SanSep™ Fine CDS Screening CSO Treatment Facility

HARBOR BROOK CSO 018

CONSTRUCTED WETLANDS PRETREATMENT PROJECT

Syracuse, NY

INSTALLATION, OPERATING AND MAINTENANCE MANUAL

REVISION 5 BY CH2M (March 2017)

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PREFACE -

This technical manual has been written in accordance with the Contract Documents on this project, including the following sections:

Onondaga County Green Infrastructure Program:
Harbor Brook CSO 018 Constructed Wetlands Pilot Treatment System
Contract Number 1G – General
Bid Reference Number: 7570, June 2012
Project Number 2012-09F4
Specification Section 11301
Continuous Deflective Separation Screening System (Bid Alt #1)

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1.0 INTRODUCTION

This Operations and Maintenance Manual is designed to ensure installers, operators and maintainers achieve effective installation, efficient operation, and the longest life from the SanSep Screen and related equipment, and at all times ensuring the safety of people, processes and property.

Before attempting to operate or perform any maintenance on this facility, it is important that all engaged personnel read Section 2 on the Health and Safety precautions and practices, to familiarize themselves with the facility and dangers that are inherent therein.

This main body contains all of the narrative of the procedures and methods needed to operate the SanSeptm fine-screening facility, troubleshoot any problems, and test procedures for assuring that it is operating properly. In some cases there may be reference to drawings, specifications, or instructions that contain more detailed information that are contained in the appendices to this main body. The appendices contain the submittal documentation, fabrication drawings, ‘as-builts’, etc.

The SanSep fine screening and floatables control system is an un-powered, passive system except for four automatic valves, working off of the energy of the water in the sewer. There is, however, electrical power to the facility, to power the controls and field instruments, as well as the automatic valves.

2.0 HEALTH & SAFETY PROCEDURES

2.1 WARNINGS

The following warning symbols are used throughout this manual to describe the type of hazard that may be encountered during the installation, operation or maintenance of this equipment. All personnel should pay special attention to the procedures indicated.

⚠ DANGER	Immediate hazard which WILL result in severe personal injury or death.
⚠ WARNING	Immediate hazard which COULD result in severe personal injury or death.
⚠ CAUTION	Hazards or unsafe practices which COULD result in personal injury or product or property damage.

2.2 INTRODUCTION

This Operating and Maintenance Manual is provided to fulfill the responsibilities of PWTech to supply sufficient documentation and instructions to enable the users of the equipment supplied under this contract to operate and maintain the equipment in a safe manner.

The operation and maintenance of this plant and equipment must be carried out in compliance with all current and relevant Occupational Safety and Health Act legislation, both state and federal.

2.3 HEALTH AND SAFETY DURING OPERATION AND MAINTENANCE

Equipment sub-suppliers documentation is contained within this manual that is specific to the individual piece of equipment or sub-system. The instructions in this introduction are offered as a general guideline and should be strictly observed but not be regarded as complete and exhaustive:

i. All work shall be carried out by appropriately trained and qualified personnel.

ii. All equipment shall be made safe; this will require isolation from electrical power and/or process liquid flows. Electrical switches and isolation valves or temporary dams shall be selected and locked in the 'OFF' position before any maintenance work is carried out.

iii. All work on electrical equipment must be completed in strict accordance with local electrical codes and the manufacture instructions.

iv. Safe access must be provided to relevant parts of the plant and all lifting equipment shall be covered by a current safety inspection certificate.

v. Appropriate protective clothing and equipment shall be worn at all times.

vi. When working in confined spaces, gas detection equipment and breathing apparatus in accordance with safety procedures shall be used.

2.4 GENERAL WARNINGS

The following general WARNINGS must be observed before any maintenance work is carried out.

! DANGER

HIGH VOLTAGE CAN KILL!

BEFORE WORKING ON ANY COMPONENT THAT HAS ELECTRICAL CONNECTIONS:

FOLLOW STANDARD SAFETY AND OPERATING PROCEDURES FOR YOUR COMPANY AND/OR FACILITY

MAKE SURE THAT THE ELECTRIC SUPPLY IS ISOLATED.

MAKE SURE THE CIRCUIT BREAKERS ARE TRIPPED AND TAGGED.

MAKE SURE A PERSONAL LOCK IS INSTALLED TO THE ISOLATION SWITCH ON THE MOTOR CONTROL CABINET TO PREVENT INADVERTENT CONNECTION OF THE ELETRICAL SUPPLY.

DANGER

WHEN WORKING IN CONFINED SPACES:

MAKE SURE YOU ARE IN CONTACT WITH A SECOND OPERATIVE WHO IS OUTSIDE OF THE CONFINED SPACE.

ONE PERSON MUST STAY IN CONTACT FROM A LOCATION OUTSIDE OF THE CONFINED SPACE.

MAKE SURE YOU HAVE THE NECESSARY SAFETY EQUIPMENT AND ARE FULLY TRAINED IN ITS USE AND OPERATION.

DANGER

DANGER OF FALLS:

ALL SURFACE ACCESS HATCHES AND MANHOLES OPEN TO UNCONSTRAINED STRUCTURES THAT EXCEED 10 FEET IN DEPTH.

WHEN OPENING ANY HATCH OR MANWAY:

ROPE OFF AN AREA THAT IS AT LEAST 10 FEET OUTSIDE OF THE ACCESS OPENING.

RESTRICT ACCESS WITHIN THIS AREA TO THOSE WITH A NEED TO BE THERE, ONLY IF THEY HAVE TRAINING IN SAFETY ISSUES ASSOCIATED WITH SUCH STRUCTURES.

USE SAFETY LADDERS AND RESTRAINT SYSTEMS THAT WILL PREVENT FALLS BY ANYONE ENTERING THE STRUCTURES.

2.5 CONCLUSIONS

It is the requirement of OSHA legislation, rules and regulations that employers provide such information, instructions, training and supervision as is necessary, to insure so far as is reasonably practicable the health and safety of its employees.

Observance of the foregoing health and safety advice, and the detailed instructions that occur throughout this manual, will benefit both employees and employers alike in seeking to ensure the safe, efficient and reliable operation of the plant and equipment.

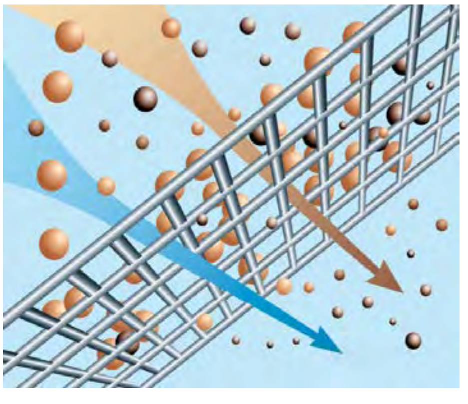
3 TECHNICAL DESCRIPTION AND FUNCTIONAL SPECIFICATIONS

3.1 THEORY OF CONTINUOUS DEFLECTIVE SEPARATION SCREENING

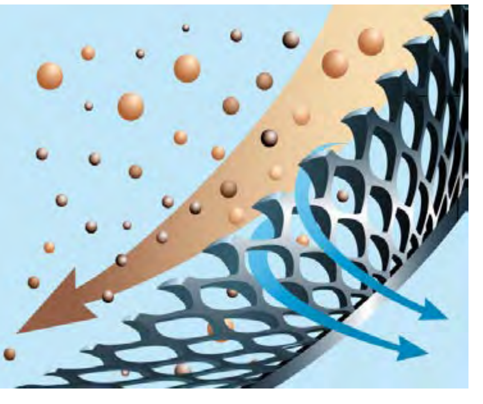
Continuous deflective screening is an INDIRECT screening process that has existed since the advent of inclined screens improved by CDS Technologies in the mid-1990's. Since then it has been used on scores of primary treatment and CSO applications and thousands of stormwater treatment facilities. INDIRECT refers to the fact that the bulk of the flow is parallel to and over the surface of the screen rather than perpendicular and through the screen. It works best when the screen is made of expanded metal (a cheese grater), and the flow travels over the raised solid surfaces of the screen. The velocity across the screens needs to be some multiple of the velocity that makes a 180 degree turn and exits through the opening in the expanded metal. That velocity ratio depends on the nature of the solids in the water stream and their concentration.

The differences between direct are indirect screening are illustrated in Figure 3.1 below.

FIGURE 3-1: COMPARISON OF DIRECT AND INDIRECT SCREENING



DIRECT SCREENING - Solids impinge on screen. Separation is limited to aperture size. Blinding a problem requiring frequent cleaning.



INDIRECT SCREENING – Solids are swept away from screen. Deflection over the aperture carries solids >10% of opening size away from the screen. Continuous self-cleaning.

A typical installation is shown below in Figure 3-2. In their most simple form they are a single unit with a sump for storage of captured suspended solids, oils and grease, and trash and debris. The sump is typically designed to be cleaned by a vacuum truck, although in the Harbor Brook CSO 018 installation there is an underflow pit for capturing and storing grit and heavy materials with an automatically adjusting underflow weir, controlled by a trapezoidal weir. The Harbor Brook CSO 018 Facility also has two CDS screening chambers – the first activates in the early part of all storms and is the only unit that activates in small events. The second screening chamber begins to operate when the first SanSep unit has filled and flows exceed **6** cfs (with all of the stop logs placed in the diversion box 1B weir wall). The system is controlled based on elevations measured upstream of the facility. That is, when flow in the Rowland Street trunk sewer at MH-3302 reaches an elevation of 403.52 (equivalent to 6cfs under normal sewer flow conditions), the facility automatically goes into operation. When the flow in the Rowland Street trunk sewer at MH-3302 drops below 404.59 (equivalent to 6cfs under surcharged conditions), the facility operation ceases.

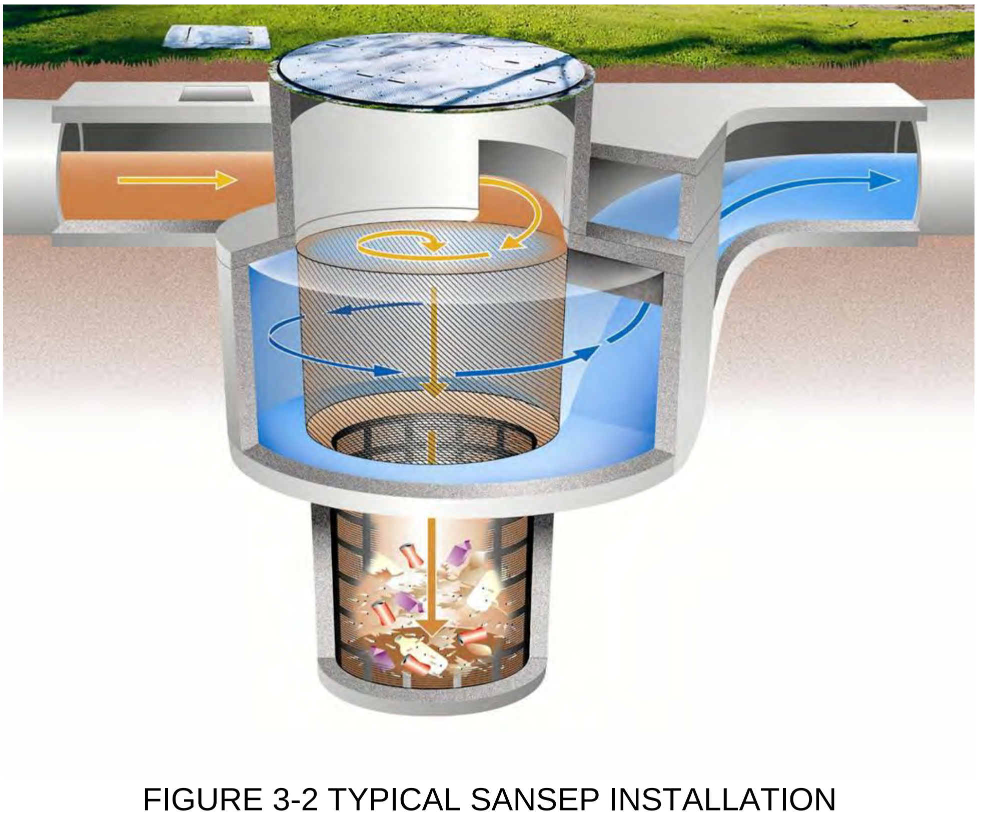


FIGURE 3-2 TYPICAL SANSEP INSTALLATION

3.2 DETAILS OF THE HARBOR BROOK CSO 018 SANSEP

A plan view combined with a flow schematic of the SanSep^{tm} fine screening and floatables control facility is shown in Figure 3-3. It consists of the following major components:

- The Box 1A structure that is built around the 42" combined sewer and contains a gate valve which diverts CSO flow through the facility. The top half of a 5 foot section of the combined sewer pipe is cut out inside this box, directly up-stream of the gate valve. Dry weather flow in this sewer is typically less than 1 foot in depth, overflows occur during wet weather events.
- Box 1B is connected directly to Box 1A and contains a weir wall with stop logs. The weir wall is used to control flows into one or both of the SanSep screening units. With all of the stop logs installed the first SanSep unit gets **6** cfs of flow before any flow can go to the second SanSep. All flow goes into the first SanSep structure until it and Manhole 3C are filled (~1800 cubic feet), and then any flow in excess of 6 cfs will overflow into and begin to fill the second SanSep structure.
- The two SanSep's (SS-1 and SS-2) are fed out of the bottom of Box 1B through an inlet pipe/nozzle that generates the tangential flow on the screen, creating the deflective screening and self-cleaning of the screens.
- The screened flow recombines in Effluent Box Structure (Box #2/MH-1D) where it enters a 48" HDPE pipe that conveys it to the wetlands for further treatment before discharge to Harbor Brook.

- The sumps of the two SanSeps are connected to an underflow control manhole (MH-3C). The 12" PVC pipes out of the SanSep sumps have Tideflex valves on their ends to prevent backflow into either unit if it is not in service. The manhole has a grit storage sump where heavy material drops out and a trapezoidal flow control weir in a weir wall inside the manhole that controls the underflow rate, and is manually adjustable. At the bottom of the weir wall, but above the grit sump, is a gate valve that allows the floatables and organic matter to be drained to the Harbor Brook Interceptor Sewer (HBIS) at the end of an event.
-

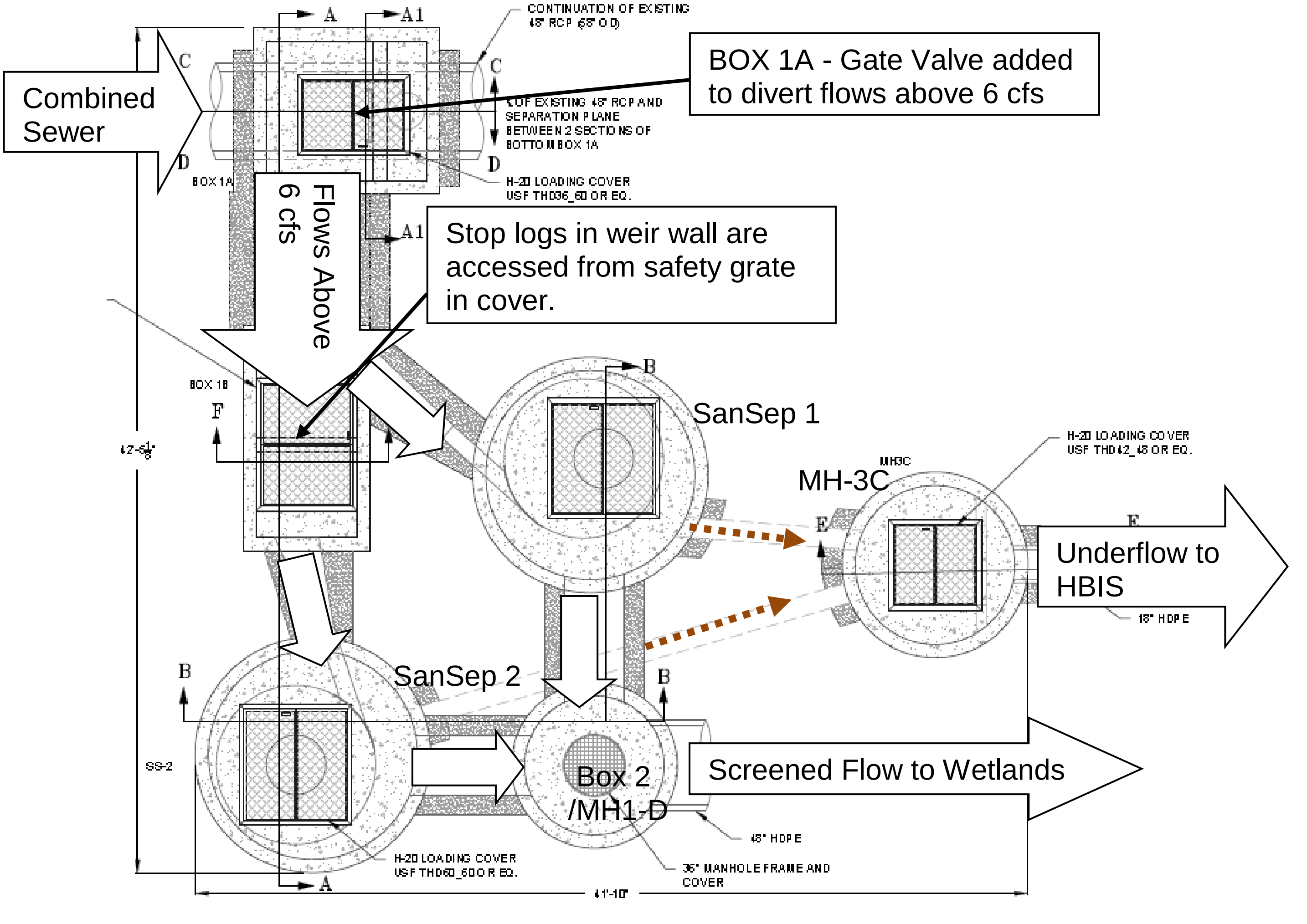


FIGURE 3-3
SanSep[tm] Fine Screen & Floatables Control
Harbor Brook Process Flow Schematic and Plan View

Other features in the facility design:
- Box 1A has an emergency overflow weir that will by-pass an additional 60 cfs of wet weather flow if necessary, directly into the Rowland Street Trunk Sewer. The SanSep screening facility will process up to 60 cfs or 140% of its rated capacity.
- Should the overflow weir pass 60 cfs, an additional 6 cfs (total of 50 cfs) is

processed through the SanSep facility.

- Self-adjusting underflow from the SanSep sumps, will temporarily increase underflow rates if the screen starts to plug from build-up of floatables and organic matter.

3.3 HYDRAULIC GRADE LINE IN THE SANSEP STRUCTURES

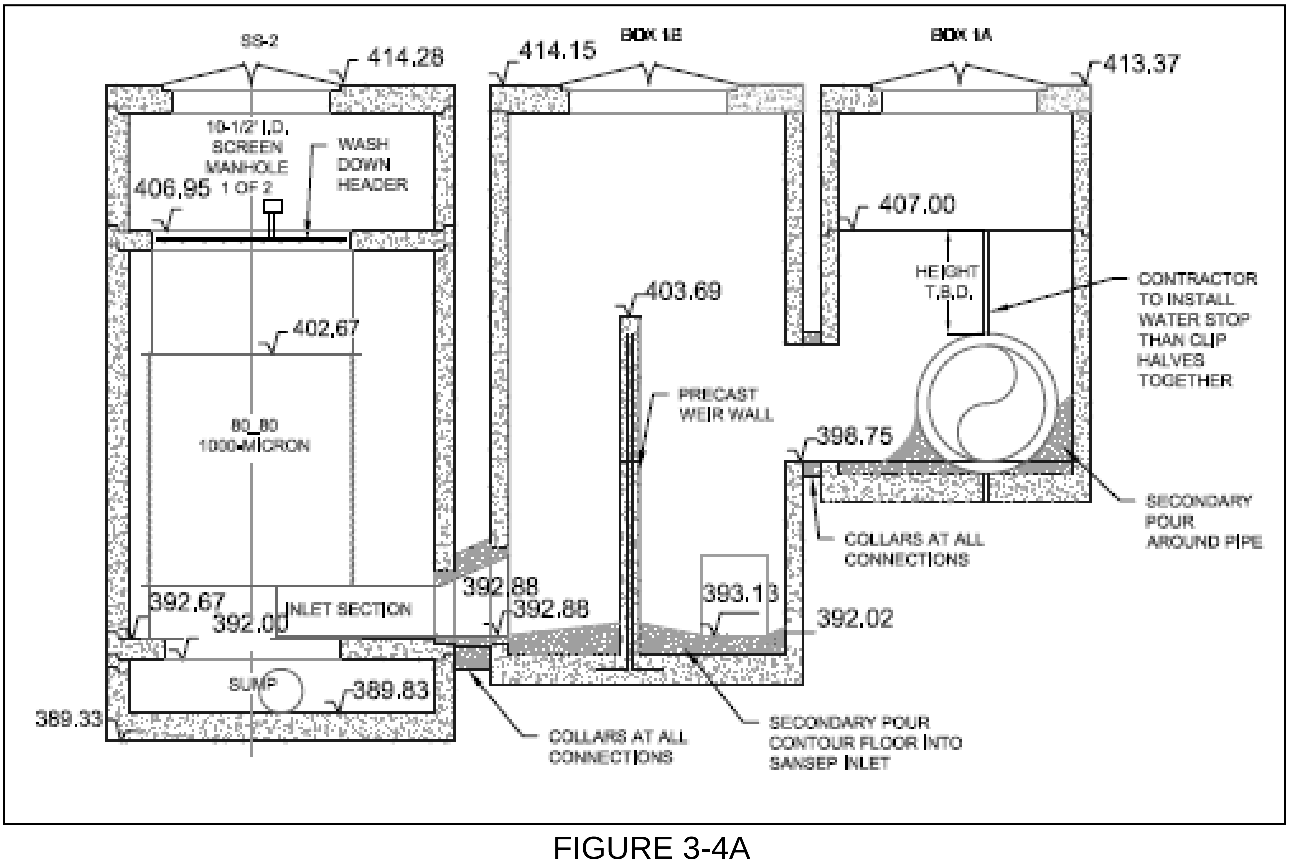
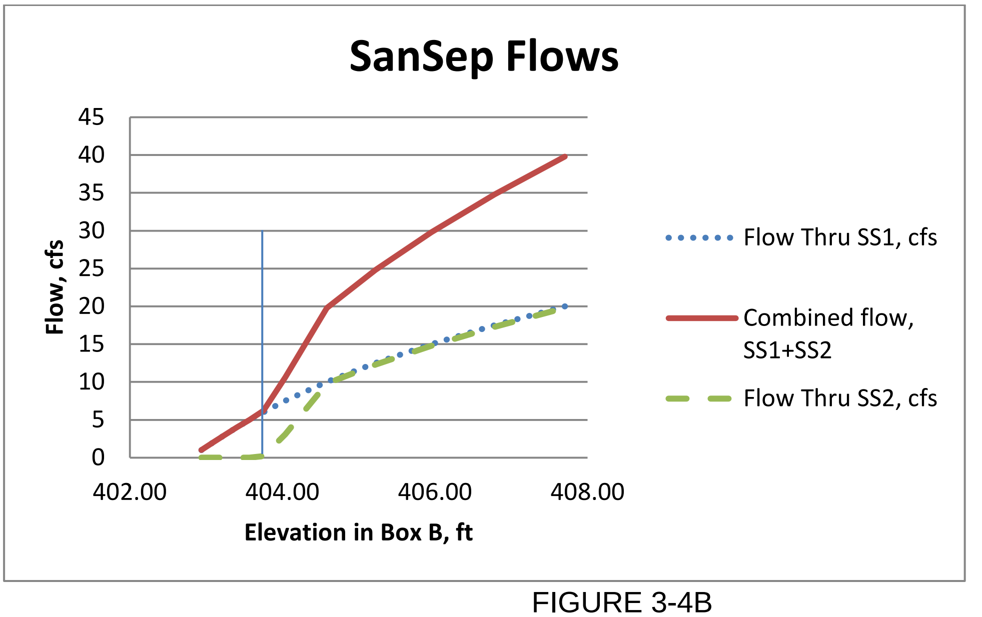
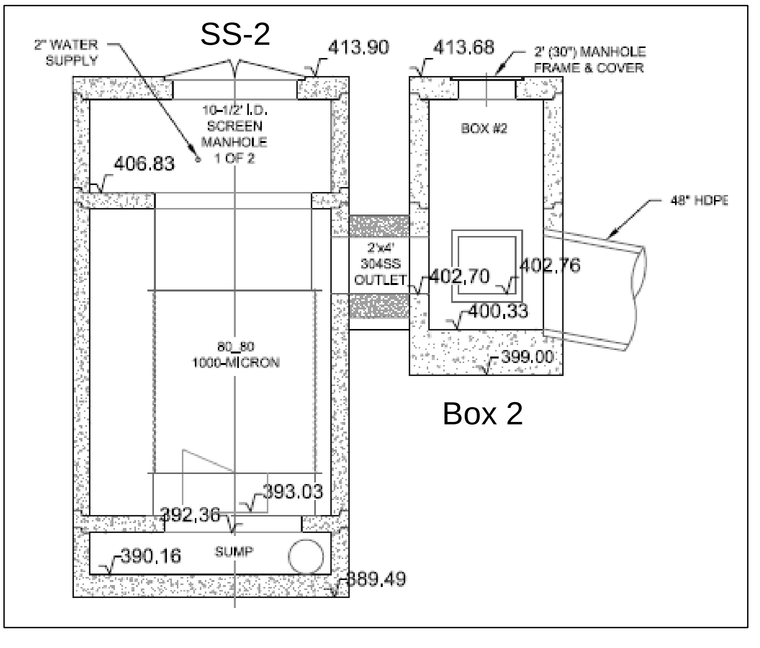


FIGURE 3-4A
HGL thru the INLET SIDE



STOP LOG IMPACT
With 5 stop logs installed all flow goes to SS1 up to 6+ cfs. Flows above 6 cfs start to overflow to SS2, and flow is even to both at roughly 20 cfs total flow.

FIGURE 3-4B
HYDRAULIC GRADE LINE



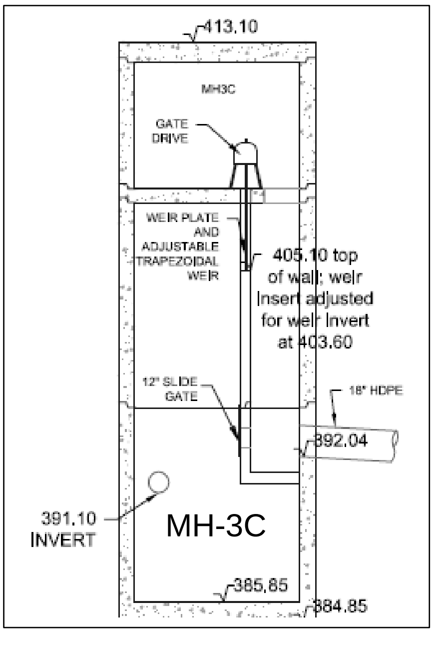


FIGURE 3-4C
HGL thru SCREEN & CLEAN WATER SIDE

FIGURE 3-4D
HGL thru UNDERFLOW SUMP

The flow curves of Figure 3-4B were calculated from the as-built elevations of the inlets and outlets. For small events the first SanSep chamber will receive all flows, and thus maintenance will be quicker and easier. The chambers quickly achieve nearly equal flow, and for major events both are working at optimum cleaning conditions.

3.4 SANSEP PANEL SCREENS

This installation has dual 8' diameter x 8' tall SanSep screens secured in 10-1/2' ID precast manholes, sitting on adjacent sides of a flow diversion box that accepts overflow from the combined sewer. When the flow in the sewer exceeds 6 cfs for 10 continuous minutes, the Box 1A gate valve lowers, diverting CSO flow into Box 1B. Box 1B has a weir wall that directs the initial flow into the first SanSep unit, SS1. When flows into SS1 exceed about 6 cfs the level in the upstream side of Box 1B will rise above the level of the weir wall (adjustable in 1' increments with stop logs) and flow will start to flow through the second SanSep, SS2.

The screens are made of panels that bolt on to stanchions bolted to the floor and roof of the working level slab of the precast manholes. There are 5 layers of panels, and each layer has 5 panels to form that level of the cylinder (Figure 3-5a). The lower panels are 30" tall and are solid steel – the inlet pipe is bolted to one of the panels on this layer, as shown in Figure 3-5b. The panels are bolted to the vertical stanchions. Three levels of 1 mm screen panels, 32" tall sit atop the inlet level, and then a 30" tall solid steel separation chamber is formed with the final (top) level of panels. Floatables, oils and fat and grease are concentrated on top of the column of water and trapped by this top level.

Figure 3-5a
View of panels being installed. Each panel is bolted to the stanchion on each side with three (3) ½"-13 flat head screws with 5/16" hex sockets. The panels are powder coated with a polyurethane plastic that prevents fat and grease from sticking to the screen.

Figure 3-5b
The stainless steel inlet pipe carries the flow from the diversion structure into the SanSep screen. Flow goes through windows in both the diversion structure and the manhole wall. The manhole wall is formed and concreted in a collar that structurally ties the three structures together and holds the inlet and outlet pipes in place.

The inlet pipe is a rectangular channel fabricated of stainless steel, with a curvature and taper to speed up the flow of water as it approaches the entry into the screening chamber. Details are in the drawings of Appendix 1.

The water that flows through the screen flows through an outlet 'pipe' that has an invert just above the elevation of the top of the screen, which traps captured oil inside the separation cylinder that sits on top of the screen. The oil is released to the HBIS when the units are drained after an event.

3.5. CONTROL PANEL, FIELD INSTRUMENTS, AND OPERATION

The screening facility is controlled and monitored by a control panel that is more fully detailed in Appendix 4. The controls are very simple –

- An ISCO 360 LaserFlow flow sensor is installed in MH-3302 upstream of Box 1A. The 360 LaserFlow flow sensor is installed above the flow of water within the sewer preventing the possibility of damage to the meter due to debris within the sewer. The 360 LaserFlow flow sensor measures flow depth (ft) and velocity (ft/s) which is then converted to flow rate (cfs) by the ISCO Signature Flow Meter in Panel A.
    - In February 2017, OCDWEP installed an ISCO ultrasonic level sensor in addition to the LaserFlow sensor, with the expectation being that the ultrasonic level sensor will take the place of the LaserFlow in the long term. If that occurs, the operation described below will be identical, except that it will be based off of the ultrasonic level sensor.
- When the 360 LaserFlow flow sensor measures an elevation greater than 403.52 (403.52 elevation equates to 6 cfs of flow within the sewer under non-surcharged conditions) in MH-3302 for 10 continuous minutes, the following occurs:
    - The Programmable Logic Controller (PLC) sends a signal to close the main sewer gate valve in Box 1A to divert flow through SanSep pretreatment system. This occurs for a minimum of 50 minutes per diversion.
    - The PLC sends a signal to close the gate valve in the lower part of the

underflow sump weir wall (MH-3C), so that the only underflow that by-passes treatment is that which flows over the weir wall through the trapezoidal weir, which in turn controls the underflow proportionally to the flow through the pretreatment system.
  - The ISCO Signature flow meter and PLC begin accumulating flow and level data. The data is primarily available over OCDWEP's SCADA system. As a backup, the data can be downloaded from the Signature flow meter and written to a USB thumb drive.
  - During an event there are three dual-channel ultrasonic level monitors, monitoring the levels inside and outside of the screen in each of the SanSep units, and the levels in the underflow sump and the filtered water manhole. These levels are recorded and serve no control purpose other than to provide information on screen blinding and to provide elevation data for calculating underflow and screened effluent flow rates.
- After flow is diverted to the SanSep facility and flows into the wetland for further treatment, the Rowland Street Trunk Sewer becomes surcharged. The surcharged flow causes artificially high flow rates computed by the 360 LaserFlow sensor. However, the level measurements measured by the sensor are still accurate.
- At the end of an event the Box 1A gate will open and stop diverting flow to the SanSep facility when the elevation measured by the 360 LaserFlow sensor in MH-3302 is less than 404.59 for 20 continuous minutes. (The 404.59 elevation equates to 6 cfs of flow within the sewer when the system is surcharged.)
- Simultaneous to when the Box 1A gate is reopened by the PLC at the end of an event, the PLC opens the MH-3C underflow gate valve. The SanSep units will drain down until the sumps are nearly empty. When this happens the PLC opens actuated washdown valves, feeding spray headers which flush the screens and the floors of the sumps for 20 minutes to prevent build-up of sediment, trash and debris in the SanSeps.
  - If a new event begins during the washdown cycle, the washdown sprays will shut off and the event will proceed as previously described.
  - The washdown sprays have proven to be ineffective after long-duration events (multi-day events). In these situations, manual cleaning of the screens by OCDWEP staff with a vactor truck is necessary.
- After flow is less than 6cfs and the Box 1A gate is opened, a 10 minute continuous time delay is programmed into the system before the Box 1A gate closes again (if flows are above 6cfs). This time delay prevents the Box 1A gate from going up and down repeatedly when flows are undulating near 6cfs.

Control Panel A also houses an Ethernet switch and a modem for communication with Panel B, located at the wetlands, which in turn, controls the valves distributing flow to the wetlands, and transmits data to the County's SCADA system. Communications over SCADA are through fiber optic cable that provides local cable service. The main FCS panel is NOT a remote SCADA station, but rather a PLC that provides data to the SCADA processor. The County has integrated data from the following flow meters/level sensors into their SCADA network:

- MH-3302 (ISCO 360 LaserFlow Sensor): Level, velocity, flow rate, and volume

- MH-4A (ISCO 350 AV Sensor): Level, velocity, flow rate, and volume
- MH-5A (ISCO 2150 AV Sensor): Level, flow rate, and volume
- MH-18 (ISCO 350 AV Sensor): Level, velocity, flow rate, and volume
- MH-19 (ISCO 350 AV Sensor): Level, velocity, flow rate, and volume

In addition, facility alarms are communicated over the SCADA network. A list of the alarm names, message, description and Metro Board action is included in Appendix 4.

3.6 DEFLECTIVE SEPARATION SCREENING PROCESS

The SanSep^{tm} fine CDS screens are mainly self-cleaning expanded metal screens that pass water and stop all solids that are roughly 10% of the size of the screen apertures (1 mm) or larger. This means that the screened flow passing through the SanSep screens will contain solids no larger than 100 microns. A small amount of head in the sewer is converted to velocity in a tapered inlet nozzle that produces a tangential velocity across the face of the screen to keep the screen from blinding. The screen is an expanded metal sheet with the raised surfaces in the same flow path as the rotating water column, so that as the water passes over the raised metal surface that shades each hole, the water and the solids in it are deflected away from the opening. The momentum of the solids away from the opening produce the effect that allows the process to capture solids that are much smaller than the aperture of the opening in the screen.

The screen is made of fabricated panels with an 8 foot inside diameter. Each panel is 32 inches tall and there are 5 panels to make the circle. Three levels of panels comprise the 8 foot tall screen. The panels are fabricated from 1 mm (.04 inch) aperture expanded metal 316L stainless steel sheets, with a frame of 316L stainless angle and flat bar that the screen is welded to. Each panel is then electro-coated with a poly-urethane plastic that prevents fat and grease from sticking to the surface of the screen. The panels are bolted to 316L stainless steel stanchions that are bolted to the floor and the ceiling slab, and have adjustments to adjust the level. The stanchions are drilled and tapped with 6 (six) each ½”-13 x 1” long 5/16” hex head screws that hold the panels to the stanchions.

The inlet to the SanSep screens is a tapered rectangular pipe that connects into a ‘separation cylinder’. This cylinder is comprised of panels the same as the screen, but shorter. The inlet panel has a mating flange for connecting the inlet pipe.

The inlet pipes are fabricated rectangular 316 stainless steel that reduce down to an inlet that is 10 inches wide and 21” tall. This ‘pipe’ accelerates the flow from the diversion structure so that at design flow rates the flow velocity in the inlet is 14 ft/sec. The head loss in the SanSep screening device, including inlet and outlet losses, is less than 4 feet at peak design flows. The additional height of the weir is necessary to overcome the tail water on the outlet, equal to the critical depth of entry into the outlet pipe from the down-stream side of the diversion structure.

The water column inside of the screen rotates with maximum velocity just inside of the screen surface. There are secondary currents that have a vertical rotation as well, and the inner 1/3 (approximately) of the liquid inside the screen is nearly at rest.

Materials heavier than water are delivered by the secondary currents to the quiescent column boundary and will gradually settle into the sump, the speed with which they do so depending on the specific gravity of the particle. Materials lighter than water will migrate to the top of the quiescent water column and accumulate there during operation of the SanSep units.

At the end of the storm event the automation switches the gate valve positions (opens the gates in the underflow sump and in the sewer), to send flow back into the sewer and drain the accumulated solids from the underflow sump into the sewer. When the levels have fallen in the SanSeps and the underflow sump, a washing regimen is initiated that flush the screens and the sumps (as described below in 3.7)

3.7. WASHDOWN SYSTEM

The facility has a potable water supply that is connected through a backflow preventer into each of the SanSep chambers. There is a working slab that is part of the SanSep manhole, with an opening just smaller than the diameter of the screens. A circular pipe with spray nozzles on approximately 24" centers connected to the fresh water supply through an actuated 1-1/2" ball valve. The ¼" diameter spray nozzles are mounted on ball joints that are in couplings in the ring for each nozzle, allowing the flow to be directed onto the separation chamber walls, just above the top screen panels. This allows the development of a falling film of water for removing solids that might have started to adhere to the screens, or that get partially trapped during draining of the SanSep structures. A photo of the wash rings in one of the SanSep chambers is shown Figure 3-6 below.

Figure 3-6
WASHDOWN RING

3.8. WEIGHTS

Stanchions – app. 100 lbs.
Screen panels - app 60 lbs.
Separation Cylinder panels – app 120 lbs.
Inlet and outlet pipes – app 275 lbs.

3.9 ACCESS TO SCREEN CHAMBER

Access into the screen chamber is through a hatch cast into the cover on each SanSep manhole structure. There are no internal ladders and the structure is more than 20 feet deep. ENTRY INTO THIS STRUCTURE SHOULD BE BY QUALIFIED OPERATING AND MAINTENANCE PEOPLE, AND ONLY WHEN ABSOLUTELY NECESSARY. ALL COMPANY PROCEDURES FOR CONFINED SPACE ENTRY AND AREAS WHERE FALL PROTECTION IS REQUIRED SHOULD BE STRICTLY FOLLOWED. See the precautions contained in Section 2 of this document.

3.10. SPECIFICS OF THIS INSTALLATION

The scope of supply for this project is as follows:

- Two 10-1/2' ID precast concrete structures, overall height of 27 feet +/-, in eight sections each, as detailed in the drawings in Attachment 1, including butyl mastic rope and ribbon for joint seals.
- Two 8' ID SanSep screening units, complete with all stanchions, screen panels, separation cylinder panels, concrete anchors and attachment screws.
- Wash rings with actuated ball valves for automatic cleaning of the screens after each event.
- Two inlet and two outlet prefabricated pipes as detailed in the drawings in Attachment 1.
- A diversion structure that is positioned around a 42" concrete sewer, with a portion of the sewer cut out and a gate valve that lowers into the pipe to block forward flow and divert storm flows through the SanSep pretreatment system, and on to the wetlands system.
- An underflow manhole connected to sumps in each SanSep structure, through 12" pipes, with a weir wall with an adjustable trapezoidal weir plate that controls the underflow being sent to the sewer, to be roughly proportional to the wet weather flow being processed through the SanSep system. The SanSep will treat flows once they reach 6 cfs, with essentially no underflow. At the peak treatment capacity of the system of 44 cfs, there will be an underflow of approximately 6 cfs. A second gate valve in the system, mounted on the internal weir wall in this structure, opens after an event is over, to release the captured underflow into the sanitary sewer system.
- And finally there is a manhole that collects the screened waters from the two SanSep screens and sends the screened CSO into a 48" pipe that connects to the wetlands.
- A control panel containing a PLC, communication gear, two dual-channel Hydroranger ultrasonic level transmitters, an ISCO Signature Flow Meter,

sensor, and motor operators for the two gate valves and two actuated solenoid valves.

4.0 INSTALLATION

The following are procedures that generally apply to installation of single or multi screens.

4.1 PRE-INSTALLATION PROCEDURES AND PRECAUTIONS

Screen chambers are usually in the form of a confined space, typically a manhole. Even if they have an open top precautions must be taken just as if entering an underground vault with a manhole or hatch.

WARNING

The following steps are typically conducted in preparing to install a SanSep fine screening assembly.

a. On arrival on site all fitters/installers should report to the site/works manager who will normally carry out a site induction into the Site Safety procedures and undertake a review of the method statement and risk assessment specific to the project. The project shall be fully discussed. On-site safety instruction from the site manager/agent shall be followed.
b Copies of training certificates for site staff will be carried by fitters/installers and issued at induction.
c Copies of equipment certification will be carried by fitters/installers and issued at induction.
d 'Permit To Enter' will usually be issued before work proceeds.
e An atmosphere analyzer (sniffer) should be used to make sure that the oxygen level in the chamber is adequate and that there are no hazardous, reducing, or explosive gases present. Otherwise, the chamber, if below ground or enclosed on all sides, MUST be ventilated for a minimum of 15 minutes.
f Fitters/installers entering the chamber should be equipped with the following equipment:
    a. Protective clothing - overalls, gloves, safety boots and hard hats. Unless local site conditions dictate otherwise Hi-Vis tabards/jackets to be worn at all times.
    b. Gloves and goggles will be required where activities dictate e.g. drilling.
    c. Ear protection shall be worn where noise assessments indicate noise exceeding 85dbA
    d. Gas detector - To be lowered five minutes before commencement of work.
    e. Escape set B.A. (breathing apparatus)
    f. Safety harness, with tether and lifting winch.
    g. If the gas detector(s) sounds, the personnel MUST don the escape set B.A. and exit the chamber. Re-entry to the chamber will only be allowed when the chamber is gas free.
    h. A top man MUST be employed at all times. He/she MUST have audible contact with the fitters at all times.
    i. It is intended that one fitter/installer will be working within the chamber at one time.
    j. Survey chamber and check dimensions.

4.2 HANDLING & LIFTING PROCEDURES

WARNING

The fabricated pieces that might have to be removed and/or replaced are heavy and if dropped could cause severe injury to people and damage to materials and equipment. Follow company procedures as well as good practices when raising or lowering these pieces into the manholes. At the minimum:

- Insure that the pieces are secured to any rigging devices used for raising and lowering.
- Don't raise or lower pieces into a manhole in which there are people that could be underneath a falling piece.
- If raising and lowering manually, make sure that there is a person with a 'brake' to keep any slack rope or chain being used tight, and that will stop the piece if grip on the rope or chain is lost.

Figure 4-1 LIFTING

Screen panels, stanchions and separation cylinder panels can all be rigged with a flexible strap such as shown here for lifting in and out of the manhole structure.

4.3 SCREEN INSTALLATION PROCEDURE / PREINSTALLATION CHECK LIST

Before installation commences the following points should be noted:

- The concrete must be cured as specified by the civil contractor.
- Precast components should be checked for dimensional accuracy, with heights and openings within ½" (13 mm) of specification, individually and cumulatively.
- The sump opening and the opening in the working level slab at the top of the screen must be placed as shown on the drawings.

Installation of the screen assemblies can proceed once the above checks are made and duly noted. The following order avoids common pitfalls and problems when installing the screen assemblies:

1. Establish a base at the specified elevation and place the SanSep sump level manhole sections.
2. Place the separation cylinder level precast piece and position it so that the inlet screen section lines up with the feed point to the SanSep. Lift the separation cylinder and place sealant (butyl mastic rope or other as specified by the manufacturer or engineer).
3. Place the next precast sections, up to the top of the screen section, and apply sealant.
4. Install the screen, making sure that stanchions are vertical and the screen panels are square. Note – the screen panels must be installed so that the raised surface of the expanded metal is raised in the direction of flow rotation.
5. Install the access slab section of the manhole and anchor the stanchions to the top of the separation slab and the bottom of the access slab.
6. Install the remaining manhole sections to the top of structure, and then install the washdown ring into the opening in the access slab, above the screen top extension.
7. Hook up the water supply to the washdown ring, start water flow, and adjust spray nozzles to provide a uniform spray onto the separation ring, above the top layer of screens.

4.4 COMMISSIONING

When the internals are installed, open the sewer to the diversion structure and wait for the next storm event of sufficient intensity to create an overflow condition in the main sewer. Make the following observations:

1. During the event – an evident 'swirling' motion should be evident inside of the screen, the velocity increasing with the intensity of the event. This should continue throughout the event, and after the storm has subsided the rotation will continue for a period, until the flow out of the sewer has completely stopped.
2. After draining the unit at the end of the event, observe the cleanliness of the screen. All leaves, paper, etc. should have flushed down into the sump. There may be some discoloration of the otherwise white screen, and this should flush off with an effective screen washdown.
3. After the gravity draining, the automation should start a flush of water onto the side of the separation cylinder just above the screen interface. Make sure that the nozzles are providing a more-or-less equal spray around the periphery of the separation cylinder. Note: The interior of the screen chamber will rapidly fill with mist so that no details are discernible. You'll need to note the final condition of the screen after the spray has stopped, and the initial spray pattern before the mist develops.

5. OPERATIONS, CONTROLS & INSTRUMENTATION

5.1 DESCRIPTION OF OPERATION AND CONTROL PHILOSOPHY

The facility's operation is simplified by the gravity-controlled underflow system, which eliminates the normal pumping-system that is used to evacuate solids captured by the SanSep during a wet weather event.

The combined sewer that is serviced by this facility has the capability of conveying over 140 cfs (in a 42" pipe). However, surcharging of the HBIS limits the flow into it during a wet weather event, to approximately 6 cfs. And therefore, it is a requirement of this facility that it divert flow to a constructed wetlands when flow in the sewer exceeds 6 cfs. This is accomplished by automatically diverting the flow when the elevation measured by the LaserFlow sensor in MH-3302 upstream of the SanSep facility exceeds 403.52 for 10 continuous minutes.

Once the sewer flow is diverted by the gate valve in Box 1A and the SanSeps fill to their capacity, surcharging of the sewer occurs. When surcharging occurs, the 360 LaserFlow sensor calculates artificially high flow rates. For this reason elevation data are used to control when the sewer flows are diverted to the SanSep system.

At the end of the event when sewer flows subside and the elevation measured by the 360 LaserFlow is less than 404.59 for 20 continuous minutes, diversion of the sewer flow will cease. At this time, the underflow bypass gate valve is automatically opened to drain the system and the SanSep washdown sprays are activated for a period of 20 minutes.

Each SanSep unit has dual ultrasonic level sensors that measure the level on the in-side and outside of the screen in the unit. Normally the velocity through the screen is less than $1/10^{th}$ ft/sec and the head loss across the screen is a fraction of an inch. However, as solids build up inside of the screen, they will impede flow through the screen and the head loss will increase. This increases the underflow sump level and the flow through the trapezoidal weir will increase, evacuating the solids that have built up at a faster rate, and thus providing the means to again decrease the head loss and restore normal levels in the screen. The underflows are regulated by Tideflex flexible rubber valves that are attached to the discharge of the underflow lines from each SanSep. When the head in one SanSep increases due to this blinding phenomenon the increased level in the underflow sump will pinch off the orifice in the non-blinded unit very slightly, decreasing the underflow from that unit, to help to clean the solids from the more-blinded unit.

Should the treatment facility lose power, the diversion valves will remain in the last position, but the washdown valves will fail to the closed position. So, if the power failure occurs during dry weather flow, nothing happens. If power failure occurs during an event, the gate valves remain closed, diverting sewer flows through the SanSep facility, and controlling underflow through the underflow by-pass weir. If power failure occurs during the washdown phase, washing flow is shut off, and both of the gate valves remain open.

5.2 INSTRUMENTATION

5.2.1. TELEDYNE-ISCO SIGNATURE FLOW METER

The Signature Flow Meter, located in Panel A, receives the level and velocity data from the flow sensors in MH-3302 and MH-4A and converts it to flow. Additionally, transmission of the collected data via OCDWEP's SCADA system occurs within this unit.

Note: An ISCO 350 area velocity sensor was initially installed within Box 1A at the time of construction. After less than 6 months of operation, the sensor was damaged by an object in the sewer. Based on subsequent conversations with the County, it was decided that a non-invasive sensor (360 LaserFlow) would be utilized instead of the area velocity sensor. Due to significant turbulence in Box 1A, the 360 LaserFlow sensor was installed in the next upstream manhole, MH-3302. Both the 350 area velocity sensor and the 360 LaserFlow flow sensor are compatible with the Teledyne ISCO Signature Flow Meter electronics in Panel A.

The 360 LaserFlow sensor provides depth, velocity, and calculated flow measurements. All of this data is monitored and available from the Signature Flow Meter. The sensor head for the 360 LaserFlow provides for laser Doppler velocity sensing and ultrasonic level sensing, and the data is transmitted via a cable to the flow meter in the control panel.

An ISCO 350 area velocity sensor is installed in MH-4A to collect influent data for flows to the wetland. This data is reported in the quarterly performance reports.

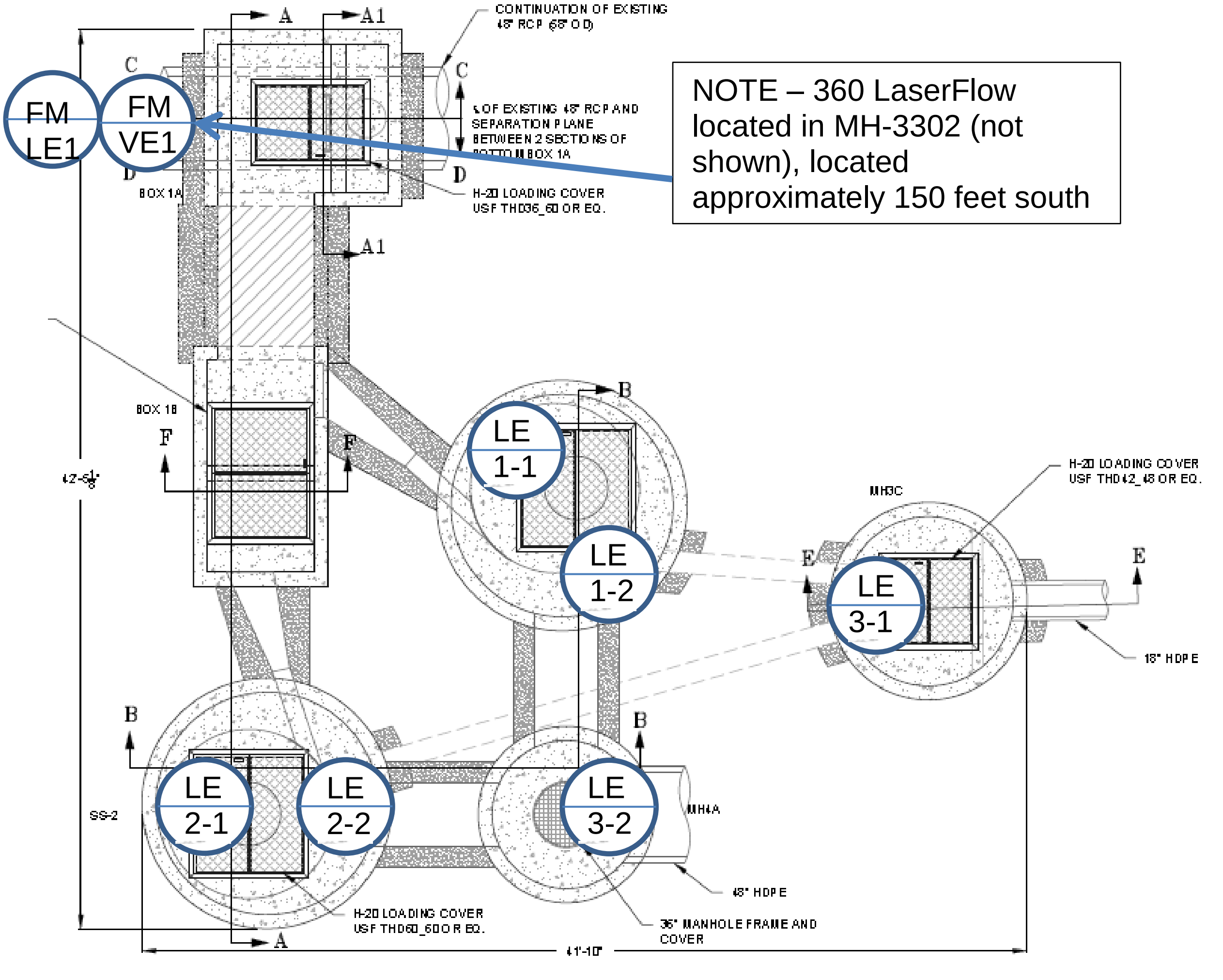
5.2.2. SIEMENS HYDRORANGER ULTRASONIC LEVEL METERS

There are three dual channel Hydroranger level meters in the pretreatment facility. The only purpose of these level monitors is to provide data for monitoring the operation of the SanSep screening facility.

Two of the level meters measure levels inside and outside of the screen, one meter in each of the two SanSep units. These two meters only measure levels during an event, when the SanSeps are full of water, and the difference in level is normally less than the sensitivity of the transducers (0.01 foot of water elevation). If the level difference across the screens increases to more than 0.16 feet (2 inches), it is an indication that the screen may be developing a head loss that requires more aggressive cleaning – such as with a firehose or a vacuum truck high-pressure cleaning system.

The third dual channel Hydroranger is used to measure elevations in the underflow sump and in the screened water manhole that collects the screened flow from the two SanSeps and feeds it into the 48" pipe going to the flow control box to the wetlands.

