

Key	Function
OK	Confirmation in the menus: Confirms and saves any changes.
ESC	Back to the HOME display or to the previous menu.
MENU	Main menu
CAL	Enables direct access to the controller's calibration menu from the HOME display. Does not work if not logged in.
STOP START	Start/Stop all **control** outputs from any display. (4-20mA = 4mA). Front panel LED is solid red. Does not affect **non control** outputs.
	(Up Arrow) Increases a displayed number value or moves upwards in the menus. (Right Arrow) Moves the cursor to the right.
	(Down Arrow) Decreases a displayed number value or step down in the menus. (Left Arrow) Moves the cursor to the left.

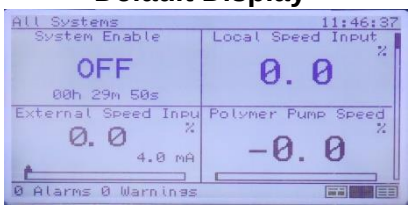
3.3.1 Navigation & Login

Using the left arrow, the display changes from the default four application display to the **Single Application** display. Conversely, using the right arrow, it will change to the **Nine Application** display.

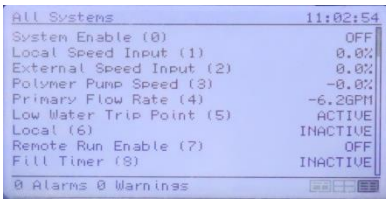
Single Application Display



Default Display

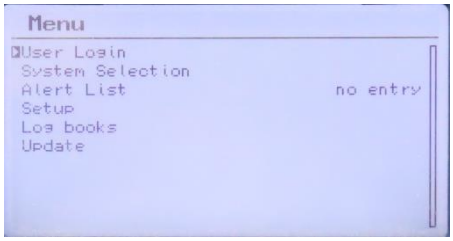


Nine Application Display



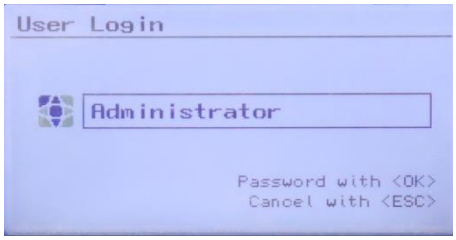
While in any of the three displays, using the down arrow will cycle to the next application or set of applications depending on which display is currently shown. Using the up arrow will return the display to the previous application or application set.

By selecting the menu button while in the default display, the “Menu” display will appear. The “User Login” option is only available within the “Menu” display.

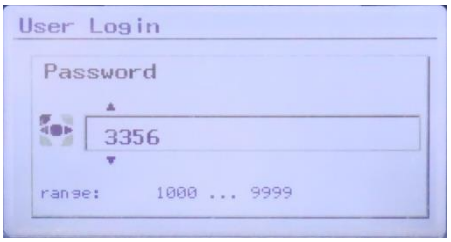


Note: Some options, including modifying certain applications, are not available without first logging in.

After selecting the user login option, the “User Login” page will appear. Select which user to log into by cycling the up and down arrows and selecting the OK button.

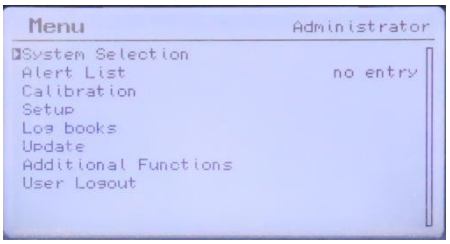


After selecting which user to log into, the “Password” prompt will appear. Using the directional buttons on the keypad, enter the 4-digit password for that specific user and select the OK button.



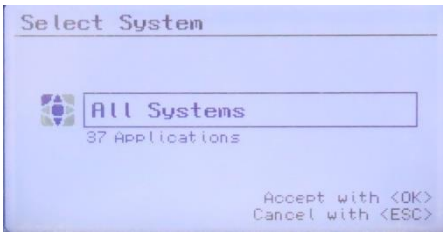
Note: There is a 5-minute idle time on the controller, where the user will be logged out after 5 minutes of inactivity.

To cycle through the systems so the Local HMI focuses on applications in a specific system, select the “System Selection” option in the “Menu”.

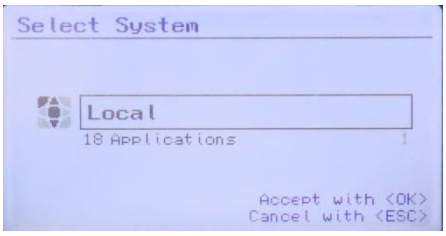


Note: By selecting a specific system, the applications contained in that system will now become the default for the controller view.

After the “System Selection” screen appears, cycle through using the up and down arrows on the keypad to select the system to view on the main screen. Select OK on the keypad to make selection.



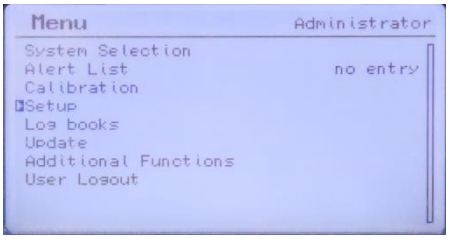
It is recommended that the “Local” system be selected since the applications grouped in the “Local” system affect the operation when the ProMix is enabled and running locally at the unit.



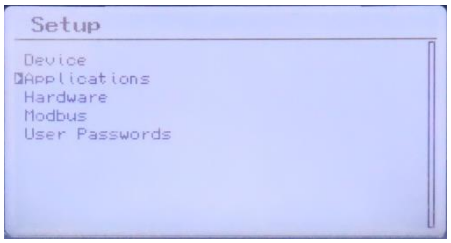
3.3.2 Operating from Keypad

Aside from running the ProMix from the Dialog X Remote HMI, the ProMix is capable of being operated from the Keypad if Remote HMI operations are unavailable. All changes from the Keypad must be made while logged in as a user. This section will explain how to get to specific applications that affect the operation of the ProMix.

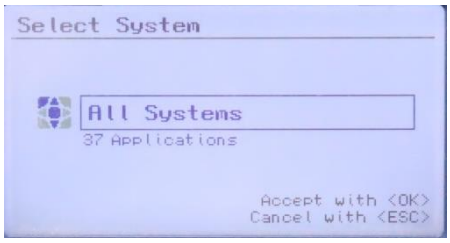
After logging in as a user, go to the “Menu” and cycle down to the “Setup” option using the down arrow on the keypad. Select the “Setup” option by selecting the OK button on the keypad.



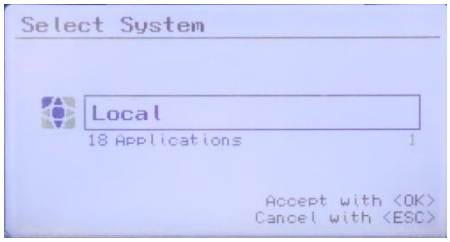
After selecting the “Setup” option, the “Setup” menu will appear. Cycle down to the “Applications” option using the down arrow on the keypad. Select the “Applications” option by selecting the OK button on the keypad.



After selecting the “Applications” option, the “Select System” page will appear. From this page, the user will be prompted to select the system needed. To select a specific system, cycle through the options using the up and down arrows on the keypad. Select the system by selecting the OK button on the keypad.



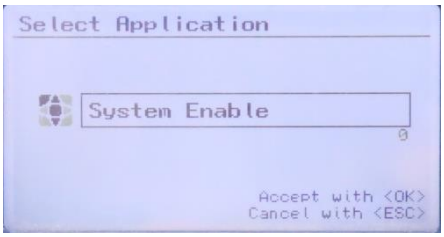
For applications AP01 (Local Speed Input) and AP05 (Low Water Trip Point), select the “Local” system option. If the “Local” system was previously selected under the “System Selection” from “Menu” as explained in **Section 3.2.1.**, the “Local” system will automatically appear when entering this page.



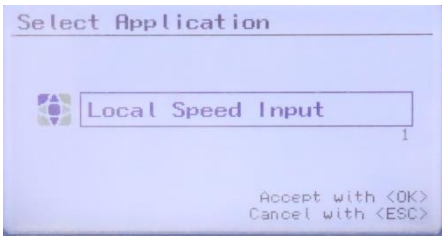
3.3.2.1 Changing Local Speed Input & Low Water Trip Point

To calculate the polymer pump speed to be entered into AP01 (Local Speed Input), utilize the equations in **Appendix H**.

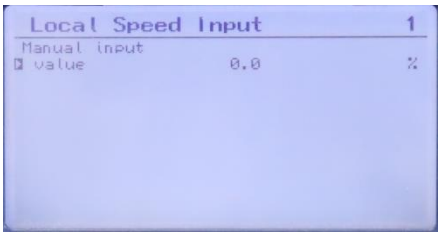
After selecting a system, the “Select Application” page will appear showing the application with the lowest number in that system. In the case of the “Local” system, AP00 (System Enable) appears first. Using the up and down arrows on the keypad, cycle to the application to modify.



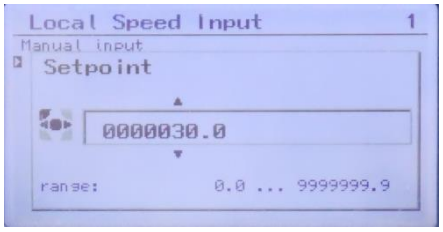
To control the polymer pump speed percentage while the polymer pump switch is in local, select AP01 (Local Speed Input) by selecting the OK button on the keypad to make the change.



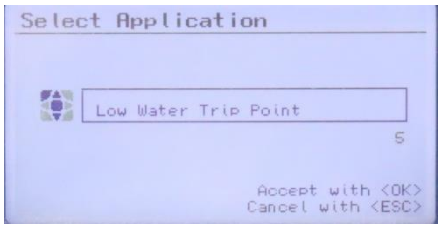
After selecting AP01, the settings page will appear. Select the “Value” option by selecting the OK button on the Keypad.



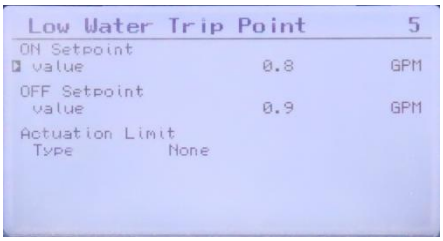
After selecting the “Value” option, the “Setpoint” page will appear. Here, the user can change the polymer pump speed percentage by first cycling the left and right arrows to the digit to be changed. Then, cycling the up and down arrows to the number they wish to enter. After the value has been selected, enter the value in by selecting the OK button on the keypad.



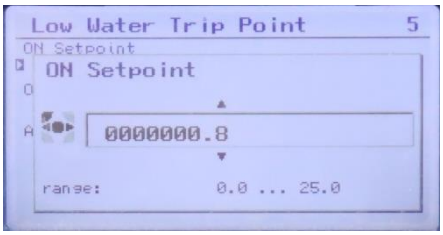
From the “Select Application” page, cycle to AP05 (Low Water Trip Point) by cycling the up and down arrows on the keypad. Enter into the application by selecting the OK button on the keypad. AP05 sets the minimum flow rate that the system must see to remain operating while maintaining less than or equal to 1% in the mixing chamber.



On the AP05 settings page there are two values to be changed. The “ON Setpoint” is the **lower setpoint** that will activate the application when the flowrate is too low. The “OFF Setpoint" is the **higher setpoint** that will deactivate the application when the flowrate is restored. Cycle the up and down arrows to switch between setpoints and select the OK button on the keypad to change setpoints.



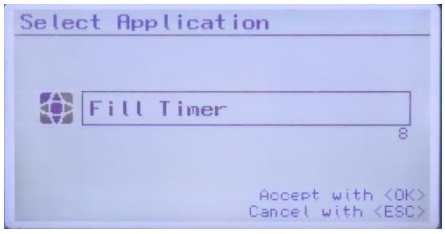
After selecting the “Value” option, the “Setpoint” page will appear. The user can change the “ON Setpoint” by first cycling the left and right arrows to the digit to be changed. Then, cycling the up and down arrows to the number they wish to enter. After the value has been selected, select the OK button on the keypad. Similarly, when selecting the “OFF Setpoint” this menu will appear and making changes are the same.



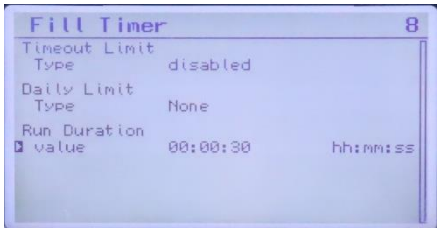
3.3.2.2 Changing Fill & Flush Timer

The following steps to change AP08 (Fill Timer) & AP09 (Flush Timer) will be discussed. These applications can only be changed by the **Administrator user**.

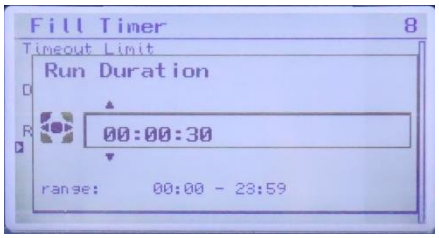
From the “Select Application” page under the “Local” system, cycle to AP08 (Fill Timer) by cycling the up and down arrows on the keypad. Enter into the application by selecting the OK button on the keypad. AP08 sets the time the chamber will fill before the polymer pump and mixer motor start.



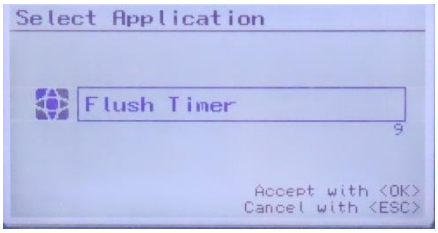
After selecting AP08, the setting page will appear where the “Run Duration” can be edited. Cycle down to the “Run Duration” using the down arrow and select it with the OK button on the keypad.



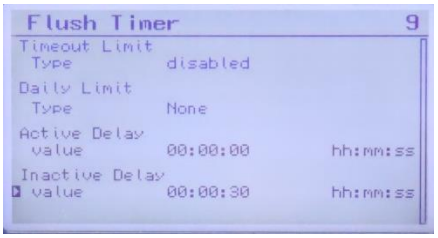
On the “Run Duration” page, the user can change the filling time. To change the filling time, cycle to the digit needing change using the left and right arrows and change the number by cycling the up and down arrows on the keypad. Select the OK button on the keypad to save the change. The Fill Time default is 30 seconds.



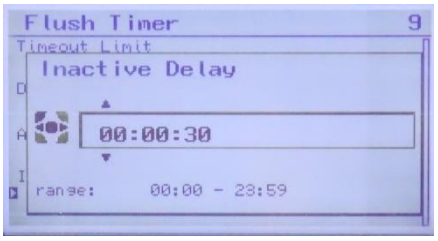
From the “Select Application” page under the “Local” system, cycle to AP09 (Flush Timer) by cycling the up and down arrows on the keypad. Enter into the application by selecting the OK button on the keypad. AP09 sets the time the ProMix will flush the polymer from the ProMix and occurs when the System Start switch is turned to the OFF position and in the case certain faults occur.



On the “Flush Timer” settings page, cycle the down arrow to the “Inactive Delay Value” option and select it with the OK button on the keypad.



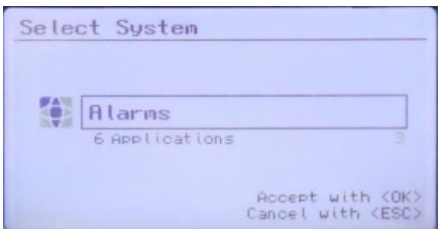
The “Inactive Delay” page will appear. Here, the user can change the “Inactive Delay” by first cycling the left and right arrows to the digit to be changed. Then, cycling the up and down arrows to the number they wish to enter. After the value has been selected, enter the value in by selecting the OK button on the keypad. The system has a default of 30 seconds.



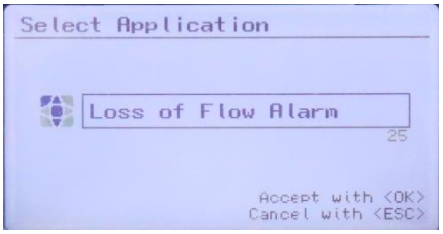
3.3.2.3 Changing Loss of Flow Alarm

The following steps to change AP25 (Loss of Flow Alarm) will be discussed. AP25 can only be changed by the **Administrator user**. This application should only be changed in the case of lengthening or shortening the time the user would like the system to allow to reestablish flow when flow has decreased enough for the concentration to exceed 1%.

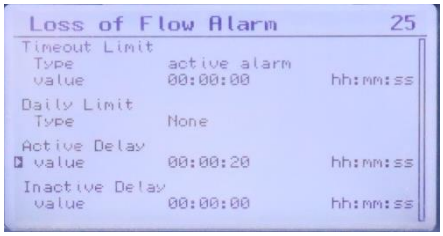
From the “Select System” page after selecting “Setup”, in the “Menu”, then “Applications” option as discussed earlier, cycle the options using the up and down arrows on the keypad until the “Alarms” system appears and select it with the OK button on the keypad.



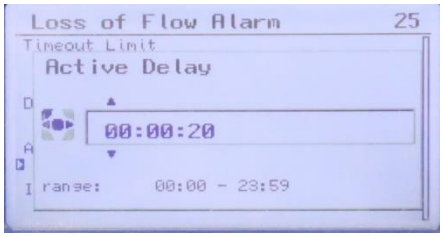
On the “Select Application” page, cycle through the up and down arrows until AP25 (Loss of Flow Alarm) appears and select the OK button on the keypad.



On the “Loss of Flow Alarm” settings page, cycle the down arrow to the “Active Delay Value” option and select it with the OK button on the keypad.

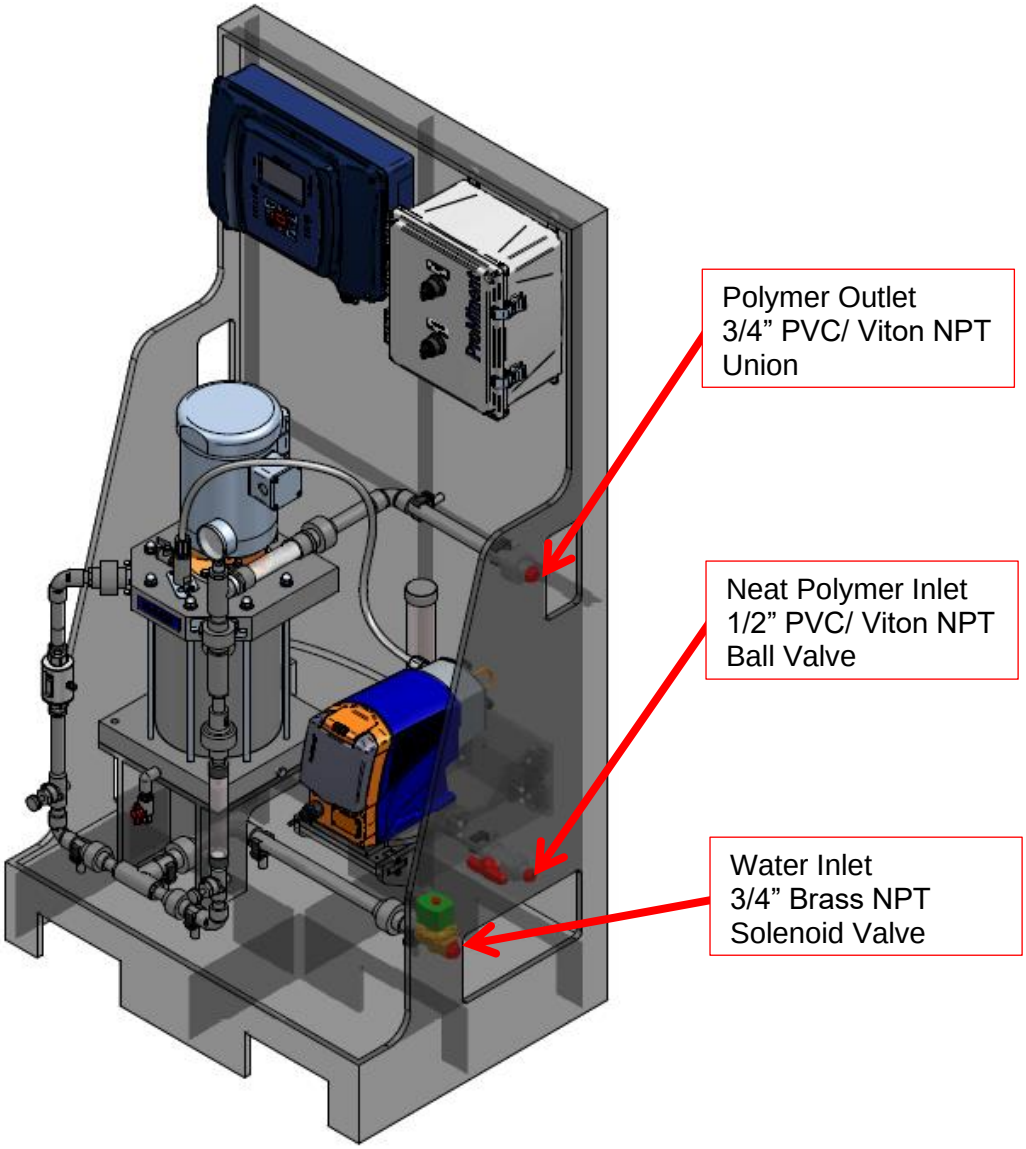


The “Active Delay” page will appear. Here, the user can change the “Active Delay” by first cycling the left and right arrows to the digit to be changed. Then, cycling the up and down arrows to the number they wish to enter. After the value has been selected, enter the value in by selecting the OK button on the keypad. The system has a default of 20 seconds.

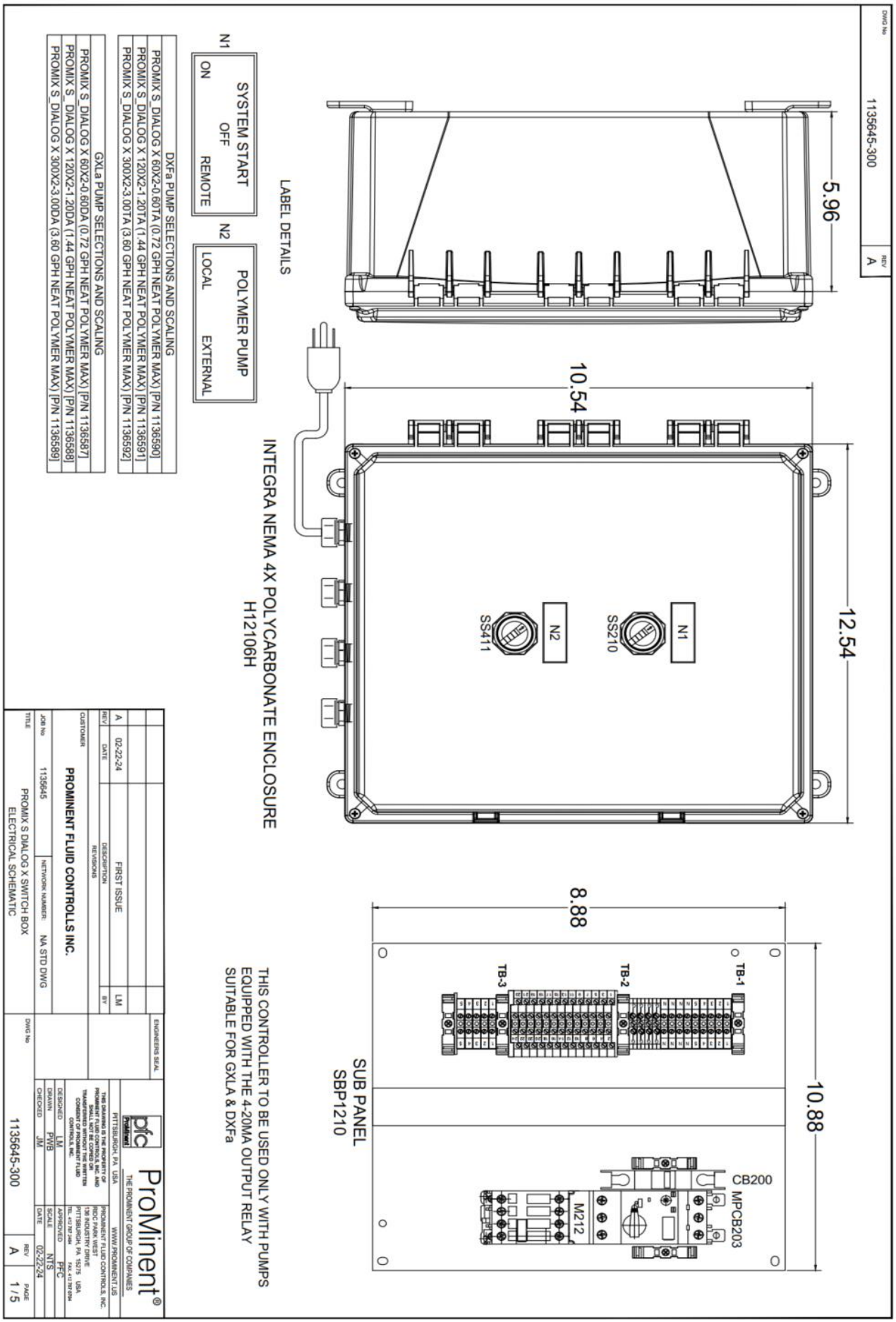


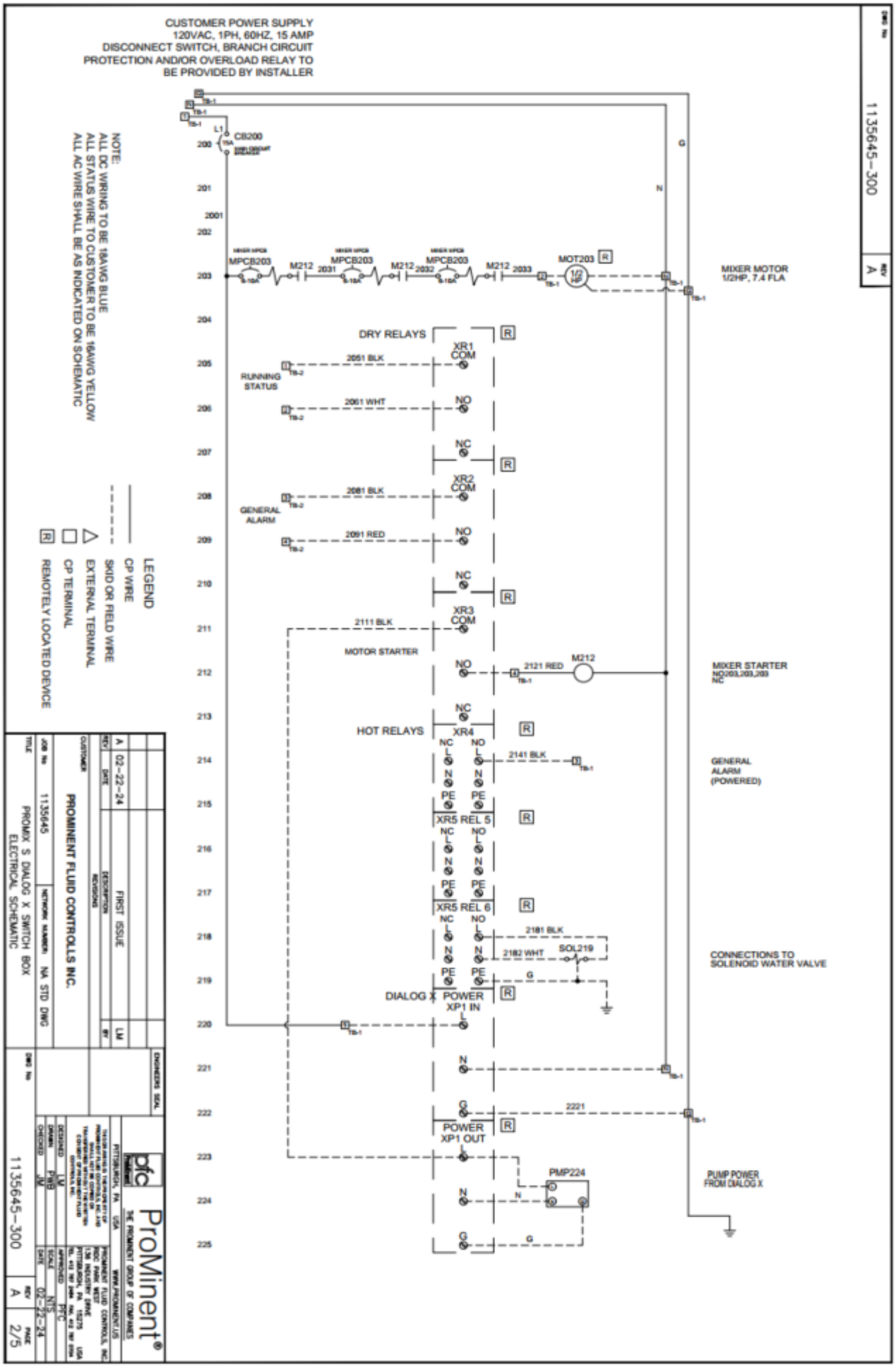
Note: Leaving the solenoid valve open without flow for extended period can result in damage to the solenoid valve.

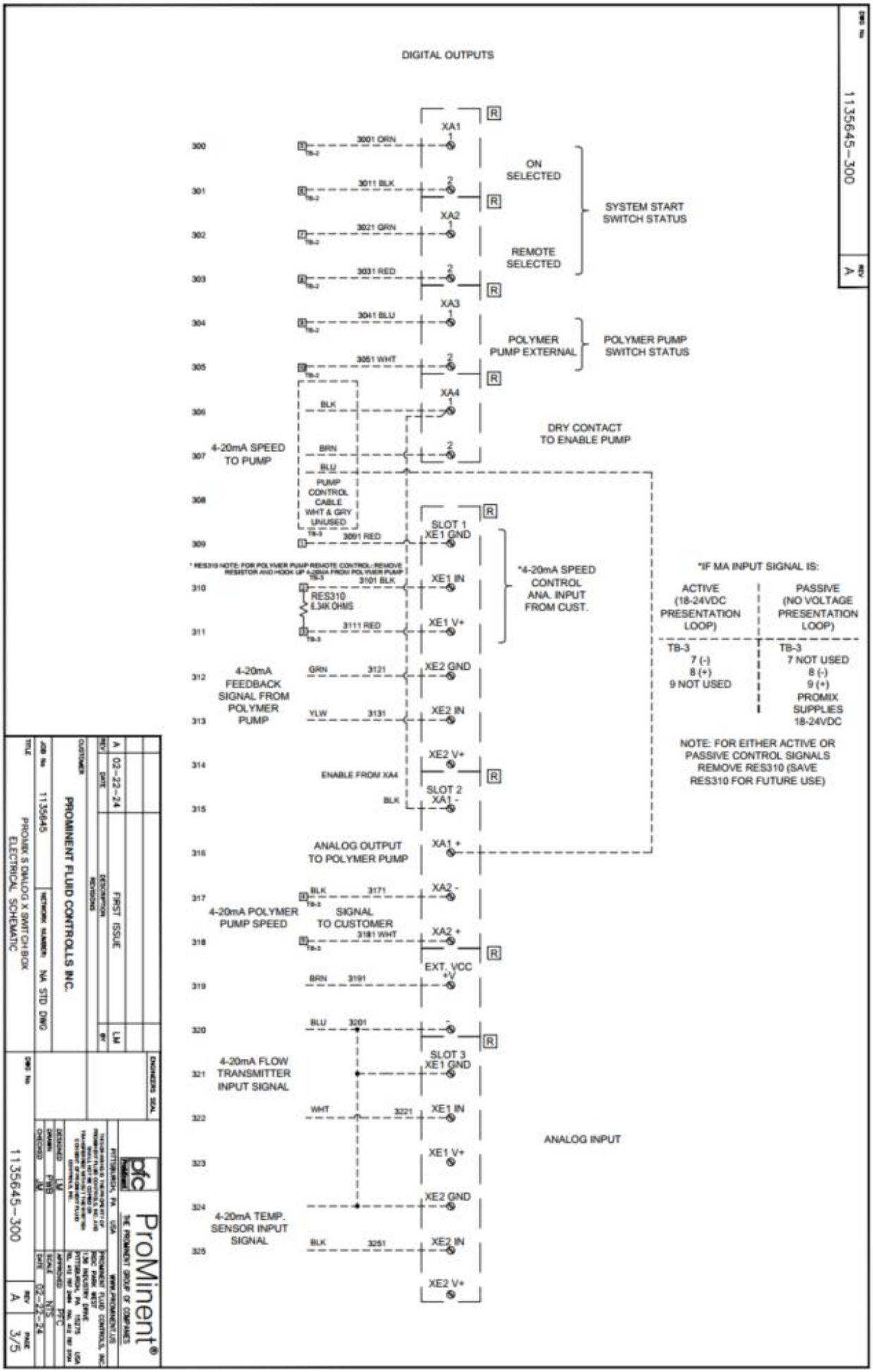
Appendix A – Fluid Connections

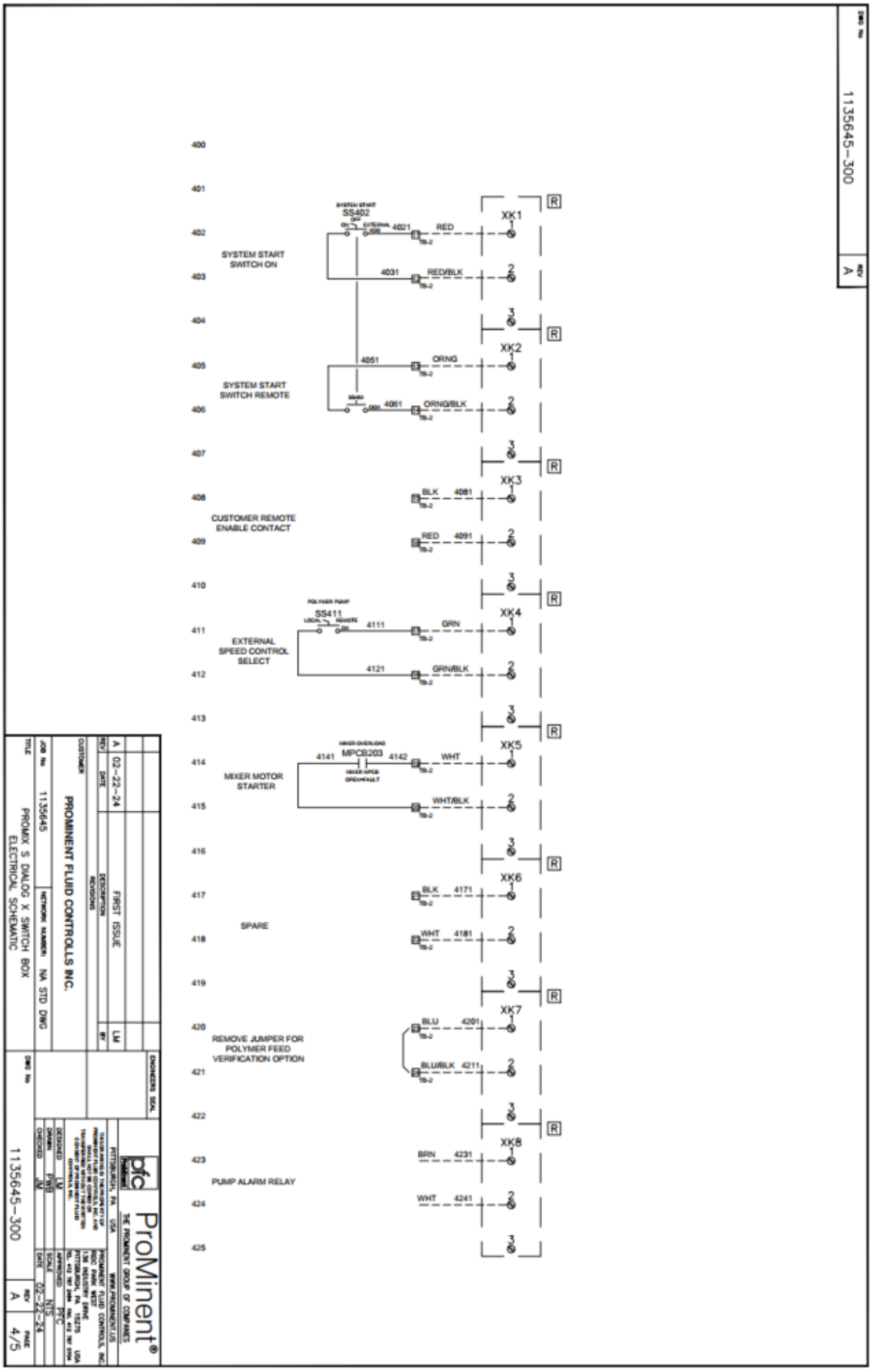


Appendix B – Electrical Drawing

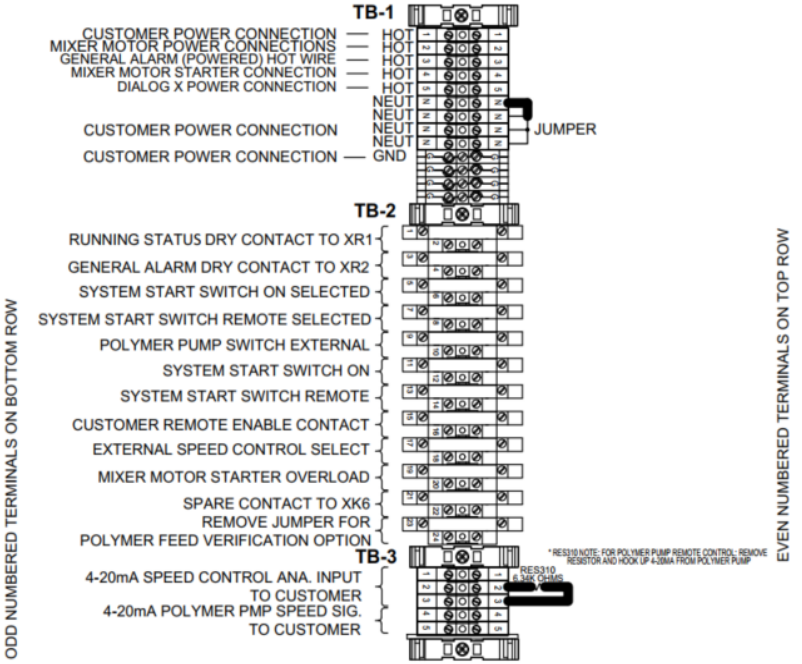



CUSTOMER POWER SUPPLY
120VAC, 1PH, 60HZ, 15 AMP
DISCONNECT SWITCH, BRANCH CIRCUIT
PROTECTION AND/OR OVERLOAD RELAY TO
BE PROVIDED BY INSTALLER
NOTE:
ALL DC WIRING TO BE 18AWG BLUE
ALL STATUS WIRE TO CUSTOMER TO BE 18AWG YELLOW
ALL AC WIRE SHALL BE AS INDICATED ON SCHEMATIC
LEGEND
CP WIRE
SKID OR FIELD WIRE
EXTERNAL TERMINAL
CP TERMINAL
REMOTELY LOCATED DEVICE
CB200
MPCB203
M212
MOT203
MIXER MOTOR
1/2HP, 7.4 FLA
DRY RELAYS
XR1
COM
NO
NC
XR2
XR3
RUNNING STATUS
GENERAL ALARM
MOTOR STARTER
2051 BLK
2061 WHT
2081 BLK
2091 RED
2111 BLK
2121 RED
MIXER STARTER
HOT RELAYS
XR4
XR5 REL 5
XR5 REL 6
2141 BLK
GENERAL ALARM (POWERED)
2181 BLK
2182 WHT
SOL219
CONNECTIONS TO SOLENOID WATER VALVE
DIALOG X POWER XP1 IN
POWER XP1 OUT
2221
PMP224
PUMP POWER FROM DIALOG X
PROMIX S DIALOG X SWITCH BOX
ELECTRICAL SCHEMATIC
PROMINENT FLUID CONTROLS INC.
1135645-300
02-22-24
FIRST ISSUE
ProMinent


DIGITAL OUTPUTS
1135645-300
A
XA1
3001 ORN
3011 BLK
ON SELECTED
SYSTEM START SWITCH STATUS
XA2
3021 GRN
3031 RED
REMOTE SELECTED
XA3
3041 BLU
3051 WHT
POLYMER PUMP EXTERNAL
POLYMER PUMP SWITCH STATUS
XA4
BLK
BRN
BLU
4-20mA SPEED TO PUMP
DRY CONTACT TO ENABLE PUMP
PUMP CONTROL CABLE WHT & GRY UNUSED
3091 RED
SLOT 1 XE1 GND
3101 BLK
XE1 IN
RES310 6.34K OHMS
3111 RED
XE1 V+
*4-20mA SPEED CONTROL ANA. INPUT FROM CUST.
4-20mA FEEDBACK SIGNAL FROM POWER PUMP
GRN 3121
XE2 GND
YLW 3131
XE2 IN
XE2 V+
ENABLE FROM XA4
SLOT 2 XA1 -
BLK
ANALOG OUTPUT TO POLYMER PUMP
XA1 +
4-20mA POLYMER PUMP SPEED
BLK 3171
SIGNAL TO CUSTOMER
XA2 -
3181 WHT
XA2 +
EXT. VCC +V
BRN 3191
BLU 3201
SLOT 3 XE1 GND
4-20mA FLOW TRANSMITTER INPUT SIGNAL
WHT 3221
XE1 IN
XE1 V+
XE2 GND
4-20mA TEMP. SENSOR INPUT SIGNAL
BLK 3251
XE2 IN
XE2 V+
ANALOG INPUT
*IF MA INPUT SIGNAL IS:
ACTIVE (18-24VDC PRESENTATION LOOP)
PASSIVE (NO VOLTAGE PRESENTATION LOOP)
TB-3
7 (-)
8 (+)
9 NOT USED
TB-3
7 NOT USED
8 (-)
9 (+)
PROMIX SUPPLIES 18-24VDC
NOTE: FOR EITHER ACTIVE OR PASSIVE CONTROL SIGNALS REMOVE RES310 (SAVE RES310 FOR FUTURE USE)
PROMIX S DIALOG X SWITCH BOX ELECTRICAL SCHEMATIC
PROMINENT FLUID CONTROLS INC.
1135645
NA
STD DWG
02-22-24
FIRST ISSUE
ProMinent
1135645-300
A
02-22-24
3/5


1135645-300
A
SYSTEM START SWITCH ON
SYSTEM START SWITCH REMOTE
CUSTOMER REMOTE ENABLE CONTACT
EXTERNAL SPEED CONTROL SELECT
MIXER MOTOR STARTER
SPARE
REMOVE JUMPER FOR POLYMER FEED VERIFICATION OPTION
PUMP ALARM RELAY
SS402
SS411
MPCB203
XK1
XK2
XK3
XK4
XK5
XK6
XK7
XK8
RED
RED/BLK
ORNG
ORNG/BLK
BLK
GRN
GRN/BLK
WHT
WHT/BLK
BLU
BLU/BLK
BRN
4021
4031
4051
4061
4081
4091
4111
4121
4141
4142
4171
4181
4201
4211
4231
4241
PROMINENT FLUID CONTROLS INC.
PROMIX S DIALOG X SWITCH BOX
ELECTRICAL SCHEMATIC
1135645
1135645-300
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FIRST ISSUE
ProMinent
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DWG No	REV
1135645–300	A



DOOR SELECTOR SW. OPERATION		
SW1 ON-OFF-REMOTE	SW2 LOCAL-EXTERNAL	IN LINE "A" CONTROL
ON	LOCAL	SYSTEM ON- LOCAL KEYPAD CONTROLS PUMP OUTPUT
ON	EXTERNAL	SYSTEM ON - EXTERNAL 4-20MA FOR PUMP OUTPUT
REMOTE	LOCAL	SYSTEM START VIA REMOTE DRY CONTACT - LOCAL KEYPAD CONTROLS PUMP OUTPUT
REMOTE	EXTERNAL	SYSTEM START VIA REMOTE DRY CONTACT - EXTERNAL 4-20MA FOR PUMP OUTPUT

BILL OF MATERIALS

TAGS	QTY	CATALOG	MFG	DESCRIPTION
	1	7747184	INTEGRA	PC ENCLOSURE 12" X 10" X 6" NEMA 4X - WALL-MOUNT NEMA 4X WATER/DUST-TIGHT SEAL - H12106H
	1	7747190	INTEGRA	STEEL SUB PANEL PAINTED WHITE FOR 12"X10" ENCLOSURE - SBP1210
CB200	1	1077610	ABB	CIRCUIT BREAKER - MINIATURE 1-POLE CIRCUIT BREAKER 15 AMPS,120 VAC, 10KAIR UL 489
MPCB203	1	1078793	SQD	MOTOR CIRCUIT PROTECTOR/CONTACTOR ASSEMBLY IEC ASSEMBLY W/ AUXILARY CONTACTS 6 - 10 AMP ADJUSTABLE
M212	1	1078795	SQD	CONTACTOR LC1D12G7+GV2AF3+GV1F03+GV1F03
RES310	1	1135736	VISHAY	PROMIX-DIALOG X 6.34 KOHMS RESISTOR -CCF556K34FKE36
SS402	1	7745915	SQD	SELECTOR SW - 3 POS MAINT, NEMA TYPE 4X 30.5MM, 2-KA1 CONTACT BLOCKS
SS411	1	7745921	SQD	SELECTOR SW - 2 POS MAINT, NEMA TYPE 4X 30.5MM, 2-KA1 CONTACT BLOCKS
TB-1	4	7746750	PHOENIX	TERMINAL - USLKG5, GROUND TERMINAL GREEN/YELLOW 26-10 AWG SCREW CLAMP
TB-1	14	7746748	PHOENIX	TERMINAL BLOCK - UK5N SINGLE LEVEL FEED -THROUGH, 41 AMPS 800V, 24-10 AWG SCREW CLAMP
TB-3	1	7746749	PHOENIX	SINGLE LEVEL END PLATE
TB-2 TB-3	12	7746744	PHOENIX	TERMINAL BLOCK - UKK5N MULTI LEVEL FEED -THROUGH, 32 AMPS 500V, 24-12 AWG SCREW CLAMP
TB-2	1	7746746	PHOENIX	MULTI LEVEL SPACER PLATE
TB-2	1	7746747	PHOENIX	MULTI LEVEL END PLATE
TB-ALL	4	7746751	PHOENIX	END BRACKET - E/NS 35N THICKNESS 9.5MM
TB-1	1	7746752	PHOENIX	EB 10-6 INSERTION BRIDGE, GREY - 0201139
	1	7746685	CAROL	3 CONDUCTOR 22AWG UNSHEILDED WIRE BLK/RED/GRN - C4062
	1	1074564	PFC	PROMIX KEYPAD DISPLAY CONTROL UL DESIGN
	1	7746684	TYCO	3-640440-3 PC BOARD RECEPTICLE
	6	1048501	SKINTOP	SLN STRAIN RLF CBL GLAND 1/2" NPT
	6	1048502	SKINTOP	CABLE GLAND INSERT 2 HOLE
	2	1048503	SKINTOP	1/2" NPT LOCK NUT
	2	7500386	PFC	STOCK PRINTED LABELS
	1	7740819	PFC	POWER CORD 12FT, #14/3 AWG NEMA 5-15 PLUG
	1	7741775	SIR SPEEDY	PROMINENT LOGO STICKER 8" BLUE W/ORANGE "O"

REV	DATE	DESCRIPTION	BY
A	02–22–24	FIRST ISSUE	LM

REVISIONS

CUSTOMER: **PROMINENT FLUID CONTROLLS INC.**

JOB No 1135645 | NETWORK NUMBER: NA STD DWG

TITLE: PROMIX S DIALOG X SWITCH BOX
TERMINAL STRIP DETAILS AND BILL OF MATERIALS

ENGINEERS SEAL

ProMinent® THE PROMINENT GROUP OF COMPANIES
PITTSBURGH, PA USA WWW.PROMINENT.US

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PROMINENT FLUID CONTROLS, INC.
RIDC PARK WEST
136 INDUSTRY DRIVE
PITTSBURGH, PA 15275 USA
TEL. 412 787 2484 FAX. 412 787 0704

DESIGNED	LM
DRAWN	PWB
CHECKED	JM
APPROVED	PFC
SCALE	NTS
DATE	02–22–24

DWG No 1135645–300 | REV A | PAGE 5/5

ProMinent ProMix Inline Polymer Feeder

Appendix C – ProMix S Models & Pumps

ProMix S Systems with Diaphragm Pumps

SYSTEM PART NO.	MODEL	PUMP TYPE	MAX CAPACITY
1136587	PROMIX S_AGIX 60X2-0.60DA	GXLAUS1608PVT4V000UVC030EN	0.72 GPH
1136588	PROMIX S_ AGIX 120X2-1.20DA	GXLAUS1020PVT4V000UVC030EN	1.44 GPH
1136589	PROMIX S_AGIX 300X2-3.00DA	GXLAUS0730PVT4V000UVC030EN	3.60 GPH

Overall Skid Dimensions ..... 24” x 34” x 66” (L x W x H)
Overall Weight of Skid ..... Approx. 170 lbs.
Power Requirements ..... 120 VAC, 60 Hz, 1 Phase, 15 Amp
Control panel FLA ..... 11.5 Amp
Volume of Mixing Chamber ..... 2.0 Gallons
Maximum Rated Chamber Pressure ..... 150 PSIG
Maximum Operating Chamber Pressure ..... 100 PSIG
Maximum Operating Pressure ..... 100 PSIG
Recommended Running Temperature ..... +50°F to 100°F
Water Connection Size ..... ¾” FNPT
Solution Discharge Connection Size ..... ¾” FNPT
Neat Polymer Inlet Connection Size ..... ½” FNPT
Drain Connection..... ¼” FNPT

PVC Mixing Chamber Spare Parts

P/N:	*Description:*
7746474	Seal, Mech, Shaft, 1/2", ProMix-U
1115310	Valve, Injection, V2, ProMix M, S
7747241	O-Ring, Chamber Insert, Viton, ProMix-U
7746516	O-Ring, Chamber, Viton, ProMix-S

Piping Components Spare Parts

P/N:	*Description:*
1062323	0-160 PSI Gauge SS 2-1/2, Bottom Mtd SM
7741514	3/8" OD Natural PE Tubing

Diaphragm Polymer Pumps Used on S Models

Series	Identification Code	Mode (Factory Setting)	SPM Max	Flowrate (GPH)		Pressure (PSIG)
				4 mA	20 mA	
GXLA	GLXAUS1608PVT4V000UVC030EN	HV2	200	0.0 gph 0.0 spm	0.72 gph 70 spm	100
GXLA	GXLAUS1020PVT4V000UVC030EN	HV2	200	0.0 gph 0.0 spm	1.44 gph 56 spm	100
GXLA	GXLAUS0730PVT4V000UVC030EN	HV2	200	0.0 gph 0.0 spm	3.60 gph 93 spm	100

1. ProMinent – Gamma XL Solenoid Driven Metering Pump
2. Original Pump GPH rating is derated 20% due to Polymer viscosity. The actual deration may vary depending on the polymer used.
3. Control Modes Available*
    a. Standard – 200 spm: 0-50 cp
    b. HV1 (slightly reduced discharge speed) – 160 spm: 50-200 cp
    c. HV2 (moderately reduced discharge speed) – 120 spm: 200-500 cp
    d. HV3 (maximum reduced discharge speed)– 80 spm: 500-1000 cp
4. Connections: ½" x 3/8" or DN10 Depending on Model Selected
5. Power Requirements: 115VAC, 60 Hz, Single Phase

Note: Viscosity values are approximate and can vary widely per specific application. Use these values as a guideline only and consult the factory for specific application capabilities.