FIGURE 5-1
LOCATION OF FIELD INSTRUMENTS



FM VE is the velocity portion of the VLE transducer
FM LE is the level portion of the VLE transducer
LE x-y is the ultrasonic level transducer, meter number x (1, 2 or 3) and channel (1 or 2)

The levels in the underflow and screened flow sumps can be used to calculate flows – through the trapezoidal weir in the case of the underflow sump, and of screened flows in the case of the screened flow sump. As long as there is no surcharging, standard hydraulic models will predict flow given the depth of the open channel flow into each outlet.

To calculate flow into the 48” pipe carrying screened flow to the wetlands, the flow out of Box 2 must be free-flowing (no surcharging) and running above critical velocity once in the pipe. The other portion of the flow that is coming into the grit and floatables system is that leaving through the underflow control trapezoidal weir.

Pipe Flow Calculation: In a 48" HDPE pipe, flow will be supercritical in the pipe at flows to over 70 cfs as long as the slope of the pipe is at 0.02% or above, which it is at the Harbor Brook CSO 018 treatment facility. The pipe will be running at less than ½ full at the 40 cfs design point for the SanSep units. Flow out of Box 2 will be critical at this point – the kinetic energy (flow) into the pipe being equal to the head energy (water depth) going into the pipe (Froude number = 1, the definition of critical flow). Mathematically the equality equation is given by:

$$\frac{Q^2}{g} = \frac{A_c^3}{T_c}$$

where Q is the flow, cfs
A_c is the area of the pipe into which the flow is entering, ft^2
g is the gravitational constant (32.2 ft-lbf / second^2-lbm
and, T_c is the width of the critical flow entry, ft.

The level instrument gives the critical depth, which allows one to calculate the critical flow area and the width of the pipe at the air-water interface, and then you solve for the flow. Or you take the measured critical depth and read the flow off the graph in Figure 5-2A below.

Trapezoidal Weir Calculation: The same thing is done with the under-flow through the trapezoidal weir that controls the amount of solids flowing into MH3C. Here the flow in the weir is the difference between the elevations measured inside of the screens in the SanSeps and the elevation at the invert of the trapezoidal weir (405.10 – 1.5 = 403.60 ft, as set in the field by the contractor). Figure 5-2B shows both underflow and main flow against depth of flow through the trapezoidal weir.

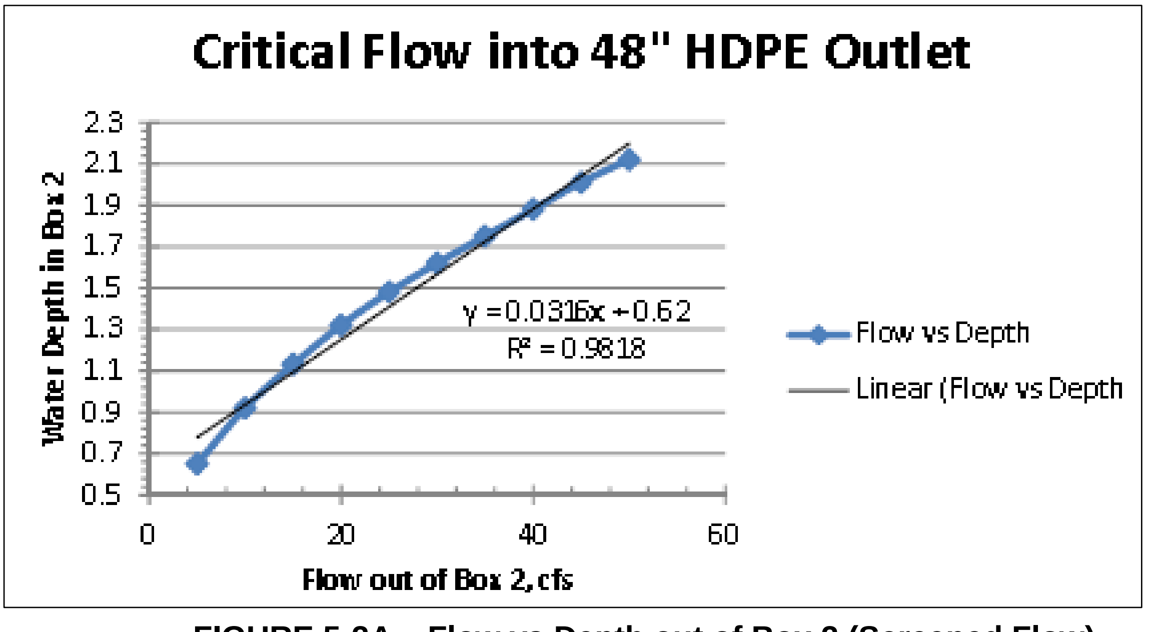


FIGURE 5-2A – Flow vs Depth out of Box 2 (Screened Flow)

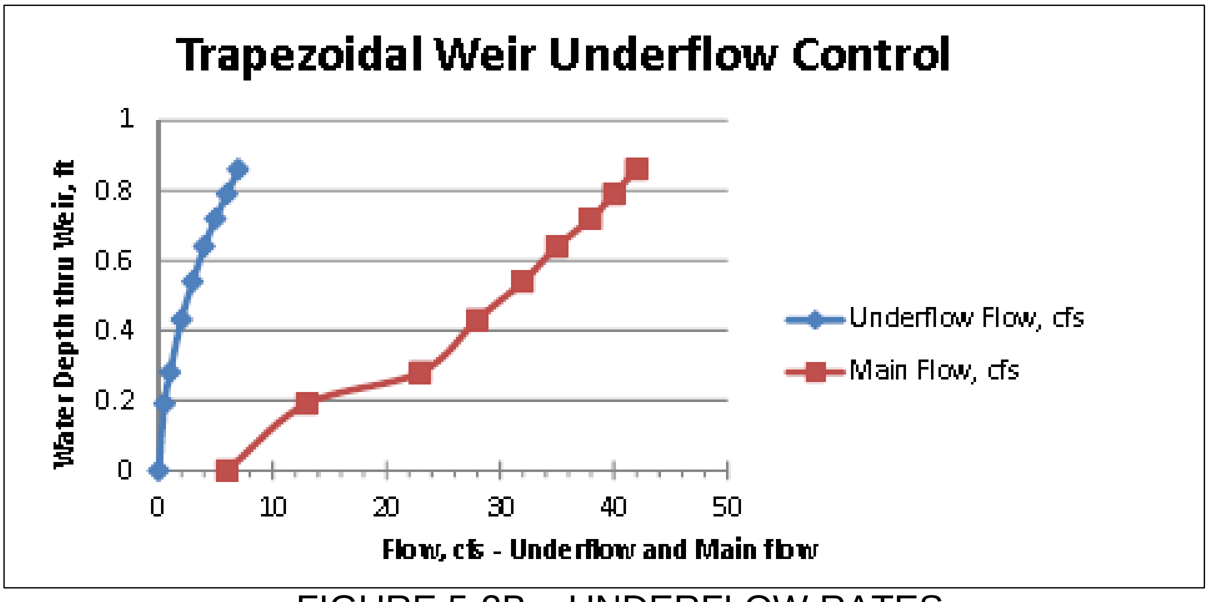


FIGURE 5-2B – UNDERFLOW RATES

Figure 5-2B shows the impact of increasing screened water flow rates on the amount of underflow that will be released by the trapezoidal weir in Manhole 3C.

- First, there will be no underflow until SanSep 1 and MH3C both fill up AND the flow stays just above 6 cfs.
- As flows into the floatables and control system (F&CS) increase, flow will start to flow over the stop logs in Box 1B and into SanSep 2. The flows increase rather dramatically, to around 20 cfs before the flow through each of the SanSep units is roughly equal, without much increase in underflow.
- Above 20 cfs total flow, the underflow will increase proportionally to the increase in total flow to the F&CS (and screened flow out to the wetlands).

Not readily apparent but of great value in minimizing operational issues and simplifying cleaning is the ability of the underflow to automatically increase the flow volume if the amount of solids removed by the screen becomes too highly concentrated. When this happens the head-loss through the screen increases, raising the water level inside of the screen, which is immediately transmitted to a rising level through the weir, and with no change in the feed flow to the system, the underflow removes a higher flow, to remove solids from inside of the SanSep screen.

In summary, to use the level elevations measured and displayed on the PLC HMI screen, there are three options –

1. Use the elevations to calculate the flow area through the inlet to the pipe, or through the trapezoidal weir, and calculate the flow (most accurate).
2. Use the curves on the graphs in Figures 5-2A and 5-2B.
3. For the flow into the 48" pipe, you can also use the least squares equation to estimate the flow from the elevation, without requiring the mechanics of calculating critical flow area.

6. MAINTENANCE

6.1 SAFETY RECOMMENDATIONS

1. Before commencement of work on any system or installed item, it is important that a PERMIT TO WORK is issued by a competent person in authority, **AND** the item of plant is isolated and "Locked Off".
2. Before commencement of work on any system or installed item, make sure you have read and understood the safety rules and regulations for the works.
3. Unreported faults and problems can cause serious breakdown to the facility. Always report findings to the maintenance supervisor.
4. After maintenance all portions of the plant that have been subjected to shutdown must be operated and tested prior to returning the system to operation.
5. Where the storm overflow chamber is a Confined Space ensure that the "Confined Space Entry Procedures" are strictly adhered to.

MAINTENANCE SCHEDULE

a. Periodic Checks

ACTION	FREQUENCY						REMARKS
	S	W	M	Q	H	Y	
Visual Check for Auto drainage & Cleanout			X				
Visual check for screen condition					X		Remove Debris
Remove oversize debris from sumps			X				Vacuum truck and/or clam shell
Check for Correct Operation of Automation	X						See automation O&M instructions
S – Each Storm, W – Weekly, M – Monthly, Q – Quarterly, H – 6 months, Y – annual							

b. Periodic Lubrication

Every 6 months – grease hub on Auma actuator drive. See p 26 of Auma Manual in Appendix 3.

The actuated ball valves supplying water for washdown are not designed for field lubrication.

MAINTENANCE LOG SHEET

DATE: ______________________

CONTROL NO. _______________

SCREEN NO. _________________

TYPE OF MAINTENANCE:
☐ Preventive or Scheduled
☐ Operating Problems

RESPONSIBILITY	NAME / CONTACT INFO	SIGNATURE
INITIATED BY		
ASSIGNED BY		
PERFORMED BY		
RECORDED BY		

DESCRIBE PROBLEM / ASSIGNED ACTIVITY:

DESCRIBE OBSERVATIONS / ACTIVITIES:

7. TROUBLESHOOTING

7.1 GENERAL

PROBLEM	POSSIBLE CAUSE	REMEDY
Water inside screen not rotating	Inlet pipe is blocked	Check operation of other unit. After the storm has subsided, pump the SanSep down and check the check inlet pipe for a blockage. Utilized a fire hose or other means to remove blockage without entering the structure.
	Screen is blinded	Inspect screen after completely draining and before washdown of the screen. If automatic washdown is inadequate to clean the screen, flush screen with a fire hose or power wash.
Visible debris is appearing in the outlet	Damaged screen panel	Replace the panel and send it back for repair. Contact PWTech for repair.
Uneven screen washing	Plugged nozzles (orifice is 1/4", so nothing smaller should interfere with nozzle operation	Remove the nozzle and clean it, reinstall.
	Missing nozzle.	Replace the nozzle.
	Misalignment.	Loosen the nozzle and swivel joint, reposition and tighten.

8. **COMPONENT REPLACEMENT**

8.1 SCREEN PANELS

Screen panels are held onto the stanchions with 6 (six) each 1/2”-13 x 1” long 5/16” hex head screws. To remove a screen panel for repair/replacement, unscrew the six screws. The panel may simply fall away from the stanchion (it should slip down slightly to rest on the panel below and can be pried out from the top or side if it doesn’t fall away.

8.2 WASH DOWN RING NOZZLES

Unscrew the nozzle and, if necessary, the swivel joint, remove, and reinstall new, repaired or cleaned pieces.

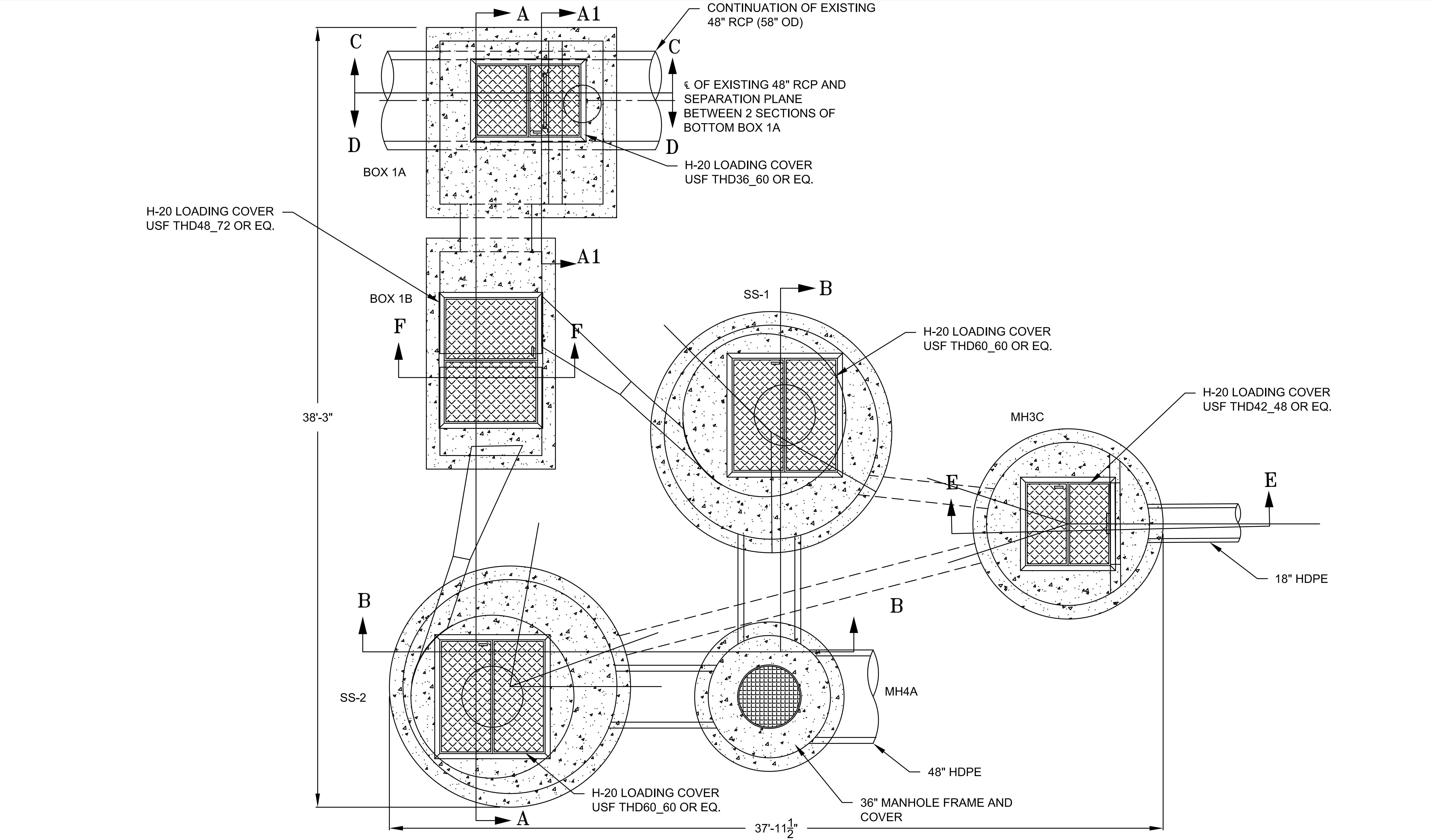
9. SPARE PARTS

Spare parts inventory decisions are made locally, based on experience and previous consequences. PWTech doesn't make recommendations on spare parts, but provides the following information for the customer to consider in deciding what to stock. PWTech can provide you with any of these parts for your stores, or on an as-need basis. Call for current prices.

COMPONENT	CONSEQUENCE	AVAILABILITY		APPROX COST
		LOCATION	DEL TIME	
CONTROL PANEL	PLC failure	Control Panel	2 days	$5,000
SCREEN PANELS	Possible by-pass of solids into outlet	PWTech	4 weeks	$5,000
WASHDOWN SYSTEM	Poor screen cleaning	PWTech		See components
1" Washdown ring pipe	Poor Cleaning	PWTech	1 week	$10,000
Nozzles / swivel joints	Poor Cleaning	PWTech	Overnight	$50
Water Valve Actuator	Poor Cleaning	PWTech	Overnight	$5000

10. LIST OF APPENDICES

APPEN-DIX NO.	DESCRIPTION	DOC CONTROL NO.
1	SCREEN & STRUCTURE DRAWINGS	SS-GA-1 and 4-9 S-FD-001 to -011
2	PRECAST STRUCTURE SUBMITTAL PACKAGE	N/A
3	VALVE O&M PACKAGES	
	GOLDEN HARVEST GATE VALVES	N/A
	ER-TEC FAIL SAFE ACTUATED BALL VALVES	N/A
	TIDEFLEX CHECK VALVES	N/A
4	TECHNICAL PACKAGE	
	ELECTRICAL DRAWINGS	J071 A, B & C
	PANEL COMPONENT CUT SHEETS	N/A
	HMI SCREENS	N/A
	SPRAY NOZZLE CUT SHEETS	N/A
	HYDRORANGER LEVEL TRANSMITTER MANUAL	N/A
	ISCO 350 AREA VELOCITY SENSOR MANUAL	N/A
	ISCO 360 LASERFLOW SENSOR MANUAL	N/A
	ISCO SIGNATURE FLOW METER MANUAL	N/A
	CSO 018 SCADA ALARMS	Revised 9/9/15
5	CERTIFICATIONS AND WARRANTY	



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REFERENCE INFORMATION AND NOTES

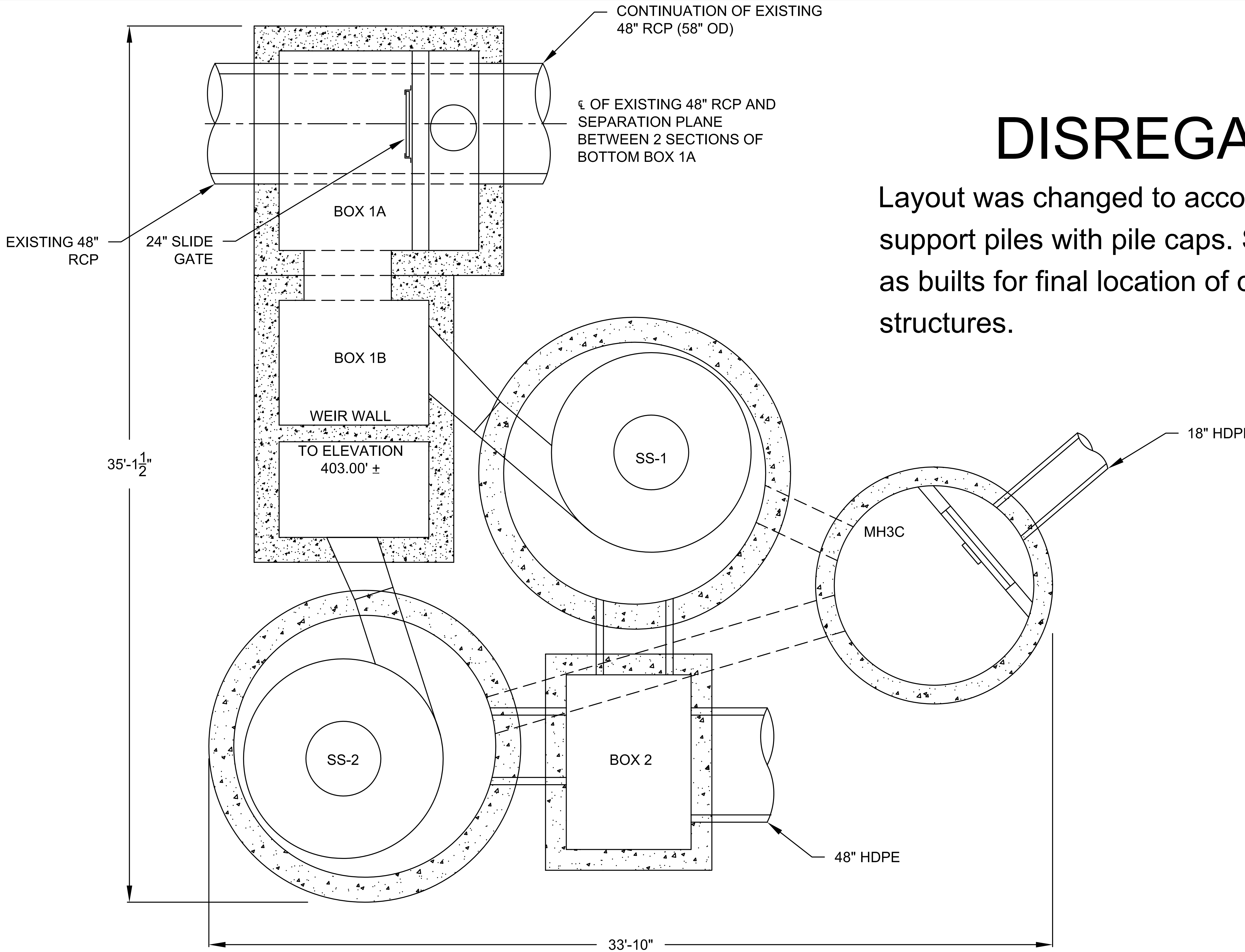
PROJECT No.	SSNY12002
DATE	5/24/2012
DESIGNED	JIM HEIST
DRAWN	J. NOLAN

TITLE

GA – PLAN VIEW
HARBOR BROOK CSO 018
SYRACUSE, NEW YORK

SCALE N.T.S.

SHEET 1



DISREGARD

Layout was changed to accommodate support piles with pile caps. See contractor as builts for final location of caps and structures.

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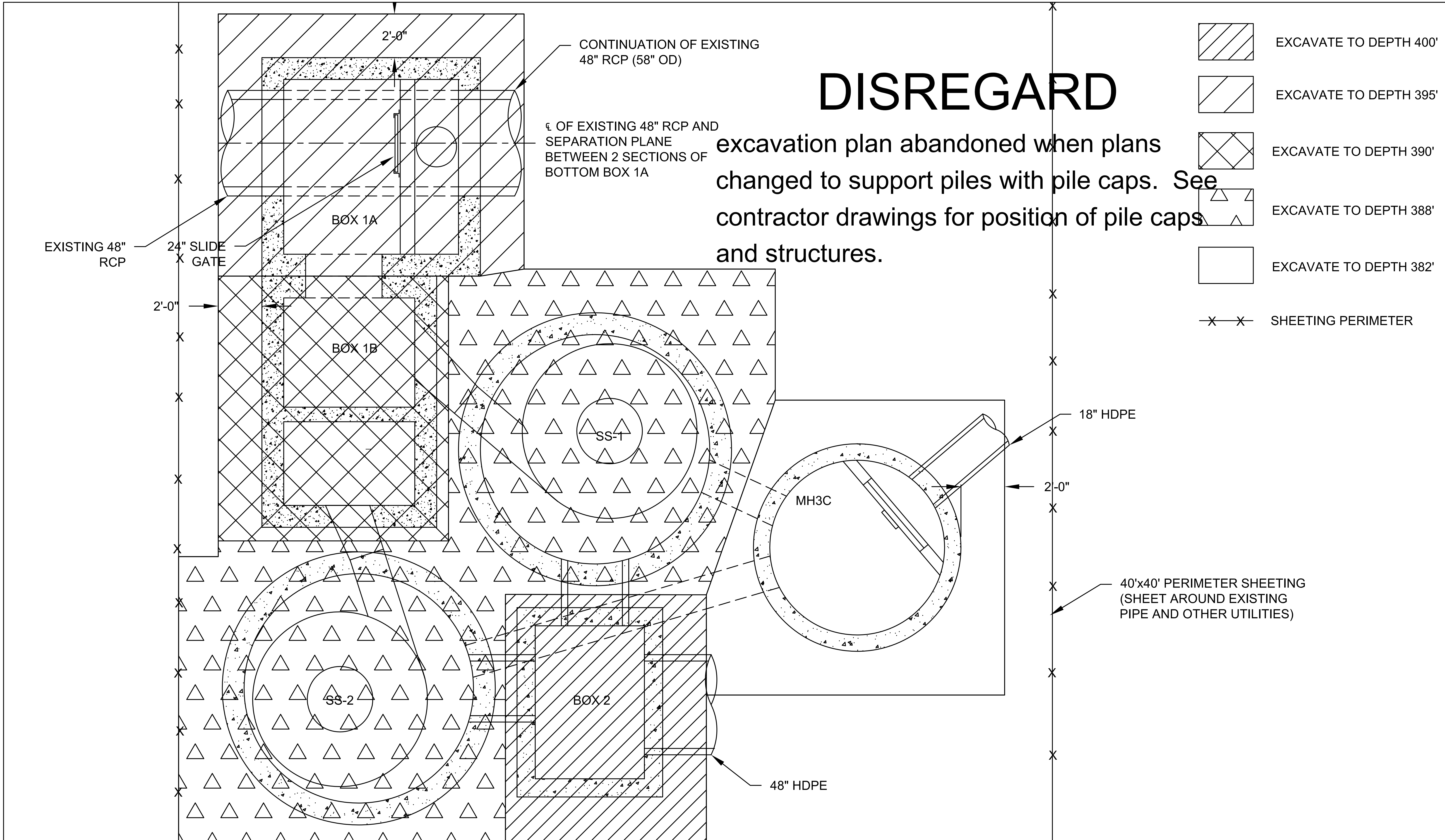
REFERENCE INFORMATION AND NOTES

PROJECT No.	SSNY12002
DATE	5/16/2012
DESIGNED	JIM HEIST
DRAWN	J. NOLAN

TITLE
GA – NEW STRUCTURE PLAN
HARBOR BROOK CSO 018
SYRACUSE, NEW YORK

SCALE 1:50
SHEET 2



DISREGARD

excavation plan abandoned when plans changed to support piles with pile caps. See contractor drawings for position of pile caps and structures.

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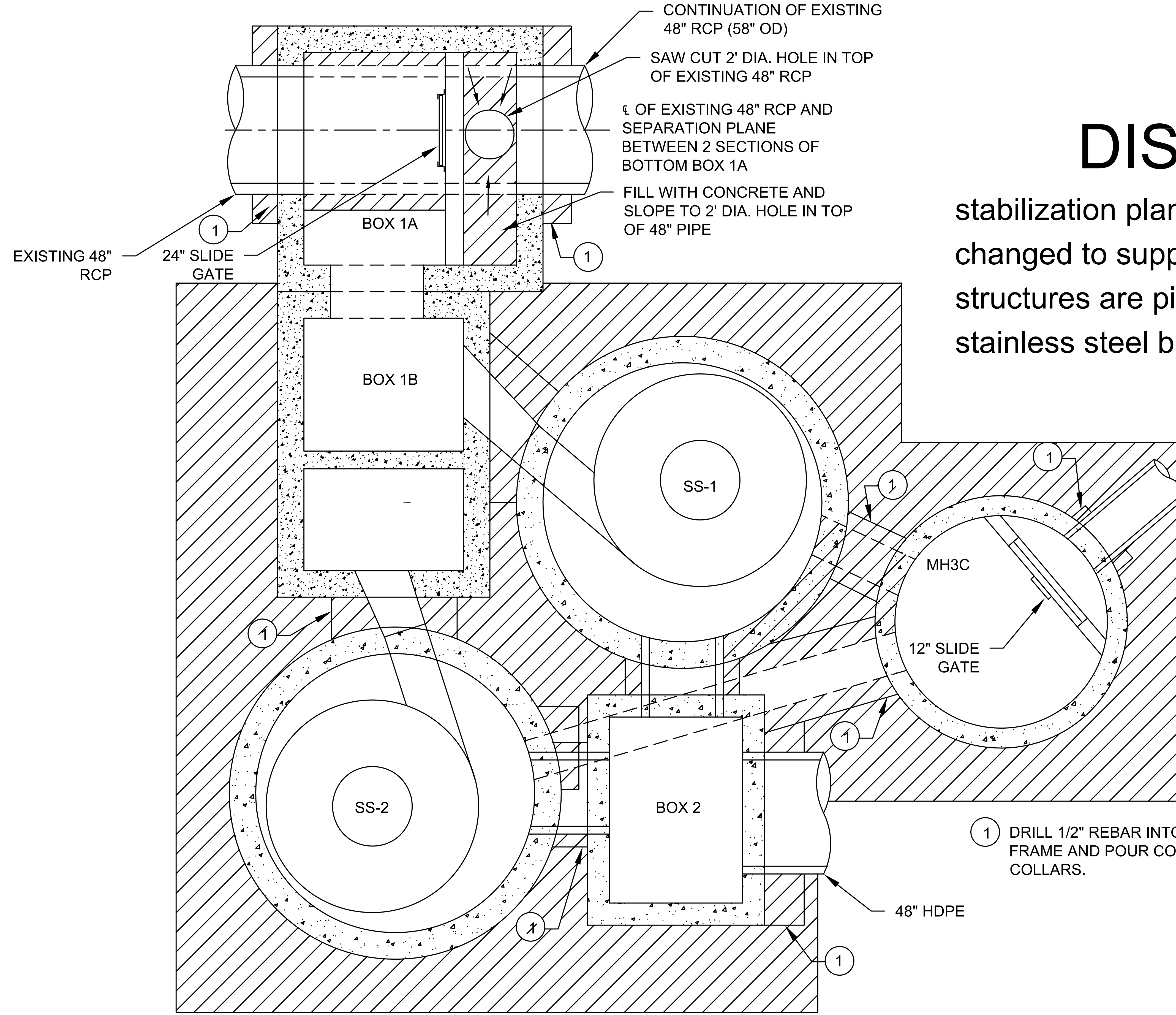
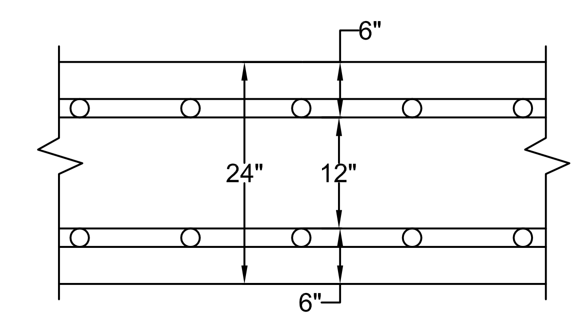


DISREGARD

stabilization plan abandoned when plans changed to support piles with pile caps. All structures are pinned to the caps with stainless steel brackets and anchors.

(1) DRILL 1/2" REBAR INTO WALLS, FRAME AND POUR CONCRETE COLLARS.



#2 REBAR ON 12" CENTERS AT TWO ELEVATIONS

SECTION ELEVATION OF STABILIZATION SLAB

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REFERENCE INFORMATION AND NOTES

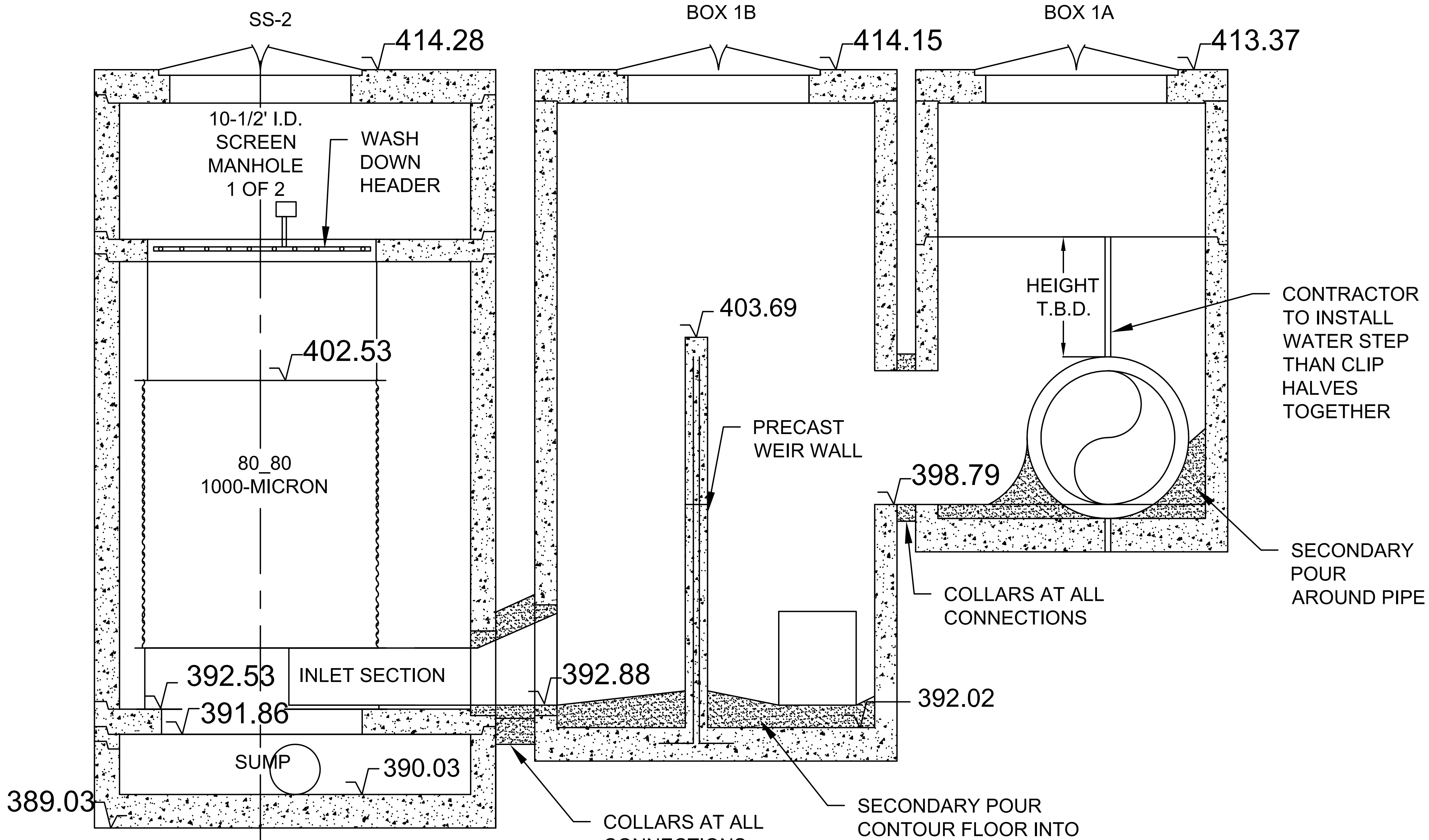
PROJECT No.	SSNY12002
DATE	5/16/2012
DESIGNED	JIM HEIST
DRAWN	J. NOLAN

TITLE

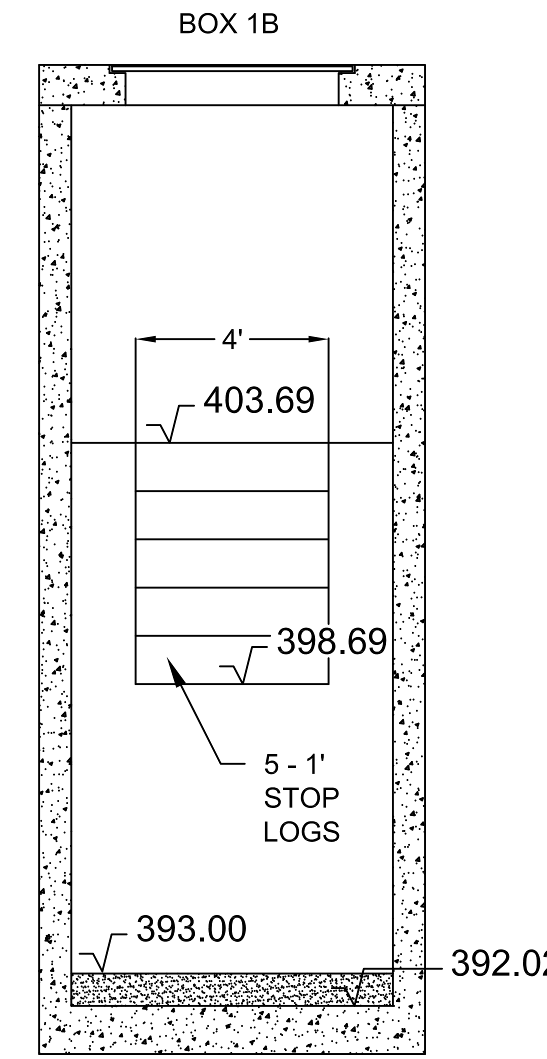
STABILIZATION PLAN
HARBOR BROOK CSO 018
SYRACUSE, NEW YORK

SCALE 1:50

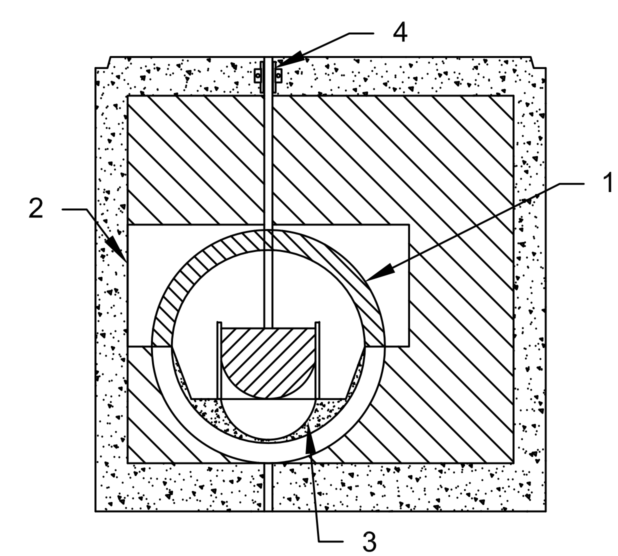
SHEET 3



SECTION A–A



SECTION F–F



1. CUT OUT TOP OF PIPE BETWEEN CRADLES.
2. PLACE $\frac{3}{8}$" 316L SS PLATE FLUSH AGAINST INTERNAL CRADLE WALL ANCHOR 4 PLACES.
3. LAY 24" HALF PIPE INTO 48" RCP AND POUR HIGH-SLUMP CONC. AROUND IT.
4. INSTALL GATE VALVE INTO FRAME IN SS PLATE.

SECTION A1–A1

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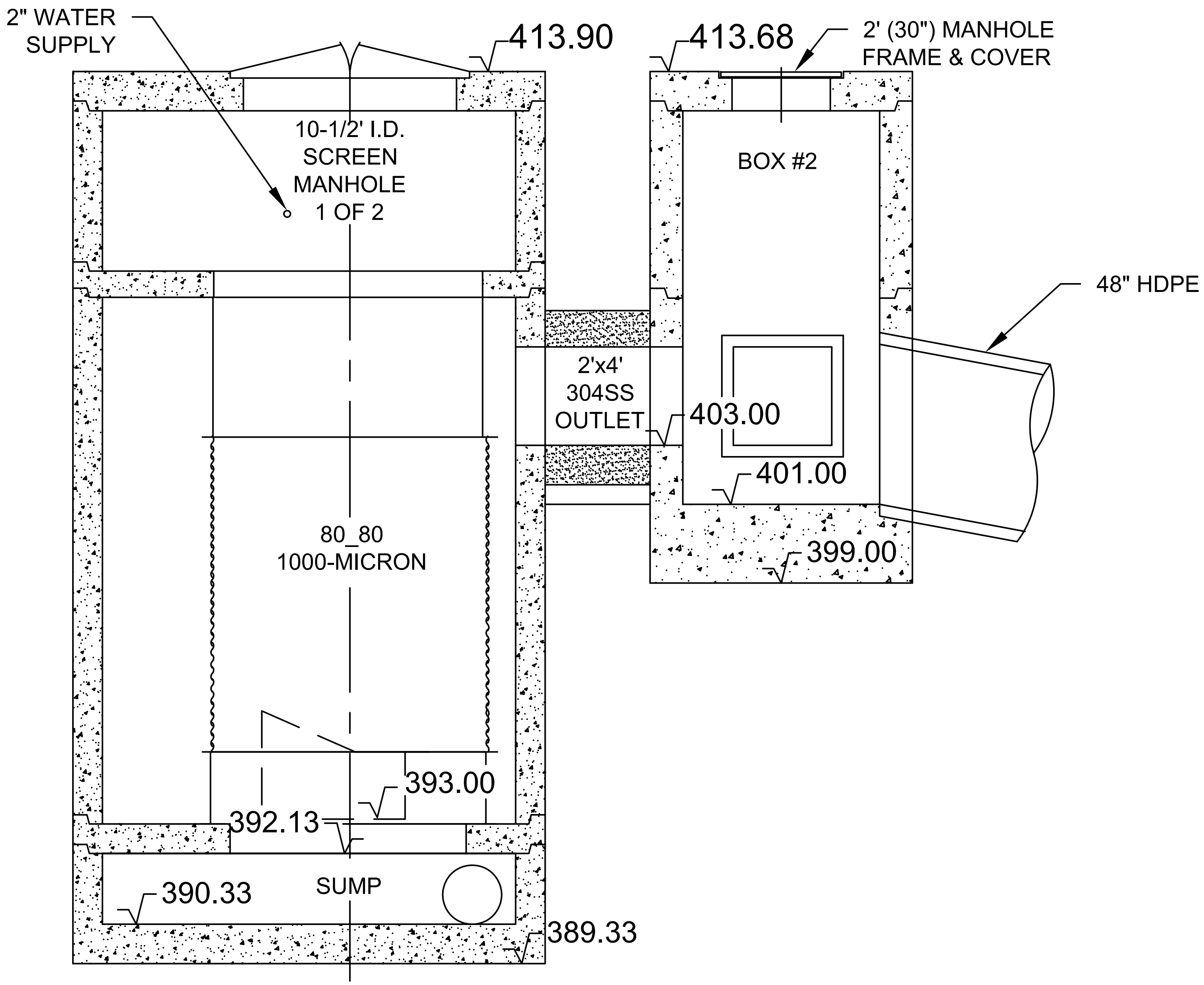
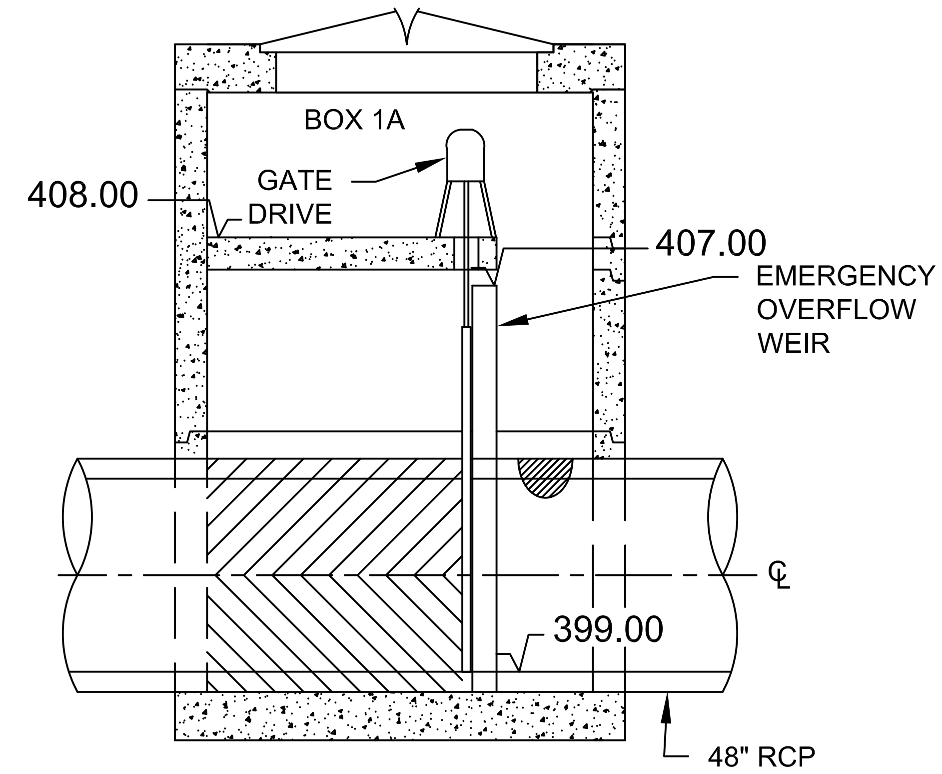
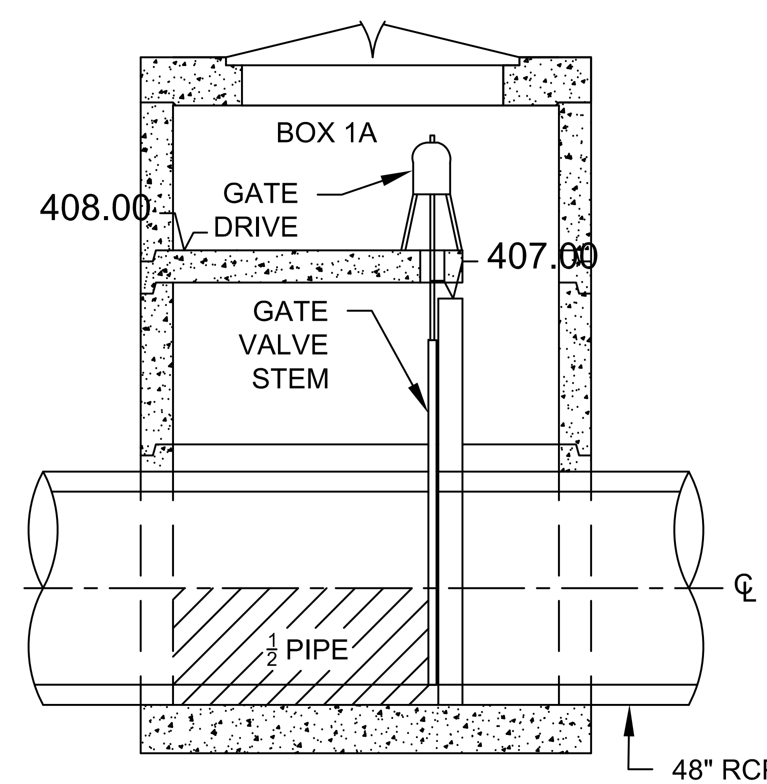
PROCESS WASTEWATER TECHNOLOGIES



SECTION B–B



SECTION C–C



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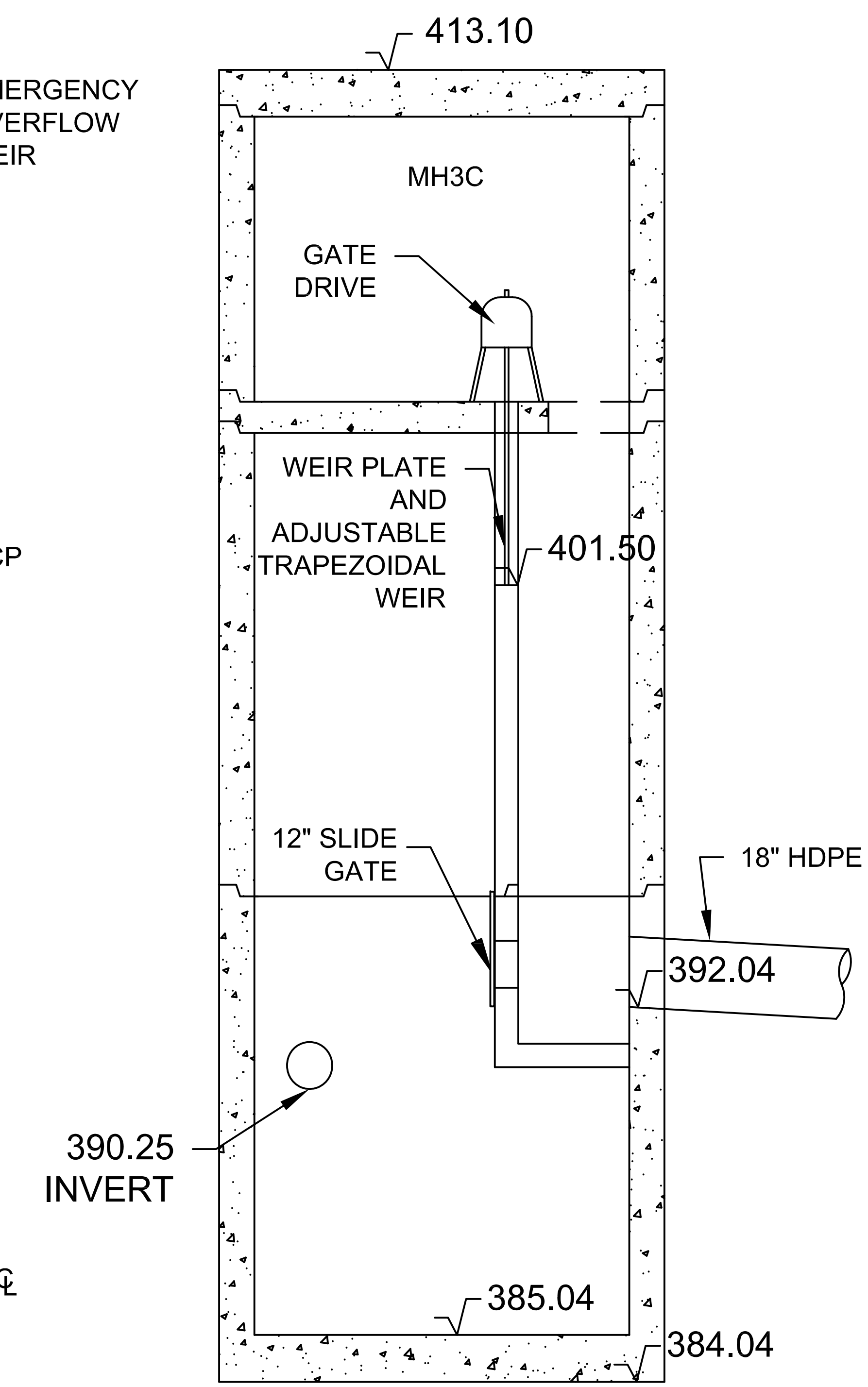

SECTION E–E

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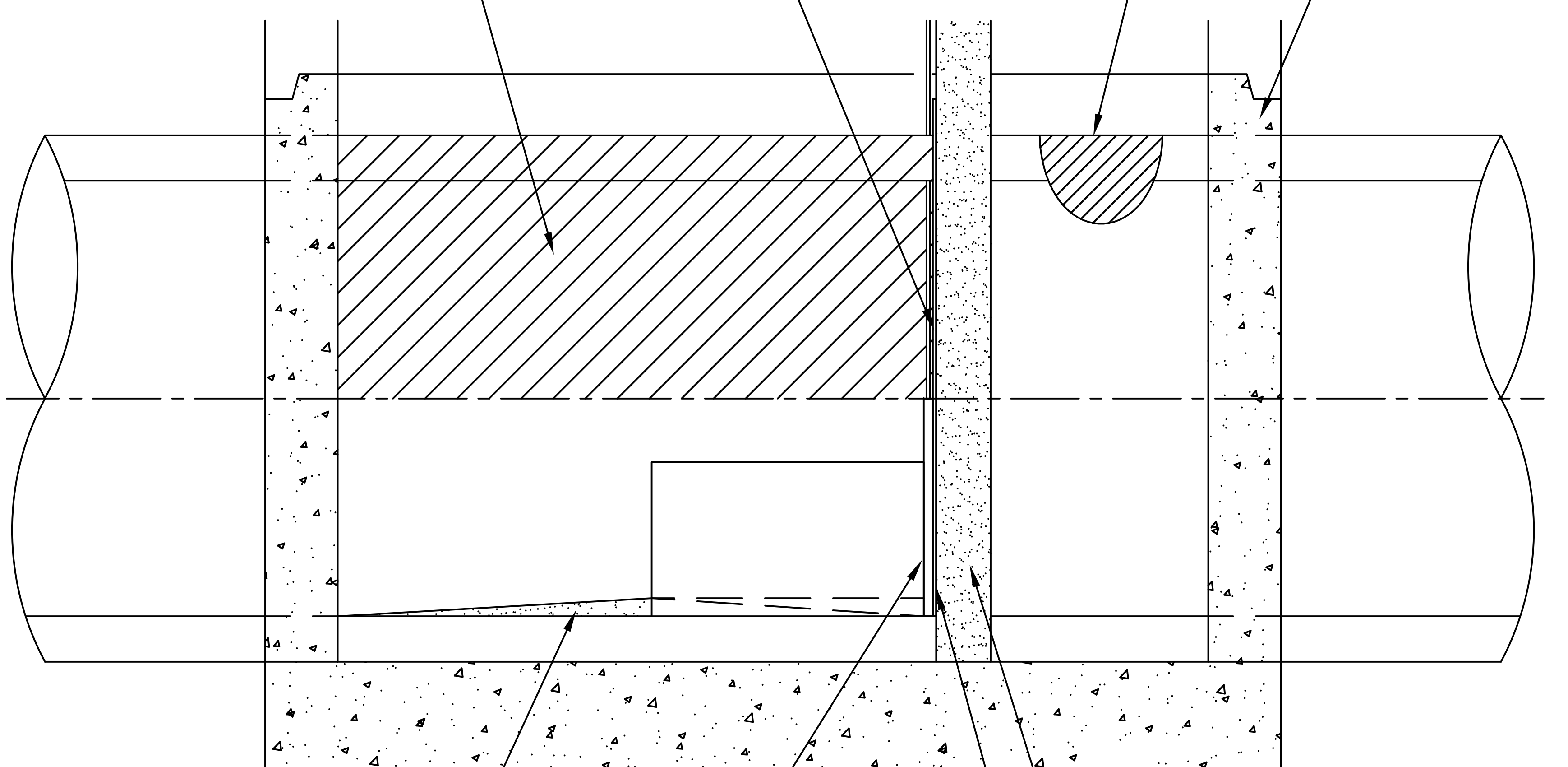
PWTech PROCESS WASTEWATER TECHNOLOGIES