GAMMA XL Pump Spare Parts

P/N:	*Description:*
1033360	GXLA 1608 Spare Parts Kit**
1030353	GXLA 1608 Diaphragm
1017391	GXLA 1608 Dosing head
1027082	GXLA 1020 Spare Parts Kit**
1000249	GXLA 1020 Diaphragm
1017393	GXLA 1020 Dosing head
1027083	GXLA 0730 Spare Parts Kit**
1000250	GXLA 0730 Diaphragm
1017404	GXLA 0730 Dosing head

**Spare Parts Kit above includes the following:
(1) Diaphragm
(1) Suction Valve Set
(1) Discharge Valve Set
(2) Ball Valves (Check)
(1) Set of O-rings
(1) Connector Set

Peristaltic Polymer Pumps Used on S Models

SYSTEM PART NO.	MODEL	Series	Pump Part Number	Flowrate (GPH)		Pressure (PSIG)
				Min Rated	Max Rated	
1136590	PROMIX S_AGIX 60X2-0.60TA	DFXA	1125793	0.012	0.72	72
1136591	PROMIX S_AGIX 120X2-1.20TA	DFXA	1125874	0.053	1.44	72
1136592	PROMIX S_AGIX 300X2-3.00TA	DFXA	1125875	0.111	3.60	72

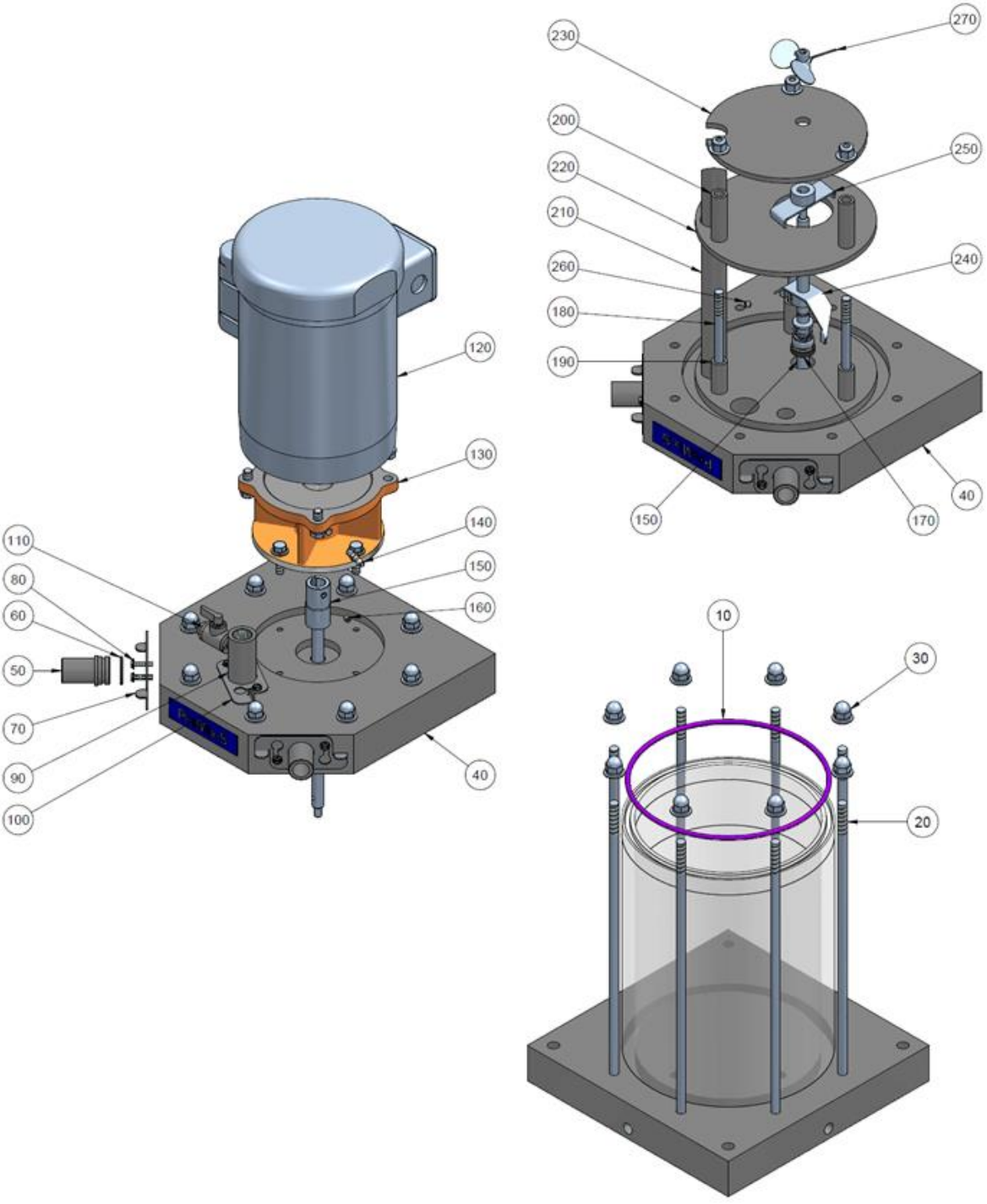
1. ProMinent DFXa Peristaltic Pumps
2. GPH Rating above based upon pumping Water not Polymer
3. Power Requirements: 120VAC, 60Hz, Single Phase (0.35 Amp)
4. Suction Lift Capabilities: Approx. 30ft. (based on water)
5. Tubing: PUR (Polyurethane)

DFXa Pump Spare Parts

P/N:	*Description:*
1104954	Spare parts kit for DFXa 0530 VPT (for pump P/N 1125793)
1112765	Spare parts kit for DFXa 0565 VPT (for pump P/Ns 1125874 & 1125875)
1104952	Spare screw kit for DFXa
1104951	PUR (Polyurethane) 72.5 PSIG (5 bar), Versions 0518, 0530 and 0565
1104727	Dosing head cover
1103249	Rotor, Complete

Appendix D – Mixing Chamber Layout & BOM

Mixing Chamber Layout

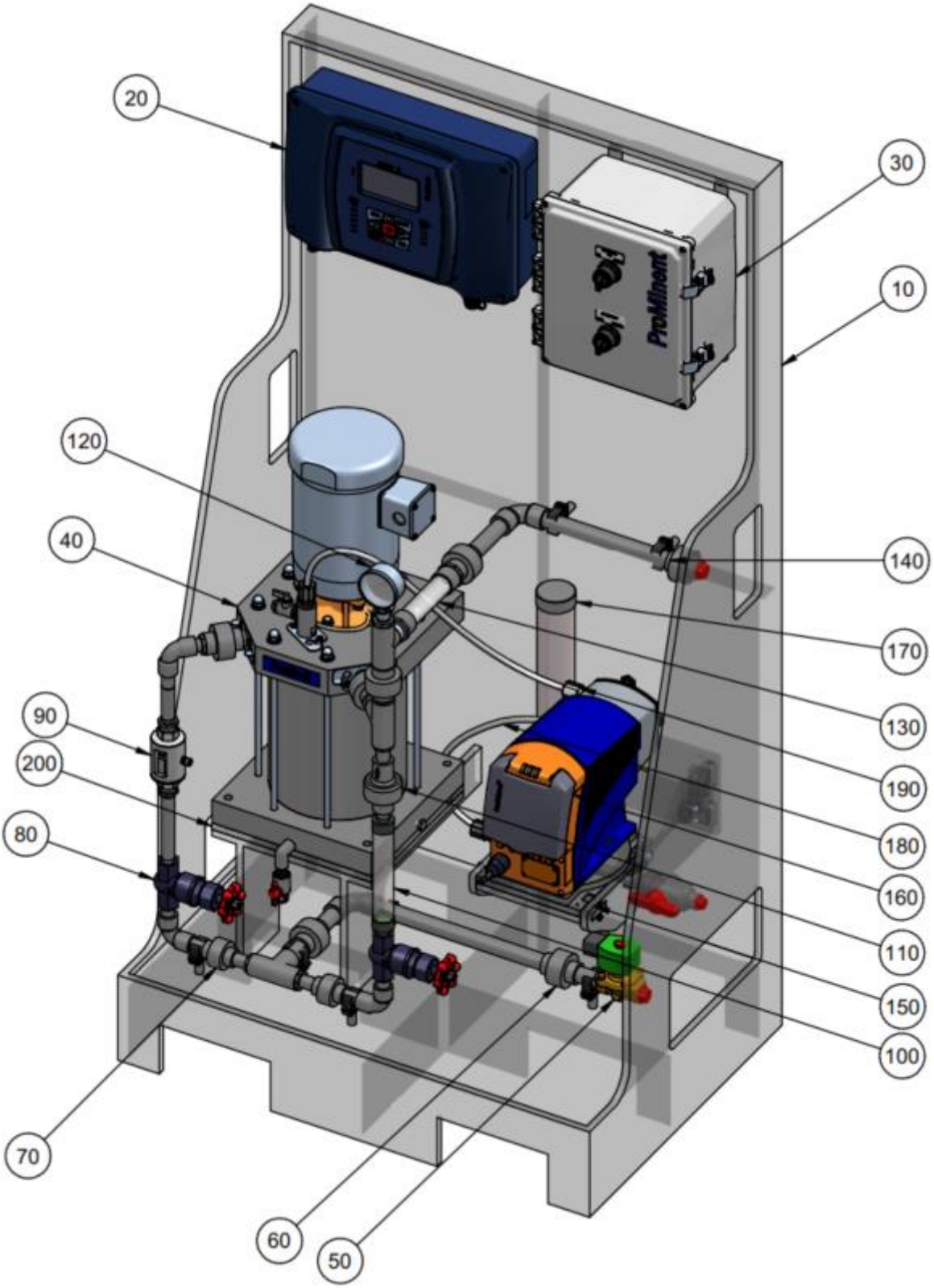


Mixing Chamber Bill Of Materials PN: 7747255

ITEM	USA P/N	QTY	DESCRIPTION
10	7746516	1	O-RING, CHAMBER, VITON, PROMIX-S
20	7747246	8	ROD, 316SS, 3/8-16 X 14.75, PROMIX-U
30	7746492	8	NUT, ACORN, 3/8-16, 18-8 SST
40	7747254	1	PLATE, TOP, PVC, 1.75, SG, PROMIX-S
50	7747269	2	INSERT, MALE, 3/4", PVC, PROMIX-S
60	7747241	2	O-RING, VITON, .987 ID X .103 CS, AS568B-120
70	7747271	2	RETAINER, MALE INSERT, 3/4" 316 SST, PROMIX-S
80	7747238	6	SCREW, 10-24X3/4", 18-8, HEX HEAD WITH WASHER
90	115310	1	Valve, Injection, V2 , Promix M, S
100	7747239	1	RETAINER, INJECTION VALVE, 316 SST
110	7747237	1	VALVE, BALL, 1/8", MNPT X FNPT, PVC, VITON
120	7747212	1	MOTOR, 1/2 HP, TEFC, 115/230 VAC, 1 PH, 56C, BALDOR VWDL3504
130	7746478	1	FLANGE, MOTOR, C56/135, PROMIX-M
140	7500346	1	HOSE BARB, 1/16" MNPT X 3/16" ID, PVDF
150	7746484	1	SHAFT, MIXER, 303SS, PROMIX-M
160	851405	1	SCREW, SET, 316SS, 1/4-28 PROMIX-U
170	7746474	1	SEAL, MECH, SHAFT, 304SS, 1/2", PROMIX-U
180	7746588	3	ROD, 316SS, 3/8-16 X 6, PROMIX-S
190	7746586	3	SPACER, TOP BAFFLE, PROMIX-S
200	7746587	3	SPACER, BOTTOM BAFFLE, PROMIX-S
210	7747257	1	PIPE, DISCHARGE, PVC, 3/4", PROMIX-U
220	1114259	1	BAFFLE, TOP, PVC, .25, WJ, PROMIX-S
230	1114258	1	BAFFLE, BOTTOM, PVC, .25, WJ, PROMIX-S
240	1108108	1	BLADE, PRIMARY, 316SS, PROMIX-S (PFC)
250	1108109	1	BLADE, SECONDARY, 316SS, PROMIX-S (PFC)
260	7746476	4	SCREW, SET, 316SS, 1/4-28 PROMIX-U
270	7746507	1	PROP, AGITATOR, CPVC, PROMIX-S

Appendix E – ProMix Mechanical Layout & BOM

General Mechanical Layout – ProMix S TA



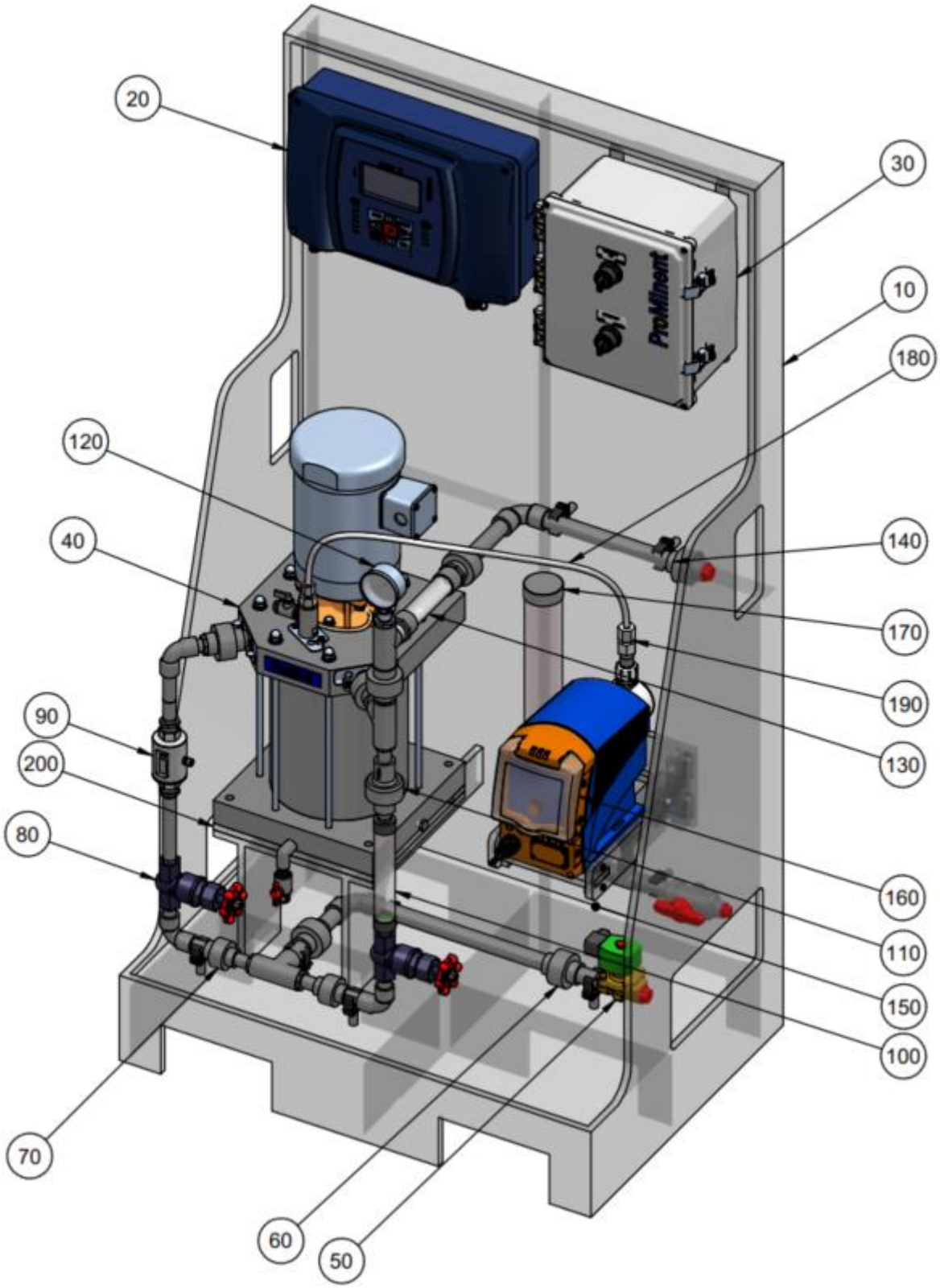
ProMix S TA with Peristaltic Tubing Pump

PROMIX S (TA SERIES) BILL OF MATERIAL

ITEM #	USA P\N	QTY.	UN	DESCRIPTION	1048347	1048349	1048352
10	1048413	1	EA	Stand, Black PP, ProMix S NG	X	X	X
20	1135634	1	EA	AGIXUSW00XXA6W0AAH1AAXX000007	X	X	X
30	1135645	1	EA	ProMix S AGIX-Switch Box	X	X	X
40	7747255	1	EA	MIXING CHAMBER COMP, SG, PROMIX-S	X	X	X
50	7746305	1	EA	3/4" ASCO N/C SOL VALVE 120V/60HZ	X	X	X
60	7744555	4	EA	3/4" PVC/VITON Union SxS Sch80 SPEARS	X	X	X
70	7744562	2	EA	1/2" PVC/VITON Union SxS Sch80 SPEARS	X	X	X
80	7746303	2	EA	NEEDLE VALVE 1/2" PVC NPT	X	X	
	1093412	2	EA	1/2" GLOBE VALVE THD PVC FKM			X
90	1135601	1	EA	ProMix S-AGIX-IFM FLOW METER SM7604 FNPT	X	X	X
	1061631	1	EA	CABLE, FLOW SWITCH, EFECTOR EVC005	X	X	X
100	7746342	1	EA	1GPM 1/2" PVC KING ROTOMETER	X		
	7746304	1	EA	2GPM 1/2" PVC KING ROTOMETER		X	
	7746343	1	EA	5GPM 1/2" PVC KING ROTOMETER			X
110	1048404	1	EA	Valve,Check,1/2" SOC,PVC,PlastOMaticCKM	X	X	X
120	1062323	1	EA	0-160PSI GAUGE SS 2-1/2, BOTTOM MTD SM	X	X	X
130	7746301	1	EA	3/4",PVC,KOFLO,STATIC,MIXER,6ELEMENT	X	X	X
140	7744556	1	EA	3/4" PVC/VITON UNION SCH80 TXT SPEARS	X	X	X
150	1124537	1	EA	SHELF, DFXa, ROTATING, BLK-PP	X	X	X
160	1125793	1	EA	Tube pump (VP) 0.72 GPH / 5 bar	X		
	1125874	1	EA	Tube pump (VP) 1.44 GPH / 5 bar		X	
	1125875	1	EA	Tube pump (VP) 3.60 GPH / 5 bar			X
170	1048564	1	EA	250ml PVC Cal Cyl 1/2"SOC w/DC (SIG)	X	X	
	1048565	1	EA	500ml PVC Cal Cyl 1/2"SOC w/DC (SIG)			X
180	37032	1	MT	Tube fabric reinf. d 6/12mm Soft-PVC	X	X	X
190	817068	4	EA	Connect. set sing. 12x 6 PCB0	X	X	X
200	1124687	2	EA	PROMIX-S_1048352_CHAMBER SPACER			X

NOTE: ITEM 160 NEEDLE VALVE NOT SHOWN IN DRAWING

General Mechanical Layout – ProMix S DA



ProMix S DA with Diaphragm Pump

PROMIX S (DA SERIES) BILL OF MATERIAL

ITEM #	USA P\N	QTY.	UN	DESCRIPTION	1048354	1048356	1048358
10	1048413	1	EA	Stand, Black PP, ProMix S NG	X	X	X
20	1135634	1	EA	AGIXUSW00XXA6W0AAH1AAXX000007	X	X	X
25	1135645	1	EA	ProMix S AGIX-Switch Box	X	X	X
30	7747255	1	EA	MIXING CHAMBER COMP, SG, PROMIX-S	X	X	X
70	7746305	1	EA	3/4" ASCO N/C SOL VALVE 120V/60HZ	X	X	X
90	7744555	4	EA	3/4" PVC/VITON Union SxS Sch80 SPEARS	X	X	X
130	7744562	2	EA	1/2" PVC/VITON Union SxS Sch80 SPEARS	X	X	X
160	7746303	2	EA	NEEDLE VALVE 1/2" PVC NPT	X	X	
	1093412	2	EA	1/2" GLOBE VALVE THD PVC FKM			X
190	1135601	1	EA	ProMix S-AGIX-IFM FLOW METER SM7604 FNPT	X	X	X
	1061631	1	EA	CABLE, FLOW SWITCH, EFECTOR EVC005	X	X	X
210	7746342	1	EA	1GPM 1/2" PVC KING ROTOMETER	X		
	7746304	1	EA	2GPM 1/2" PVC KING ROTOMETER		X	
	7746343	1	EA	5GPM 1/2" PVC KING ROTOMETER			X
220	1048404	1	EA	Valve,Check,1/2" SOC,PVC,PlastOMaticCKM	X	X	X
250	1062323	1	EA	0-160PSI GAUGE SS 2-1/2, BOTTOM MTD SM	X	X	X
260	7746301	1	EA	3/4",PVC,KOFLO,STATIC,MIXER,6ELEMENT	X	X	X
270	7744556	1	EA	3/4" PVC/VITON UNION SCH80 TXT SPEARS	X	X	X
290	1107739	1	EA	SHELF, GAMMA XL, BLK-PP, PROMIX-S, WJ	X	X	X
310	1128556	1	EA	GXLAUS1608PVT4V000UV4030EN	X		
	1128558	1	EA	GXLAUS1020PVT4V000UV4030EN		X	
	1128559	1	EA	GXLAUS0730PVT4V000UV4030EN			X
340	1048564	1	EA	250ml PVC Cal Cyl 1/2"SOC w/DC (SIG)	X	X	
	1048565	1	EA	500ml PVC Cal Cyl 1/2"SOC w/DC (SIG)			X
350	37032	1	MT	Tube fabric reinf. d 6/12mm Soft-PVC	X	X	X
370	817068	4	EA	Connect. set sing. 12x 6 PCB0	X	X	X
410	1124687	2	EA	PROMIX-S_1048352_CHAMBER SPACER			X

NOTE: ITEM 160 NEEDLE VALVE NOT SHOWN IN DRAWING

Appendix F – Reference Documents

Mechanical General Arrangement Drawings – ProMix S:

Drawing Number	System Description
1136590-0-200-001	PROMIX S_AGIX 60X2-0.60TA
1136591-0-200-001	PROMIX S_AGIX 120X2-1.20TA
1136592-0-200-001	PROMIX S_AGIX 300X2-3.00TA
1136587-0-200-001	PROMIX S_AGIX 60X2-0.60DA
1136588-0-200-001	PROMIX S_AGIX 120X2-1.20DA
1136589-0-200-001	PROMIX S_AGIX 300X2-3.00DA

Electrical Schematic Drawings:

1135645-A-300	PROMIX S AGIX SWITCH BOX

Pump Manuals:

981953	DFXa Peristatic Pump Operations Manual
982271	GMXa Solenoid Driven Metering Pump Operations Manual

Instructions Manuals:

7746471-400	Injection Valve Cleaning Instructions
7746589-400	Mixing Chamber Mechanical Seal Replacement

Dialog X Manual:

990204	Dialog X Installation and Operating Manual

Appendix G – Maintenance

MAINTENANCE		
Description / Task	**Remarks**	**Frequency**
Visual inspection of unit		Weekly
Check dosing line fittings and valves for tightness		Every 3 Months (Approx 30% continuous operation.)
Verify equipment is operating properly	No leaks in the piping or at the “weep hole” or abnormal noises	Weekly
Check the electrical connections for integrity		Quarterly
Check process tubing for wear or cuts		Weekly
Check Mixing Chamber Motor amperage. Check fan cover for obstruction or Dirt		Monthly
Check pump tubing for wear or cuts		Weekly
Short Term - Flushing of Piping & Chamber	24 Hour Shut Down	Run 60 Second Flush Min
Long Term – Flushing of Piping & Chamber	24 Hour + or if large amount of polymer is dosed into chamber w/o water running	Run Water until piping is visibly clear in static mixer

LUBRICATION		
Description / Task	**Lubrication**	**Frequency**
Mixing Chamber Motor 1/2 Hp - Standard Bearings	Ball Bearing Grease	5,000 Hours of Service per Year or every three years

Appendix H – Equations

Polymer Pump Speed Percentage:

$$\text{Desired Activated Polymer Conc. (\%)} = \text{Polymer Pump Flow (gpm)} \div \text{Total Water Flow (gpm)}$$

$$\text{Desired Activated Polymer Conc. (\%)} \times \text{Total Water Flow (gpm)} = \text{Polymer Pump Flow (gpm)}$$

$$\text{Polymer Pump Max Flow (gph)} \div 60 = \text{Max Polymer Pump Flow (gpm)}$$

$$\frac{\text{Polymer Pump Flow (gpm)}}{\text{Max Polymer Pump Flow (gpm)}} \times 100 = \text{Polymer Pump Speed (\%)}$$

Polymer Concentration w/ Secondary Dilution

The polymer concentration from the ProMix S/C Polymer feeder is based upon the neat polymer pump rate divided by the total water flow through the primary flowmeter and secondary rotameter.

$$\frac{\text{Polymer Pump Flow (gph)}}{60(\text{Primary Flow (gpm)} + \text{Secondary Flow (gpm)})} \times 100 = \text{Activated Polymer Conc. (\%)}$$

Polymer Dosage Estimations

The desired polymer dosage must be considered prior to selecting the ProMix and pump speed. Typically, the user will know how much polymer is required. This information is from jar tests or from prior experience. Otherwise, the dosage can be derived from an initial manual calculation which must be adjusted based upon actual operation.

Below are typical guidelines to estimate polymer feed dosage:

For Clarifier & Filter Applications:

$$\frac{\text{Plant Flow (MGD)} \times \text{Active Polymer (ppm)}}{24} = \text{Active Polymer (gph)}$$

$$\frac{\text{Active Polymer (gph)}}{\text{Desired Solution Conc. (\%)}} = \text{Required Dilution Range}$$

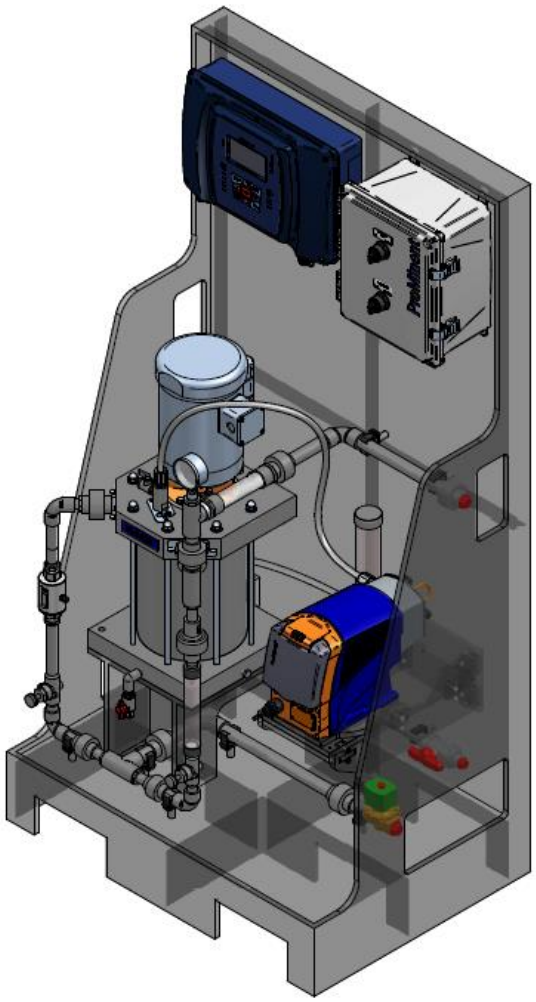
For Sludge Dewatering Applications:

$$\frac{\text{Sludge Flow (gpm)} \times \text{Solids Conc. (\%)} \times 8.34 \times 60}{2000} = \text{Dry Sludge (Ton/hr)}$$

$$\frac{\text{Dry Sludge (Ton/hr)} \times \text{Polymer (lbs/dry ton)}}{8.34(\text{Active Polymer (\%)} \times \text{Desired Solution Conc. (\%)})} = \text{Required Dilution Range}$$

ProMinent ProMix Inline Polymer Feeder

Operating Instructions
ProMinent® ProMix S
Polymer Blending Systems



Please completely read through these operating instructions first! Do not discard!

The warranty shall be invalidated by damage caused by operating errors!

ProMix_S _IOM (3/20/24): – P/N: 1135600-(Rev-0)

ProMinent Fluid Controls, Inc. (USA) 136 Industry Drive, Pittsburgh, PA 15275

Tel: (412) 787-2484 www.prominent.com Fax: (412) 787-0704

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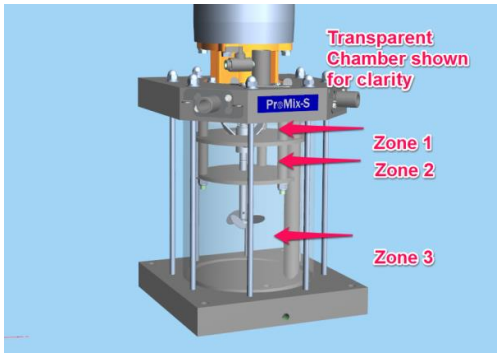
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1 Overview

The ProMix Inline Polymer Feeder is a skid system designed to control feed water and polymer and combine them to produce a high-quality solution. The system is designed to receive liquid neat polymer while mixing it with feed water to produce and discharge a quality solution from the system.

Research in the science of polymer activation indicates that the activation energy must decrease as the polymeric chain is uncoiled to prevent rupture and hence decrease the performance of the product.

The mixing by the Polymer Feeder is accomplished mechanically with three distinct mixing zones separated by baffles. The first zone consists of a fast-mixing blade that delivers high shear at the precise point of polymer injection, creating an immediate dispersion before agglomeration takes place. The second mixing zone induces a vortex and draws solution down through the center of the chamber from zone one and forces the solution outward to the sides and then down into the third zone. Finally, the third zone mixing blade gently agitates/blends the active polymer solution before it exits the chamber via the discharge tube.



The ProMix Inline Polymer Feeder controller offers several operating options. These options are selected using various combinations of the controller door switch positions and polymer type selections via the controller menu. The controller allows the polymer pump speed to be controlled either locally via the keypad or remotely via a customer supplied 4-20 mA signal over a 0 to 100% speed range. The polymer dosage rate must be calculated, and the pump adjusted for the desired ratio concentration of polymer to dilution water leaving the feeder by volume. Different maximum concentrations are possible based upon the type of polymer. Emulsion polymers should be limited to a maximum of 1% concentration in the mixing chamber and Mannich polymers should not exceed 10% in the mixing chamber.

The System Start switch on the controller door has three positions: ON, OFF and REMOTE. ON enables the controller locally and REMOTE allows the controller to be enabled via a customer supplied dry contact. The Polymer Pump switch has two positions: LOCAL and EXTERNAL. Placing the System Start switch in the OFF position after having first been in either of the other two positions will initiate a flush cycle for the system before shutting down.

The Polymer Pump switch on the controller front door has two positions to choose the source of the pump control signal. In the LOCAL position, the controller uses the keypad entry for polymer pump speed. In the EXTERNAL position, a user supplied 4-20 mA signal representing 0 – 100% pump speed controls the pump. The user must manually adjust the primary and post dilution valves for the desired dilution water flow rate and must calculate the required pump speed to attain the desired concentration. A flow meter and rotameter are provided to monitor the dilution and post-dilution water flow rates, respectively.

The ProMix Polymer Feeder is equipped with all the necessary components for easy installation, reliable performance, and safe operation. The design incorporates an electric solenoid valve (water inlet), flow meter, manually adjustable rotameter for secondary dilution flow, either a peristaltic, progressive cavity or diaphragm type neat polymer pump (depending on model), Dialog X controller, manual ball valves, pump calibration column, PVC piping and components, and polymer mixing chamber mounted on a skid to facilitate proper mixing and deliver.

2 Installation & Quick Start Guide

2.1 Safety

Utilize appropriate protective safety gear when operating or maintaining this equipment. Recommended safety gear is as follows:

Personal Protective Equipment (PPE):

- Hard Hats (Where overhead hazards exist)
- Safety Glasses with side shields
- PVC Apron
- PVC Gloves
- Safety-Toed Work Boots

2.2 Delivery & Storage Checklist

1. Check packing list for completeness and note any missing items immediately.
2. Inspect equipment and shipping container for damages before accepting delivery. Make note of the carrier's bill-of-lading, the extent of the damage, if any, and notify the carrier.
3. Store the equipment on firm level surface in original packing container. Do not store the equipment where it may be exposed to extreme temperatures, precipitation, humidity, or dust. Avoid direct sunlight that could overheat and damage equipment.

Ambient Conditions for storage and transport:
Temperature: 14°F to 120°F
Air Humidity: ≤ 92% relative humidity, non-condensing

2.3 Installation Considerations

- Required Polymer System Voltage
- Available Water Pressure
- Available Water Quality (Flowmeter requires water conductivity higher than 20 µS/cm)
- Injection Point Pressure
- Number of Injection Points
- Polymer Solution Discharge: For example (Length of Piping Run and Pipe Size)
- Neat Polymer Suction: Flooded or Lift
- Type of Application / Dewatering Device
- Type of Polymer: Emulsion, Dispersion, Solution

2.4 Installation

NOTE: ProMix systems are a flow through design. Incoming water pressure must be adequate to overcome pressure losses in the system and the pressures in the downstream system.

1. Unpack and position equipment on sturdy level surface. Fasten to prevent movement.
2. Do not install equipment in areas of extreme heat, cold, dust or humidity. Avoid areas where objects or fluids can drop from overhead.
3. Units are to be installed as close to the point of application as possible.
4. Inlet pressure is not to exceed the working pressure of the neat polymer pump.
5. System pressure at the discharge is not to exceed 80% of inlet pressure.
6. Piping Internal to the System:
    a. Inspect the piping for breakage. The system may have been jarred during shipping.
    b. Check the tightness on all unions. Hand tighten only – no tools. Unions incorporate an o-ring seal. Ensure that the o-ring is seated properly prior to tightening.
7. Piping External to the System (Reference Appendix A for connection location):
    a. Install piping so that connections properly meet system termination points. Do not “stretch” field installed piping to meet system termination points. Stressed piping will fail.
    b. Piping should be at a minimum ¾” to and from the piping on the system.
    c. Avoid getting dirt and debris inside the piping during installation. Plug ends of piping with rags if construction activities are underway. All debris must be flushed from piping before system start-up.
    d. Connect to outlet piping ¾” FNPT from static mixer to associated customer application point.
    e. Connect to make-up water inlet piping ¾” FNPT.
    f. Connect to Neat Polymer pump inlet piping ½” FNPT.
    g. Install ¾” pressure regulator and ¾” y-strainer / basket strainer on the clean make-up water line if equipment is currently not installed. (Recommended)
    h. Allow provisions for draining the system piping. Skid components will require maintenance. Ensure that chemicals can be evacuated from the skid piping and components for servicing.
8. Electrical Supply Needed for the System:
    a. Review local Electrical Code and follow accordingly.
    b. Connect incoming power to skid mounted control panel *(120VAC, Single Phase, 15 Amp, 60 Hz).* Ensure panel is properly grounded.
    c. Check electrical connections to be sure proper voltage is supplied to the system.
    d. Power the unit using a dedicated, separate breaker in the local lighting distribution panel.
    e. Do not route the AC power in common conduit with variable frequency pump drives.
    f. Do not put conduit entries in the top of the control panel. Resulting conduit condensation and failure to seal may damage controller circuit boards.
9. The Overload relay should be set to the Motor Nameplate Full Load Amps. Setting this to a higher value will result in possible damage to the motor and associated wiring. Overload conditions should be investigated, and possible process changes may need to be made to prevent overload conditions.
10. Connect Digital Remote Start Functions (note wiring termination points in Appendix B) for remote start permissive. Default jumpers should remain in place for any input not available.

2.5 Quick Start Guide

1. Check unit thoroughly to be sure all fittings and wire connections are tight.
2. Before powering the system on:
   a. Be sure “System Start” switch on the gray control box door is in the “OFF” position and the “Polymer Pump” switch is in the “Local” position.

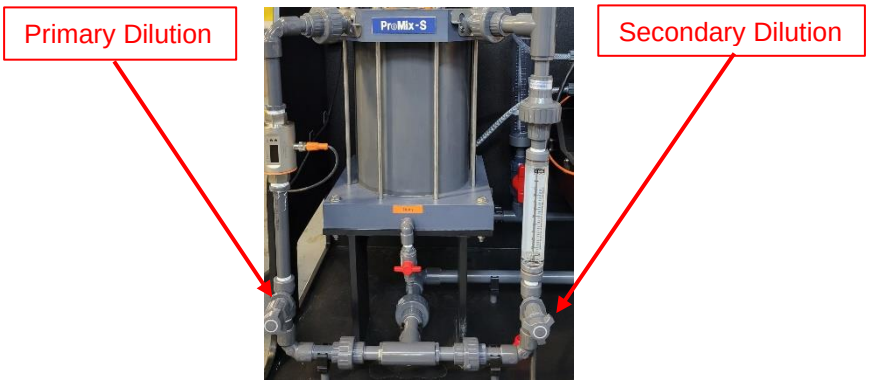


- Switching to "ON" starts the unit locally.
- Switching to "Remote" the unit waits for a dry contact at terminals TB-2 15 and 16.



- Switching to "LOCAL" the % speed from the Polymer Calc. is entered on the Dialog X Web HMI in the "Polymer Pump Speed" input.
- Switching to "External" the % speed is controlled via 4-20 mA signal from terminals TB-3 2 (-) and 3(+) for passive and TB-3 1(-) and 2 (+) for active.

   b. Open ball valve on the suction of the pump to allow chemical to flow into the system by gravity. If the application is suction lift, then ensure liquid is present in pump suction.
   c. Fully open the needle valve that controls the water going into the mixing chamber (Primary Dilution), while fully closing the needle valve that controls the water flow after the mixing chamber (Secondary/Post Dilution).



3. Power on both the breaker and motor overload rotary switch inside the gray control box.

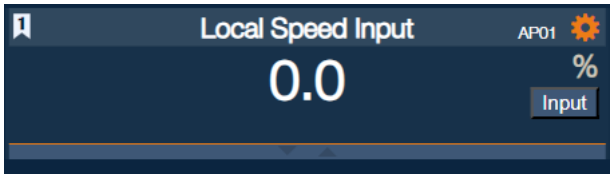


- The breaker is in the down position, signifying it is off.
- The motor overload switch is pointed at the 9 o'clock position, signifying it is off.
- Current trip point should be 10% above the FLA of the motor at maximum.

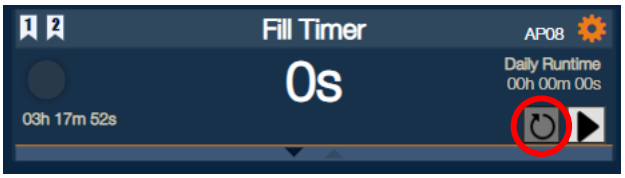


- The breaker is in the up position, signifying it is on.
- The motor overload switch is pointed at the 12 o'clock position, signifying it is on.

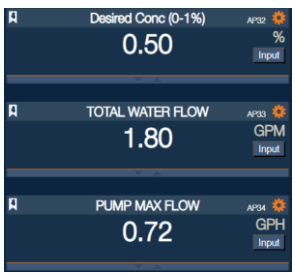
4. Startup pump at maximum output to purge all air and prime the system. To prime the pump, press and hold the PRIME button ⏩ on the pump keypad until chemical is visible in the discharge line.
5. Connect to the controller via WiFi with either smartphone, tablet or computer.
   a. Select Dialog_X_nnnn from the device WiFi settings and enter 1234567890 as the password.
   b. Open device browser and enter 192.168.1.1 in address bar.
   c. Login as Administrator with the password 3356 to make changes to the process settings.
   d. For instructions running the system via the keypad, see **Section 3.3.2** of the manual.
6. Verify that the “Local Speed Input” (AP01) value is set to 0%. For more information refer to Section 3.2.2.



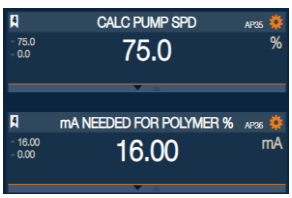
7. Turn “System Start” switch to “ON” to begin filling the chamber. This step will ensure that the mixing chamber motor does not run dry, which will result in damage to mechanical seal.
   a. Ensure that air has been purged from the chamber by verifying that water coming through the static mixer is no longer aerated within the fill timer limit.
      i. If aerated water continues and the fill cycle needs reset, turn “System Start” switch to the “OFF” position. Then reset the “Fill Timer” AP08 by selecting the reset button and repeat step 7. For more information refer to Section 3.2.2.



8. Adjust the Primary Dilution flow control valve to obtain the desired flow rate. If additional dilution water is needed, adjust the secondary accordingly.
9. Perform and verify pump calibration using drawdown calibration cylinder. When finished, switch back to bulk supply. To perform pump calibration, refer to the pump name plate data.
10. Perform calculations by utilizing the calculator apps in the controller to obtain pump speed based on desired concentration, set flow rate and maximum output of the polymer pump.



- AP32 - Input desired final polymer concentration, not to exceed 1%.
- AP33 - Input total water flow obtained in step 8.
- AP34 - Input the maximum flow of the polymer pump.



- AP35 - The calculated pump speed value obtained is the value to be entered in the Local Speed Input AP01 while polymer pump switch is in local.
- AP36 - mA Needed for Polymer % is the signal required while the Polymer pump switch is in external.

11. Enter in the calculated pump speed value from AP35 into AP01 or apply calculated input signal from AP36 (if polymer pump switch is external selected).
12. Observe system and check for leaks.
13. This completes the quick start guide. For further information consult operation manual.

3 Controller

The ProMinent ProMix Polymer Feeder utilizes the ProMinent Dialog X controller to deliver the operation required to operate the feeder.

3.1 Communication

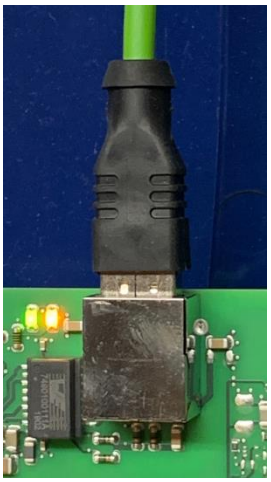
The Dialog X supports multiple types of communication with the unit. The two that will be discussed are LAN and WiFi connection. Refer to the Dialog X manual for further communication settings.

3.1.1 LAN Connection

The most common connection is a physical Local Area Network (LAN) connection. This requires an Ethernet cable (provided), and you will need to set up the Ethernet port address on your device to be compatible with the address of the controller.
Use the included **green Ethernet cable** to attach to the LAN port on your PC and to the LAN port on the door of the controller. A green light should be seen on your PC next to the connection. The amber light will blink with each packet that passes by in either direction.



Round 4 pin M12 connector



Open the controller and note that the LAN green and amber lights are lit on the back of the door next to the RJ45 port.

NOTICE

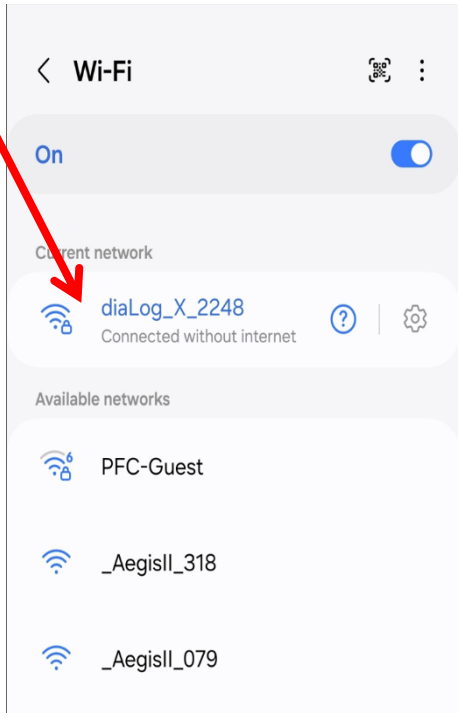
The Ethernet cable no longer needs to be a ‘crossover’ type cable. However, please note that the **Dialog X controllers require a <u>recent version</u> of whichever Browser you choose to use.**

Next, you need to open a web browser session (Remote HMI) to be able to communicate with the controller. This step requires you to enter the LAN IP address of the Dialog X controller where **10.10.6.106** is the controller default.

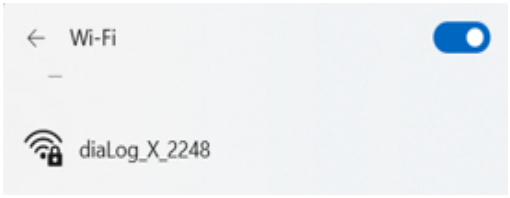
NOTE: In order to access the Remote HMI, you will need to configure your device’s IP settings. For step-by-step instructions, please refer to the Dialog X manual.

3.1.2 WiFi Connection

Click on the **Wi-Fi** icon on your device to see a list of available Wi-Fi devices.
Click on the **Dialog_X_nnnn** choice and press the Connect button. You will be prompted to enter the password where the default is 1234567890.
The numbers **nnnn** are taken from the last 4 digits of the controller serial number. The serial number is located on a sticker on the outside of the Dialog X. This unique name allows you to differentiate between controllers when more than one is within the **Wi-Fi** range of your device. In the example here, the controller SN ends in 2248.
Further simplify identifying nearby controllers by changing the Wi-Fi name. **Dialog X 2248** could become **Dialog X ProMix** for example.



You are now on the Dialog X **Wi-Fi** network. You have established a path between the two devices.

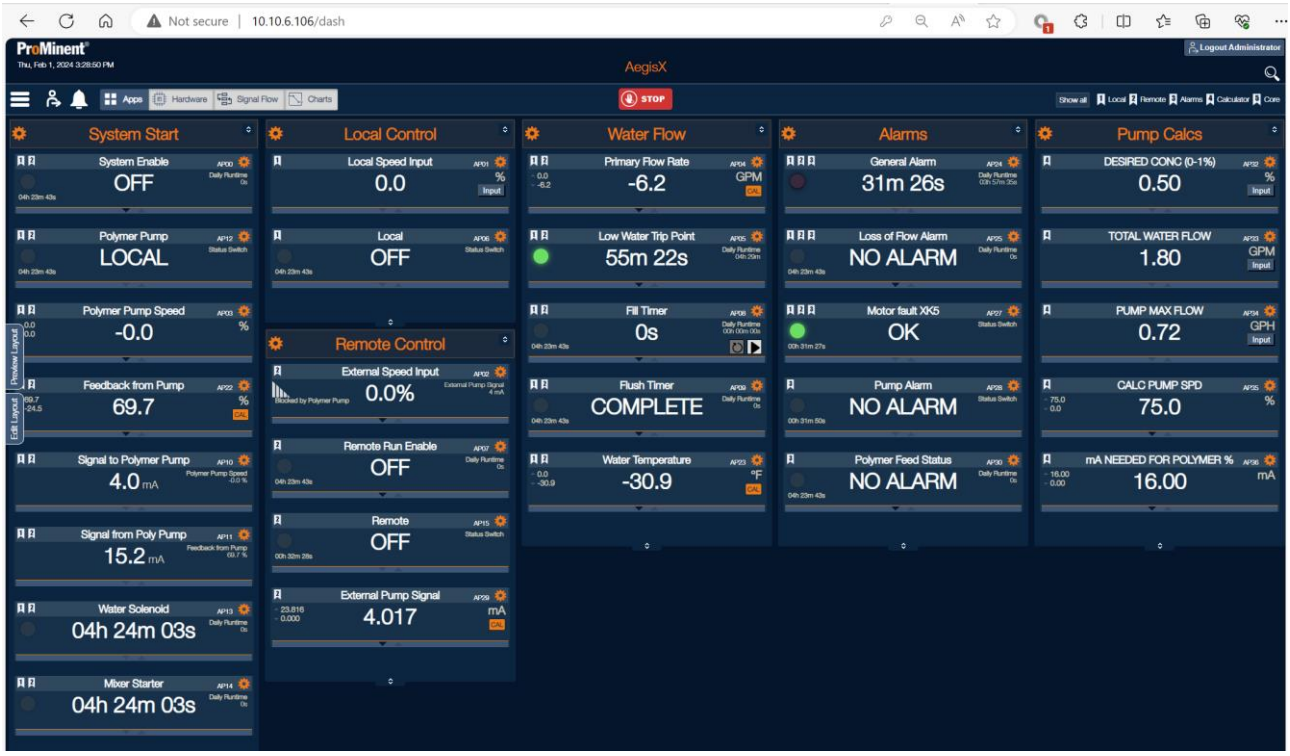


Next, you need to open a web browser session (Remote HMI) to be able to communicate with the controller. This step requires you to enter the WiFi IP address of the Dialog X controller where **192.168.1.1** is the controller address.

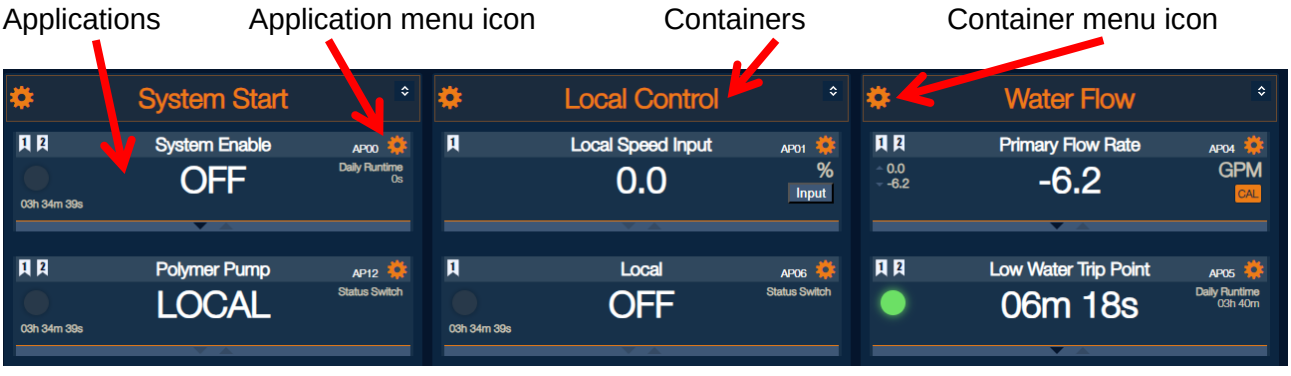
3.2 Remote HMI

The Remote HMI (Human Machine Interface) is accessed by typing the controller IP address into the address bar in a web browser. Again, when connected to the controller via LAN connection the default address to type in the address bar is **10.10.6.106** whereas **192.168.1.1** is utilized when connected via WiFi.

When first connecting to the controller via the web browser, the Remote HMI application page will appear after the initializing and loading screen has finished. The initial view of the Remote HMI is defaulted to the Administrator view.