REFERENCE INFORMATION AND NOTES

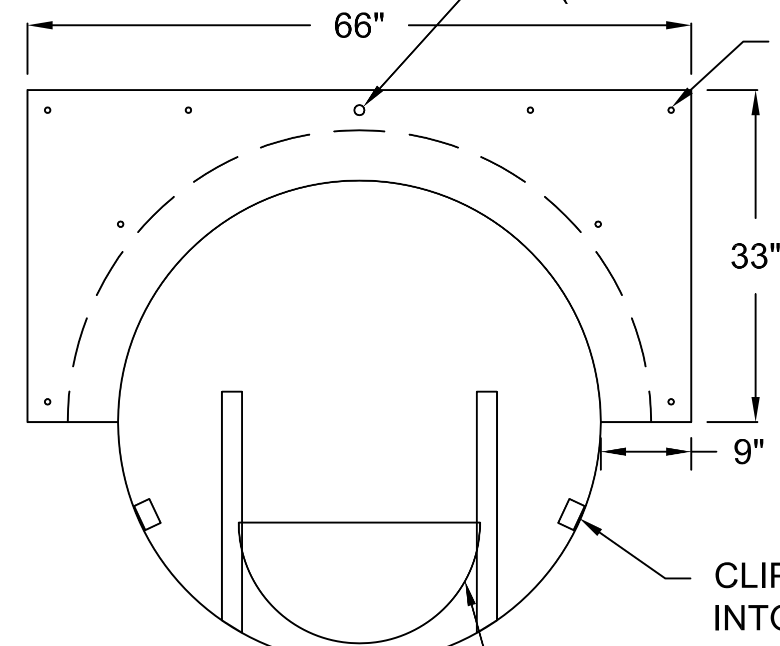
PROJECT No.	SSNY12002
DATE	5/24/2012
DESIGNED	JIM HEIST
DRAWN	J. NOLAN

TITLE
GA – SECTION ELEVATIONS
HARBOR BROOK CSO 018
SYRACUSE, NEW YORK

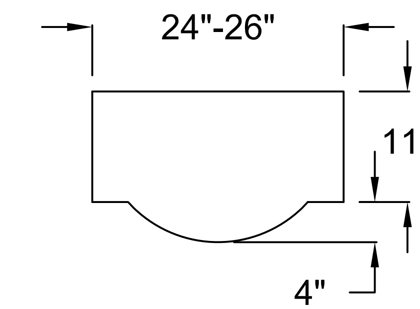
SCALE 1:50
SHEET 5



HALF PIPE FLOW CHANNEL DETAIL



3/8" SS PLATE

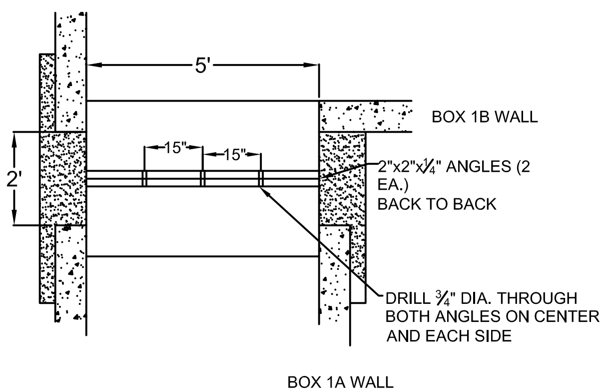


GATE DETAIL

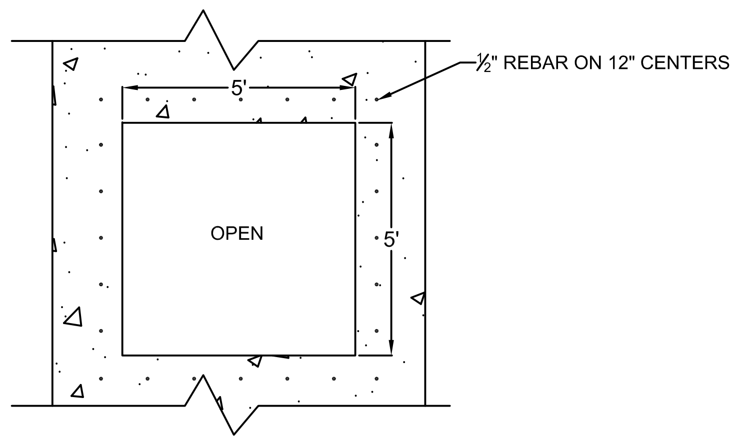
PWTech
PROCESS WASTEWATER TECHNOLOGIES
Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

REFERENCE INFORMATION AND NOTES

PROJECT No.	SSNY12002
DATE	5/24/2012
DESIGNED	JIM HEIST
DRAWN	J. NOLAN
TITLE	GA – Box 1A Gate HARBOR BROOK CSO 018 SYRACUSE, NEW YORK
SCALE	1:50
SHEET	6



PLAN VIEW BOX 1A AND 1B
PIPE CONNECTIONS

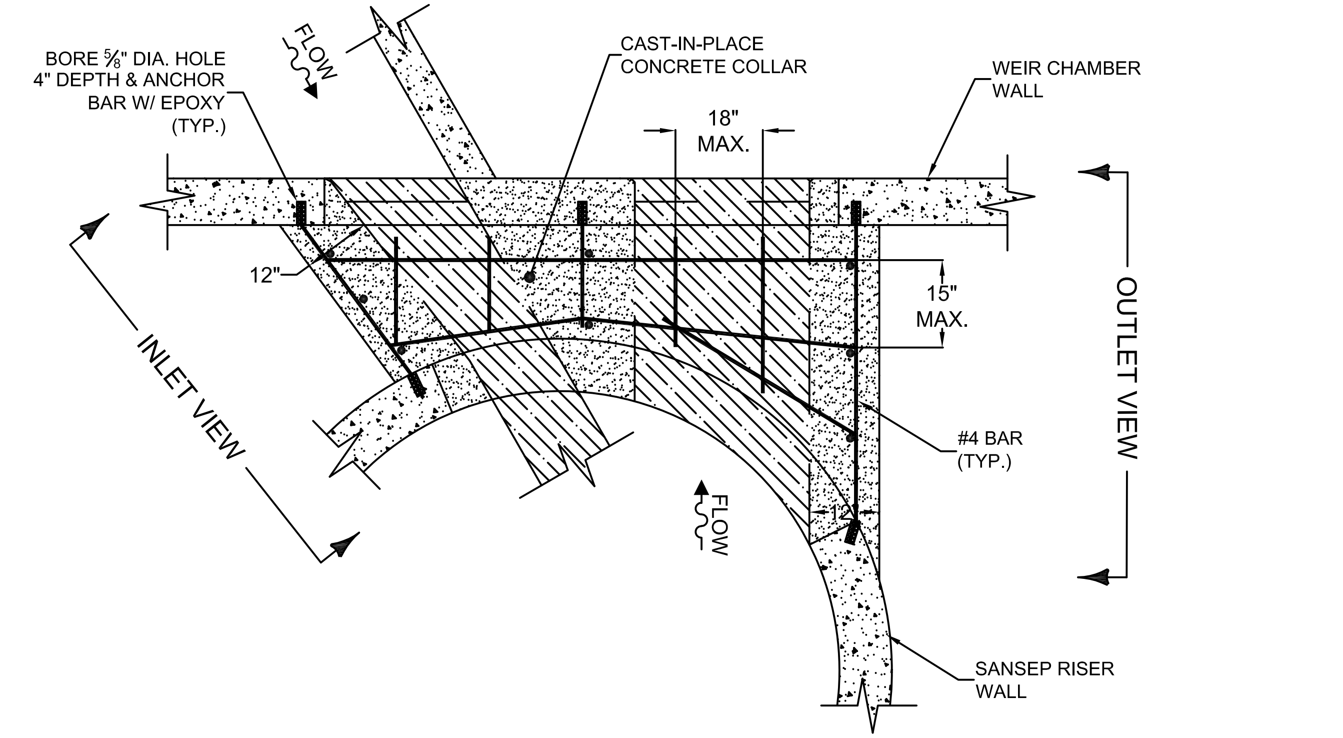


EXTERIOR ELEVATION BOX 1B
PIPE CONNECTIONS

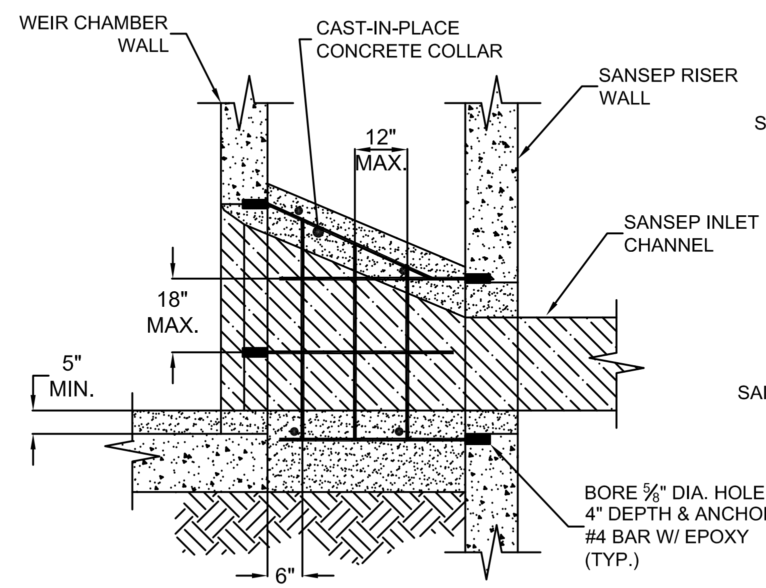
NOTES:

1. THE CONTRACTOR IS TO USE 1" ADEKA PRODUCT SHOWN IN PRODUCT LITERATURE, WITH ADHESIVE APPLICATION UNLESS THE CONCRETE IS WET. IN THE EVENT THE CONCRETE IS WET, IT WILL BE APPLIED AND NAILED DOWN.
2. ½" REBAR ON 12" CENTERS 6" AWAY FROM OPENING ALL THE WAY AROUND IT. ½" REBAR IS TO BE EPOXIED INTO THE PRECAST 4" DEEP TO EXTEND ¾ OF THE WAY BETWEEN PRECAST STRUCTURES.
3. OVERLAPPED REBAR TO BE BOUND WITH WIRE.
4. CONTRACTOR TO FORM AND POUR SECONDARY CONCRETE COLLAR 12" LARGER THAN THE OPENING IN ALL DIRECTIONS.

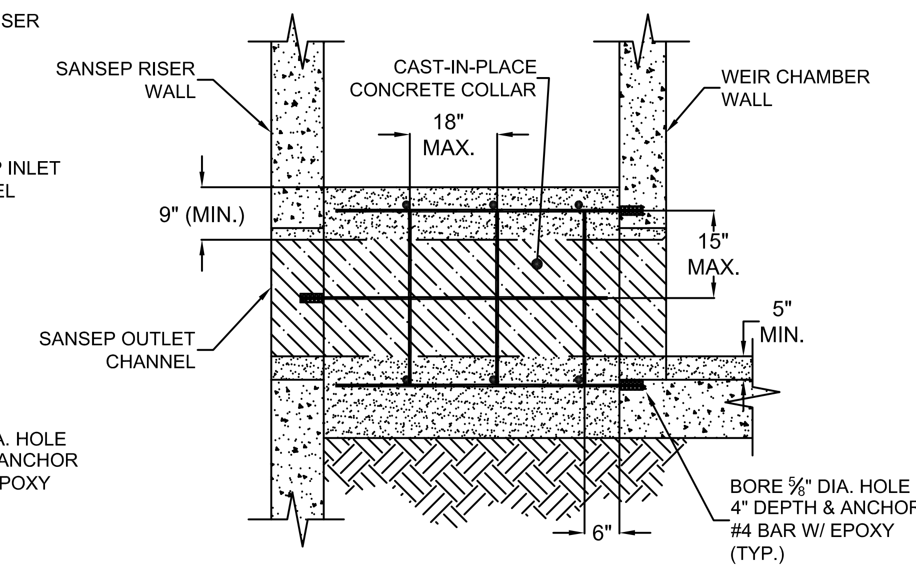
INDICATES MOST OF THE LOCATIONS WHERE CONCRETE IS TO BE POURED IN THE FIELD.



PLAN VIEW



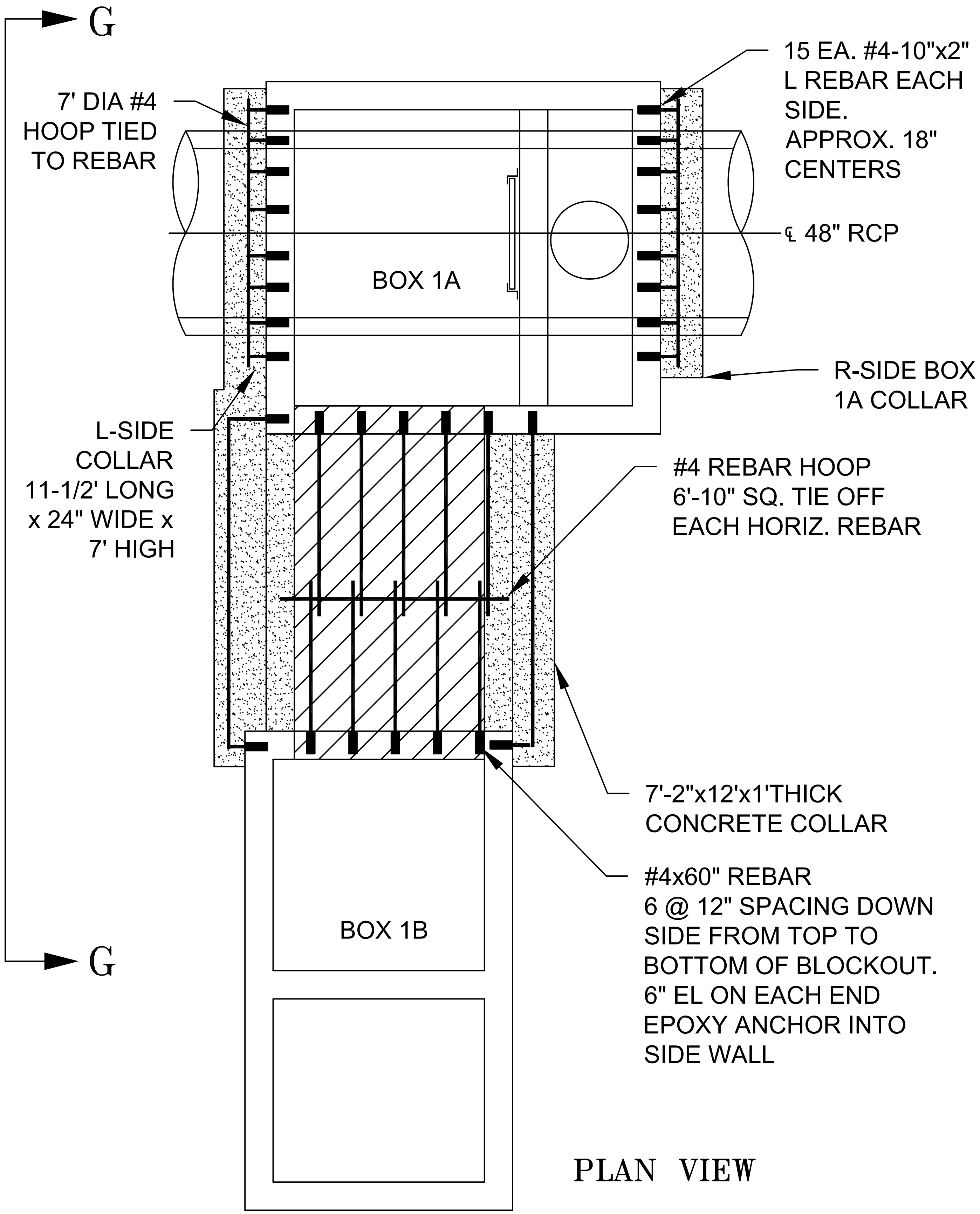
INLET VIEW



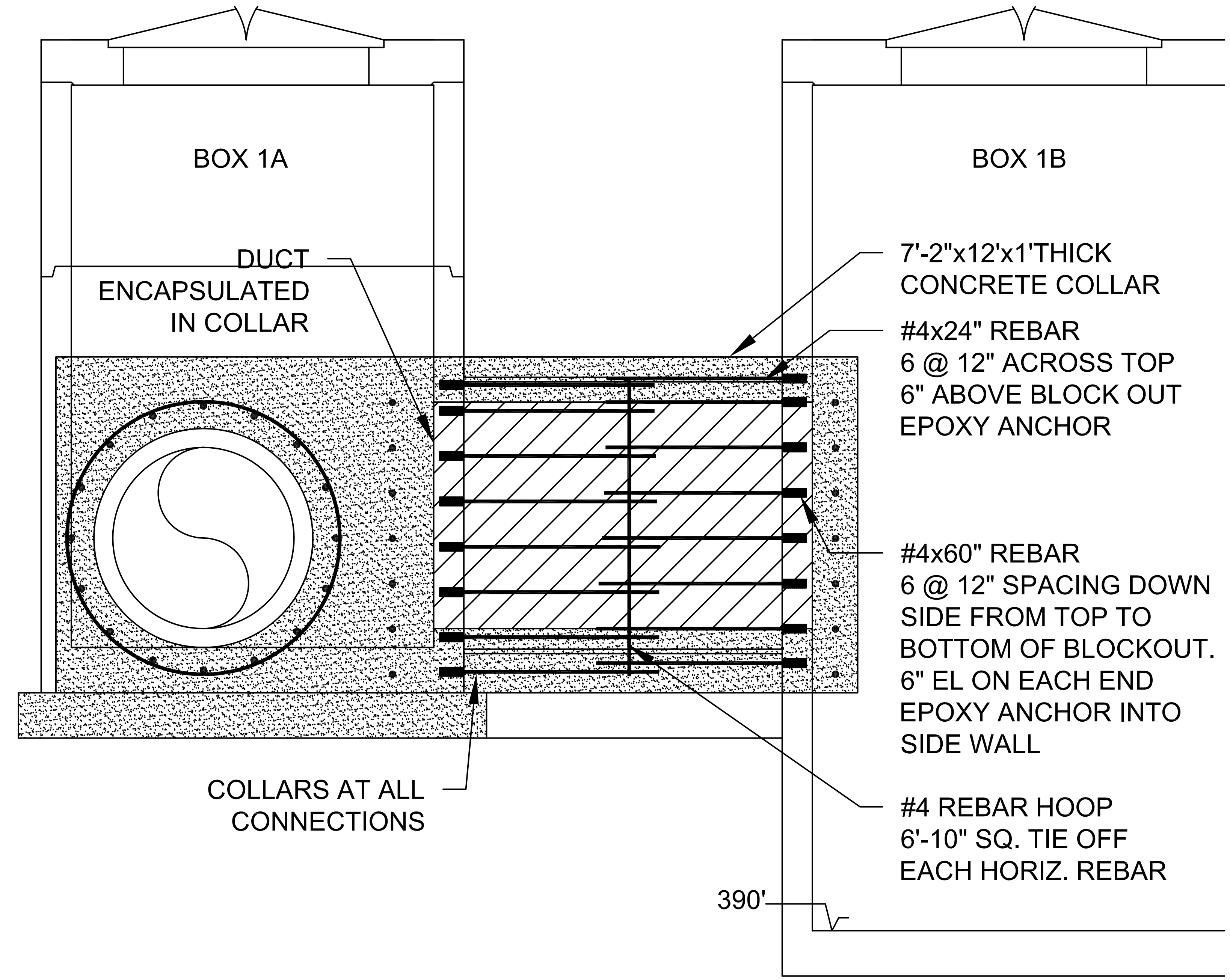
OUTLET VIEW

PWTech PROCESS WASTEWATER TECHNOLOGIES	**Process Wastewater Technologies** 105 Springbrook Place Cary, North Carolina 27518 Tel. 919.858.8887 Fax 919.858.8983 www.PWTech.us	REFERENCE INFORMATION AND NOTES	PROJECT No. SSNY12002 DATE 5/24/2012 DESIGNED JIM HEIST DRAWN J. NOLAN	TITLE GA – CONNECTION DETAILS HARBOR BROOK CSO 018 SYRACUSE, NEW YORK

SCALE N.T.S.
SHEET 7



PLAN VIEW



SECTION G–G

PWTech
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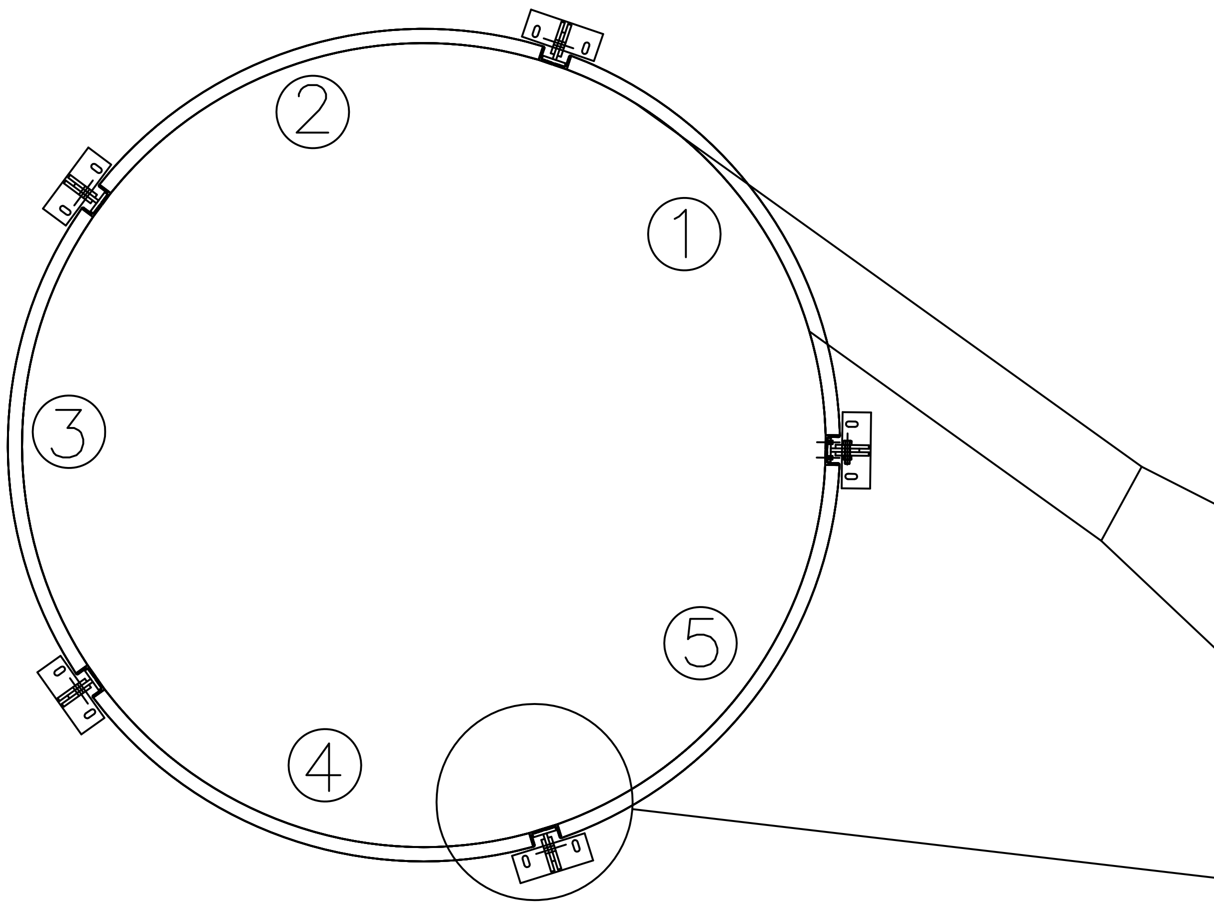
Process Wastewater
Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

REFERENCE INFORMATION AND NOTES

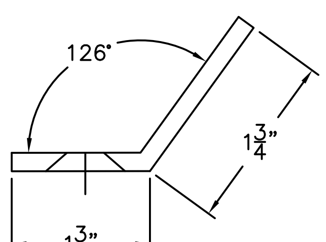
PROJECT No.	SSNY12002
DATE	5/24/2012
DESIGNED	JIM HEIST
DRAWN	J. NOLAN

TITLE
GA – CONNECTION DETAILS
HARBOR BROOK CSO 018
SYRACUSE, NEW YORK

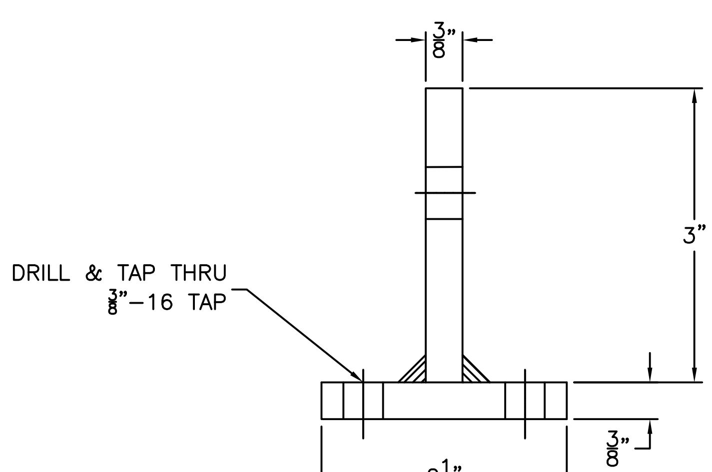
SCALE 1:40
SHEET 8



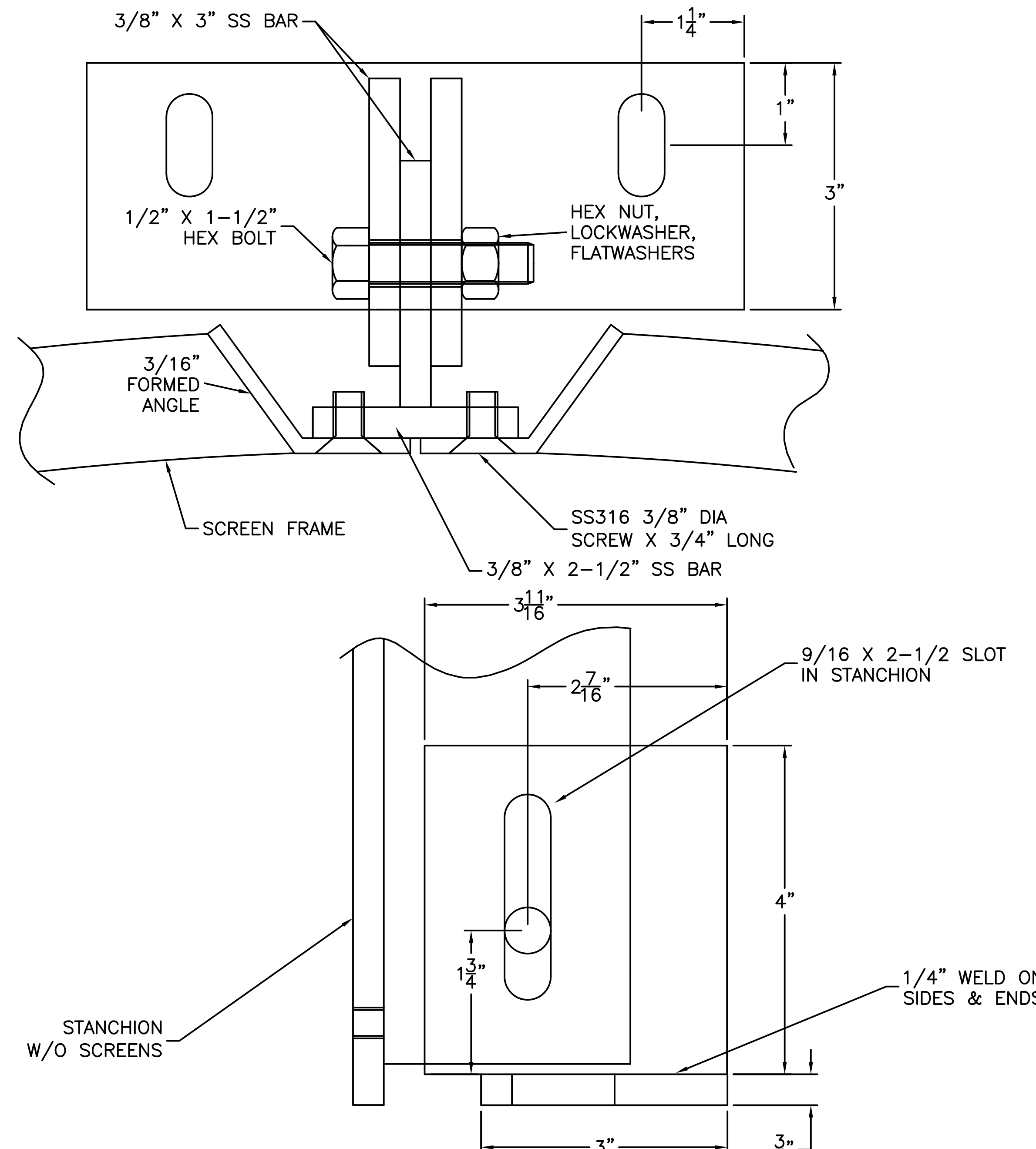
SCREEN ASSEMBLY PLAN



ANGLE DETAIL



T-CHANNEL DETAIL



ANGLE CONNECTION DETAIL

Drawing No.	Sht.	Rev.
S-FD-001	1 of 9	

PWTech Notes

1	
2	

MATERIAL:	PWT PROJECT NO:
SS	SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED:	DATE:
JIM HEIST	10/24/15

SIGNATURE:

Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

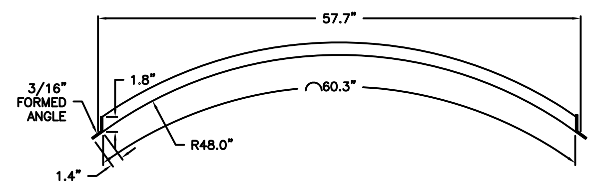
DRAWING TITLE:
SCREEN
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

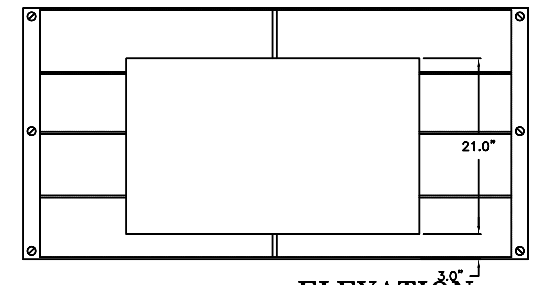
PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST. WETLANDS PILOT TREATMENT SYS.

DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
JLN	01/14/13	N.T.S.	11x17

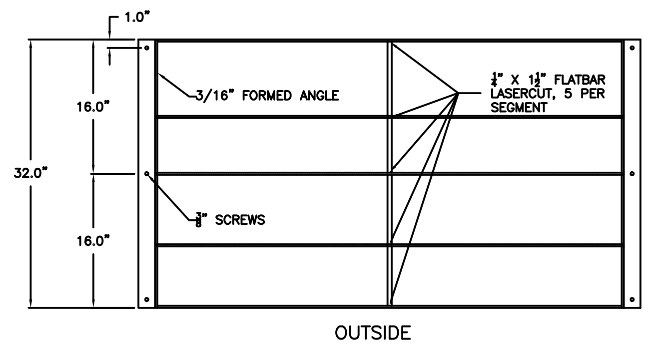
DRAWING NO:	SHEET:	REV:
S-FD-001	1 OF 9	B

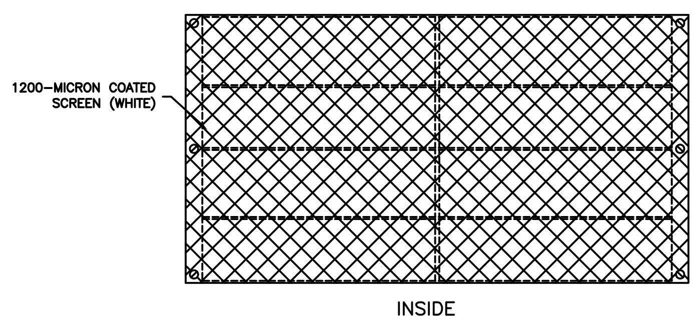
SCREEN PANEL



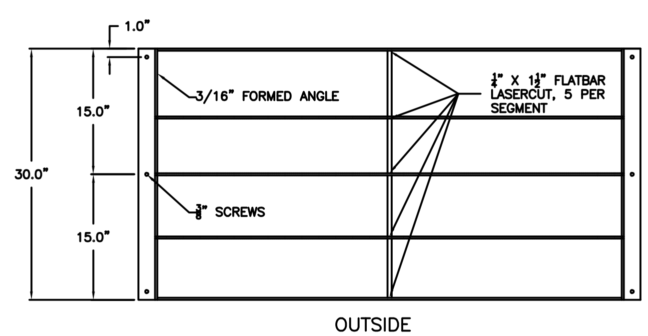


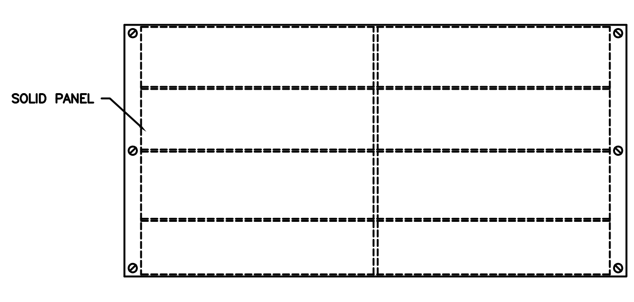
ELEVATION
SOLID PANEL OF VERTICAL SCREEN ASSEMBLY WITH INLET OPENINGS



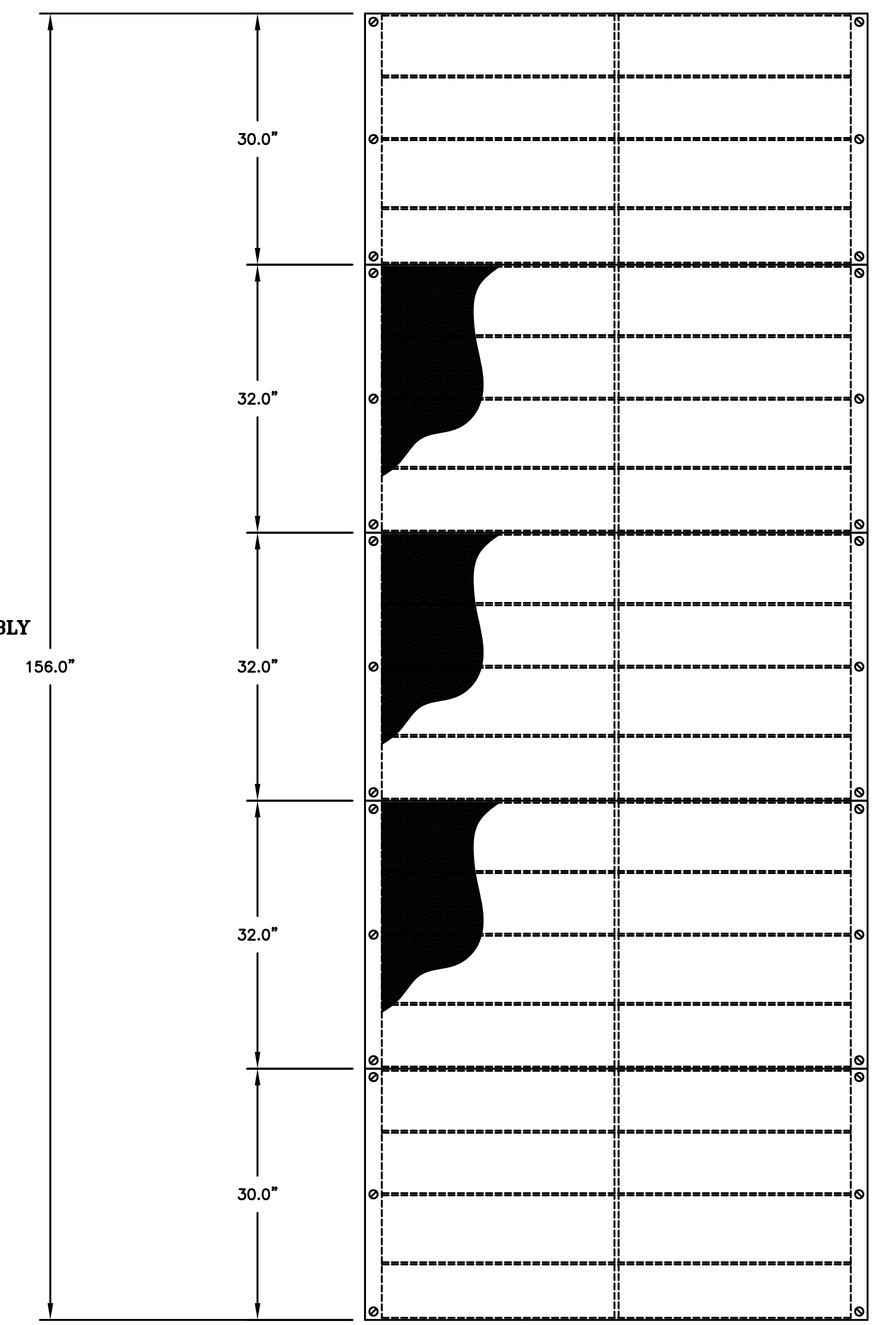


ELEVATION
PERFORATED PANEL OF VERTICAL SCREEN ASSEMBLY





ELEVATION
SOLID PANEL OF VERTICAL SCREEN ASSEMBLY



ELEVATION
VERTICAL SCREEN ASSEMBLY

Drawing No.	Sht.	Rev.
S–FD–002	2 of 9	

PWTech Notes

1	
2	

MATERIAL:	PWT PROJECT NO:
SS	SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED: DATE:
JIM HEIST 10/24/15
SIGNATURE:

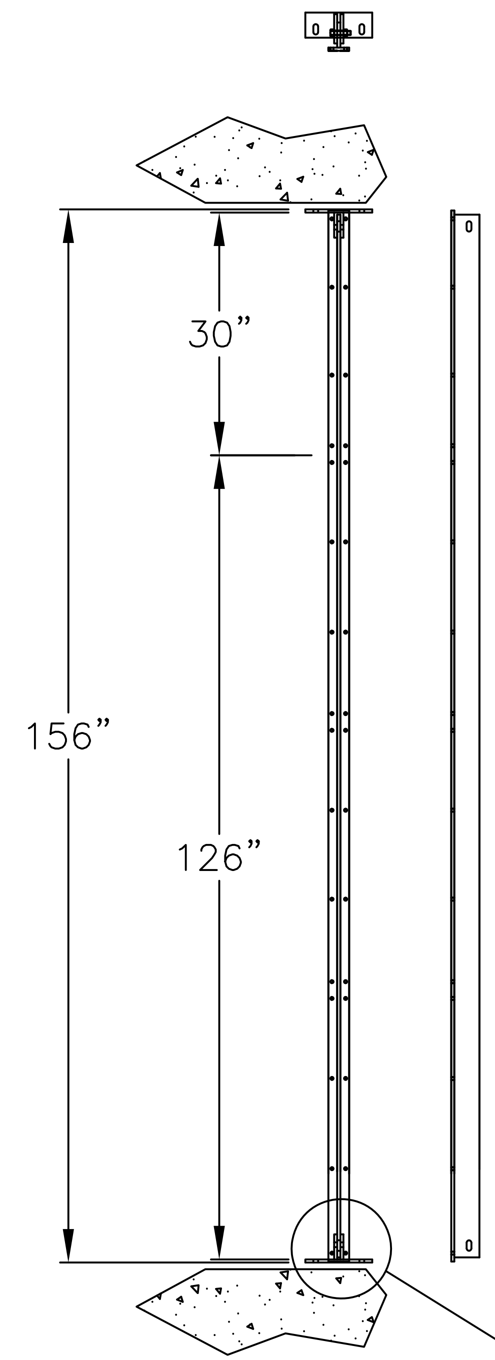
PWTech
PROCESS WASTEWATER TECHNOLOGIES
Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

DRAWING TITLE:
SCREEN
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

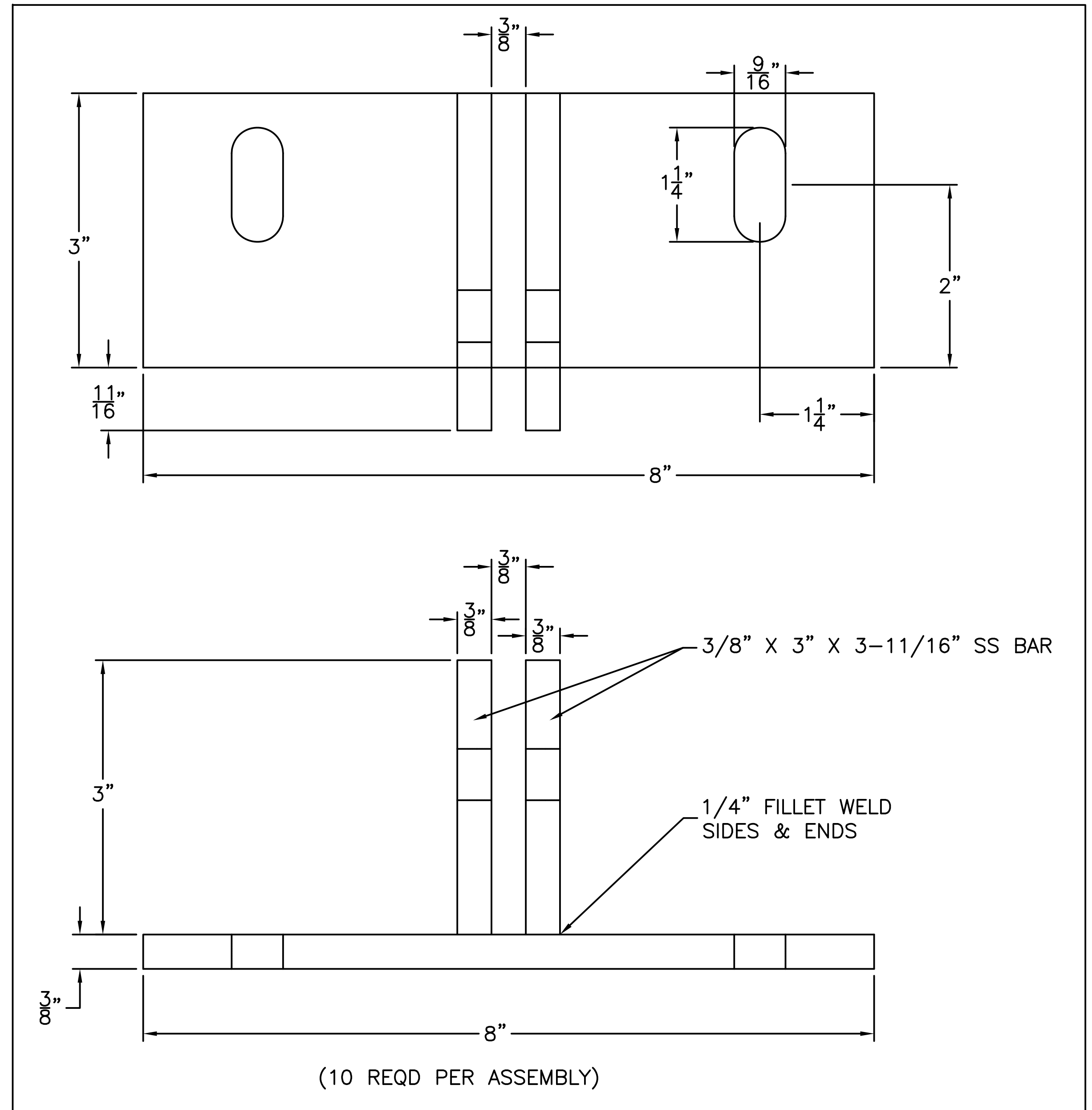
PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST.
WETLANDS PILOT TREATMENT SYS.

DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
JLN	01/14/13	N.T.S.	11x17

DRAWING NO:	SHEET:	REV:
S-FD-002	2 OF 9	B



VERTICAL STANTION ASSEMBLY



STANTION ANCHOR PLATES

Drawing No. S-FD-003	Sht. 3 of 9	Rev.
PWTech Notes		
1		
2		

MATERIAL: SS

PWT PROJECT NO: SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED: JIM HEIST

DATE: 10/24/15

SIGNATURE:

Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
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www.PWTech.us

DRAWING TITLE:
SCREEN
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST.
WETLANDS PILOT TREATMENT SYS.

DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
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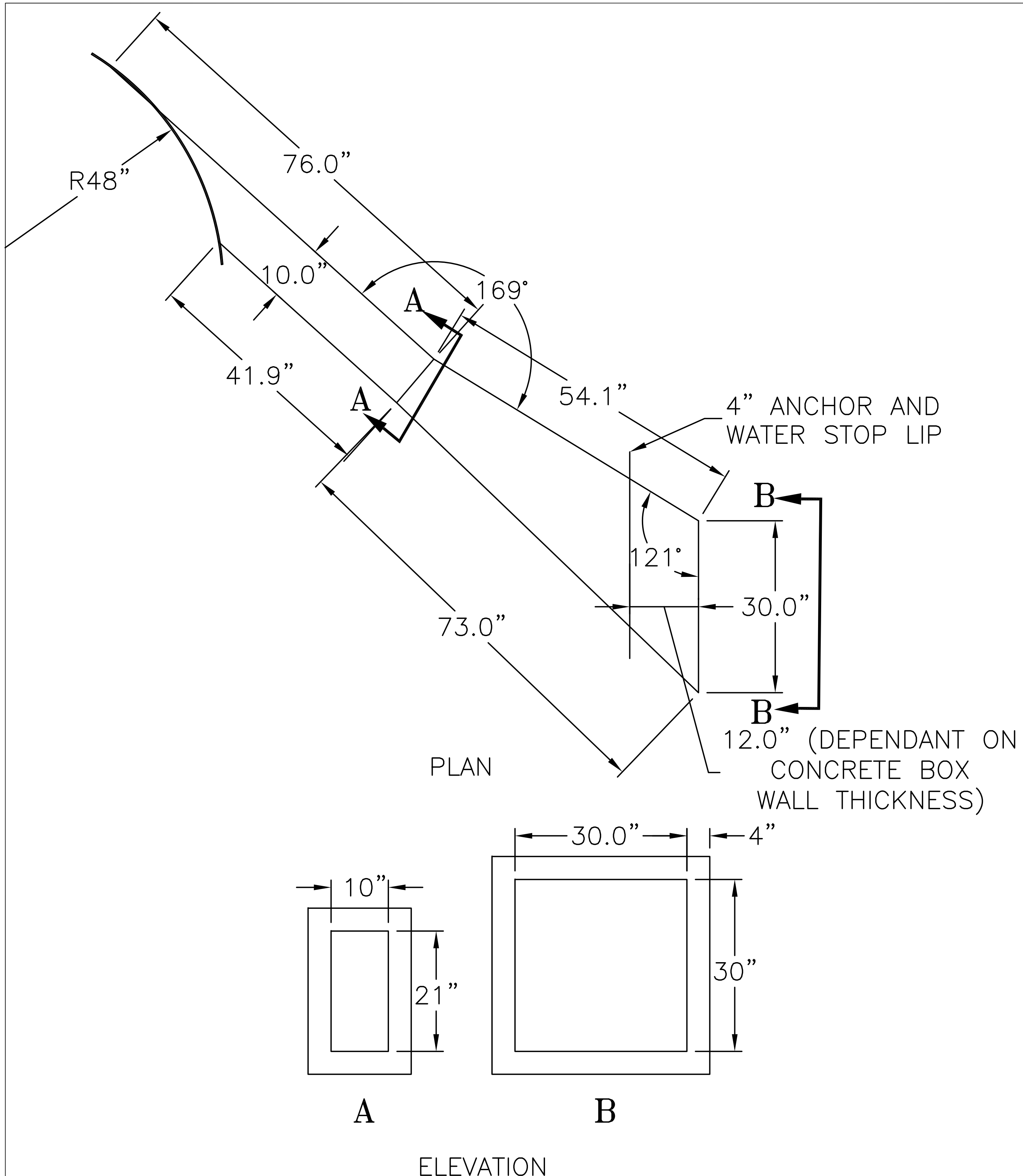
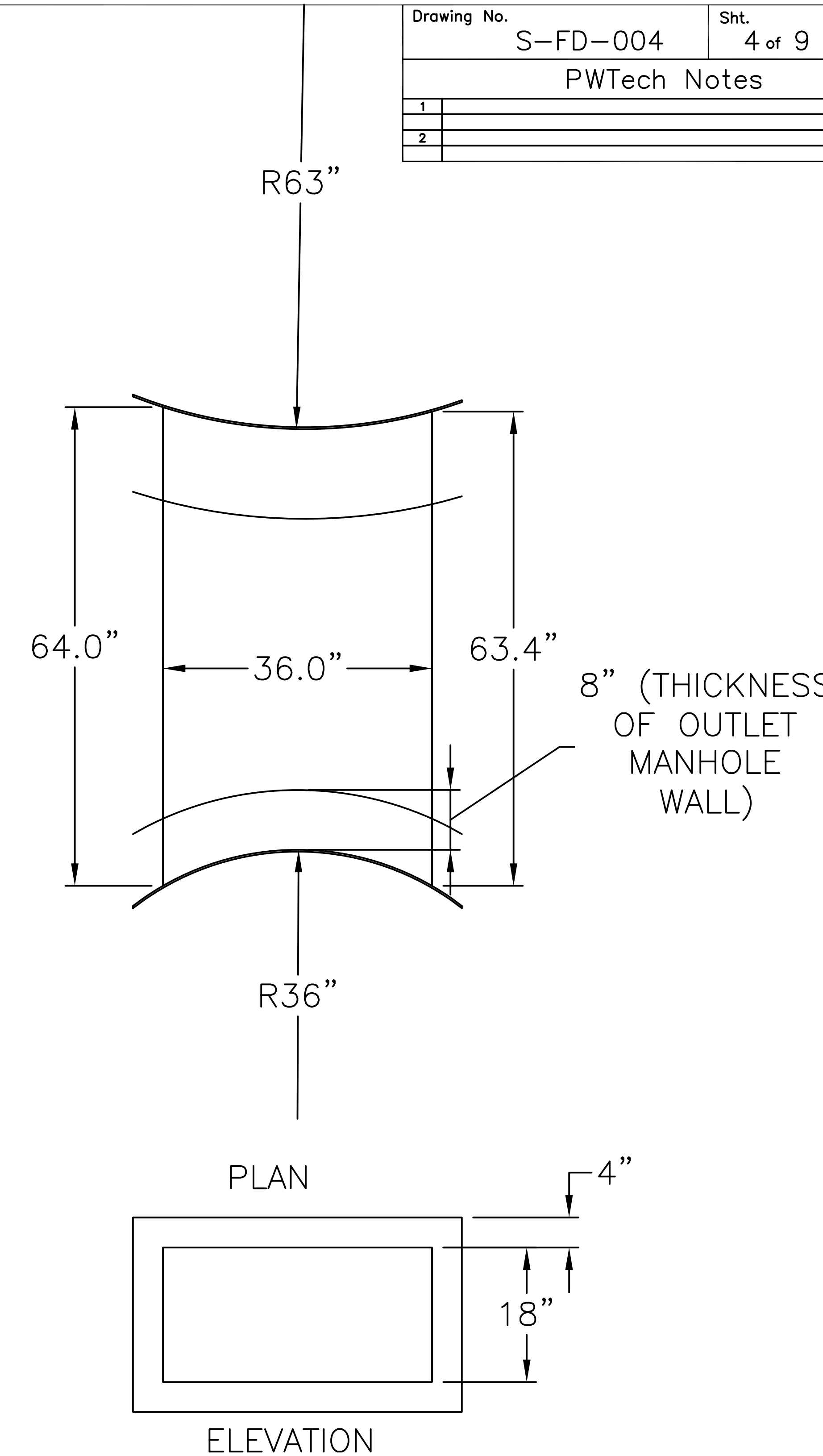
DRAWING NO:	SHEET:	REV:
S-FD-003	3 OF 9	B



INLET DETAIL



OUTLET DETAIL

Drawing No.	Sht.	Rev.
S–FD–004	4 of 9	
PWTech Notes		
1		
2		

MATERIAL: SS

PWT PROJECT NO: SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED:	DATE:
JIM HEIST	10/24/15

SIGNATURE:

PWTech PROCESS WASTEWATER TECHNOLOGIES
Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

DRAWING TITLE:
SS-1 INLET/OUTLET DETAILS
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST. WETLANDS PILOT TREATMENT SYS.

DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
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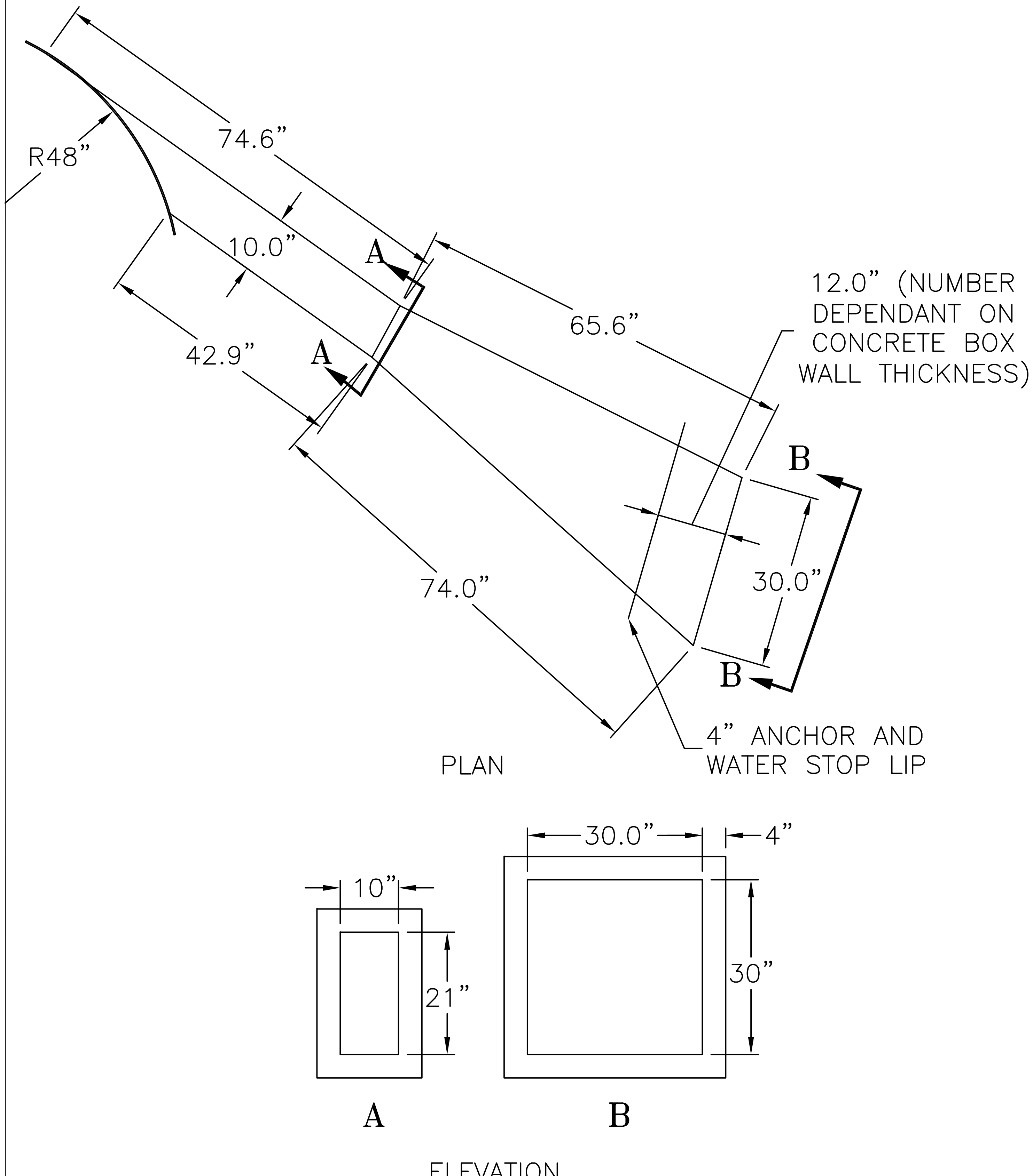
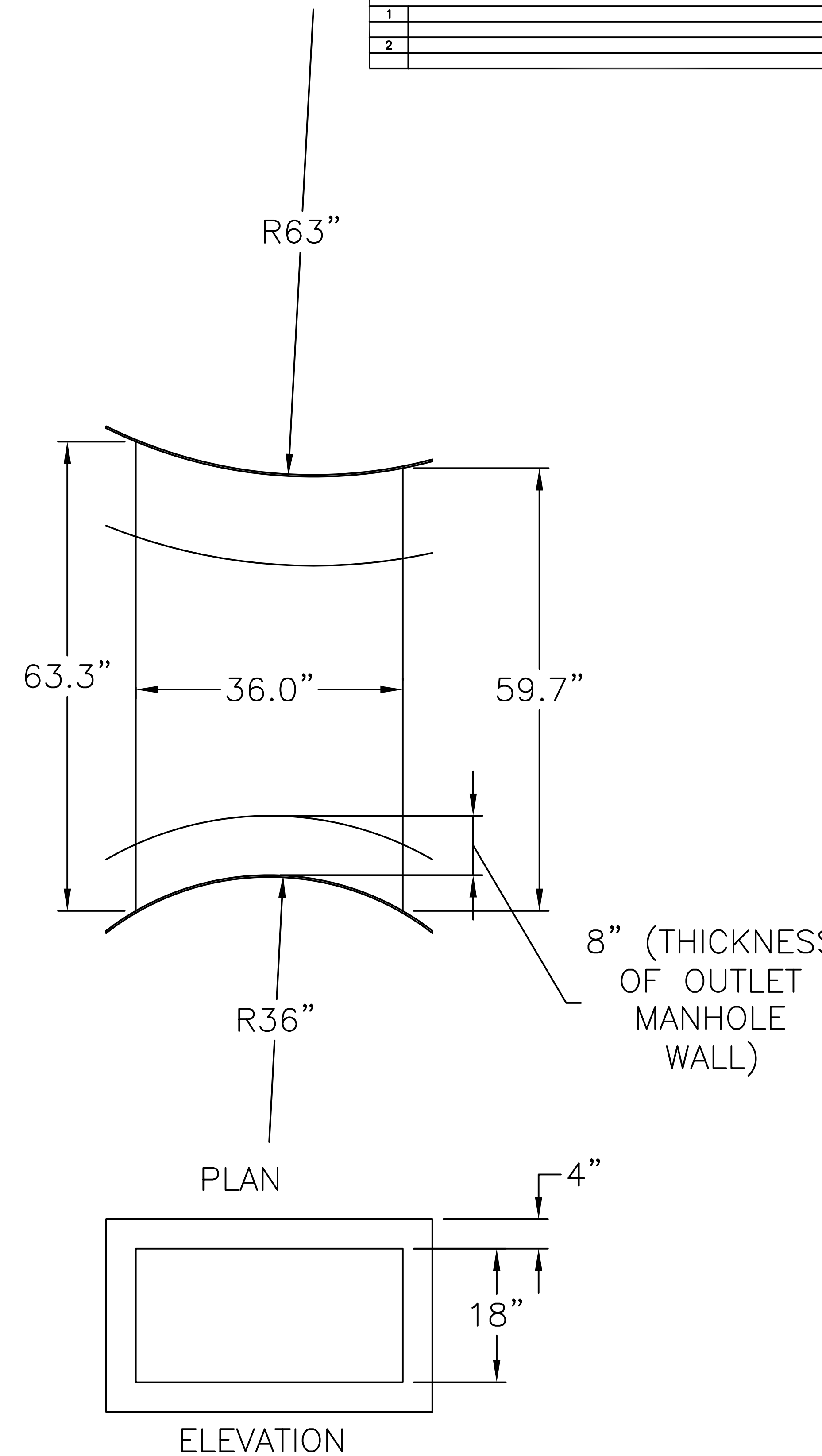
DRAWING NO:	SHEET:	REV:
S-FD-004	4 OF 9	B



SS-2 INLET DETAIL



SS-2 OUTLET DETAIL

Drawing No.	Sht.	Rev.
S-FD-005	5 of 9	

PWTech Notes

1	
2	

MATERIAL: SS

PWT PROJECT NO: SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED:	DATE:
JIM HEIST	10/24/15

SIGNATURE:

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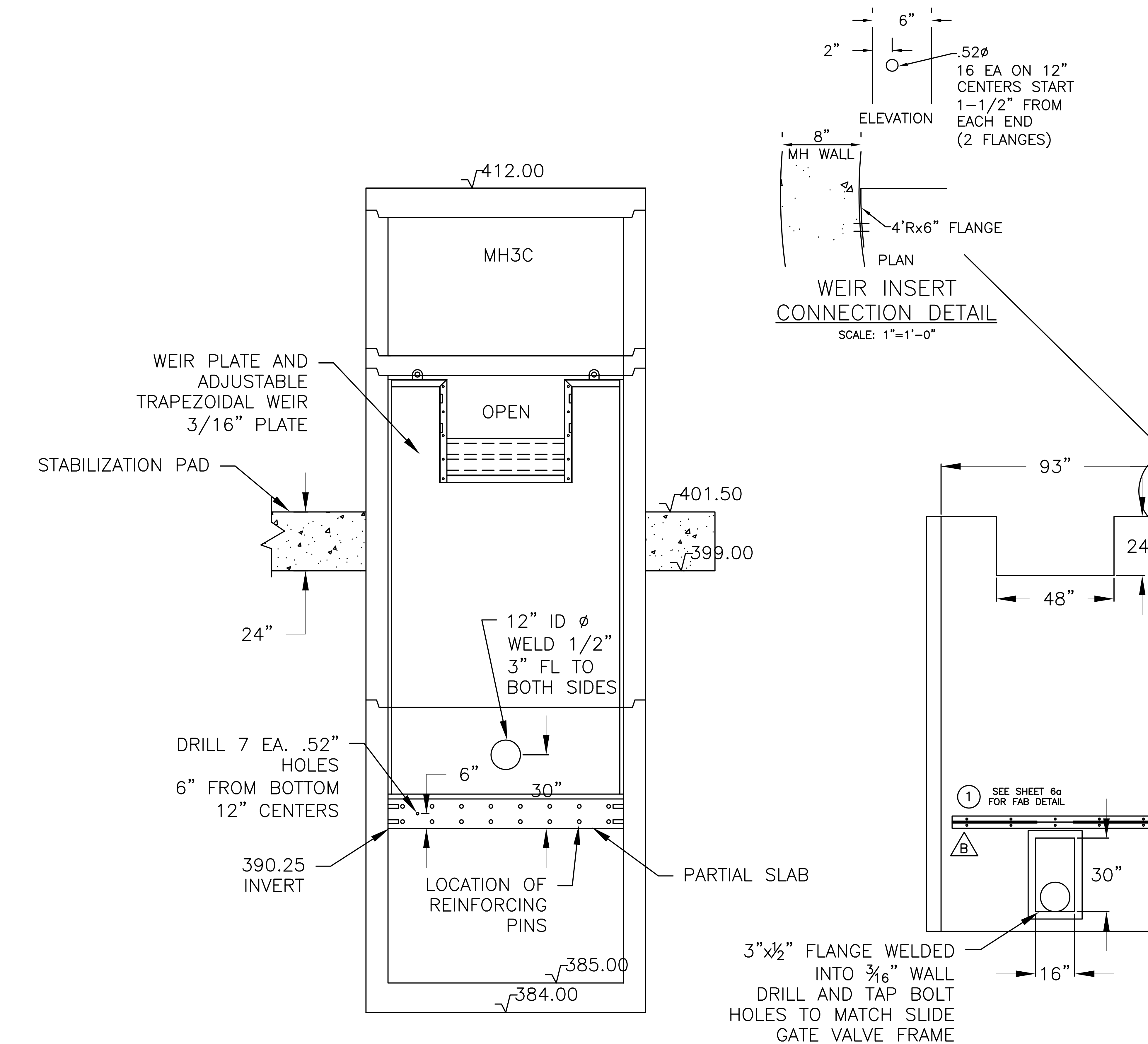
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

DRAWING TITLE:
SS-2 INLET/OUTLET DETAILS
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST. WETLANDS PILOT TREATMENT SYS.

DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
JLN	01/14/13	1/2"=1'	11x17

DRAWING NO:	SHEET:	REV:
S-FD-005	5 OF 9	B



Drawing No.	Sht.
S-FD-006	6 of 9

PWTech Notes

1	
2	

MATERIAL: SS

PWT PROJECT NO: SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED: JIM HEIST
DATE: 10/24/15
SIGNATURE:

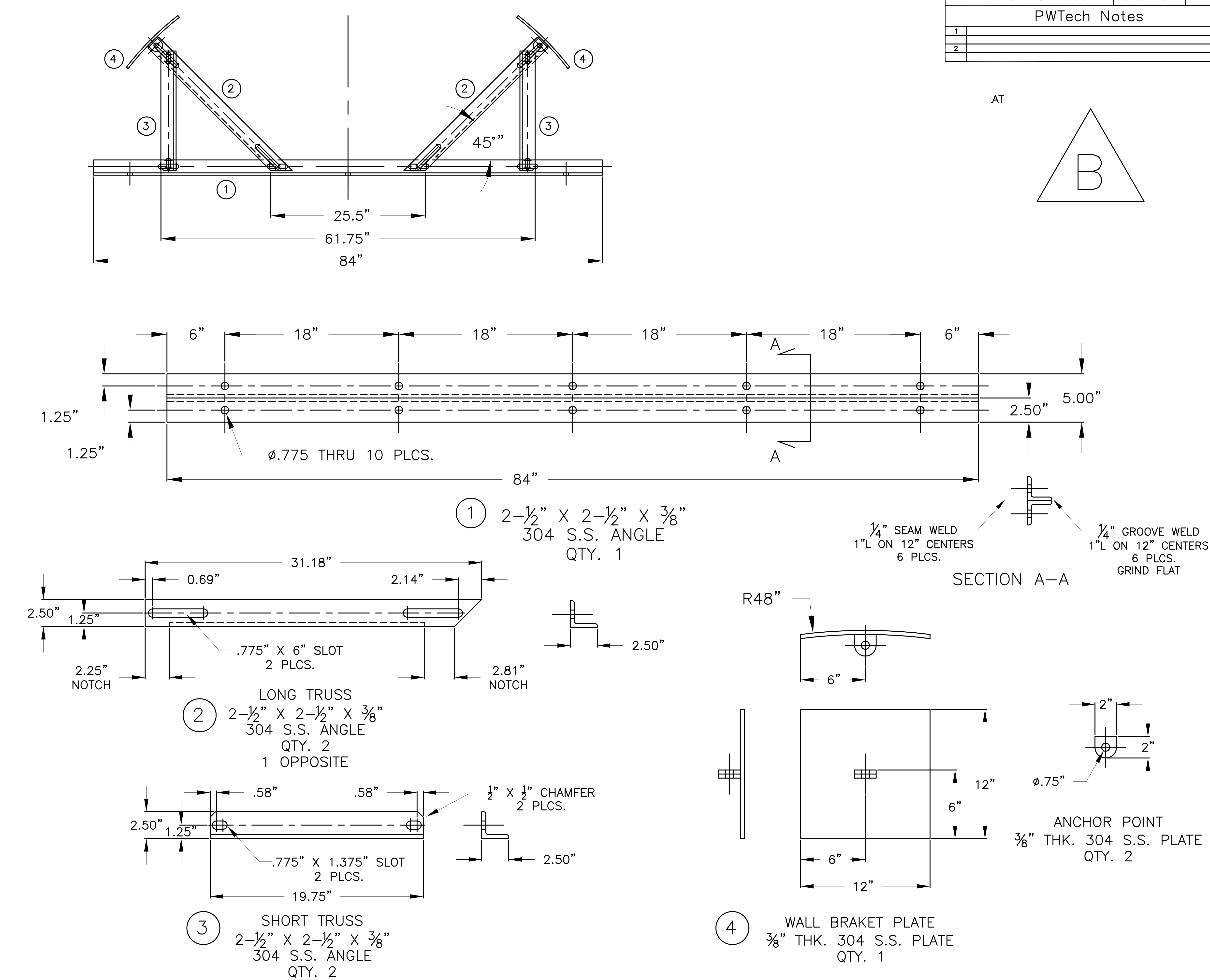
PWTech PROCESS WASTEWATER TECHNOLOGIES
Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

DRAWING TITLE:
MH-3C WEIR LAYOUT
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST. WETLANDS PILOT TREATMENT SYS.

DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
JPS	10/24/15	1/4"=1'	11x17

DRAWING NO:	SHEET:	REV:
S-FD-006	6 OF 9	B



Drawing No.	Sht.	Rev.
S–FD–006	6a of 9	

PWTech Notes

1	
2	

MATERIAL:	PWT PROJECT NO:
SS	SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED: JIM HEIST DATE: 10/24/15

SIGNATURE:

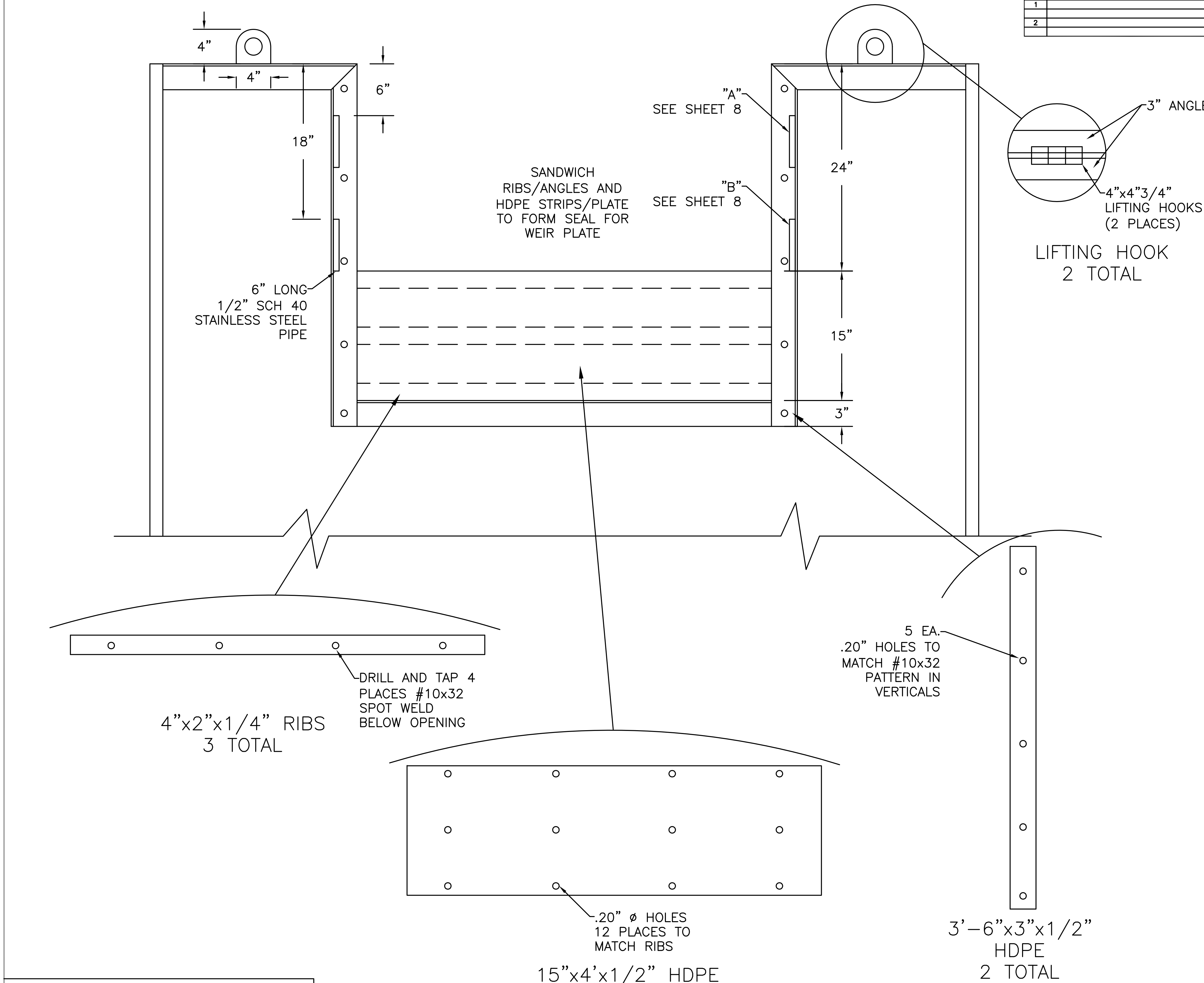
PWTech PROCESS WASTEWATER TECHNOLOGIES
Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

DRAWING TITLE:
MH-3C WEIR LAYOUT
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST.
WETLANDS PILOT TREATMENT SYS.

DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
JPS	10/24/15	1/4"=1'	11x17

DRAWING NO:	SHEET:	REV:
S-FD-006	6a OF 9	B



Drawing No.	Sht.	Rev.
S-FD-007	7 of 9	

PWTech Notes

1	
2	

MATERIAL:	PWT PROJECT NO:
SS	SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED: DATE:

JIM HEIST 10/24/15

SIGNATURE:

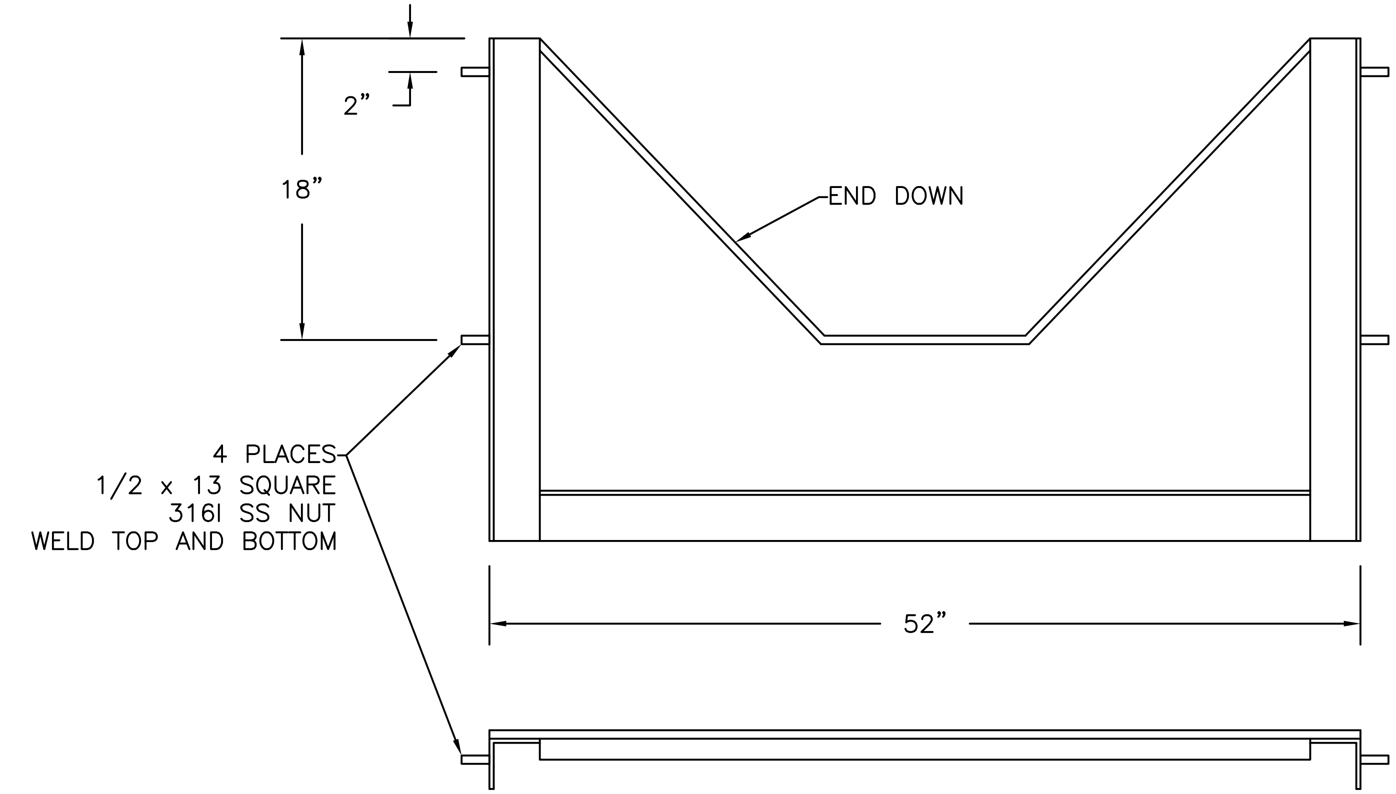
Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

DRAWING TITLE:
MH-3C WEIR DETAILS
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST.
WETLANDS PILOT TREATMENT SYS.

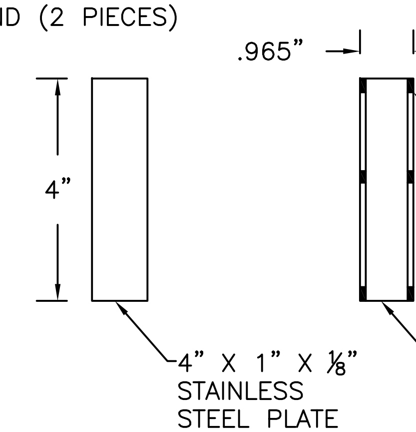
DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
JLN	01/14/13	1"=1'	11x17

DRAWING NO:	SHEET:	REV:
S-FD-007	7 OF 9	B



TRAPEZOIDAL
WEIR PLATE

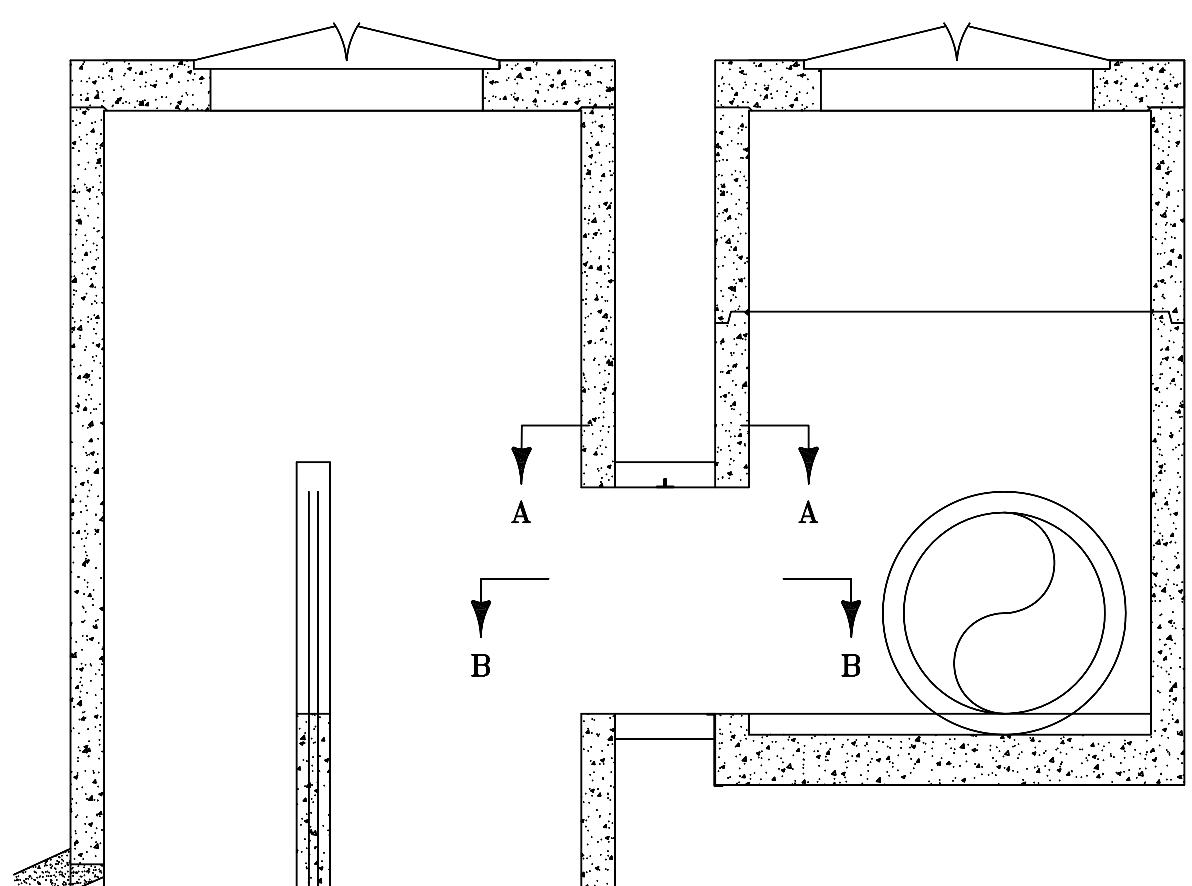
1/2 x 13
ALL-THREAD
ADJUSTING RODS WELD
3/4 HEX HEAD ON
ONE END (2 PIECES)



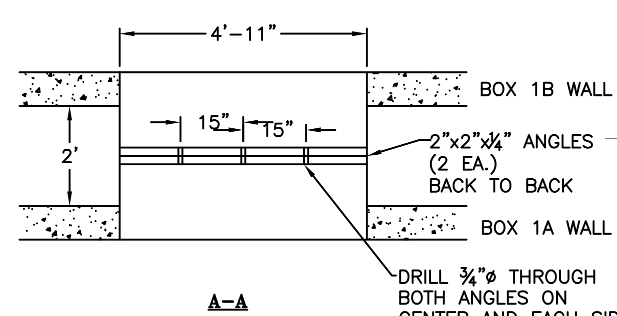
UPPER (A) PIECES
OPEN BOTH ENDS

LOWER (B) PIECES
WELD STAINLESS STEEL
PLUG INTO BOTTOM

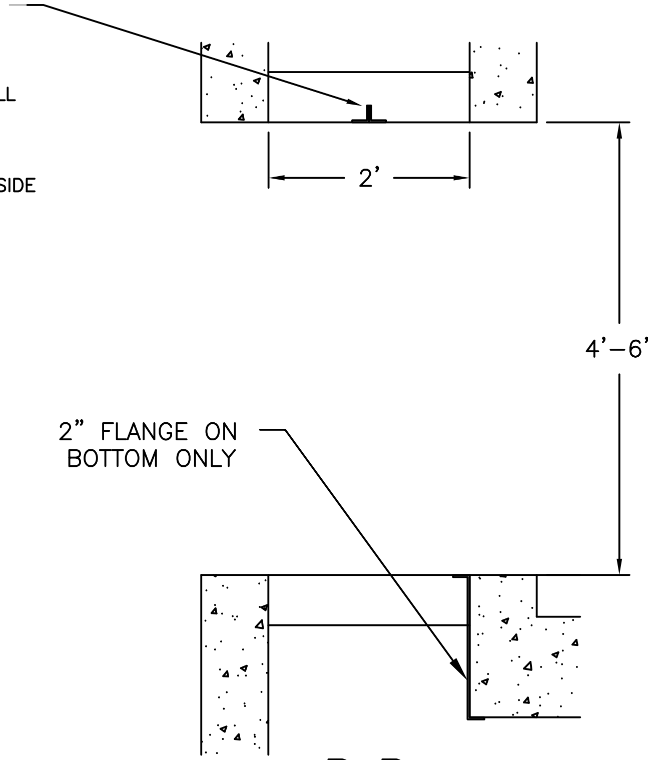
WEIR WALL GUIDES FOR
ADJUSTING SCREWS
N.T.S.



CONNECTION PIPE
BOX 1A TO 1B



A-A
SCALE: ¼"=1'-0"



B-B
SCALE: ½"=1'-0"

Drawing No.	Sht.	Rev.
S-FD-008	8 of 9	

PWTech Notes

1	
2	

MATERIAL: SS

PWT PROJECT NO: SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED: JIM HEIST
DATE: 10/24/15
SIGNATURE:

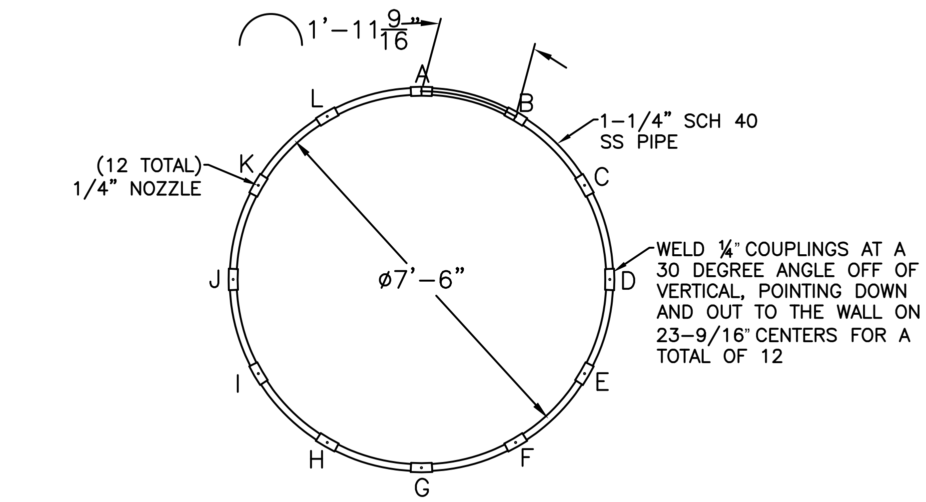
Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

DRAWING TITLE:
MH-3C WEIR DETAILS
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST.
WETLANDS PILOT TREATMENT SYS.

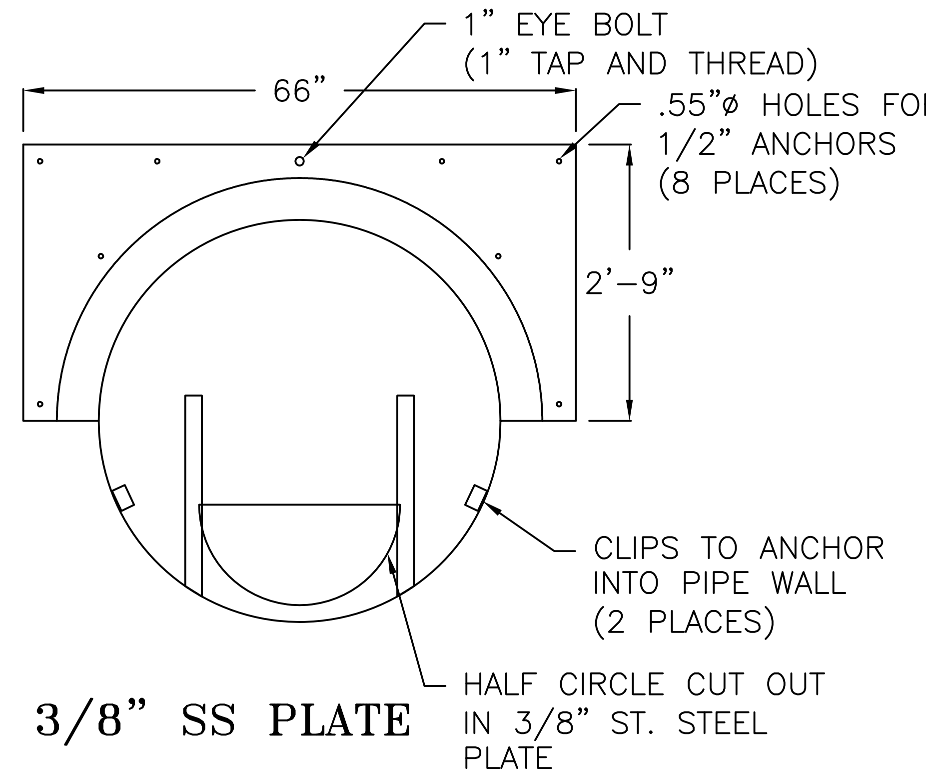
DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
JLN	01/14/13	1"=1'	11x17

DRAWING NO:	SHEET:	REV:
S-FD-008	8 OF 9	B

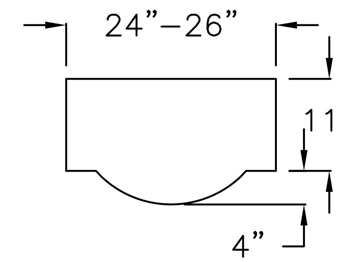


WASHDOWN RING DETAIL

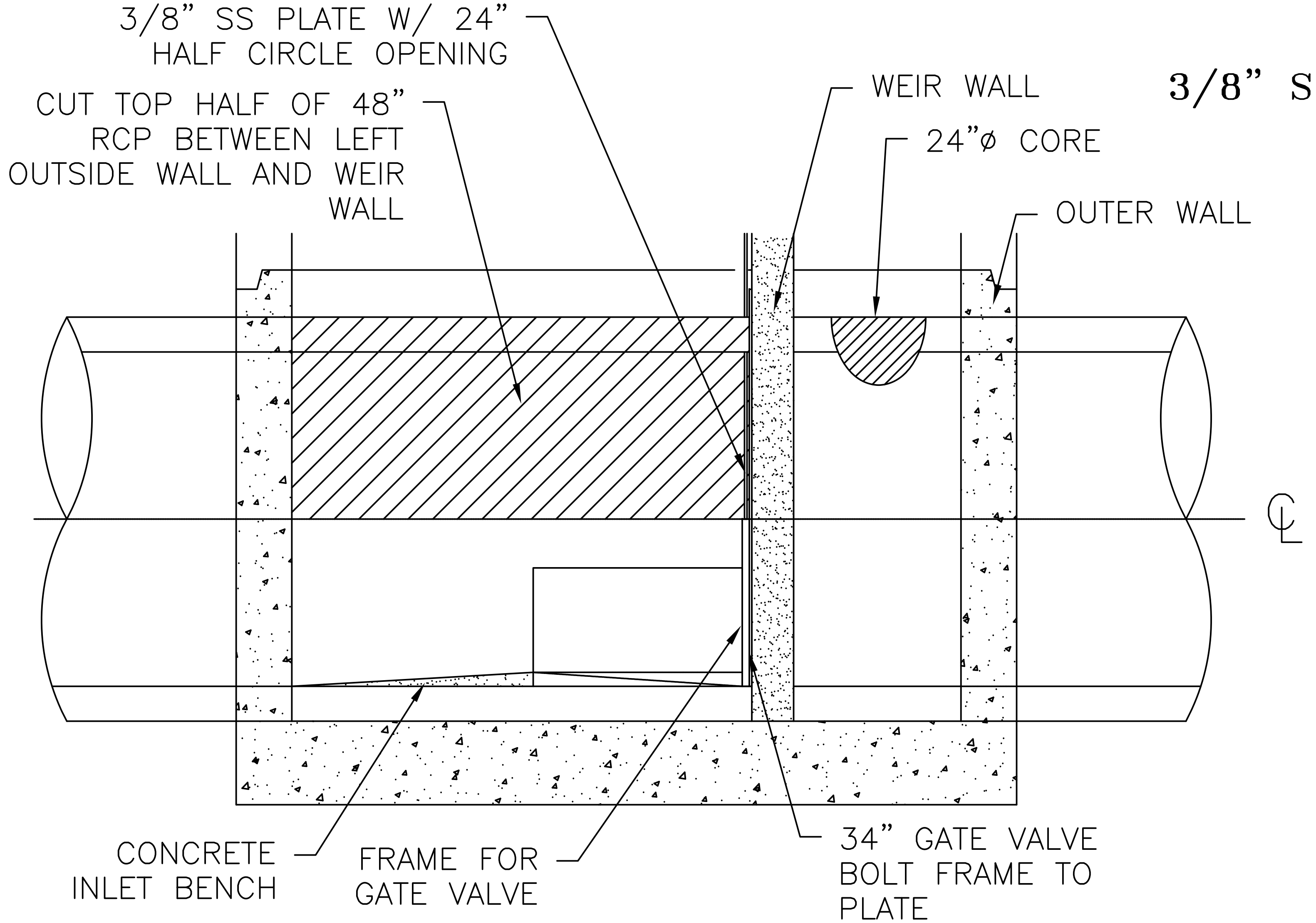
SCALE: ¼"=1'-0"



3/8" SS PLATE



GATE DETAIL



HALF PIPE FLOW CHANNEL DETAIL

Drawing No.	Sht.	Rev.
S-FD-009	9 of 9	

PWTech Notes

1	
2	

MATERIAL:	PWT PROJECT NO:
SS	SS-NY12002

PW TECH NOTES

B	ADDED SHEET 6a GATE FRAME STIFFENER

DRAWING APPROVAL

APPROVED:	DATE:
JIM HEIST	10/24/15

SIGNATURE:

PWTech PROCESS WASTEWATER TECHNOLOGIES
Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

DRAWING TITLE:
HALF PIPE FLOW CHANNEL DETAILS
FABRICATION DRAWINGS
SANSEP TWIN 80_80 FINE SCREEN FACILITY

PROJECT TITLE:
HARBOR BROOK CSO 018 - CONST.
WETLANDS PILOT TREATMENT SYS.

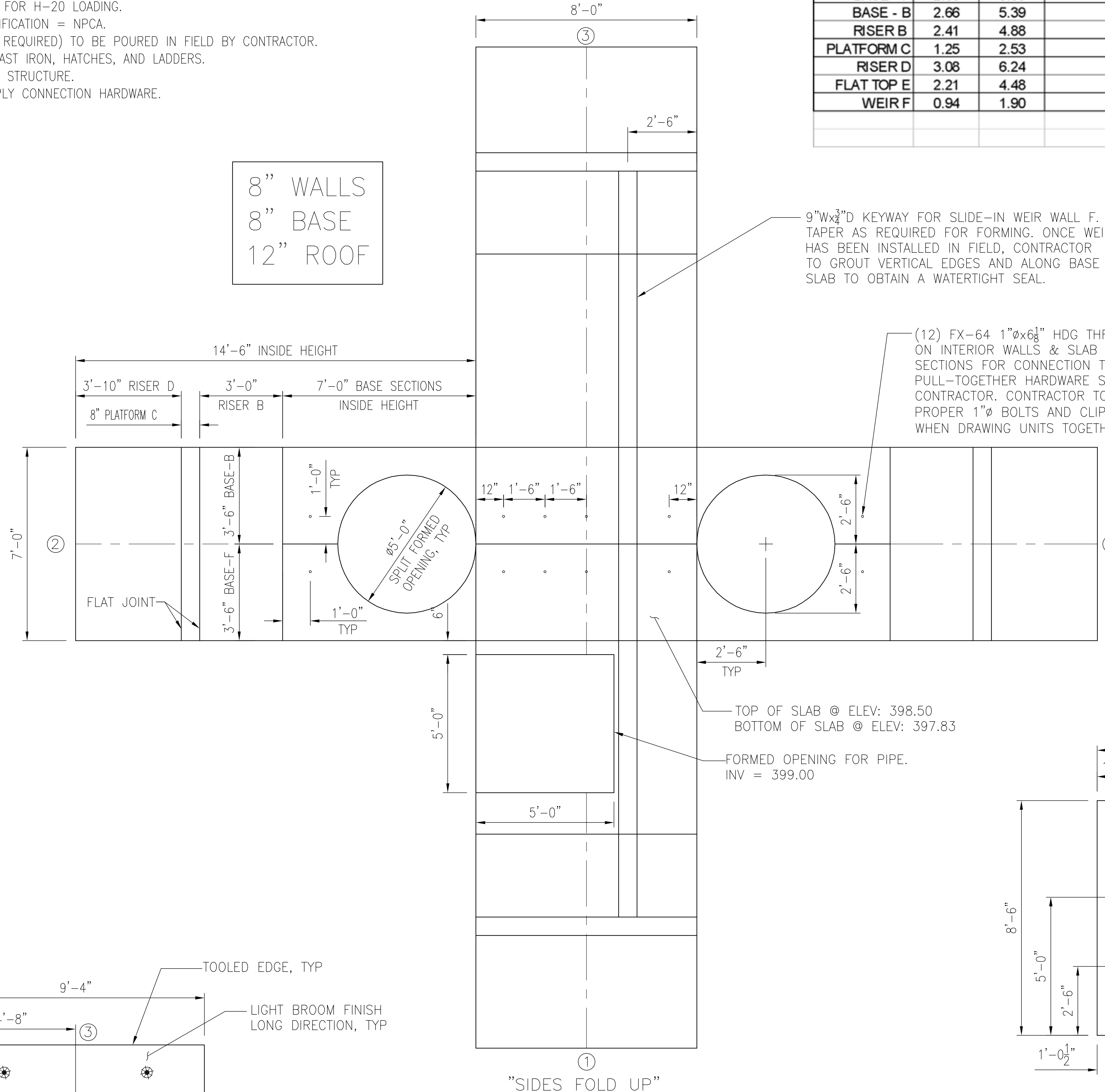
DRAWN BY:	DATE:	SCALE:	SHEET SIZE:
JLN	01/14/13	1/2"=1'	11x17

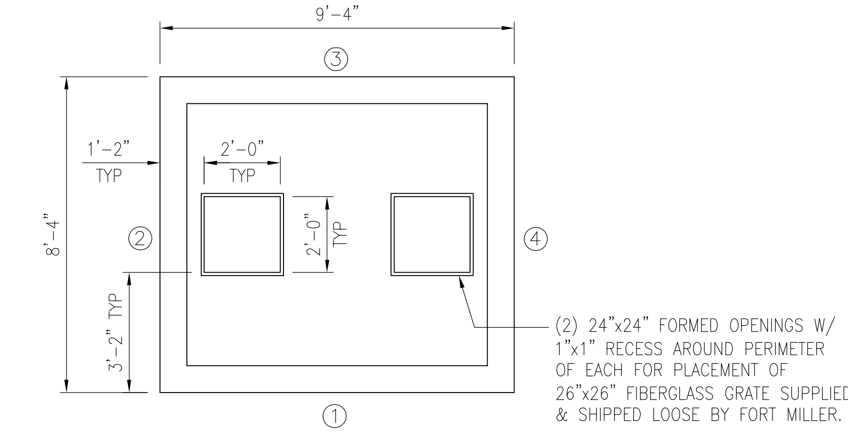
DRAWING NO:	SHEET:	REV:
S-FD-009	8 OF 9	B

NOTES:
1) WATER TABLE SPECIFIED TO BE AT ELEVATION 400.00'.
2) CONCRETE 28-DAY COMPRESSIVE STRENGTH TO BE 4,000 PSI MIN.
3) REINFORCEMENT SHALL BE GRADE 60 BLACK.
4) STRUCTURE DESIGNED FOR H-20 LOADING.
5) MANUFACTURING SPECIFICATION = NPCA.
6) CONCRETE BENCH (IF REQUIRED) TO BE POURED IN FIELD BY CONTRACTOR.
7) FM TO SUPPLY ALL CAST IRON, HATCHES, AND LADDERS.
8) HATCH TO DRAIN INTO STRUCTURE.
9) CONTRACTOR TO SUPPLY CONNECTION HARDWARE.

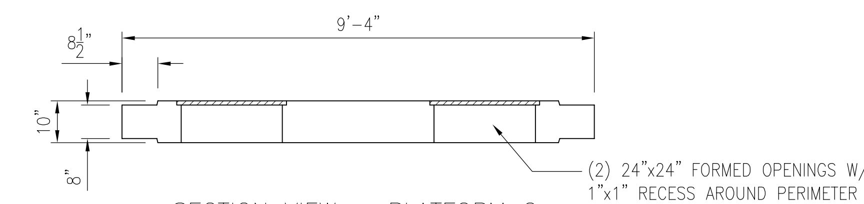
	VOL (CY)	WEIGHT (TONS)	REF
BASE - F	2.66	5.39	
BASE - B	2.66	5.39	
RISER B	2.41	4.88	
PLATFORM C	1.25	2.53	
RISER D	3.08	6.24	
FLAT TOP E	2.21	4.48	
WEIR F	0.94	1.90	

8" WALLS
8" BASE
12" ROOF

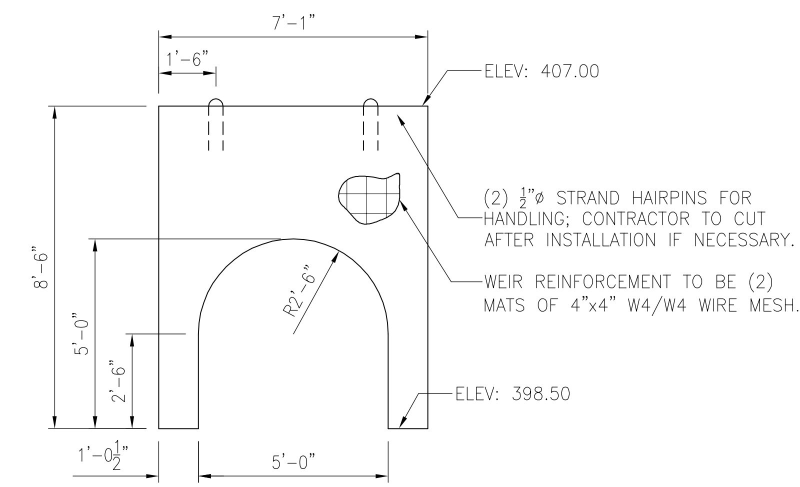




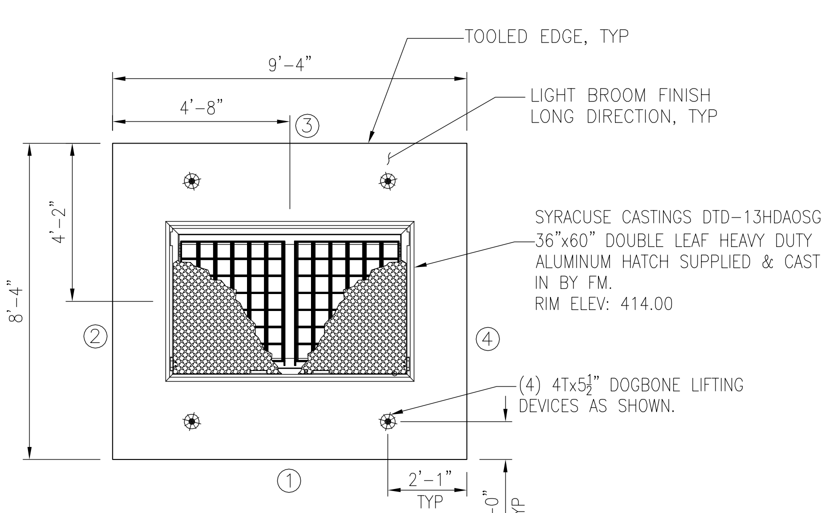
PLAN – PLATFORM C



SECTION VIEW – PLATFORM C



WIER F
8" THICK



PLAN – FLAT TOP E
12" THICK

SHIPLOOSE:
(10) ROLLS 1" BUTYL (21053)
(4) 4T LIFTING EYES (5336)
(2) 4T RING CLUTCHES (5328)
(2) 26"x26" FIBERGLASS GRATES

NOTE TO CONTRACTOR:

THIS SHOP DRAWING REPRESENTS OUR INTERPRETATION OF THE PLANS AND SPECIFICATIONS, AND OUR CONTRACT REQUIREMENTS FOR THIS PROJECT. PRIOR TO THE MANUFACTURE OF ANY ITEM FOR THIS PROJECT, ALL DIMENSIONS, METHODS OF CONSTRUCTION AND EXISTING CONDITIONS MUST BE CHECKED, CORRECTED AND/OR APPROVED BY OUR CUSTOMER. NO ITEM WILL BE SCHEDULED FOR PRODUCTION UNTIL WE HAVE BEEN NOTIFIED IN WRITING THAT OUR DRAWINGS HAVE BEEN APPROVED FOR FABRICATION. APPROVAL DELAYS WILL RESULT IN FABRICATION DELAYS. ANY ITEM THAT IS FABRICATED IN ACCORDANCE WITH APPROVED SHOP DRAWINGS THAT DOES NOT FIT THE CUSTOMER'S REQUIREMENTS WILL BE REMADE AND SHIPPED TO THE PROJECT ONLY AT THE CUSTOMER'S EXPENSE, AND ONLY AFTER RECEIPT OF A PURCHASE ORDER TO COVER THE ADDED EXPENSE. WE ASSUME NO RESPONSIBILITY FOR THE ALTERING OF OUR PRODUCTS TO ACCOMMODATE OTHER TRADES UNLESS REQUIRED INFORMATION IS FURNISHED AND SHOWN ON OUR SHOP DRAWINGS AT THE TIME THEY ARE APPROVED FOR FABRICATION BY OUR CUSTOMER.