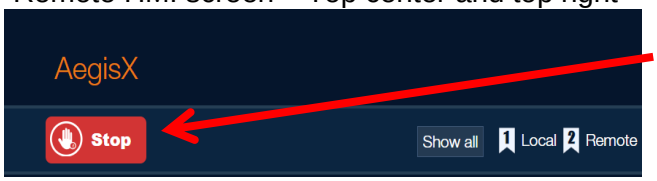
The Application Page is where the logic of the controller is programmed. Use the Remote HMI to easily change setpoints, alarm and warning limits, input and output scales, and create graphs.



Applications are the logic of the controller's programming. To make changes to the application, use the Application Menu icon. Applications are organized into containers. To add or duplicate applications in the container, use the container menu icon.

The Remote HMI can also stop the I/O of the controller without being at the physical controller.

Remote HMI screen – Top center and top right



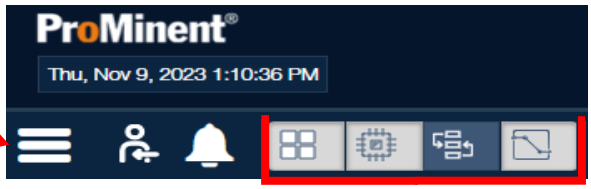
Remote start/stop button.

System buttons. For more information please refer to the Dialog X manual.

Systems group applications are on the controller level as opposed to containers for the user level. For the ProMix the applications are grouped into systems based on how the application affects the ProMix.

Remote HMI screen – Top left

The Controller settings menu handles system maintenance issues like time and date, adding new users, creating and describing the purpose of new containers on the application page, firmware versions, and more.



Login Alarms Pages

The page buttons allow the user to view the application, hardware, signal flow, and charting pages. For more information on the different pages, please refer to the Dialog X manual.

3.2.1 Login Information

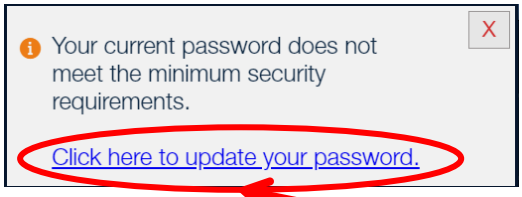
To log into the Administrator or Operator level user by selecting the login button located in the top left corner.

When logging into the Administrator user account, type “administrator” into the Username field.

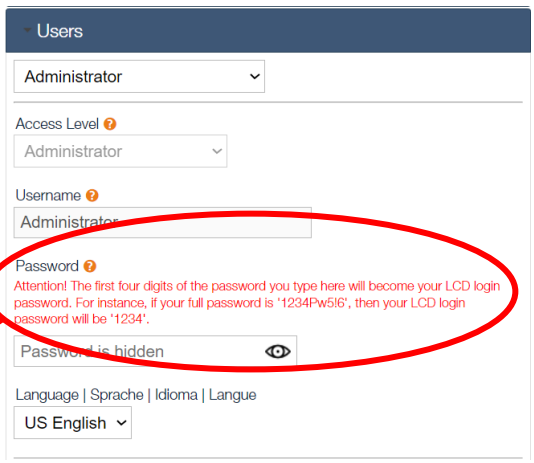
When entering the Administrator account, the default password is “3356”.



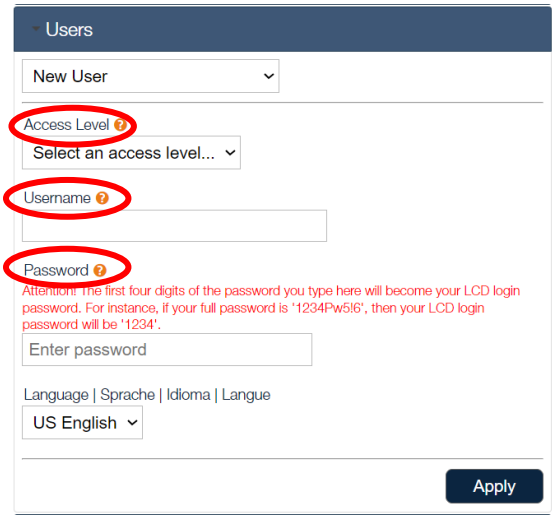
The user will be prompted to change the password for the administrator account. **It is suggested to change the password and keep it on file.**



By selecting the link in the prompt above, the Users tab of the Setup section in the Controller Settings menu will appear. From here, you can change the password by following the red dialog.



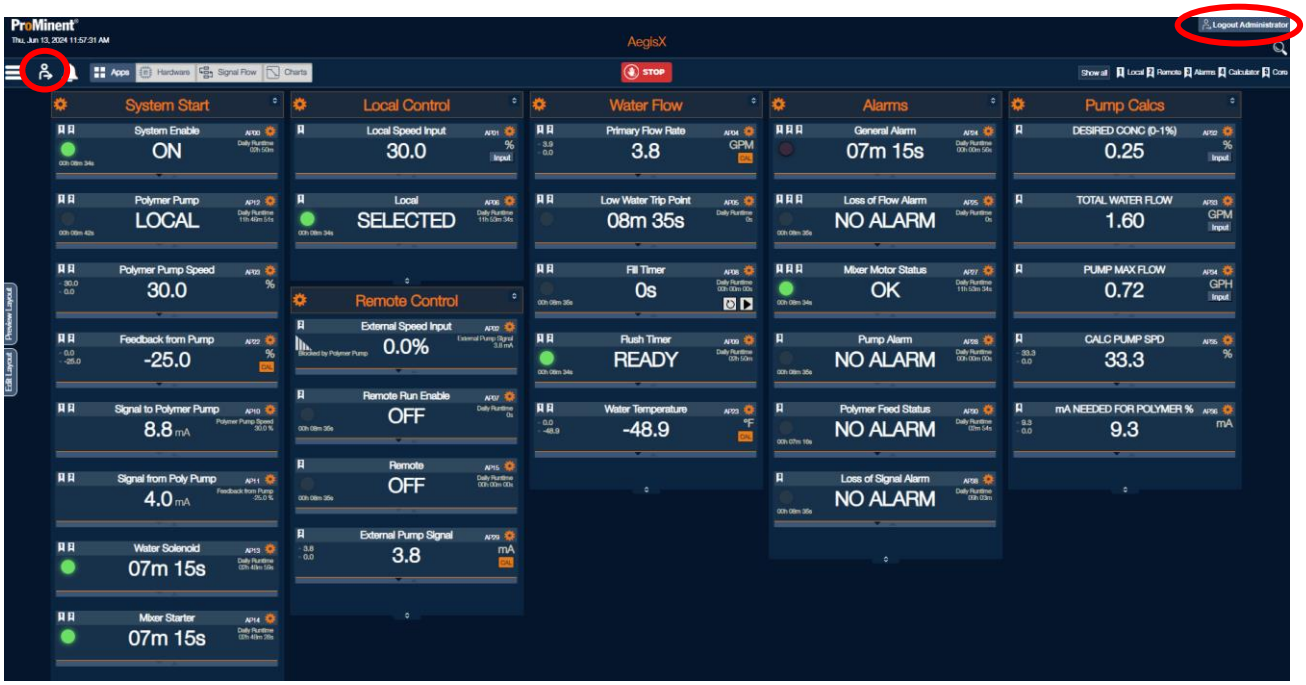
From the same Users tab, while logged in as the Administrator, the user can create other administrator level and operator level users. To do so, the Administrator will select the Access level drop-down and choose either an administrator or operator, assign the username in the username box, and enter in a password for that user, following the red dialog.



With the ProMix, a default operator level user has been created. The username **OP1** accompanied with the password **3356ProOp!**. The username and password can both be changed. **It is suggested to keep on file all usernames and passwords after creation.**

3.2.2 Remote HMI Operation

As explained in **Section 3.2.1**, when logging in as the administrator, the administrator view is similar to the default view but with two exceptions. These exceptions are the Logout button in the top left corner and the Logout Administrator button in the top right corner as depicted below.



Most applications are not able to be modified by the administrator or operator users. This is to prevent accidental changes from occurring causing a malfunction with the equipment.

The administrator view shows 30 apps which are organized into 6 containers. The default organization of the containers and applications was designed to help the user determine where specific applications would be corresponding to function. The container layout and naming can both be changed by the user at their discretion.

3.2.2.1 System Containers

As explained in **Section 3.2**, the logic blocks (applications) are stored in containers. The default containers are arranged by how the applications operate the system.

Container Name	Description	App IDs
System Start	Applications stored in the System Start container processes the logic of the controller and establishes operation of the system.	AP00 – System Enable
		AP12 – Polymer Pump
		AP03 – Polymer Pump Speed
		AP22 – Feedback from Pump
		AP10 – Signal to Polymer Pump
		AP11 – Signal from polymer Pump
		AP13 – Water Solenoid
		AP14 – Mixer Status
Local Control	Applications stored in the Local Control container run the system when in local.	AP01 – Local Speed Input
		AP06 – Local
Remote Control	Applications stored in the Remote Control container run the system when in external and remote.	AP02 – External Speed Input
		AP07 – Remote Run Enable
		AP15 – Remote
		AP29 – External Pump Signal
Water Flow	Applications stored in the Water Flow container manage operations concerning the water flow.	AP04 – Primary Flow Rate
		AP05 – Low Water Trip Point
		AP08 – Fill Timer
		AP09 – Flush Timer
		AP23 – Water Temperature
Alarms	Applications stored in the Alarms container manage the alarm state and individual alarms of the system.	AP24 – General Alarm
		AP25 – Loss of Flow Alarm
		AP27 – Mixer Motor Status
		AP28 – Pump Alarm
		AP30 (Optional) – Polymer Feed Status
Pump Calcs	Applications stored in the Pump Calcs container setup the calculation of the polymer pump speed for a desired concentration at a given flow rate.	AP32 – Desired Conc (0-1%)
		AP33 – Total Water Flow
		AP34 – Pump Max Flow
		AP35 – Calc Pump Spd
		AP36 – mA Needed for Polymer %

Further explanations of the applications and their operation are discussed in later sections of the manual.

3.2.2.2 System Start Container

The **System Start** container contains the applications that sequence through the logic to begin operation of the equipment. The applications stored in this container cannot be modified.

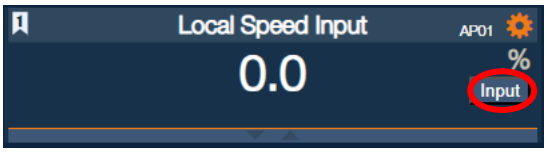
System Start		
App Number	**App Name**	**Description**
AP00	System Enable	Indicates the on/off status of the system.
AP12	Polymer Pump	Indicates the control state of the polymer pump (local or external).
AP03	Polymer Pump Speed	Speed percentage sent to the polymer pump from the controller.
AP22	Feedback from Pump	Speed verification sent back from the polymer pump. *Should be the same value as AP03.
AP10	Signal to Polymer Pump	Indicates the mA signal being sent to the polymer pump.
AP11	Signal from Polymer Pump	Verification mA signal being sent to the controller from the pump. *Should be the same value as AP10.
AP13	Water Solenoid	Indicates the status of the water solenoid. *Green indicator light means open.
AP14	Mixer Starter	Indicates the status of the mixer. *Green indicator light means on.

3.2.2.3 Local Control Container

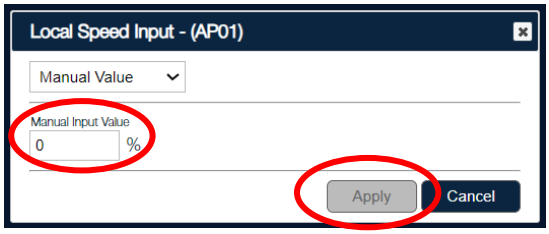
The **Local Control** container contains the applications utilized when the polymer pump control switch is set in local. AP06 is unable to be modified.

Local Control		
AP01	Local Speed Input	Speed percentage input from the user to run the polymer pump while in local.
AP06	Local	Indicates if the system is on locally.

AP01 (Local Speed Input) is the application that is utilized by the user to control the speed percentage of the pump manually.



By selecting the “Input” button, the Manual Value menu will appear where the change in pump speed percentage can be made. After making a change in the “Manual Input Value”, be sure to use the “Apply” button to save the change.



3.2.2.4 Remote Control Container

The **Remote Control** container contains the applications utilized when polymer pump control switch is set to “external”. The applications stored in this container cannot be modified.

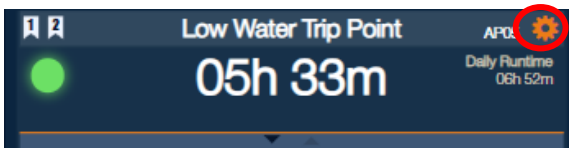
Remote Control		
AP02	External Speed Input	Takes the signal from AP29 and converts it to polymer pump speed percentage.
AP07	Remote Run Enable	Indicates that the system is on locally and has been given a remote contact to run.
AP15	Remote	Indicates if the system is on remotely.
AP29	External Pump Signal	Indicates the mA signal sent to the controller, from an external source, for running the polymer pump.

3.2.2.5 Water Flow Container

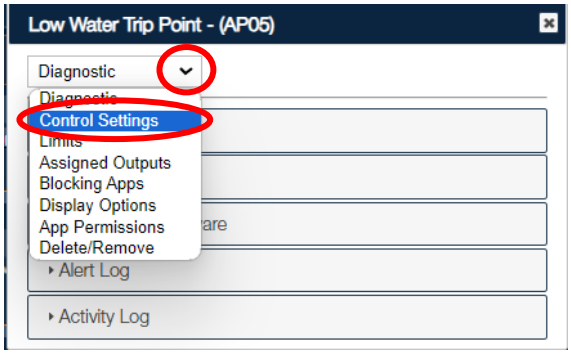
The **Water Flow** container contains the applications that manage the primary dilution water flow. Applications AP04 and AP23 cannot be modified by user.

Water Flow		
AP04	Primary Flow Rate	Displays the flowrate produced from the flowmeter on the primary dilution line.
AP05	Low Water Trip Point	Indicates if the primary water flow has not met the minimum flowrate. *Trip point to be set by user
AP08	Fill Timer	Indicates the system is going through a fill cycle. *Green indicator light means the chamber is filling. Fill time to be set by user (default 30s).
AP09	Flush Timer	Indicates the system is going through a flush cycle. *Yellow indicator light means flushing. Flush time to be set by user (default 30s).
AP23	Water Temperature	Displays the water temperature measurement from the flowmeter on the primary dilution line.

AP05 (Low Water Trip Point) sets the minimum flow rate that the system must see to remain operating while maintaining less than or equal to 1% in the mixing chamber. It is crucial to not exceed 1% due to the risk of tripping the motor starter.



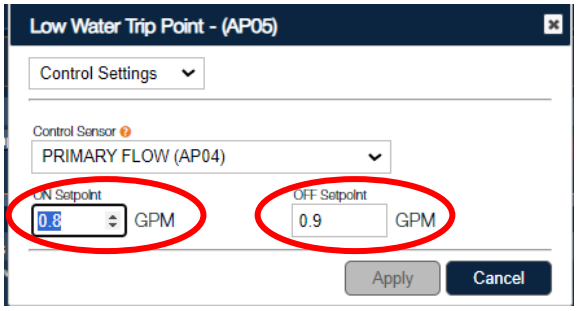
Adjust the setpoints by first selecting the application menu icon.



Then, select the application control settings drop-down menu. Then select the “Control Settings” option to gain access to the “Control Settings” setpoints.

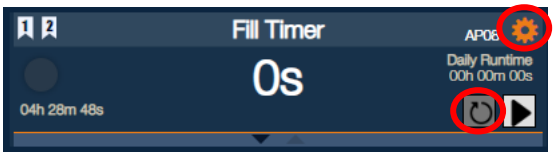
Adjust the “On Setpoint” to the minimum allowable flow rate that will not exceed a 1% concentration.

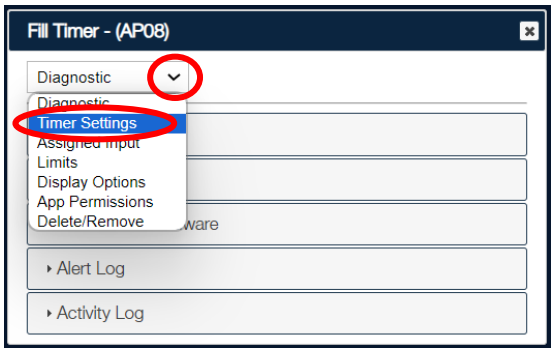
Adjust the “Off Setpoint” slightly above the on setpoint. If the flow does not exceed the “Off Setpoint” in a set time (AP25), an alarm condition will occur, and the water solenoid will close.



AP08 (Fill Timer) sets the time required to fill the mixing chamber (default 30s) before the mixer motor and polymer pump start. Depending on the operational flow rate, this time will need to be changed (chamber capacity is two gallons). **It is critical that the mixing chamber is full prior to the mixer motor turning on to prevent the shaft seals from sustaining damage.**

The Fill Timer is set to run after the system has been enabled and is set to run only once. Reset the timer by either selecting the reset button or by power cycling the unit. To adjust fill time, select the application menu icon.



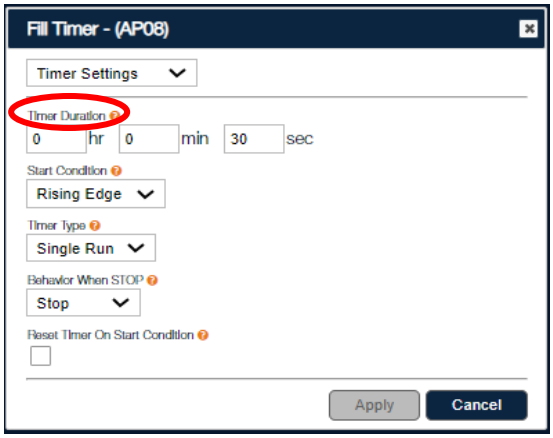


Then, select the application control settings drop-down menu. Then select the “Timer Settings” option to gain access to the “Timer Duration” setpoint.

Set the “Timer Duration” in accordance with the operational flow rate and the mixing chamber capacity.

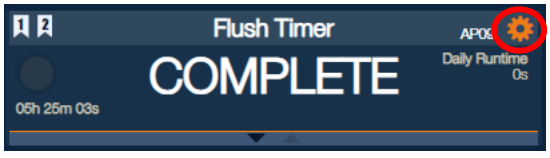
Once the chamber is filled, you can elect to set the “Timer Duration” to zero. This option is if the facility power fluctuates routinely.

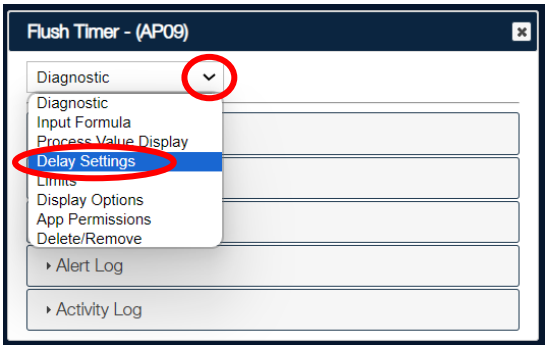
If maintenance on the mixing chamber requires the chamber to be drained and the timer has been set to zero, be sure to restore the “Timer Duration” to the previous time.



AP09 (Flush Timer) sets the time required (default 30s) to flush the polymer out of the mixing chamber leaving the mixing chamber with water only. Depending on the operational flow rate and process, this time will need to be changed.

The Flush Timer is set to run after the system has been disabled through setting the Enable Switch to OFF or when certain fault conditions happen. To adjust flush time, select the application menu icon.

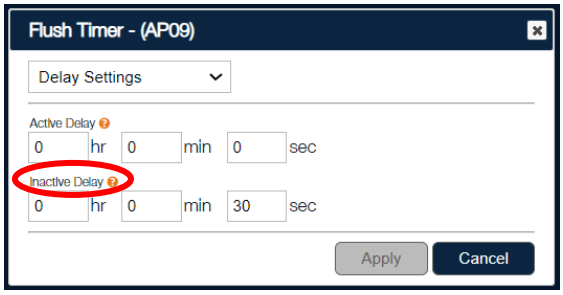




Then, select the application control settings drop-down menu. Then select the “Delay Settings” option to gain access to the “Inactive Delay” setpoint.

Set the “Inactive Delay” in accordance with the operational flow rate and the mixing chamber capacity.

Once the chamber is mixed, you can elect to set the “Inactive Delay” to zero. This option is if the process starts and stops routinely and if flush water cannot be tolerated downstream.



When the unit is to be shut down and requires flushing, be sure to restore the “Inactive Delay” to the previous time.

Note: When the controller is put into STOP during a flush, the system will pause the flush. The system will continue flushing when the STOP has been lifted.

3.2.2.6 Alarms Container

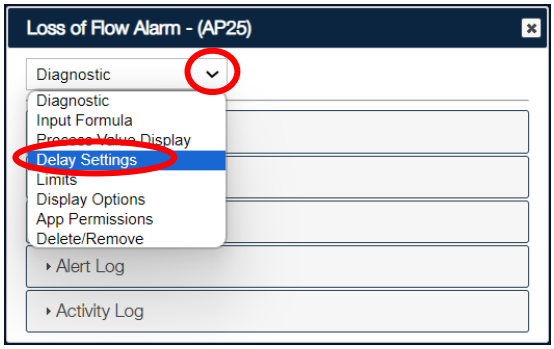
The **Alarms** container contains the applications that indicate faults with the major components of the system. AP24 and AP27-AP30 cannot be modified by the user.

Alarms		
AP24	General Alarm	Indicates if the system has triggered an alarm. *Red indicator light means the system is in an alarm state.
AP25	Loss of Flow Alarm	Indicates if AP05 has been active long enough where flow could not be reestablished. (Default Time 20s)
AP27	Mixer Motor Status	Indicates if the mixer motor has gone into a fault. *Green indicator light means the motor is NOT in a fault.
AP28	Pump Alarm	Indicates if the polymer pump has gone into an alarm state.
AP30 (optional)	Polymer Feed Status	Indicates if the polymer feed sensor is verifying polymer flow. *This app is only added if the polymer feed verification option is installed.
AP38	Loss of Signal Alarm	Indicates if the system is receiving <3.8mA signal for the polymer pump.

AP25 (Loss of Flow Alarm) activates in the event the Low Water Trip Point activates due to flowrate not exceeding the required minimum flowrate. AP25 has a delay to restore flow before the solenoid valve closes from lack of flow.

To change the delay time, first select the application menu icon.

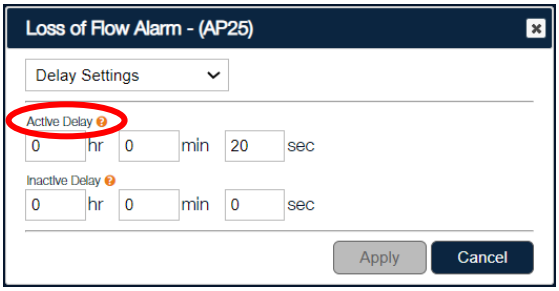




Then, select the application control settings drop-down menu. Then select the “Delay Settings” option to gain access to the “Active Delay” setpoint.

Set the “Active Delay” in accordance with the maximum time allowed for solenoid valve to stay open to restore flow dependent on inlet flow needs.

Note: This app is only available to be changed by the administrator user. Leaving the solenoid valve open without flow for extended period can result in damage to the solenoid valve.



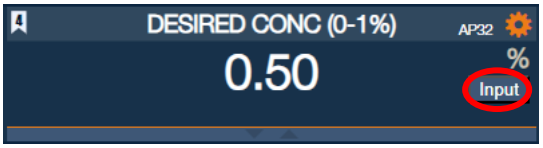
3.2.2.7 Pump Calcs Container

The **Pump Calcs** container displays the applications associated with calculating the polymer pump speed percentage and the signal needed to operate the polymer pump at the calculated speed percentage. Both AP35 and AP36 cannot be modified by the user.

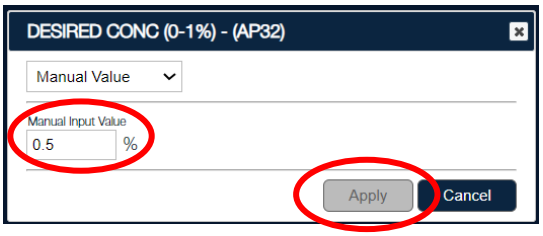
Pump Calcs		
AP32	Desired Conc (0-1%)	Input for the polymer percent concentration the user wishes to make down. *Utilized only in pump speed calculation.
AP33	Total Water Flow	Input for the total water flow the user anticipates running the system at. *Utilized only in pump speed calculation.
AP34	Pump Max Flow	Input for the maximum flowrate of the polymer pump. *Utilized only in pump speed calculation.
AP35	Calc Pump Spd	Polymer pump speed percentage calculated from the inputs of AP32-AP34. *To be entered into AP01
AP36	mA Needed for Polymer %	mA signal calculated from the inputs of AP32-AP34 for verifying the signal sent to the pump. *Use with AP10

AP32 (Desired Conc (0-1%)) sets the user’s desired polymer concentration for calculating the appropriate polymer pump speed.

To change the desired concentration for pump speed percentage calculation, first select the “Input” button.

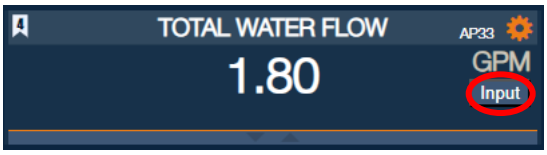


The Manual Value menu will appear where the change in polymer concentration can be made. After making a change in the “Manual Input Value”, be sure to use the “Apply” button to save the change.

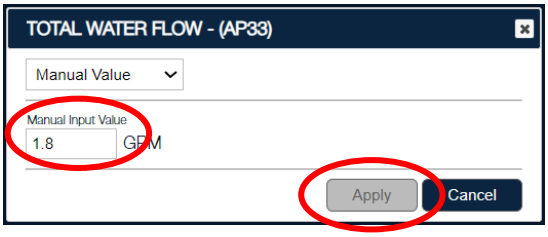


AP33 (Total Water Flow) is where the planned operating flowrate is entered for calculating the appropriate polymer pump speed.

To change the flowrate for pump speed percentage calculation, first select the “Input” button.

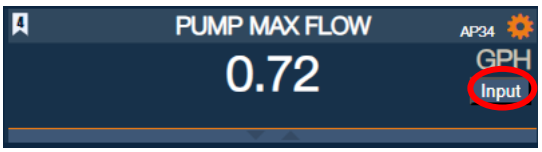


The Manual Value menu will appear where the change in water flowrate can be made. After making a change in the “Manual Input Value”, be sure to use the “Apply” button to save the change.

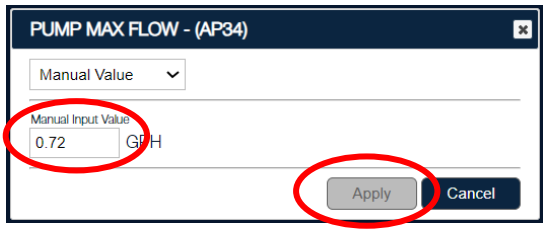


AP34 (Pump Max Flow) is where the maximum flowrate of the polymer pump is entered for calculating the appropriate polymer pump speed (refer to model information for max rate). Once the original polymer pump max flowrate has been entered, the value entered should only change if the polymer pump is replaced with a pump that has a different max flowrate.

To change the pump max flowrate for pump speed percentage calculation, first select the “Input” button.



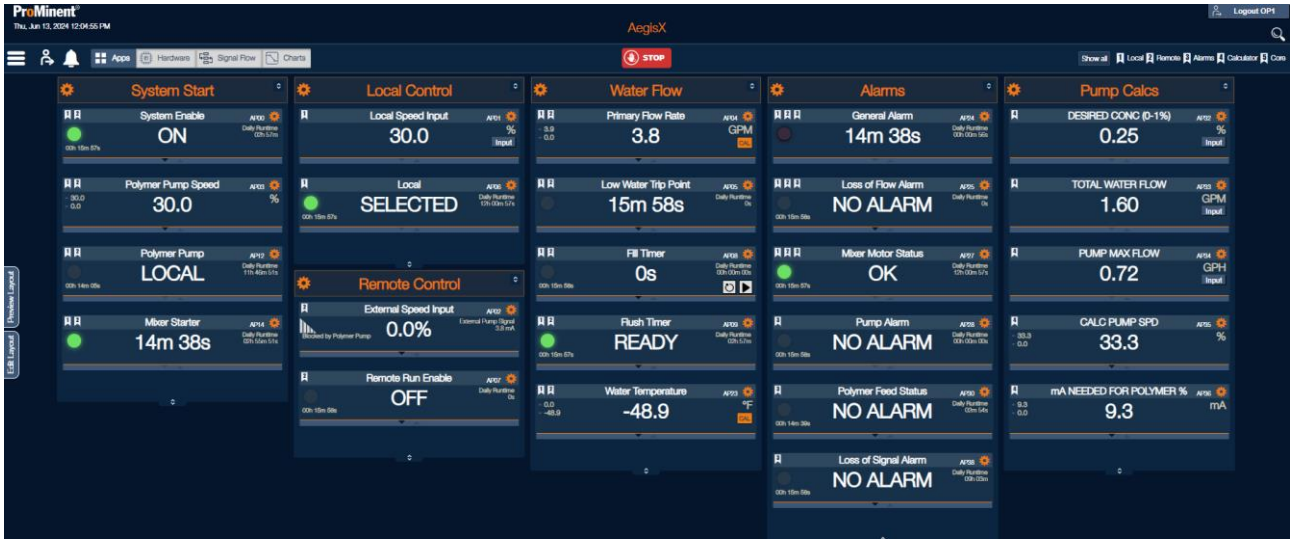
The Manual Value menu will appear where the change for the maximum pump flowrate can be made. After making a change in the “Manual Input Value”, be sure to use the “Apply” button to save the change.



After calculations are made, use the value obtained from AP35 as the input for the AP01. The value obtained from AP36 can be used to verify the signal being sent to the pump as seen in AP10.

3.2.2.8 Default Operator View

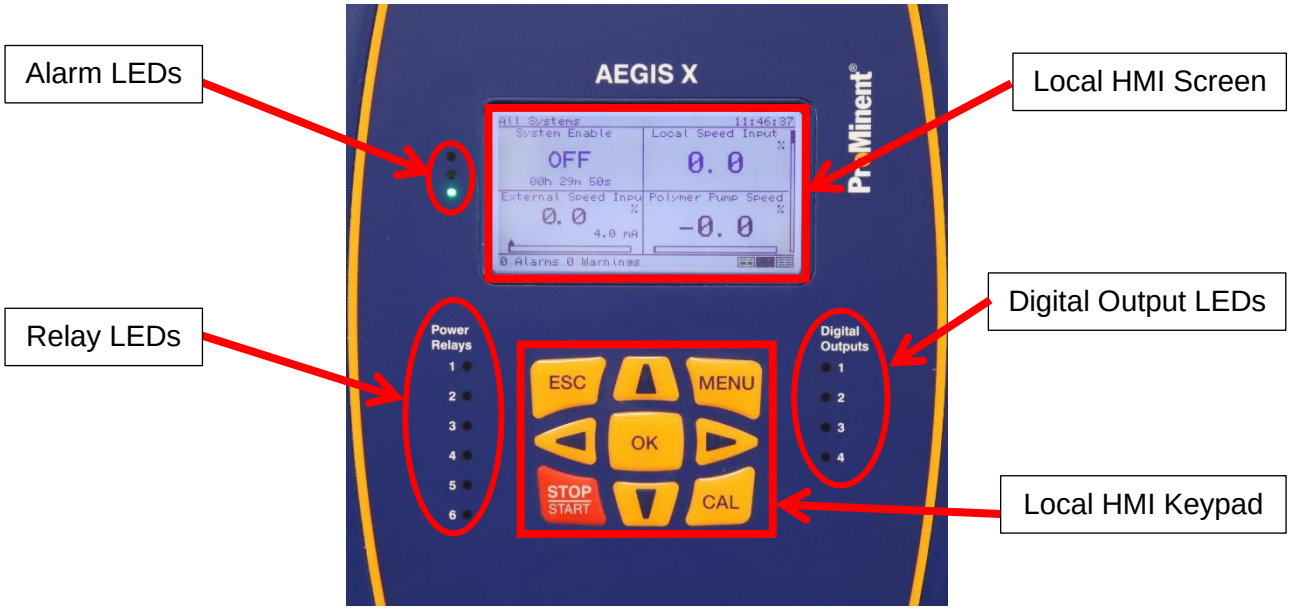
When logging into the operator user that is preprogrammed into the controller, the following view will show.



The operator view is condensed from the administrator to focus on normal operation. The applications in the operator view are highlighted earlier in this section.

3.3 Local HMI

The controller Local HMI (Keypad) indicates real time I/O values and programming information. The front cover LEDs provide relay and digital output status as well as alarms for immediate attention. The keypad allows for local operator interface. Altering of most applications is not available to keyboard users.



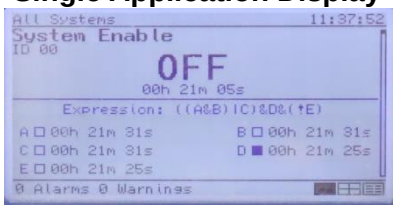
The basic understanding of the keypad is shown in this chart.

Key	Function
OK	Confirmation in the menus: Confirms and saves any changes.
ESC	Back to the HOME display or to the previous menu.
MENU	Main menu
CAL	Enables direct access to the controller's calibration menu from the HOME display. Does not work if not logged in.
STOP START	Start/Stop all **control** outputs from any display. (4-20mA = 4mA). Front panel LED is solid red. Does not affect **non control** outputs.
	(Up Arrow) Increases a displayed number value or moves upwards in the menus. (Right Arrow) Moves the cursor to the right.
	(Down Arrow) Decreases a displayed number value or step down in the menus. (Left Arrow) Moves the cursor to the left.

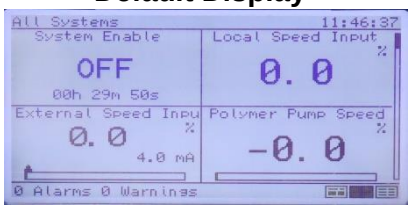
3.3.1 Navigation & Login

Using the left arrow, the display changes from the default four application display to the **Single Application** display. Conversely, using the right arrow, it will change to the **Nine Application** display.

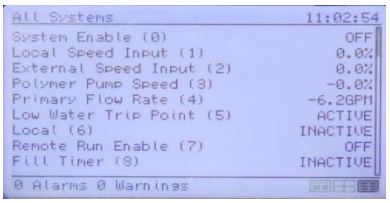
Single Application Display



Default Display

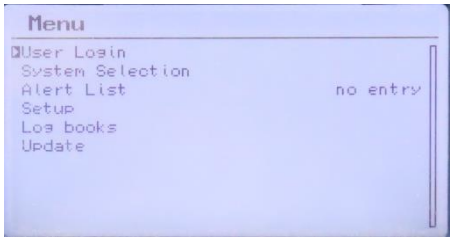


Nine Application Display



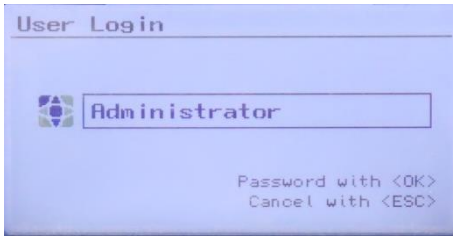
While in any of the three displays, using the down arrow will cycle to the next application or set of applications depending on which display is currently shown. Using the up arrow will return the display to the previous application or application set.

By selecting the menu button while in the default display, the “Menu” display will appear. The “User Login” option is only available within the “Menu” display.

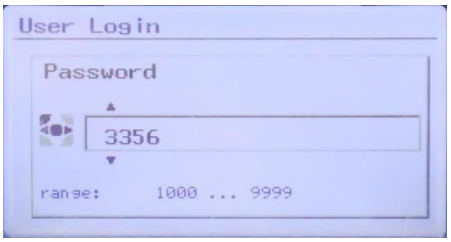


Note: Some options, including modifying certain applications, are not available without first logging in.

After selecting the user login option, the “User Login” page will appear. Select which user to log into by cycling the up and down arrows and selecting the OK button.

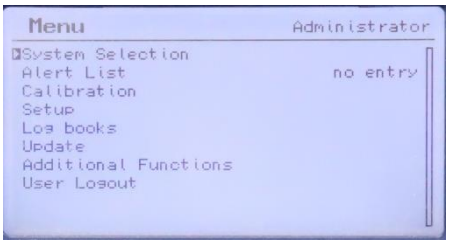


After selecting which user to log into, the “Password” prompt will appear. Using the directional buttons on the keypad, enter the 4-digit password for that specific user and select the OK button.



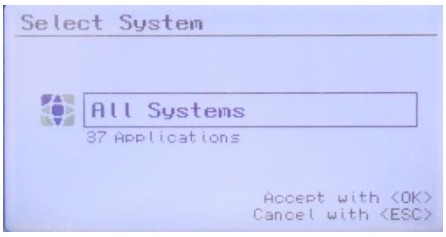
Note: There is a 5-minute idle time on the controller, where the user will be logged out after 5 minutes of inactivity.

To cycle through the systems so the Local HMI focuses on applications in a specific system, select the “System Selection” option in the “Menu”.

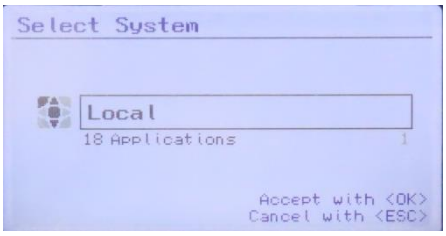


Note: By selecting a specific system, the applications contained in that system will now become the default for the controller view.

After the “System Selection” screen appears, cycle through using the up and down arrows on the keypad to select the system to view on the main screen. Select OK on the keypad to make selection.



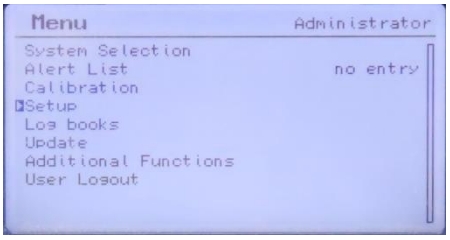
It is recommended that the “Local” system be selected since the applications grouped in the “Local” system affect the operation when the ProMix is enabled and running locally at the unit.



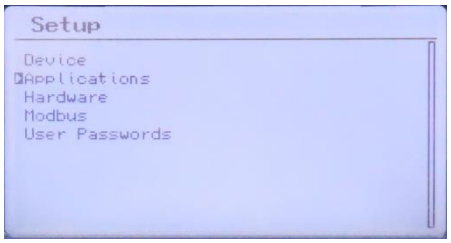
3.3.2 Operating from Keypad

Aside from running the ProMix from the Dialog X Remote HMI, the ProMix is capable of being operated from the Keypad if Remote HMI operations are unavailable. All changes from the Keypad must be made while logged in as a user. This section will explain how to get to specific applications that affect the operation of the ProMix.

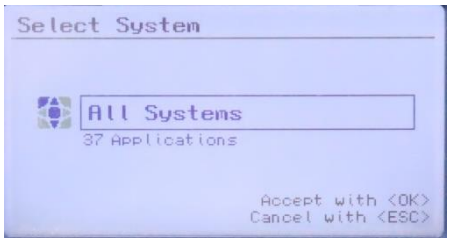
After logging in as a user, go to the “Menu” and cycle down to the “Setup” option using the down arrow on the keypad. Select the “Setup” option by selecting the OK button on the keypad.



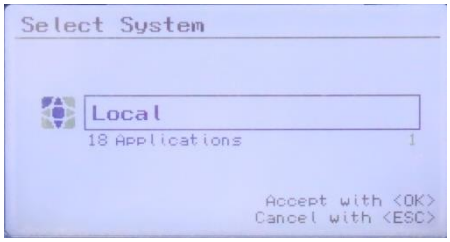
After selecting the “Setup” option, the “Setup” menu will appear. Cycle down to the “Applications” option using the down arrow on the keypad. Select the “Applications” option by selecting the OK button on the keypad.



After selecting the “Applications” option, the “Select System” page will appear. From this page, the user will be prompted to select the system needed. To select a specific system, cycle through the options using the up and down arrows on the keypad. Select the system by selecting the OK button on the keypad.



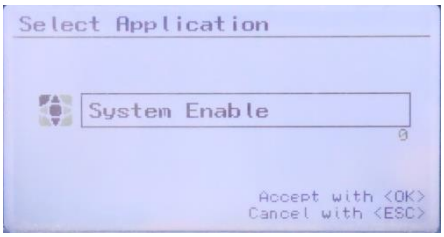
For applications AP01 (Local Speed Input) and AP05 (Low Water Trip Point), select the “Local” system option. If the “Local” system was previously selected under the “System Selection” from “Menu” as explained in **Section 3.2.1.**, the “Local” system will automatically appear when entering this page.



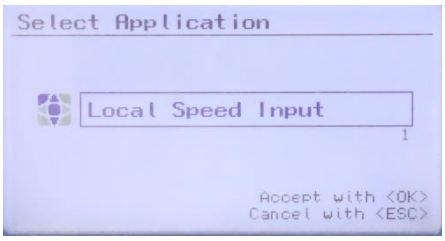
3.3.2.1 Changing Local Speed Input & Low Water Trip Point

To calculate the polymer pump speed to be entered into AP01 (Local Speed Input), utilize the equations in **Appendix H**.

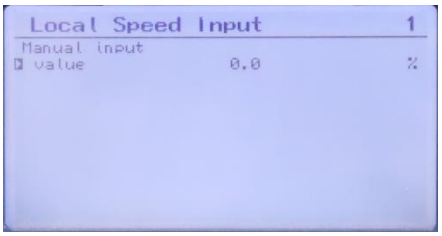
After selecting a system, the “Select Application” page will appear showing the application with the lowest number in that system. In the case of the “Local” system, AP00 (System Enable) appears first. Using the up and down arrows on the keypad, cycle to the application to modify.



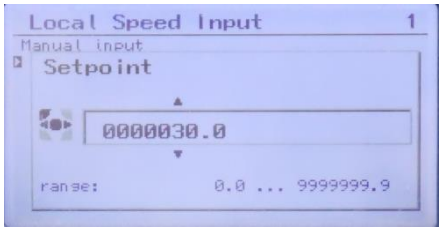
To control the polymer pump speed percentage while the polymer pump switch is in local, select AP01 (Local Speed Input) by selecting the OK button on the keypad to make the change.



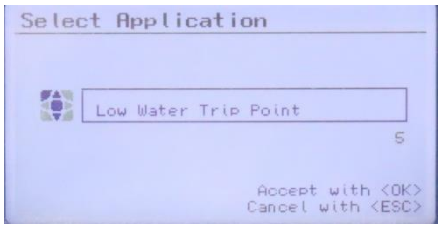
After selecting AP01, the settings page will appear. Select the “Value” option by selecting the OK button on the Keypad.



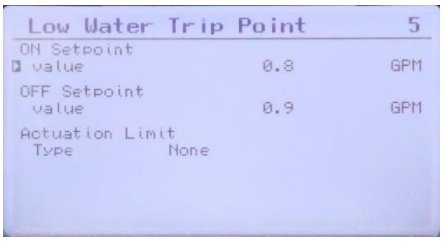
After selecting the “Value” option, the “Setpoint” page will appear. Here, the user can change the polymer pump speed percentage by first cycling the left and right arrows to the digit to be changed. Then, cycling the up and down arrows to the number they wish to enter. After the value has been selected, enter the value in by selecting the OK button on the keypad.



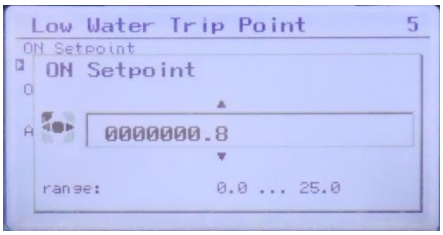
From the “Select Application” page, cycle to AP05 (Low Water Trip Point) by cycling the up and down arrows on the keypad. Enter into the application by selecting the OK button on the keypad. AP05 sets the minimum flow rate that the system must see to remain operating while maintaining less than or equal to 1% in the mixing chamber.



On the AP05 settings page there are two values to be changed. The “ON Setpoint” is the **lower setpoint** that will activate the application when the flowrate is too low. The “OFF Setpoint" is the **higher setpoint** that will deactivate the application when the flowrate is restored. Cycle the up and down arrows to switch between setpoints and select the OK button on the keypad to change setpoints.



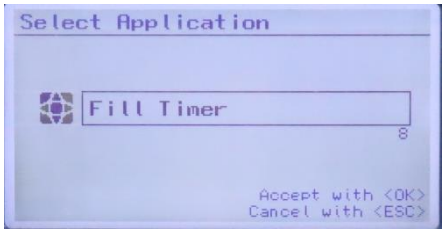
After selecting the “Value” option, the “Setpoint” page will appear. The user can change the “ON Setpoint” by first cycling the left and right arrows to the digit to be changed. Then, cycling the up and down arrows to the number they wish to enter. After the value has been selected, select the OK button on the keypad. Similarly, when selecting the “OFF Setpoint” this menu will appear and making changes are the same.



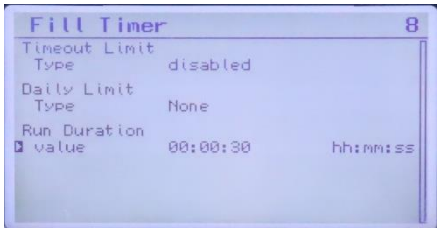
3.3.2.2 Changing Fill & Flush Timer

The following steps to change AP08 (Fill Timer) & AP09 (Flush Timer) will be discussed. These applications can only be changed by the **Administrator user**.

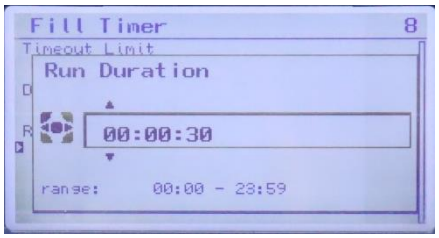
From the “Select Application” page under the “Local” system, cycle to AP08 (Fill Timer) by cycling the up and down arrows on the keypad. Enter into the application by selecting the OK button on the keypad. AP08 sets the time the chamber will fill before the polymer pump and mixer motor start.



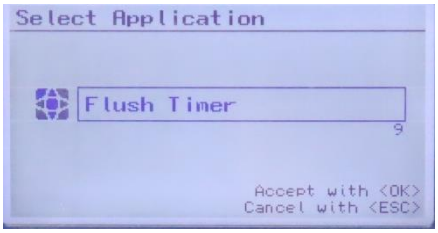
After selecting AP08, the setting page will appear where the “Run Duration” can be edited. Cycle down to the “Run Duration” using the down arrow and select it with the OK button on the keypad.



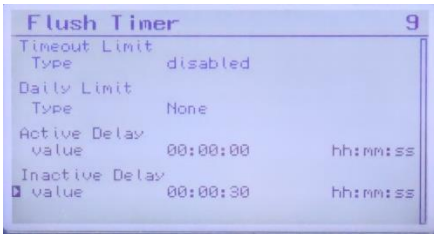
On the “Run Duration” page, the user can change the filling time. To change the filling time, cycle to the digit needing change using the left and right arrows and change the number by cycling the up and down arrows on the keypad. Select the OK button on the keypad to save the change. The Fill Time default is 30 seconds.



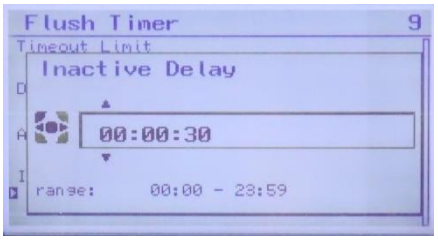
From the “Select Application” page under the “Local” system, cycle to AP09 (Flush Timer) by cycling the up and down arrows on the keypad. Enter into the application by selecting the OK button on the keypad. AP09 sets the time the ProMix will flush the polymer from the ProMix and occurs when the System Start switch is turned to the OFF position and in the case certain faults occur.



On the “Flush Timer” settings page, cycle the down arrow to the “Inactive Delay Value” option and select it with the OK button on the keypad.



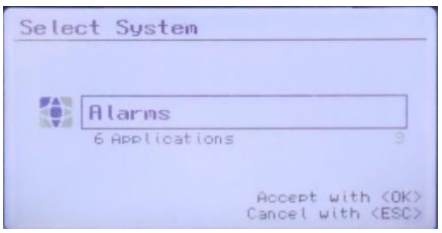
The “Inactive Delay” page will appear. Here, the user can change the “Inactive Delay” by first cycling the left and right arrows to the digit to be changed. Then, cycling the up and down arrows to the number they wish to enter. After the value has been selected, enter the value in by selecting the OK button on the keypad. The system has a default of 30 seconds.



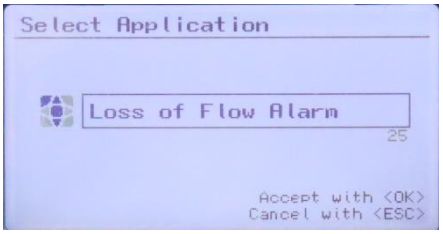
3.3.2.3 Changing Loss of Flow Alarm

The following steps to change AP25 (Loss of Flow Alarm) will be discussed. AP25 can only be changed by the **Administrator user**. This application should only be changed in the case of lengthening or shortening the time the user would like the system to allow to reestablish flow when flow has decreased enough for the concentration to exceed 1%.

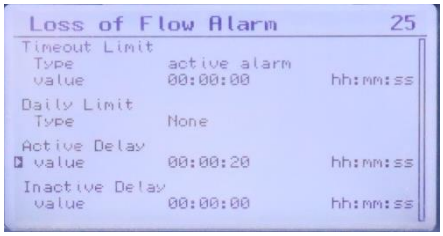
From the “Select System” page after selecting “Setup”, in the “Menu”, then “Applications” option as discussed earlier, cycle the options using the up and down arrows on the keypad until the “Alarms” system appears and select it with the OK button on the keypad.



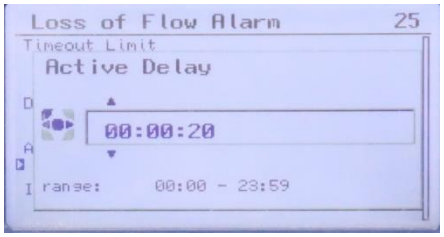
On the “Select Application” page, cycle through the up and down arrows until AP25 (Loss of Flow Alarm) appears and select the OK button on the keypad.



On the “Loss of Flow Alarm” settings page, cycle the down arrow to the “Active Delay Value” option and select it with the OK button on the keypad.