THE FORT MILLER Co., Inc.
P.O. BOX 98
SCHUYLERVILLE, NY 12871
(518) 695-5000/(518) 695-4970 FAX
www.fortmiller.com

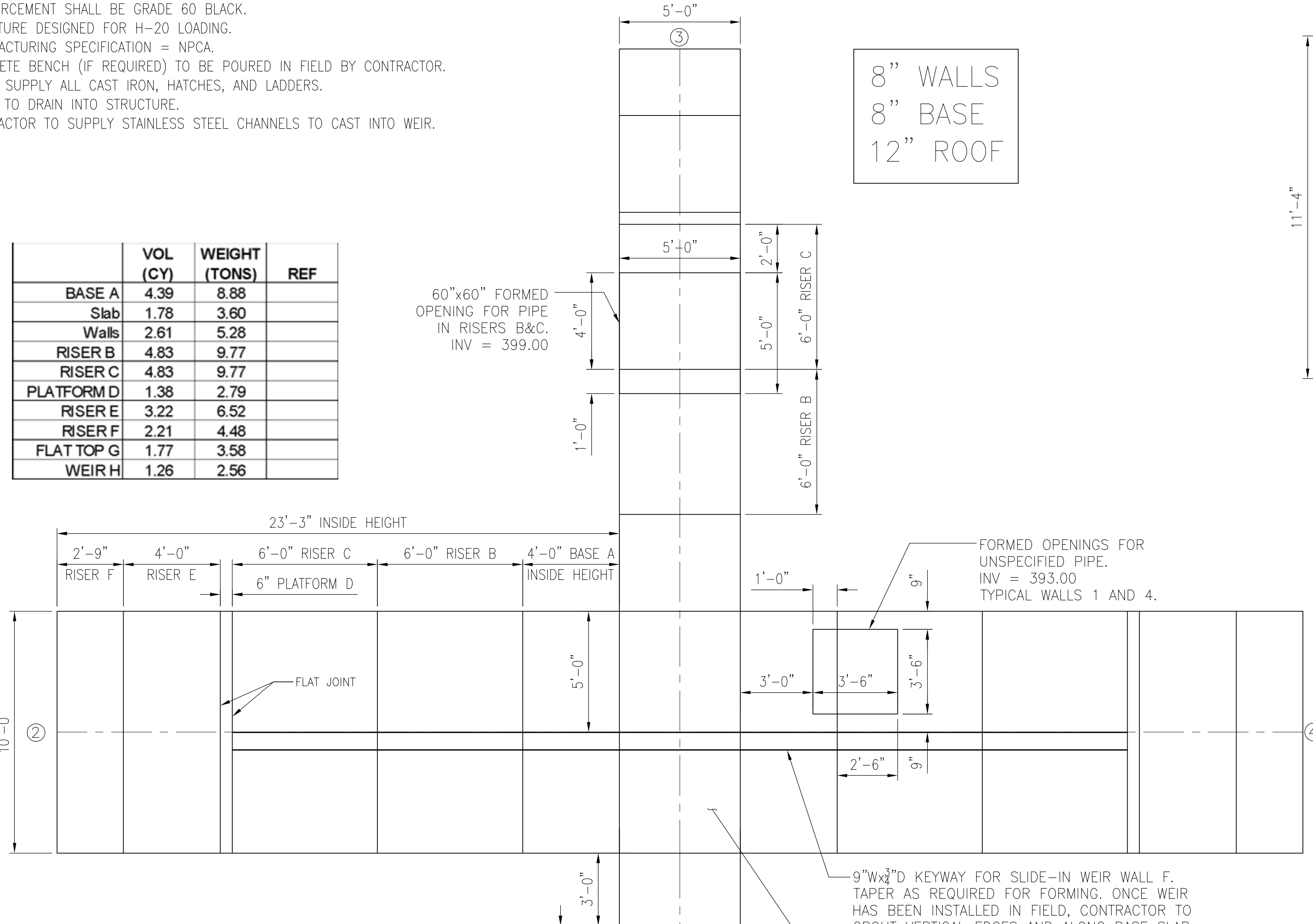
CONTRACT NO.:
PROJECT: HARBOR BROOK CSO
LOCATION: SYRACUSE, NEW YORK
SUBJECT: BOX 1A STRUCTURES DETAILS
CONTRACTOR: PWTech
ENGINEER/ARCHITECT

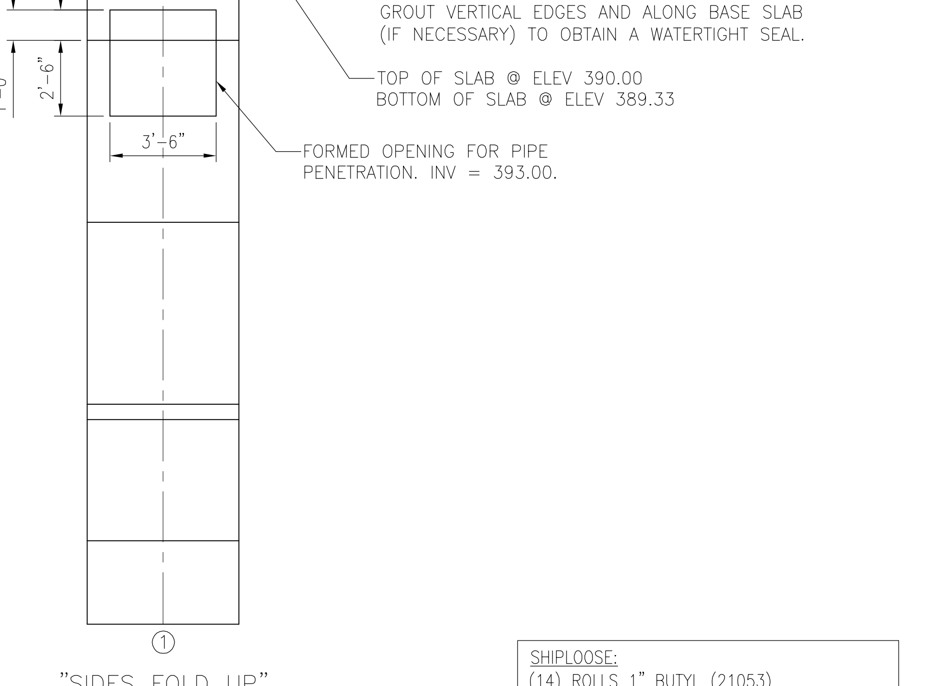
F.M. JOB NO. 14220
SHEET NO. 1
DATE: 2/18/13
DRN. BY: PJR
CHK. BY:
SCALE: NONE
DWG. NO.
D1

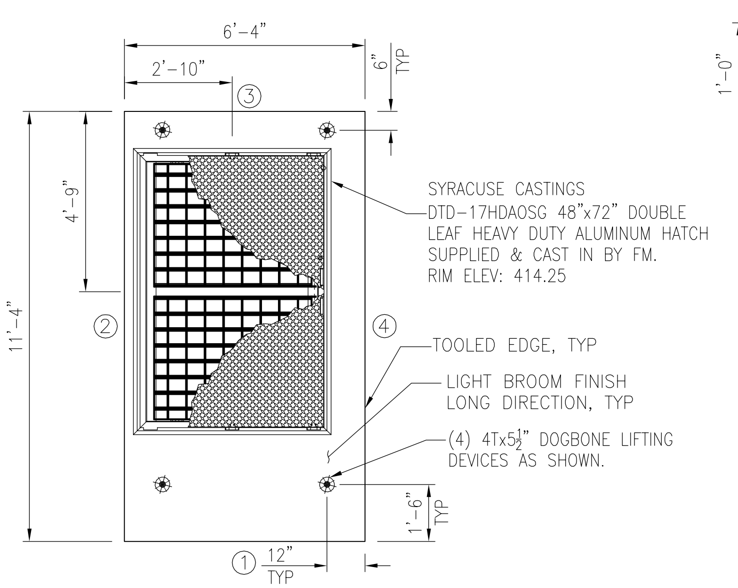
NOTES:
1) WATER TABLE SPECIFIED TO BE AT ELEVATION 400.00'.
2) CONCRETE 28-DAY COMPRESSIVE STRENGTH TO BE 5,000 PSI MIN.
3) REINFORCEMENT SHALL BE GRADE 60 BLACK.
4) STRUCTURE DESIGNED FOR H-20 LOADING.
5) MANUFACTURING SPECIFICATION = NPCA.
6) CONCRETE BENCH (IF REQUIRED) TO BE POURED IN FIELD BY CONTRACTOR.
7) FM TO SUPPLY ALL CAST IRON, HATCHES, AND LADDERS.
8) HATCH TO DRAIN INTO STRUCTURE.
9) CONTRACTOR TO SUPPLY STAINLESS STEEL CHANNELS TO CAST INTO WEIR.

8" WALLS
8" BASE
12" ROOF

	VOL (CY)	WEIGHT (TONS)	REF
BASE A	4.39	8.88	
Slab	1.78	3.60	
Walls	2.61	5.28	
RISER B	4.83	9.77	
RISER C	4.83	9.77	
PLATFORM D	1.38	2.79	
RISER E	3.22	6.52	
RISER F	2.21	4.48	
FLAT TOP G	1.77	3.58	
WEIR H	1.26	2.56	

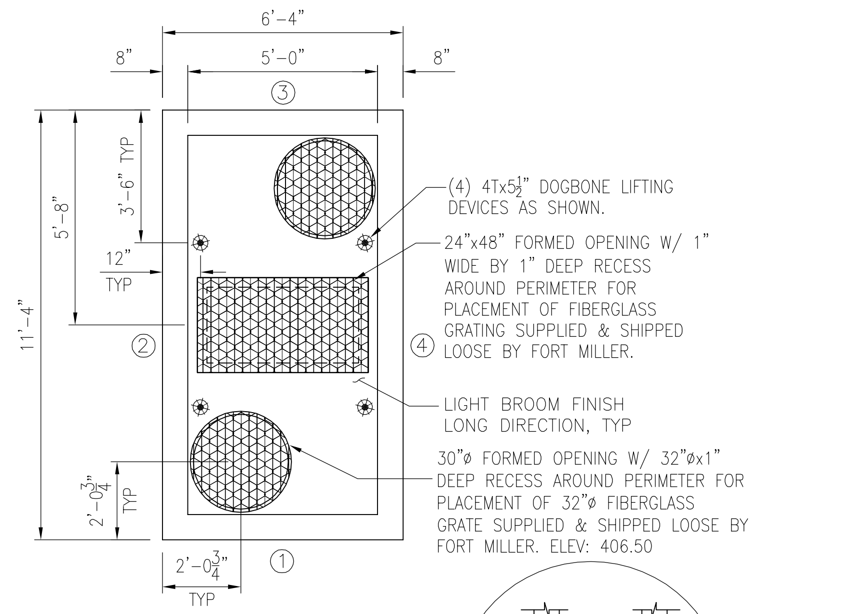






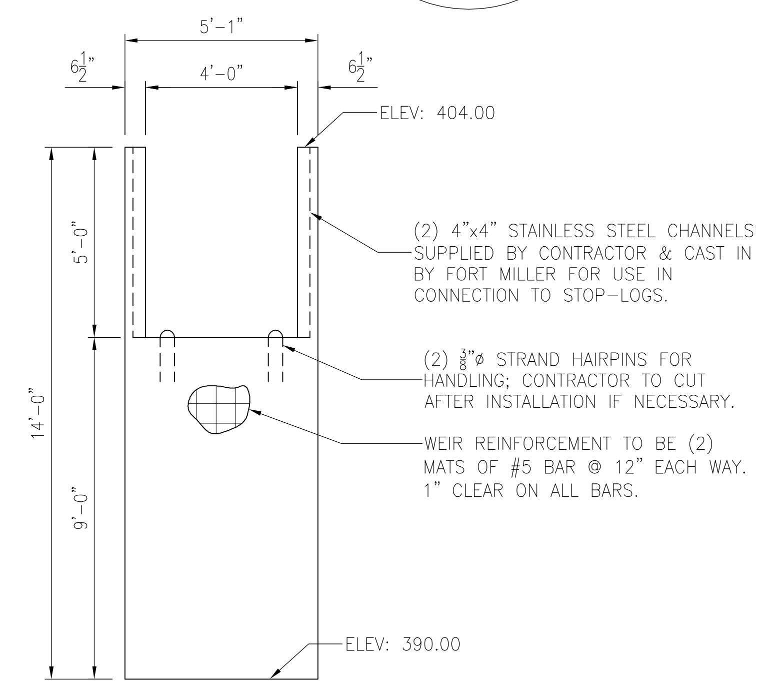
PLAN – FLAT TOP G

12" THICK



PLAN – PLATFORM D

6" THICK ABOVE AND BELOW WALLS, 8" THICK IN INTERIOR



WIER H

8" THICK

NOTE: 28 DAY STRENGTH NEEDS TO BE 6000 PSI MIN & STRIPPING STRENGTH NEEDS TO BE 5000 PSI MIN FOR WEIR.

SHIPLOOSE:
(14) ROLLS 1" BUTYL (21053)
(4) 4T LIFTING EYES (5336)
(1) 26"x50" FIBERGLASS GRATE
(2) 32"ø FIBERGLASS GRATES

NOTE TO CONTRACTOR:

THE FORT MILLER Co., Inc.
P.O. BOX 98
SCHUYLERVILLE, NY 12871
(518) 695-5000/(518) 695-4970 FAX
www.fortmiller.com

CONTRACT NO.:
PROJECT: HARBOR BROOK CSO
LOCATION: SYRACUSE, NEW YORK
SUBJECT: BOX 1B STRUCTURES DETAILS
CONTRACTOR: PWTech
ENGINEER/ARCHITECT

F.M. JOB NO. 14220
SHEET NO. 1
DATE: 2/18/13
DRN. BY: PJR
CHK. BY:
SCALE: NONE

DWG. NO.
B1

THE FORT MILLER CO., INC.
P.O. BOX 98, SCHUYLERVILLE, N.Y. 12871
PHONE: 518/695-5000 FAX: 518/695-4970

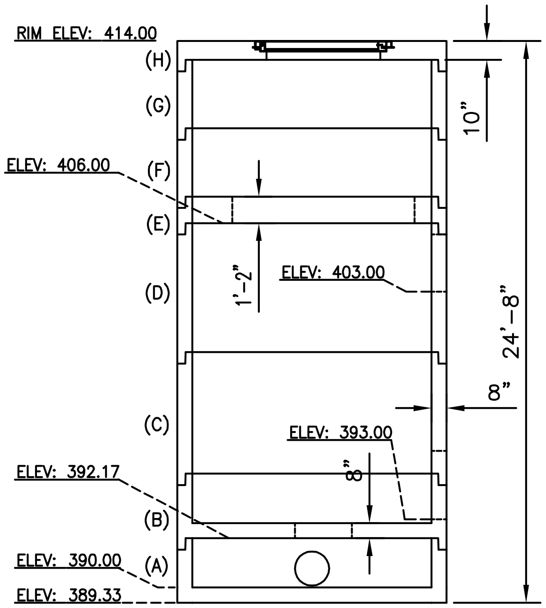
MANHOLE DATA SHEET

 RFP:

DATE: 10/15/12
REV: 12/13/12
REV: 2/18/13
BY: PJR

MH NO.: SS-1 JOB NO.: 14220
CONTRACTOR: PWTech
PROJECT: HARBOR BROOK CSO
LOCATION: SYRACUSE, NEW YORK
SPEC: ASTM C478
TESTING: NONE

MH DIA: 126" QTY REQ'D: 1
FRAME OP'G: DTD-18HDAOSG 60"x60" ALUMINUM HATCH CAST IN, ECCENTRIC
BASE TYPE: INTEGRAL BASE, 8" THICK
STEPS: NONE
COATING: NONE
JOINT TYPE: BUTYL



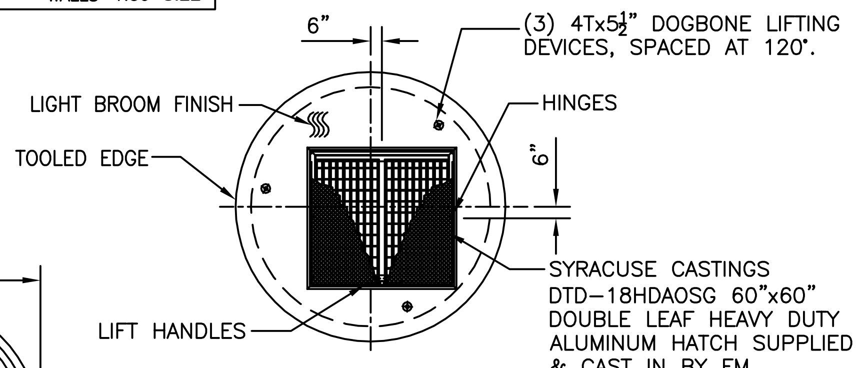
MANHOLE COMPONENTS						
NO.	TYPE	REF.	DIA.	HGT. (ft)	CY	TONS
A	BASE SECTION	145.803A	126"	2.33	4.32	8.75
B	PLATFORM W/ RISER, SEE SHEET 2	SHEETS 4&5	126"	2.83	4.56	9.23
C	RISER, SEE SHEET 2	145.804	126"	5.33	4.60	9.32
D	RISER	145.804	126"	5.67	4.90	9.92
E	TRANSITION SLAB	SHEET 3	126"	1.17	2.59	5.24
F	RISER	145.804	126"	3.00	2.59	5.25
G	RISER	145.804	126"	3.00	2.59	5.25
5	ROOF SLAB	SHEETS 6&7	126"	1.33	2.62	5.30

SUM OF HEIGHTS: 24'-8"

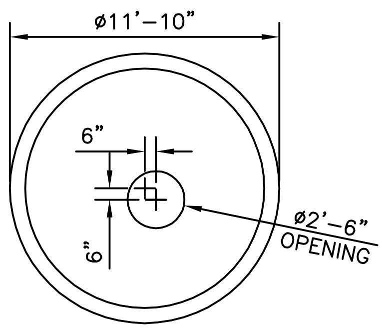
BASE SECTION	CY	TONS
SLAB	2.73	5.53
WALLS	1.59	3.22

RIM ELEVATION: 414.00
BOTTOM ELEV. − 389.33
TOTAL HEIGHT = 24.67'

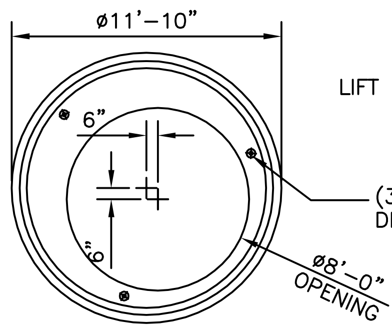
NOTE:
CONTRACTOR TO VERIFY ALL PIPE TYPES, SIZES AND INVERT ELEVATIONS.



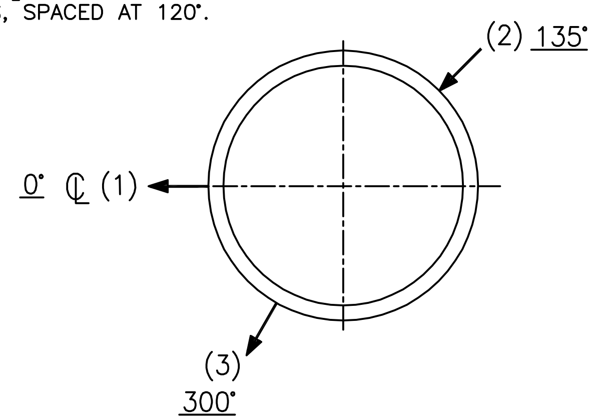
PLAN VIEW - ROOF SLAB



PLAN VIEW - PLATFORM B W/ RISER
CONTRACTOR TO ROTATE AS REQUIRED.



PLAN VIEW - TRANSITION SLAB E
CONTRACTOR TO ROTATE AS REQUIRED.



PLAN VIEW OF ALL PIPE PENETRATIONS

NOTES:
1) WATER TABLE SPECIFIED TO BE AT ELEVATION 400.00.
2) CONCRETE 28-DAY COMPRESSIVE STRENGTH TO BE 4,000 PSI MIN.
3) H-20 TRAFFIC LOADING DESIGN FOR PRECAST CONCRETE; ALUMINUM HATCH RATED FOR H-20 LIVE LOAD. HATCH SUPPLIED BY FM.
4) REINFORCEMENT IN TOP COVER AND BASE SECTION SHALL CONFORM TO ASTM A615, GRADE 60 BLACK.
5) CONCRETE BENCH TO BE POURED IN THE FIELD BY THE CONTRACTOR.
6) MANUFACTURING SPECIFICATION = NPCA.
7) HATCH TO DRAIN INTO STRUCTURE.
8) CONTRACTOR TO SUPPLY ADAPTER RINGS FOR HDPE PIPE.

SHIPLOOSE:
(38) ROLL(S) 1" CS-102 BUTYL (21053)
(3) 4T LIFTING EYES (5336)

IMPORTANT NOTE:
"Y" DIMENSION TAKEN FROM TOP OF BASE SLAB

PIPE INFORMATION							
PIPE	COMP	DIA.	PIPE TYPE	INV ELEV	"Y"(UP C.L.)	DEG.	CONNECTOR
1	D	2'x4'	SS	403.00	14'-3"	0°	48"Wx30"H FORMED OPENING
2	B/C	---	SS	393.00	4'-6"	280°	48"Wx36"H FORMED OPENING
3	A	12"	HDPE	390.33	0'-10"	135°	FORMED HOLE, 18"ø

NOTES: "X" = DISTANCE FROM BOTTOM OF BASE SLAB TO INVERT OF OUTLET PIPE
"Y" = DISTANCE FROM TOP OF BASE SLAB TO CENTERLINE OF OPENING

THE FORT MILLER CO., INC.
P.O. BOX 98, SCHUYLERVILLE, N.Y. 12871
PHONE: 518/695-5000 FAX: 518/695-4970

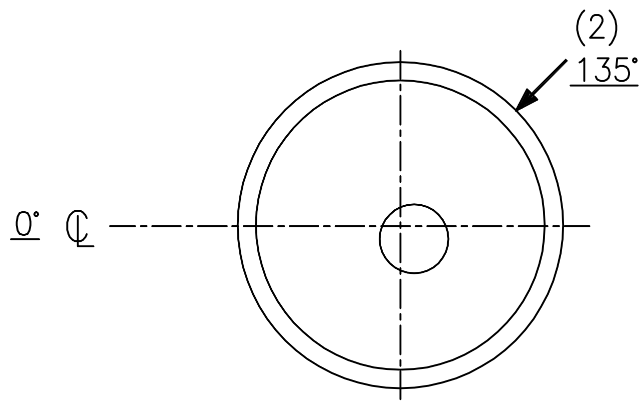
MANHOLE DATA SHEET

RFP:___________

DATE: 10/15/12
REV: 12/13/12
REV: 2/18/13
BY: PJR

MH NO.: SS-1
JOB NO.: 14220
CONTRACTOR: PWTech
PROJECT: HARBOR BROOK CSO
LOCATION: SYRACUSE, NEW YORK
SPEC: ASTM C478
TESTING: NONE

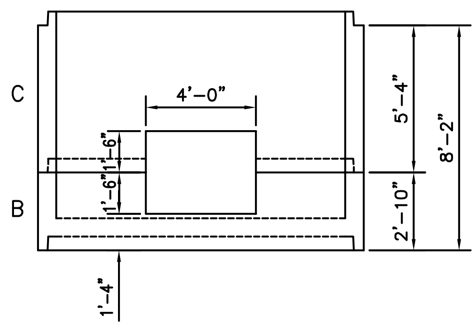
MH DIA: 126"
QTY. REQ'D: 1
FRAME OP'G: DTD-18HDAOSG 60"x60" ALUMINUM HATCH CAST IN, ECCENTRIC
BASE TYPE: INTEGRAL BASE, 8" THICK
STEPS: NONE
COATING: NONE
JOINT TYPE: BUTYL

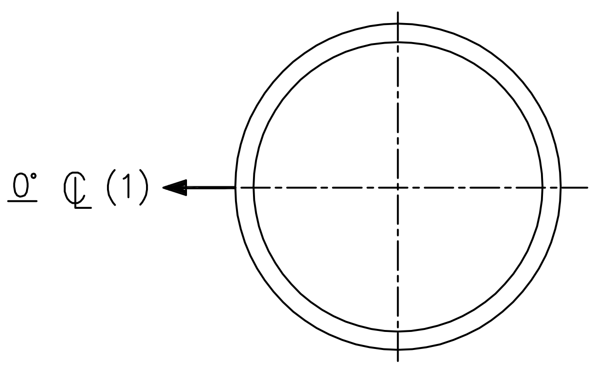


COMPONENT NUMBER: B, C
TYPE: RISER, DIA: 126", HGT: B=2'-10", C=5'-4"

PIPE INFORMATION

PIPE	DIA.	PIPE TYPE	"Z"(UP C.L.)	DEG.	CONNECTOR
2	---	SS	SEE BELOW	135°	48"Wx36"H FORMED OPENING





COMPONENT NUMBER: D
TYPE: RISER, DIA: 126"", HGT: 5'-8"

PIPE INFORMATION

PIPE	DIA.	PIPE TYPE	"Z"(UP C.L.)	DEG.	CONNECTOR
1	2'x4'	SS	4'-5"	0°	48"Wx30"H FORMED OPENING

*NOTE: TOP OF OPENING WILL BE AGAINST BOTTOM OF RING, BUT MUST BE POURED AS SUCH. OPENING ELEVATIONS ARE CRITICAL, AND CANNOT BE CHANGED.

NOTES: "Z" = DISTANCE FROM BOTTOM OF COMPONENT TO CENTERLINE OF OPENING.

SPECIAL FORT MILLER PRODUCTION NOTE:
PROJECT SPECIFICATIONS REQUIRED MAJOR CENTERLINES OF STRUCTURE (AS SEEN IN PLAN VIEWS OF PIPES TO BE DRAWN ON ALL COMPONENTS OF THE STRUCTURE INTERIOR & EXTERIOR WALLS AND TOP OF TRANSITION, BASE, AND ROOF SLABS, USING CHALK, PAINT, OR EQUIVALENT.

THE FORT MILLER CO., INC.
P.O. BOX 98, SCHUYLERVILLE, N.Y. 12871
PHONE: 518/695-5000 FAX: 518/695-4970

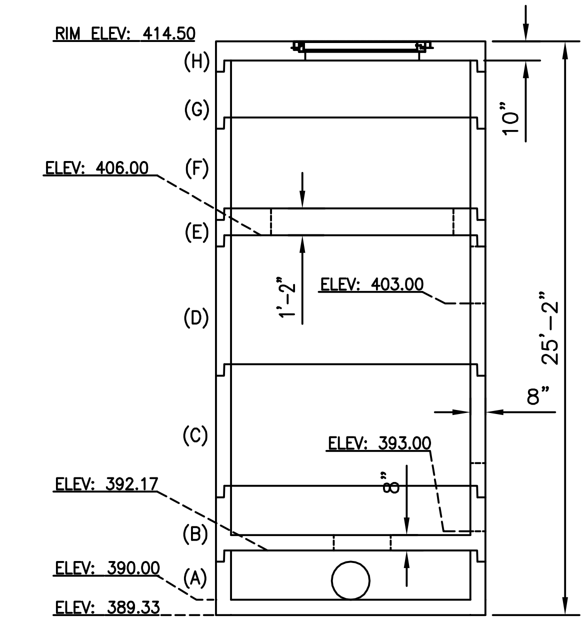
MANHOLE DATA SHEET

 RFP:

DATE: 10/15/12
REV: 12/13/12
REV: 2/18/13
BY: PJR

MH NO.: SS-2 JOB NO.: 14220
CONTRACTOR: PWTech
PROJECT: HARBOR BROOK CSO
LOCATION: SYRACUSE, NEW YORK
SPEC: ASTM C478
TESTING: NONE

MH DIA: 126" QTY REQ'D: 1
FRAME OP'G: DTD-18HDAOSG 60"x60" ALUMINUM HATCH CAST IN, ECCENTRIC
BASE TYPE: INTEGRAL BASE, 8" THICK
STEPS: NONE
COATING: NONE
JOINT TYPE: BUTYL



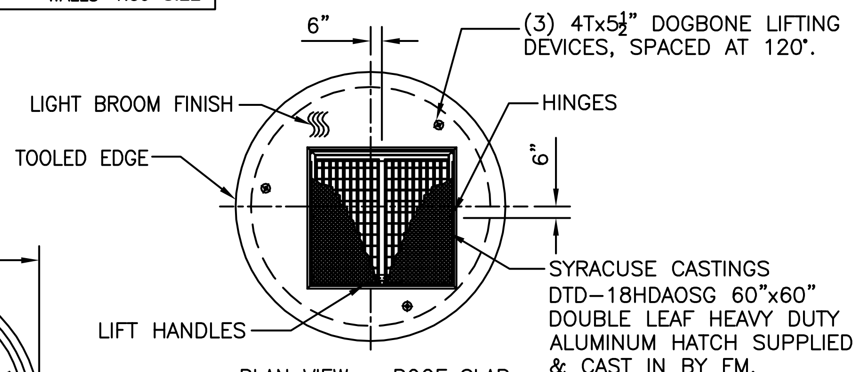
MANHOLE COMPONENTS						
NO.	TYPE	REF.	DIA.	HGT. (ft)	CY	TONS
A	BASE SECTION	145.803A	126"	2.33	4.32	8.75
B	PLATFORM W/ RISER, SEE SHEET 2	SHEETS 4&5	126"	2.83	4.56	9.23
C	RISER, SEE SHEET 2	145.804	126"	5.33	4.60	9.32
D	RISER	145.804	126"	5.67	4.90	9.92
E	TRANSITION SLAB	SHEET 3	126"	1.17	2.59	5.24
F	RISER	145.804	126"	4.00	3.46	7.00
G	RISER	145.804	126"	2.50	2.16	4.37
H	ROOF SLAB	SHEETS 6&7	126"	1.33	2.62	5.30

SUM OF HEIGHTS: 25'-2"

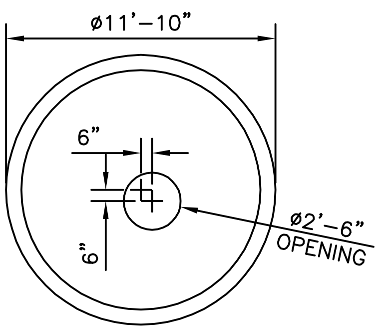
BASE SECTION	CY	TONS
SLAB	2.73	5.53
WALLS	1.59	3.22

RIM ELEVATION: 414.50
BOTTOM ELEV. − 389.33
TOTAL HEIGHT = 25.17'

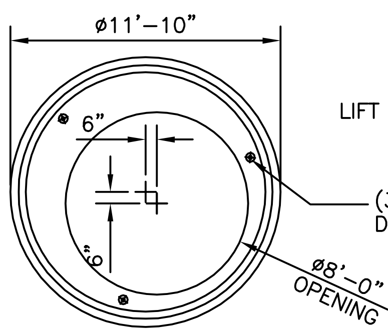
NOTE:
CONTRACTOR TO VERIFY ALL PIPE TYPES, SIZES AND INVERT ELEVATIONS.



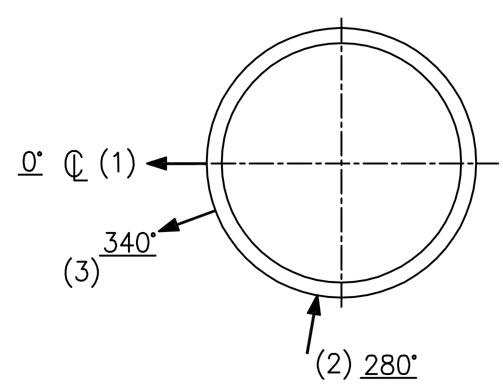
PLAN VIEW - ROOF SLAB



PLAN VIEW - PLATFORM B
CONTRACTOR TO ROTATE AS REQUIRED.



PLAN VIEW - TRANSITION SLAB E
CONTRACTOR TO ROTATE AS REQUIRED.



PLAN VIEW OF ALL PIPE PENETRATIONS

NOTES:
1) WATER TABLE SPECIFIED TO BE AT ELEVATION 400.00.
2) CONCRETE 28-DAY COMPRESSIVE STRENGTH TO BE 4,000 PSI MIN.
3) H-20 TRAFFIC LOADING DESIGN FOR PRECAST CONCRETE; ALUMINUM HATCH RATED FOR H-20 LIVE LOAD. HATCH SUPPLIED BY FM.
4) REINFORCEMENT IN TOP COVER AND BASE SECTION SHALL CONFORM TO ASTM A615, GRADE 60 BLACK.
5) CONCRETE BENCH TO BE POURED IN THE FIELD BY THE CONTRACTOR.
6) MANUFACTURING SPECIFICATION = NPCA.
7) HATCH TO DRAIN INTO STRUCTURE.
8) CONTRACTOR TO SUPPLY ADAPTER RINGS FOR HDPE PIPE.

SHIPLOOSE:
(38) ROLL(S) 1" CS-102 BUTYL (21053)
(3) 4T LIFTING EYES (5336)

IMPORTANT NOTE:
"Y" DIMENSION TAKEN FROM TOP OF BASE SLAB

PIPE INFORMATION							
PIPE	COMP	DIA.	PIPE TYPE	INV ELEV	"Y"(UP C.L.)	DEG.	CONNECTOR
1	D	2'x4'	SS	403.00	14'-3"	0°	48"Wx30"H FORMED OPENING
2	B/C	---	SS	393.00	4'-6"	280°	48"Wx36"H FORMED OPENING
3	A	12"	HDPE	390.33	0'-10"	340°	FORMED HOLE, 18"ø

NOTES: "X" = DISTANCE FROM BOTTOM OF BASE SLAB TO INVERT OF OUTLET PIPE
"Y" = DISTANCE FROM TOP OF BASE SLAB TO CENTERLINE OF OPENING

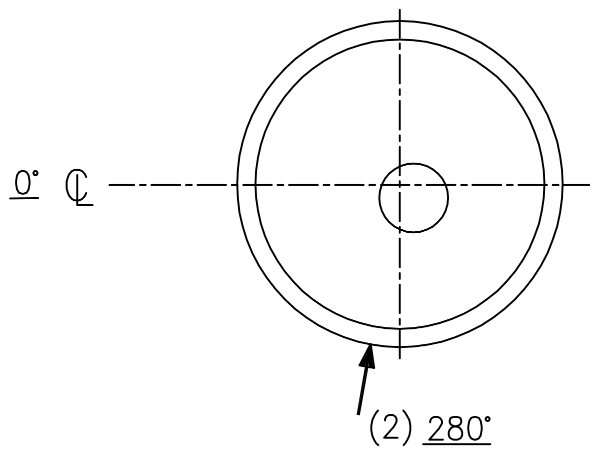
THE FORT MILLER CO., INC.
P.O. BOX 98, SCHUYLERVILLE, N.Y. 12871
PHONE: 518/695-5000 FAX: 518/695-4970

MANHOLE DATA SHEET

RFP:__________

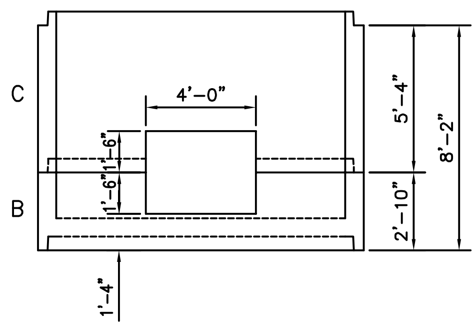
DATE: 10/15/12
REV: 12/13/12
REV: 2/18/13
BY: PJR

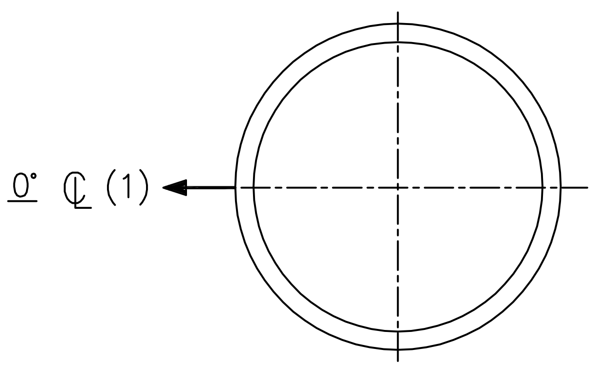
MH NO.: SS-2 JOB NO.: 14220	MH DIA: 126" QTY. REQ'D: 1
CONTRACTOR: PWTech	FRAME OP'G: DTD-18HDAOSG 60"x60" ALUMINUM HATCH CAST IN, ECCENTRIC
PROJECT: HARBOR BROOK CSO	BASE TYPE: INTEGRAL BASE, 8" THICK
LOCATION: SYRACUSE, NEW YORK	STEPS: NONE
SPEC: ASTM C478	COATING: NONE
TESTING: NONE	JOINT TYPE: BUTYL



COMPONENT NUMBER: B, C
TYPE: RISER, DIA: 126", HGT: B=2'-10", C=5'-4"

PIPE INFORMATION					
PIPE	DIA.	PIPE TYPE	"Z"(UP C.L.)	DEG.	CONNECTOR
2	---	SS	SEE BELOW	280°	48"Wx36"H FORMED OPENING





COMPONENT NUMBER: D
TYPE: RISER, DIA: 126"", HGT: 5'-8"

PIPE INFORMATION					
PIPE	DIA.	PIPE TYPE	"Z"(UP C.L.)	DEG.	CONNECTOR
1	2'x4'	SS	4'-5"	0°	48"Wx30"H FORMED OPENING

*NOTE: TOP OF OPENING WILL BE AGAINST BOTTOM OF RING, BUT MUST BE POURED AS SUCH. OPENING ELEVATIONS ARE CRITICAL, AND CANNOT BE CHANGED.

NOTES: "Z" = DISTANCE FROM BOTTOM OF COMPONENT TO <u>CENTERLINE OF OPENING.</u>

<u>SPECIAL FORT MILLER PRODUCTION NOTE:</u>
PROJECT SPECIFICATIONS REQUIRED MAJOR CENTERLINES OF STRUCTURE (AS SEEN IN PLAN VIEWS OF PIPES TO BE DRAWN ON ALL COMPONENTS OF THE STRUCTURE INTERIOR & EXTERIOR WALLS AND TOP OF TRANSITION, BASE, AND ROOF SLABS, USING CHALK, PAINT, OR EQUIVALENT.

THE FORT MILLER CO., INC.
P.O. BOX 98, SCHUYLERVILLE, N.Y. 12871
PHONE: 518/695-5000 FAX: 518/695-4970

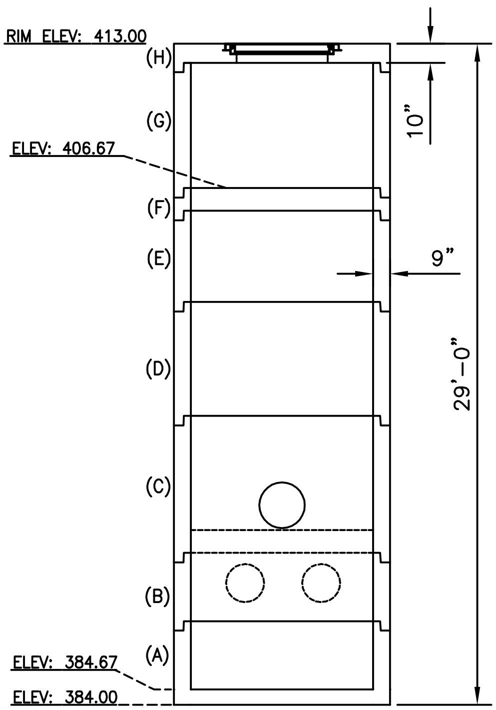
MANHOLE DATA SHEET

SHEET 1 OF 5 RFP:

DATE: 10/15/12
REV: 12/13/12
REV: 2/18/13
BY: PJR

MH NO.: MH3C JOB NO.: 14220
CONTRACTOR: PWTech
PROJECT: HARBOR BROOK CSO
LOCATION: SYRACUSE, NEW YORK
SPEC: ASTM C478
TESTING: NONE

MH DIA: 96" QTY REQ'D: 1
FRAME OP'G: DTD-12HDAOSG 36"x48" ALUMINUM HATCH CAST IN, CONCENTRIC
BASE TYPE: INTEGRAL BASE, 8" THICK
STEPS: NONE
COATING: NONE
JOINT TYPE: BUTYL



MANHOLE COMPONENTS

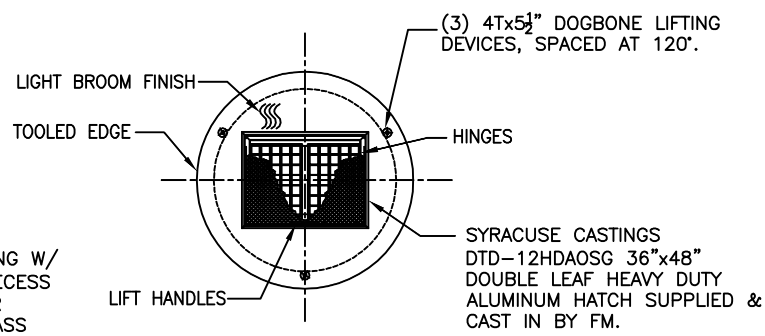
NO.	TYPE	REF.	DIA.	HGT. (ft)	CY	TONS
A	BASE SECTION	145.701	96"	3.25	3.97	8.04
B	RISER, SEE SHEET 2	145.704	96"	3.00	2.29	4.64
C	RISER, SEE SHEET 2	145.704	96"	6.00	4.58	9.28
D	RISER	145.704	96"	5.00	3.82	7.73
E	RISER	145.704	96"	4.00	3.05	6.19
F	TRANSITION SLAB	SHEETS 3&4	96"	1.00	2.63	5.32
G	RISER	145.704	96"	5.50	4.20	8.50
H	ROOF SLAB	SHEET 5	96"	1.25	2.90	5.87

SUM OF HEIGHTS: 29'-0"

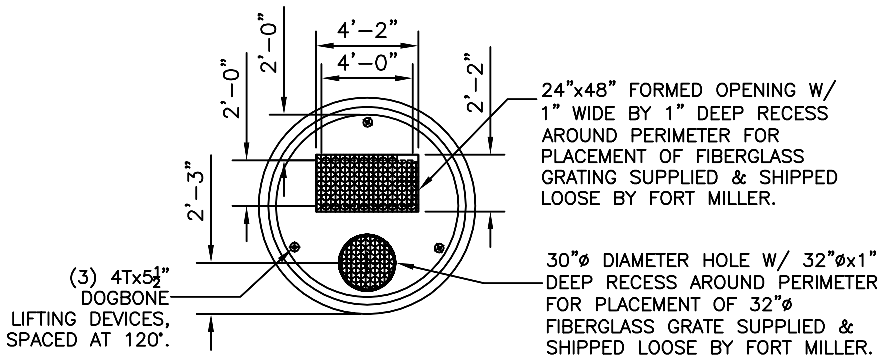
RIM ELEVATION: 413.00
BOTTOM ELEV. - 384.00
TOTAL HEIGHT = 29.00'

BASE SECTION	CY	TONS
SLAB	1.76	3.56
WALLS	2.21	4.48

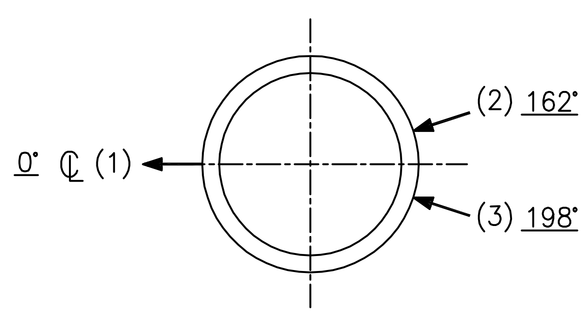
NOTE:
CONTRACTOR TO VERIFY ALL PIPE TYPES, SIZES AND INVERT ELEVATIONS.



PLAN VIEW



PLAN VIEW - TRANSITION SLAB E



PLAN VIEW OF ALL PIPE PENETRATIONS

NOTES:

1) WATER TABLE SPECIFIED TO BE AT ELEVATION 400.00.
2) CONCRETE 28-DAY COMPRESSIVE STRENGTH TO BE 4,000 PSI MIN.
3) H-20 TRAFFIC LOADING DESIGN FOR PRECAST CONCRETE; ALUMINUM HATCH RATED FOR H-20 LIVE LOAD. HATCH SUPPLIED BY FM.
4) REINFORCEMENT IN TOP COVER AND BASE SECTION SHALL CONFORM TO ASTM A615, GRADE 60 BLACK.
5) CONCRETE BENCH TO BE POURED IN THE FIELD BY THE CONTRACTOR.
6) MANUFACTURING SPECIFICATION = NPCA.
7) HATCH TO DRAIN INTO STRUCTURE.
8) CONTRACTOR TO PROVIDE ADAPTER RINGS IF REQUIRED.

SHIPLOOSE:
(22) ROLL(S) 1" CS-102 BUTYL (21053)
(3) 4T LIFTING EYES (5336)
(1) 26"x50" FIBERGLASS GRATE
(1) 32"ø FIBERGLASS GRATE

IMPORTANT NOTE:
"Y" DIMENSION TAKEN FROM TOP OF BASE SLAB

PIPE INFORMATION

PIPE	COMP	DIA.	PIPE TYPE	INV ELEV	"Y"(UP C.L.)	DEG.	CONNECTOR
1	C	18"	HDPE	392.00	8'-1"	0°	KOR-N-SEAL, S206-24L
2	B	12"	HDPE	388.17	4'-8"	162°	KOR-N-SEAL S106-20BWS
3	B	12"	HDPE	388.17	4'-8"	198°	KOR-N-SEAL S106-20BWS

NOTES: "X" = DISTANCE FROM BOTTOM OF BASE SLAB TO INVERT OF OUTLET PIPE
"Y" = DISTANCE FROM TOP OF BASE SLAB TO CENTERLINE OF OPENING

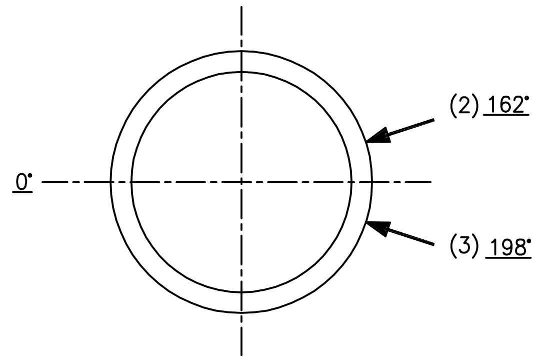
THE FORT MILLER CO., INC.
P.O. BOX 98, SCHUYLERVILLE, N.Y. 12871
PHONE: 518/695-5000 FAX: 518/695-4970

MANHOLE DATA SHEET

DATE: 10/15/12
REV: 12/13/12
REV: 2/18/13
RFP:___________ BY: PJR

MH NO.: MH3C	JOB NO.: 14220
CONTRACTOR: PWTech	
PROJECT: HARBOR BROOK CSO	
LOCATION: SYRACUSE, NEW YORK	
SPEC: ASTM C478	
TESTING: NONE	

MH DIA: 96"	QTY. REQ'D: 1
FRAME OP'G: DTD-12HDAOSG 36"x48" ALUMINUM HATCH CAST IN, CONCENTRIC	
BASE TYPE: INTEGRAL BASE, 8" THICK	
STEPS: NONE	
COATING: NONE	
JOINT TYPE: BUTYL	

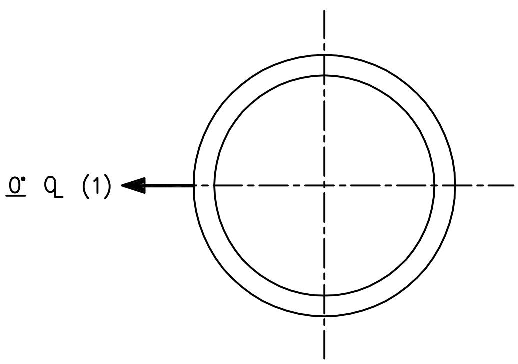


COMPONENT NUMBER: B
TYPE: RISER, DIA: 96"", HGT: 3'-0"

PIPE INFORMATION

PIPE	DIA.	PIPE TYPE	"Z"(UP C.L.)	DEG.	CONNECTOR
2	12"	HDPE	2'-1"	162°	KOR-N-SEAL S106-20BWS
3	12"	HDPE	2'-1"	198°	KOR-N-SEAL S106-20BWS

NOTES: "Z" = DISTANCE FROM BOTTOM OF COMPONENT TO CENTERLINE OF OPENING.

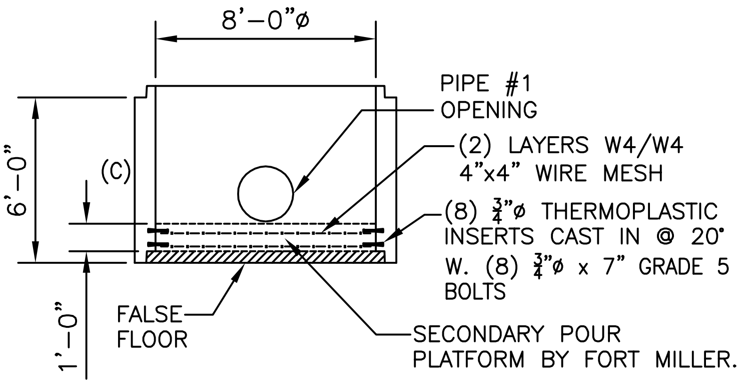


COMPONENT NUMBER: C
TYPE: RISER, DIA: 96"", HGT: 6'-0"

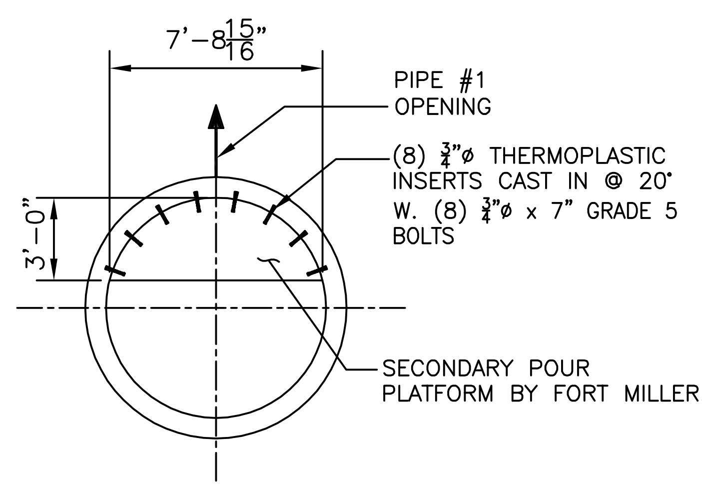
PIPE INFORMATION

PIPE	DIA.	PIPE TYPE	"Z"(UP C.L.)	DEG.	CONNECTOR
1	18"	HDPE	2'-6"	0°	KOR-N-SEAL, S206-24L

NOTES: "Z" = DISTANCE FROM BOTTOM OF COMPONENT TO CENTERLINE OF OPENING.



RISER C ELEVATION



RISER C PLAN VIEW

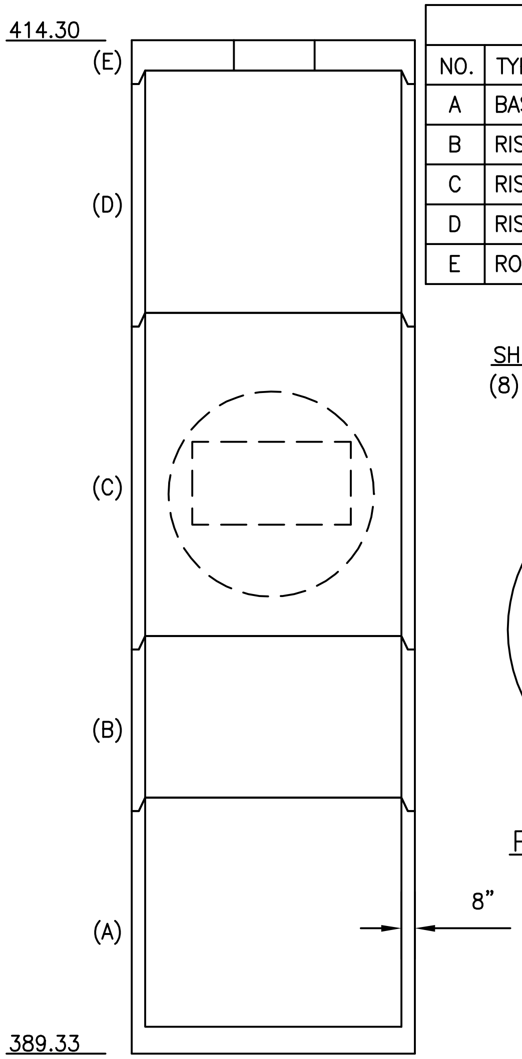
THE FORT MILLER CO., INC.
P.O. BOX 98, SCHUYLERVILLE, N.Y. 12871
PHONE: 518/695-5000 FAX: 518/695-4970

MANHOLE DATA SHEET

SHEET 1 OF 2 RFP:

DATE: 12/13/12
REV: 1/21/13
REV: 2/18/13
BY: PJR

MH NO.: MH4A	JOB NO.: 14220	MH DIA: 84"	QTY REQ'D: 1
CONTRACTOR: PWTech		FRAME OP'G: (1) R-5900G FRAME & LID CAST IN CONCENTRIC	
PROJECT: HARBOR BROOK CSO		BASE TYPE: MONOLITHIC, 8" THICK	
LOCATION: SYRACUSE, NEW YORK,		STEPS: NONE	
SPEC: ASTM C478		COATING: INT: NONE, EXT: NONE	
TESTING: NONE		JOINT TYPE: BUTYL	

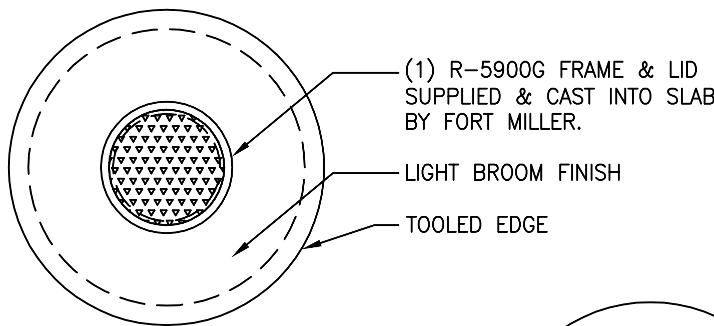


MANHOLE COMPONENTS						
NO.	TYPE	REF.	DIA.	HGT.	CY	TONS
A	BASE SECTION	145.502	84"	5.89'	4.64	9.4
B	RISER (STOCK)	145.504	84"	4.00'	2.37	4.8
C	RISER, SEE SHEET 2	145.504	84"	8.00'	4.74	9.6
D	RISER (STOCK)	145.504	84"	6.00'	3.56	7.2
E	ROOF SLAB	145.511	84"	1.08'	1.48	3.0

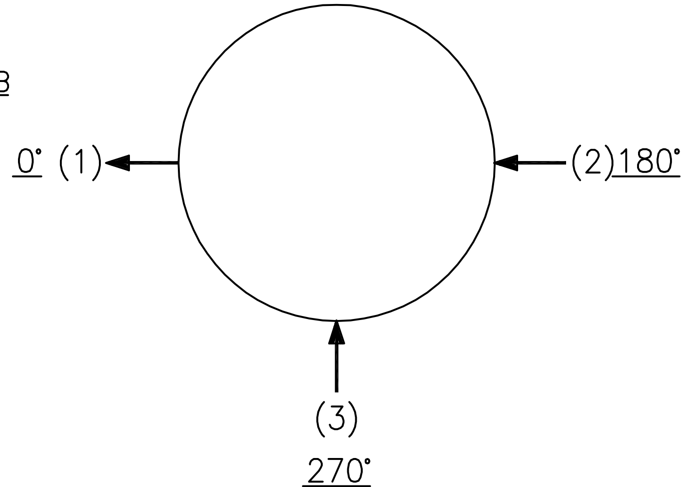
SUM OF HEIGHTS: 24.97'

RIM/TOP EL:	414.30
OUTLET INV EL: −	401.00
RIM TO OUTLET: =	13.30
"X": +	11.67
=	24.97
84" ø MAT'L: −	24.97
MASONRY ADJ: =	0.00

SHIPLOOSE:
(8) ROLL(S) 1" BUTYL (21053)



PLAN VIEW–ROOF SLAB



PLAN VIEW OF ALL PIPE PENETRATIONS

NOTES:

1) WATER TABLE SPECIFIED TO BE AT ELEVATION 400.00'.
2) CONCRETE 28-DAY COMPRESSIVE STRENGTH TO BE 4000 PSI MIN.
3) H-20 TRAFFIC LOADING DESIGN.
4) REINFORCEMENT SHALL CONFORM TO ASTM A615, GRADE 60 BLACK.
5) CONCRETE BENCH (IF REQUIRED) TO BE POURED IN THE FIELD BY THE CONTRACTOR.
6) MANUFACTURING SPECIFICATION = NPCA / ASTM C478.
7) CAST IRON F&C'S / F&G'S ARE SUPPLIED BY THE FORT MILLER CO.
8) CONTRACTOR TO SUPPLY ADAPTER RINGS IF REQUIRED.

IMPORTANT NOTE:
"Y" DIMENSION TAKEN FROM TOP OF BASE SLAB

PIPE INFORMATION							
PIPE	COMP	DIA.	PIPE TYPE	INV ELEV	"Y"(UP C.L.)	DEG.	CONNECTOR
1	C	48"	HDPE	401.00'	13'-0"	0°	KOR-N-SEAL S306-56L
2	C	---	SS	*403.00'	14'-1 1/2"	180°	HOLE, 45"W x 27"H
3	C	---	SS	*403.00'	14'-1 1/2"	270°	HOLE, 45"W x 27"H

*ELEVATION IS AT BOTTOM OF CONCRETE OPENING

NOTES: "X" = DISTANCE FROM BOTTOM OF BASE SLAB TO INVERT OF OUTLET PIPE
"Y" = DISTANCE FROM TOP OF BASE SLAB TO CENTERLINE OF OPENING

THE FORT MILLER CO., INC.
P.O. BOX 98, SCHUYLERVILLE, N.Y. 12871
PHONE: 518/695-5000 FAX: 518/695-4970

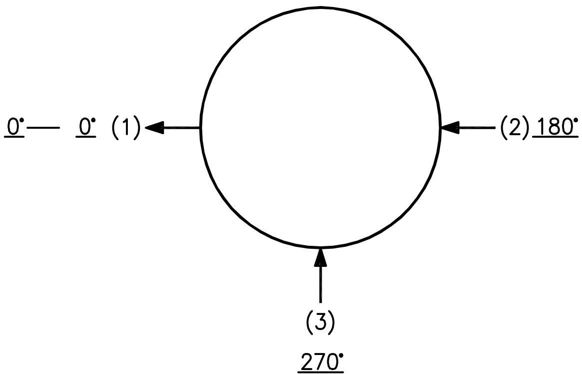
MANHOLE DATA SHEET

SHEET 2 OF 2

RFP:___________

DATE: 12/13/12
REV: 1/21/13
REV: 2/18/13
BY: PJR

MH NO.: MH4A	JOB NO.: 14220	MH DIA: 84"	QTY. REQ'D: 1
CONTRACTOR: PWTech		FRAME OP'G: (1) R-5900G FRAME & LID CAST IN CONCENTRIC	
PROJECT: HARBOR BROOK CSO		BASE TYPE: MONOLITHIC, 8" THICK	
LOCATION: SYRACUSE, NEW YORK,		STEPS: NONE	
SPEC: ASTM C478		COATING: INT: NONE, EXT: NONE	
TESTING: NONE		JOINT TYPE: BUTYL	

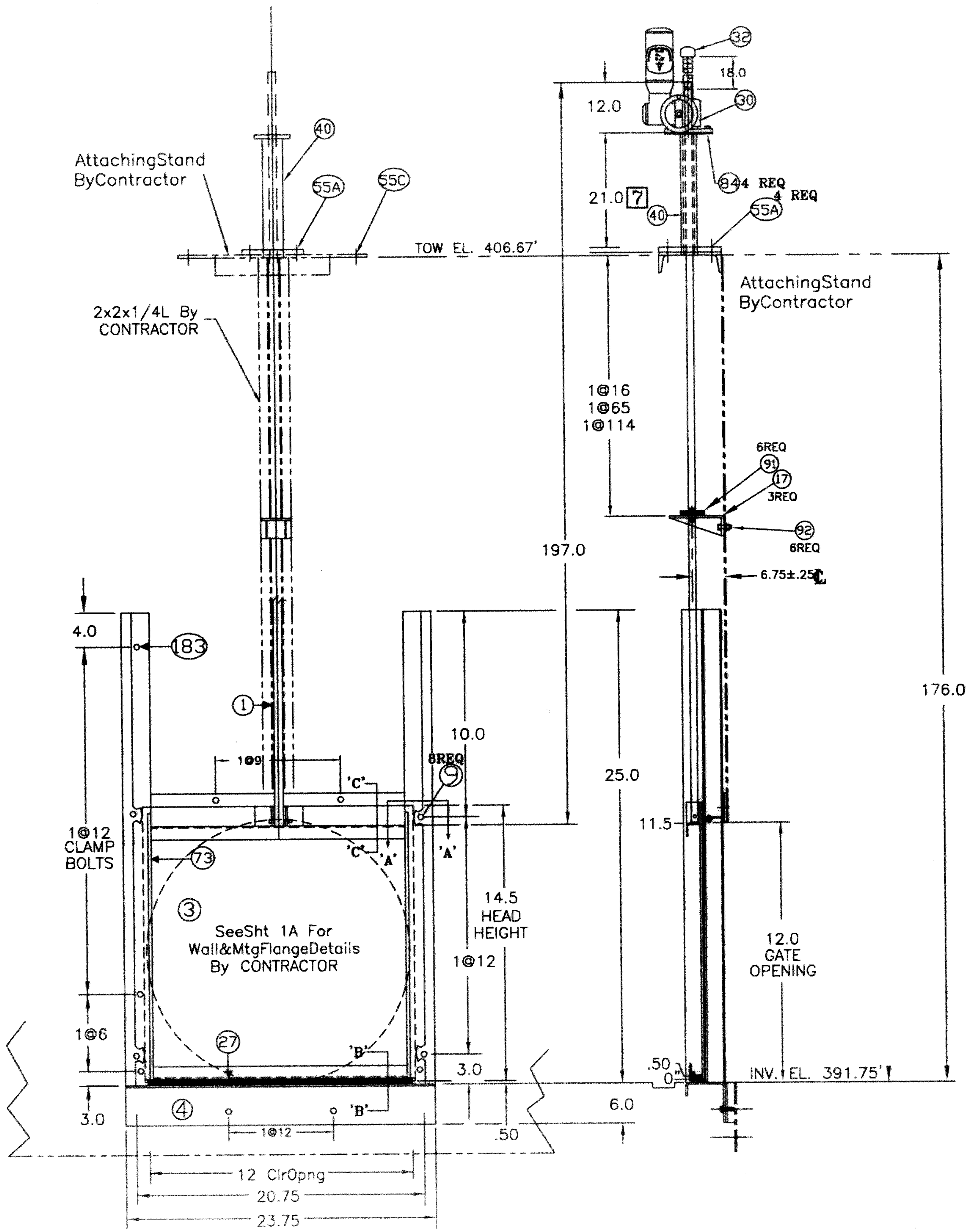


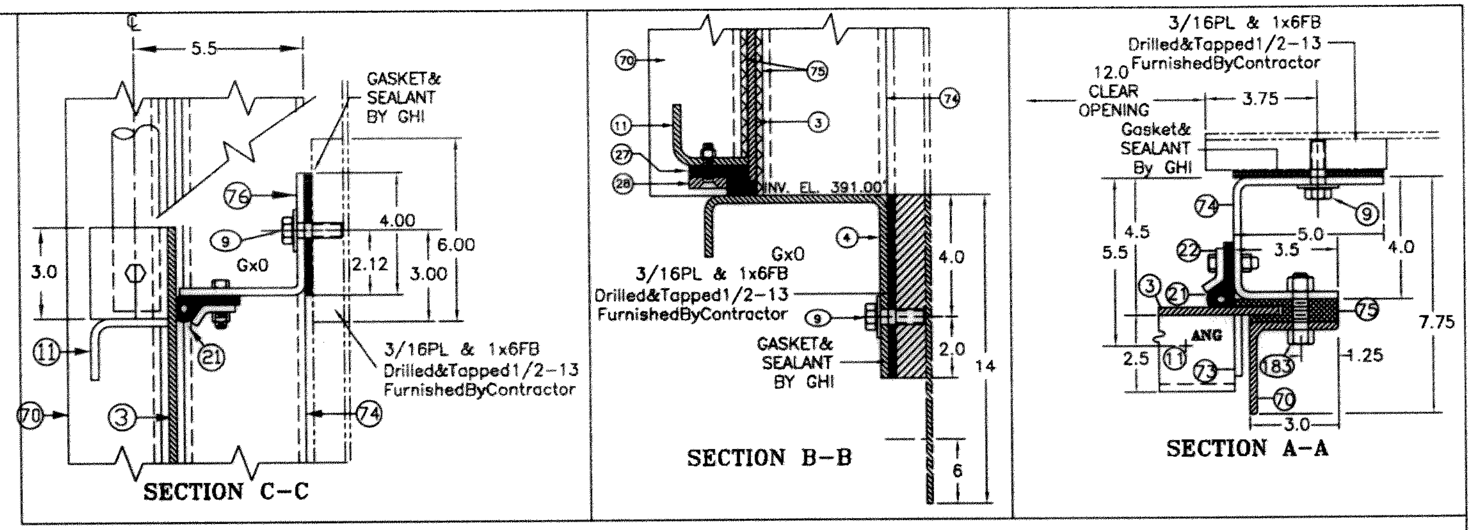
COMPONENT NUMBER: C
TYPE: RISER, DIA: 84", HGT: 8'-0"

PIPE INFORMATION					
PIPE	DIA.	PIPE TYPE	"Z"(UP C.L.)	DEG.	CONNECTOR
1	48"	HDPE	45.5"	0°	KOR-N-SEAL S306-56L
2	---	SS	59"	180°	HOLE, 45"W x 27"H
3	---	SS	59"	270°	HOLE, 45"W x 27"H

NOTES: "Z" = DISTANCE FROM BOTTOM OF COMPONENT TO CENTERLINE OF OPENING.

NOTES: "X" = DISTANCE FROM BOTTOM OF BASE SLAB TO INVERT OF OUTLET PIPE
"Y" = DISTANCE FROM TOP OF BASE SLAB TO CENTERLINE OF OPENING

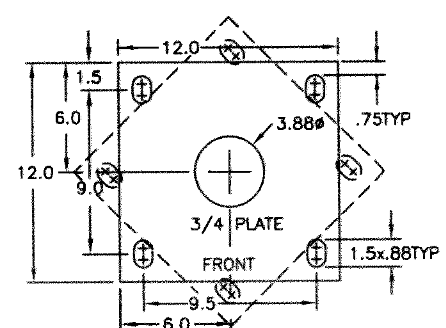




ELECTRIC MOTOR OPERATOR INFORMATION	
OUTLINE DRAWING #	SEE ATTACHED
MODEL #	AUMA SAEXC10.1-54A
WIRING DIAGRAM #	SEE ATTACHED
SPEC SHEET #	GHI-1

OPEN/CLOSE SERVICE

1. **CONTRACTOR/ENGINEER:** PLEASE CONFIRM OR PROVIDE TOP OF WALL (TOW) ELEVATION, INVERT ELEVATIONS, OTHER ELEVATIONS, & OPERATING HEADS ON ALL DRAWINGS.
2. **CONTRACTOR/ENGINEER** TO VERIFY/PROVIDE FLOOR SLAB THICKNESS
3. **INSTALLER NOTE:** ROTATE ITEM #300 45 DEGREES TO AVOID ANCHOR BOLTS INTERFERING WITH ANCHOR BOLTS FOR ITEM #40.
4. SHOP NOTE: 4 TPI SINGLE LEAD STEM.
5. SHOP NOTE: KEEP FRAME ON PLANE FOR FLANGE MOUNTING.
6. **INSTALLATION NOTE:** TIGHTEN FLANGE MOUNTING BOLTS EVENLY. DO NOT TIGHTEN TO THE POINT OF DISTORTING GATE FRAME.
7. SHOP NOTE: NON-STANDARD PEDESTAL HEIGHT REQUIRED.



STD. STRAIGHT PED. BASE ANCHOR BOLT LAYOUT 3

MD GH-46 STAINLESS STEEL SLUICE GATE MATERIAL LIST

Note	Item	Description	Material
4	1	STEM (SINGLE LEAD)	1.5" DIAMETER, SSTL, W/L HAND SINGLE LEAD ROLLED ACME THREADS, 16 MICRO IN. RMS OR LESS FINISH
	3	GATE HEAD	1/4 SSTL PLATE
	4	INVERT MEMBER	2.0x.6.0x6.0x1/4 FORMED SSTL CHANNEL
	9	ANCHOR BLT	1/2-13x1.5 HEXHDBLT, F/W & L/W
	11	STIFFENER	2.5x2.0x1/4 SSTL ANGLE
	17	STEM GUIDE TYPE 1-8	SSTL , W/UHMW STEM GUIDE BUSHING
	21	P-BULB SEAL	NEOPRENE RUBBER #7274
	22	P-SEAL RETAINER	SSTL FLAT BAR WITH SLOTTED HOLES
	27	INVERT SEAL	NEOPRENE RUBBER PART# 7509
	28	INV. SEAL RETNR.	3/8x1.25 SSTL FLAT BAR
	30	OPERATOR	ELECTRIC MOTOR OPERATOR- AUMA MODEL SAEXC10.1-54A
	32	STEM COVER	CLEAR BUTYRATE PLASTIC WITH MYLAR STRIP INDICATOR CALIBRATED IN FEET AND INCHES WITH PVC END CAP
7	40	STR. PEDESTAL EMO	MILD STEEL (SMALL PIPE)
	55A	PED. MTD BLT	3/4x3.0 SSTL HXHDBLT, NUT & F/W
	70	GUIDE RAIL	3.0x3.0x1/4 SSTL ANGLE
	73	VERT. STIFF.	1/4x2.0 SSTL FLAT BAR
	74	SPIGOT RAIL	5.0x4.0x3.5x1/4" FORMED S-STL CHANNEL
	75	GUIDE BEARING BAR	UHMW POLYETHYLENE #UHMW-01
	76	TOP SPIGOT	4 1/8x4.0x1/4 FORMED SSTL ANGLE
	84	OPERATOR BOLT	3/8x1.5 SSTL HEX HEAD BOLT, WITH F/W & L/W
	91	SG MOUNTING BLT	CONTRACTOR FURNISHED HARDWARE
	92	SG BRACKET BLT	1/2x1.5 SSTL HXHDBLT W/NUT & F/W
	183	CLAMP BLT	1/2x2.0 SSTL HEX BOLT, W/NUT & L/W

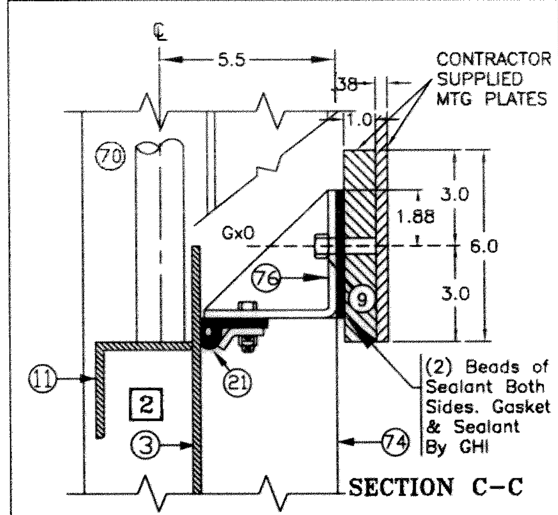
* ANCHOR BOLTS ARE DESIGNED FOR USE WITH HILTI HIT-RE 500-SD ADHESIVE INJECTION SYSTEM OR EQUAL INSTALLED IN DRY CONCRETE (ADHESIVE BY CONTRACTOR)

MATERIAL SPECIFICATIONS:
MILD STEEL = ASTM-A36 W/16.0 MILS EPOXY COATING
HARDWARE & FASTENERS = TYPE 304 SS ASTM-F593 / F594
S-STL FORMED & PLATE = 304L SS ASTM-A240
S-STL HR & FLAT BAR SHAPES = TYPE 304L SS ASTM-A276
S-STL STEM = TYPE 304 SS ASTM-A276
S-STL ANCHOR ROD = TYPE 304 SS ASTM-A276
UHMWPE = ASTM-D4020
NEOPRENE RUBBER = ASTM-D2000
BRONZE = ASTM-B584

Max Seating Head = 11.25 Ft.
Max Operating Head = 11.25 Ft.
Max Unseating Head = 11.25 Ft.
Measured From GATE INVERT

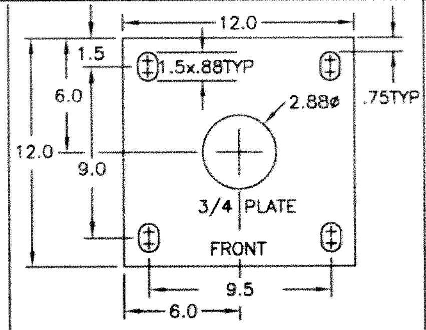
12 x 12 MD GH-46 WALL MTD SS SLUICE GATE	GOLDEN HARVEST GOLDEN GATES 1-800-338-6238 P.O. BOX 287 Burlington, WA 98233	MH-3C SLD-1 1 - REQ'D
Project Description: HARBOR BROOK CSO		Date Drawn: 02-20-13
For: SYRACUSE, NY		Revision: 03-04-13
Contractor: PW TECH		Revision: (DWG #2 ONLY) 03-12-13
Engineer:		Revision: (DWG #1 & 2 ONLY) 04-08-13
		G.H. Drawing #: (4 TOTAL DWGS) 1 of 3
Drawn By: PNH/JR	FL = 29#	Scale: NTS Job No.: 12-1048 Contract Sht #:

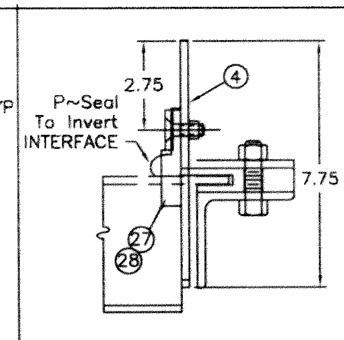
GOLDEN HARVEST	
ORIGINAL	-
CHECKED	-
CHECKED	-

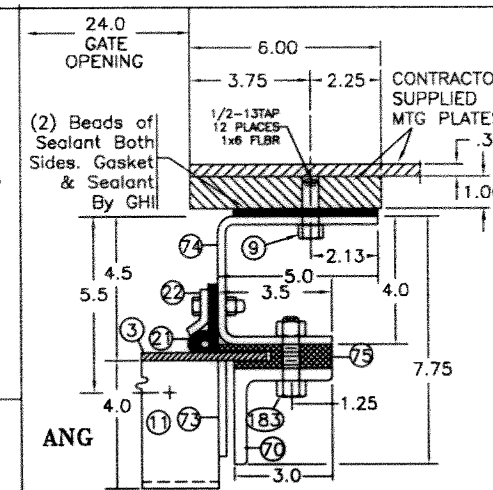


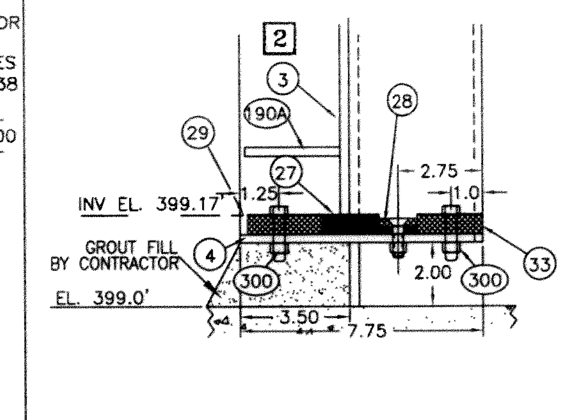
ELECTRIC MOTOR OPERATOR INFORMATION	
OUTLINE DRAWING #	SEE ATTACHED
MODEL #	AUMA SAEXC10.1-54A
WIRING DIAGRAM #	SEE ATTACHED
SPEC SHEET #	GHI-2

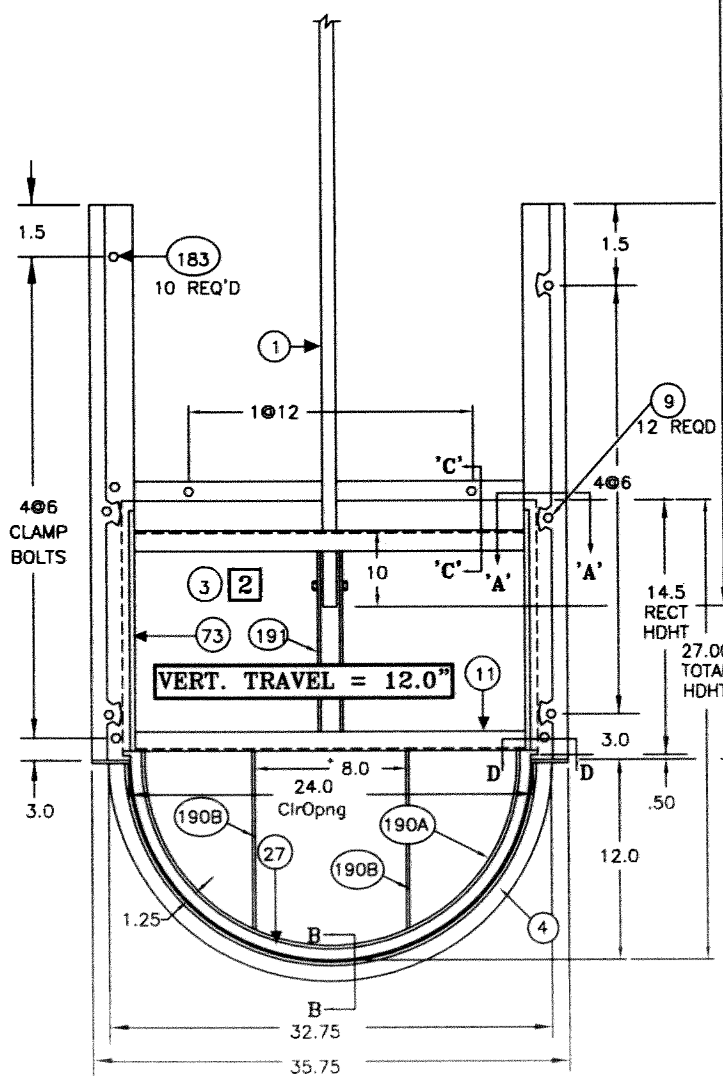
OPEN/CLOSE SERVICE

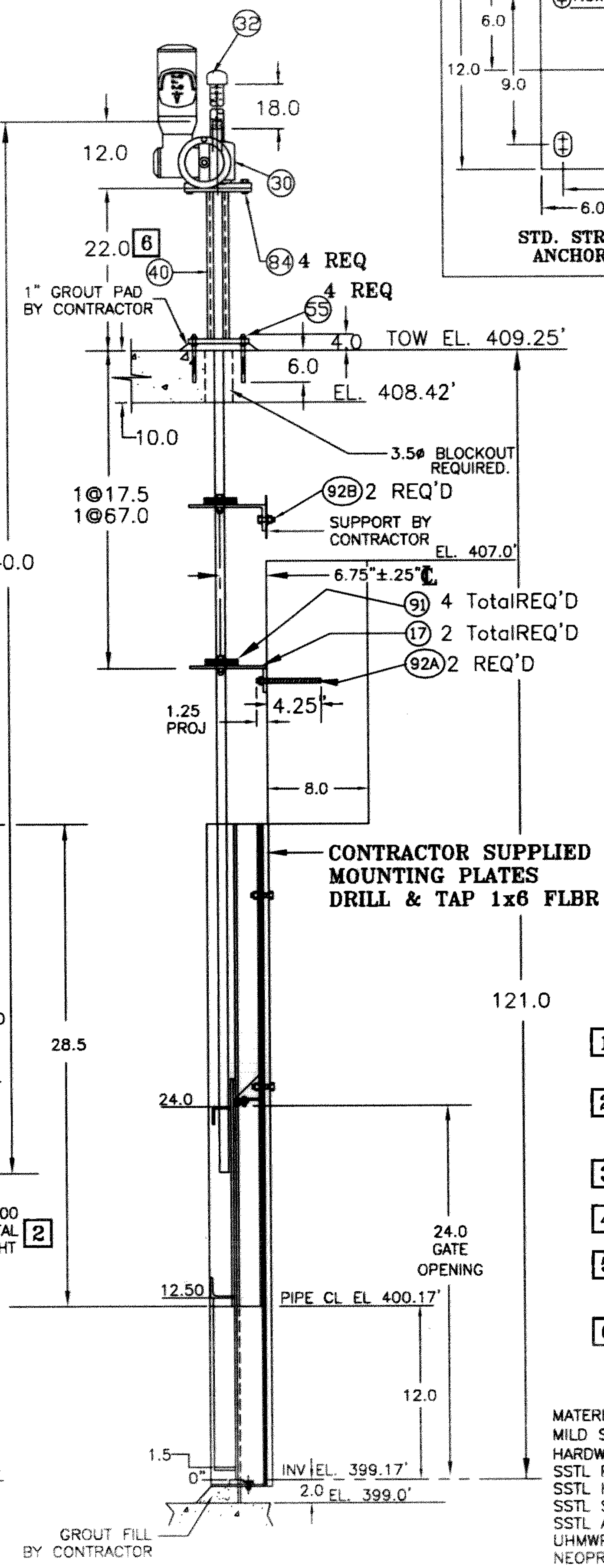












MD GH-46 STAINLESS STEEL SLUICE GATE MATERIAL LIST

Note	Item	Description	Material
3	1	STEM (SINGLE LEAD)	1.5" DIAMETER, SSTL, W/L HAND SINGLE LEAD ROLLED ACME THREADS, 16 MICRO IN. RMS OR LESS FINISH
2	3	GATE HEAD-SPECIAL	1/4 SSTL PLATE SEE GHI DWG -02Shop
	4	INVERT MEMBER	1/4x7.75 FORMED SSTL FLBR & 1/4x2 ROLLED HRDWAY FLBR
	9	FLNG MTG BLT	1/2 x 1.5 SSTL HEX BOLT, WITH F/W & L/W
	11	STIFFENER	4.0 x 3.0 x 1/4 FORMED SSTL ANGLE
	17	STEM GUIDE TYPE 1-8	S-STL , W/UHMW STEM GUIDE BUSHING
	21	P-BULB SEAL	NEOPRENE RUBBER
	22	P-SEAL RETAINER	SSTL FLAT BAR WITH SLOTTED HOLES
	27	INVERT SEAL	NEOPRENE RUBBER GHI PART# 7666
	28	INV. SEAL RETNR.	3/8 x 1.25 UHMW
	29	FRONT SEAL GUARD	1/2x2.5 UHMW
	33	BACK SEAL GUARD	1/2x2.0 UHMW
	30	OPERATOR	ELECTRIC MOTOR OPERATOR- AUMA MODEL SAEXC10.1-54A
	32	STEM COVER	CLEAR BUTYRATE PLASTIC WITH MYLAR STRIP INDICATOR CALIBRATED IN FEET & INCH INCREMENTS WITH PVC END CAP
6	40	STR. PEDESTAL EMO	MILD STEEL (SMALL PIPE)
	55	PED. MTD BLT	3/4 x 10.0 SSTL ANCHOR ROD, W/2 NUTS & 2 F/W
	70	GUIDE RAIL	3.0x3.0x1/4 SSTL ANGLE
	73	VERT. STIFF.	1/4 x 3.0 S-STL FLAT BAR
	74	SPIGOT RAIL	5.0x4.0x3.5x1/4 FORMED SSTL CHANNEL
	75	GUIDE BEARING BAR	UHMW POLYETHYLENE
	76	TOP SPIGOT	4.13 x 4 x 1/4 FORMED SSTL ANGLE
	84	OPERATOR BOLT	3/8 x 1.5 SSTL HEX HEAD BOLT, WITH L/W & F/W
	91	SG MOUNTING BLT	3/8 x 1.75 SSTL HEX BOLT, NUT, L/W, (2)3/8" F/W, (1)1/2" F/W
	*92A	SG ANCHOR BLT	1/2 x 5.5 SSTL ANCHOR ROD W/NUT & F/W
	91B	SG MOUNTING BLT	1/2x2.5 SSTL HEX BOLT, NUT, L/W, (2)1/2" F/W, (1)5/8" F/W
	183	CLAMP BLT	1/2 x 2.0 SSTL HEX BOLT, W/NUT & L/W
	190A	EDGE STIFFENER	1/4 x 3.0 SSTL FLAT BAR
	190B	CENTER STIFFENER	1/4 x 3.0 SSTL FLAT BAR
	191	STEM POCKET STIFFENER	3/8 x 2.0 SSTL FLAT BAR
	300	SEAL GUARD MTG BLTS	3/8 x 2.0 SSTL HEX HEAD BOLT WITH NUT, & F/W

* ANCHOR BOLTS ARE DESIGNED FOR USE WITH HILTI HIT-RE 500-SD ADHESIVE INJECTION SYSTEM OR EQUAL INSTALLED IN DRY CONCRETE (ADHESIVE BY CONTRACTOR)

1 CONTRACTOR/ENGINEER:
PLEASE VERIFY/PROVIDE ELEVATIONS. [OK Checked]

2 SHOP NOTE:
NON STANDARD HEAD SEE GHI DWG#-02Shop

3 SHOP NOTE: 4 TPI SINGLE LEAD STEM.

4 SHOP NOTE: KEEP FRAME ON PLANE FOR FLANGE MOUNTING.

5 INSTALLATION NOTE:
TIGHTEN FLANGE MOUNTING BOLTS EVENLY. DO NOT TIGHTEN TO THE POINT OF DISTORTING GATE FRAME.

6 SHOP NOTE: NON-STANDARD PEDESTAL HEIGHT REQUIRED.

MATERIAL SPECIFICATIONS:
MILD STEEL=ASTM-A36 W/16.0 MILS EPOXY COATING
HARDWARE & FASTENERS=TYPE 304 ASTM-F593/F594
SSTL FORMED & PLATE = 304L ASTM-A240
SSTL HR & FLAT BAR SHAPES=TYPE 304L ASTM-A276
SSTL STEM = TYPE 304 SS ASTM-A276
SSTL ANCHOR ROD = TYPE 304 ASTM-A276
UHMWPE = ASTM-D4020
NEOPRENE RUBBER = ASTM-D2000
BRONZE = ASTM-B584

INSTALLATION NOTES for INSTALLER

FRAME OR FRAME COMPONENTS, PEDESTAL, WALL BRACKET, STEM GUIDE, AND OPERATOR MUST BE INSTALLED FLAT STRAIGHT AND PLUMB, SHIM AND BRACE AS NECESSARY.
SEE OPERATION & MAINTENANCE MANUAL FOR ADDITIONAL INSTALLATION INFORMATION.

TOLERANCES AS FOLLOWS:
PARALLEL ±1/8"
COPLANER ± 1/8"
FLAT & STRAIGHT + 1/16"
SQUARE + 1/8"

GOLDEN HARVEST	
ORIGINAL	PH
CHECKED	KB
CHECKED	DW

Max Seating Head = 11.0 Ft.
Max Operating Head = 11.0 Ft.
Max Unseating Head = 11.0 Ft.
Measured From GATE INVERT

24 x 24
MD GH-46XX
RAD BOT FLANGE MNT
SS SLUICE GATE

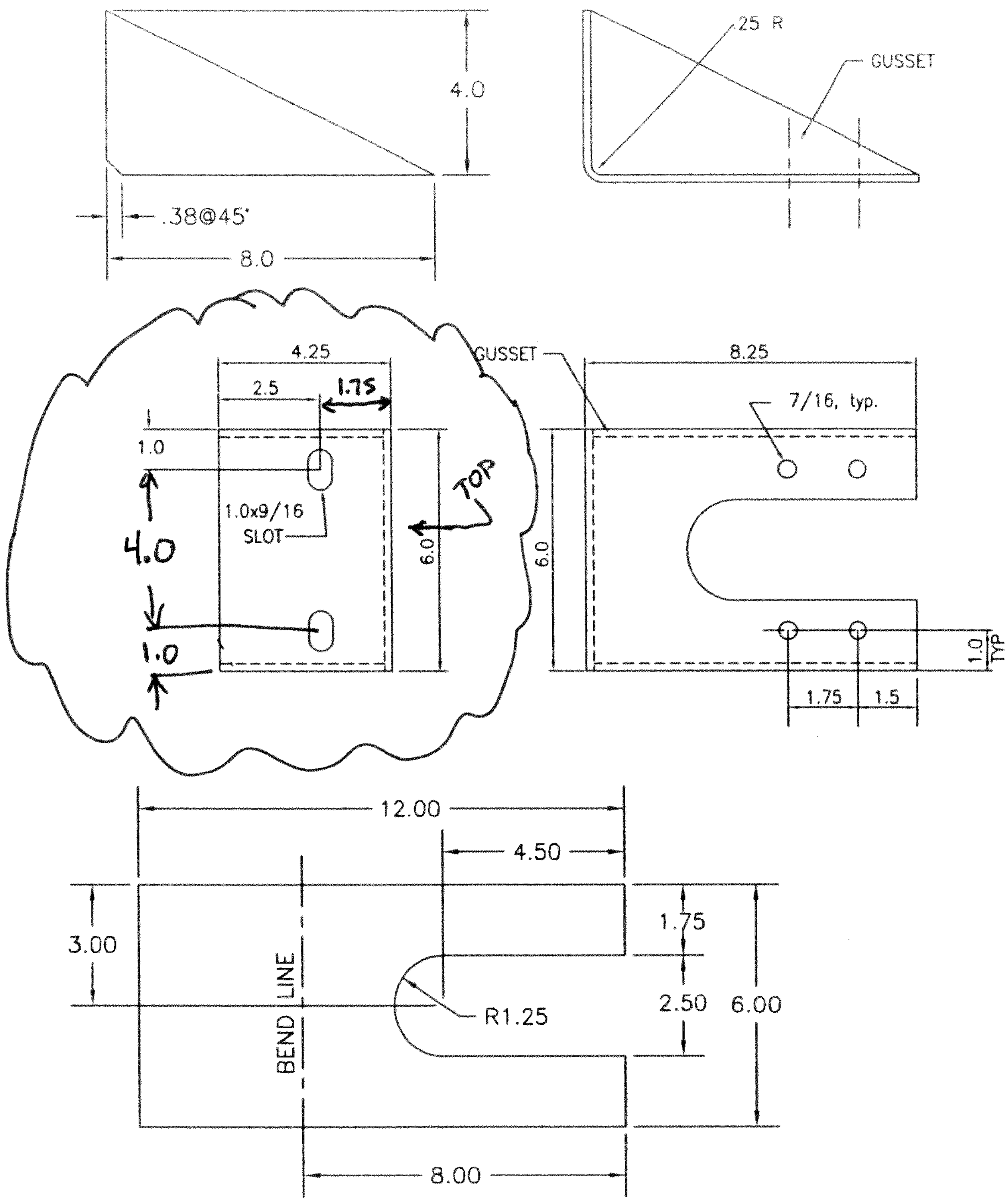
GOLDEN HARVEST
GOLDEN GATES
1-800-338-6238
P.O. BOX 287 Burlington, WA 98233

1 - REQ'D

Project Description: HARBOR BROOK CSO	Date Drawn: 02-20-13
For: SYRACUSE, NY	Revision: 03-05-13
	Revision: 03-12-13
Contractor: PW TECH	Revision: 04-08-13
Engineer:	G.H. Drawing #: 2
Drawn By: JR	FL = 57#
Scale: NTS	Job No.: 12-1048
Contract Sht #:	

BILL OF MATERIAL		
ITEM	DESCRIPTION	COMPONENT MATERIALS

MATL = TYPE 304 SSTL
MATL = TYPE 316 SSTL



GOLDEN HARVEST GOLDEN GATES 1-800-338-6238 P.O. BOX 287 Burlington, WA 98233			Date Drawn: 11-02-98 Revision: 03-03-04 Revision: Revision:
STEM GUIDE BRACKET DETAIL FOR 8" STANDARD			G.H. Drawing #: STMGUIDE
DW	Scale: NTS	Job No.: ----	Job Name: GENERAL STANDARD

CERTIFIED SHOP DRAWING

DESIGN APPROVAL ______

DATE: ______

Electric multi-turn actuators

SA 07.1 – SA 48.1
SAR 07.1 – SAR 30.1
AUMA NORM
for flanges type FA

AUMA Actuators, Inc.
Registered to ISO 9001
Certificate No. A4682

Operation instructions

Scope of these instructions:	These instructions are valid for multi-turn actuators of the type range SA 07.1 – SA 48.1 and SAR 07.1 – SAR 30.1 in version AUMA NORM. These operation instructions are only valid for “clockwise closing”, i.e. driven shaft turns clockwise to close the valve.

Table of contents

1. Safety instructions

1.1 Range of application

AUMA actuators are designed for the operation of industrial valves, e.g. globe valves, gate valves, butterfly valves and ball valves. For other applications, please consult us. The manufacturer is not liable for any possible damage resulting from use in other than the designated applications. Such risk lies entirely with the user.
Observance of these operation instructions is considered as part of the actuator's designated use.

1.2 Commissioning (electrical connection)

During electrical operation, certain parts inevitably carry lethal voltages. Work on the electrical system or equipment must only be carried out by a skilled electrician themselves or by specially instructed personnel under the control and supervision of such an electrician and in accordance with the applicable electrical engineering rules.

1.3 Maintenance

The maintenance instructions (refer to page 25) must be observed, otherwise a safe operation of the actuator is no longer guaranteed.

1.4 Warnings and notes

Non-observance of the warnings and notes may lead to serious injuries or damage. Qualified personnel must be thoroughly familiar with all warnings and notes in these operation instructions.
Correct transport, proper storage, mounting, and installation, as well as careful commissioning are essential to ensure a trouble-free and safe operation.
During operation, the multi-turn actuator warms up and surface temperatures > 140 °F may occur. Check the surface temperature prior to contact in order to avoid burns.
The following references draw special attention to safety-relevant procedures in these operation instructions. Each is marked by the appropriate pictograph.

This pictograph means: Note!
"Note" marks activities or procedures which have major influence on the correct operation. Non-observance of these notes may lead to consequential damage.

This pictograph means: Electrostatically endangered parts!
If this pictograph is attached to a printed circuit board, it contains parts which may be damaged or destroyed by electrostatic discharges. If the boards need to be touched during setting, measurement, or for exchange, it must be assured that immediately before a discharge through contact with an earthed metallic surface (e.g. the housing) has taken place.

This pictograph means: Warning!
"Warning" marks activities or procedures which, if not carried out correctly, can affect the safety of persons or material.

2. Short description

AUMA multi-turn actuators type SA 07.1 – SA 48.1 and SAR 07.1 – SAR 30.1 have a modular design. The limitation of travel is realized via limit switches in both end positions. Torque seating is also possible in both end positions. The type of seating is determined by the valve manufacturer.

3. Technical data

Table 1: Multi-turn actuator SA 07.1 – SA 48.1 /SAR 07.1 – SAR 30.1

Multi-turn actuators AUMA NORM require electric controls. AUMA offers the controls AUMA MATIC AM or AUMATIC AC for the sizes SA(R) 07.1 - SA(R) 16.1. These can also easily be mounted to the actuator at a later date.

Features and functions	
Type of duty [1)]	Standard: SA Short time duty S2 - 15 min SAR Intermittent duty S4 - 25 % Option: SA Short time duty S2 - 30 min SAR Intermittent duty S4 -50 % Intermittent duty S5 - 25 %
Motors	Standard: 3-ph AC asynchronous motor, type IM B9 according to IEC 34 Options: 1-ph AC motor, type IM B14 according to IEC 34 DC shunt motor, type IM B14 according to IEC 34 DC compound motor, type IM B14 according to IEC 34 Special motors
Insulation class	Standard: F, tropicalized Option: H, tropicalized
Motor protection	Standard: Thermoswitches (NC) Option: PTC thermistors (according to DIN 44082)
Supply voltage	Refer to motor nameplate
Self-locking	yes; for output speeds from 4,8 to 108 rpm and from size SA 35.1 for output speeds from 4,8 to 26 rpm
Limit switching	Counter gear mechanism for end positions CLOSED and OPEN for 1 to 500 turns per stroke (optional for 1 to 5,000 turns per stroke) Standard: Tandem switch (2 NC and 2 NO) for each end position; switches galvanically isolated Options: Single switch (1 NC and 1 NO) for each end position Triple switch (3 NC and 3 NO) for each end position, switches galvanically isolated Intermediate position switch (DUO limit switching)
Torque switching	adjustable torque switching for direction OPEN and CLOSE Standard: Single switch (1 NC and 1 NO) for each direction Options: Tandem switch (2 NC and 2 NO) for each direction, switches galvanically isolated
Non-intrusive setting (option)	Magnetic limit and torque transmitter MWG for the sizes SA 07.1 – SA 48.1 (only possible in combination with actuator controls AUMATIC) for 1 to 500 turns per stroke or for 10 to 5,000 turns per stroke
Position feedback signal, analogue (options)	Potentiometer or 0/4 – 20 mA For further details see separate data sheet
Torque feedback signal, analogue (option)	Only in combination with magnetic limit and torque transmitter MWG and actuator controls AUMATIC
Mechanical position indicator (option)	Continuous indication, adjustable indicator disc with symbols OPEN and CLOSED
Running indication (option)	Blinker transmitter
Heater in switch compartment	Standard: self-regulating PTC heater, 5 – 20 W, 110 – 250 V DC/AC Options: 24 – 48 V DC/AC or 380 – 400 V AC A resistance type heater (5 W, 24 V DC) is installed in the actuator in combination with the actuator controls AUMA MATIC or AUMATIC.
Motor heater (option)	SA(R) 07.1 – 10.1: 12.5 W SA(R) 14.1 – 16.1: 25 W SA(R) 25.1 – 30.1: 50 W SA 35.1 – 48.1: 50 W
Manual operation	Manual drive for setting and emergency operation, handwheel does not rotate during electrical operation. Option: Handwheel lockable
Electrical connections	Standard: SA(R) 07.1 – 16.1: AUMA plug/socket connector with screw type connection, SA(R) 25.1 – 48.1: Control connections on AUMA plug/socket connector, motor connection via terminals Option: for special motors: Motor connection directly via terminal board at the motor
Threads for cable glands	Standard: NPT-threads Options: Pg-threads, G-threads
Terminal plan	Terminal plan according to commission number included in delivery

1) Based on 68 °F ambient temperature and at an average load with running torque according to Technical data SA(R).

Service conditions	
Output drive types	A, B1, B2, B3, B4 according ISO 5210 (A, B2, B4 according to MSS SP-102) A, B, D, E according to DIN 3210 C according to DIN 3338 Special output drives: AF, AK, AG, IB1, IB3
Enclosure protection according to EN 60 529[2)]	Standard: IP 67 Options: IP 68 IP 67-DS (Double Sealed) IP 68-DS (Double Sealed) (Double Sealed = additional protection of the interior of the housing against ingress of dust and dirt when removing the plug)
Corrosion protection	Standard: KN Suitable for installation in industrial units, in water or power plants with a low pollutant concentration Options: KS Suitable for installation in occasionally or permanently aggressive atmosphere with a moderate pollutant concentration (e.g. in wastewater treatment plants, chemical industry) KX Suitable for installation in extremely aggressive atmosphere with high humidity and high pollutant concentration KX-G Same as KX, however aluminium-free version (outer parts)
Finish coating	Standard: Two part acrylic polyurethane
Color	Standard: Dark grey (DB 702, similar to RAL 9007) Option: Other colours are possible on request
Ambient temperature [3)]	Standard: SA – 20 to + 80 °C/ – 20 to + 175 °F SAR – 25 to + 60 °C/ – 20 to + 140 °F Options: SA – 40 to + 60 °C/ – 40 to + 140 °F (low temperature) – 50 to + 60 °C/ – 58 to + 140 °F (extreme low temperature) – 60 to + 60 °C/ – 75 to + 140 °F (extreme low temperature) – 0 to + 120 °C/ + 32 to + 250 °F (high temperature) SAR – 40 to + 60 °C/ – 40 to + 140 °F (low temperature)
Vibration resistance according to IEC 60068-2-6	2 g, for 10 to 200 Hz (only for sizes SA(R) 07.1 – SA(R) 16.1 without controls) Resistant to vibrations during start-up or for failures of the plant. However, a fatigue strength may not be derived from this. Valid for multi-turn actuators in version AUMA NORM (with AUMA plug/socket connector, without actuator controls). Not valid in combination with gearboxes
Lifetime[4)]	SA 07.1 – SA 10.1 20,000 operating cycles (OPEN - CLOSE - OPEN) with 30 turns per stroke SA 14.1 – SA 16.1 15,000 operating cycles SA 25.1 – SA 30.1 10,000 operating cycles SA 35.1 – SA 48.1 5,000 operating cycles SAR 07.1 – SAR 10.1[4)] 5 millon starts SAR 14.1 – SAR 16.1[4)] 3.5 million starts SAR 25.1 – SAR 30.1[4)] 2.5 million starts
Other information	
Reference documents	Product description “Electric multi-turn actuators SA” Dimension sheets SA(R) Electrical data sheets SA/SAR Technical data sheets SA/SAR

2) For 3-phase asynchronous motors in enclosure protection IP 68, higher corrosion protection KS or KX is strongly recommended. Additionally, for enclosure protection IP 68, we recommend to use the double sealed terminal compartment DS.
For 1-phase AC motors, DC motors, or special motors, the enclosure protection according the name plate applies.
3) Versions with RWG up to max. to + 158 °F
4) The lifetime depends on the load and the number of starts. A high starting frequency will rarely improve the modulating accuracy. To reach the longest possible maintenance and fault-free operation time, the number of starts per hour chosen should be as low as permissible for the process.

4. Transport, storage and packaging

4.1 Transport

- For transport to place of installation, use sturdy packaging.
- Do not attach ropes or hooks to the handwheel for the purpose of lifting by hoist.
- If multi-turn actuator is mounted on valve, attach ropes or hooks for the purpose of lifting by hoist to valve and not to multi-turn actuator.

Fitting the handwheel:

For transport purposes, handwheels from a diameter of 400 mm (1 inch corresponds to 25.4 mm) are supplied separately.

Engage manual operation prior to mounting the handwheel! If the manual operation is not engaged, damages can occur at the change-over mechanism.

- Engage manual operation (figure A-1):
  Manually lift the red change-over lever while slightly turning the shaft back and forth until manual operation engages. The manual operation is correctly engaged if the change-over lever can be lifted by approx. 85°.

Manual force is sufficient for operating the change-over lever. It is not necessary to use an extension. Excessive force may damage the change-over mechanism.

- Install the hand wheel over the red change-over lever on to the shaft (figure A-2).
- Secure handwheel using the snapring supplied.

Figure A-1

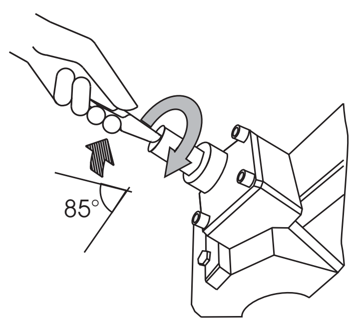
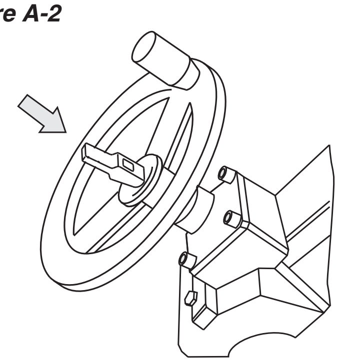


Figure A-2



4.2 Storage

- Store in well-ventilated, dry room.
- Protect against floor dampness by storage on a shelf or on a wooden pallet.
- Cover to protect against dust and dirt.
- Apply suitable corrosion protection agent to uncoated surfaces.

If multi-turn actuators are to be stored for a long time (more than 6 months), in addition, the following points must imperatively be observed :

- Prior to storage: Protect uncoated surfaces, in particular the output drive parts and mounting surface, with long-term corrosion protection agent.
- Check for corrosion approximately every 6 months. If first signs of corrosion show, apply new corrosion protection.

After mounting, connect actuator immediately to electrical system, so that the heater prevents condensation.

4.3 Packaging

Our products are protected by special packaging for the transport ex works. The packaging consists of environmentally friendly materials which can easily be separated and recycled.

We use the following packaging materials: wood, cardboard, paper and Polyurethane foam. For the disposal of the packaging material, we recommend recycling and collection centers.

5. Mounting to valve/gearbox

- **Prior to mounting the multi-turn actuator must be checked for damage. Damaged parts must be replaced by original spare parts.**
- **After mounting, check multi-turn actuator for damage to paint finish. If damage to paint-finish has occurred after mounting, it has to be touched up to avoid corrosion.**

Mounting is most easily done with the valve shaft/gearbox shaft pointing vertically upward. But mounting is also possible in any other position.
The multi-turn actuator leaves the factory in position CLOSED (limit switch CLOSED tripped).

- Check if mounting flange fits the valve/gearbox.

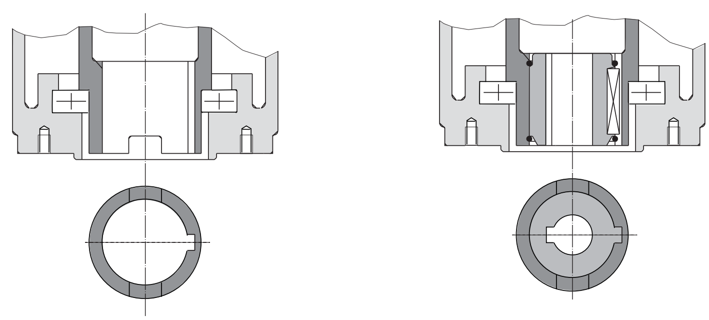
Spigot at flanges should be loose fit!

The output drive types B1, B2, B3 or B4 (figure A-3) are delivered with bore and keyway (usually according to ISO 5210) and are sometimes shipped with bore and keyway according to customer request.

Figure A-3

Output drive type B1/B2
Plug sleeve (option)

Output drive type B3/B4
Bore with keyway (standard)



For output drive type A (figure B-1), the internal thread of the stem nut must match the thread of the valve stem. If not ordered explicitly with thread, the stem nut is unbored or with pilot bore when delivered. For finish machining of stem nut refer to next page.

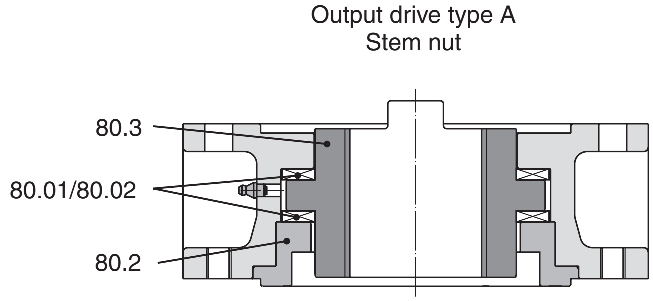
- Check whether bore and keyway match the input shaft of valve/gearbox.
- Thoroughly degrease mounting faces at multi-turn actuator and valve/gearbox.
- Apply a small quantity of grease to input shaft of valve/gearbox.
- Place actuator on valve/gearbox and fasten. Fasten bolts (quality grade 5, refer to table 2) evenly crosswise.

Table 2: Standard dry fastening torques for bolts

UNC threads	T_A (ft lbs)
5/16 - 18	19
3/8 - 16	33
1/2 - 13	78
5/8 - 11	155
3/4 - 10	255
1 - 8	590
1 1/4 - 7	1,200
Conversion factor: 1 Nm corresponds to 1.3529 ft lbs.	

Finish machining of stem nut (output drive type A):

Figure B-1



The output drive flange does not have to be removed from the actuator.

- Remove spigot ring (80.2, figure B-1) from mounting flange.
- Take off stem nut (80.3) together with thrust bearing (80.01) and thrust bearing races (80.02).
- Remove thrust bearing and thrust bearing races from stem nut.
- Drill and bore stem nut and cut thread.
  When fixing in the chuck, make sure stem nut runs true!
- Clean the machined stem nut.
- Apply Lithium soap EP multi-purpose grease to thrust bearing and races, then place them on stem nut.
- Re-insert stem nut with thrust bearings into the mounting flange. Ensure that dogs are placed correctly in the slots of the hollow shaft.
- Screw in spigot ring until it is firm against the shoulder.
- Press Lithium soap EP multi-purpose grease on mineral oil base into the grease nipple with a grease gun (for quantities, refer to table below):

Table 3: Grease quantities for lubricating bearings

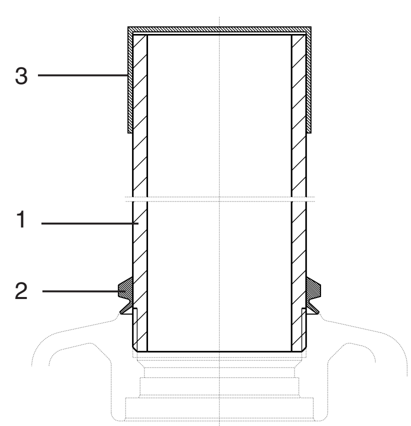
Output drive	**A 07.2**	**A 10.2**	**A 14.2**	**A 16.2**	**A 25.2**	**A 30.2**	**A 35.2**	**A 40.2**	**A 48.2**
Qty[1] in g	1.5 g	2 g	3 g	5 g	10 g	14 g	20 g	25 g	30 g

1) For grease with a density ρ = 900 g/dm^3; conversion factor: 1 oz corresponds to 28.35 g

Protection tube for rising valve stem

- Protection tubes may be supplied loose. Seal thread with hemp, Teflon tape, or thread sealing material.
- Screw protection tube (1) into thread (figure B-2) and tighten it firmly.
- Push down the sealing (2) to the housing.
- Check whether cap (3) is available and without damage.

Figure B-2: Protection tube for rising valve stem



6. Manual operation

The actuator may be operated manually for purposes of setting and commissioning, and in case of motor failure or power failure.
Manual operation is engaged by an internal change-over mechanism.