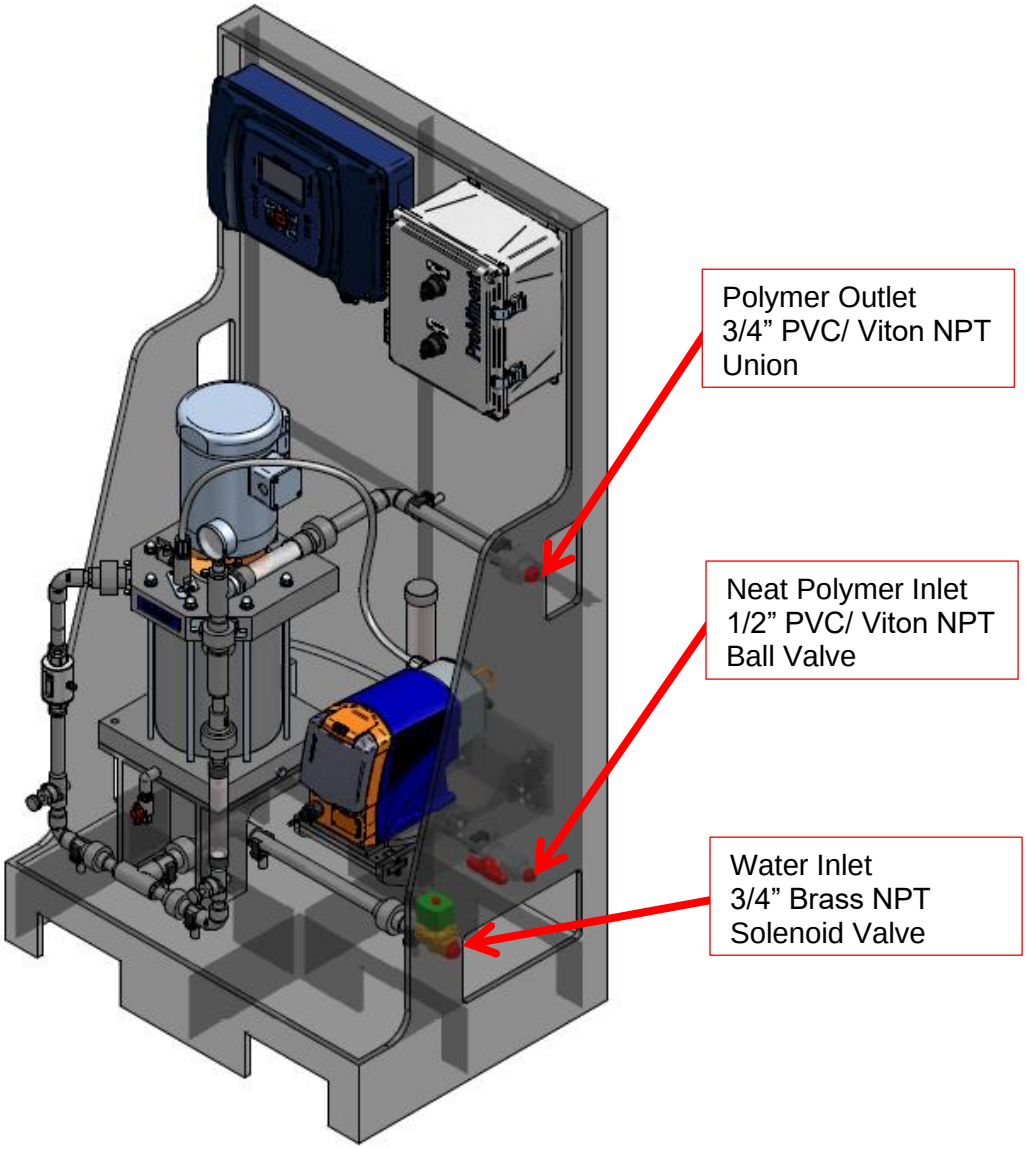


The “Active Delay” page will appear. Here, the user can change the “Active Delay” by first cycling the left and right arrows to the digit to be changed. Then, cycling the up and down arrows to the number they wish to enter. After the value has been selected, enter the value in by selecting the OK button on the keypad. The system has a default of 20 seconds.

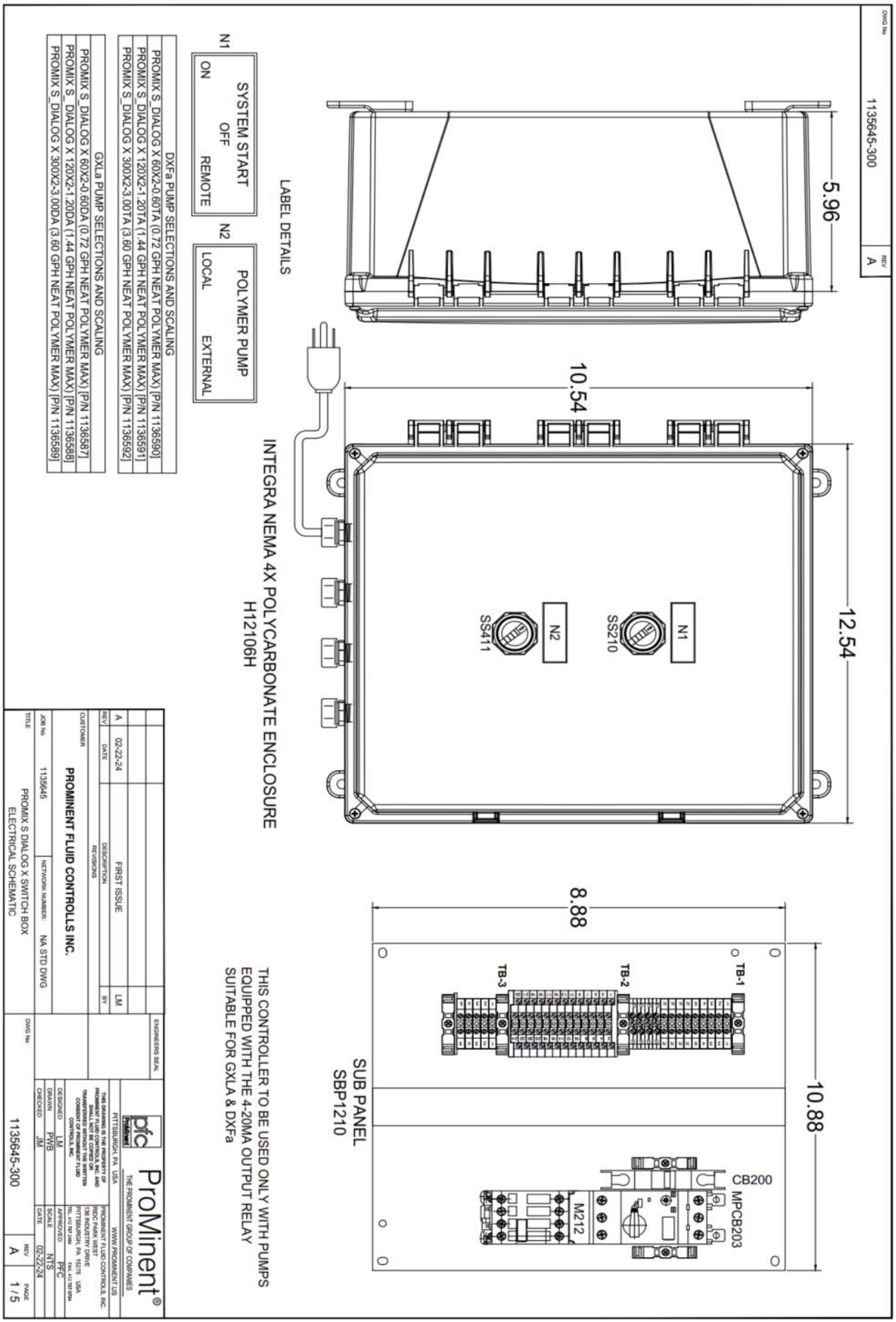


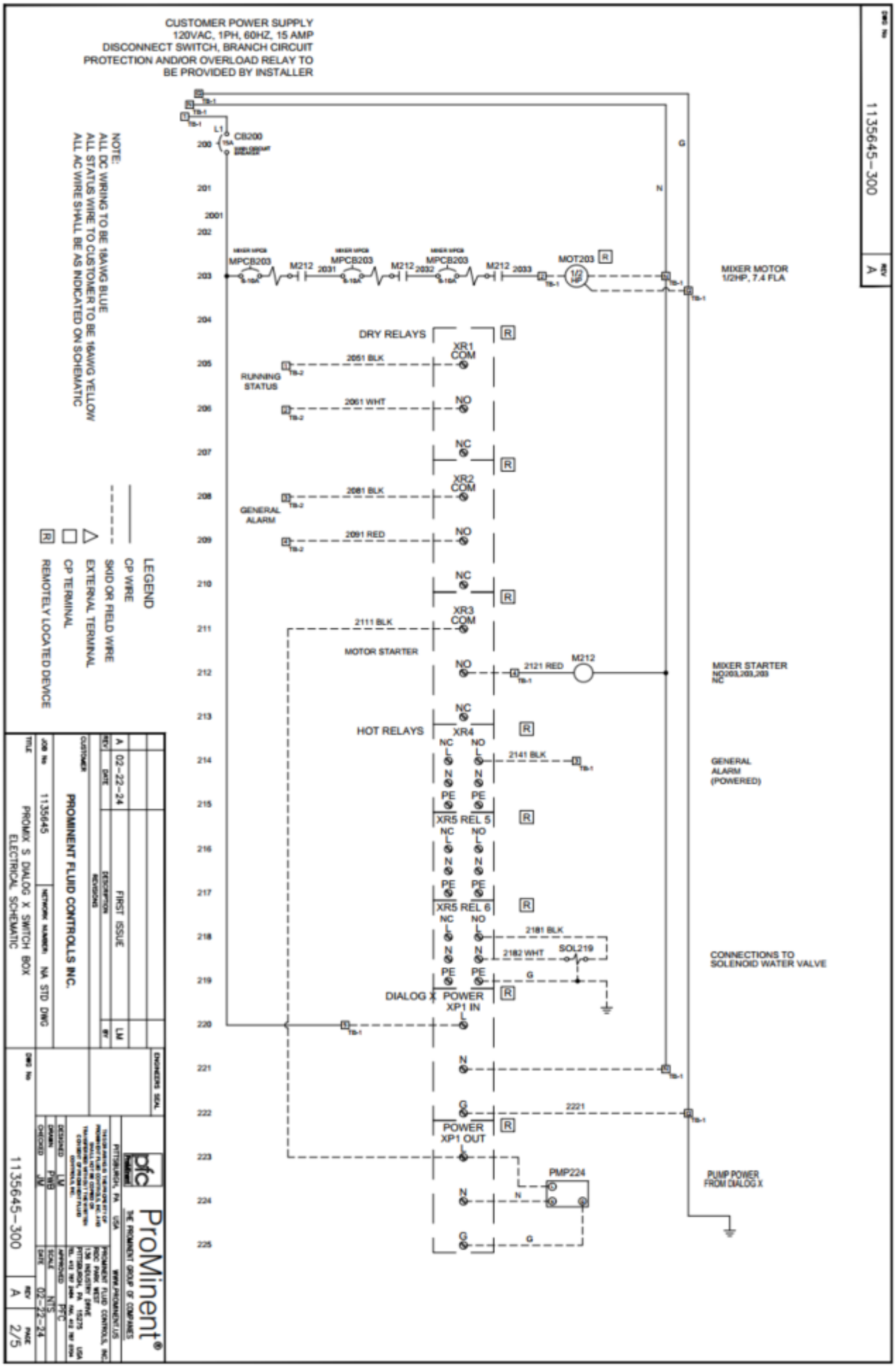
Note: Leaving the solenoid valve open without flow for extended period can result in damage to the solenoid valve.

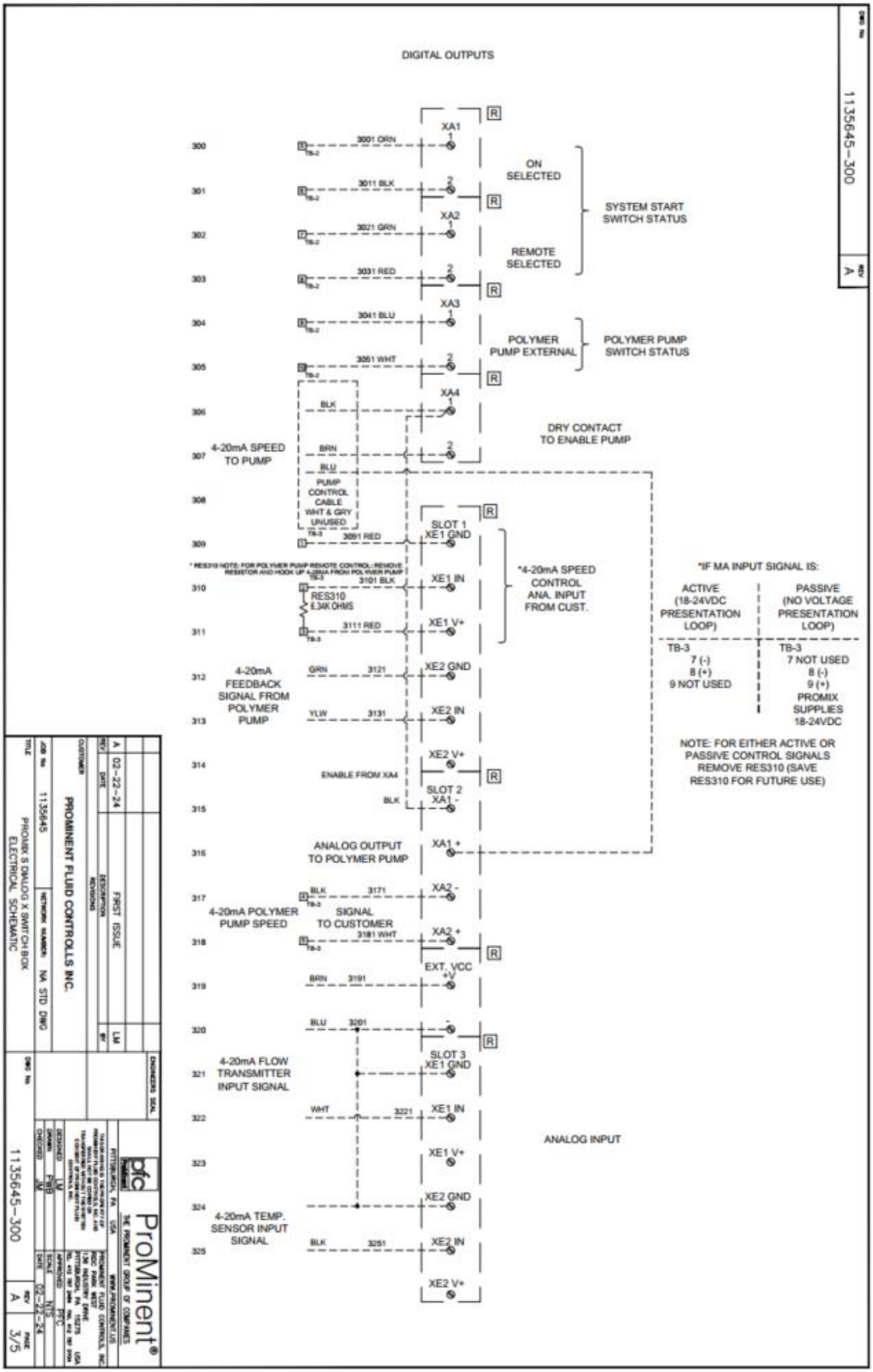
Appendix A – Fluid Connections

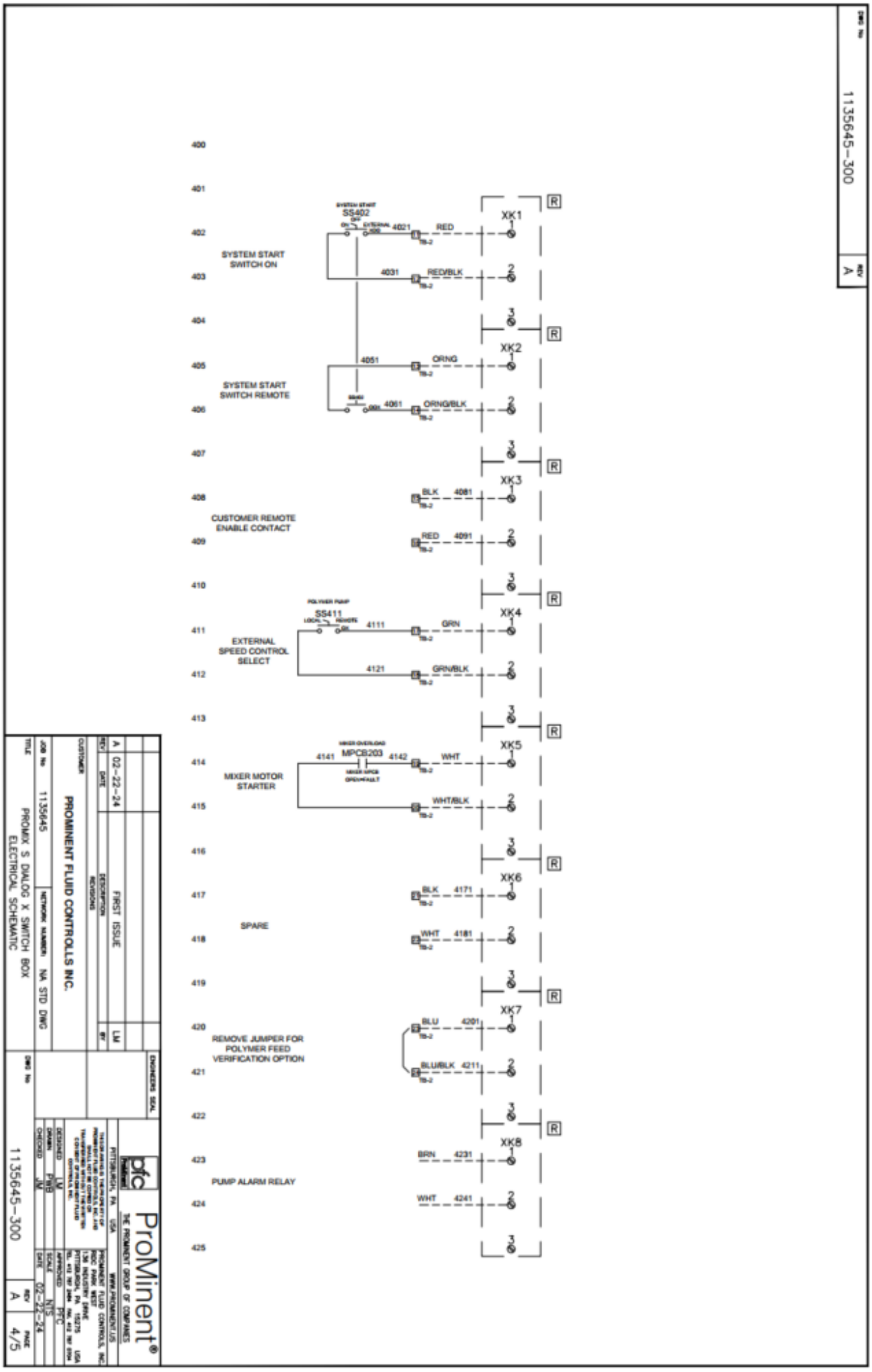


Appendix B – Electrical Drawing

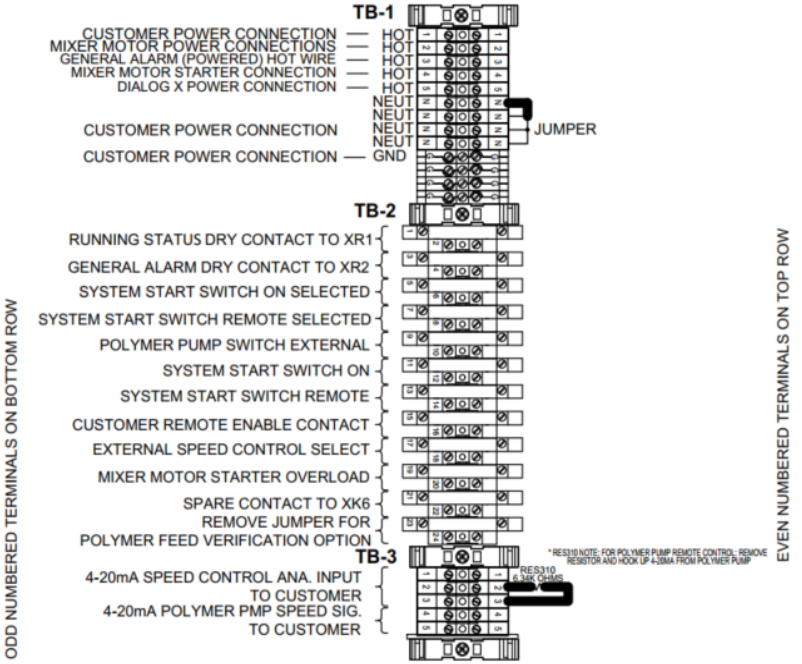



CUSTOMER POWER SUPPLY
120VAC, 1PH, 60HZ, 15 AMP
DISCONNECT SWITCH, BRANCH CIRCUIT
PROTECTION AND/OR OVERLOAD RELAY TO
BE PROVIDED BY INSTALLER
NOTE:
ALL DC WIRING TO BE 18AWG BLUE
ALL STATUS WIRE TO CUSTOMER TO BE 18AWG YELLOW
ALL AC WIRE SHALL BE AS INDICATED ON SCHEMATIC
LEGEND
CP WIRE
SKID OR FIELD WIRE
EXTERNAL TERMINAL
CP TERMINAL
REMOTELY LOCATED DEVICE
CB200
MPCB203
M212
MOT203
MIXER MOTOR
1/2HP, 7.4 FLA
DRY RELAYS
XR1
COM
NO
NC
XR2
XR3
RUNNING STATUS
GENERAL ALARM
MOTOR STARTER
2051 BLK
2061 WHT
2081 BLK
2091 RED
2111 BLK
2121 RED
MIXER STARTER
HOT RELAYS
XR4
XR5 REL 5
XR5 REL 6
2141 BLK
GENERAL ALARM (POWERED)
2181 BLK
2182 WHT
SOL219
CONNECTIONS TO SOLENOID WATER VALVE
DIALOG X POWER XP1 IN
POWER XP1 OUT
2221
PMP224
PUMP POWER FROM DIALOG X
PROMIX S DIALOG X SWITCH BOX
ELECTRICAL SCHEMATIC
PROMINENT FLUID CONTROLS INC.
1135645-300
02-22-24
FIRST ISSUE
ProMinent


DIGITAL OUTPUTS
1135645-300
A
XA1
3001 ORN
3011 BLK
ON SELECTED
SYSTEM START SWITCH STATUS
XA2
3021 GRN
3031 RED
REMOTE SELECTED
XA3
3041 BLU
3051 WHT
POLYMER PUMP EXTERNAL
POLYMER PUMP SWITCH STATUS
XA4
BLK
BRN
BLU
4-20mA SPEED TO PUMP
DRY CONTACT TO ENABLE PUMP
PUMP CONTROL CABLE WHT & GRY UNUSED
3091 RED
SLOT 1 XE1 GND
3101 BLK
XE1 IN
RES310 6.34K OHMS
3111 RED
XE1 V+
*4-20mA SPEED CONTROL ANA. INPUT FROM CUST.
4-20mA FEEDBACK SIGNAL FROM POWER PUMP
GRN 3121
XE2 GND
YLW 3131
XE2 IN
XE2 V+
ENABLE FROM XA4
SLOT 2 XA1 -
BLK
ANALOG OUTPUT TO POLYMER PUMP
XA1 +
4-20mA POLYMER PUMP SPEED
BLK 3171
SIGNAL TO CUSTOMER
XA2 -
3181 WHT
XA2 +
EXT. VCC +V
BRN 3191
BLU 3201
SLOT 3 XE1 GND
4-20mA FLOW TRANSMITTER INPUT SIGNAL
WHT 3221
XE1 IN
XE1 V+
XE2 GND
4-20mA TEMP. SENSOR INPUT SIGNAL
BLK 3251
XE2 IN
XE2 V+
ANALOG INPUT
*IF MA INPUT SIGNAL IS:
ACTIVE (18-24VDC PRESENTATION LOOP)
PASSIVE (NO VOLTAGE PRESENTATION LOOP)
TB-3
7 (-)
8 (+)
9 NOT USED
TB-3
7 NOT USED
8 (-)
9 (+)
PROMIX SUPPLIES 18-24VDC
NOTE: FOR EITHER ACTIVE OR PASSIVE CONTROL SIGNALS REMOVE RES310 (SAVE RES310 FOR FUTURE USE)
PROMIX S DIALOG X SWITCH BOX ELECTRICAL SCHEMATIC
PROMINENT FLUID CONTROLS INC.
1135645
NA
STD DWG
02-22-24
FIRST ISSUE
ProMinent
1135645-300
A
02-22-24
3/5


1135645-300
A
SYSTEM START SWITCH ON
SYSTEM START SWITCH REMOTE
CUSTOMER REMOTE ENABLE CONTACT
EXTERNAL SPEED CONTROL SELECT
MIXER MOTOR STARTER
SPARE
REMOVE JUMPER FOR POLYMER FEED VERIFICATION OPTION
PUMP ALARM RELAY
SS402
SS411
MPCB203
XK1
XK2
XK3
XK4
XK5
XK6
XK7
XK8
RED
RED/BLK
ORNG
ORNG/BLK
BLK
GRN
GRN/BLK
WHT
WHT/BLK
BLU
BLU/BLK
BRN
4021
4031
4051
4061
4081
4091
4111
4121
4141
4142
4171
4181
4201
4211
4231
4241
PROMINENT FLUID CONTROLS INC.
PROMIX S DIALOG X SWITCH BOX
ELECTRICAL SCHEMATIC
1135645
1135645-300
02-22-24
FIRST ISSUE
ProMinent
PAGE 4/5

DWG No	REV
1135645–300	A



DOOR SELECTOR SW. OPERATION		
SW1 ON-OFF-REMOTE	SW2 LOCAL-EXTERNAL	IN LINE "A" CONTROL
ON	LOCAL	SYSTEM ON- LOCAL KEYPAD CONTROLS PUMP OUTPUT
ON	EXTERNAL	SYSTEM ON - EXTERNAL 4-20MA FOR PUMP OUTPUT
REMOTE	LOCAL	SYSTEM START VIA REMOTE DRY CONTACT - LOCAL KEYPAD CONTROLS PUMP OUTPUT
REMOTE	EXTERNAL	SYSTEM START VIA REMOTE DRY CONTACT - EXTERNAL 4-20MA FOR PUMP OUTPUT

BILL OF MATERIALS

TAGS	QTY	CATALOG	MFG	DESCRIPTION
	1	7747184	INTEGRA	PC ENCLOSURE 12" X 10" X 6" NEMA 4X - WALL-MOUNT NEMA 4X WATER/DUST-TIGHT SEAL - H12106H
	1	7747190	INTEGRA	STEEL SUB PANEL PAINTED WHITE FOR 12"X10" ENCLOSURE - SBP1210
CB200	1	1077610	ABB	CIRCUIT BREAKER - MINIATURE 1-POLE CIRCUIT BREAKER 15 AMPS,120 VAC, 10KAIR UL 489
MPCB203	1	1078793	SQD	MOTOR CIRCUIT PROTECTOR/CONTACTOR ASSEMBLY IEC ASSEMBLY W/ AUXILARY CONTACTS 6 - 10 AMP ADJUSTABLE
M212	1	1078795	SQD	CONTACTOR LC1D12G7+GV2AF3+GV1F03+GV1F03
RES310	1	1135736	VISHAY	PROMIX-DIALOG X 6.34 KOHMS RESISTOR -CCF556K34FKE36
SS402	1	7745915	SQD	SELECTOR SW - 3 POS MAINT, NEMA TYPE 4X 30.5MM, 2-KA1 CONTACT BLOCKS
SS411	1	7745921	SQD	SELECTOR SW - 2 POS MAINT, NEMA TYPE 4X 30.5MM, 2-KA1 CONTACT BLOCKS
TB-1	4	7746750	PHOENIX	TERMINAL - USLKG5, GROUND TERMINAL GREEN/YELLOW 26-10 AWG SCREW CLAMP
TB-1	14	7746748	PHOENIX	TERMINAL BLOCK - UK5N SINGLE LEVEL FEED -THROUGH, 41 AMPS 800V, 24-10 AWG SCREW CLAMP
TB-3	1	7746749	PHOENIX	SINGLE LEVEL END PLATE
TB-2 TB-3	12	7746744	PHOENIX	TERMINAL BLOCK - UKK5N MULTI LEVEL FEED -THROUGH, 32 AMPS 500V, 24-12 AWG SCREW CLAMP
TB-2	1	7746746	PHOENIX	MULTI LEVEL SPACER PLATE
TB-2	1	7746747	PHOENIX	MULTI LEVEL END PLATE
TB-ALL	4	7746751	PHOENIX	END BRACKET - E/NS 35N THICKNESS 9.5MM
TB-1	1	7746752	PHOENIX	EB 10-6 INSERTION BRIDGE, GREY - 0201139
	1	7746685	CAROL	3 CONDUCTOR 22AWG UNSHEILDED WIRE BLK/RED/GRN - C4062
	1	1074564	PFC	PROMIX KEYPAD DISPLAY CONTROL UL DESIGN
	1	7746684	TYCO	3-640440-3 PC BOARD RECEPTICLE
	6	1048501	SKINTOP	SLN STRAIN RLF CBL GLAND 1/2" NPT
	6	1048502	SKINTOP	CABLE GLAND INSERT 2 HOLE
	2	1048503	SKINTOP	1/2" NPT LOCK NUT
	2	7500386	PFC	STOCK PRINTED LABELS
	1	7740819	PFC	POWER CORD 12FT, #14/3 AWG NEMA 5-15 PLUG
	1	7741775	SIR SPEEDY	PROMINENT LOGO STICKER 8" BLUE W/ORANGE "O"

REV	DATE	DESCRIPTION	BY
A	02–22–24	FIRST ISSUE	LM

REVISIONS

CUSTOMER: **PROMINENT FLUID CONTROLLS INC.**

JOB No 1135645 | NETWORK NUMBER: NA STD DWG

TITLE: PROMIX S DIALOG X SWITCH BOX
TERMINAL STRIP DETAILS AND BILL OF MATERIALS

ENGINEERS SEAL

ProMinent® THE PROMINENT GROUP OF COMPANIES
PITTSBURGH, PA USA WWW.PROMINENT.US

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PROMINENT FLUID CONTROLS, INC.
RIDC PARK WEST
136 INDUSTRY DRIVE
PITTSBURGH, PA 15275 USA
TEL. 412 787 2484 FAX. 412 787 0704

DESIGNED	LM
DRAWN	PWB
CHECKED	JM
APPROVED	PFC
SCALE	NTS
DATE	02–22–24

DWG No 1135645–300 | REV A | PAGE 5/5

ProMinent ProMix Inline Polymer Feeder

Appendix C – ProMix S Models & Pumps

ProMix S Systems with Diaphragm Pumps

SYSTEM PART NO.	MODEL	PUMP TYPE	MAX CAPACITY
1136587	PROMIX S_AGIX 60X2-0.60DA	GXLAUS1608PVT4V000UVC030EN	0.72 GPH
1136588	PROMIX S_ AGIX 120X2-1.20DA	GXLAUS1020PVT4V000UVC030EN	1.44 GPH
1136589	PROMIX S_AGIX 300X2-3.00DA	GXLAUS0730PVT4V000UVC030EN	3.60 GPH

Overall Skid Dimensions ..... 24” x 34” x 66” (L x W x H)
Overall Weight of Skid ..... Approx. 170 lbs.
Power Requirements ..... 120 VAC, 60 Hz, 1 Phase, 15 Amp
Control panel FLA ..... 11.5 Amp
Volume of Mixing Chamber ..... 2.0 Gallons
Maximum Rated Chamber Pressure ..... 150 PSIG
Maximum Operating Chamber Pressure ..... 100 PSIG
Maximum Operating Pressure ..... 100 PSIG
Recommended Running Temperature ..... +50°F to 100°F
Water Connection Size ..... ¾” FNPT
Solution Discharge Connection Size ..... ¾” FNPT
Neat Polymer Inlet Connection Size ..... ½” FNPT
Drain Connection..... ¼” FNPT

PVC Mixing Chamber Spare Parts

P/N:	*Description:*
7746474	Seal, Mech, Shaft, 1/2", ProMix-U
1115310	Valve, Injection, V2, ProMix M, S
7747241	O-Ring, Chamber Insert, Viton, ProMix-U
7746516	O-Ring, Chamber, Viton, ProMix-S

Piping Components Spare Parts

P/N:	*Description:*
1062323	0-160 PSI Gauge SS 2-1/2, Bottom Mtd SM
7741514	3/8" OD Natural PE Tubing

Diaphragm Polymer Pumps Used on S Models

Series	Identification Code	Mode (Factory Setting)	SPM Max	Flowrate (GPH)		Pressure (PSIG)
				4 mA	20 mA	
GXLA	GLXAUS1608PVT4V000UVC030EN	HV2	200	0.0 gph 0.0 spm	0.72 gph 70 spm	100
GXLA	GXLAUS1020PVT4V000UVC030EN	HV2	200	0.0 gph 0.0 spm	1.44 gph 56 spm	100
GXLA	GXLAUS0730PVT4V000UVC030EN	HV2	200	0.0 gph 0.0 spm	3.60 gph 93 spm	100

1. ProMinent – Gamma XL Solenoid Driven Metering Pump
2. Original Pump GPH rating is derated 20% due to Polymer viscosity. The actual deration may vary depending on the polymer used.
3. Control Modes Available*
    a. Standard – 200 spm: 0-50 cp
    b. HV1 (slightly reduced discharge speed) – 160 spm: 50-200 cp
    c. HV2 (moderately reduced discharge speed) – 120 spm: 200-500 cp
    d. HV3 (maximum reduced discharge speed)– 80 spm: 500-1000 cp
4. Connections: ½" x 3/8" or DN10 Depending on Model Selected
5. Power Requirements: 115VAC, 60 Hz, Single Phase

Note: Viscosity values are approximate and can vary widely per specific application. Use these values as a guideline only and consult the factory for specific application capabilities.

GAMMA XL Pump Spare Parts

P/N:	*Description:*
1033360	GXLA 1608 Spare Parts Kit**
1030353	GXLA 1608 Diaphragm
1017391	GXLA 1608 Dosing head
1027082	GXLA 1020 Spare Parts Kit**
1000249	GXLA 1020 Diaphragm
1017393	GXLA 1020 Dosing head
1027083	GXLA 0730 Spare Parts Kit**
1000250	GXLA 0730 Diaphragm
1017404	GXLA 0730 Dosing head

**Spare Parts Kit above includes the following:
(1) Diaphragm
(1) Suction Valve Set
(1) Discharge Valve Set
(2) Ball Valves (Check)
(1) Set of O-rings
(1) Connector Set

Peristaltic Polymer Pumps Used on S Models

SYSTEM PART NO.	MODEL	Series	Pump Part Number	Flowrate (GPH)		Pressure (PSIG)
				Min Rated	Max Rated	
1136590	PROMIX S_AGIX 60X2-0.60TA	DFXA	1125793	0.012	0.72	72
1136591	PROMIX S_AGIX 120X2-1.20TA	DFXA	1125874	0.053	1.44	72
1136592	PROMIX S_AGIX 300X2-3.00TA	DFXA	1125875	0.111	3.60	72

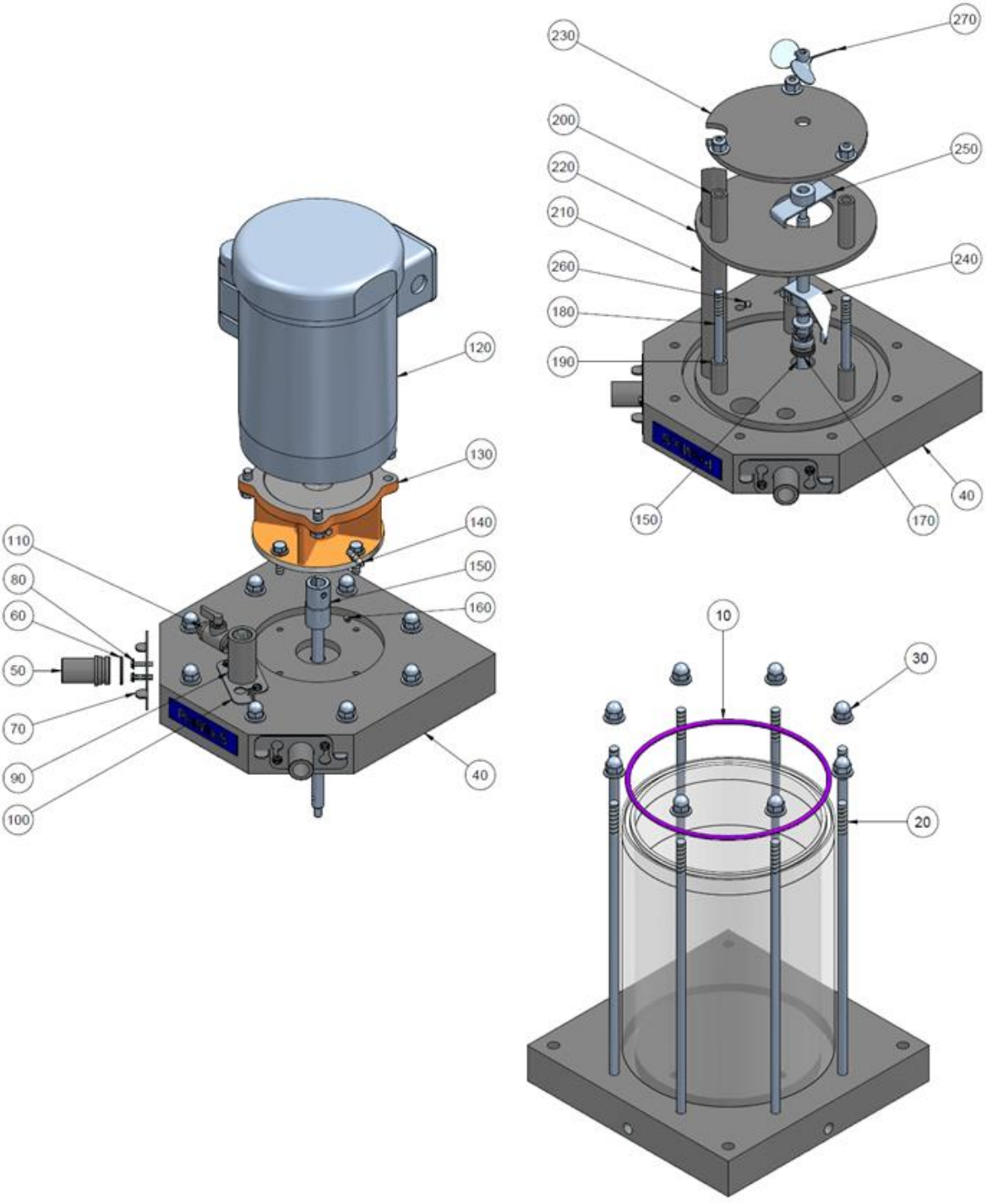
1. ProMinent DFXa Peristaltic Pumps
2. GPH Rating above based upon pumping Water not Polymer
3. Power Requirements: 120VAC, 60Hz, Single Phase (0.35 Amp)
4. Suction Lift Capabilities: Approx. 30ft. (based on water)
5. Tubing: PUR (Polyurethane)

DFXa Pump Spare Parts

P/N:	*Description:*
1104954	Spare parts kit for DFXa 0530 VPT (for pump P/N 1125793)
1112765	Spare parts kit for DFXa 0565 VPT (for pump P/Ns 1125874 & 1125875)
1104952	Spare screw kit for DFXa
1104951	PUR (Polyurethane) 72.5 PSIG (5 bar), Versions 0518, 0530 and 0565
1104727	Dosing head cover
1103249	Rotor, Complete

Appendix D – Mixing Chamber Layout & BOM

Mixing Chamber Layout

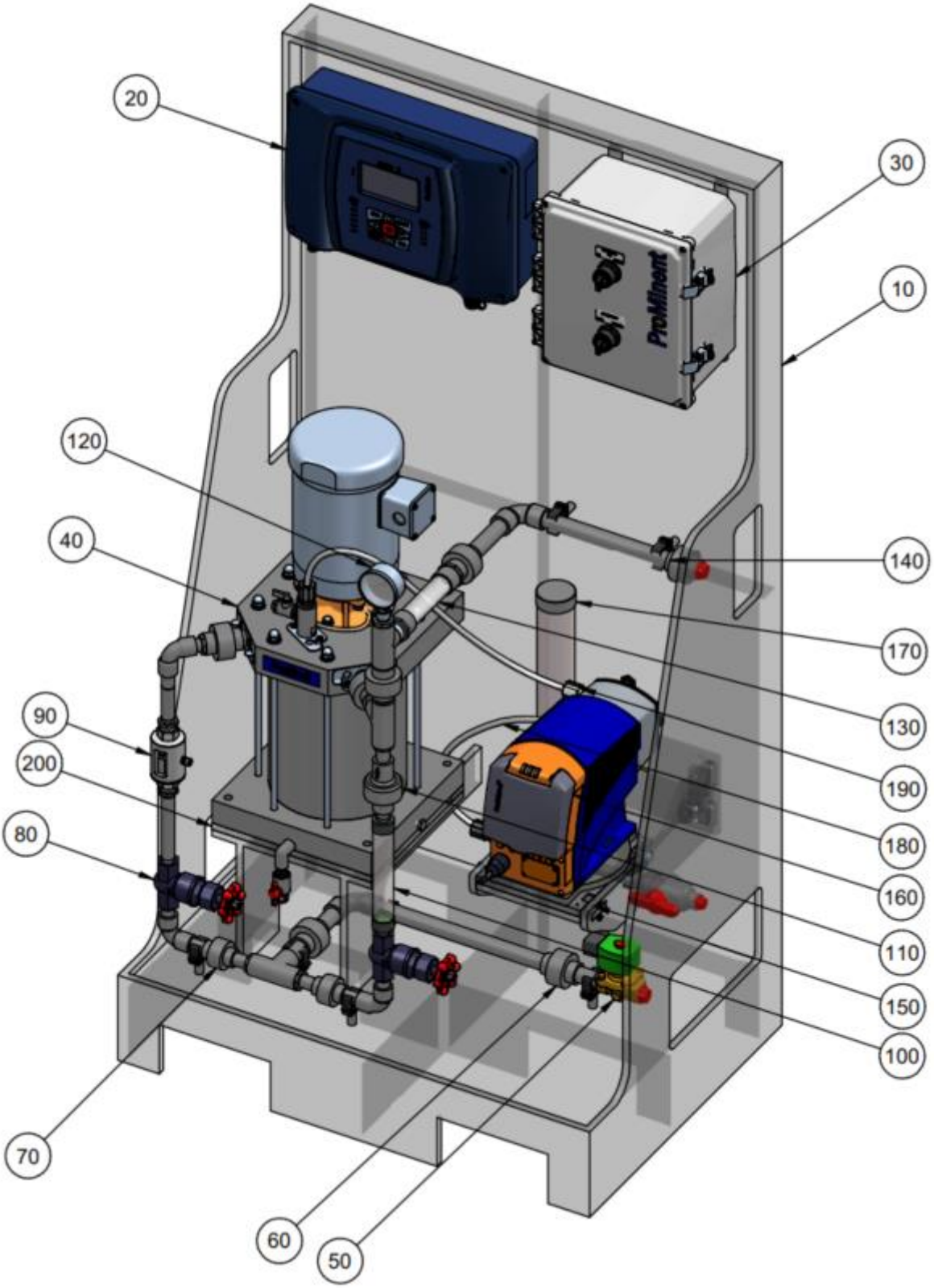


Mixing Chamber Bill Of Materials PN: 7747255

ITEM	USA P/N	QTY	DESCRIPTION
10	7746516	1	O-RING, CHAMBER, VITON, PROMIX-S
20	7747246	8	ROD, 316SS, 3/8-16 X 14.75, PROMIX-U
30	7746492	8	NUT, ACORN, 3/8-16, 18-8 SST
40	7747254	1	PLATE, TOP, PVC, 1.75, SG, PROMIX-S
50	7747269	2	INSERT, MALE, 3/4", PVC, PROMIX-S
60	7747241	2	O-RING, VITON, .987 ID X .103 CS, AS568B-120
70	7747271	2	RETAINER, MALE INSERT, 3/4" 316 SST, PROMIX-S
80	7747238	6	SCREW, 10-24X3/4", 18-8, HEX HEAD WITH WASHER
90	115310	1	Valve, Injection, V2 , Promix M, S
100	7747239	1	RETAINER, INJECTION VALVE, 316 SST
110	7747237	1	VALVE, BALL, 1/8", MNPT X FNPT, PVC, VITON
120	7747212	1	MOTOR, 1/2 HP, TEFC, 115/230 VAC, 1 PH, 56C, BALDOR VWDL3504
130	7746478	1	FLANGE, MOTOR, C56/135, PROMIX-M
140	7500346	1	HOSE BARB, 1/16" MNPT X 3/16" ID, PVDF
150	7746484	1	SHAFT, MIXER, 303SS, PROMIX-M
160	851405	1	SCREW, SET, 316SS, 1/4-28 PROMIX-U
170	7746474	1	SEAL, MECH, SHAFT, 304SS, 1/2", PROMIX-U
180	7746588	3	ROD, 316SS, 3/8-16 X 6, PROMIX-S
190	7746586	3	SPACER, TOP BAFFLE, PROMIX-S
200	7746587	3	SPACER, BOTTOM BAFFLE, PROMIX-S
210	7747257	1	PIPE, DISCHARGE, PVC, 3/4", PROMIX-U
220	1114259	1	BAFFLE, TOP, PVC, .25, WJ, PROMIX-S
230	1114258	1	BAFFLE, BOTTOM, PVC, .25, WJ, PROMIX-S
240	1108108	1	BLADE, PRIMARY, 316SS, PROMIX-S (PFC)
250	1108109	1	BLADE, SECONDARY, 316SS, PROMIX-S (PFC)
260	7746476	4	SCREW, SET, 316SS, 1/4-28 PROMIX-U
270	7746507	1	PROP, AGITATOR, CPVC, PROMIX-S

Appendix E – ProMix Mechanical Layout & BOM

General Mechanical Layout – ProMix S TA



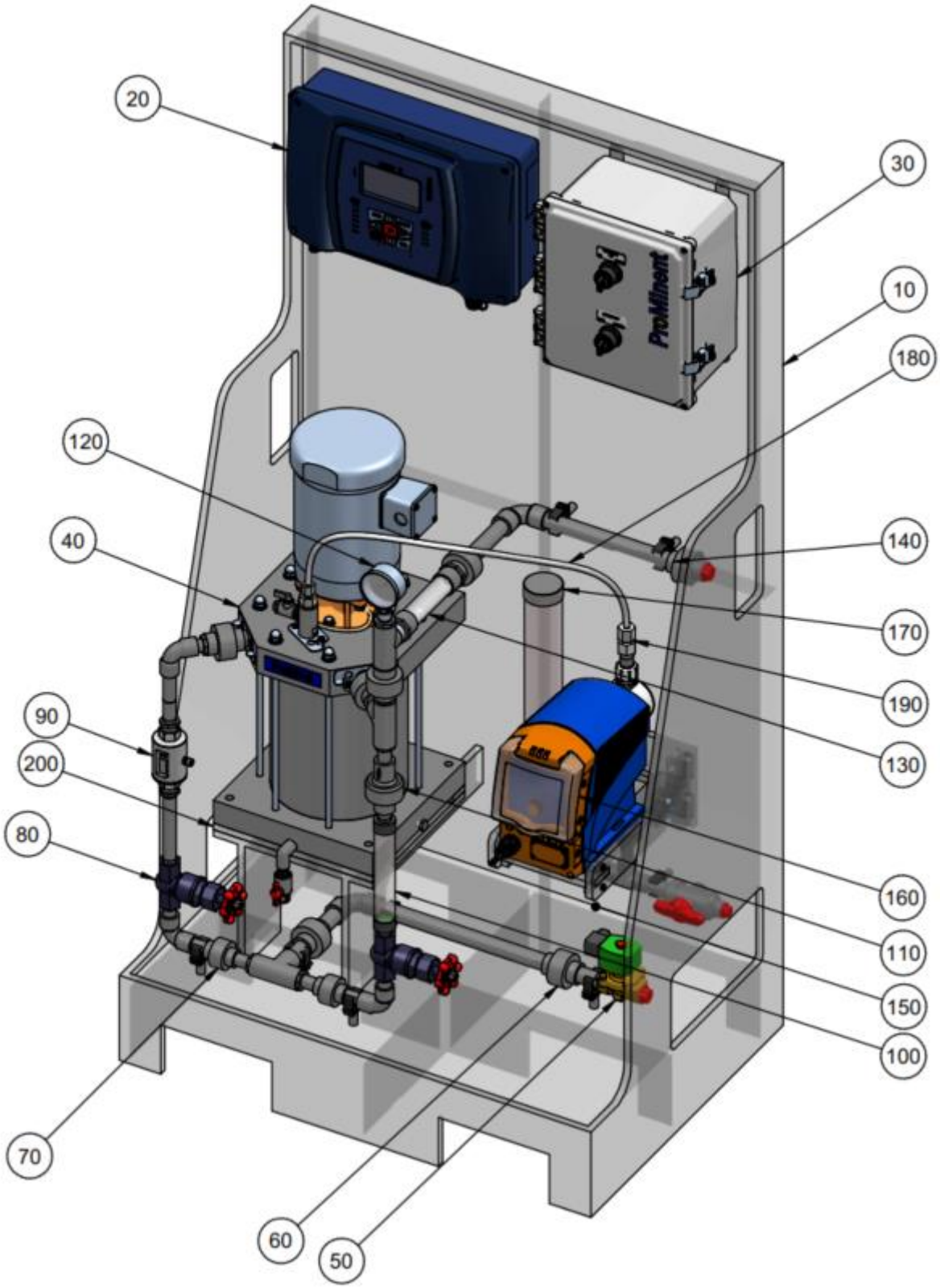
ProMix S TA with Peristaltic Tubing Pump

PROMIX S (TA SERIES) BILL OF MATERIAL

ITEM #	USA P\N	QTY.	UN	DESCRIPTION	1048347	1048349	1048352
10	1048413	1	EA	Stand, Black PP, ProMix S NG	X	X	X
20	1135634	1	EA	AGIXUSW00XXA6W0AAH1AAXX000007	X	X	X
30	1135645	1	EA	ProMix S AGIX-Switch Box	X	X	X
40	7747255	1	EA	MIXING CHAMBER COMP, SG, PROMIX-S	X	X	X
50	7746305	1	EA	3/4" ASCO N/C SOL VALVE 120V/60HZ	X	X	X
60	7744555	4	EA	3/4" PVC/VITON Union SxS Sch80 SPEARS	X	X	X
70	7744562	2	EA	1/2" PVC/VITON Union SxS Sch80 SPEARS	X	X	X
80	7746303	2	EA	NEEDLE VALVE 1/2" PVC NPT	X	X	
	1093412	2	EA	1/2" GLOBE VALVE THD PVC FKM			X
90	1135601	1	EA	ProMix S-AGIX-IFM FLOW METER SM7604 FNPT	X	X	X
	1061631	1	EA	CABLE, FLOW SWITCH, EFECTOR EVC005	X	X	X
100	7746342	1	EA	1GPM 1/2" PVC KING ROTOMETER	X		
	7746304	1	EA	2GPM 1/2" PVC KING ROTOMETER		X	
	7746343	1	EA	5GPM 1/2" PVC KING ROTOMETER			X
110	1048404	1	EA	Valve,Check,1/2" SOC,PVC,PlastOMaticCKM	X	X	X
120	1062323	1	EA	0-160PSI GAUGE SS 2-1/2, BOTTOM MTD SM	X	X	X
130	7746301	1	EA	3/4",PVC,KOFLO,STATIC,MIXER,6ELEMENT	X	X	X
140	7744556	1	EA	3/4" PVC/VITON UNION SCH80 TXT SPEARS	X	X	X
150	1124537	1	EA	SHELF, DFXa, ROTATING, BLK-PP	X	X	X
160	1125793	1	EA	Tube pump (VP) 0.72 GPH / 5 bar	X		
	1125874	1	EA	Tube pump (VP) 1.44 GPH / 5 bar		X	
	1125875	1	EA	Tube pump (VP) 3.60 GPH / 5 bar			X
170	1048564	1	EA	250ml PVC Cal Cyl 1/2"SOC w/DC (SIG)	X	X	
	1048565	1	EA	500ml PVC Cal Cyl 1/2"SOC w/DC (SIG)			X
180	37032	1	MT	Tube fabric reinf. d 6/12mm Soft-PVC	X	X	X
190	817068	4	EA	Connect. set sing. 12x 6 PCB0	X	X	X
200	1124687	2	EA	PROMIX-S_1048352_CHAMBER SPACER			X