Engaging manual operation:

- Lift up change-over lever in the center of the handwheel to approx. 85°, while slightly turning the handwheel back and forth until manual operation engages (figure C).

Figure C

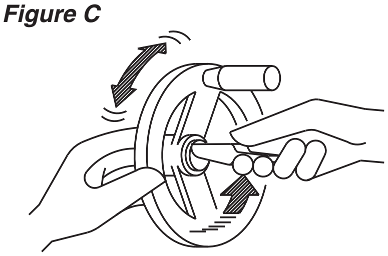
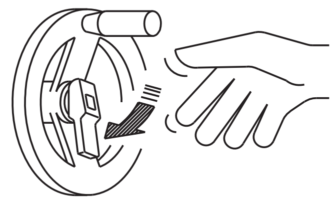


Figure D



Manual force is sufficient for operating the change-over lever. It is not necessary to use an extension. Excessive force may damage the change-over mechanism.

- Release change-over lever (should snap back into initial position by spring action, figure D), if necessary, push it back manually.

Operating the change-over lever while the motor is running (figure E) can lead to increased wear at the change-over mechanism.

Figure E

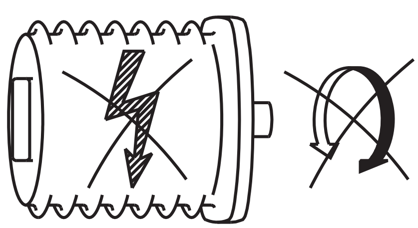
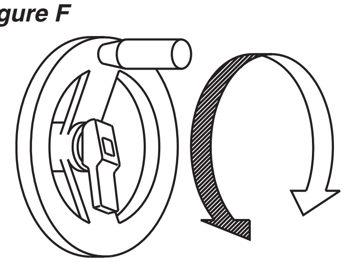


Figure F



- Turn handwheel in desired direction (figure F).

Disengaging manual operation:

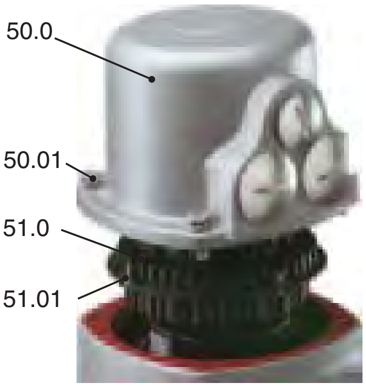
Manual operation is automatically disengaged when the motor is started again.
The handwheel does not rotate during motor operation.

7. Electrical connection

Work on the electrical system or equipment must only be carried out by a skilled electrician themselves or by specially instructed personnel under the control and supervision of such an electrician and in accordance with the applicable electrical engineering rules.

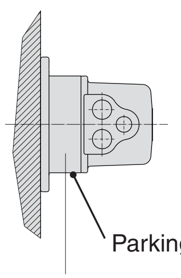
7.1 Connection with AUMA plug/socket connector

Figure G-1: Connection



- Check whether type of current, supply voltage, and frequency correspond to motor data (refer to name plate at motor).
- Loosen bolts (50.01) (figure G-1) and remove plug cover.
- Loosen screws (51.01) and remove socket carrier (51.0) from plug cover (50.0).
- Insert cable glands or conduit fittings suitable for connecting cables. (The enclosure protection stated on the name plate is only ensured if properly sealed connections are made).
- Seal cable entries which are not used with sealed threaded plugs.
- Connect cables according to order-related terminal plan.
- The terminal plan applicable to the actuator is placed inside the terminal compartment, the operation instructions are attached to the handwheel in a weather-proof bag.

Figure G-2: Parking frame (accessory)



A special parking frame (figure G-2) for protection against touching the bare contacts and against environmental influences is available.

Table 4: Technical data AUMA plug/socket connectors

Technical data	Power terminals[1]	Protective earth	Control pins
No. of contacts max.	6 (3 are used)	1 (leading contact)	50 pins/sockets
Marking	U1, V1, W1, U2, V2, W2	according to VDE	1 to 50
Voltage max.	750 V	–	250 V
Nominal current max.	25 A	–	16 A
Type of customer connection	Screws	Screw for ring lug	Screws
Cross section max.	6 mm^2 (10 AWG)	6 mm^2 (10 AWG)	2.5 mm^2 (12 AWG)
Material: Pin/ socket carrier	Polyamide	Polyamide	Polyamide
Contacts	Brass (Ms)	Brass (Ms)	Brass, tin plated or gold plated (option)

1) Suitable for copper wires. For aluminium wires it is necessary to contact AUMA.
From size SA(R) 25.1, the motor connection is realised via a separate terminal board

7.2 Motor connection for the sizes SA(R) 25.1/SAR 30.1 – SA 48.1.

From the size SA(R) 25.1, the power for the motor is connected to separate terminals. For this, the cover at the motor connection compartment has to be removed.
The control contacts are connected to the AUMA plug/socket connector.

Cross section motor terminals:
16 mm² to 70 mm² (6 to 2/0 AWG), depending on the actuator size

Figure G-3: Connection to SA(R) 25.1

7.3 Motor connection for special motors

For versions with special motors (e.g. DC motors), the connection is performed directly at the motor (figure G-4).

Figure G-4: Connection special motor

7.4 Delay time

The delay time is the time from the tripping of the limit or torque switches to the motor power being removed. To protect the valve and the actuator, we recommend a delay time < 50 ms. Longer delay times are possible provided the output speed, output drive type, valve type, and the type of installation are taken into consideration.
We recommend to switch off the corresponding contactor directly by the limit or torque switch.

7.5 Controls made by AUMA

In case the required reversing contactors are not to be installed in the control cabinet, the controls AUMA MATIC or AUMATIC for the sizes SA(R) 07.1 – SA(R) 16.1 can be easily mounted to the actuator at a later date.
For enquiries and more information, please state our commission no. (refer to actuator name plate).

7.6 Heater

AUMA multi-turn actuators have a heater installed as standard. To prevent condensation, the heater must be connected.

7.7 Motor protection

In order to protect against overheating and extreme high temperatures at the actuator, PTC thermistors or thermoswitches are embedded in the motor winding. The thermoswitch is tripped as soon as the max. permissible winding temperature has been reached.

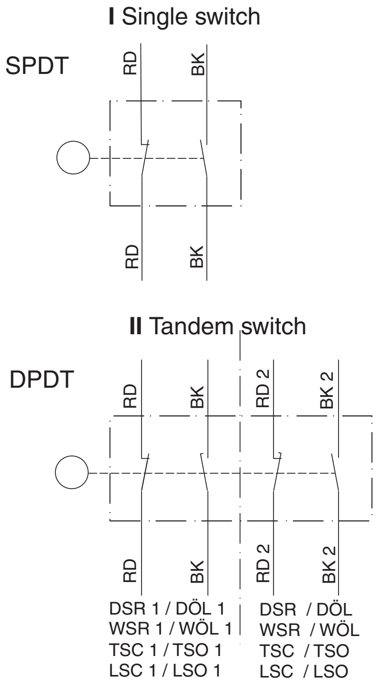
Failure to integrate PTC thermistors or thermoswitches into the control circuit voids the warranty for the motor.

7.8 Remote position transmitter

For the connection of remote position transmitters (potentiometer, RWG) shielded cables must be used.

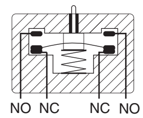
7.9 Limit and torque switches

Figure G-5



Only the same potential can be switched on the two circuits (NC/NO contact) of a limit or torque switch. If different potentials are to be switched simultaneously, tandem switches are required.
To ensure correct actuator indications, the leading contacts of the tandem switches must be used for that purpose and the lagging contacts for motor switching off.

Table 5: Technical data for limit and torque switches

	Mechanical lifetime = 2 x 10^6 starts		
Type of current	**Switch rating I_{max}**		
	30 V	**125 V**	**250 V**
1-phase AC (ind. load) cos phi = 0,8	5 A	5 A	5 A
DC (resistive load)	2 A	0,5 A	0.4 A
with gold plated contacts	**min. 5 V, max. 50 V**		
Current	min. 4 mA, max. 400 mA		

7.10 Fitting of the cover

After connection:

- Insert the socket carrier (51.0) into the plug cover (50.0) and fasten it with screws (51.01).
- Clean sealing faces at the plug cover and the housing.
- Check whether O-ring is in good condition.
- Apply a thin film of non-acidic grease (e.g. Vaseline) to the sealing faces.
- Replace plug cover (50.0) and fasten bolts (50.01) evenly crosswise.
- Fasten conduit connections with the specified torque to ensure the required enclosure protection.

8. Opening the switch compartment

To be able to carry out the following settings (sections 9. to 15.), the switch compartment must be opened and, if installed, the indicator disc must be removed.

These settings are only valid for “clockwise closing”, i.e. driven shaft turns clockwise to close the valve.

Work on the electrical system or equipment must only be carried out by a skilled electrician themselves or by specially instructed personnel under the control and supervision of such an electrician and in accordance with the applicable electrical engineering rules.

8.1 Removing the switch compartment cover

- Loosen 4 bolts and take off the cover at the switch compartment (figures H) .

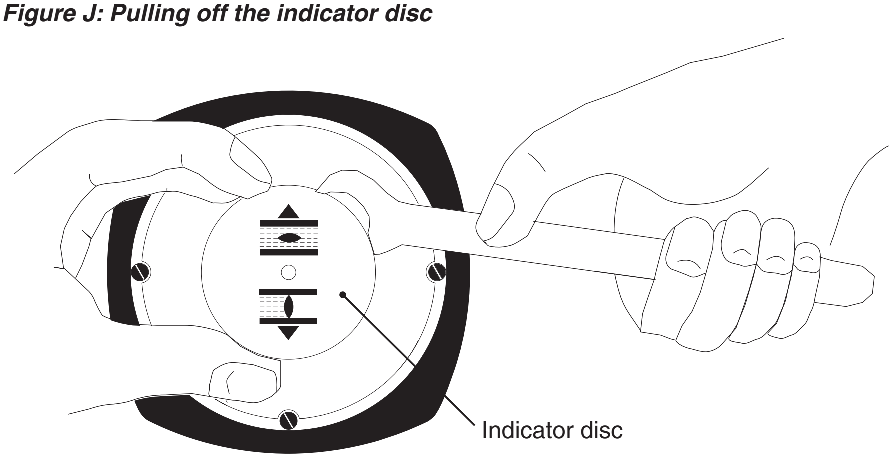
Fig. H-1: Cover with indicator glass

Fig. H-2: Cover without indicator glass

8.2 Pulling off the indicator disc (option)

- If installed, pull off indicator disc (figure J). Open end wrench may be used as lever.

Figure J: Pulling off the indicator disc

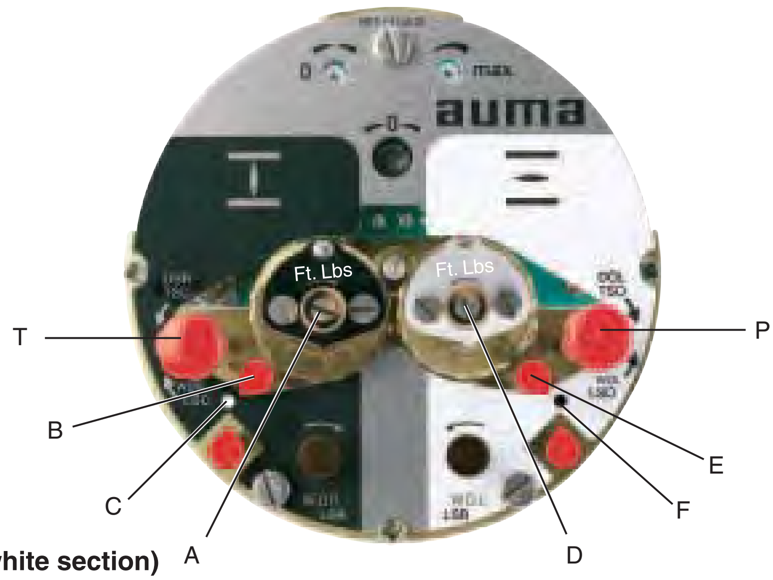


9. Setting the limit switching

9.1 Setting the end position CLOSED (black section)

- Turn handwheel clockwise until valve is closed.
- After having reached the end position, turn back handwheel by approximately ½ a turn (overrun). During test run, check overrun and, if necessary, correct setting of the limit switching.
- **Press down** and turn setting spindle A (figure K-1) with a flat blade screw driver in direction of arrow, thereby observe pointer B.
  While a ratchet is felt and heard, the pointer B moves 90° every time.
  When pointer B is 90° from mark C, continue turning slowly. When pointer B has reached the mark C, stop turning and release setting spindle. If you override the tripping point inadvertently (ratchet is heard after the pointer has rotated), continue turning the setting spindle in the same direction and repeat setting process.

Figure K-1: Control unit



9.2 Setting the end position OPEN (white section)

- Turn handwheel counterclockwise until valve is open, then turn back by approximately ½ a turn.
- **Press down** and turn setting spindle D (figure K-1) with a flat blade screw driver in direction of arrow, thereby observe pointer E.
  While a ratchet is felt and heard, the pointer E moves 90° every time.
  When pointer E is 90° from mark F, continue turning slowly. When pointer E has reached the mark F, stop turning and release setting spindle. If you override the tripping point inadvertently (ratchet is heard after the pointer has rotated), continue turning the setting spindle in the same direction and repeat setting process.

9.3 Checking the limit switches

The red test buttons T and P (figure K-1) are used for manual operation of the limit switches.

- Turning T in direction of the arrow LSC (WSR) triggers limit switch CLOSED.
- Turning P in direction of the arrow LSO (WÖL) triggers limit switch OPEN.

10. Setting the DUO limit switching (option)

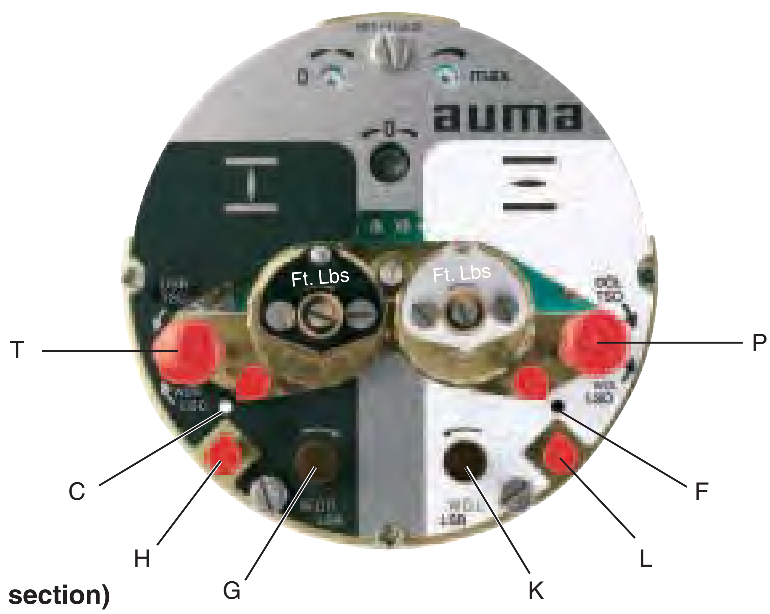
Any application can be switched on or off via the two intermediate position switches.

For setting, the switching point (intermediate position) must be approached from the same direction as later during electrical operation.

10.1 Setting the direction CLOSE (black section)

- Move valve to desired intermediate position.
- **Press down** and turn setting spindle G (figure K-2) with a flat blade screw driver in direction of arrow, thereby observe pointer H.
  While a ratchet is felt and heard, the pointer H moves 90° every time.
  When pointer H is 90° from mark C, continue turning slowly. When pointer H has reached the mark C, stop turning and release setting spindle. If you override the tripping point inadvertently (ratchet is heard after the pointer has rotated), continue turning the setting spindle in the same direction and repeat setting process.

Figure K-2: Control unit



10.2 Setting the direction OPEN (white section)

- Move valve to desired intermediate position.
- **Press down** and turn setting spindle K (figure K-2) with a flat blade screw driver in direction of arrow, thereby observe pointer L.
  While a ratchet is felt and heard, the pointer L moves 90° every time.
  When pointer L is 90° from mark F, continue turning slowly. When pointer L has reached the mark F, stop turning and release setting spindle. If you override the tripping point inadvertently (ratchet is heard after the pointer has rotated), continue turning the setting spindle in the same direction and repeat setting process.

10.3 Checking the DUO switches

The red test buttons T and P (Figure K-2) are used for manual operation of DUO limit switches.

- Turning T in direction of the arrow TSC (DSR) triggers DUO limit switch CLOSED. The torque switch CLOSED is actuated at the same time.
- Turning P in direction of the arrow TSO (DÖL) triggers DUO limit switch OPEN. The torque switch OPEN is actuated at the same time.

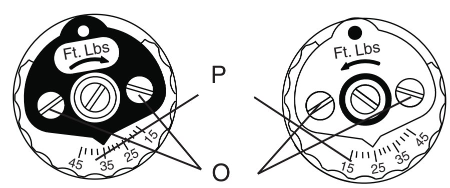
11. Setting the torque switching

11.1 Setting

- **The set torque must suit the valve!**
- **This setting should only be changed with the consent of the valve manufacturer!**

Figure L: Torque switching heads indication in ft lbs

Setting CLOSED   Setting OPEN



- Loosen both lock screws O at the torque dial (figure L).
- Turn torque dial P to set it to the required torque.
  Examples:
  Figure L shows the following setting:
  35 ft lbs for direction CLOSE
  25 ft lbs for direction OPEN
- Tighten lock screws O again

- **The torque switches can also be operated in manual operation.**
- **The torque switching acts as overload protection over full travel, also when stopping in the end positions by limit switching.**

11.2 Checking the torque switches

The red test buttons T and P (figure K-2) are used for manual operation of the torque switches:

- Turning T in direction of the arrow TSC (DSR) triggers torque switch CLOSED.
- Turning P in direction of the arrow TSO (DÖL) triggers torque switch OPEN.
- If a DUO limit switching (optional) is installed in the actuator, the intermediate position switches will be operated at the same time.

12. Test run

12.1 Check direction of rotation

- If provided, place indicator disc on shaft.
  The direction of rotation of the indicator disc (figure M-1) indicates the direction of rotation of the output drive.
- If there is no indicator disc, the direction of rotation can also be observed on the hollow shaft. For this, remove screw plug (no. 27) (figure M-2).

Figure M-1: Indicator disc

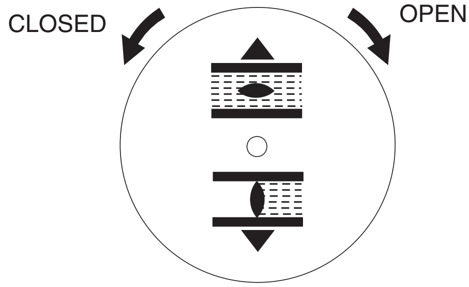
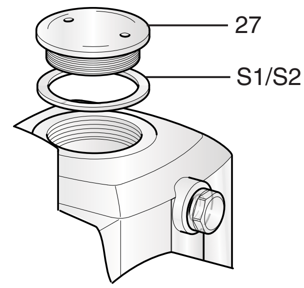


Figure M-2: Opening the hollow shaft



- Move actuator manually to intermediate position or to sufficient distance from end position.
- Switch on actuator in direction CLOSE and observe the direction of rotation:

If the direction of rotation is wrong, switch off immediately
Then, correct phase sequence at motor connection. Repeat test run.

Table 6:

Direction of rotation of the indicator disc:	
counterclockwise	correct
Direction of rotation of the hollow shaft:	
clockwise	correct

12.2 Check limit switching

- Move actuator manually into both end positions of the valve.
- Check if limit switching is set correctly. Hereby observe that the appropriate switch is tripped in each end position and released again after the direction of rotation is changed. If this is not the case, the limit switching must first be set, as described from page 15.

If no other options (sections 13. to 15.) require setting:
- Close switch compartment (see page 23, section 16.).

13. Setting the potentiometer (option)

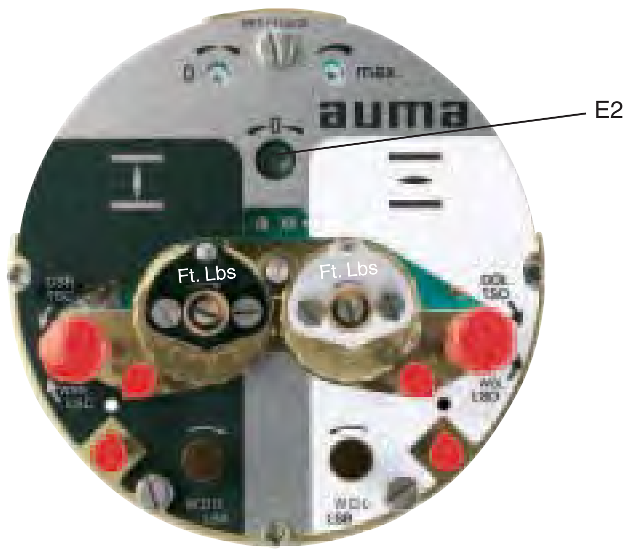
– For remote indication –

- Move valve to end position CLOSED.
- If installed, pull off indicator disc.
- Turn potentiometer (E2) clockwise until stop is felt.
  End position CLOSED corresponds to 0 %, end position OPEN to 100 %.
- Turn potentiometer (E2) back a little.

Due to the ratio of the reduction gearings for the position transmitter the complete resistance range is not always utilized for the whole travel. Therefore, an external possibility for adjustment (setting potentiometer) must be provided.

- Perform fine-tuning of the zero point at external setting potentiometer (for remote indication).

Figure N: Control unit



14. Setting the electronic position transmitter RWG (option)

– For remote indication or external controls –

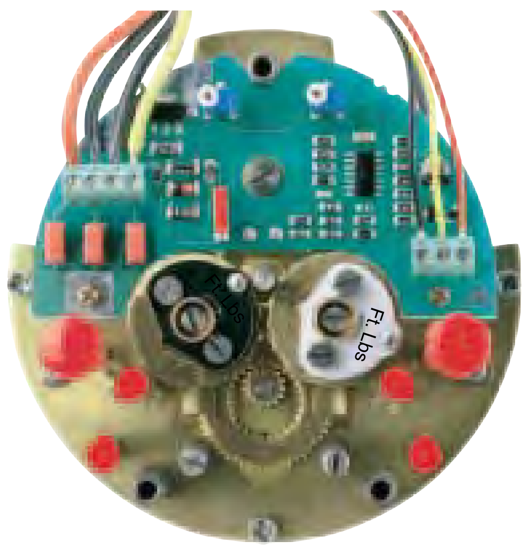
After mounting the multi-turn actuator to the valve, check setting by measuring the output current (see sections 14.1 or 14.2) and re-adjust, if necessary.

Table 7: Technical data RWG 4020

Terminal plans		KMS TP_ _ 4 / _ _ _ 3- or 4-wire system	KMS TP _ 4 _ / _ _ _ KMS TP _ 5 _ / _ _ _ 2-wire system
Output current	I_a	0 – 20 mA, 4 – 20 mA	4 – 20 mA
Power supply	U_v	24 V DC, ± 15 % regulated	14 V DC + (I x R_B), max. 30 V
max. input current	I	24 mA at 20 mA output current	20 mA
max. load	R_B	600 Ω	(Uv - 14 V) /20 mA

The position transmitter board (figure P-1) is located under the cover plate (figure P-2).

Figure P-1: Position transmitter board



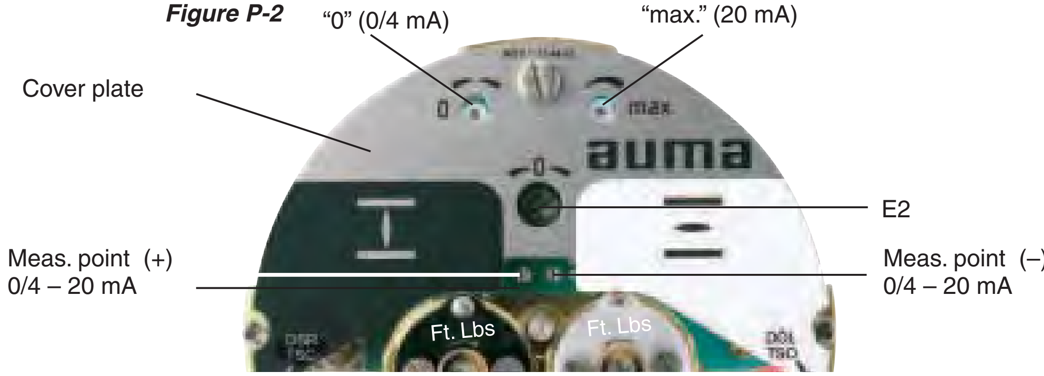
14.1 Setting for 2-wire system 4 – 20 mA and 3-/4-wire system 0 – 20 mA

- Connect voltage to electronic position transmitter.
- Move valve to **end position CLOSED**.
- If installed, pull off indicator disc.
- Connect ammeter for 0 – 20 mA to measuring points (figure P-2).

The circuit (external load) must be connected (max. load R_B), or the appropriate connections at the terminals (refer to terminal plan) must be jumpered, otherwise no value can be measured.

- Turn potentiometer (E2) clockwise to the stop.
- Turn potentiometer (E2) back a little.

Figure P-2



- Turn potentiometer "0" clockwise until output current starts to increase.
- Turn potentiometer "0" back until the following value is reached:
  for 3- or 4-wire system: approx. 0.1 mA
  for 2-wire system: approx. 4.1 mA.
  This ensures that the signal remains above the dead and live zero point.
- Move valve to end position OPEN.
- Set potentiometer "max." to end value 20 mA.
- Approach end position CLOSED again and check minimum value (0.1 mA or 4.1 mA). If necessary, correct the setting.

If the maximum value cannot be reached, the selection of the reduction gearing must be checked.

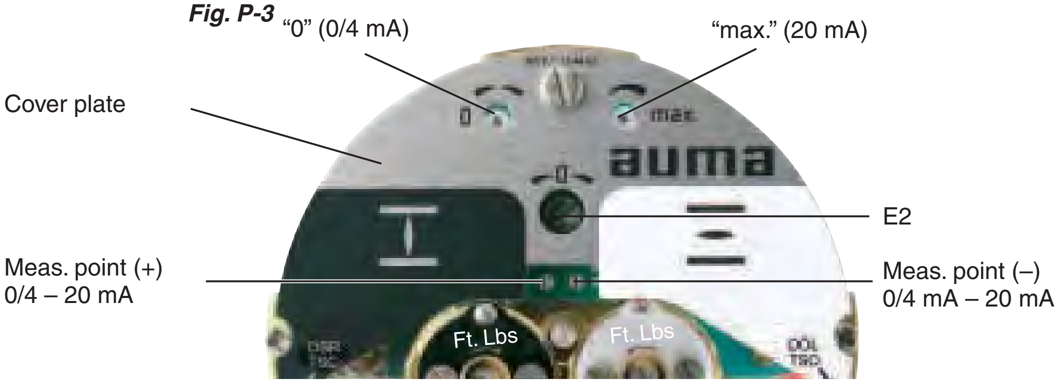
14.2 Setting the 3-/4- wire system 4 – 20 mA

- Connect voltage to electronic position transmitter.
- Move valve to end position CLOSED.
- If installed, pull off indicator disc.
- Connect ammeter for 0 – 20 mA to measuring points (figure P-2).

The circuit (external load) must be connected (max. load R_B), or the appropriate connections at the terminals (refer to terminal plan) must be jumpered, otherwise no value can be measured.

- Turn potentiometer (E2) clockwise to the stop.
- Turn potentiometer (E2) back a little.

Fig. P-3



- Turn potentiometer "0“ clockwise until output current starts to increase.
- Turn back potentiometer "0“ until a residual current of approx. 0.1 mA is reached.

- Move valve to end position OPEN.
- Set potentiometer "max." to end value 16 mA.
- Move valve to end position CLOSED.
- Set potentiometer "0“ from 0.1 mA to initial value 4 mA.
  This results in a simultaneous shift of the end value by 4 mA, so that the range is now 4 – 20 mA.
- Approach both end positions again and check setting. If necessary, correct the setting.

If the maximum value cannot be reached, the selection of the reduction gearing must be checked.

15. Setting the mechanical position indicator (option)

- Place indicator disc on shaft.
- Move valve to end position CLOSED.
- Turn lower indicator disc (figure Q1) until symbol CLOSED is in alignment with the mark on the cover (figure Q-2).
- Move actuator to end position OPEN.
- Hold lower indicator disc CLOSED in position and turn upper disc with symbol OPEN until it is in alignment with the mark on the cover.

Figure Q-1

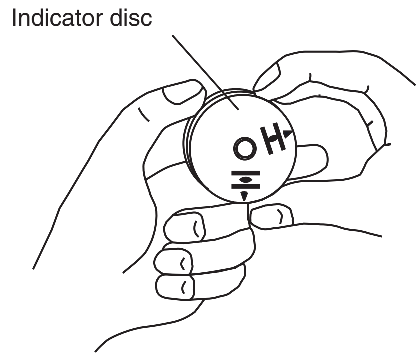


Figure Q-2

Indicator disc rotates by approximately 180° to 230°at full travel from OPEN to CLOSED or vice versa.
A suitable reduction gearing was installed in our factory. If the turns per stroke are changed at a later date, the reduction gearing may have to be exchanged, too.

16. Closing the switch compartment

- Clean sealing faces of housing and cover
- Check whether O-ring is in good condition.
- Apply a thin film of non-acidic grease to the sealing faces.
- Replace cover on switch compartment and fasten bolts evenly crosswise.

After commissioning, check for damage to paint finish of multi-turn actuator. If damage to paint-finish has occurred after mounting, it has to be touched up to avoid corrosion.

17. Enclosure protection IP 68 (option)

Definition

According to EN 60 259, the conditions for meeting the requirements of enclosure protection IP 68 are to be agreed between manufacturer and user.
AUMA actuators and controls in enclosure protection IP 68 meet the following requirements according to AUMA:
- Duration of submersion in water max. 72 hours
- Head of water max. 6 m
- Up to 10 operations during submersion
- Modulating duty is not possible during submersion

Enclosure protection IP 68 refers to the interior of the actuators (motor, gearing, switch compartment, control, and terminal compartment).

For multi-turn actuators, the following has to be observed:
When using output drive types A and AF (stem nut), it cannot be prevented that water enters the hollow shaft along the valve stem during submersion. This leads to corrosion. The water also enters the thrust bearings of output drive type A, causing corrosion and damage of the bearings. The output drive types A and AF should therefore not be used.

Inspection

AUMA actuators and controls in enclosure protection IP 68 undergo a routine testing for tightness in the factory.

Cable glands

- For the entries of the motor and control cables appropriate, cable glands in enclosure protection IP 68 must be used. The size of the cable glands must be suitable for the outside diameter of the cables, refer to recommendations of the cable gland manufacturers.
- As standard, actuators and controls are delivered without cable glands. For delivery, the threads are sealed with plugs in the factory.
- When ordered, cable glands can also be supplied by AUMA at an additional charge. For this, it is necessary to state the outside diameter of the cables.
- The cable glands must be sealed against the housing at the thread with an O-ring.
- It is recommended to additionally apply a liquid sealing material (Loctite or similar).

Commissioning

When commissioning, the following should be observed:
- Sealing faces of housing and covers must be clean
- O-rings of the covers must not be damaged
- A thin film of non-acidic grease should be applied to sealing faces
- Covers should be tightened evenly and firmly

After submersion

- Check actuator.
- In case of ingress of water, dry actuator correctly and check for proper function.

18. Maintenance

After maintenance, check multi-turn actuator for damage to paint finish. If damage to paint-finish has occurred, it has to be touched up to avoid corrosion. Original paint in small quantities can be supplied by AUMA.

AUMA multi-turn actuators require low-level maintenance.
Precondition for reliable service is correct commissioning.

Seals made of elastomers are subject to ageing and must therefore regularly be checked and, if necessary, exchanged.

It is also very important that the O-rings at the covers are placed correctly and cable glands tightened firmly to prevent ingress of dirt or water.

We recommend additionally:

- If rarely operated, perform a test run about every 6 months. This ensures that the actuator is always ready to operate.
- Approximately six months after commissioning and then every year, check bolts between actuator and valve/gearbox for tightness. If required, tighten applying the torques given in table 2, page 8.
- For multi-turn actuators with output drive type A: at intervals of approx. 6 months from commissioning press in Lithium soap EP multi-purpose grease on mineral oil base at the grease nipple with grease gun (quantity see table 3, page 9).

19. Lubrication

- The gear housing is filled with lubricant in the factory.
- A grease change is recommended after the following operation time:

- If rarely operated, after 10 – 12 years
- If operated frequently, after 6 – 8 years

Lubrication of the valve stem must be done separately.

20. Disposal and recycling

AUMA actuators have an extremely long lifetime. However, they have to be replaced at one point in time.
The actuators have a modular design and may therefore easily be disassembled, separated, and sorted according to materials, i.e.:

- electronic scrap
- various metals
- plastics
- greases and oils

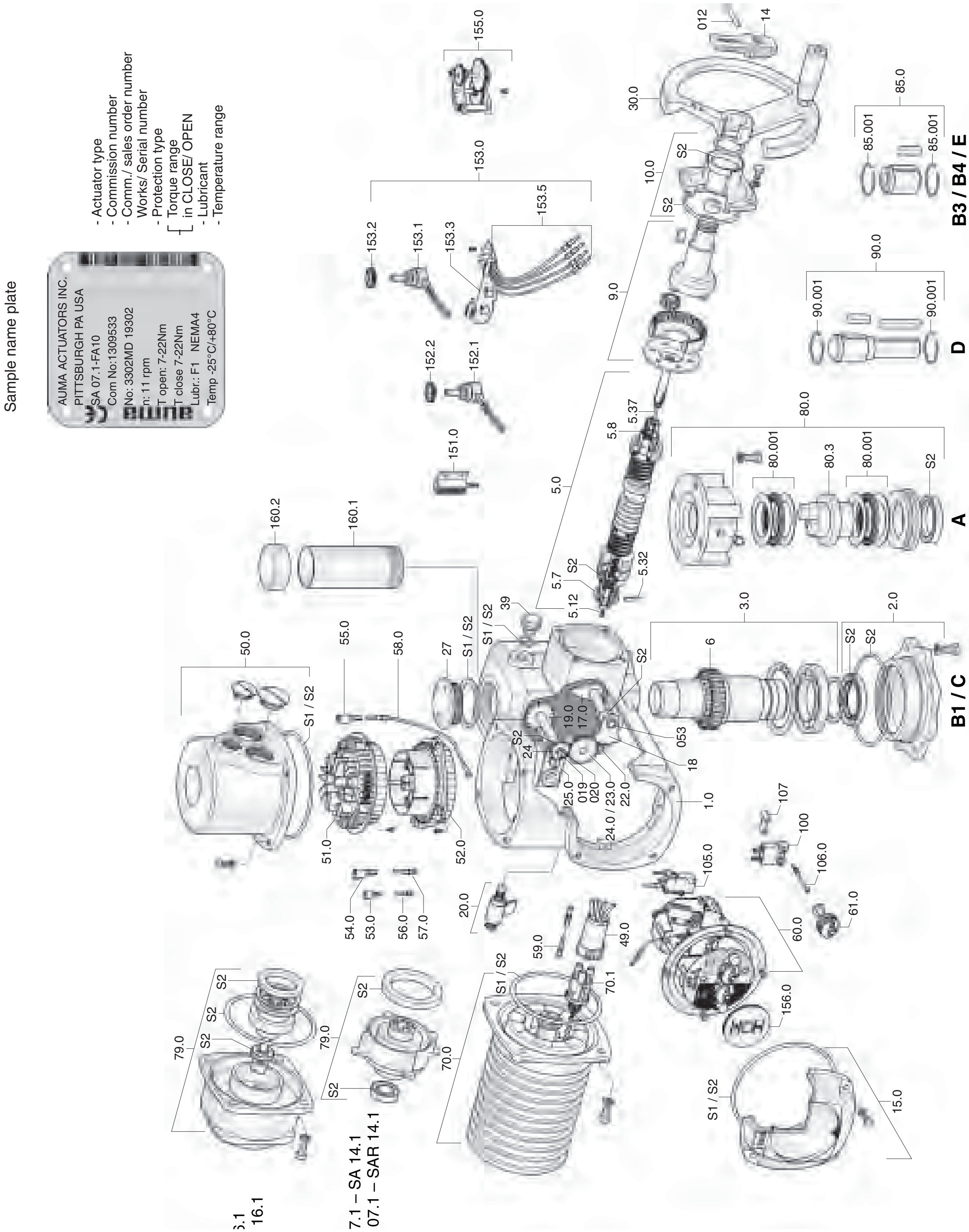
The following generally applies:

- Collect greases and oils during disassembly. As a rule, these substances are hazardous to water and must not be released into the environment.
- Arrange for controlled waste disposal of the disassembled material or for separate recycling according to materials.
- Observe the regional regulations for waste disposal.

21. Service

AUMA offers extensive services such as maintenance and inspection for actuators.
The AUMA service department can be reached at:
phone: 724-743-AUMA (2862)
fax: 724-743-7411
email: mailbox@auma-usa.com
www.auma-usa.com or www.auma.com.

22. Spare parts list Multi-turn actuator SA(R) 07.1 – SA(R) 16.1 with plug/socket connector

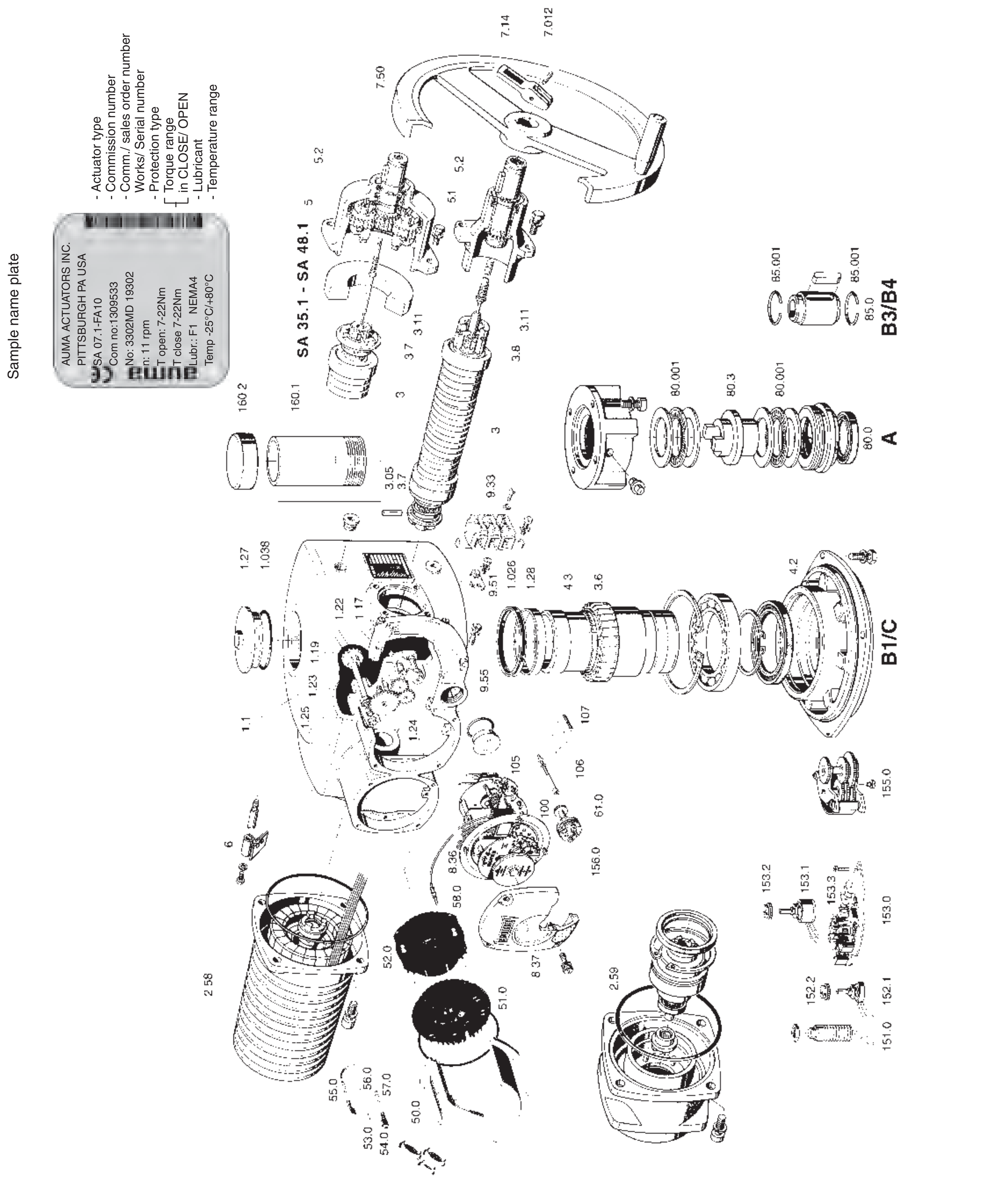


Notes:
When placing orders for spare parts, it is essential to mention type of actuator and our commission number (refer to actuator name plate). Delivered spare parts may slightly vary from the representation in these instructions.

No.	Type	Designation	No.	Type	Designation
012	E	Notched pin	58.0	B	Wire for protective earth
019	E	Cheese head screw	59.0 1)	B	Pin for motor and thermoswitch in motor plug
020	E	Clamping washer			
053	E	Countersunk screw	60.0	B	Control unit assly. (but without torque head, without switches)
1.0	B	Housing assly.			
2.0	B	Flange, bottom assly.	61.0	B	Torque switching head
3.0	B	Hollow shaft assly. (without worm wheel)	70.0	B	Motor
5.0	B	Worm shaft assly.	70.1 1)	B	Motor pin carrier (without pins)
5.12	E	Set screw			
5.32	E	Coupling pin	79.0 2)	B	Planetary gearing for motor drive assly.
5.37	B	Pull rod assly.	80.0 3)	B	Output drive form A assly. (without thread in stem nut)
5.7	E	Motor coupling			
5.8	B	Manual drive coupling assly.	80.001 3	E	Thrust bearing set
6	E	Worm wheel	80.3 3)	E	Stem nut form A (without thread)
9.0	B	Planetary gear assly. for manual drive	85.0 3)	B	Output drive B3
10.0	B	Retaining flange assly.	85.001 3)	E	Snap ring
14	E	Change-over lever	90.0 3)	B	Output drive D
15.0	B	Cover for switch compartment assly.	90.001 3)	E	Snap ring
17.0	B	Torque lever assly.	100	B	Switch for limit/ torque switching (including pins at wires)
18	E	Gear segment			
19.0	B	Crown wheel assly.	105.0	B	Blinker transmitter including pins at wires (without impulse disc and insulation plate)
20.0	B	Swing lever assly.			
22.0	B	Drive pinion II for torque switching assly.	106.0	B	Stud bolt for switches
23.0	B	Drive wheel for limit switching assly.	107	E	Spacer
24	E	Drive wheel for limit switching	151.0	B	Heater
24.0	B	Intermediate wheel for limit switching assly.	152.1 3)	B	Potentiometer (without slip clutch)
25.0	E	Locking plate	152.2 3)	B	Slip clutch for potentiometer
27	E	Screw plug	153.0 3)	B	RWG assly.
30.0	B	Handwheel with ball handle assly.	153.1 3)	B	Potentiometer for RWG (without slip clutch)
39	E	Screw plug			
49.0 1)	B	Motor plug, socket assly.	153.2 3)	B	Slip clutch for RWG
50.0	B	Cover assly.	153.3 3)	B	Electronic board RWG
51.0	B	Socket carrier assly. (with sockets)	153.5 3)	B	Wires for RWG
52.0	B	Pin carrier (without pins)	155.0 3)	B	Reduction gearing
53.0	B	Socket for control	156.0 3)	B	Mechanical position indicator
54.0	B	Socket for motor	160.1 3)	E	Protection tube(without cap)
55.0	B	Socket for protective earth	160.2 3)	E	Cap for stem protection tube
56.0	B	Pin for control	S1	S	Seal kit, small
57.0	B	Pin for motor	S2	S	Seal kit, large

1) SA 16.1 with output speeds of 32 to 216 rpm or SAR 16.1 with output speeds of 32 and 54 rpm without plug/ socket connector; motor directly wired to pin carrier (No. 52.0) .
2) not available for all output speeds
3) not included in basic equipment

23. Spare parts list Multi-turn actuator SA 25.1 – SA 48.1/SAR 25.1 – SAR 30.1



Notes:
When placing orders for spare parts, it is essential to mention type of actuator and our commission number (refer to actuator name plate). Delivered spare parts may slightly vary from the representation in these instructions.

No.	Type	Designation	No.	Type	Designation
1.026	E	Quad ring / radial seal	54.0	B	Socket for motor
1.038	E	O-ring	55.0	B	Socket for protective earth
1.1	B	Housing assly.	56.0	B	Pin for control
1.17	B	Torque lever assly.	57.0	B	Pin for motor
1.19	B	Crown wheel assly.	58.0	B	Wire for protective earth
1.22	B	Drive pinion II for torque switching assly.	61.0	B	Torque switching head
1.23	B	Drive wheel for limit switching assly.	80.0 *	B	Output drive form A assly. (without thread in stem nut)
1.24	B	Intermediate wheel for limit switching assly.	80.001*	S	Thrust bearing set
1.25	E	Locking plate	80.3 *	E	Stem nut form A (without thread)
1.27	E	Screw plug	85.0 *	B	Output drive form B3 assly.
1.28	E	Bearing bush	85.001*	E	Snap ring
2.58	B	Motor	100	B	Switch for limit/ torque switching (including pins at wires)
2.59 ●	B	Planetary gear assly. for motor drive			
3	B	Drive shaft assly.	105	B	Blinker transmitter including pins at wires (without impulse disc and insulation plate)
3.05	E	Dowel pin			
3.11	B	Pull rod assly.	106.0	B	Stud bolts for switches
3.6	B	Worm wheel assly.	107	E	Spacer
3.7	E	Motor coupling	151.0	B	Heater
3.8	B	Manual drive coupling assly.	152.1 *	B	Potentiometer (without slip clutch)
4.2	B	Flange, bottom assly.	152.2 *	B	Slip clutch for potentiometer
4.3	B	Hollow shaft assly.	153.0 *	B	RWG assly.
5	B	Planetary gear assly. for manual drive	153.1 *	B	Potentiometer for RWG (without slip clutch)
5.1	E	Mounting flange	153.2 *	B	Slip clutch for RWG
5.2	B	Hand wheel shaft assly.	153.3 *	B	Printed board for RWG
6	B	Swing lever assly	155.0 *	B	Reduction gearing
7.012	E	Notched pin	156.0 *	B	Mechanical position indicator
7.14	E	Change-over lever	160.1 *	E	Protection tube (without cap)
7.50	B	Handwheel with ball handle assly.	160.2 *	E	Cap
8.36	B	Control unit assly. (but without torque head, without switches)	S1	S	Seal kit (small)
			S2	S	Seal kit (large)
8.37	B	Switch compartment cover			
9.33	B	Terminals for motor connection			
9.51	B	Protective earth connection			
9.55	B	Cover for motor connection compartment assly.			
50.0	B	Plug cover assly.			
51.0	B	Socket carrier assly. (with sockets)			
52.0	B	Pin carrier (without pins)			
53.0	B	Socket for control			

● not available for all output speeds
* not included in basic equipment

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Solutions for a world in motion

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2005-06-27

Y000.001/015/us/1.05

ACTIONNEUR ELECTRIQUE
ELECTRIC ACTUATOR
ELEKTRISCHER STELLANTRIEB

25-45-75-100-150-300

VRX / VSX

25Nm » 75Nm

100Nm » 300Nm

Facteur de marche 50% Duty cycle

Indice de protection IP67 Enclosure

Résistance de série / Resistor in standard

Système sécurité FAIL SAFE Security system

Positionnement POSI Positioning

3 positions GF3 3 positions

FR **DOCUMENTATION TECHNIQUE**
MISE EN SERVICE

GB ***TECHNICAL LITERATURE***
SET UP PROCEDURE

D **TECHNISCHE UNTERLAGEN**
BETRIEBSANLEITUNG

100% CONTROL MADE IN EU 100% CONTROL

II 2 GD Ex d IIB T6 tD A21 IP67 T80°C - CE 0038 LCIE 06 ATEX 6006X

Pour actionneurs 400V et option EBS.24 :
For 400V actuators and option EBS.24 :
Für 400V Stellantriebe und optione EBS.24 :

II 2 GD Ex d IIB T5 tD A21 IP67 T95°C

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DESCRIPTION

These electric actuators have been designed to perform the control of a valve with 90° rotation. Please consult us for any different application. We cannot be held responsible if the mentioned actuators are used in contradiction to this advice.

SAFETY INSTRUCTIONS

To be read prior to the installation of the product

- The electric power supply must be switched-off before any intervention on the electric actuator (i.e. prior demounting its cover or manipulating the manual override knob).
- Any intervention must only be carried out by a qualified electrician or other person instructed in accordance with the regulations of electric engineering, safety, and all other applicable directives.
- Strictly observe the wiring and set-up instructions as described in the manual: otherwise, the proper working of the actuator can not be guaranteed anymore. Verify that the indications given on the identification label of the actuator fully correspond to the characteristics of the electric supply.
- The product must be protected by an easily accessible electric safety device (power isolator) corresponding to its power.
- As stipulated in the applicable regulation, the connection to earth contact is compulsory for devices with working voltages exceeding 42 V.
- Used symbols : Danger : risk of electric shock — Earth protection — Direct voltage — Alternating voltage

TRANSPORT AND STORAGE

- The forwarding agents being held as responsible for damages and delays of the delivered goods, the consignees are obliged to express if applicable their reserves, prior to accept the goods. The goods delivered directly ex works are subject to the same conditions.
- The transport to the place of destination is carried out by using rigid packing material.
- The products must be stored in clean, dry, and ventilated places preferably on appropriate palettes or shelves.

MAINTENANCE

- Maintenance is ensured by our factory. If the supplied unit does not work, please check the wiring according to the electric diagram as well as the power supply of the concerned electric actuator.
- For any question, please contact our after-sales service.
- To clean the outside of the actuator, use a lint and soapy water.
  DO NOT USE CLEANING PRODUCT WITH SOLVENT OR ALCOHOL

GUARANTEE

- 100% of the actuators are fully tested and set in the factory.
- These products are guaranteed two years from the delivery date or 50,000 operating cycles against all types of manufacturing and material faults (operating time and model class according to standard CEI34).
- This guarantee will only be valid if the unit has not been disassembled or self-repaired during its service life. It does not cover any wear and damage caused by shocks or faulty operation neither by the use of the unit under conditions not in accordance with its nominal characteristics. The guarantee is strictly limited to the replacement of original parts found defective on checking by our service personnel. The cost of shipping to our premises, the return of devices to the customer as well as the repair cost will be chargeable. We will not assume the responsibility for any direct or indirect accidents/risks originated by a failure of our products. The guarantee does not cover the consequences of breakdown and excludes any payments for indemnities. The accessories and adaptations are excluded from the guarantee. In the case where a customer has not proceeded to payments within the agreed period, our guarantee will be suspended until the delayed payments have been received and with the consequence that this suspension will not prolong the guarantee period in any case.

RETURN OF GOODS

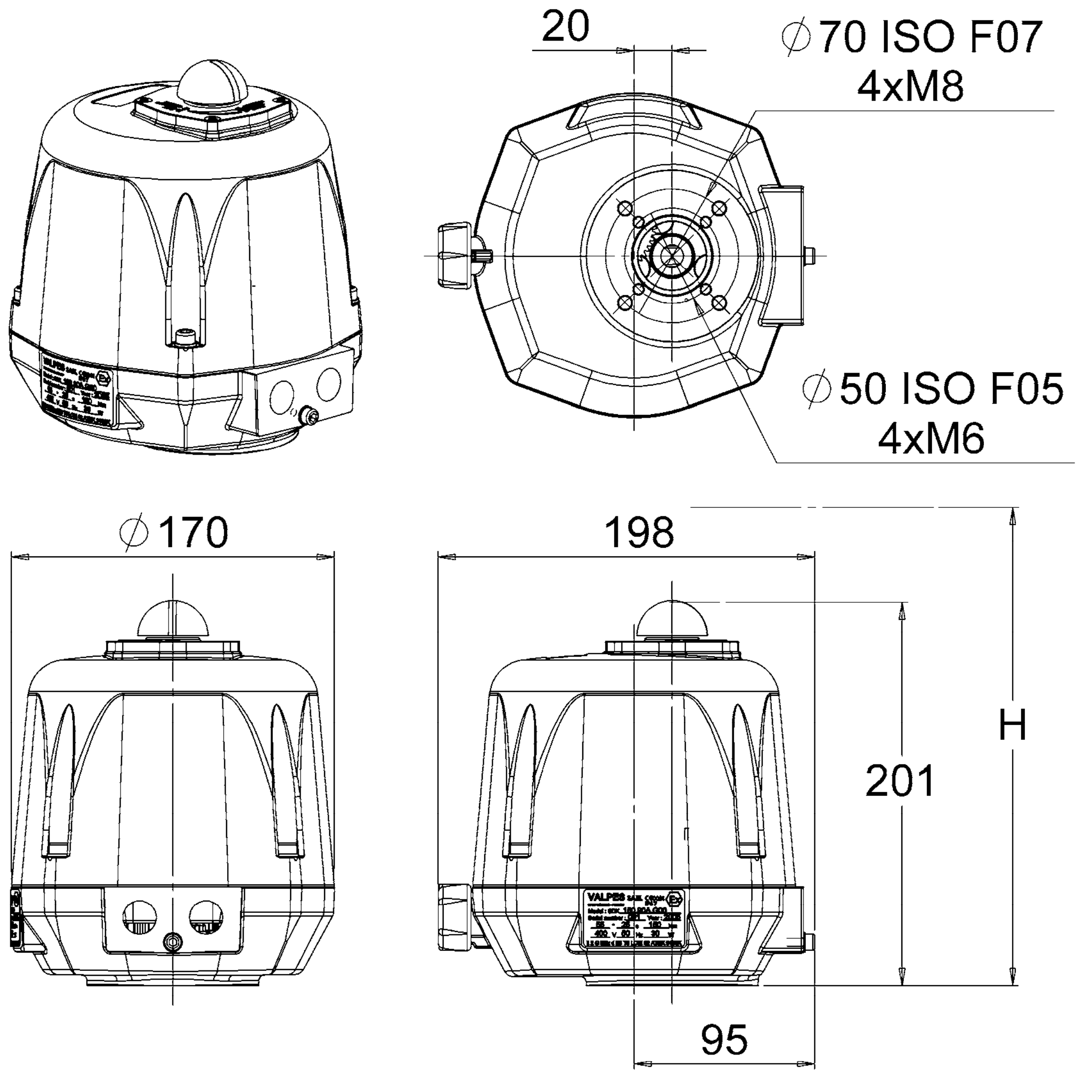
- The customer is obliged to check the conformity of the goods with regard to their definition at the time of delivery.
- The acceptance of the goods by the purchaser disclaims the supplier of all responsibility if the purchaser discovers any non-conformity after the date of acceptance. In such case, the repair cost will be borne by the purchaser who will also exclusively bear all financial consequences of any resulting damage. Returned goods will only be accepted if our prior agreement has been given to this procedure : the goods must be sent free of all cost and being shipped solely and in their original packing. The returned goods will be credited to the purchaser with a reduction of 20% on the unit's price charged in accordance with the original invoice of the returned goods.