NOTE: ITEM 160 NEEDLE VALVE NOT SHOWN IN DRAWING

General Mechanical Layout – ProMix S DA



ProMix S DA with Diaphragm Pump

PROMIX S (DA SERIES) BILL OF MATERIAL

ITEM #	USA P\N	QTY.	UN	DESCRIPTION	1048354	1048356	1048358
10	1048413	1	EA	Stand, Black PP, ProMix S NG	X	X	X
20	1135634	1	EA	AGIXUSW00XXA6W0AAH1AAXX000007	X	X	X
25	1135645	1	EA	ProMix S AGIX-Switch Box	X	X	X
30	7747255	1	EA	MIXING CHAMBER COMP, SG, PROMIX-S	X	X	X
70	7746305	1	EA	3/4" ASCO N/C SOL VALVE 120V/60HZ	X	X	X
90	7744555	4	EA	3/4" PVC/VITON Union SxS Sch80 SPEARS	X	X	X
130	7744562	2	EA	1/2" PVC/VITON Union SxS Sch80 SPEARS	X	X	X
160	7746303	2	EA	NEEDLE VALVE 1/2" PVC NPT	X	X	
	1093412	2	EA	1/2" GLOBE VALVE THD PVC FKM			X
190	1135601	1	EA	ProMix S-AGIX-IFM FLOW METER SM7604 FNPT	X	X	X
	1061631	1	EA	CABLE, FLOW SWITCH, EFECTOR EVC005	X	X	X
210	7746342	1	EA	1GPM 1/2" PVC KING ROTOMETER	X		
	7746304	1	EA	2GPM 1/2" PVC KING ROTOMETER		X	
	7746343	1	EA	5GPM 1/2" PVC KING ROTOMETER			X
220	1048404	1	EA	Valve,Check,1/2" SOC,PVC,PlastOMaticCKM	X	X	X
250	1062323	1	EA	0-160PSI GAUGE SS 2-1/2, BOTTOM MTD SM	X	X	X
260	7746301	1	EA	3/4",PVC,KOFLO,STATIC,MIXER,6ELEMENT	X	X	X
270	7744556	1	EA	3/4" PVC/VITON UNION SCH80 TXT SPEARS	X	X	X
290	1107739	1	EA	SHELF, GAMMA XL, BLK-PP, PROMIX-S, WJ	X	X	X
310	1128556	1	EA	GXLAUS1608PVT4V000UV4030EN	X		
	1128558	1	EA	GXLAUS1020PVT4V000UV4030EN		X	
	1128559	1	EA	GXLAUS0730PVT4V000UV4030EN			X
340	1048564	1	EA	250ml PVC Cal Cyl 1/2"SOC w/DC (SIG)	X	X	
	1048565	1	EA	500ml PVC Cal Cyl 1/2"SOC w/DC (SIG)			X
350	37032	1	MT	Tube fabric reinf. d 6/12mm Soft-PVC	X	X	X
370	817068	4	EA	Connect. set sing. 12x 6 PCB0	X	X	X
410	1124687	2	EA	PROMIX-S_1048352_CHAMBER SPACER			X

NOTE: ITEM 160 NEEDLE VALVE NOT SHOWN IN DRAWING

Appendix F – Reference Documents

Mechanical General Arrangement Drawings – ProMix S:

Drawing Number	System Description
1136590-0-200-001	PROMIX S_AGIX 60X2-0.60TA
1136591-0-200-001	PROMIX S_AGIX 120X2-1.20TA
1136592-0-200-001	PROMIX S_AGIX 300X2-3.00TA
1136587-0-200-001	PROMIX S_AGIX 60X2-0.60DA
1136588-0-200-001	PROMIX S_AGIX 120X2-1.20DA
1136589-0-200-001	PROMIX S_AGIX 300X2-3.00DA

Electrical Schematic Drawings:

1135645-A-300	PROMIX S AGIX SWITCH BOX

Pump Manuals:

981953	DFXa Peristatic Pump Operations Manual
982271	GMXa Solenoid Driven Metering Pump Operations Manual

Instructions Manuals:

7746471-400	Injection Valve Cleaning Instructions
7746589-400	Mixing Chamber Mechanical Seal Replacement

Dialog X Manual:

990204	Dialog X Installation and Operating Manual

Appendix G – Maintenance

MAINTENANCE		
Description / Task	**Remarks**	**Frequency**
Visual inspection of unit		Weekly
Check dosing line fittings and valves for tightness		Every 3 Months (Approx 30% continuous operation.)
Verify equipment is operating properly	No leaks in the piping or at the “weep hole” or abnormal noises	Weekly
Check the electrical connections for integrity		Quarterly
Check process tubing for wear or cuts		Weekly
Check Mixing Chamber Motor amperage. Check fan cover for obstruction or Dirt		Monthly
Check pump tubing for wear or cuts		Weekly
Short Term - Flushing of Piping & Chamber	24 Hour Shut Down	Run 60 Second Flush Min
Long Term – Flushing of Piping & Chamber	24 Hour + or if large amount of polymer is dosed into chamber w/o water running	Run Water until piping is visibly clear in static mixer

LUBRICATION		
Description / Task	**Lubrication**	**Frequency**
Mixing Chamber Motor 1/2 Hp - Standard Bearings	Ball Bearing Grease	5,000 Hours of Service per Year or every three years

Appendix H – Equations

Polymer Pump Speed Percentage:

$$\text{Desired Activated Polymer Conc. (\%)} = \text{Polymer Pump Flow (gpm)} \div \text{Total Water Flow (gpm)}$$

$$\text{Desired Activated Polymer Conc. (\%)} \times \text{Total Water Flow (gpm)} = \text{Polymer Pump Flow (gpm)}$$

$$\text{Polymer Pump Max Flow (gph)} \div 60 = \text{Max Polymer Pump Flow (gpm)}$$

$$\frac{\text{Polymer Pump Flow (gpm)}}{\text{Max Polymer Pump Flow (gpm)}} \times 100 = \text{Polymer Pump Speed (\%)}$$

Polymer Concentration w/ Secondary Dilution

The polymer concentration from the ProMix S/C Polymer feeder is based upon the neat polymer pump rate divided by the total water flow through the primary flowmeter and secondary rotameter.

$$\frac{\text{Polymer Pump Flow (gph)}}{60(\text{Primary Flow (gpm)} + \text{Secondary Flow (gpm)})} \times 100 = \text{Activated Polymer Conc. (\%)}$$

Polymer Dosage Estimations

The desired polymer dosage must be considered prior to selecting the ProMix and pump speed. Typically, the user will know how much polymer is required. This information is from jar tests or from prior experience. Otherwise, the dosage can be derived from an initial manual calculation which must be adjusted based upon actual operation.

Below are typical guidelines to estimate polymer feed dosage:

For Clarifier & Filter Applications:

$$\frac{\text{Plant Flow (MGD)} \times \text{Active Polymer (ppm)}}{24} = \text{Active Polymer (gph)}$$

$$\frac{\text{Active Polymer (gph)}}{\text{Desired Solution Conc. (\%)}} = \text{Required Dilution Range}$$

For Sludge Dewatering Applications:

$$\frac{\text{Sludge Flow (gpm)} \times \text{Solids Conc. (\%)} \times 8.34 \times 60}{2000} = \text{Dry Sludge (Ton/hr)}$$

$$\frac{\text{Dry Sludge (Ton/hr)} \times \text{Polymer (lbs/dry ton)}}{8.34(\text{Active Polymer (\%)} \times \text{Desired Solution Conc. (\%)})} = \text{Required Dilution Range}$$

EQUIPMENT TECHNICAL DATA SHEETS

FILTER REGULATOR

PNEUMATIC VALVES & KROFTA AIR DISSOLVING TUBE (ADT) AIR FEED AIR FILTER / REGULATOR:

SMC Pneumatics – Model#AW40-N03BDG-6Z, 3/8" NPT, w/ bracket, auto-drain valve, gauge, and nylon bowl. 0-160 psi

SLUDGE TRANSFER PUMP AIR FEED AIR FILTER / REGULATOR:

SMC Pneumatics – Model#AW40-N06BDG-6Z, 3/4" NPT, w/ bracket, auto-drain valve, gauge, and nylon bowl. 0-160 psi

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

AW1000 to 4000

How to Order

AW **30** **00** – **[ ]** **03** **BG** – **2N**

Filter Regulator

Body size

10	M5
20	1/8
30	3/8
40	1/2

Thread

—	Metric (M5)
	Rc(PT)
N	NPT
F	G(PF)

Port size

M5	M5 X 0.8
01	1/8
02	1/4
03	3/8
04	1/2
06	3/4

Accessory

Symbol		Description	Applicable model
—		—	—
B		Bracket	AW1000 to AW4000-06
C	Auto drain	Auto drain float style (N.C.)	AW3000 to AW4000-06
D	Auto drain	Auto drain pressure differential	AW1000/2000
	Auto drain	Auto drain float style (N.O.)	AW3000 to AW4000-06
G	Gauge	Without limit indicator	AW1000
	Gauge	With limit indicator	AW2000 to AW4000-06

Option

1(1)	Set at 0.02 to 0.2MPa
2	Metal bowl
6	Nylon bowl
8	Metal bowl with level gauge (AW3000/4000 only)
C	Bowl guard (AW2000 only)
J(2)	Drain guide (AW3000/4000 only)
N	Non relieving
R	Flow direction: Right to left
W	With drain cock and barb fittings (AW 3000/4000 only) (For nylon ø6, ø4)

∗If more than one symbol is required to be listed when ordering, list in the alphabetical order. (Ex. 2NR)

Note 1) Only regulating spring is different from the standard model.
Note 2) Without valve mechanism

Option Combinations

◎Combinable ▭Impossible ●Depends on the model

	Description	Symbol	Auto drain			Option									Applicable Filter Regulator			
			D	D	C	1	2	6	8	C	J	N	R	W	AW1000	AW2000	AW3000	AW4000
Accessory	Auto drain pressure differential style	D				◎	◎	◎		●		◎	◎		◎	◎		
	Auto drain float style (N.O.)	D				◎	◎	◎	◎			◎	◎				◎	◎
	Auto drain float style (N.C.)	C				◎	◎	◎	◎			◎	◎				◎	◎
Option	0.02 to 0.2MPa	–1	◎	◎	◎		◎	◎	●	●	●	◎	◎	●	◎	◎	◎	◎
	Metal bowl	–2	◎	◎	◎	◎					●	◎	◎		◎	◎	◎	◎
	Nylon bowl	–6	◎	◎	◎	◎				●	●	◎	◎	●	◎	◎	◎	◎
	Metal bowl with level gauge	–8		◎	◎	◎					◎	◎	◎				◎	◎
	With bowl guard	–C	◎			◎		◎				◎	◎			◎		
	Drain guide (Bore size: 1/4)	–J				◎	◎	◎	◎			◎	◎				◎	◎
	Non relieving	–N	◎	◎	◎	◎	◎	◎	●	●	●		◎	●	◎	◎	◎	◎
	Flow direction: Right to left	–R	◎	◎	◎	◎	◎	◎	●	●	●	◎		●	◎	◎	◎	◎
	One-touch drain cock with barb fittings	–W				◎		◎				◎	◎				◎	◎

⚠ Precautions

Be sure to read before handling. Refer to p.0-26 and 0-27 for Safety Instructions and common precautions on the products mentioned in this catalog, and refer to p.1.0-1 and 1.0-2 for precautions on every series.

Selection

⚠Warning

①The residual secondary pressure cannot be released by releasing the supply pressure. To release the residual pressure, use a filter regulator designed for such use.

Installation and Adjustment

⚠Warning

①Set up the regulator while verifying the pressure that is indicated on the supply and the secondary pressure gauges. Turning the handle excessively could damage the internal parts.

①The pressure gauge that is provided with the product for setting a pressure between 0.02 to 0.2MPa is the 0.2MPa style. To prevent damage to the pressure gauge, make sure that pressure in excess of 0.2MPa is not applied.

③The adjustment handle must be operated manually. Using a tool to turn the handle could lead to damage.

⚠Caution

①Release the lock to adjust the pressure. After the adjustment, engage the lock.
Failure to observe this procedure could damage the handle or cause the secondary pressure to fluctuate.

1) On the AW1000 and AW2000 styles, pull the adjustment handle to release the lock and push the handle to engage the lock. If it does not lock easily, turn the handle slightly clockwise or counterclockwise before pushing it.

2) On the AW3000 and AW4000 styles, pull the adjustment handle to release the lock. (An orange colored line is provided at the bottom of the adjustment handle for visual checking.) Push the adjustment handle to engage the lock. If it does not lock easily, turn the handle slightly clockwise or counterclockwise; then, push it until the orange colored line is no longer visible.



Maintenance Inspection

⚠Warning

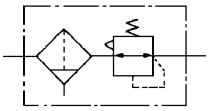
①Replace the filter element within 2 years of operation or before the pressure drop reaches 0.1MPa. Failure to observe this precaution could damage the filter element.

Modular Type
Filter Regulators
Series AW

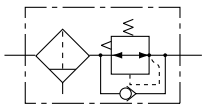
	Model	Port size	Options
Filter Regulator Series AW  Pages 366 through to 377	**AW10**	M5 x 0.8	Bracket Float type auto drain Square embedded type pressure gauge (except the AW10) Round type pressure gauge Digital pressure switch (except the AW10) Panel mount
	AW20	1/8, 1/4	
	AW30	1/4, 3/8	
	AW40	1/4, 3/8, 1/2	
	AW40-06	3/4	
	AW60	3/4, 1	
Filter Regulator with Backflow Function Series AW□K  Pages 366 through to 377	**AW20K**	1/8, 1/4	
	AW30K	1/4, 3/8	
	AW40K	1/4, 3/8, 1/2	
	AW40K-06	3/4	
	AW60K	3/4, 1	
Mist Separator Regulator Series AWM  Pages 378 through to 387	**AWM20**	1/4, 1/4	
	AWM30	1/4, 3/8	
	AWM40	1/4, 3/8, 1/2	
Micro Mist Separator Regulator Series AWD  Pages 378 through to 387	**AWD20**	1/4, 1/4	
	AWD30	1/4, 3/8	
	AWD40	1/4, 3/8, 1/2	

Filter Regulator
AW10 to AW60
Filter Regulator with Backflow Function
AW20K to AW60K

JIS Symbol
Filter Regulator

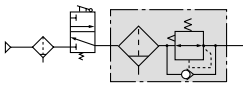


Filter Regulator with Backflow Function



- **Integrated filter and regulator units save space and require less piping.**
- **With the backflow function it incorporates a mechanism to exhaust the air pressure in the outlet side reliably and quickly.**

Example)
When the air supply is cut off and releasing the inlet pressure to the atmosphere, the residual pressure release of the outlet side can be ensured for a safety purpose.



How to Order

AW ❶**30** ❷**K** – ❸**□** ❹**03** ❺**BE** – ❻**□** – **□**

- **Made to Order**
  Refer to pages 374 through to 377 for details.

- Option/Semi-standard: Select one each for **a** to **i**.
- Option/Semi-standard symbol: When more than one specification is required, indicate in alphanumeric order.
  Example) AW30K-03BE-1N

			Symbol	Description	❶ Body size 10	20	30	40	60
❷	With backflow function		**Nil**	Without backflow function	●	●	●	●	●
			K Note 1)	With backflow function	—	●	●	●	●
❸	Thread type		**Nil**	Metric thread (M5)	●	—	—	—	—
				Rc	—	●	●	●	●
			N Note 2)	NPT	—	●	●	●	●
			F Note 3)	G	—	●	●	●	●
❹	Port size		**M5**	M5	●	—	—	—	—
			01	1/8	—	●	—	—	—
			02	1/4	—	●	●	●	—
			03	3/8	—	—	●	●	—
			04	1/2	—	—	—	●	—
			06	3/4	—	—	—	●	●
			10	1	—	—	—	—	●
❺ Option Note 4)	**a**	Mounting	**Nil**	Without mounting option	●	●	●	●	●
			B Note 5)	With bracket	●	●	●	●	●
			H	With set nut (for panel fitting)	●	●	●	●	—
	b	Float type auto drain	**Nil**	Without auto drain	●	●	●	●	●
			C	Float type auto drain (N.C.)	●	●	●	●	●
			D	Float type auto drain (N.O.)	—	—	●	●	●
	c	Pressure gauge	**Nil**	Without pressure gauge	●	●	●	●	●
			E	Square embedded type pressure gauge (with limit indicator)	—	●	●	●	●
			G	Round type pressure gauge (without limit indicator)	●	—	—	—	—
				Round type pressure gauge (with limit indicator)	—	●	●	●	●
			M	Round type pressure gauge (with color zone)	—	●	●	●	●
		Digital pressure switch	**E1** Note 6)	Output: NPN output / Electrical entry: Wiring bottom entry	—	●	●	●	●
			E2 Note 6)	Output: NPN output / Electrical entry: Wiring top entry	—	●	●	●	●
			E3 Note 6)	Output: PNP output / Electrical entry: Wiring bottom entry	—	●	●	●	●
			E4 Note 6)	Output: PNP output / Electrical entry: Wiring top entry	—	●	●	●	●
❻ Semi-standard	**d**	Set pressure	**Nil** Note 7)	0.05 to 0.85 MPa setting	●	●	●	●	●
			1 Note 8)	0.02 to 0.2 MPa setting	●	●	●	●	●
	e	Bowl Note 9)	**Nil**	Polycarbonate bowl	●	●	●	●	●
			2	Metal bowl	●	●	●	●	●
			6	Nylon bowl	●	●	●	●	●
			8	Metal bowl with level gauge	—	—	●	●	●
			C	With bowl guard	—	●	—	—	—
			6C	Nylon bowl with bowl guard	—	●	—	—	—



AW20, AW20K AW40, AW40K

		Symbol	Description	❶ Body size 10	20	30	40	60
❻ Semi-standard	f Drain port Note 10)	Nil	With drain cock	●	●	●	●	●
		J Note 11)	Drain guide 1/8	—	●	—	—	—
			Drain guide 1/4	—	—	●	●	●
		W Note 12)	Drain cock with barb fitting: For ø6 x ø4 nylon tube	—	—	●	●	●
	+							
	g Exhaust mechanism	Nil	Relieving type	●	●	●	●	●
		N	Non-relieving type	●	●	●	●	●
	+							
	h Flow direction	Nil	Flow direction: Left to right	●	●	●	●	●
		R	Flow direction: Right to left	●	●	●	●	●
	+							
	i Pressure unit	Nil	Name plate, caution plate for bowl, and pressure gauge in imperial units: MPa	●	●	●	●	●
		Z Note 13)	Name plate, caution plate for bowl, and pressure gauge in imperial units: psi, °F	○ Note 15)	○ Note 15)	○ Note 15)	○ Note 15)	○ Note 15)
		ZA Note 14)	Digital pressure switch: With unit conversion function	—	△ Note 16)	△ Note 16)	△ Note 16)	△ Note 16)

Note 1) The AW10 type comes with a backflow function as a standard feature. (K is not available.) When using the AW10 type as w/ backflow function, backflow may not occur with the set pressure 0.15 MPa or less. Please set the inlet pressure to at least 0.05 MPa higher than the set pressure.
Note 2) Drain guide is NPT 1/8 (applicable to the AW20(K)) and NPT 1/4 (applicable to the AW30(K) to AW60(K)). The auto drain port comes with ø3/8" one-touch fitting (applicable to the AW30(K) to AW60(K)).
Note 3) Drain guide is G 1/8 (applicable to the AW20(K)) and G 1/4 (applicable to the AW30(K) to AW60(K)).
Note 4) Option B, G, H, M are not assembled and supplied loose at the time of shipment.
Note 5) Assembly of a bracket and set nuts (AW10, AW20(K) to AW40(K))
Including 2 mounting screws for the AW60(K)
Note 6) When choosing with H (panel mount), the installation space for lead wires will not be secured. In this case, select "wiring top entry" for the electrical entry.
Note 7) Only the AW10 has a pressure setting of 0.05 to 0.7 MPa.
Note 8) The only difference from the standard specifications is the adjusting spring for the regulator. It does not restrict the setting of 0.2 MPa or more. When the pressure gauge is attached, a 0.2 MPa pressure gauge will be fitted.
Note 9) Refer to Chemical Data on page 287 when selecting a case material.
Note 10) Float type auto drain: The combination of C and D is not possible.
Note 11) Without a valve function
Note 12) Metal bowl: The combination of 2 and 8 is not possible.
Note 13) For thread type: M5 and NPT. This product is for overseas use only according to the new Measurement Law. (The SI unit type is provided for use in Japan.) The digital pressure switch will be equipped with the unit conversion function, setting to psi initially.
Note 14) For options: E1, E2, E3, E4. This product is for overseas use only according to the new Measurement Law. (The SI unit is provided for use in Japan.)
Note 15) ○: For thread type: M5 and NPT only
Note 16) △: Select with options: E1, E2, E3, E4.

Standard Specifications

Model	AW10	AW20(K)	AW30(K)	AW40(K)	AW40(K)-06	AW60(K)
Port size	M5 x 0.8	1/8, 1/4	1/4, 3/8	1/4, 3/8, 1/2	3/4	3/4, 1
Pressure gauge port size Note 1)	1/16 Note 2)	1/8		1/4		
Fluid	Air					
Ambient and fluid temperature Note 3)	–5 to 60°C (with no freezing)					
Proof pressure	1.5 MPa					
Maximum operating pressure	1.0 MPa					
Set pressure range	0.05 to 0.7 MPa	0.05 to 0.85 MPa				
Relief pressure Note 4)	Set pressure + 0.05 MPa [at relief flow rate of 0.1 ℓ/min (ANR)]					
Nominal filtration rating	5 µm					
Drain capacity (cm³)	2.5	8	25	45	45	45
Bowl material	Polycarbonate					
Bowl guard	—	Semi-standard	Standard			
Construction	Relieving type					
Mass (kg)	0.09	0.32	0.40	0.72	0.75	2.00

Note 1) Pressure gauge connection threads are not available for F.R.L. unit with a square embedded type pressure gauge (AW20(K) to AW60(K)).
Note 2) Use a bushing (part no:131368) when connecting the R1/8 pressure gauge to the Rc 1/16.
Note 3) –5 to 50°C for the products with the digital pressure switch
Note 4) Not applicable to the AW10.

Options/Part No.

Optional specifications			Model					
			AW10(K)	AW20(K)	AW30(K)	AW40(K)	AW40(K)-06	AW60(K)
Bracket assembly Note 1)			AR10P-270AS	AW20P-270AS	AR30P-270AS	AR40P-270AS		AW60P-270AS Note 6)
Set nut			AR10P-260S	AR20P-260S	AR30P-260S	AR40P-260S		— Note 7)
Pressure gauge	Round type Note 2)	Standard	G27-10-R1	G36-10-□01		G46-10-□02		
		0.02 to 0.2 MPa setting	G27-10-R1 Note 3)	G36-2-□01		G46-2-□02		
	Round type Note 2) (with color zone)	Standard	—	G36-10-□01-L		G46-10-□02-L		
		0.02 to 0.2 MPa setting	—	G36-2-□01-L		G46-2-□02-L		
	Square embedded type Note 4)	Standard	—	GC3-10AS [GC3P-010AS (Pressure gauge cover only)]				
		0.02 to 0.2 MPa setting	—	GC3-2AS [GC3P-010AS (Pressure gauge cover only)]				
Digital pressure switch Note 5)		NPN output / Wiring bottom entry	—	ISE35-N-25-MLA [ISE35-N-25-M (Switch body only)]				
		NPN output / Wiring top entry		ISE35-R-25-MLA [ISE35-R-25-M (Switch body only)]				
		PNP output / Wiring bottom entry		ISE35-N-65-MLA [ISE35-N-65-M (Switch body only)]				
		PNP output / Wiring top entry		ISE35-R-65-MLA [ISE35-R-65-M (Switch body only)]				
Note 8) Note 9) Float type auto drain		N.C.	AD17	AD27	AD37	AD47		
		N.O.	—	—	AD38	AD48		

Semi-standard/Bowl Assembly Part No.

Semi-standard specifications						Model					
Bowl material	Note 8) Note 9) Float type auto drain		Note 9) With drain guide	With barb fitting	With bowl guard	AW10(K)	AW20(K)	AW30(K)	AW40(K)	AW40(K)-06	AW60(K)
	N.C.	N.O.									
Polycarbonate	—	—	—	—	●	—	C2SF-C	—	—		
	●	—	—	—	●	—	AD27-C	—	—		
	—	—	●	—	—	—	C2SF-J	C3SF-J	C4SF-J		
	—	—	—	●	—	—	—	C3SF-W	C4SF-W		
	—	—	●	—	●	—	C2SF-CJ	—	—		
Nylon	—	—	—	—	—	C1SF-6	C2SF-6	C3SF-6	C4SF-6		
	—	—	—	—	●	—	C2SF-6C	—	—		
	●	—	—	—	—	AD17-6	AD27-6	AD37-6	AD47-6		
	—	●	—	—	—	—	—	AD38-6	AD48-6		
	●	—	—	—	●	—	AD27-6C	—	—		
	—	—	●	—	—	—	C2SF-6J	C3SF-6J	C4SF-6J		
	—	—	—	●	—	—	—	C3SF-6W	C4SF-6W		
	—	—	●	—	●	—	C2SF-6CJ	—	—		
Metal	—	—	—	—	—	C1SF-2	C2SF-2	C3SF-2	C4SF-2		
	●	—	—	—	—	AD17-2	AD27-2	AD37-2	AD47-2		
	—	●	—	—	—	—	—	AD38-2	AD48-2		
	—	—	●	—	—	—	C2SF-2J	C3SF-2J	C4SF-2J		
Metal bowl with level gauge	—	—	—	—	—	—	—	C3LF-8	C4LF-8		
	●	—	—	—	—	—	—	AD37-8	AD47-8		
	—	●	—	—	—	—	—	AD38-8	AD48-8		
	—	—	●	—	—	—	—	C3LF-8J	C4LF-8J		

Note 1) Assembly of a bracket and set nuts
Note 2) □ in part numbers for a round pressure gauge indicates a type of connection thread. No indication is necessary for R; however, indicate N for NPT. Please contact SMC regarding the connection thread NPT and pressure gauge supply for psi unit specifications.
Note 3) Standard pressure gauge
Note 4) Including one O-ring and 2 mounting screws. [ ]: Pressure gauge cover only
Note 5) Lead wire with connector (2 m), adapter, lock pin, O-ring (1 pc.), mounting screw (2 pcs.) are attached. [ ]: Switch body only. Also, regarding how to order the digital pressure switch, please refer to page 388. A pressure switch adapter assembly (AW60P-310AS) will be additionally required for the AW60(K) only. Use the attached mounting screw (M3 x 0.5 x 14) for mounting. The mounting screw (M3 x 0.5 x 7) attached to the digital pressure switch assembly will not be required.
Note 6) Assembly of a bracket and 2 mounting screws
Note 7) Please consult SMC regarding the set nuts for the AW60(K).
Note 8) Minimum operating pressure: N.O. type–0.1 MPa; N.C. type–0.1 MPa (AD27) and 0.15 MPa (AD37/47). Please contact SMC for psi and °F unit specifications.
Note 9) Please consult SMC for details on drain piping to fit NPT or G port sizes.
Note) • Bowl O-ring is included for the AW20(K) to AW60(K).
• Bowl assembly for the AW30(K) to AW60(K) models comes with a bowl guard (steel band material). (except when the bowl material is metal)

Series AW10 to AW60
Series AW20K to AW60K
Specific Product Precautions

Be sure to read before handling. Refer to front matters 42 and 43 for Safety Instructions and pages 287 to 291 for F.R.L. Precautions.

Selection

⚠ Warning

1. Residual pressure disposal (outlet pressure removal) is not possible for the AW20 to AW60 even though the inlet pressure is exhausted. When the residual pressure disposal is performed, use the filter regulator with backflow function (AW20K to AW60K).

Maintenance

⚠ Warning

1. Replace the element every 2 years or when the pressure drop becomes 0.1 MPa, whichever comes first, to prevent damage to the element.

Mounting and Adjustment

⚠ Warning

1. Set the regulator while verifying the displayed values of the inlet and outlet pressure gauges. Turning the regulator knob excessively can cause damage to the internal parts.

2. The pressure gauge included with regulators for 0.02 to 0.2 MPa setting is for up to 0.2 MPa use only (except the AW10). Exceeding 0.2 MPa of pressure can damage the gauge.

3. Do not use tools on the pressure regulator knob as this may cause damage. It must be operated manually.

⚠ Caution

1. Be sure to unlock the knob before adjusting the pressure and lock it after setting the pressure. Failure to follow this procedure can cause damage to the knob and the outlet pressure may fluctuate.

- Pull the pressure regulator knob to unlock. (You can visually verify this with the “orange mark” that appears in the gap.)
- Push the pressure regulator knob to lock. When the knob is not easily locked, turn it left and right a little and then push it (when the knob is locked, the “orange mark”, i.e., the gap will disappear).



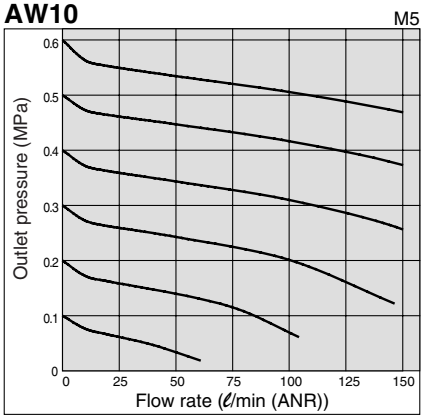
2. A knob cover is available to prevent careless operation of the knob. Refer to page 389 for details.

Flow Characteristics (Representative values)

Condition: Inlet pressure 0.7 MPa

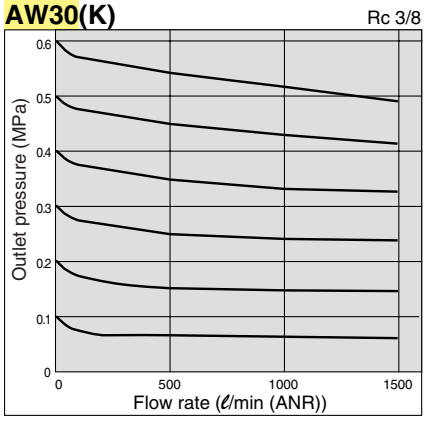
AW10

M5



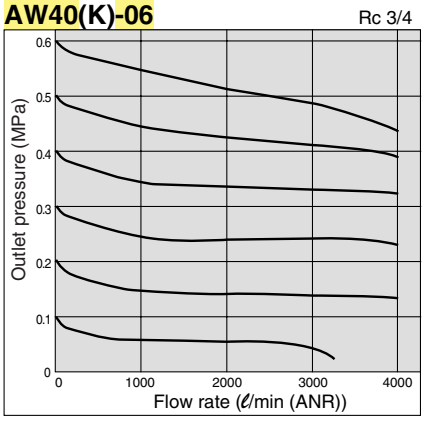
AW30(K)

Rc 3/8



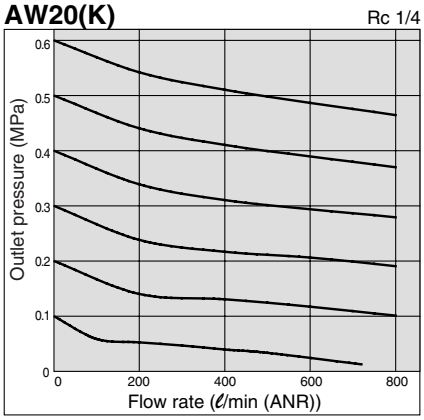
AW40(K)-06

Rc 3/4



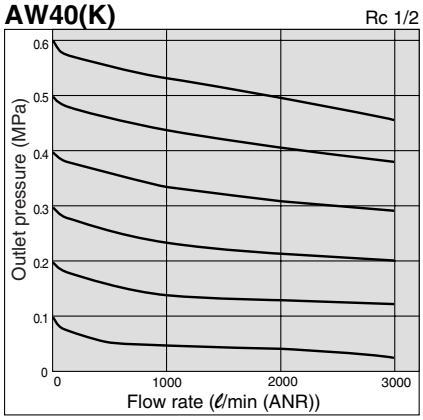
AW20(K)

Rc 1/4



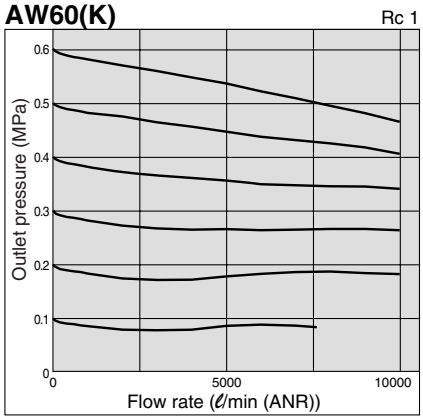
AW40(K)

Rc 1/2



AW60(K)

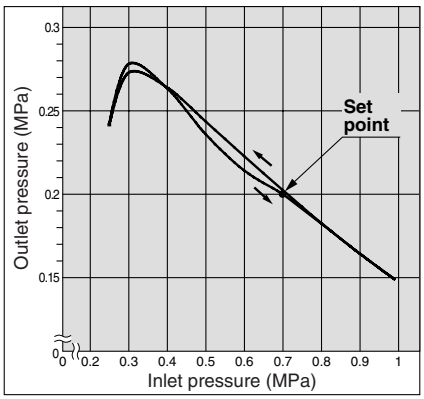
Rc 1



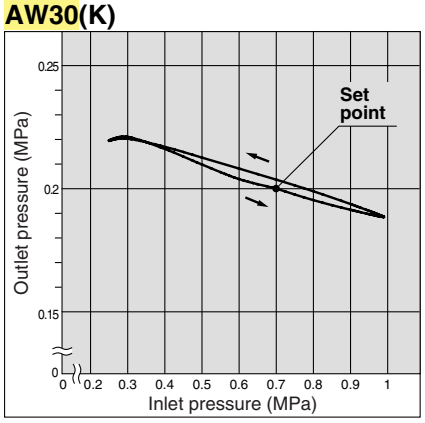
Pressure Characteristics (Representative values)

Conditions: Inlet pressure 0.7 MPa, Outlet pressure 0.2 MPa, Flow rate 20 ℓ/min (ANR)

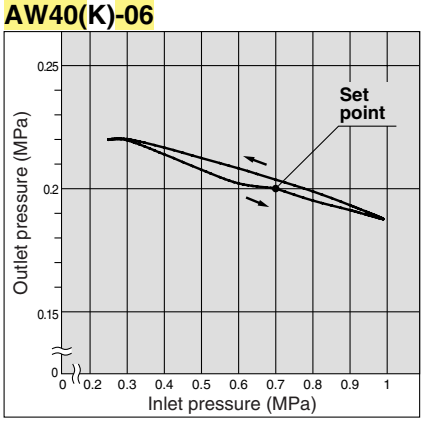
AW10



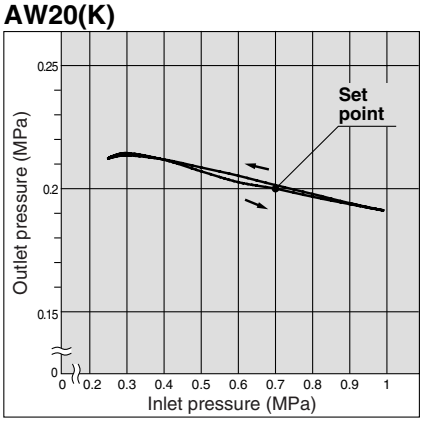
AW30(K)



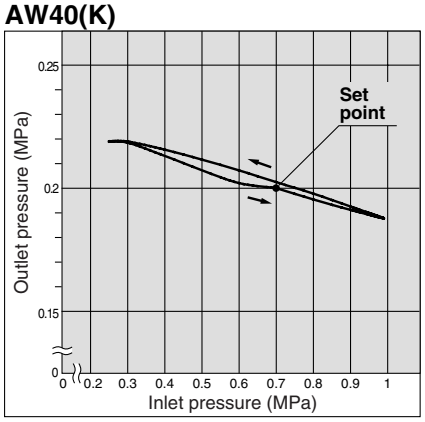
AW40(K)-06



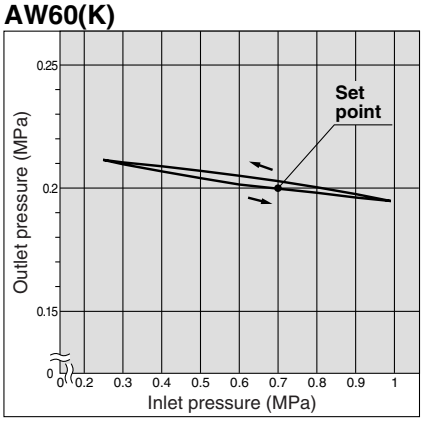
AW20(K)



AW40(K)

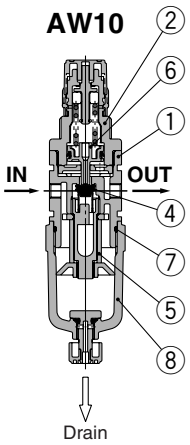


AW60(K)

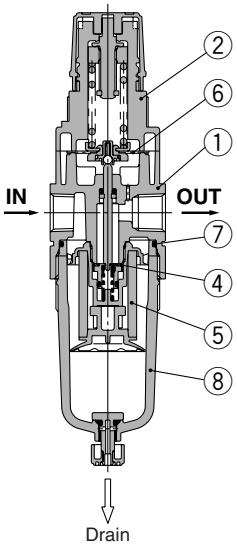


Construction

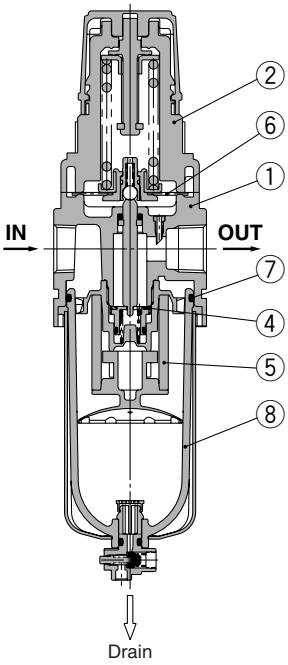
AW10



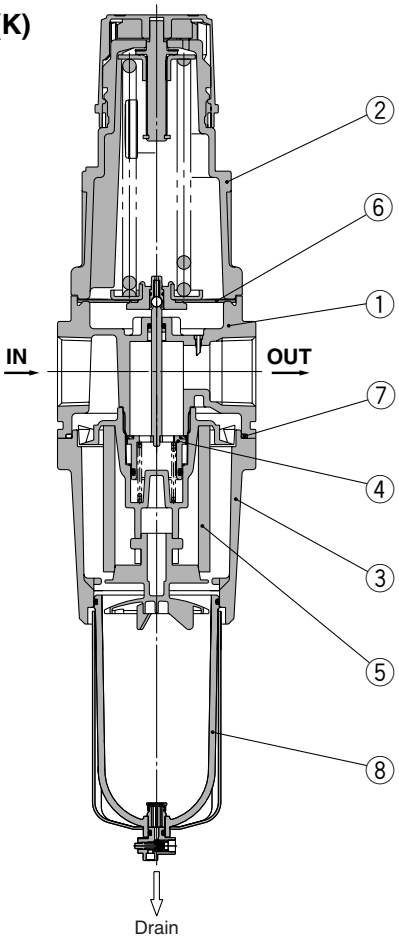
AW20(K)



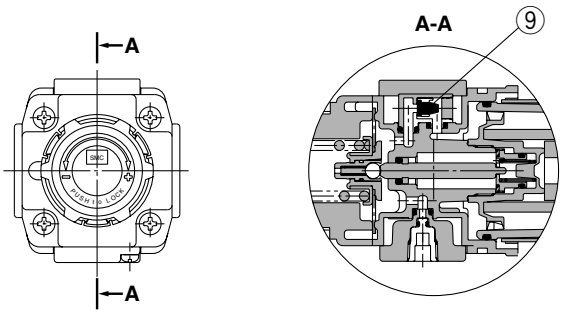
AW30(K), AW40(K)



AW60(K)



AW20K to AW60K
(Filter Regulator with Backflow Function)



Component Parts

No.	Description	Material	Model	Color
1	**Body**	Zinc die-cast	AW10, AW20	Platinum silver
		Aluminum die-cast	AW30 to AW60	
2	**Bonnet**	Polyacetal	AW10 to AW40	Black
		Aluminum die-cast	AW60	
3	**Housing**	Aluminum die-cast	AW60	Platinum silver

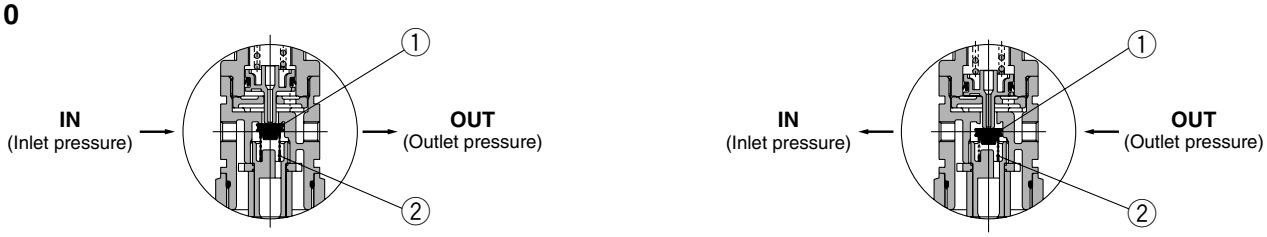
Replacement Parts

No.	Description	Material	Part no.					
			AW10	**AW20(K)**	**AW30(K)**	**AW40(K)**	**AR40(K)-06**	**AW60(K)**
4	**Valve assembly**	Brass, HNBR	AR10P-090S	AW20P-340AS	AW30P-340AS	AW40P-340AS		AW60P-090AS
5	**Filter element**	Non-woven fabric	AF10P-060S	AF20P-060S	AF30P-060S	AF40P-060S		AW60P-060S
6	**Diaphragm assembly**	Weatherable NBR	AR10P-150AS Note 1)	AR20P-150AS	AR30P-150AS	AR40P-150AS		AR50P-150AS
7	**Bowl O-ring**	NBR	C1SFP-260S	C2SFP-260S	C3SFP-260S	C4SFP-260S		
8	**Bowl assembly** Note 2)	Polycarbonate	C1SF	C2SF	C3SF Note 3)	C4SF Note 3)		
9	**Check valve assembly** Note 4)	—	—	AR20KP-020AS				

Note 1) The AW10 is a piston type. Assembly of a piston and a seal (KSYP-13).
Note 2) Bowl O-ring is included for the AW20(K) to AW60(K). Please contact SMC regarding the bowl assembly supply for psi and °F unit specifications.
Note 3) Bowl assembly for the AW30(K) to AW60(K) models comes with a bowl guard (steel band material).
Note 4) Check valve assembly is applicable for a filter regulator with backflow function (AW20K to AW60K) only.
Assembly of a check valve cover, check valve body assembly and 2 screws

Working Principle (Filter Regulator with Backflow Function)

AW10



When the inlet pressure is higher than the regulating pressure, the check valve operates as a normal regulator (Figure 1).
When the inlet pressure is shut off and exhausted, any inlet pressure applied to the valve ① will be lost. The force for seating the valve ① is the valve spring force ② only. When the valve ① is opened using the outlet force, the outlet pressure will be exhausted at the inlet side. (Figure 2)
When the set pressure is 0.15 MPa or less, valve ① may not open due to the valve spring ② force.

AW20K to AW60K

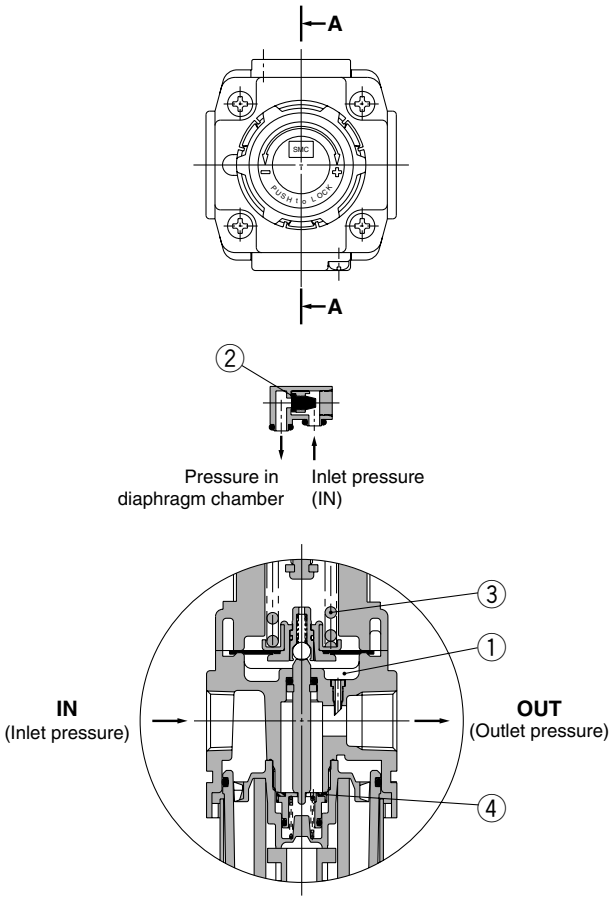


Figure 1 Normal

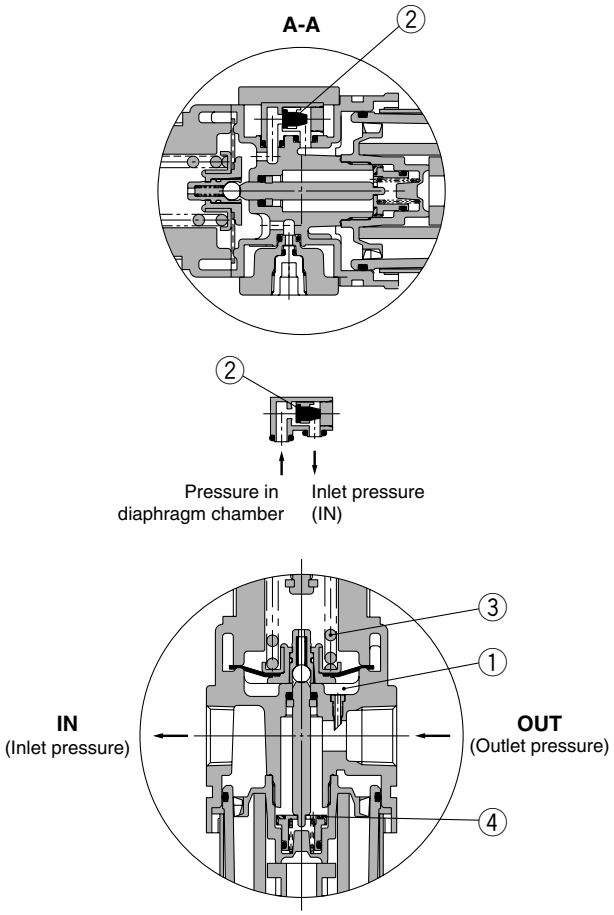
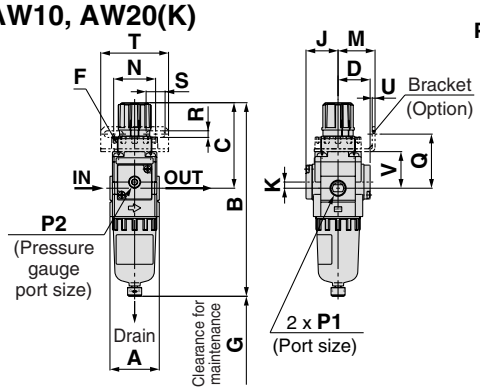


Figure 2 Backflow

When the inlet pressure is higher than the regulating pressure, the check valve ② closes and operates as a normal regulator (Figure 1).
When the inlet pressure is shut off and released, the check valve ② opens and the pressure in the diaphragm chamber ① is released into the inlet side (Figure 2).
This lowers the pressure in the diaphragm chamber ① and the force generated by the pressure regulator spring ③ lifts the diaphragm. Valve ④ opens through the stem, and the outlet pressure is released to the inlet side (Figure 2).

Dimensions

AW10, AW20(K)



Panel fitting dimension

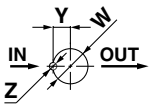
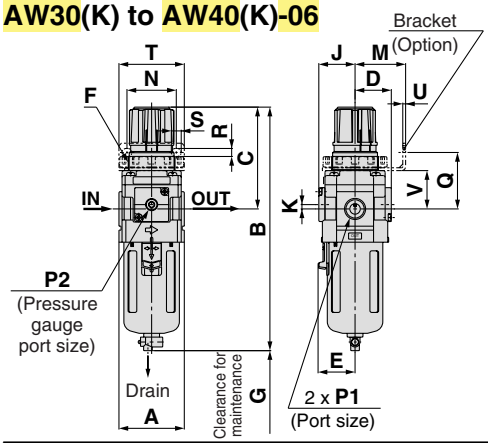


Plate thickness
AW10, AW20(K): Max. 3.5

AW30(K) to AW40(K)-06



Panel fitting dimension

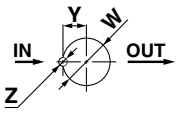
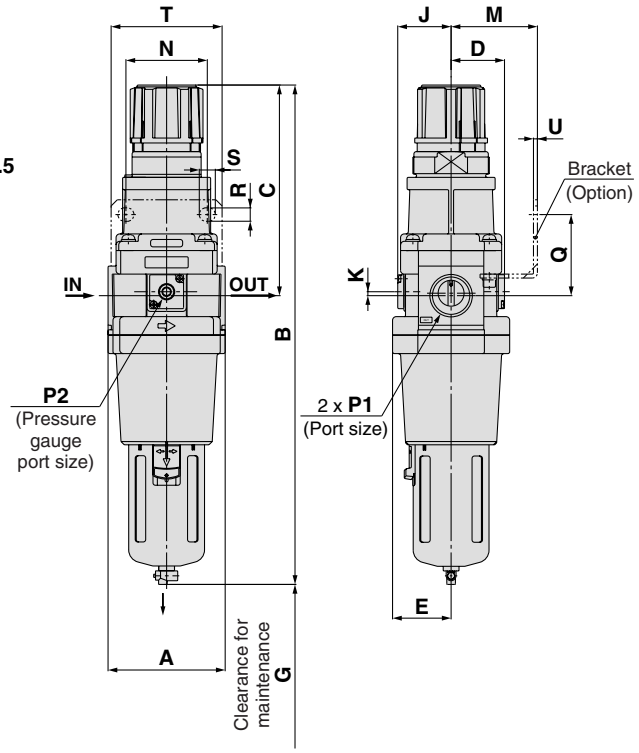
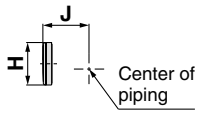
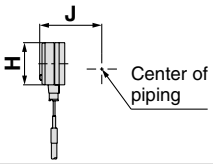
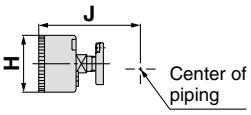
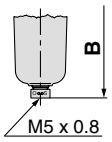
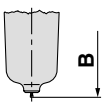
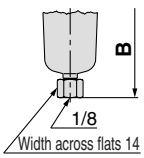
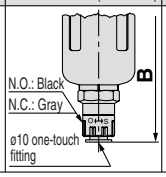
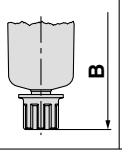
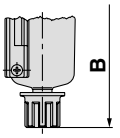
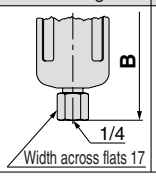
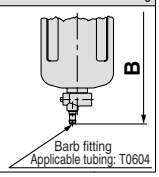


Plate thickness
AW30(K): Max. 3.5
AW40(K): Max. 5

AW60(K)



Applicable model	AW20(K) to AW60(K)		AW10, AW20(K) to AW60(K)	AW20(K) to AW60(K)
Option	Square embedded type pressure gauge	Digital pressure switch	Round type pressure gauge	Round type pressure gauge (with color zone)
Dimensions				

Applicable model	AW10, AW20(K)		AW20(K)	AW30(K) to AW60(K)				
Optional/Semi-standard specifications	With auto drain (N.C.)	Metal bowl	With drain guide	With auto drain (N.O./N.C.)	Metal bowl	Metal bowl with level gauge	With drain guide	Drain cock with barb fitting
Dimensions								

Model	Standard specifications											Optional specifications							
												Square type pressure gauge		Digital pressure switch		Round type pressure gauge		Round type pressure gauge (with color zone)	
	P1	P2	A	B Note)	C	D	E	F	G	J	K	H	J	H	J	H	J	H	J
AW10	M5 x 0.8	1/16	25	108	48	12.5	—	M18 x 1	25	13	0	—	—	—	—	ø26	26	—	—
AW20(K)	1/8, 1/4	1/8	40	160	73	26	—	M28 x 1	40	26	5	□28	27	□27.8	37.5	ø37.5	63	ø37.5	63
AW30(K)	1/4, 3/8	1/8	53	201	86	29.5	30	M38 x 1.5	55	29.5	3.5	□28	30.5	□27.8	41	ø37.5	66	ø37.5	66
AW40(K)	1/4, 3/8, 1/2	1/4	70	239	92	37.5	38	M42 x 1.5	80	37.5	1.5	□28	38.5	□27.8	49	ø42.5	76	ø42.5	76
AW40(K)-06	3/4	1/4	75	242	93	37.5	38	M42 x 1.5	80	37.5	1.2	□28	38.5	□27.8	49	ø42.5	76	ø42.5	76
AW60(K)	3/4, 1	1/4	95	409	175	43.5	47.5	—	20	43.5	3.2	□28	44.5	□27.8	61.5	ø42.5	84	ø42.5	84

Model	Optional specifications											Semi-standard specifications				
	Bracket mount							Panel mount				With auto drain	With barb fitting	With drain guide	Metal bowl	Metal bowl with level gauge
	M	N	Q	R	S	T	U	V	W	Y	Z	B Note)	B Note)	B Note)	B Note)	B Note)
AW10	25	28	30	4.5	6.5	40	2	18	18.5	—	—	125	—	—	107	—
AW20(K)	30	34	44	5.4	15.4	55	2.3	30	28.5	14	6	177	—	164	160	—
AW30(K)	41	40	46	6.5	8	53	2.3	31	38.5	19	7	242	209	208	214	234
AW40(K)	50	54	54	8.5	10.5	70	2.3	35.5	42.5	21	7	278	247	246	252	272
AW40(K)-06	50	54	56	8.5	10.5	70	2.3	37	42.5	21	7	282	251	249	255	275
AW60(K)	70	66	66	11	13	90	3.2	—	—	—	—	448	417	416	422	442

Note) The total length of B dimension is the length when the filter regulator knob is unlocked.

Salt Spray Test Results (for reference)

1. Test Conditions

1) Method: In compliance with ASTM B117-07a (JIS Z 2371), leave parts in a salt spray test chamber, and compare rust generation.

2) Conditions: Temperature: 95˚F (35˚C) Salt Water Concentration: 5%

3) Time: 1000 hours [Frequency: 0hr, 24hrs, 48hrs, 72hrs, 96hrs, 168hrs, 240hrs, 480hrs, 720hrs, 1000hrs]

4) Samples: Parts for AF and AW30 (See Figure 1.)

- Part descriptions: 4 parts (1) Body (2) Drain cock (3) Small screw for level gauge (4) Bonnet screw
- Types: 2 Types A) Standard B) Special X480 (Coated with epoxy resin [External metal parts are made of SUS])
- Refer to Table 1 for part materials and treatments. *Quantity; 2 pieces for each

2. Test Results

Table 1 Salt spray resistance test results

No.	Description	Type		Material & Treatment	Results
1	Body	A	Standard	Material: Die Cast Aluminum Treatment: Platinum Coating	Rusted in 480hrs Part of coating swelled
		B	Special X480	Material: Die Cast Aluminum Treatment: Platinum & Epoxy Coating	Not rusted in 1000hrs Part of coating swelled
2	Drain cock	A	Standard	Material: Die Cast Aluminum Treatment: Zinc Chromate	Rusted in 24hrs
		B	Special X480	Material: SUS	Not rusted in 1000hrs
3	Cross recessed round head screw for metal bowl with level gauge	A	Standard	Material: Steel Treatment: Nickel Plating	Rusted in 24hrs
		B	Special X480	Material: SUS	Not rusted in 1000hrs
4	Self-tapping screw for AR and AW bonnet	A	Standard	Material: Steel Treatment: Zinc Chromate	Rusted in 24hrs
		B	Special X480	Material: SUS	Not rusted in 1000hrs

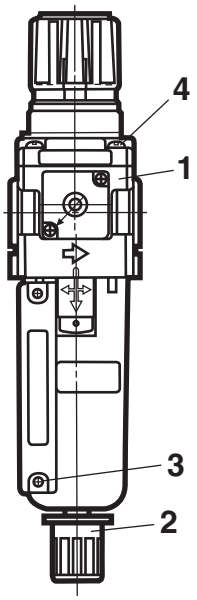
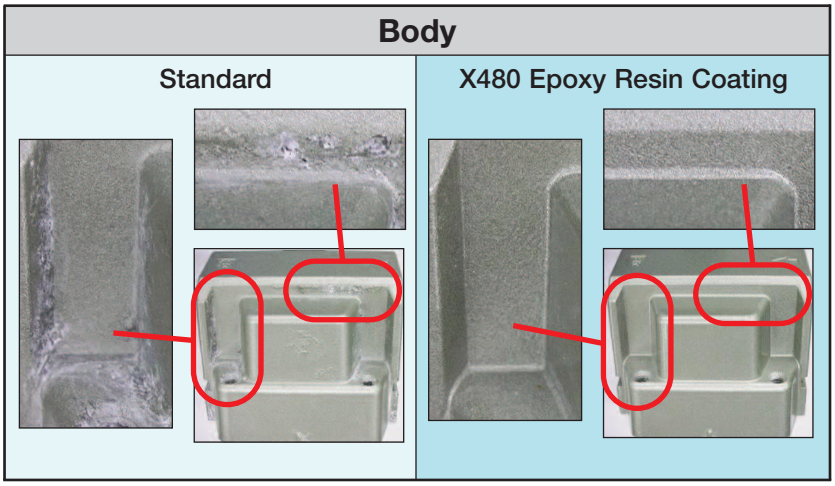
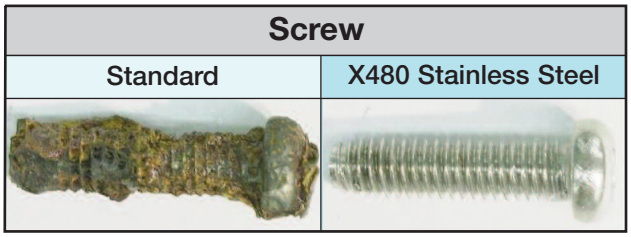
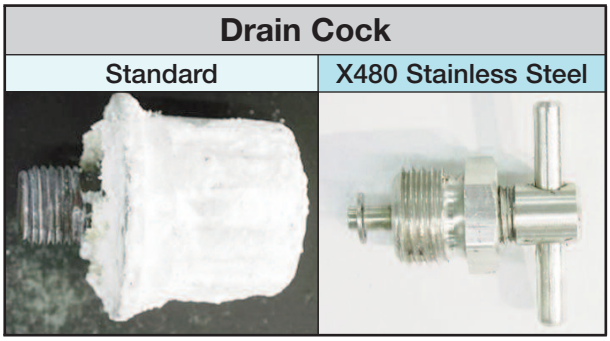


Figure 1







Caution! To ensure the safest possible operation of this product, please be sure to read thoroughly the “Safety Instructions” in our “Best Pneumatics” catalog before use.

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UD45+ (NPT3/4)

Quality Air



8102372408

Product Links

Brochure

Technical Data

Dimensional Drawing

Installation Guide

Technical Specifications

100psi CFM: 95.0
125psi CFM: 107.2
150psi CFM: 118.7
Air Outlet: 3/4"
Weight (lbs): 5.2

Model: UD+, DD+, DDp+, PD+, PDp+, QD+ 45

	Name	UD 45+ (2)	UD 45+ (4)	DD 45+ (2)	DD 45+ (4)	DDp 45+ (2)	DDp 45+ (4)	PD 45+ (2)	PD 45+ (4)	PDp 45+ (2)	PDp 45+ (4)	QD 45+ (2)	QD 45+ (4)
	inPASS (INPASS)	Yes (Y)	No (N)	Yes (Y)	No (N)	Yes (Y)	No (N)	Yes (Y)	No (N)	Yes (Y)	No (N)	Yes (Y)	No (N)
A	REFERENCE CONDITIONS												
8	Compressed air effective inlet pressure (psig)	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5
9	Ambient air temperature (°F)	68	68	68	68	68	68	68	68	68	68	68	68
10	Compressed air inlet temperature (°F)	68	68	68	68	68	68	68	68	68	68	68	68
159	Compressed air inlet dewpoint (°F)	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
160	Test oil aerosol inlet concentration (mg/m³)	10	10	10	10	-	-	10	10	-	-	-	-
B	LIMITATIONS												
1	Minimum ambient temperature (°F)	34	34	34	34	34	34	34	34	34	34	34	34
26	Maximum ambient temperature (°F)	150	150	150	150	150	150	150	150	150	150	150	150
25	Minimum compressed air inlet pressure (psig)	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
23	Maximum compressed air inlet pressure (psig)	232	232	232	232	232	232	232	232	232	232	232	232
27	Minimum compressed air inlet temperature (°F)	34	34	34	34	34	34	34	34	34	34	34	34
24	Maximum compressed air inlet temperature (°F)	149	149	149	149	149	149	149	149	149	149	149	149
140	Maximum time in use for element change (month) (174)	12	12	12	12	12	12	12	12	12	12	12	12
141	Maximum running hours for element change (h) (174)	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	2000	2000
29	Maximum pressure drop for element change (psi) (174)	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	-	-
C	PERFORMANCE DATA												
24	Nominal volume flow at filter inlet (cfm) (64)	95.4	95.4	95.4	95.4	95.4	95.4	95.4	95.4	95.4	95.4	95.4	95.4
25	Initial pressure drop over filter when dry (psi)	-	-	-	-	0.73	0.73	-	-	0.8	0.8	1.1	1.1
26	Initial pressure drop over filter when saturated (psi) (189)	3.41	3.41	1.74	1.74	-	-	1.89	1.89	-	-	-	-
270	Outlet oil aerosol concentration (mg/m³) (64) (189)	<0.001	<0.001	<0.1	<0.1	-	-	<0.01	<0.01	-	-	<0.003	<0.003
272	Fractional filtration efficiency 0,01µm (%) (173)	99.999	99.999	99.999	99.999	99.999	99.999	99.999	99.999	99.999	99.999	-	-
273	Fractional filtration efficiency 1µm (%) (173)	99.999	99.999	99.999	99.999	99.999	99.999	99.999	99.999	99.999	99.999	-	-
274	Fractional filtration at MPPS (%) (173) (190)	99.940	99.940	97.030	97.030	97.550	97.550	99.670	99.670	99.970	99.970	-	-
182	Quaitity class of air at outlet of filter (68)	1:-:2	1:-:2	2:-:3	2:-:3	1:-:-	1:-:-	1:-:2	1:-:2	1:-:-	1:-:-	-:-:1	-:-:1
D	DESIGN DATA												
21	Mass (lbs)	5.91	5.23	5.91	5.23	6.02	5.32	5.91	5.23	6.02	5.32	6.09	5.47
23	Shipping length (in.)	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3
24	Shipping width (in.)	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
25	Shipping height (in.)	5	5	5	5	5	5	5	5	5	5	5	5
31	Shipping mass (lbs)	5.91	5.23	5.91	5.23	6.02	5.32	5.91	5.23	6.02	5.32	6.09	5.47
32	Dimensions of inlet and outlet connections	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"
34	Number of filter elements	1	1	1	1	1	1	1	1	1	1	1	1
O	REMARKS	(64)(68)(173)(174)(189)(190)	(64)(68)(173)(174)(189)(190)	(64)(68)(173)(174)(189)(190)	(64)(68)(173)(174)(189)(190)	(64)(68)(173)(174)(190)	(64)(68)(173)(174)(190)	(64)(68)(173)(174)(189)(190)	(64)(68)(173)(174)(189)(190)	(64)(68)(173)(174)(190)	(64)(68)(173)(174)(190)	(64)(68)(174)	(64)(68)(174)

64 C24;C Referred to an absolute pressure of 1 bar and temperature of 20 °C

68 C182 According to ISO 8573-1 in a typical installation

173 C272 According to ISO 12500-3.

174 B140; Whatever comes first.

189 C26;C According to ISO 12500-1 at oil concentration upstream of the filter of 10 mg/m3.

190 C274 MPPS = 0,1 µm.

T DATA ON DATAPLATE

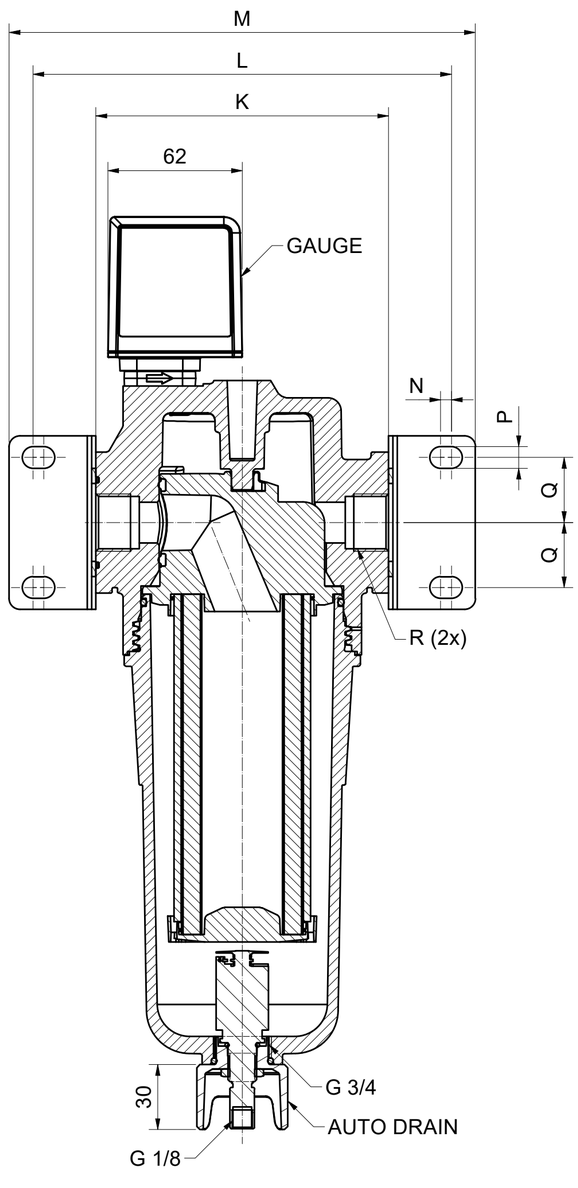
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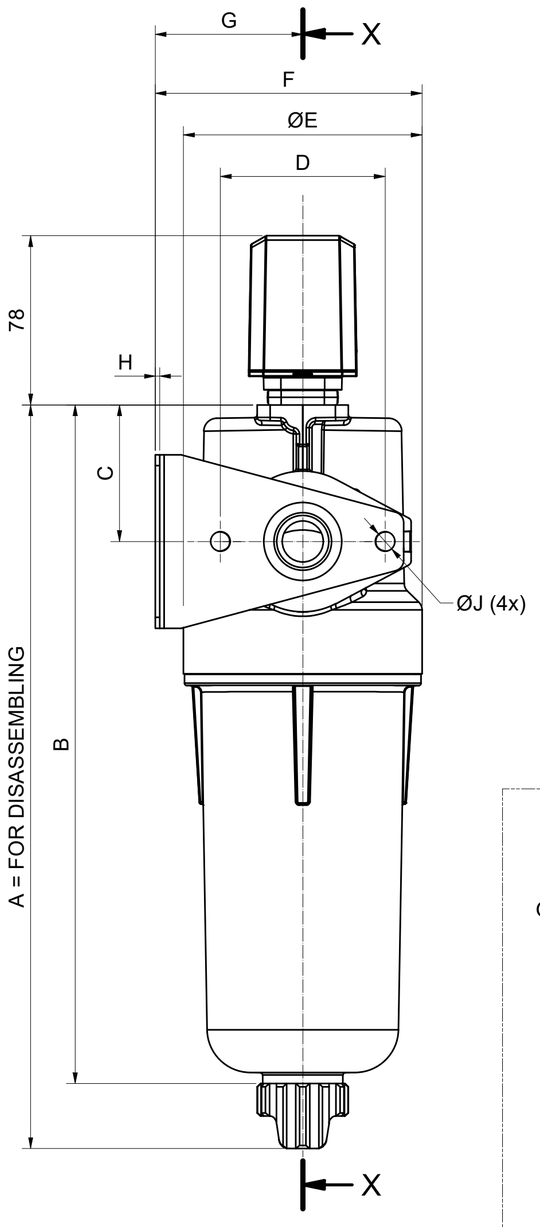
V TECHNICAL PERFORMANCE DATA

All materials supplied are in compliance with the requirements of the List of Prohibited Substances

For DD+, PD+, UD+ and QD+

For: DDp+ and PDp+

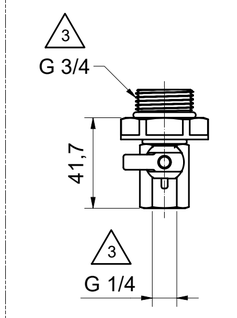




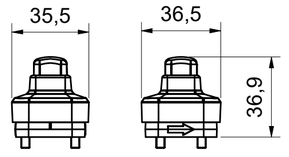
STANDARD SCOPE OF SUPPLY														
DESIGNATION	7	15	25	45	75	110	145	180	240	300	360	430	525	630
DD+	1+3	1+3	1+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3
PD+	1+3	1+3	1+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3
UD+	1+3	1+3	1+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3
DDp+	1+4	1+4	1+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4
PDp+	1+4	1+4	1+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4
QD+	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5

1. POP UP INDICATOR
2. GAUGE
3. AUTO DRAIN
4. MANUAL DRAIN
5. CONNECTIONS OF INDICATOR OR GAUGE ARE PLUGGED WITH HEXAGONAL SOCKET SCREW M4x4 OR M6x8

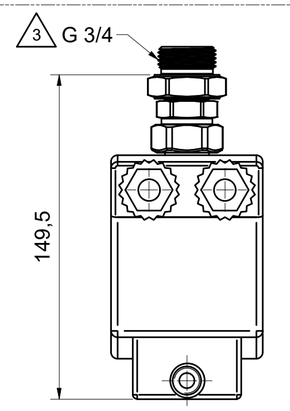
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7	1.2 kg	353	233	52	60	90	97	52	2	7	106	152	174	8	7	20	G 1/2	NPT 1/2
15	1.25 kg	353	233	52	60	90	97	52	2	7	106	152	174	8	7	20	G 1/2	NPT 1/2
25	1.43 kg	406	285.5	52	60	90	97	52	2	7	106	152	174	8	7	20	G 1/2	NPT 1/2
45	2.43 kg	453	313	63	76	110	123	68	2	9	135	193	215	5	10	30	G 3/4	NPT 3/4
75	2.87 kg	538	398	63	76	110	123	68	2	9	135	193	215	5	10	30	G 1	NPT 1
110	5.08 kg	590	429.5	84.5	103	143	163.5	92	2.5	8.5	175	253	275	5	10	42	G 1 1/2	NPT 1 1/2
145	5.6 kg	660	499.5	84.5	103	143	163.5	92	2.5	8.5	175	253	275	5	10	42	G 1 1/2	NPT 1 1/2
180	6.12 kg	730	569.5	84.5	103	143	163.5	92	2.5	8.5	175	253	275	5	10	42	G 1 1/2	NPT 1 1/2
240	9.34 kg	805	600	98	135	171	193.5	108	4	11.5	222	300	332	10	9	37.5	G 2	NPT 2
300	10.38 kg	898	693	98	135	171	193.5	108	4	11.5	222	300	332	10	9	37.5	G 2	NPT 2
	10.2 kg																G 2 1/2	NPT 2 1/2
360	10.2 kg	898	693	98	135	171	193.5	108	4	11.5	222	300	332	10	9	37.5	G 2 1/2	NPT 2 1/2
430	13.98 kg	1028	797.5	110	155	191	215.5	120	4	11.5	250	328	360	10	9	50	G 3	NPT 3
525	15.32 kg	1144	913.5	110	155	191	215.5	120	4	11.5	250	328	360	10	9	50	G 3	NPT 3
630	19.24 kg	1382	1151.5	110	155	191	215.5	120	4	11.5	250	328	360	10	9	50	G 3	NPT 3



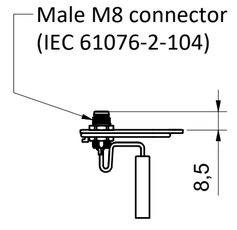
MANUAL DRAIN



POP-UP INDICATOR



EWD OPTION KIT



POTENTIAL FREE CONTACT NO / NC

3

Modification Notes:
- Thread values in Manual Drain and EWD Option Kit added.
- Recommended Torque values updated.

All Dimensions are in Metric System

3

Designation	Recommended Torque
Indicator / Pressure Gauge	1 Nm
Automatic Drain	Handtight
Manual Drain	4 Nm

Ed	Position	Modified from	Date	Intr./Appd.
3		See modification notes		

Parent 3D model	Ed . Version 3D
9827928800-M1	

Tolerances, if not indicated, according to: ATLAS COPCO STANDARD CLASS

Name DIMENS. DRWG — DIMENS. DRWG (NO BYPASS)
Material See Drawing
Treatment See Drawing
Confidentiality Class acc. to 1102 K: Confidential
INV

Scale 1 : 2 | Family | A2 | Compare | Drawing owner: API
Drawn by AIR27282 | Blank nr. | Replaces
Version Drwg | Blank wt Kg | Fini wt. NA | Designation | Sheet 1 / 2
STATUS: Pending
Des checked. | Prod checked. | Approved. | Date 1/03/2022

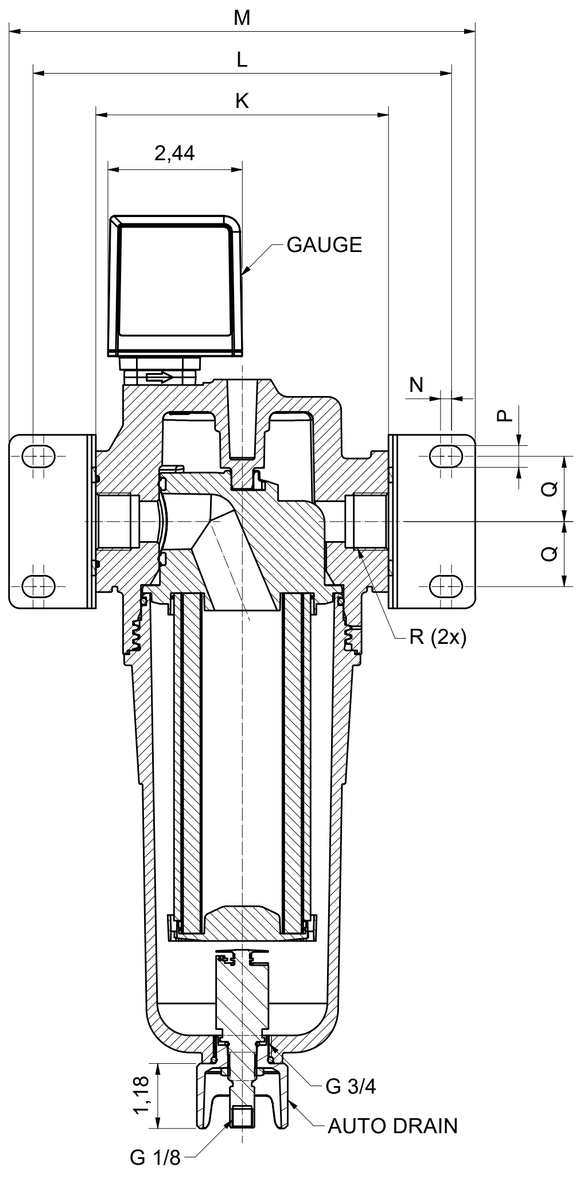
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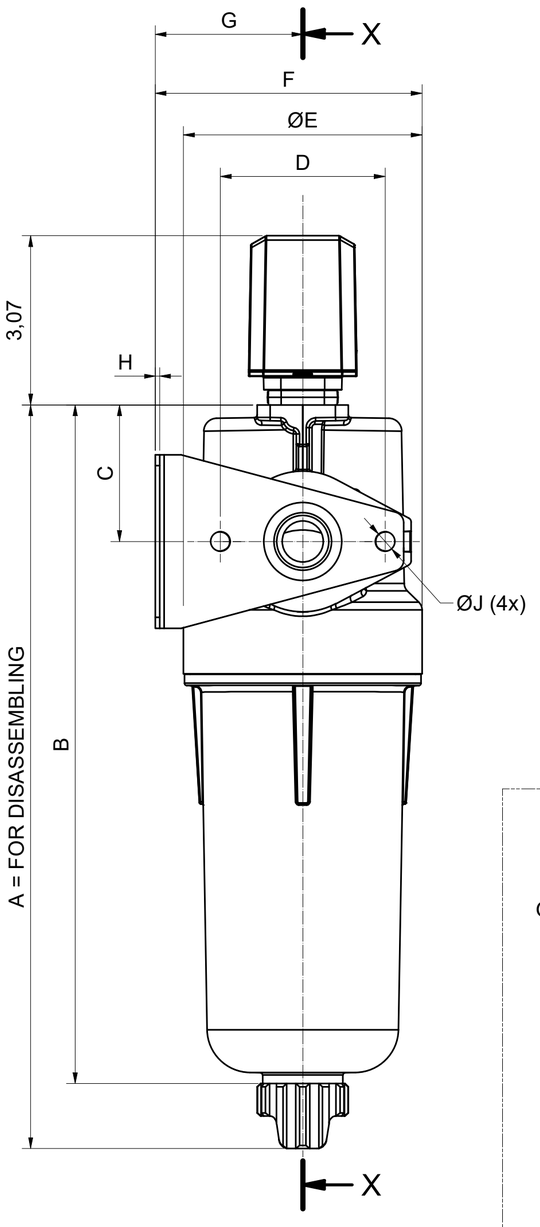
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For DD+, PD+, UD+ and QD+

For: DDp+ and PDp+

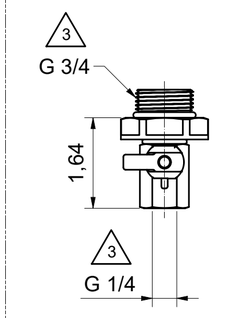




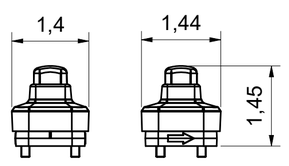
STANDARD SCOPE OF SUPPLY														
DESIGNATION	7	15	25	45	75	110	145	180	240	300	360	430	525	630
DD+	1+3	1+3	1+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3
PD+	1+3	1+3	1+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3
UD+	1+3	1+3	1+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3	2+3
DDp+	1+4	1+4	1+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4
PDp+	1+4	1+4	1+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4	2+4
QD+	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5	4+5

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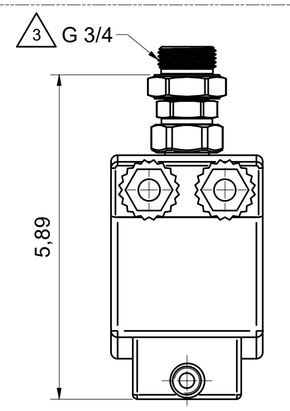
TYPE	NET MASS	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	
7	2.65 lbs	13.90	9.17	2.05	2.36	3.54	3.82	2.05	0.08	0.28	4.17	5.98	6.85	0.31	0.28	0.79	G 1/2	NPT 1/2
15	2.76 lbs	13.90	9.17	2.05	2.36	3.54	3.82	2.05	0.08	0.28	4.17	5.98	6.85	0.31	0.28	0.79	G 1/2	NPT 1/2
25	3.15 lbs	15.98	11.24	2.05	2.36	3.54	3.82	2.05	0.08	0.28	4.17	5.98	6.85	0.31	0.28	0.79	G 1/2	NPT 1/2
45	5.36 lbs	17.83	12.32	2.48	2.99	4.33	4.84	2.68	0.08	0.35	5.31	7.60	8.46	0.20	0.39	1.18	G 3/4	NPT 3/4
75	6.33 lbs	21.18	15.67	2.48	2.99	4.33	4.84	2.68	0.08	0.35	5.31	7.60	8.46	0.20	0.39	1.18	G 1	NPT 1
110	11.20 lbs	23.23	16.91	3.33	4.06	5.63	6.44	3.62	0.10	0.33	6.89	9.96	10.83	0.20	0.39	1.65	G 1 1/2	NPT 1 1/2
145	12.35 lbs	25.98	19.67	3.33	4.06	5.63	6.44	3.62	0.10	0.33	6.89	9.96	10.83	0.20	0.39	1.65	G 1 1/2	NPT 1 1/2
180	13.49 lbs	28.74	22.42	3.33	4.06	5.63	6.44	3.62	0.10	0.33	6.89	9.96	10.83	0.20	0.39	1.65	G 1 1/2	NPT 1 1/2
240	20.59 lbs	31.69	23.62	3.86	5.31	6.73	7.62	4.25	0.16	0.45	8.74	11.81	13.07	0.39	0.35	1.48	G 2	NPT 2
300	22.89 lbs	35.35	27.28	3.86	5.31	6.73	7.62	4.25	0.16	0.45	8.74	11.81	13.07	0.39	0.35	1.48	G 2	NPT 2
	22.49 lbs																G 2 1/2	NPT 2 1/2
360	22.49 lbs	35.35	27.28	3.86	5.31	6.73	7.62	4.25	0.16	0.45	8.74	11.81	13.07	0.39	0.35	1.48	G 2 1/2	NPT 2 1/2
430	30.83 lbs	40.47	31.40	4.33	6.10	7.52	8.48	4.72	0.16	0.45	9.84	12.91	14.17	0.39	0.35	1.97	G 3	NPT 3
525	33.78 lbs	45.04	35.96	4.33	6.10	7.52	8.48	4.72	0.16	0.45	9.84	12.91	14.17	0.39	0.35	1.97	G 3	NPT 3
630	42.42 lbs	54.41	45.33	4.33	6.10	7.52	8.48	4.72	0.16	0.45	9.84	12.91	14.17	0.39	0.35	1.97	G 3	NPT 3



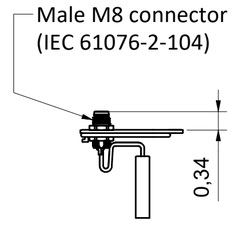
MANUAL DRAIN



POP-UP INDICATOR



EWD OPTION KIT



POTENTIAL FREE CONTACT NO / NC

3

Modification Notes:

- Thread values in Manual Drain and EWD Option Kit added.
- Recommended Torque values updated.

All Dimensions are in Imperial System

3

Designation	Recommended Torque
Indicator / Pressure Gauge	8.9 lb-in
Automatic Drain	Handtight
Manual Drain	35.4 lb-in

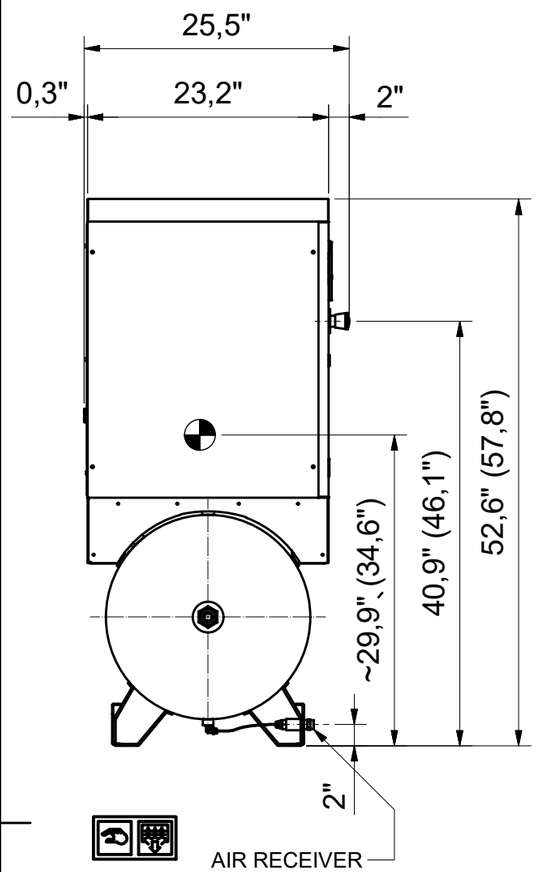
3		See modification notes		
Ed	Posi-tion	Modified from	Date	Intr./Appd.

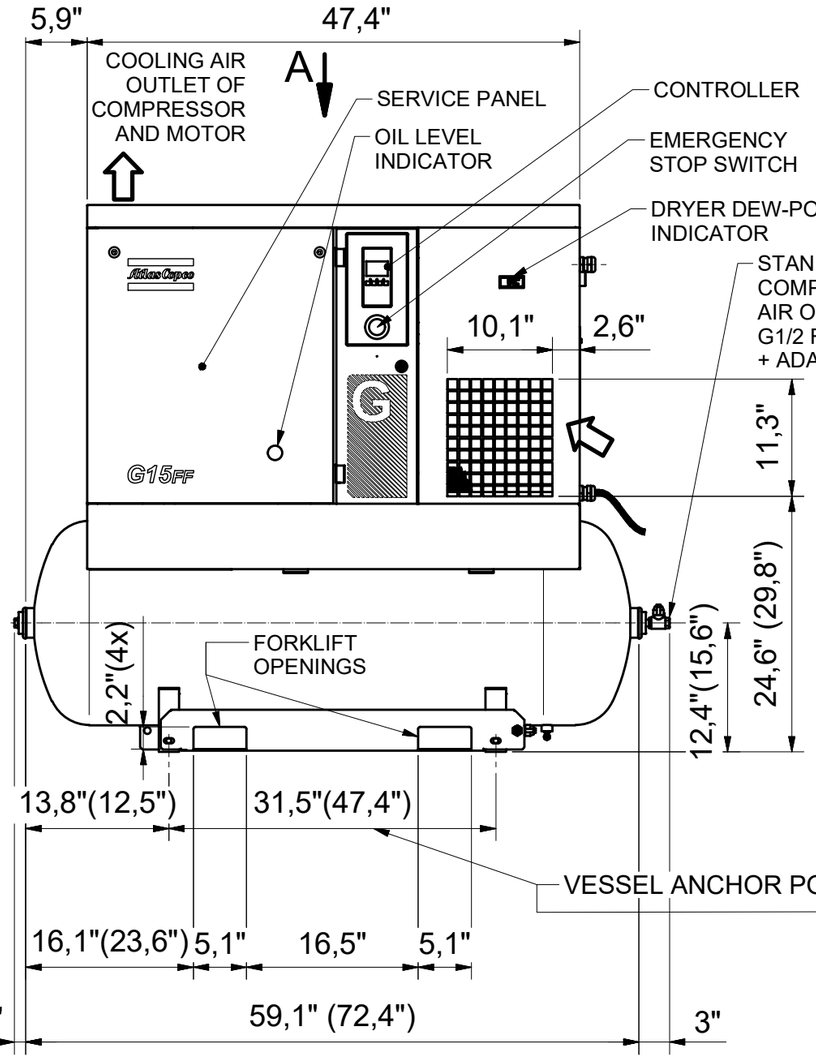
9827928800-M1	
Parent 3D model	Ed . Version 3D

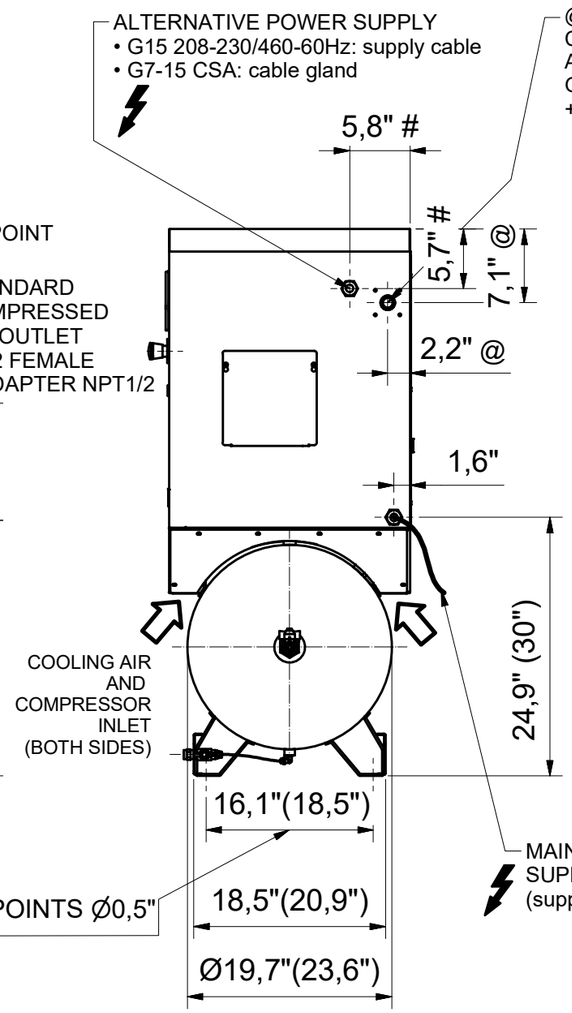
Tolerances, if not indicated, according to:						
ATLAS COPCO STANDARD CLASS						
Name	DIMENS. DRWG		DIMENS. DRWG (NO BYPASS)		Confidentiality Class acc. to 1102 K	Confidential
Material	See Drawing					
Treatment	See Drawing					INV
Atlas Copco	Scale 1 : 2	Family		A2	Compare	Drawing owner
	Drawn by AIR27282	Blank nr.			Replaces	API
STATUS	Version Drwg	Blank wt	Kg	Fini wt.	NA	Designation
Pending	Des checked.	Prod checked.	Approved.	Date 1/03/2022		Sheet 2 / 2
						9827928800-01

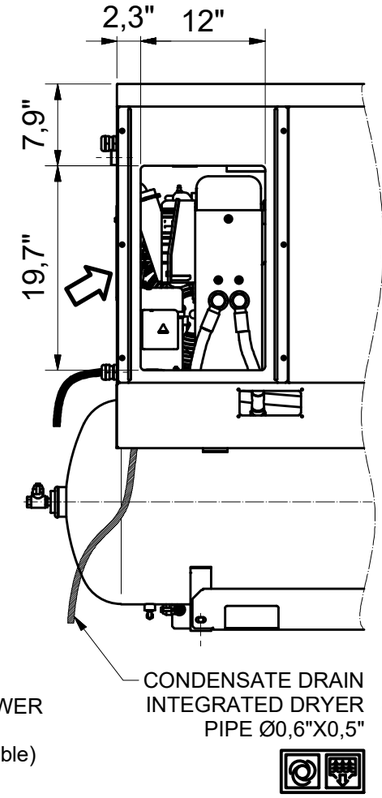
CONFIDENTIAL:
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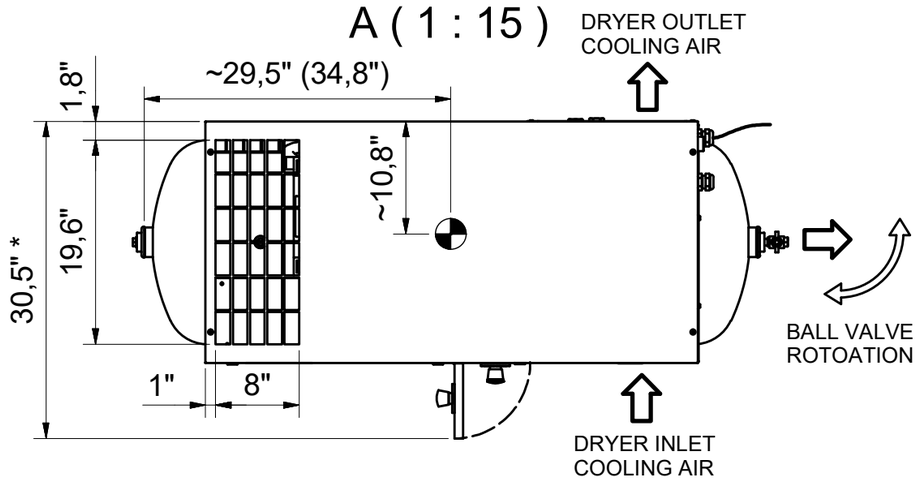
All materials supplied are in compliance with the requirements of the List of Prohibited Substances











NOTES:

- CENTER OF GRAVITY
- * - CUBICLE DOOR FULLY OPEN
- # - UL/CSA VARIANTS
- @ - OPTION DDx/PDx FILTER

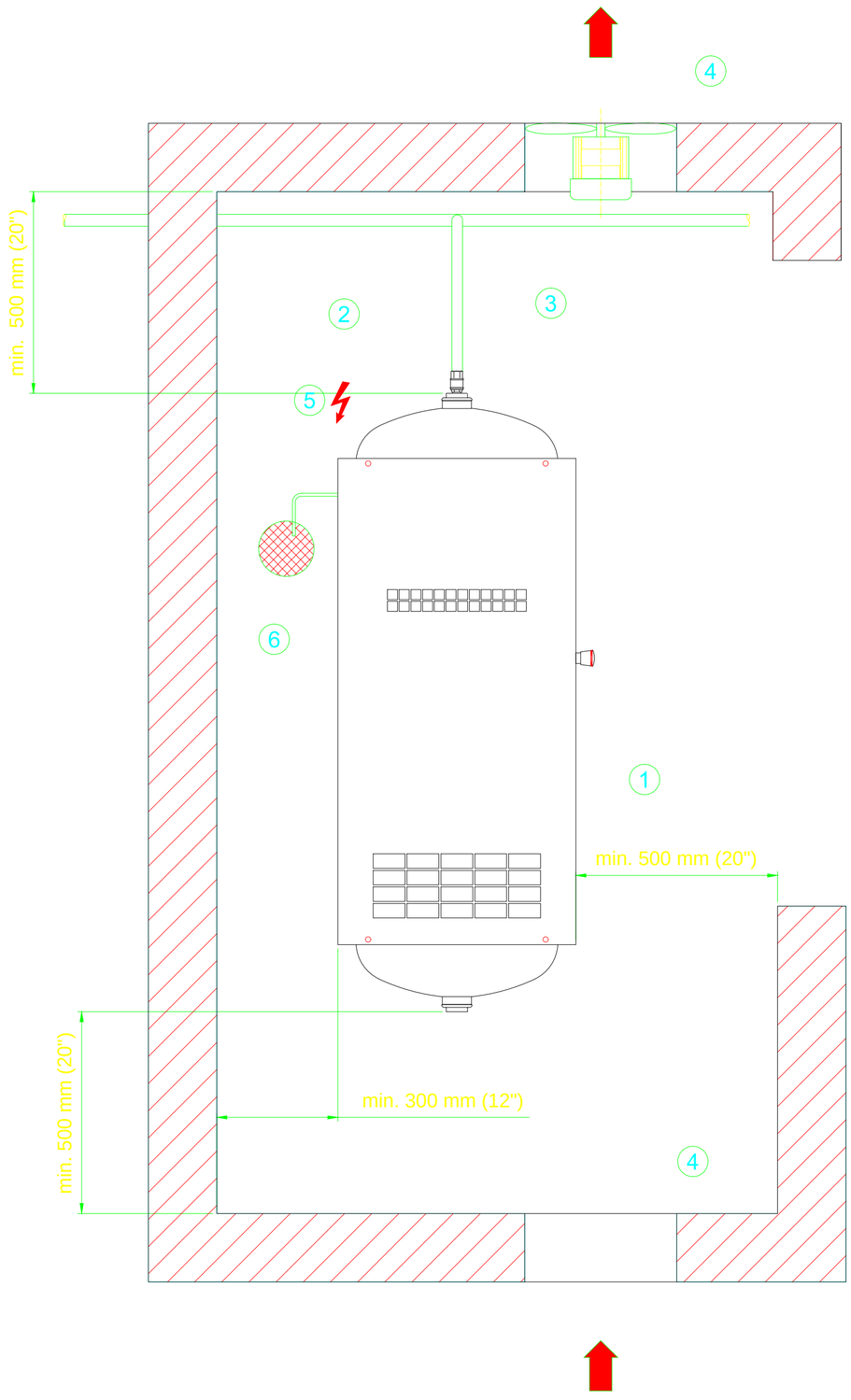
500L/125GAL VESSEL DIMENSIONS WITHIN BRACKETS

Ed	Position	Modified from	Date	Intr./Appd.	Parent 3D model	Edition 3D
01		Update roof grid dimension, from 6,4" to 8". CID 27156/14-02-19 - DN 190620.00	14/02/2019	sgraser	9828083239	00.01

Tolerances, if not indicated, according to: ATLAS COPCO STANDARD CLASS

Name	DIMENSION DRAWING G7-15 FF TANKMOUNTED	Confidentiality Class acc. to 1102 K	
Material	Not Applicable IMPERIAL	Confidential	
Treatment	Not applicable	INV	
Scale 1:15	Family G7-15	Compare	Drawing Owner: CAI; Transferred from
Drawn by CAIsgraser	Blank nr.	Replaces	
Drawing format A3	Blank wt Kg	Fini wt. 348,849 kg	Designation 9828083239 Sheet 1 / 1
STATUS: Approved	Des checked.	Prod checked.	Approved. Date 16/12/2015

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Ref	Action
1	Install the compressor on a solid, level floor suitable for taking its weight. The recommended minimum distance between the top of the unit and the ceiling is 900 mm (35 in). The air receiver must not be bolted to the floor. The minimum distance between the wall and the back of the compressor is 500 mm (20 in).
2	Position of the compressed air outlet valve. Close the valve. Connect the air net to the valve.
3	The pressure drop over the delivery pipe can be calculated from the following formula: $dp = (L \times 450 \times Qc^{185}) / (d^5 \times P)$ dp = pressure drop (recommended maximum = 0.1 bar / 1.5 psi) L = length of delivery pipe in m d = inner diameter of the delivery pipe in mm P = absolute pressure at the compressor outlet in bar(a) Qc = free air delivery of the compressor in l/s
4	Ventilation: The inlet grids and ventilation fan should be installed in such a way that any recirculation of cooling air to the compressor or dryer is avoided. The air velocity to the grids must be limited to 5 m/s (200 in/s). The required ventilation capacity to limit the temperature of the compressor room can be calculated from the following formula: $Qv = 0.92 \ N / dT$ Qv = required ventilation capacity in m^3/s N = nominal motor power of compressor in kW dT = temperature increase in compressor room
5	Position of the mains cable entry.
6	The drain pipes to the drain collector must not dip into the water of the drain collector.

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Nota Note	Positie	Gewijzigd van Modified from	Datum Date	Ingev./Goedg. Intr./Appd.
00		ISSUED - CID 23064/29-10-07. DN 070512 50	2007-10-31	CAD

Parent 3D Model	Ed. Version 3D

Toleranties,indien niet aangegeven,zijn volgens:
Tolerances,if not indicated,according to:
ATLAS COPCO STANDARD/Klasse/Class

Benaming Name	DIMENS. INSTALL.	DIMENS. INSTALL. PROPOS.GX7-11	Geheimh.klasse Secrecy Class	
Materiaal Material	SEE DRAWING		1102 K/	Confidential
Behandeling Treatment	See Drawing		CAD	

Atlas Copco	Schaal Scale 1:10	Familie Family GX7-11	A2	Vergelijk Compare	Eigenaar Drawing owner
	Getekend Drawn by sgraser	Ruw nr. Blank nr.		Vervangt Replaces	CAI
STATUS	Version Drwg 00	Ruw gew. Blank wt. 0 Kg	Afg gew. Fini wt. 0 Kg	Identificatie/Designation	Blad/Sheet ( ) 01 01
Approved	Des gez./chd.	Prod gez/chd.	Goedg./Appd.	Datum/Date 2007-10-31	9828492700

G 7L 100-175

ATLAS COPCO COMPRESSORS

Model: G7L (100-175 psi) Inlet conditions	Q	125 psi	150 psi	175 psi	Unit
1. Barometric pressure	14.5	14.5	14.5	14.5	psi(a)
2. Ambient air temperature	68	68	68	68	°F
3. Relative humidity	0	0	0	0	%
Performance[(1)]					
1. Discharge pressure[1]	100	125	150	175	psi(g)
2. Capacity delivered	45.1	39.2	34.3	28.4	CFM
3. Package power input, loaded Pack	10.6	10.8	10.5	10.4	kW
4. Package power input, unloaded Pack	5.0	4.7	4.3	3.9	kW
5. Package power input, loaded FF	11.2	11.3	11.0	10.6	kW
6. Package power input, unloaded FF	5.2	4.9	4.5	4.1	kW
7. Sound level[(2)]	65	65	65	65	dB(A)
8. Minimum ambient temperature	32	32	32	32	°F
9. Maximum ambient temperature	115	115	115	115	°F
10. Maximum altitude	3281	3281	3281	3281	ft
Cooling data					
1. Cooling air flow Pack	742	742	742	742	CFM
3. Discharge air temp Pack(ambient+°F)	16	16	16	16	°F
2. Cooling air flow Integrated Dryer	230	230	230	230	CFM
4. Discharge air temp FF(ambient+°F)	9	9	9	9	°F
Electrical data					
1. Motor	10	10	10	10	HP
2. Motor type	IE3 Prem. Eff.	IE3 Prem. Eff.	IE3 Prem. Eff.	IE3 Prem. Eff.	
3. Enclosure	TEFC	TEFC	TEFC	TEFC	
4. Efficiency	90.3	90.3	90.3	90.3	%
5. Starter type	DOL	DOL	DOL	DOL	
Physical data					
1. Dimensions(L x W x H)/Weight(lbs)					
- Floor-mounted Pack	34x29x43 / 408	34x29x43 / 408	34x29x43 / 408	34x29x43 / 408	In/lbs
- 71G Tank-mounted Pack	63x26x53 / 540	63x26x53 / 540	63x26x53 / 540	63x26x53 / 540	In/lbs
- 120G Tank-mounted Pack	77x26x58 / 798	77x26x58 / 798	77x26x58 / 798	77x26x58 / 798	In/lbs
- Floor-mounted Full Feature	48x29x43 / 551	48x29x43 / 551	48x29x43 / 551	48x29x43 / 551	In/lbs
- 71G Tank-mounted Full Feature	63x26x53 / 739	63x26x53 / 739	63x26x53 / 739	63x26x53 / 739	In/lbs
- 120G Tank-mounted Full Feature	77x26x58 / 891	77x26x58 / 891	77x26x58 / 891	77x26x58 / 891	In/lbs
2. Air discharge size	0.5	0.5	0.5	0.5	NPT
3. Condensate drain size	0.375	0.375	0.375	0.375	NPT
4. Oil sump capacity	0.8	0.8	0.8	0.8	gal

1. Performance (free air delivery) measured according to ISO1217.

2. Operating Sound Level: Operating sound levels for machines equipped with recommended standard motors and enclosures are guaranteed ±3 dB(A) when measured in free field conditions at a distance of 1 meter according to CAGI PNEUROP Test Code.

ELECTRICAL CONTROL PANEL SCHEMATICS

- **KROFTA PLC CONTROL PANEL**
- **KROFTA MOTOR CONTROL PANEL**

KROFTA Technologies, LLC
PO Box 7, 401 South Street, Dalton, MA 01227
Ph: 413-236-5634 Fax: 413-236-6917

KROFTA

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

AUMSVILLE WWTP

AUMSVILLE, OR

KROFTA PROJECT NUMBER: 25-K01
ELECTRICAL PROJECT NUMBER: 56003EN-25

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

FILENAME	SUB	SH	DESCRIPTION-1	DESCRIPTION-2	CR
56003EN25_0A01	A	1	COVER SHEET		A.1
56003EN25_0A02	A	2	INDEX PAGE		A.1
56003EN25_0A03	A	3	DEFINITIONS PAGE		A.1
56003EN25_0A04	A	4	ECP-DAF-3001	BILL OF MATERIALS	A.1
56003EN25_0A05	A	5	MCP-DAF-3002	BILL OF MATERIALS	A.1
56003EN25_0B01	B	1	ECP-DAF-3001	EXTERNAL LAYOUT	A.1
56003EN25_0B02	B	2	ECP-DAF-3001	INTERNAL LAYOUT	A.1
56003EN25_0B03	B	3	MCP-DAF-3002	EXTERNAL LAYOUT	A.1
56003EN25_0B04	B	4	MCP-DAF-3002	INTERNAL LAYOUT	A.1
56003EN25_0B05	B	5	ECP-DAF-3001	PLC AND I/O TERMINALS DETAILS	A.1
56003EN25_0B06	B	6	ECP-DAF-3001	POWER DISTRIBUTION & NETWORK SWITCH DETAILS	A.1
56003EN25_0B07	B	7	MCP-DAF-3002	480VAC POWER DISTRIBUTION DETAILS	A.1
56003EN25_0B08	B	8	MCP-DAF-3002	SPARE SHEET	A.1
56003EN25_0B09	B	9	NETWORK LAYOUT		A.1
56003EN25_0C01	C	1	MCP-DAF-3002	3 PHASE WIRING	A.1
56003EN25_0C02	C	2	MCP-DAF-3002	3 PHASE WIRING	A.1
56003EN25_0C03	C	3	MCP-DAF-3002	3 PHASE WIRING	A.1
56003EN25_0D01	D	1	ECP-DAF-3001	120 VAC CONTROL POWER	A.1
56003EN25_0E01	E	1	CONTROL WIRING		A.1
56003EN25_0E02	E	2	CONTROL WIRING		A.1
56003EN25_0E03	E	3	E-STOP SAFETY CIRCUIT	DRIVE SAFE OFF	A.1
56003EN25_0F01	F	1	ECP-DAF-3001	ANALOG INPUT	A.1
56003EN25_0F02	F	2	ECP-DAF-3001	ANALOG OUTPUT	A.1
56003EN25_0G01	G	1	ECP-DAF-3001	DIGITAL INPUTS	A.1
56003EN25_0G02	G	2	ECP-DAF-3001	DIGITAL OUTPUTS	A.1
56003EN25_0H01	H	1	CHEMICAL PUMPS		A.1

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

KROFTA

SECTION:	DWN BY:	CHK'D BY:	DATE DWN:	PROJECT NUM:
	CFW		04/15/2025	56003EN-25

DRAWING NUM:	SUB SEC:	SHEET:	OF:	REV:
56003EN25 0A02	A	2	5	A.1

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INDEX PAGE

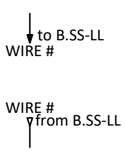
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REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

LINE NUMERS

REPEATING TO EACH SHEET
TO THE LEFT OF EACH SCHEMATIC COLUMN
1-20 LADDER COLUMN 1 AND
21-40 LADDER COLUMN 2
ON EQUAL INTERVALS. (EXAMPLE TO LEFT)

WIRE COLUMN / PAGE BREAK



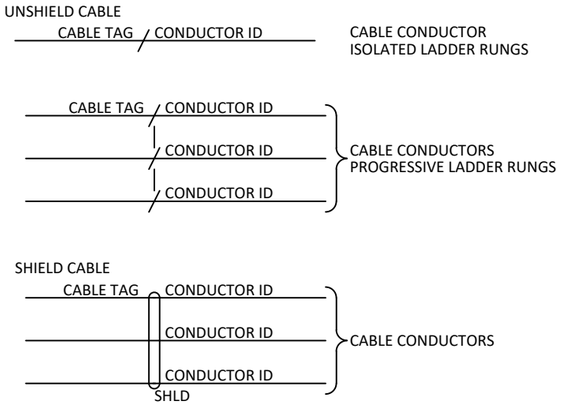
B = DESTINATION SUB SECTION NUMBER
SS = DESTINATION SHEET NUMBER
LL = DESTINATION LINE NUMBER

B = SOURCE SUB SECTION NUMBER
SS = SOURCE SHEET NUMBER
LL = SOURCE LINE NUMBER

WIRE NUMBERS

A:BB/CC	A = TYPE OF CARD (I FOR INPUT, O FOR OUTPUT) BB = MODULE SLOT NUMBER CC = INPUT/OUTPUT NUMBER
A.BBCC.D	A = SUB SECTION NUMBER BB = SHEET NUMBER CC = LINE NUMBER D = LINE REFERENCE

CABLE MARKERS





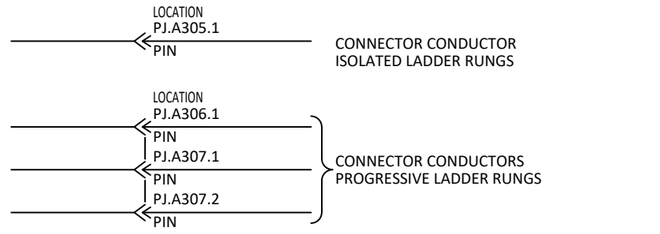
TWISTED PAIR

CABLE COLOR ABBREVIATIONS

BLK	—	BLACK
BLU	—	BLUE
BRN	—	BROWN
CYN	—	CYAN
GRY	—	GRAY
GRN	—	GREEN
ORG	—	ORANGE
PUR	—	PURPLE
RED	—	RED
VIO	—	VIOLET
WHT	—	WHITE
YEL	—	YELLOW

BLK-WHT BLACK WIRE, WHITE TRACER

SOCKET & PLUG CONNECTOR



CONTINUOUS LINES ARE WIRED IN THE PANEL

DASHED LINES ARE WIRED IN THE FIELD

FOOTNOTE DEFINITIONS

OO\A311.1 SHIELD ISOLATED

OO\A312.1 FLOW METER, REMOTE SIGNAL CABLE
TRANSMITTER END, INNER SHIELD TERMINATED
OUTER SHIELD ISOLATED
FLOW HEAD END, INNER SHIELD TERMINATED
OUTER SHIELD TERMINATED

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

KROFTA

SECTION:	DWN BY: CFW	CHK'D BY:	DATE DWN: 04/15/2025	PROJECT NUM: 56003EN-25
DRAWING NUM: 56003EN25 0A03		SUB SEC: A	SHEET: 3	OF: 5 REV: A.1

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DEFINITIONS PAGE

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

ECP-DAF-3001 BILL OF MATERIALS (BOM)				
ITEM	QTY	CATALOG	MFG	DESCRIPTION
1	1	SCE-72XM4018	SCE	FREE-STANDING TYPE 12 SINGLE-DOOR ENCLOSURE
2	1	SCE-DCP	SCE	DISCONNECT COVER PLATE
3	1	SCE-64P37	SCE	60 X 33.75, SUB-PANEL, PAINTED WHITE
8	1	194R-PY	AB	RED/YELLOW PADLOCKABLE HANDLE
9	1	194U-S1	AB	S SHAFT 12 INCH
10	1	194U-A60-1753	AB	IEC LOAD SWITCH, OPEN - BASE / DIN RAIL, CHANGEOVER 1-0-2 90°, 60A, 3 POLES
11	1	194U-N1	AB	NFPA HANDLE
14	1	4983-DS120-401	AB	SURGE PROTECTION, 35mm DIN RAIL MOUNT, UL 1449 , 120V, 40kA, 1 POLE
17	1	SCE-SLMS	SCE	ENCLOSURE LIGHT, 14.07" LONG, 400 LUMENS, LED, MOTION SENSOR
18	1	SCE-SLCC	SCE	CABLE FOR ENCLOSURE LIGHT
29	16	GMC-63-R	BUSSMANN	FERRULE FUSE (5mm) 63mA, BUSSMANN, MEDIUM TIME DELAY, 250VAC, 63mA, GLASS FUSE, 5x20mm
30	32	GMC-2-R	BUSSMANN	FERRULE FUSE (5mm) 3A, BUSSMANN, MEDIUM TIME DELAY, 250VAC, 2A, GLASS FUSE, 5x20mm
37	2	LP-CC-25	BUSSMAN	FUSE, CLASS CC, 25A, 600VAC, 200KAIC
38	1	1492-FB2C30	AB	FUSE HOLDER, CLASS CC FUSES, 2-POLE, FINGERSAFE
44	2	1489-M1C150	AB	BULLETIN 1489 MINIATURE CIRCUIT BREAKER, 1 POLE, TRIP CURVE C, 15 AMP, UL/CSA 277V AC, 48V DC
45	1	1489-M1C010	AB	BULLETIN 1489 MINIATURE CIRCUIT BREAKER, 1 POLE, TRIP CURVE C, 1 AMP, UL/CSA 277V AC, 48V DC
46	1	1489-M1D100	AB	BULLETIN 1489 MINIATURE CIRCUIT BREAKER, 1 POLE, TRIP CURVE D, 10 AMP, UL/CSA 277V AC, 48V DC
47	1	1489-M1C400	AB	BULLETIN 1489 MINIATURE CIRCUIT BREAKER, 1 POLE, TRIP CURVE C, 40 AMP, UL/CSA 277V AC, 48V DC
48	3	1489-M1C050	AB	BULLETIN 1489 MINIATURE CIRCUIT BREAKER, 1 POLE, TRIP CURVE C, 5 AMP, UL/CSA 277V AC, 48V DC
49	1	1115661	PHOENIX CONTACT	POWER FEED MODULE WITH STATUS OUTPUT AND RESET INPUT.
50	1	1110989	PHOENIX CONTACT	BUSBAR FOR THE CAPAROC SYSTEM WITH 20 SLOTS. FOR INSTALLATION ON A DIN RAIL.
51	2	1115657	PHOENIX CONTACT	4-CHANNEL ELECTRONIC CIRCUIT BREAKER MODULE. NOMINAL CURRENT ADJUSTABLE FROM 1A TO 4A VIA LED BUTTON. NEC CLASS 2
52	2	1115658	PHOENIX CONTACT	4-CHANNEL ELECTRONIC CIRCUIT BREAKER MODULE. NOMINAL CURRENT ADJUSTABLE FROM 1A TO 10A VIA LED BUTTON.
53	4	1110987	PHOENIX CONTACT	POTENTIAL DISTRIBUTOR WITH PUSH-IN CONNECTIONS FOR DIRECTLY CONNECTING THE 0 V RETURN CONDUCTOR IN THE CAPAROC SYSTEM.
75	1	1159038	PHOENIX CONTACT	PRIMARY-SWITCHED TRIO3 POWER POWER SUPPLY WITH PUSH-IN CONNECTION, DIN RAIL, INPUT: SINGLE-PHASE, OUTPUT: 24 V DC/10 A
76	1	2907067	PHOENIX CONTACT	QUINT4 DC UPS MODULE, DIN RAIL, INPUT: 24VDC, OUTPUT: 24 V DC/10 A, USB PORT
77	1	1274118	PHOENIX CONTACT	QUINT4 DC UPS BATTERY, 24VDC, 7 AH
85	1	2711P-T9W22D9P	AB	PANELVIEW PLUS 7 PERFORMANCE TERMINAL, TOUCH SCREEN, 12 WXGA, WIDE ASPECT RATION COLOR, ETHERNET DLR, 24V DC
86	1	FLEXY205	EWON	MODULAR INDUSTRIAL M2M ROUTER AND DATA GATEWAY
88	1	P-P11R2-K4RF0	GRACE ENGINEERING	PROGRAMMING PORT, 5e ETHERNET, USB, GFCI W/ NO CIRCUIT BREAKER, UL TYPE 12
89	1	LNX-800A-T	ANTAIRA	8-PORT INDUSTRIAL UNMANAGED SWITCH, 10/100TX, EOT
95	1	1756-A10	AB	1756 CONTROL LOGIX RACK I/O, 10 SLOT CHASSIS
96	1	1756-PB50	AB	1756 CONTROL LOGIX POWER SUPPLY
97	1	1756-L81E	AB	1756 CONTROL LOGIX PROCESSORS LOGIX 5580, 3MB MEMORY
98	1	1756-IF8	AB	1756 CONTROL LOGIX PLC ANALOG INPUT MODULE
99	1	1756-OF8	AB	1756 CONTROL LOGIX PLC ANALOG OUTPUT MODULE
100	2	1756-IB16	AB	1756 CONTROL LOGIX PLC DIGITAL DC INPUT MODULE
101	2	1756-OW16I	AB	1756 CONTROL LOGIX PLC DIGITAL RELAY OUTPUT MODULE
102	3	1756-N2	AB	1756 CONTROL LOGIX SLOT FILLER CARD
103	3	1756-TBCH	AB	1756 TERMINAL BLOCK
104	3	1756-TBNH	AB	1756 TERMINAL BLOCK
105	4	1756-JMPR	AB	1756 JUMPER
110	5	700-HLT1Z24	AB	HL TYPE TERMINAL BLOCK RELAY, 24VDC, 6A, SPDT, ELECTROMECHANICAL RELAY OUTPUT, SCREW TERMINAL
111	1	DC 2BD0	WARRICK	CONDUCTIVE LEVEL CONTROL, 8 PIN, 10K OHMS, 10-SEC DELAY
112	1	700-HN100	AB	SCREW TERMINAL TUBE BASE SOCKET, GUARDED TERMINAL CONSTRUCTION
120	1	440R-S12R2	AB	GUARDMASTER SINGLE INPUT SAFETY RELAY (SI), 1 DUAL CHANNEL UNIVERSAL INPUT, 1 N.C. SOLID STATE AUXILIARY OUTPUT
121	3	700-HPS2Z24	AB	SAFETY CONTROL RELAY, 700-HP GENERAL PURPOSE PCB PIN STYLE RELAY, 8 A, 2 POLE, DPDT, 24V DC
	3	700-HN123	AB	SCREW TERMINAL MINIATURE SOCKET
122	3	700-ADL1R	AB	VARISTOR WITH LED SURGE SUPPRESSOR, 6-24VDC
130	2	1492-BSPJLD3N	AB	END BARRIER FOR 1492-JDG3N, GREY (STANDARD)
131	3	1492-J4-BL	AB	SCREW CONNECTION TERMINAL BLOCK; 1492-J
133	4	1492-J4-W	AB	SCREW CONNECTION TERMINAL BLOCK; 1492-J
134	6	1492-JG3	AB	SCREW CONNECTION TERMINAL BLOCK; 1492-J
135	2	1492-JG4	AB	SCREW CONNECTION TERMINAL BLOCK; GREEN/YELLOW; 20-10AWG, GFEED-THROUGH GROUND BLOCK
136	49	1492-JD3-B	AB	SCREW CONNECTION TERMINAL BLOCK; 1492-J
138	9	1492-JDG3N	AB	TERMINAL BLOCK 1492, GRAY
139	32	1492-JD3FB	AB	TERMINAL BLOCK 1492, GRAY
140	16	1492-JDG3FB	AB	TERMINAL BLOCK 1492, GRAY
141	3	1492-WTF3	AB	TERMINAL BLOCK 1492, GRAY
143	5	1492-EBJD3-B	AB	END BARRIER; 1492-J, BLUE
144	4	1492-EBJD3FB	AB	END BARRIER; 1492-J, GREY
145	2	1492-EBTF3	AB	END BARRIER FOR 1492-WFT3, GREY (STANDARD)
146	1	1492-JT3M	AB	TERMINAL BLOCK 1492, GRAY
147	1	1492-EBJ3TM	AB	END BARRIER; 1492-J
148	35	1492-EAJ35	AB	1492 TERMINAL BLOCK ACCESSORIES, END ANCHOR, USED W/ STANDARD 35MM DIN RAIL
165	1	800FP-LMT44	AB	800F ILLUMINATED MUSHROOM OPERATORS, ILLUMINATED, TWIST TO RELEASE, 40MM, TYPE 4/4X/13, IP66, RED
	1	800F-X20D	AB	22.5mm PB NO LATCH, SCREW CONTACT BLOCK, 2 N.O. DOUBLE CIRCUIT
	1	800F-X02D	AB	22.5mm PB NO LATCH, SCREW CONTACT BLOCK, 2 N.C. DOUBLE CIRCUIT
	1	800F-ALP	AB	800F LATCH, PLASTIC LATCH
167	1	800F-15YSE112	AB	800F LEGEND PLATE, 60MM ROUND, 22.5MM OPENING
166	1	800FP-LF0	AB	800F MOMENTARY PUSH BUTTON - PLASTIC, ILLUMINATED, FLUSH, AMBER
	1	800F-N3W	AB	POWERBLOCK MODULE w LED
	1	800F-ALP	AB	800F MOUNTING LATCH
	1	800F-X10	AB	800F CONTACT BLOCK
170	1	800F-11WE186	AB	800F LEGEND PLATE, 30 X 40MM STD., 2 PIECE SNAP-IN, RESET, WHITE WITH BLACK LEGEND TEXT, 22.5MM OPENING
169	1	800FP-SM22	AB	SELECTOR SW - 2 POS MAINTAINED
	1	800F-X10	AB	800F CONTACT BLOCK
	1	800F-ALP	AB	800F MOUNTING LATCH
168	1	800F-11WE156	AB	LEGEND PLATE FOR 2 POS SELECTOR SW, MANUAL - AUTO
171	1	855PC-B24ME422	AB	PANEL MOUNT SOUNDER WITH LED, 855PC SERIES
172	1	855PB-B24ME522	AB	PANEL MOUNT SELECTABLE STEADY OR FLASHING LED, 855PB SERIES

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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	CFW		04/15/2025	56003EN-25	
DRAWING NUM:		SUB SEC:	SHEET:	OF:	REV:
56003EN25 0A04		A	4	5	A.1

AUMSVILLE WWTP
AUMSVILLE, OR

ECP-DAF-3001
BILL OF MATERIALS

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

MCP-DAF-3002 BILL OF MATERIALS (BOM)				
ITEM	QTY	CATALOG	MFG	DESCRIPTION
1	1	SCE-72XM4018	SCE	FREE-STANDING TYPE 12 SINGLE-DOOR ENCLOSURE
2	1	SCE-DCP	SCE	DISCONNECT COVER PLATE
3	1	SCE-64P37	SCE	60 X 33.75, SUB-PANEL, PAINTED WHITE
4	1	140G-G2C3-C40	AB	140G - MOLDED CASE CIRCUIT BREAKER, G FRAME, 25 KA, T/M - THERMAL MAGNETIC, 40 AMPS
5	1	140G-G-TLC13	AB	FRAME-G, TERMINAL LUG, QTY 3, FCCU 1X14-1/0AWG
6	1	140G-G-MTL63	AB	FRAME-G, MULTI TERMINAL LUG, QTY 3, 6X14-2AWG
7	1	140G-G-NVM21R	AB	140G PRODUCT HANDLE ACCESSORIES/OPERATING MECHANISMS, 140G ROTARY , ROTARY HANDLE WITH NFPA79 HANDLE ,21" , RED/YELLOW
12	1	VS-AVT-C08-L10	PANDUIT	ABSENCE OF VOLTAGE TESTER
13	1	813S-V3-480V	AB	THREE-PHASE VOLTAGE MONITORING RELAY, 440...480V AC (TYPE V3),
16	1	599-GR1	AB	GROUND LUG KIT, 30A...100A
17	1	SCE-SLMS	SCE	ENCLOSURE LIGHT, 14.07" LONG, 400 LUMENS, LED, MOTION SENSOR
18	1	SCE-SLCC	SCE	CABLE FOR ENCLOSURE LIGHT
20	1	SCE-N12FA66LG	SCE	FAN ASSEBBLY, 6", 115VAC, 0.36AM RAL 7035, UL TYPE 12
21	1	SCE-N12FGA66LG	SCE	FAN GRILLE ASSEMBLY, RAL 7035, UL TYPE 12
26	1	1492-FB3C30-L	AB	3 POLE FUSE BLOCK - CLASS CC
27	3	1492-FB3J30-L	AB	3 POLE FUSE BLOCK - CLASS J
31	3	FNQ-R-2	BUSSMANN	FUSE - CLASS CC, 2AMPS
33	3	LPJ-30SP	BUSSMANN	DUAL ELEMENT FUSE - CLASS J, 30AMPS
35	3	JJS-6	BUSSMANN	FUSE - CLASS T
36	3	JJS-15	BUSSMANN	FUSE - CLASS T
60	1	100-C16EJ10	AB	100-C CONTACTOR, 3-POLE
62	1	193-1EFDB	AB	IEC E100 SOLID-STATE OVERLOAD RELAY, 3-PHASE, SCREW TYPE CONTROL TERMINALS
64	1	20G21RD3P4JA0NNNNN	AB	AC Drive, W/ Dual Embedded EtherNet/IP, Forced Air, AC Input W/Precharge, Incl. DC Term., 480 VAC, 3 PH, CM Jumper Installed, DB Transistor
65	1	20G21RD8P0JA0NNNNN	AB	AC Drive, W/ Dual Embedded EtherNet/IP, Forced Air, AC Input W/Precharge, Incl. DC Term., 480 VAC, 3 PH, CM Jumper Installed, DB Transistor
66	2	20-750-S	AB	POWERFLEX 750 AC DRIVE, SAFE TORQUE OFF MODULE
131	9	1492-J4-BL	AB	SCREW CONNECTION TERMINAL BLOCK; 1492-J
132	2	1492-J4-G	AB	SCREW CONNECTION TERMINAL BLOCK; 1492-J
135	3	1492-JG4	AB	SCREW CONNECTION TERMINAL BLOCK; GREEN/YELLOW; 20-10AWG, GFEED-THROUGH GROUND BLOCK
137	7	1492-JD3-Y	AB	SCREW CONNECTION TERMINAL BLOCK; 1492-J
141	8	1492-WTF3	AB	TERMINAL BLOCK 1492, GRAY
142	3	1492-EBJD3	AB	END BARRIER; 1492-J, GREY
145	1	1492-EBTF3	AB	END BARRIER FOR 1492-WFT3, GREY (STANDARD)
148	17	1492-EAJ35	AB	1492 TERMINAL BLOCK ACCESSORIES, END ANCHOR, USED W/ STANDARD 35MM DIN RAIL
149	1	1492-JD3	AB	TERMINAL BLOCK, 2 TIER, GREY

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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SECTION:	DWN BY:	CHK'D BY:	DATE DWN:	PROJECT NUM:
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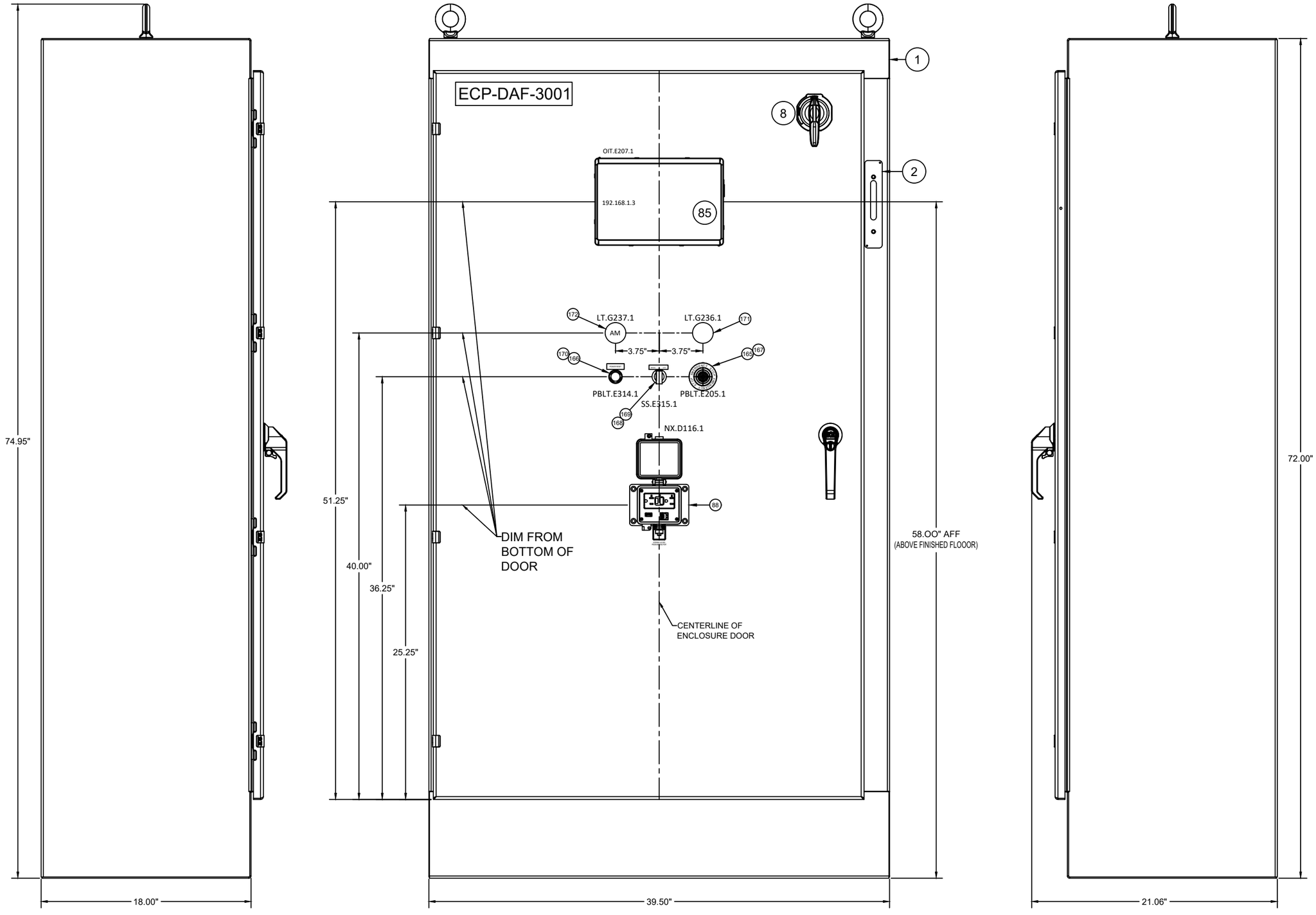
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56003EN25 0A05	A	5	5	A.1

AUMSVILLE WWTP
AUMSVILLE, OR

MCP-DAF-3002
BILL OF MATERIALS

RELEASED FOR: REVIEW

REV:	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
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PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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DRAWING NUM:		SUB SEC:	SHEET:	OF:	REV:
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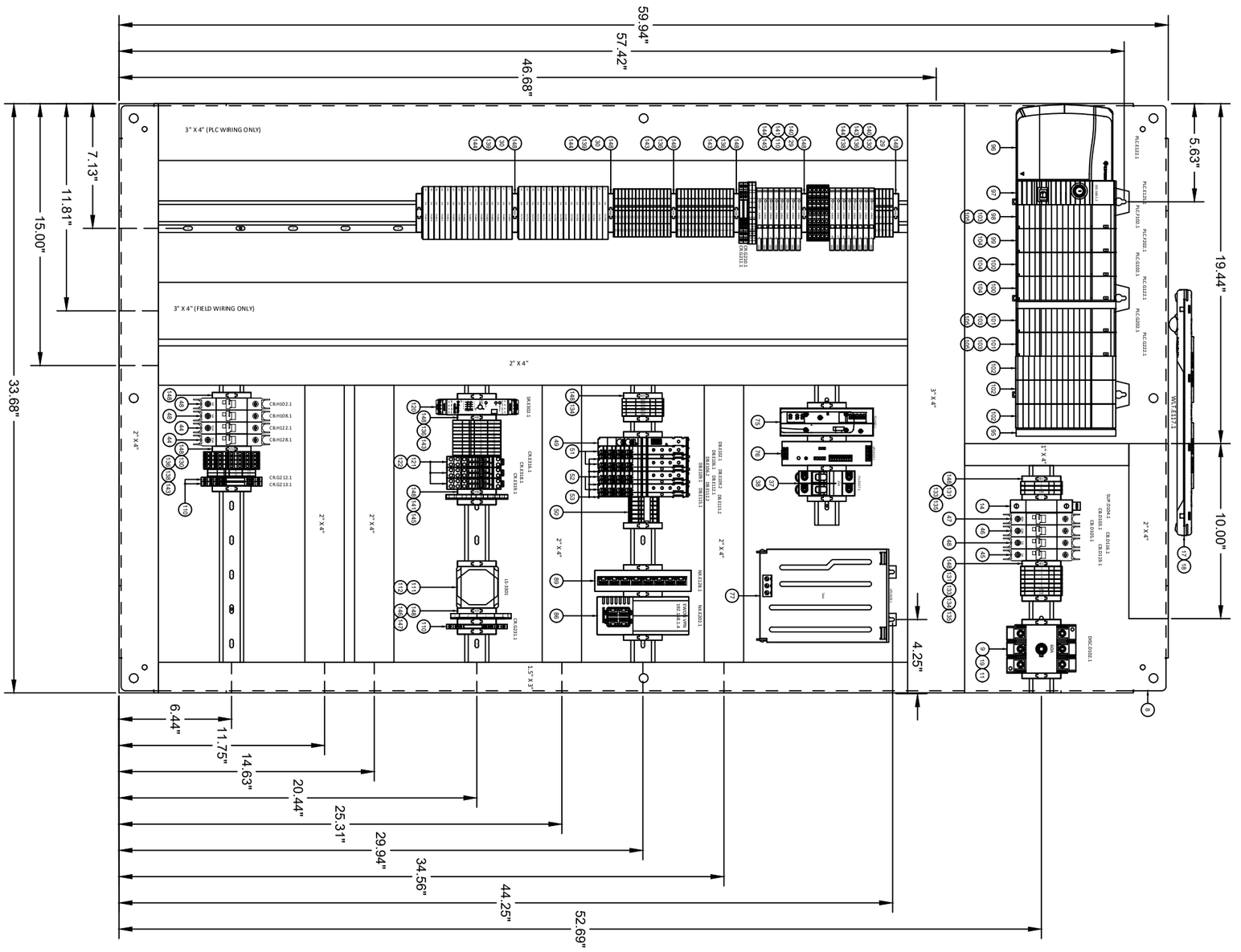
AUMSVILLE WWTP

AUMSVILLE, OR

ECP-DAF-3001
EXTERNAL LAYOUT

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS



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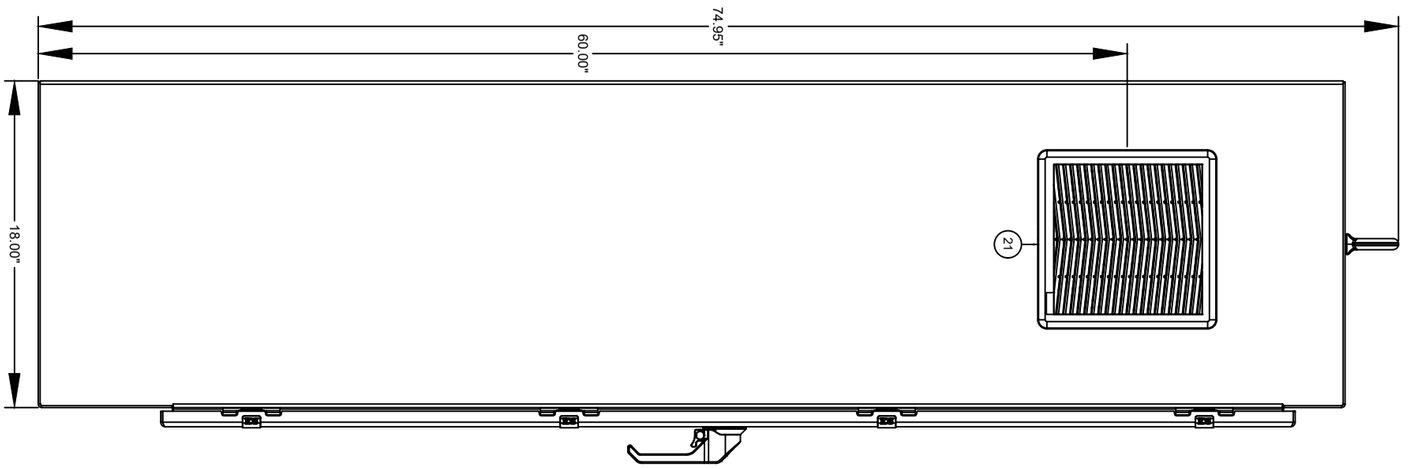
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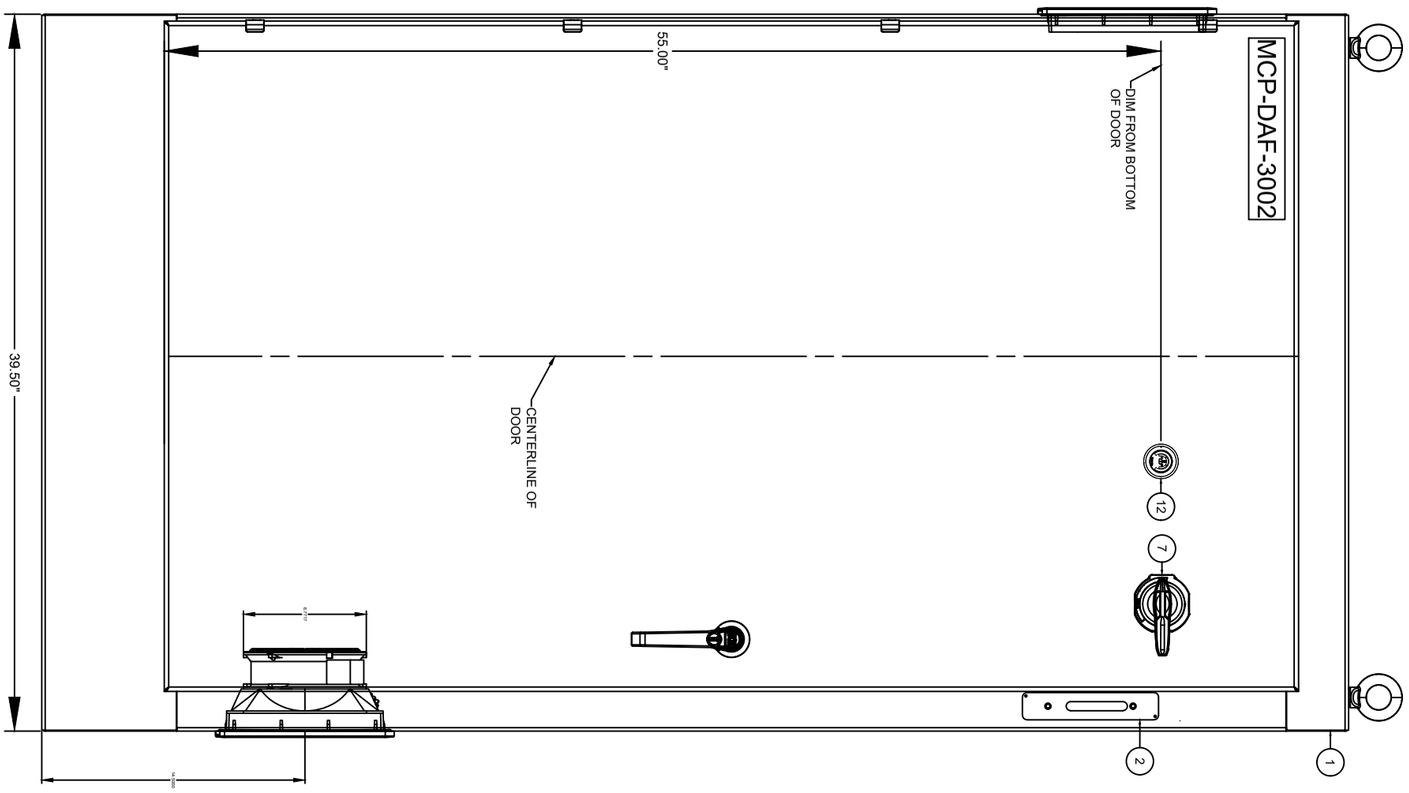
ECP-DAF-3001
INTERNAL LAYOUT

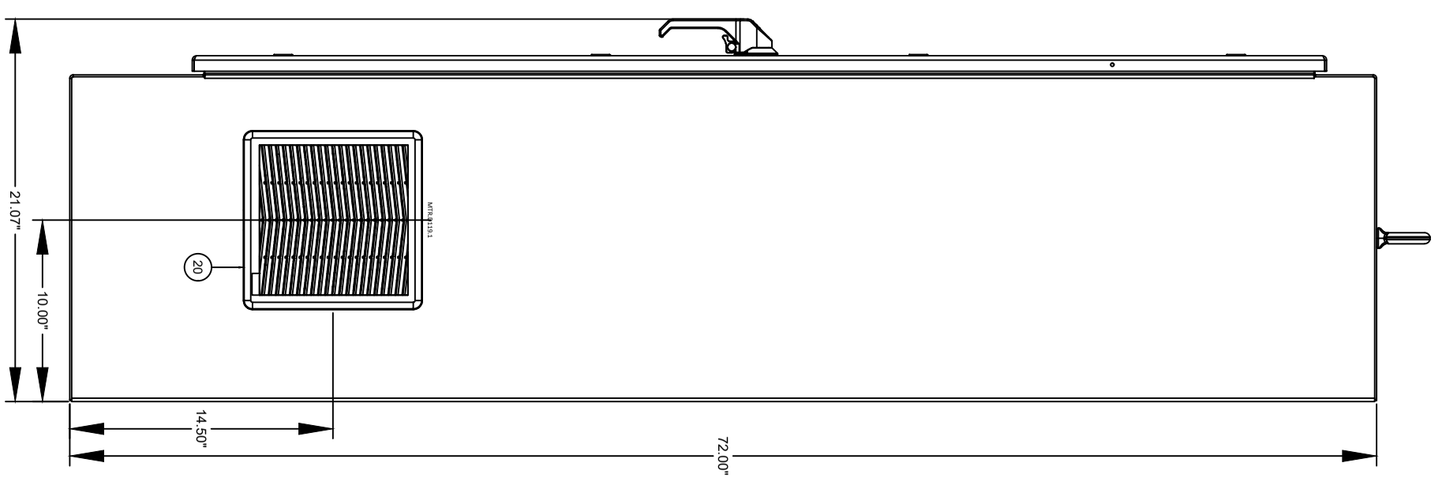
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PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

SECTION:	DWN BY:	CHK'D BY:	DATE DWN:	PROJECT NUM:
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DRAWING NUM:	SUB SEC:	SHEET:	OF:	REV:
56003EN25_0B02	B	2	9	A.1







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AUMSVILLE WWTP

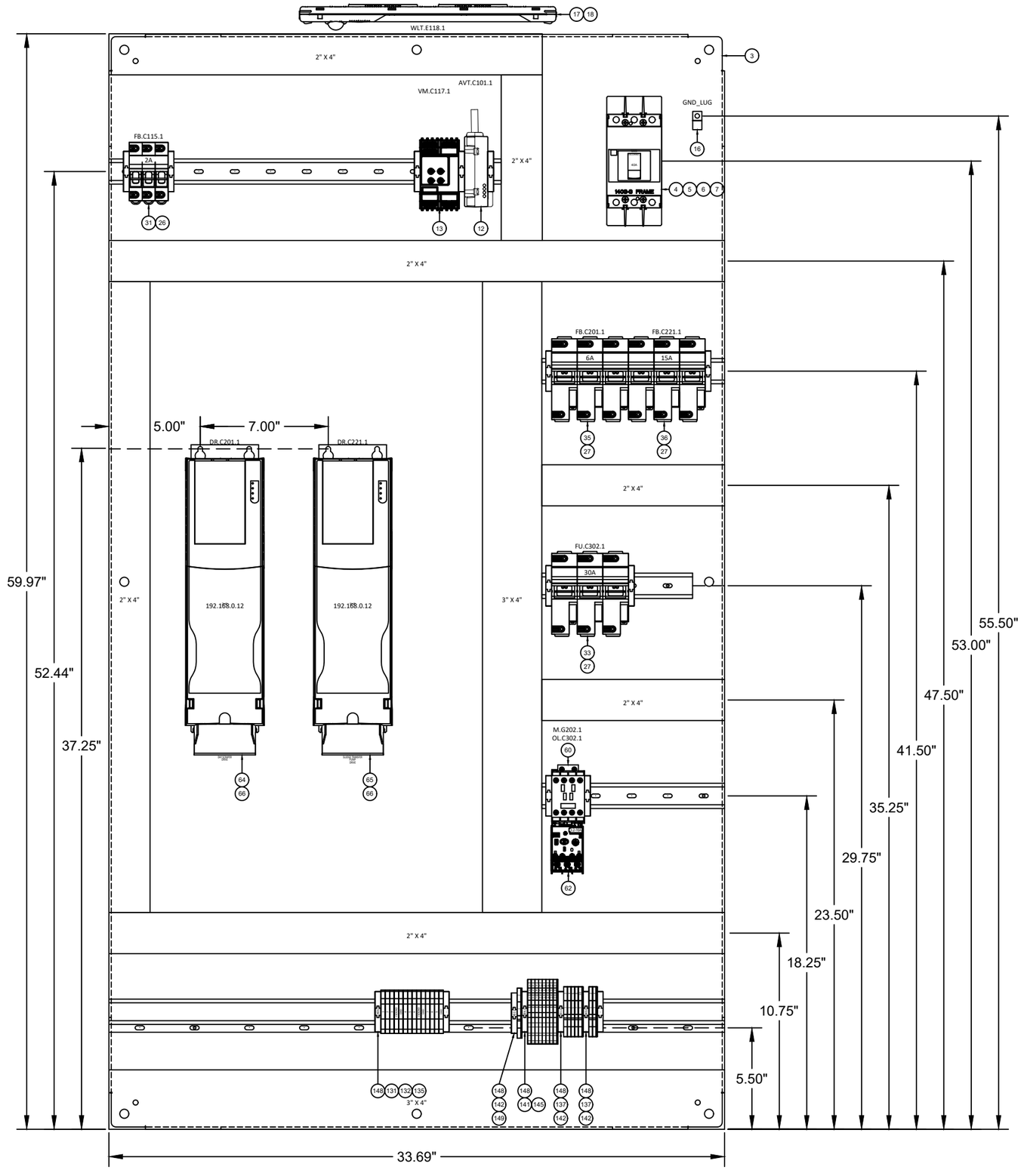
AUMSVILLE, OR

MCP-DAF-3002
EXTERNAL LAYOUT

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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

SECTION:	DWN BY:	CHK'D BY:	DATE DWN:	PROJECT NUM:
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DRAWING NUM:	SUB SEC:	SHEET:	OF:	REV:
56003EN25_0B03	B	3	9	A.1



Krofta Technologies LLC	SECTION:
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KROFTA	SUB SEC: B
	DATE DWN: 04/15/2025
	SHEET: 4 OF: 9
	PROJECT NUM: 56003EN-25
	REV: A.1
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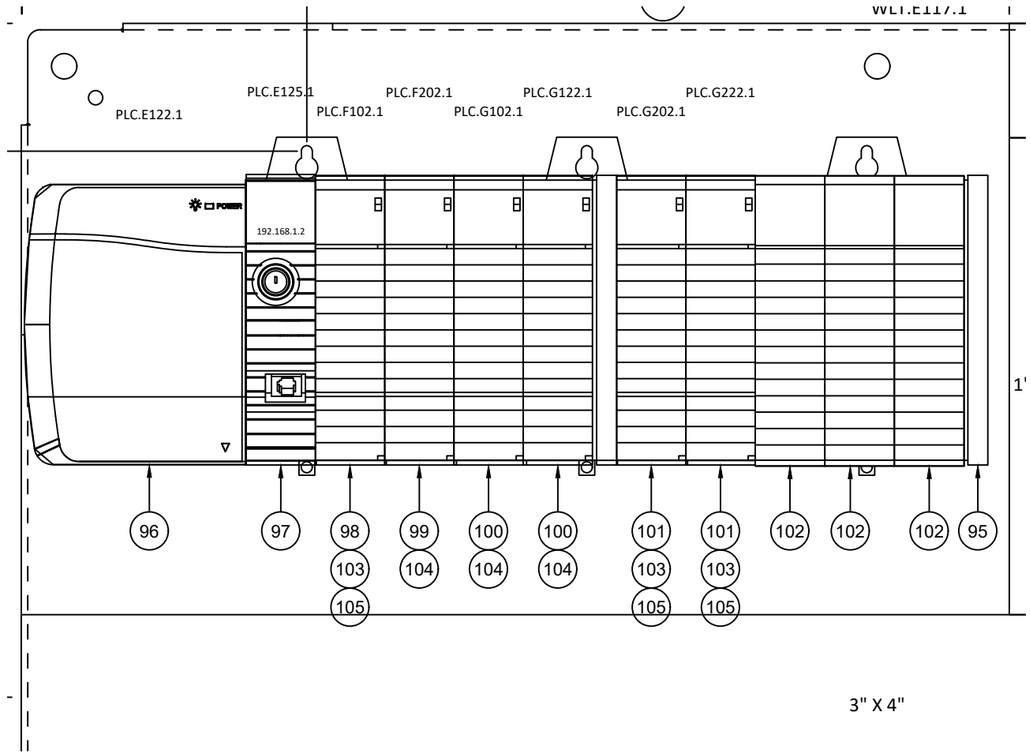
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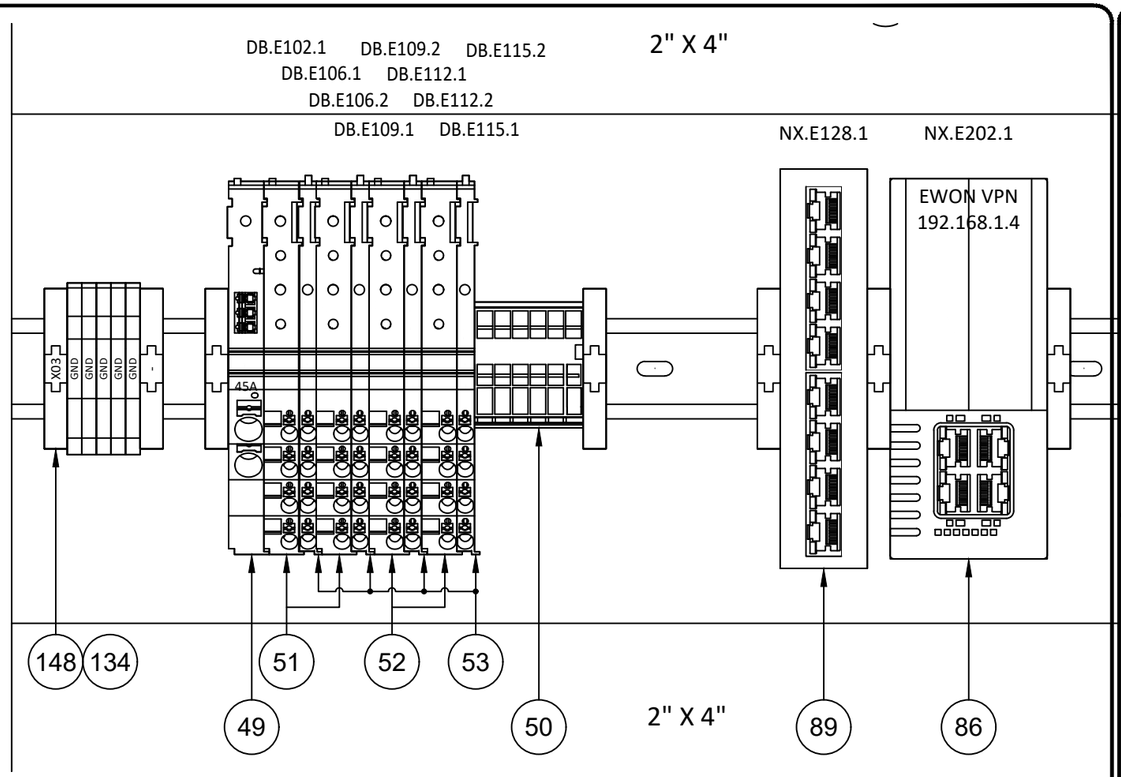
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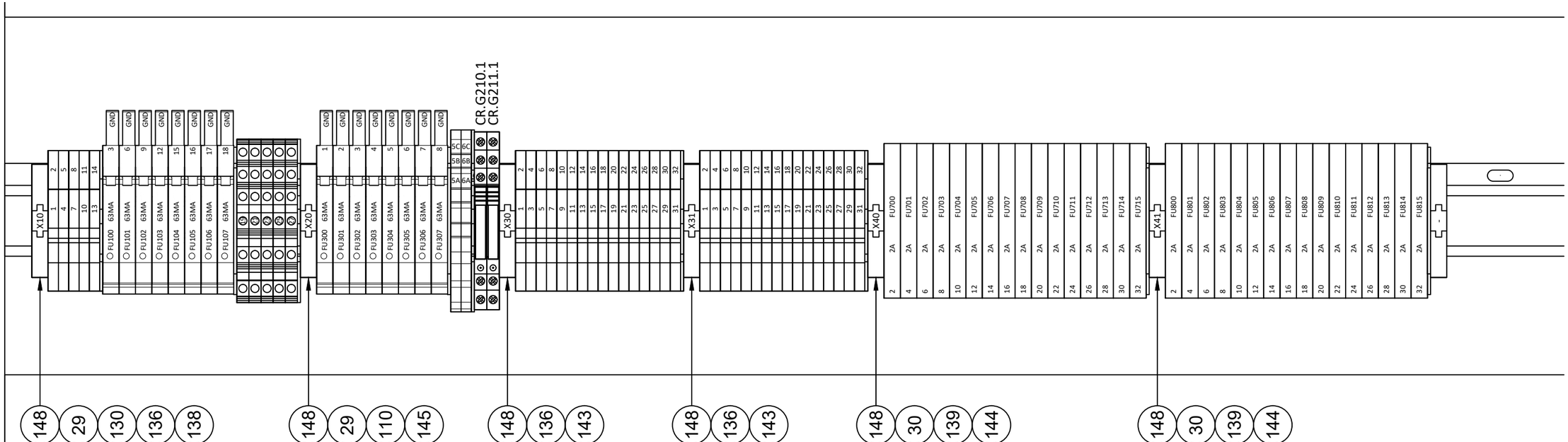
MCP-DAF-3002
INTERNAL LAYOUT

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REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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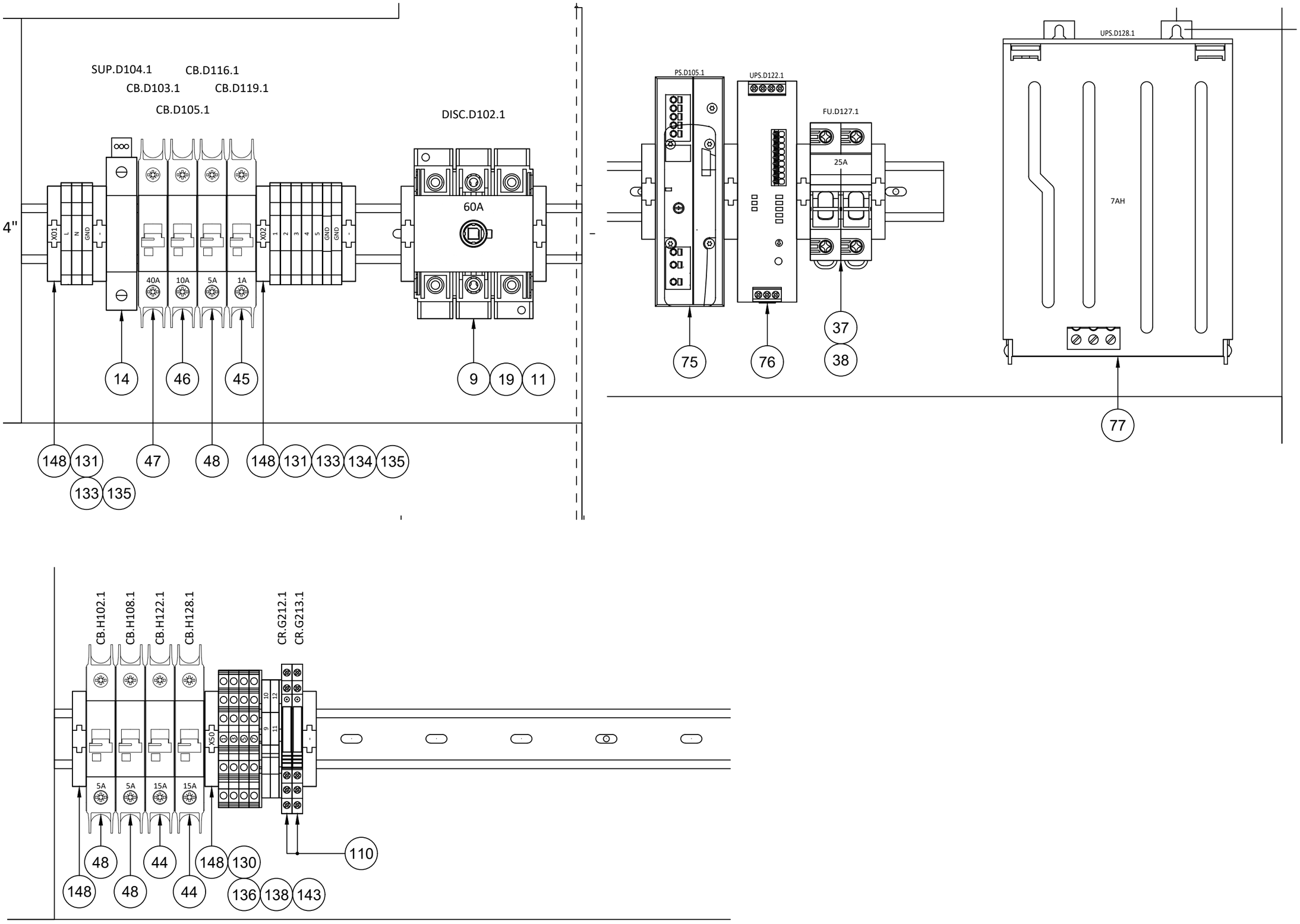
AUMSVILLE WWTP

AUMSVILLE, OR

ECP-DAF-3001
PLC AND I/O TERMINALS DETAILS

RELEASED FOR: REVIEW

REV:	DATE	BY	REVISION DESCRIPTION
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A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS



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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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DRAWING NUM: 56003EN25 0B06		SUB SEC: B	SHEET: 6	OF: 9	REV: A.1

AUMSVILLE WWTP

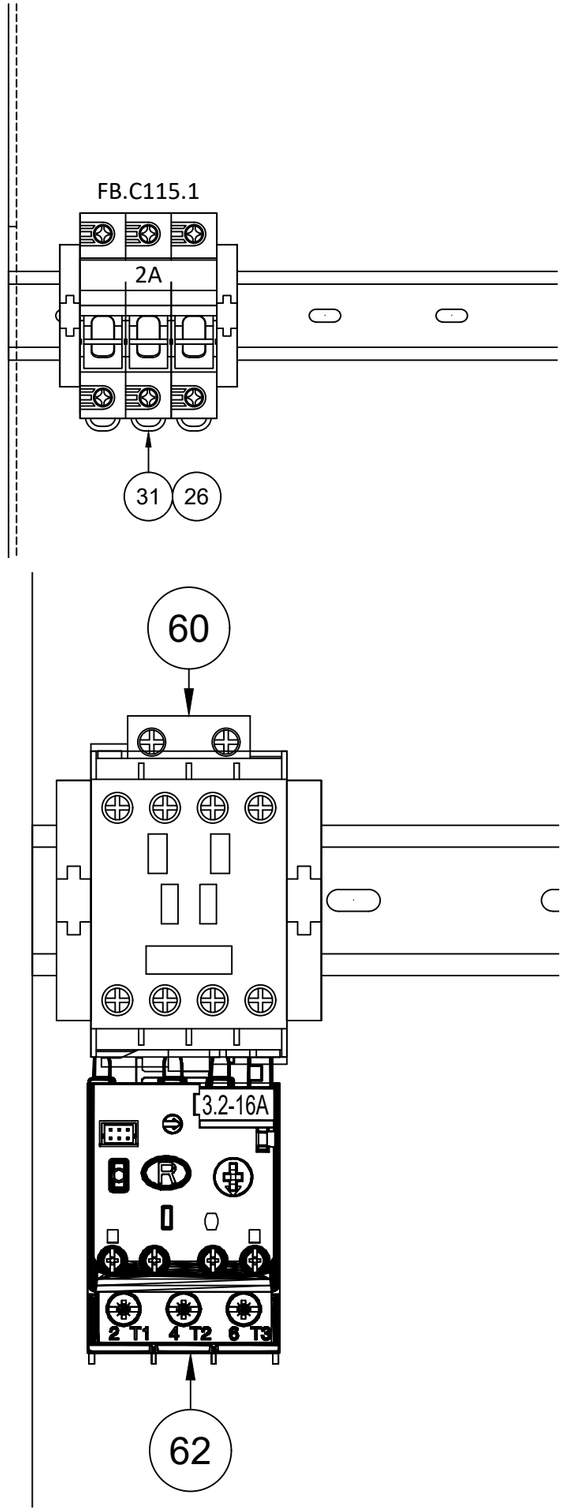
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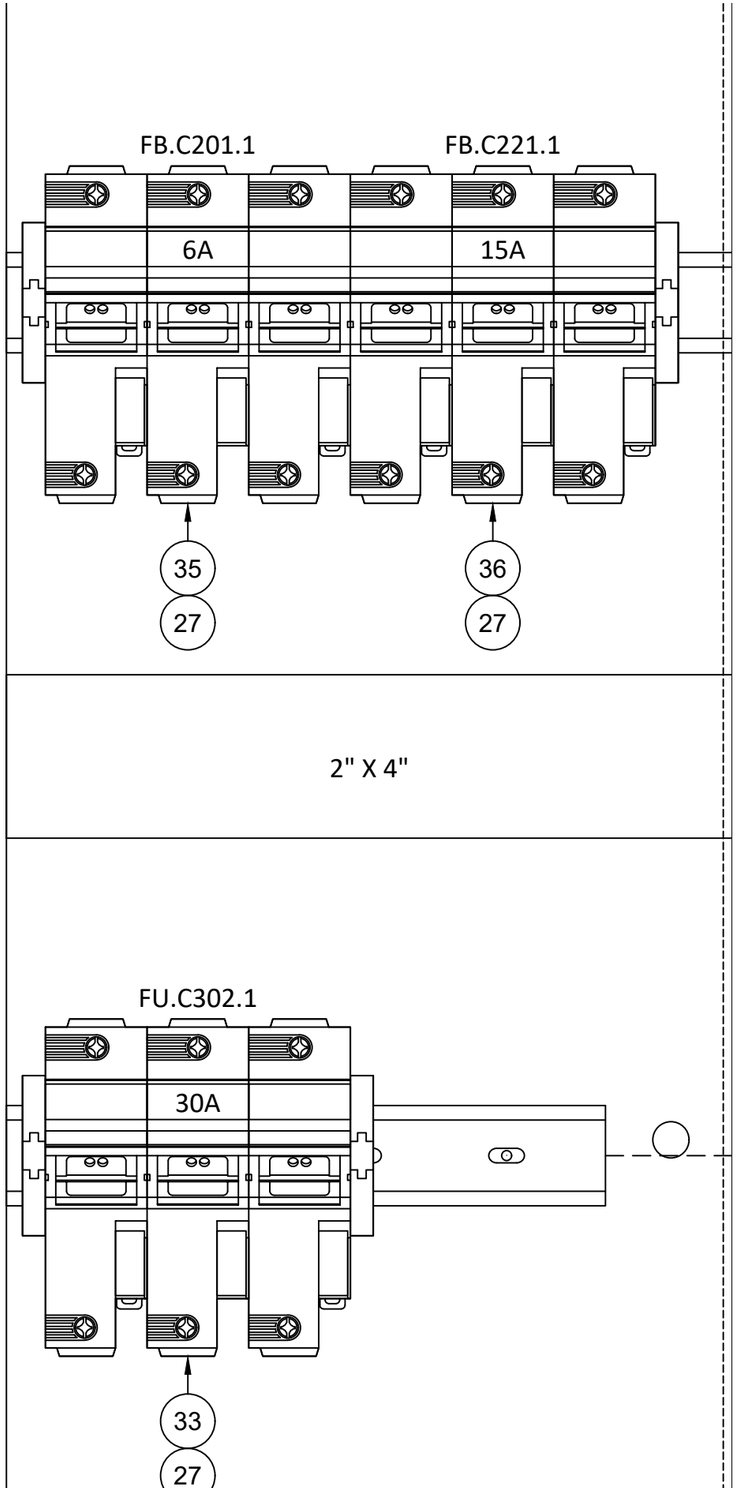
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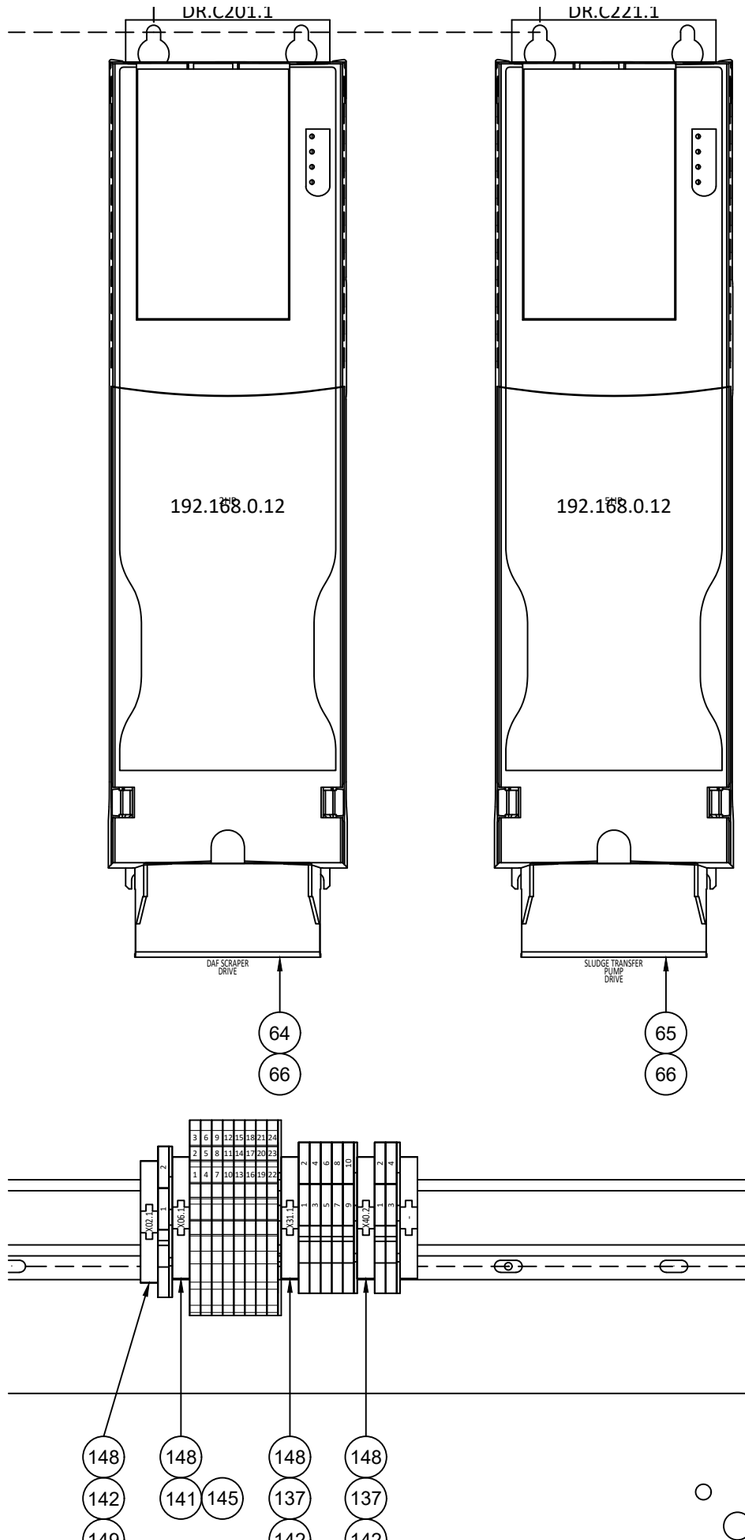
POWER DISTRIBUTION & NETWORK SWITCH DETAILS

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS







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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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	CFW		04/15/2025	56003EN-25

DRAWING NUM:	SUB SEC:	SHEET:	OF:	REV:
56003EN25 0B07	B	7	9	A.1

AUMSVILLE WWTP
AUMSVILLE, OR

MCP-DAF-3002
480VAC POWER DISTRIBUTION DETAILS

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

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AUMSVILLE, OR

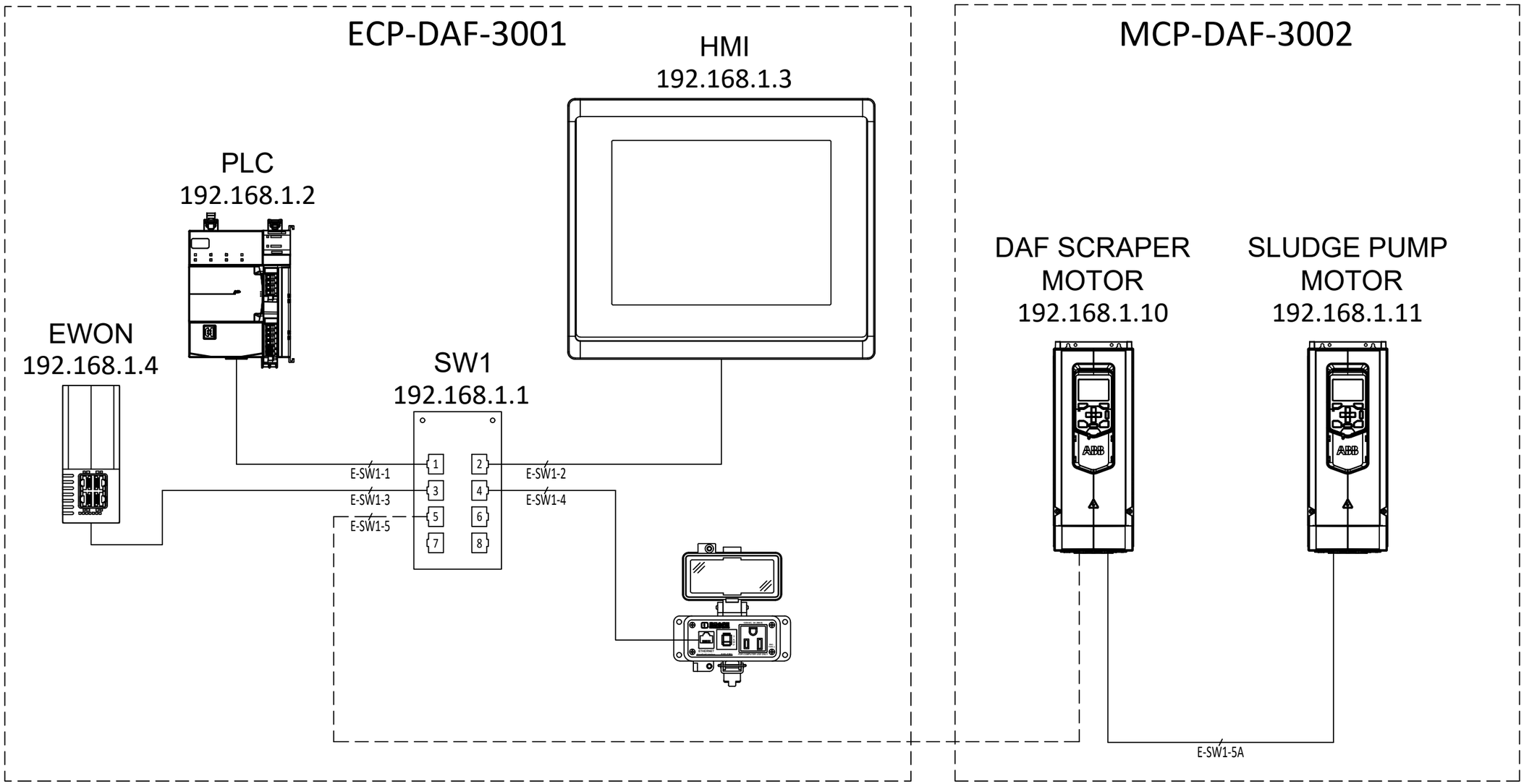
MCP-DAF-3002
SPARE SHEET

KROFTA

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PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

SECTION:	DWN BY:	CHK'D BY:	DATE DWN:	PROJECT NUM:
	CFW		04/15/2025	56003EN-25

DRAWING NUM:	SUB SEC:	SHEET:	OF:	REV:
56003EN25_0B08	B	8	9	A.1



THESE IP ADDRESSES CONFORM TO KROFTA STANDARDS
ANY CHANGES SHOULD BE CONVEYED PRIOR TO COMMISSIONING OF THE SYSTEM.

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PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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SECTION:	DWN BY:	CHK'D BY:	SUB SEC:	DATE DWN:	SHEET:	OF:	PROJECT NUM:	REV:
DRAWING NUM: 56003EN25 0B09	CFW		B	04/15/2025	9	9	56003EN-25	A.1

AUMSVILLE WWTP
AUMSVILLE, OR

NETWORK LAYOUT

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
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A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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SECTION:	DWN BY:	CHK'D BY:	DATE DWN:	PROJECT NUM:	
	CFW		04/15/2025	56003EN-25	
DRAWING NUM:		SUB SEC:	SHEET:	OF:	REV:
56003EN25_0C01		C	1	3	A.1

AUMSVILLE WWTP

AUMSVILLE, OR

MCP-DAF-3002
3 PHASE WIRING

RELEASED FOR: REVIEW

REV:	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

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KROFTA

PROJECT NUM:	56003EN-25
DATE DWN:	04/15/2025
SHEET:	2
OF:	3
REV:	A.1
CHK'D BY:	
DWN BY:	CFW
SUB SEC:	C
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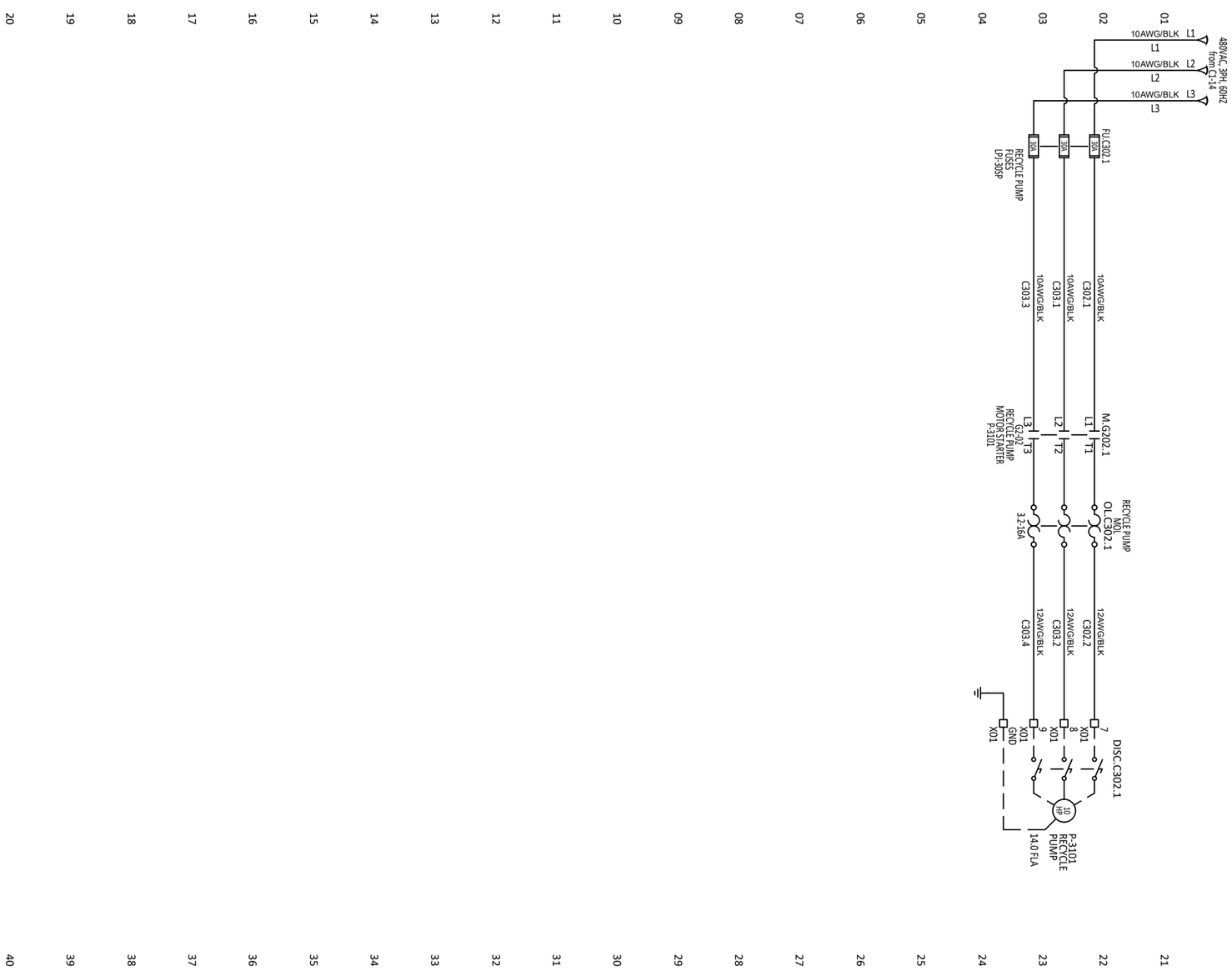
AUMSVILLE WWTP

AUMSVILLE, OR

MCP-DAF-3002
3 PHASE WIRING

RELEASED FOR: REVIEW

REV:	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
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REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

AUMSVILLE WWTP

AUMSVILLE, OR

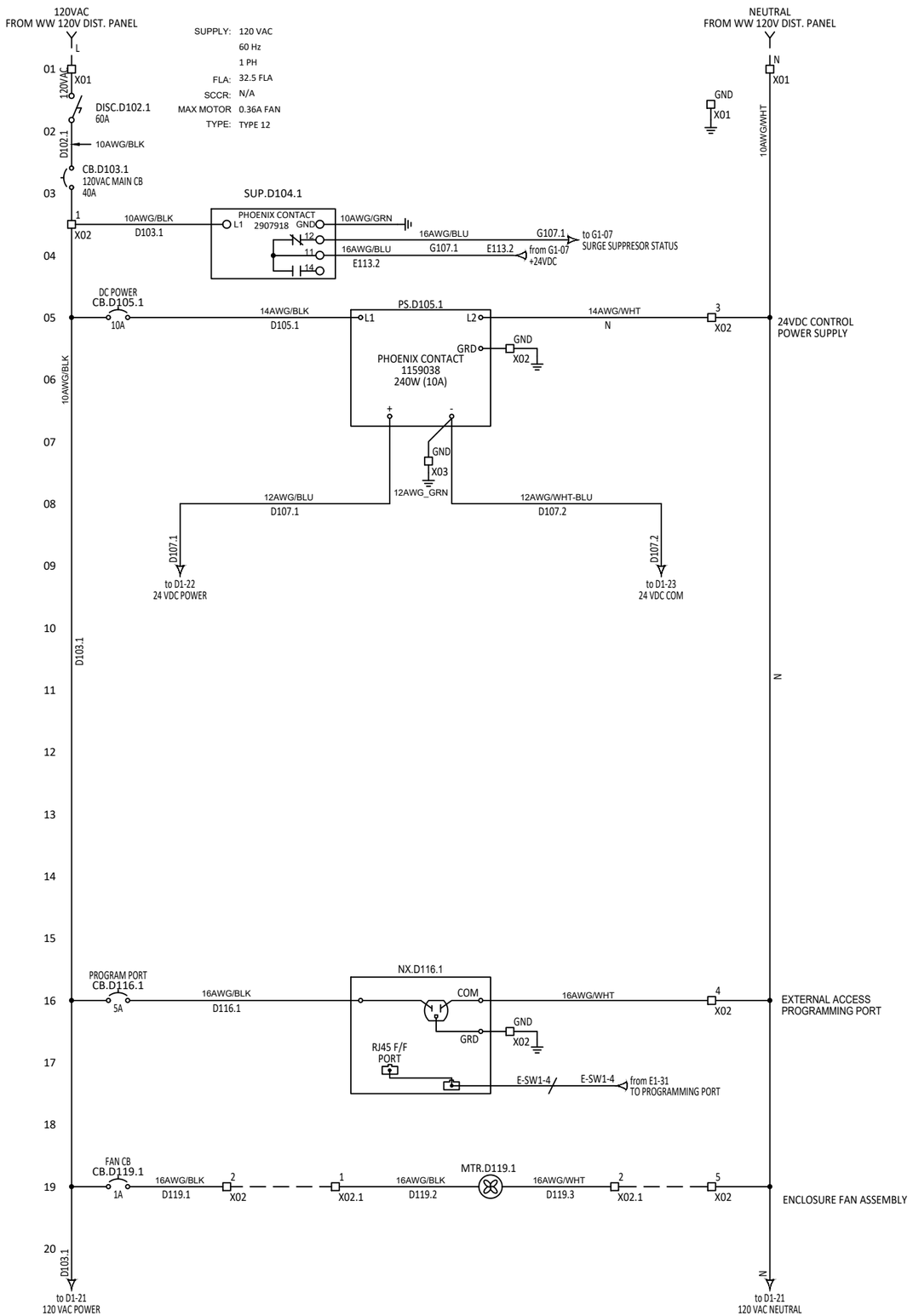
MCP-DAF-3002
3 PHASE WIRING

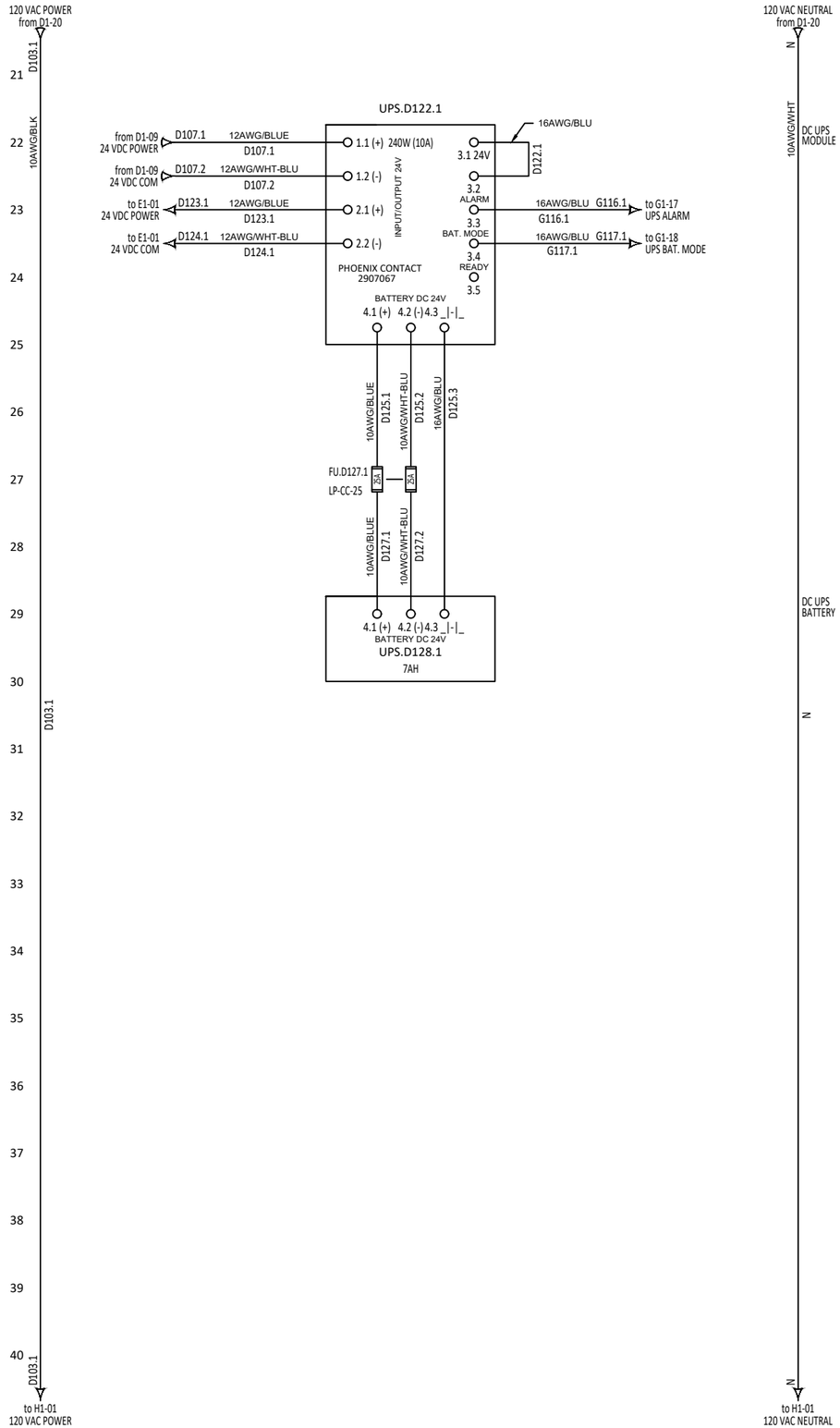
KROFTA

Krofta Technologies LLC
PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

SECTION:	DWN BY:	CHK'D BY:	DATE DWN:	PROJECT NUM:
	CFW		04/15/2025	56003EN-25

DRAWING NUM:	SUB SEC:	SHEET:	OF:	REV:
56003EN25_0C03	C	3	3	A.1





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SECTION:	
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DATE DWN:	04/15/2025
SUB SEC:	D
SHEET:	1
OF:	1
DRAWING NUM:	56003EN25_0D01
PROJECT NUM:	56003EN-25
REV:	A.1

AUMSVILLE WWTP
AUMSVILLE, OR

ECP-DAF-3001
120 VAC CONTROL POWER

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	CFW		04/15/2025	56003EN-25	
DRAWING NUM:		SUB SEC:	SHEET:	OF:	REV:
56003EN25 0E01		E	1	3	A.1

AUMSVILLE WWTP

AUMSVILLE, OR

CONTROL WIRING

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
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A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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	CFW		04/15/2025	56003EN-25

DRAWING NUM:	SUB SEC:	SHEET:	OF:	REV:
56003EN25 0E02	E	2	3	A.1

AUMSVILLE WWTP

AUMSVILLE, OR

CONTROL WIRING

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A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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SECTION:	
DWN BY:	CFW
CHK'D BY:	
DATE DWN:	04/15/2025
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PROJECT NUM:	56003EN-25
REV:	A.1
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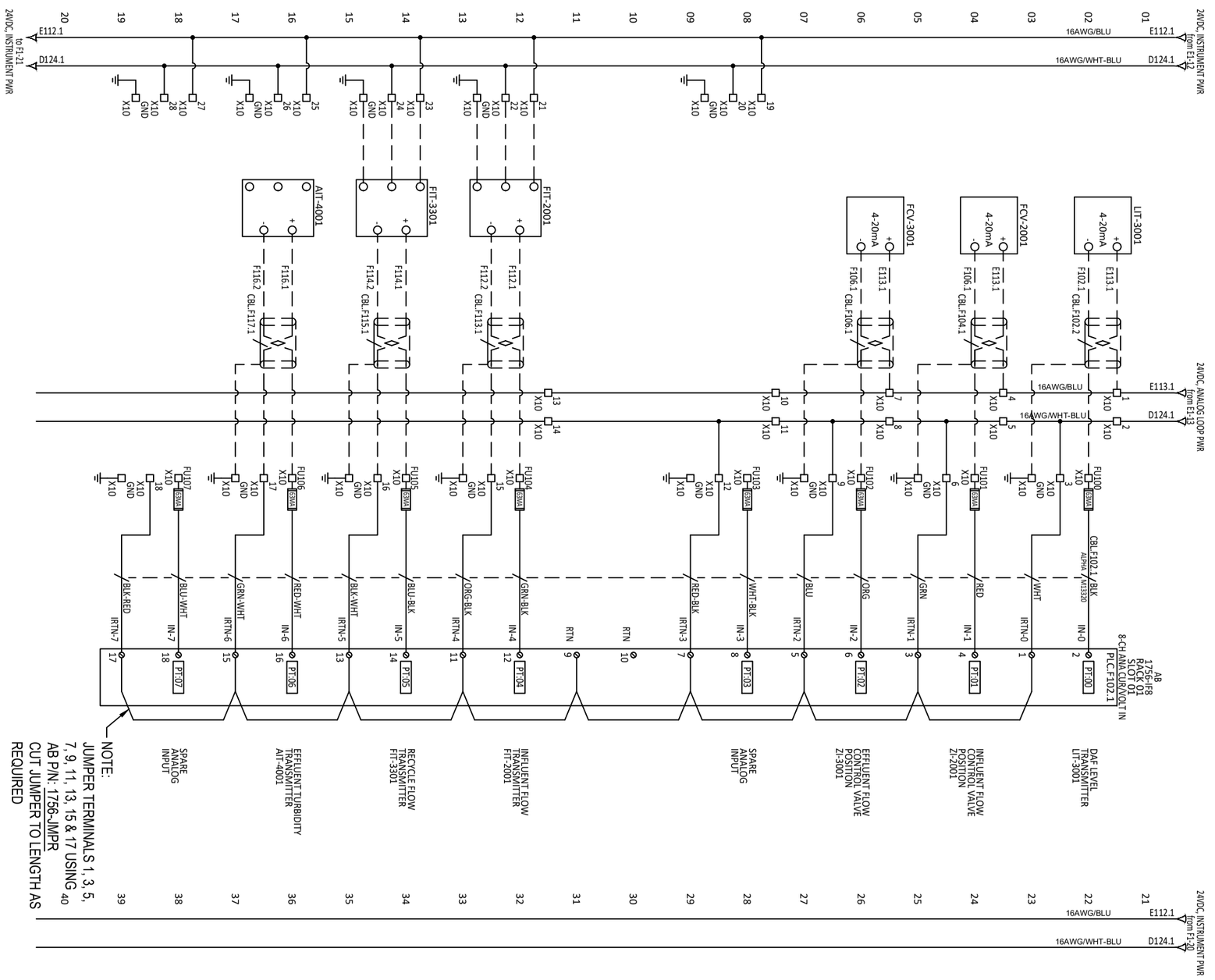
AUMSVILLE WWTP

AUMSVILLE, OR

E-STOP SAFETY CIRCUIT
DRIVE SAFE OFF

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
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AUMSVILLE WWTP

AUMSVILLE, OR

ECP-DAF-3001
ANALOG INPUT

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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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	CFW		04/15/2025	56003EN-25
DRAWING NUM:	SUB SEC:	SHEET:	OF:	REV:
56003EN25_0F01	F	1	2	A.1

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SECTION:	DWN BY:	CHK'D BY:	DATE DWN:	PROJECT NUM:	REV:
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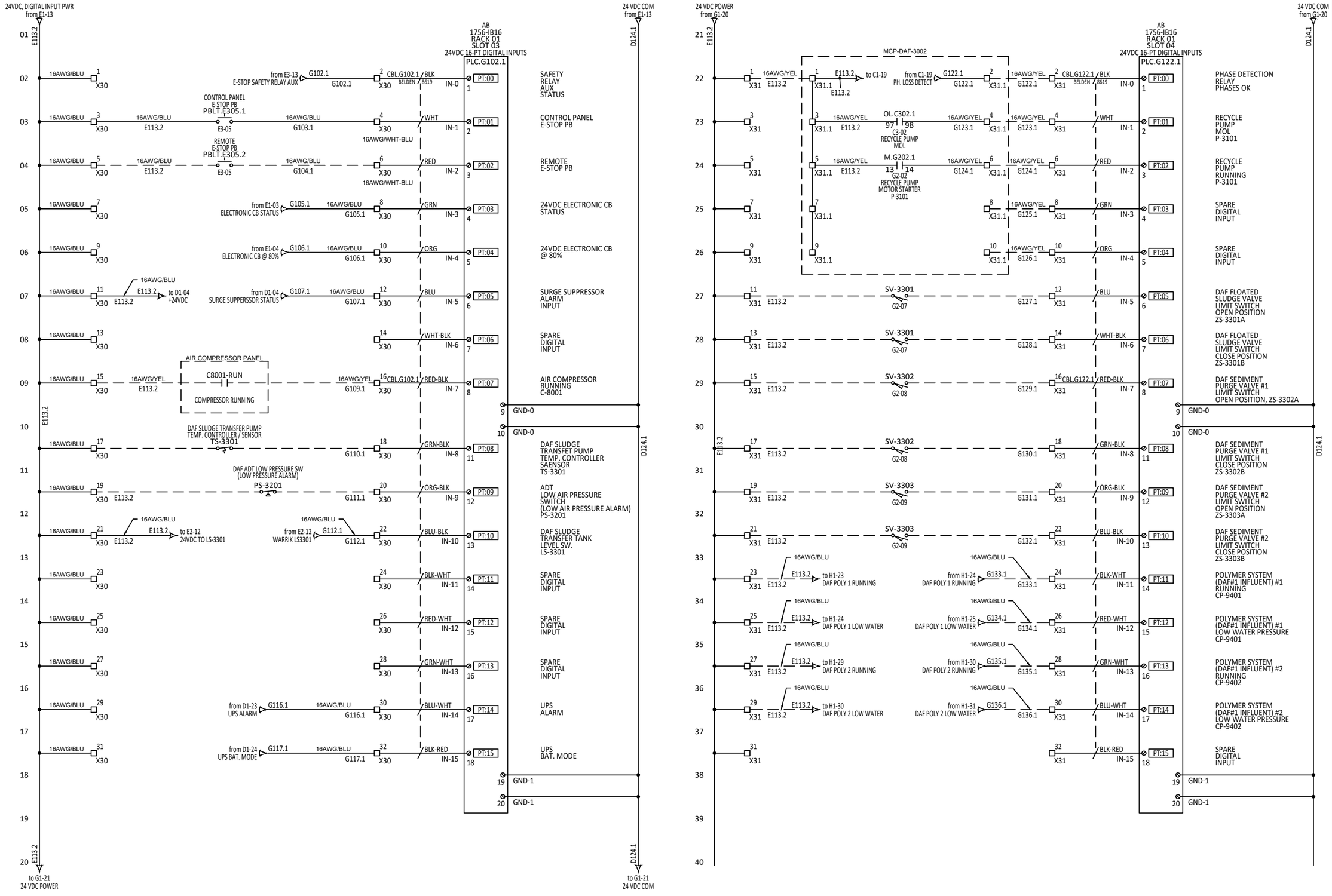
AUMSVILLE WWTP

AUMSVILLE, OR

ECP-DAF-3001
ANALOG OUTPUT

RELEASED FOR: REVIEW

REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS



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PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

SECTION:	DWN BY:	CHK'D BY:	DATE DWN:	PROJECT NUM:
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DRAWING NUM:		SUB SEC:	SHEET:	OF:
56003EN25 0G01			1	2

AUMSVILLE WWTP

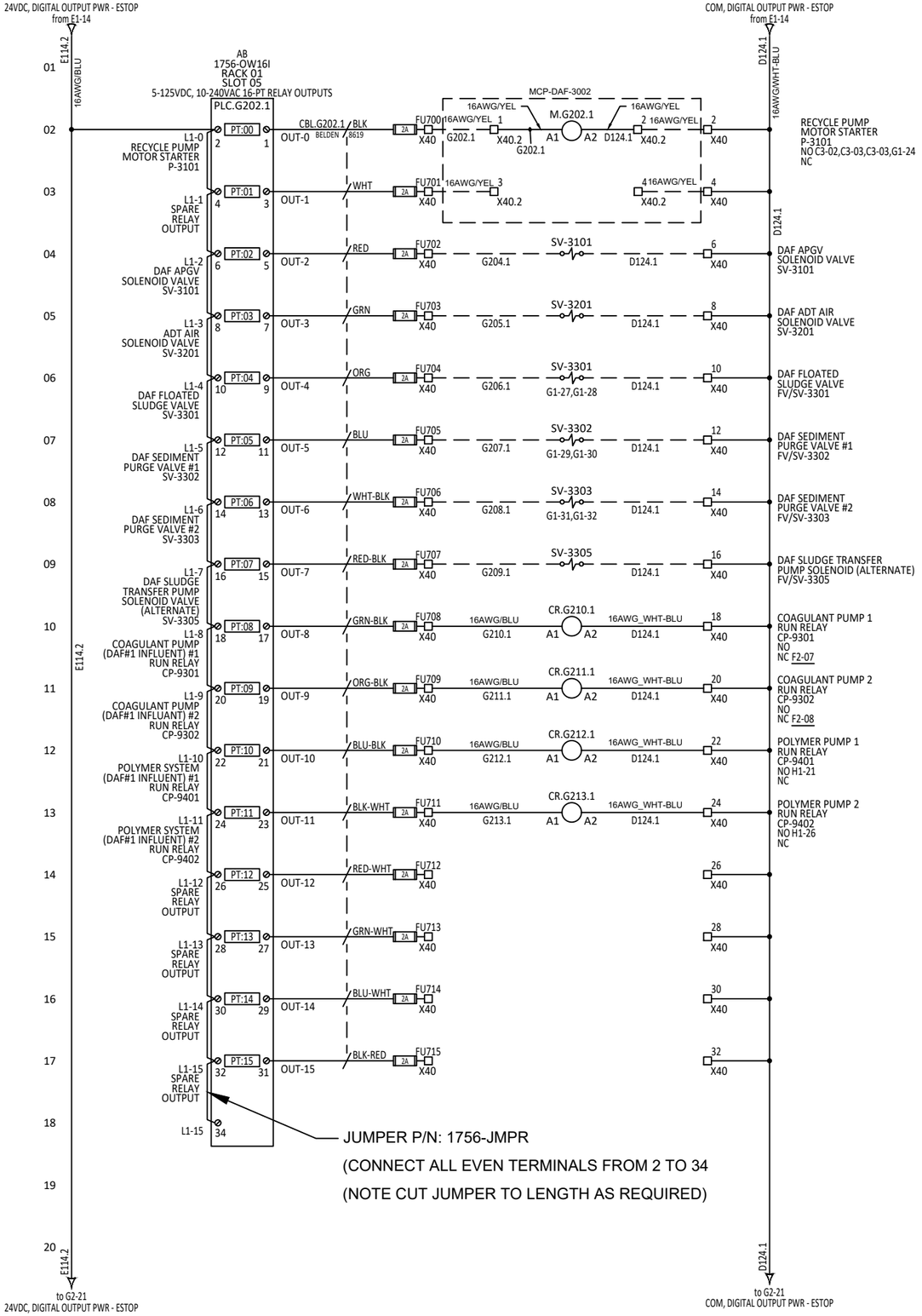
AUMSVILLE, OR

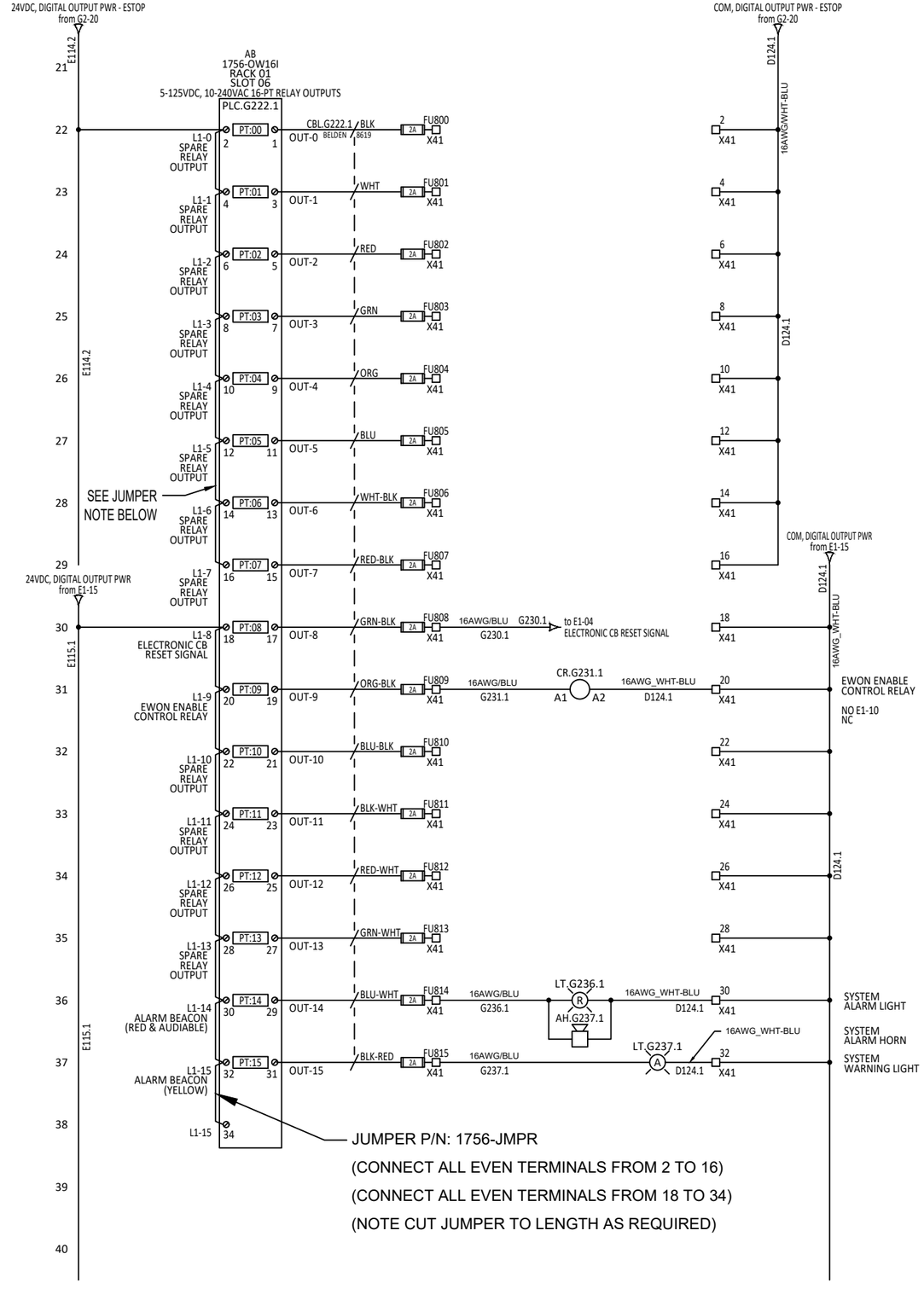
ECP-DAF-3001
DIGITAL INPUTS

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REV.	DATE	BY	REVISION DESCRIPTION
A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

REV: A.1





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PO Box 7 401 South Street Dalton MA 01227
Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

SECTION:	
DWN BY:	CFW
CHK'D BY:	
DRAWING NUM:	56003EN25_0G02
DATE DWN:	04/15/2025
SUB SEC:	G
SHEET:	2
OF:	2
PROJECT NUM:	56003EN-25
REV:	A.1

AUMSVILLE WWTP

AUMSVILLE, OR

ECP-DAF-3001
DIGITAL OUTPUTS

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A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS

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Tel: 413.236.5634 Fax: 413.236.6917 info@krofta.com

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SECTION:	
DWN BY:	CFW
CHK'D BY:	
DATE DWN:	04/15/2025
SUB SEC:	H
SHEET:	1
OF:	1
PROJECT NUM:	56003EN-25
REV:	A.1
DRAWING NUM:	56003EN25_0H01

AUMSVILLE WWTP

AUMSVILLE, OR

CHEMICAL PUMPS

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A	04/15/2025	CWF	FOR REVIEW
A.1	05/29/2025	CWF	UPDATED PER CUSTOMER COMMENTS