- Do not mount the actuator « upside down ».
- Do not mount the actuator less than 30 cm of a electromagnetic disturbances source.

Mechanical mounting (VRX models)

DIMENSIONS OF THE ACTUATOR

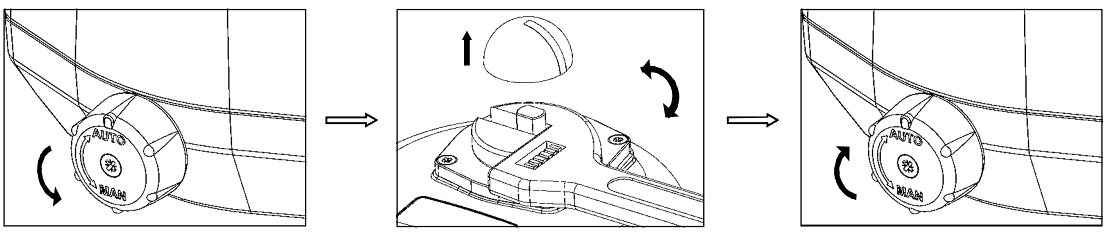
- The actuator is set to its closed position in our factory.
- Possible fixations : F05 (4xM6 with Ø50) and F07 (4xM8 with Ø70), star 17, depth 19mm.
- Do not mount the actuator « upside down ».
- Necessary height above the valve for the mounting of the actuator : H=300mm.



EMERGENCY MANUAL OVERRIDE

In case of an electric supply failure, it is possible to operate the actuator manually :

- Turn the knob (appendix p.31 mark 9) to position MAN and hold it in position.
- Turn the outgoing drive shaft of the actuator with the help of an adjusting spanner.
- In order to re-engage the reduction, release the knob.



MOUNTING / DISASSEMBLY OF THE COVER AND POSITION INDICATOR

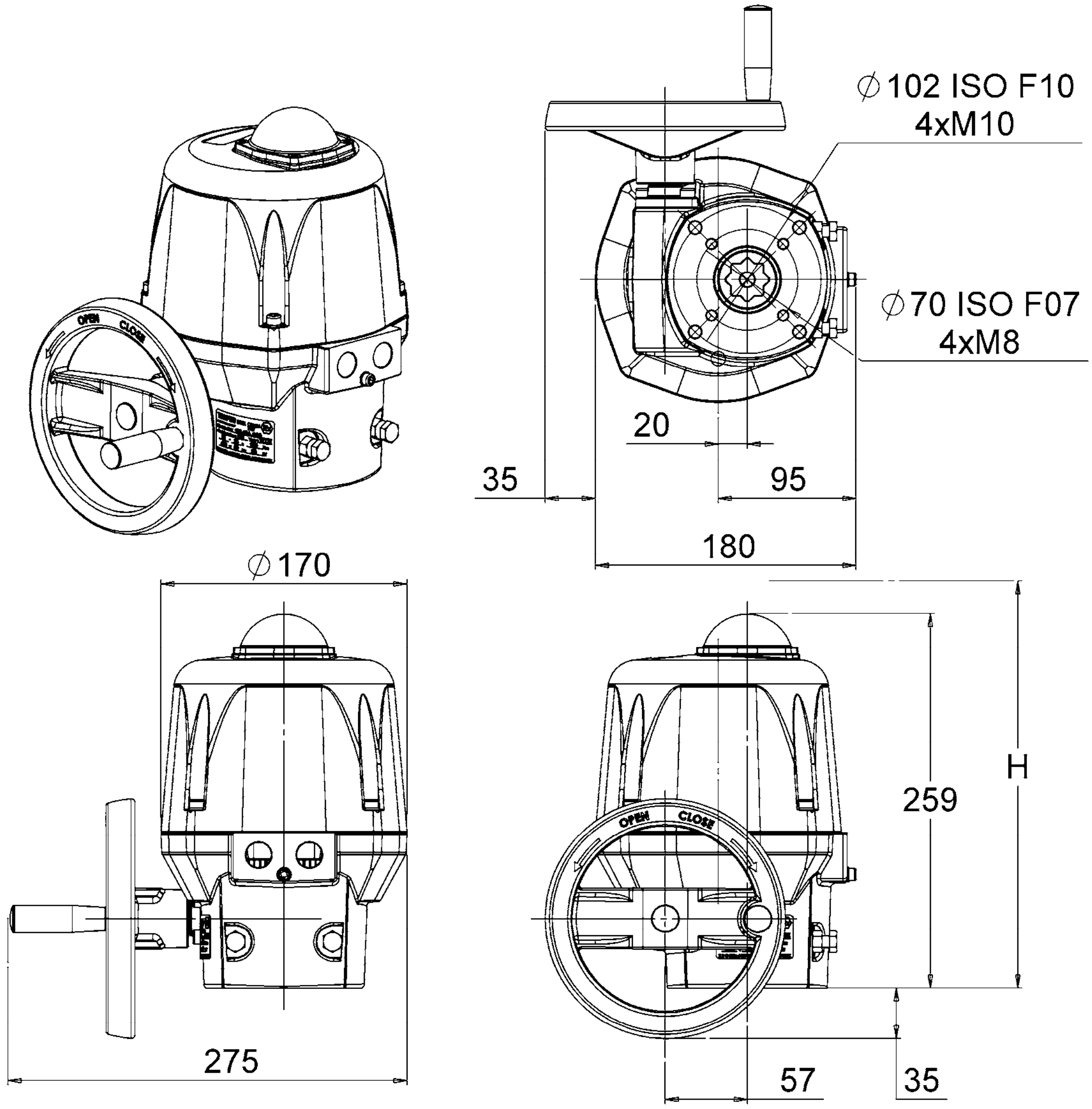
For the wiring and setting of the actuator, it is necessary to remove the cover.

- Mounting of the cover (appendix p.31 mark 2) : make sure that the seal ring (appendix p.31 mark 7) is correctly placed in its position, mount the cover and tighten the 4 screws M6 (appendix p.31 mark 3, torque : max. 6Nm).
- Mounting of the position indicator (appendix p.31 mark 1) : fit the indicator onto the outgoing axle.

Mechanical mounting (VSX models)

DIMENSIONS OF THE ACTUATOR

- The actuator is set to its closed position in our factory.
- Possible fixations : F07 (4xM8 with Ø70) and F10 (4xM10 with Ø102), star 22, depth 24mm.
- Do not mount the actuator « upside down ».
- Necessary height above the valve for the mounting of the actuator : H=360mm.
- Do not mount the actuator less than 30 cm of a electromagnetic disturbances source.



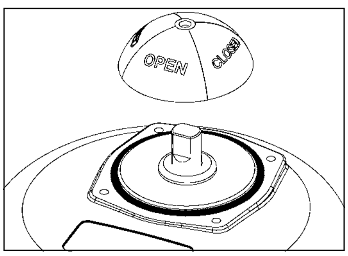
EMERGENCY MANUAL OVERRIDE AND MECHANICAL STOPS SETTING

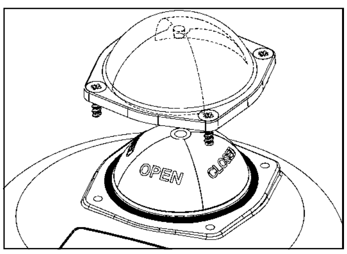
The actuator operates in electric priority. Ensure that the power supply is cut off prior to manually operation. No declutching is required, the hand wheel has simply to be turned (appendix p.32 mark 9).
The end mechanical stops are preset to 90° and stuck (Tubetanche Loctite 577 or equivalent). It is posible to adjust then by moving the 2 screws M8 (appendix p.32 mark 17) but you need to stick them again in order to ensure a proper sealing.

MOUNTING / DEMOUNTING OF THE COVER AND POSITION INDICATOR

For the wiring and setting of the actuator, it is necessary to remove the cover.

- Mounting of the cover (appendix p.32 mark 2) : make sure that the seal ring (appendix p.32 mark 7) is correctly placed in its position, mount the cover and tighten the 4 screws M6 (appendix p.32 mark 3, torque : max. 6Nm).
- Mounting of the position indicator (appendix p.326 mark 1) : mount the seal ring and the indicator then the window with the 4 screws M4.





Sense of window for standard mounting

Electric connection

RESPECT SAFETY INSTRUCTIONS

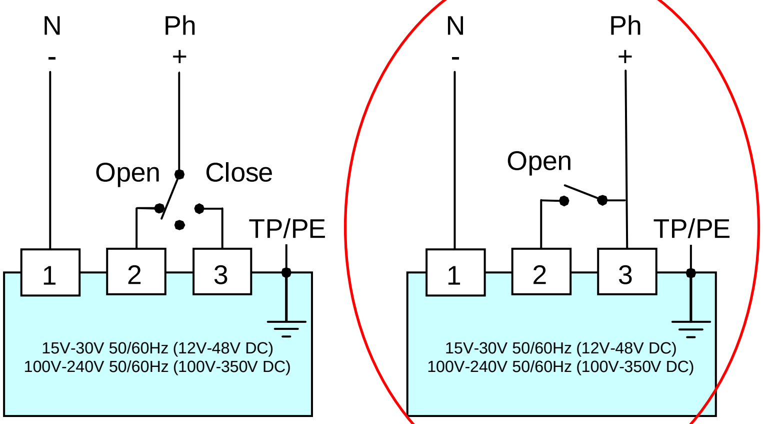
The caps placed on M20x1.5 openings (appendix p.14 mark 15) must be replaced by ATEX certified connection glands.

- Remove the position indicator, unscrew the four screws and take off the cover.

SUPPLY AND CONTROL WIRING (Except POSI - see p.22)

- Ensure that the voltage indicated on the actuator ID label (appendix p.31/32 mark 11) corresponds to the voltage supply.
- Connect to earth through the exterior bolt M5 located under the cable gland (appendix p.31/32 mark 16). It is also possible to connect the actuator to earth inside the actuator through the bolt M3 next to the terminal strip (appendix p.17 mark A).
- Unscrew the left cable gland and insert the cable.
- Connect the wires to the terminal strip (appendix p.17 mark B) in accordance with the required control mode.

3-points modulating mode   On-Off mode (pre-set to closed)

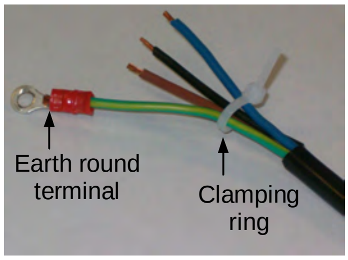


The terminal temperature can reach 90°C

NOTA BENE : The used wires must be rigid (feedback voltages : 4 to 250V AC/DC)

NOTA BENE: The actuator is always powered, so it must be connected to a disconnection system (switch, circuit breaker) to ensure the actuator power cut.

- Put a lacing cord around the wires (see the picture beside) and re-tighten the cable gland.



WIRING OF THE FEEDBACK SIGNAL

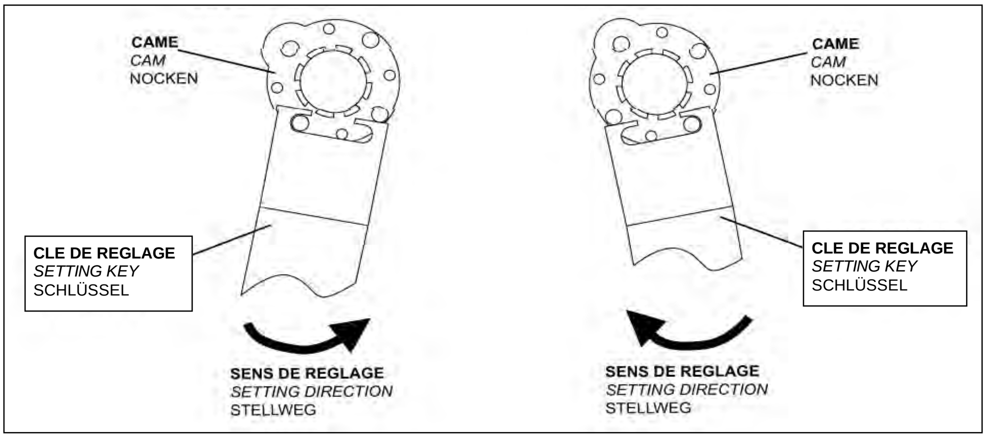
Our actuators are equipped with two simple limit switch contacts normally set in their open position (NO). As per factory setting, the white cam is used to detect the open position (FC1) and the black cam is used to detect the closed position (FC2).
This feedback system accepts voltages between 24V and 240V AC/DC.

- Unscrew the right cable gland and insert the cable.
- Remove 25mm of the cable sheath and strip each wire by 8mm.
- Connect the wires to the terminal strip (appendix p.31/32 mark 12) in accordance with the diagram beside.
- Tighten the cable gland.

SETTING OF END LIMIT SWITCHES

The actuator is pre-set in our factory. Do not touch the two lower cams in order to avoid any malfunctioning or even damage to the actuator.

- To adjust the position of the auxiliary contacts, make rotate the two superior cams by using the appropriate wrench.



- Re-mount the cover, fasten the four screws and attach the position indicator.

Schéma électrique : Série V : 100V - 240V AC (50/60Hz) et 100V - 350V DC ou 15V - 30V AC (50/60Hz) et 12V - 48V DC

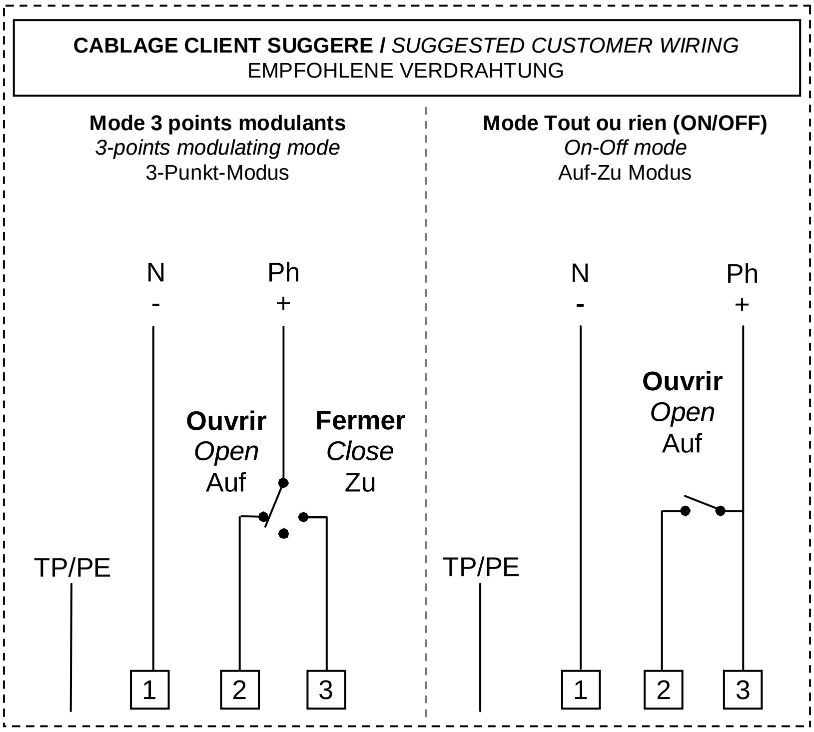
Electric wiring : V range: 100V - 240V AC (50/60Hz) and 100V - 350V DC or 15V - 30V AC (50/60Hz) and 12V - 48V DC

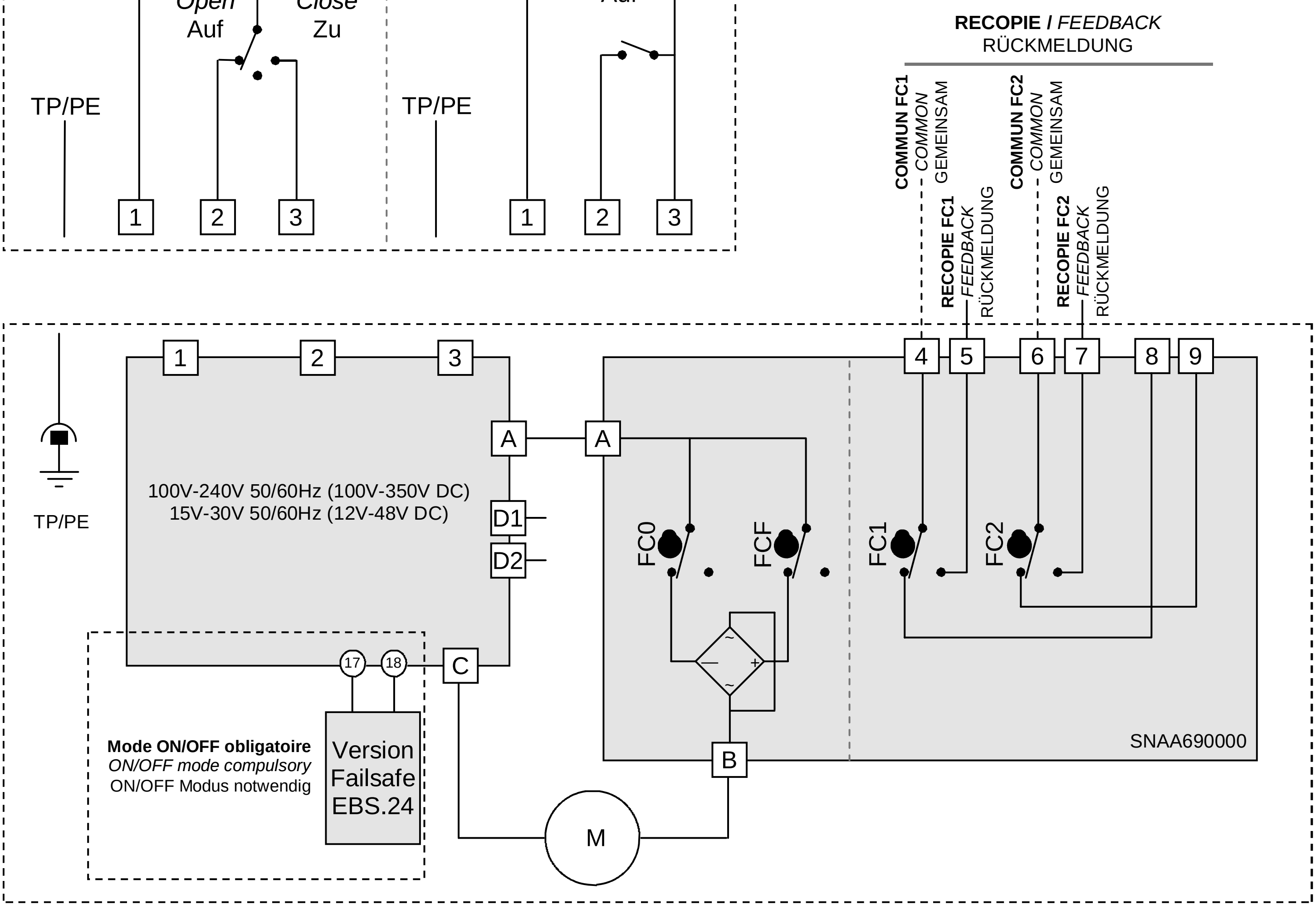
Schaltplan : Serie V : 100V - 240V AC (50/60Hz) und 100V - 350V DC oder 15V - 30V AC (50/60Hz) und 12V - 48V DC

La température du bornier peut atteindre 90°C
The terminal temperature can reach 90°C
Die Terminal-Temperatur kann bis zu 90°C erreichen.

- Les câbles utilisés doivent être rigides (tensions pour la recopie : 4 à 250V AC/DC)
- N.B.: The used wires must be rigid (feedback voltages : 4 to 250V AC/DC)
- N.B.: Die Anschlusskabel müssen biegesteif sein (Rückmeldespannungen 4 bis 250V AC/DC)

REP	DESIGNATION / BESCHREIBUNG
FC0	**Fin de course ouverture** *Open limit switch* Endschalter AUF
FCF	**Fin de course fermeture** *Close limit switch* Endschalter ZU
FC1	**Fin de course auxiliaire 1** *Auxiliary limit switch 1* Zusätzlicher Endschalter 1
FC2	**Fin de course auxiliaire 2** *Auxiliary limit switch 2* Zusätzlicher Endschalter 2
D1/D2	**Bornier report défaut (24V DC / 3A max)** *Failure report Terminal strip (24V DC / 3A max)* Fehlermeldung Klemmleiste (24V DC / 3A max)



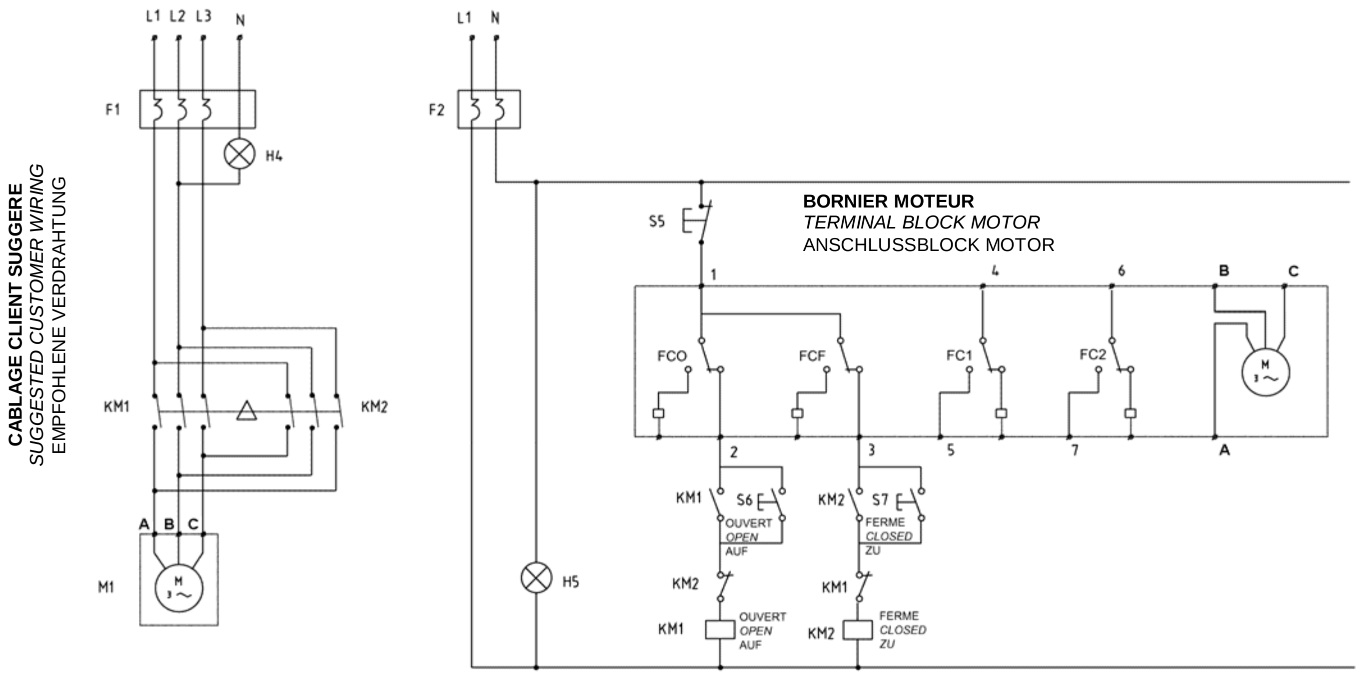


~~Schéma électrique : Série V 400V~~

~~*Electric wiring : standard V 400V*~~
~~Schaltplan : standard V 400V~~

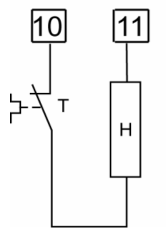
ALIMENTATION MOTEUR
MOTOR POWER SUPPLY
SPANNUNGSVERSORGUNG MOTOR

ALIMENTATION COMMANDE
CONTROL POWER SUPPLY
STELLERSPANNUNG



REP	DESIGNATION BESCHREIBUNG	REP	DESIGNATION BESCHREIBUNG
FC0	**Fin de course ouverture** *Open limit switch* Endschalter AUF	**H4**	**Signalisation alimentation moteur** *Motor supply indication* Rückmeldungmotorspannung
FCF	**Fin de course fermeture** *Close limit switch* Endschalter ZU	**H5**	**Signalisation alimentation commande** *Control supply indication* Rückmeldungstellerspannung
FC1	**Fin de course auxiliaire 1** *Auxiliary limit switch 1* Zusätzlicher Endschalter 1	**KM1**	**Contact ouverture** *Opening swith* Öffner
FC2	**Fin de course auxiliaire 2** *Auxiliary limit switch 2* Zusätzlicher Endschalter 2	**KM2**	**Contact fermeture** *Closing swith* Schliesser
S5	**Poussoir d’arrêt** *Stop button* Stopschalter	**F1**	**Contact thermique** *Thermical switch* Thermoschalter
S6	**Poussoir d’ouverture** *Opening button* Startschalter	**F2**	**Contact thermique** *Thermical switch* Thermoschalter
S7	**Poussoir de fermeture** *Closing button* Ausschalter	**H**	**Résistance de réchauffage** *Heating resistor* Heizwiderstand
M	**Moteur** *Motor* Motor	**T**	**Thermostat** *Thermoswitch* Thermoschalter

ERT.B



- L’alimentation du moteur est câblée sur un relais bistable triphasé à inversion de phase (non livré)
- The motor power supply is wired on bistable three-phase relay (not delivered)
- Anschluss des Motors ist auf einem bistabiles Drehstrom-Relais mit Phasenumkehrung verkabelt (nicht geliefert)

- En cas de fonctionnement inverse, inverser 2 des phases du moteur
- If working inverted, invert 2 phases of motor
- Bei umgekehrter Laufrichtung, umkehren sie die beiden Phasen des Motors

Cartes électroniques

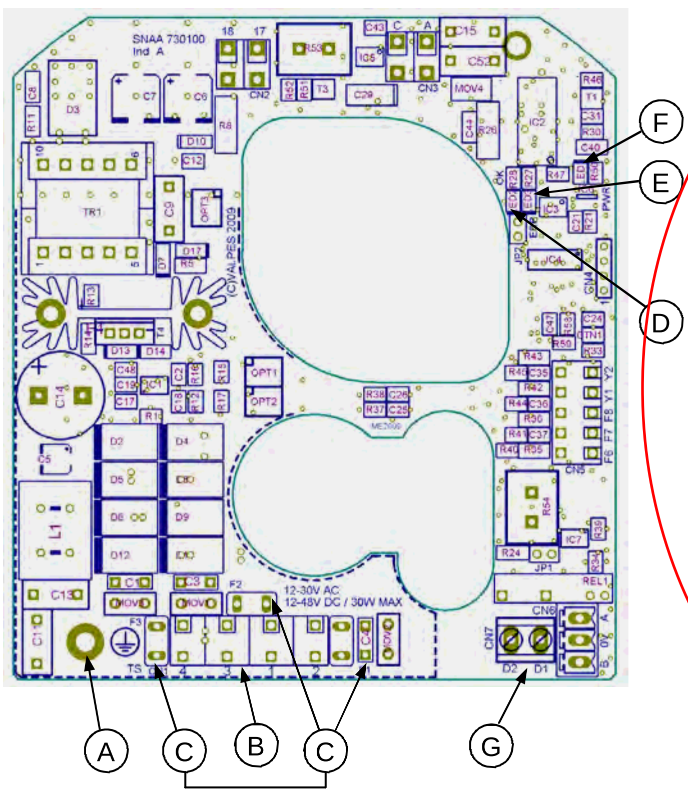
FR GB D

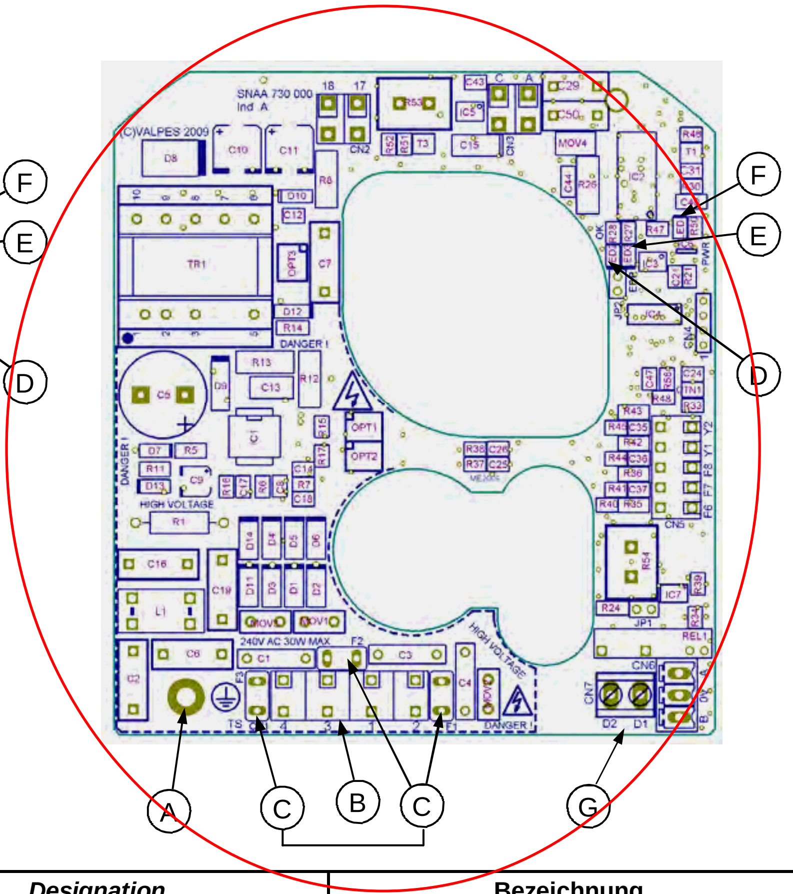
Electronic cards
Elektronische Karten

Cartes d’alimentation et commande
Pilot and power supply cards
Steuerung und Stromversorgung Karten

SNAA730100
15V-30V 50/60Hz (12V-48V DC)

SNAA730000
100V-240V 50/60Hz (100V-350V DC)





Rep.	Désignation	*Designation*	Bezeichnung
A	**Vis de terre**	*Earth screw*	Erde Schraube
B	**Bornier alimentation et commande**	*Pilot and power supply terminal strip*	Steuerung und Stromversorgung Verbindung
C*	**Fusibles protection carte**	*Card protection fuses*	Karte Sicherung
D	**LED 2 : microprocesseur ok**	*LED 1 : microprocessor ok*	LED 1 : Mikroprozessor ok
E**	**LED 3 : défaut détecté**	*LED 2 : detected failure*	LED 2 : Aufgespürter Fehler
F	**LED 1 : présence tension**	*LED 3 : power presence*	LED 3 : Spannungsanwesenheit
G	**Bornier report défaut (24V DC - 3A max)**	*Failure reportTerminal strip (24V* DC - 3A max)	Fehlermeldung Klemmleiste (24V DC - 3A max)

* **Fusibles pour carte multi-tensions** / *Fuses for multivolt card* / Sicherung für Multispannung Karte :
- **Carte** / *Card* / Karte **SNAA730100** : 5A / T 125V (Littelfuse 39615000000)
- **Carte** / *Card* / Karte **SNAA730000** : 3,15A / T 250V (Multicomp MST 3,15A 250V)

** **Défauts possibles : limitation de courant, limitation thermique ou erreur programme**
=> vérifier que le couple de la vanne n’est pas supérieur au couple maximum fourni par l’actionneur
=> vérifier que l’actionneur ne dépasse pas la durée sous tension donnée (surchauffe possible)
Pour redémarrer l’actionneur, inverser le sens de marche ou l’éteindre et le remettre sous tension.

Possible defects : limitation of current, thermic limitation or program error
=> check that the valve torque is not superior to the maximum torque stand by the actuator
=> check that the actuator do not exceed the duty cycle indicated (possible overheat)
To re-start the actuator, reverse the sense of rotation or switch the power off and on.

Mögliche Fehler : Strombegrenzung, thermische Begrenzung oder Programmsfehler
=> Überprüfen sie das Drehmoment von dem Ventil
=> Überprüfen sie das die Einschaltdauer nicht grober als spezifisiert in die technischen Daten von den Antrieb ist
Um die Antrieb neue zu starten, muss man den Drehrichtung auswechseln oder die Spannung Auf/Zu Umschalten.

Modèles FAILSAFE

FAILSAFE models
FAILSAFE Modele

FR	GB	D

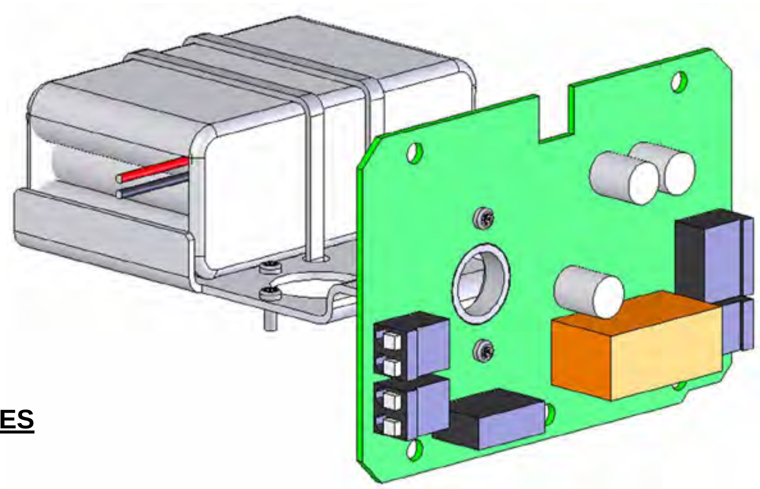
Pour actionneurs 400V et option EBS.24 :
For 400V actuators and option EBS.24 :
Für 400V Stellantriebe und optione EBS.24 :
II 2 GD Ex d IIB T5 tD A21 IP67 T95°C

DESCRIPTION
DESCRIPTION
BESCHREIBUNG

Système de sécurité (mode Tout ou Rien obligatoire) Pour des actionneurs VR / VS

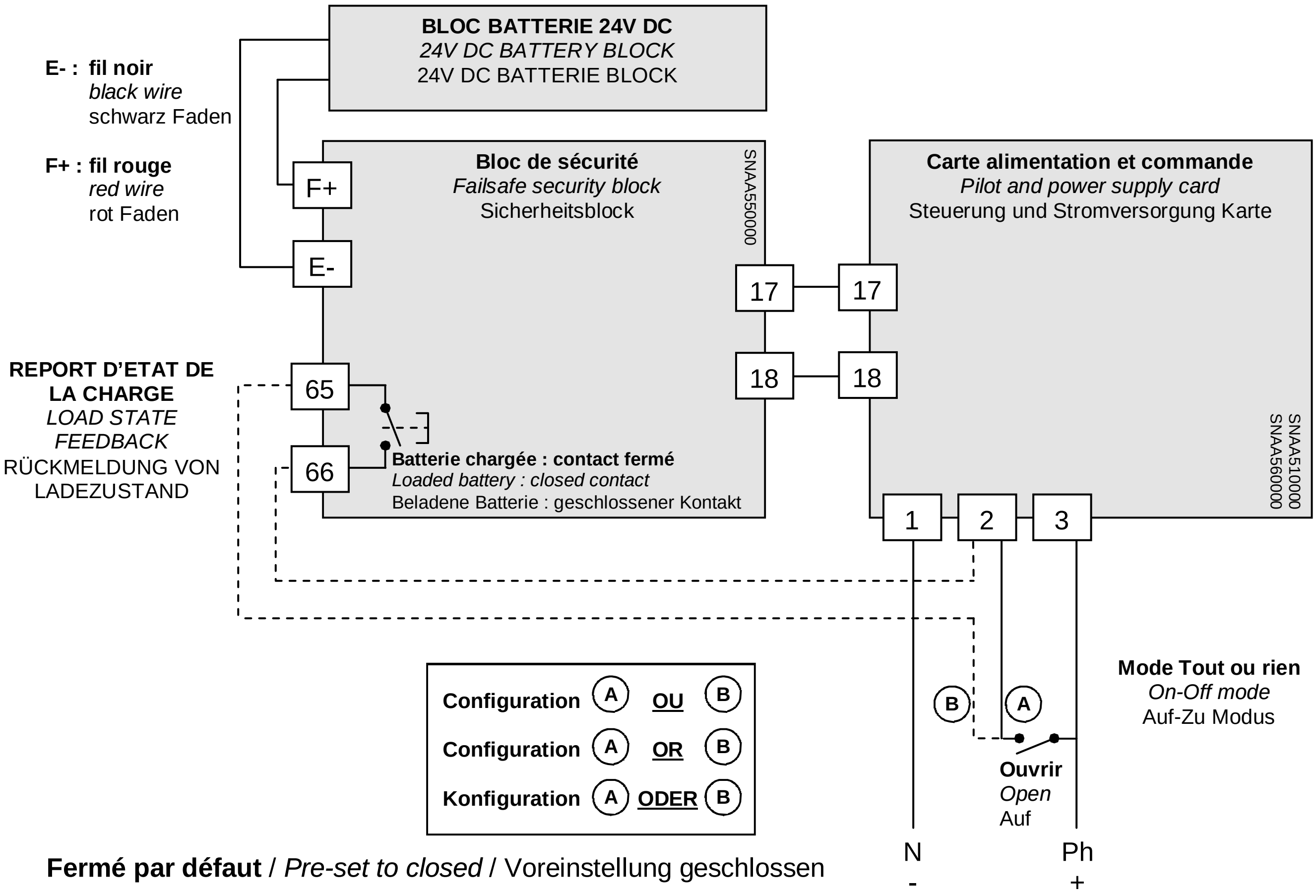
Safety system (ON/OFF mode compulsory) For VR / VS actuators

Sicherheitssystem (*ON/OFF* Modus notwendig) Für VR / VS Stellantriebe



DONNEES TECHNIQUES
TECHNICAL DATA
TECHNISCHE DATEN

TYPE	EBS.24
Tension *Voltage* Spannung	24V DC
Courant nominal *Nominal current* Nennstrom	0,8A
Courant maximal *Maximal current* Max. Strom	2,4A
Durée initiale de charge *Initial loading time* Ladezeit	14h max
Relais de report d'état de la charge *Load state feedback relay* Rückmelderelais für Ladezustand	250V AC 50/60Hz - 5A max 30V DC - 5A max
Température *Temperature* Temperatur	-10°C à/*to*/bis 40°C



Fermé par défaut / *Pre-set to closed* / Voreinstellung geschlossen

<u>Configuration A ou B :</u>

A- Mode standard : en cas de pilotage de l'actionneur avec un automate, le report d'état de la charge peut être connecté à celui-ci pour plus de sécurité.

B- Mode de sécurité totale (en utilisant le relais de report d'état, bornes 65 et 66) : l'actionneur n'ouvrira la vanne que si le bloc de sécurité est opérationnel (charge suffisante, carte initialisée).

<u>Configuration A or B :</u>

A- Standard mode : *when piloting the actuator with an automat (PLC), the load state feedback can be connected to it for more safety.*

B- Total security mode *(using the feedback relay, terminals 65 and 66) : the actuator will open only if the security block is operational (sufficient loading, initialized card).*

<u>Konfiguration A oder B :</u>

A- Standard Modus : Im Fälle der Steuerung des Antrieb mit einer Automat kann der Rückmeldung des Batteriesladung an diesen hier für Sicherheit angeschlossen sein.

B- Total Sicherheit Modus (mit benutzung des Rückmeldungsrelais, Klemmen 65 und 66) : der Antrieb wird den Hahn nur öffnen wenn das Sicherheitsblock geladen ist (gemïgenede Ladung, initializierte Karte).

POSI models - Electric connection

GB

RESPECT SAFETY INSTRUCTIONS

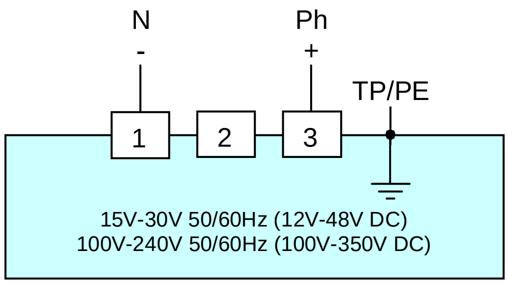
ACTUATOR PRE-SET IN FACTORY

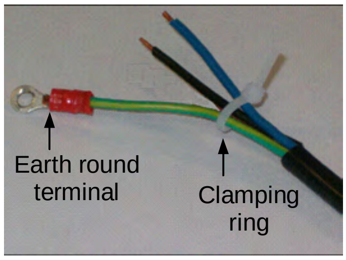
Our cable glands (appendix p.31/32 mark 15) are designed for cables with a diameter between 7mm and 12mm. The used cables must be able to withstand the ambient conditions (maximum temperature 70°C).

- Remove the position indicator, unscrew the four screws and take off the cover.

POWER SUPPLY WIRING

- Ensure that the voltage indicated on the actuator ID label (appendix p.31/32 mark 11) corresponds to the voltage supply.
- Connect to earth through the exterior bolt M5 located under the cable gland (appendix p.31/32 mark 16). For multivolt version, it is also possible to connect the actuator to earth inside the actuator through the bolt M3 next to the terminal strip.
- Unscrew the left cable gland and insert the cable.
- Connect the wires to the power supply card's terminal strip (appendix p.31/32 mark 14).





- Put a lacing cord around the wires (see the picture beside) and re-tighten the cable gland.

POSITIONING CARD WIRING (OUTPUT AND INPUT SIGNAL)

In order to avoid electromagnetic perturbations, it is compulsory to use shielded cables (cables longer than 3m).

- Unscrew the right gland and pass the cable.
- Connect the input signal between terminals 15 and 16 (appendix p.27 mark B).
  Terminal 15 is the negative polarity (-) and terminal 16 is the positive polarity (+).
- Connect the output signal between terminals 13 and 14 (appendix p.27 mark B).
  Terminal 13 is the positive polarity (+) and terminal 14 is the negative polarity (-).
- Tighten the cable gland.

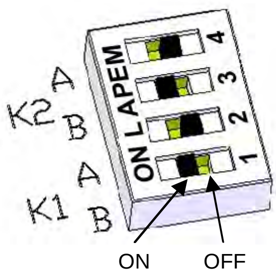
Factory setting : by default, 4-20mA input and output signals with normal rotation sense.
To proceed to a new setting of the card : please see next page, "Parameter selection sequence".
To check the proper operation of the card : please see next page, "Normal operating mode".

Type 0-20 or 4-20mA : 5V DC max.
The terminal temperature can reach 90°C

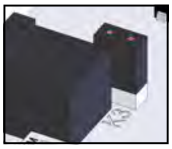
N.B.: The actuator is always powered, so it must be connected to a disconnection system (switch, circuit breaker) to ensure the actuator power cut.

N.B.: The used wires must be rigid (feedback voltages : 4 to 250V AC/DC)

PARAMETER SELECTION SEQUENCE




K3 OFF


K3 ON

1 Shunts positioning K1, K2 and K3

- Position the shunts as follows (before modification, switch off the card) :

Input signal	Output signal	Schunt K1		Schunt K2		Schunt K3
		A	B	A	B	
0-10V	**0-10V**	ON	OFF	ON	OFF	OFF
0-10V	**0-20mA**	ON	OFF	OFF	ON	OFF
0-10V	**4-20mA**	ON	OFF	OFF	ON	ON
0-20mA	**0-10V**	OFF	ON	ON	OFF	OFF
0-20mA	**0-20mA**	OFF	ON	OFF	ON	OFF
0-20mA	**4-20mA**	OFF	ON	OFF	ON	ON
4-20mA	**0-10v**	OFF	ON	ON	OFF	OFF
4-20mA	**0-20mA**	OFF	ON	OFF	ON	OFF
4-20mA	**4-20mA**	OFF	ON	OFF	ON	ON

2 Selection of the flow direction of the valve

2.1 Normal flow direction (by default)
- Press the **OPEN** button and apply the operating voltage to the card while keeping this button depressed.
- The **green LED lights up**. Release the **OPEN** button.
- Disconnect the card.

2.2 Inverse flow direction
- Press the **CLOSE** button and apply the operating voltage to the card while keeping this button depressed.
- The **red LED lights up**. Release the **CLOSE** button.
- Disconnect the card.

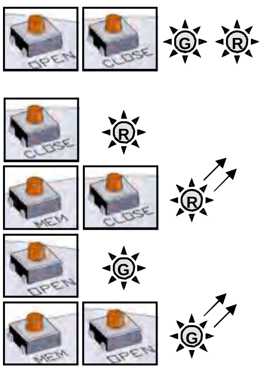
3 Selection of the type of set value

3.1 Voltage set value 0-10V
- Press the **MEM** button and apply the operating voltage to the card while keeping this button depressed.
- The **red LED will light up 3 times**. Release this button.
- Disconnect the card.

3.2 Current set value 0-20mA
- Press the **MEM** and **OPEN** buttons and apply the operating voltage to the card while keeping these buttons depressed.
- The **red LED will light up 3 times**. Release these buttons.
- Disconnect the card.

3.3 Current set value 4-20mA (by default)
- Press the **MEM** and **CLOSE** buttons and apply the operating voltage to the card while keeping these buttons depressed.
- The **red LED will light up 3 times**. Release these buttons.
- Disconnect the card.

4 Learning mode



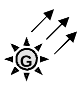
- Press the **OPEN** and **CLOSE** buttons and apply the operating voltage to the card while keeping these buttons depressed.
- The **2 LEDs will light up**. Release these buttons and the 2 LEDs will extinguish. The card is now in the learning mode.

- Press the **CLOSE** button to put the valve in its closed position. The **red LED will light up**.
- Store this selected closed position by pushing **MEM + CLOSE,** the **red LED will light up 3 times** as a confirmation of acknowledgement.

- Press the **OPEN** button to put the valve in its open position. The **green LED will light up**.
- Store this selected open position by pushing **MEM + OPEN,** the **green LED will light up 3 times** as a confirmation of acknowledgement.

- Now, the positions selected have been stored. Disconnect the card.

NORMAL OPERATING MODE



- Apply the operating voltage to the card. The **green LED will light up 3 times**.
- Under normal operating conditions, the green LED will light up when the drive motor opens the valve, and the red LED will light up when the drive motor closes it.
- If both LEDs remain extinguished, it means that the drive motor has not been triggered.

- In the case of an over torque, the motor stops and the **2 LEDS lights** then together to indicate the action of the torque limiter. To re-start it, you must either reverse the sense of rotation, either

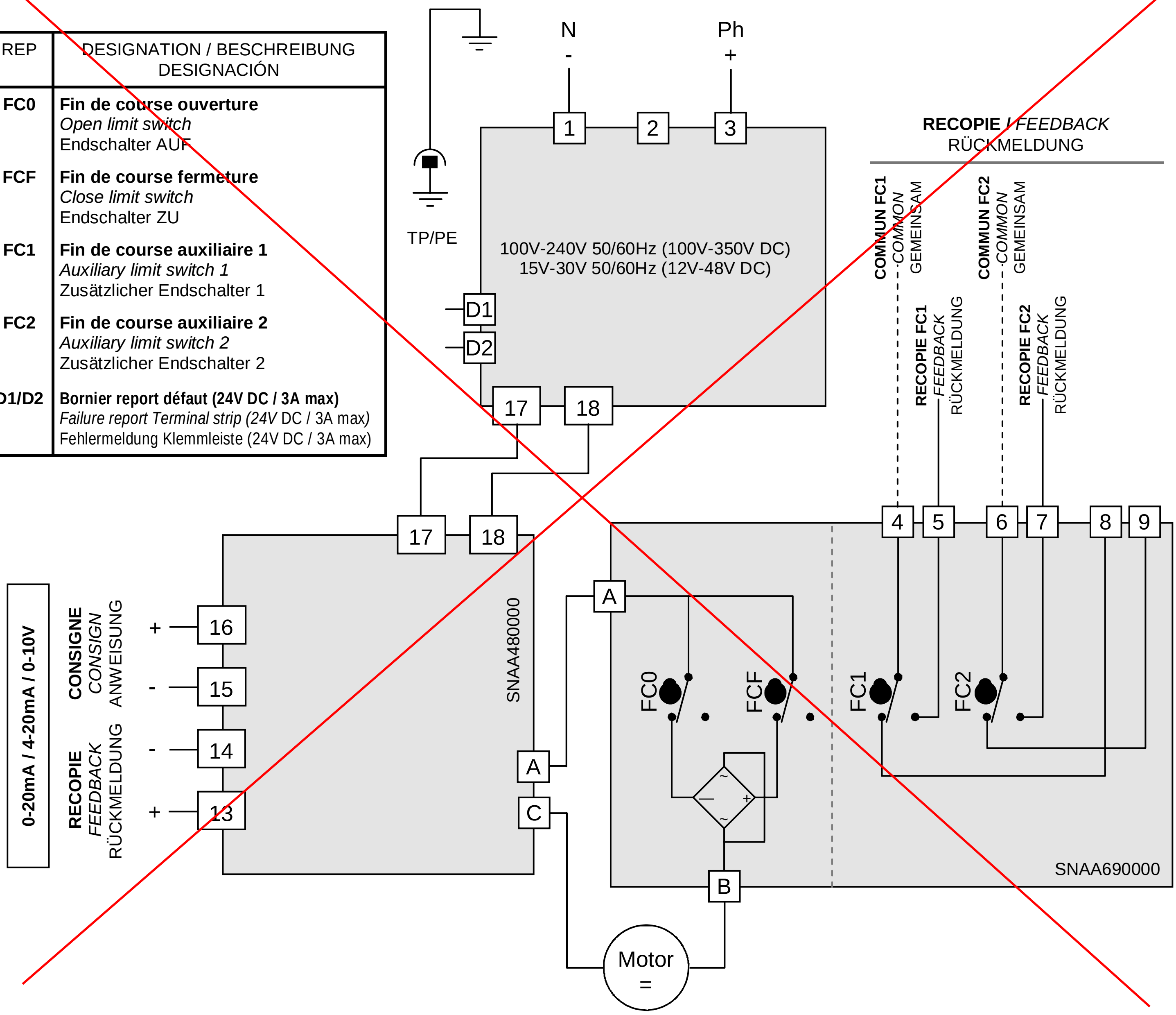
Schéma électrique : Série VRX/VSX .GP5

Electric wiring : VRX/VSX .GP5 range

Schaltplan : VRX/VSX .GP5 Serie

La température du bornier peut atteindre 90°C
The terminal temperature can reach 90°C
Die Terminal-Temperatur kann bis zu 90°C erreichen

REP	DESIGNATION / BESCHREIBUNG DESIGNACIÓN
FC0	**Fin de course ouverture** *Open limit switch* Endschalter AUF
FCF	**Fin de course fermeture** *Close limit switch* Endschalter ZU
FC1	**Fin de course auxiliaire 1** *Auxiliary limit switch 1* Zusätzlicher Endschalter 1
FC2	**Fin de course auxiliaire 2** *Auxiliary limit switch 2* Zusätzlicher Endschalter 2
D1/D2	**Bornier report défaut (24V DC / 3A max)** *Failure report Terminal strip (24V DC / 3A max)* Fehlermeldung Klemmleiste (24V DC / 3A max)



- La résolution de la carte est de 1°
Impédance d'entrée de 10 Kohm si pilotage en tension (0-10V) / Impédance d'entrée de 100 Ohm si pilotage en courant (0-20mA ou 4-20mA)
- The card resolution is 1°
10 KOhm input impedance if control with voltage (0-10V) / 100 Ohm input impedance if control with current (0-20mA ou 4-20mA)
- Die Auflösung des Regelantriebs beträgt 1°
Der Eingangswiderstand bei Ansteuerung 0-10V beträgt 10 kOhm / Der Eingangswiderstand bei Ansteuerung 0-20mA / 4-20mA beträgt 100 Ohm

La tension de pilotage doit être de type T.B.T.S. (Très Basse Tension de Sécurité)
The control voltage must be L.V.D. (Low Voltage Directive)
Berücksichtigen Sie für die Spannungsversorgung eine Schutzkleinspannung!

Pour une utilisation avec de grandes longueurs de câbles, le courant induit généré par les câbles ne doit pas dépasser 1mA
For a use with a long wiring, the induction current generated by the wires mustn't be higher than 1mA
Bei Verwendung einer langen Zuleitung für die Spannungsversorgung darf die Induktionsspannung der Leitung nicht 1mA überschreiten.

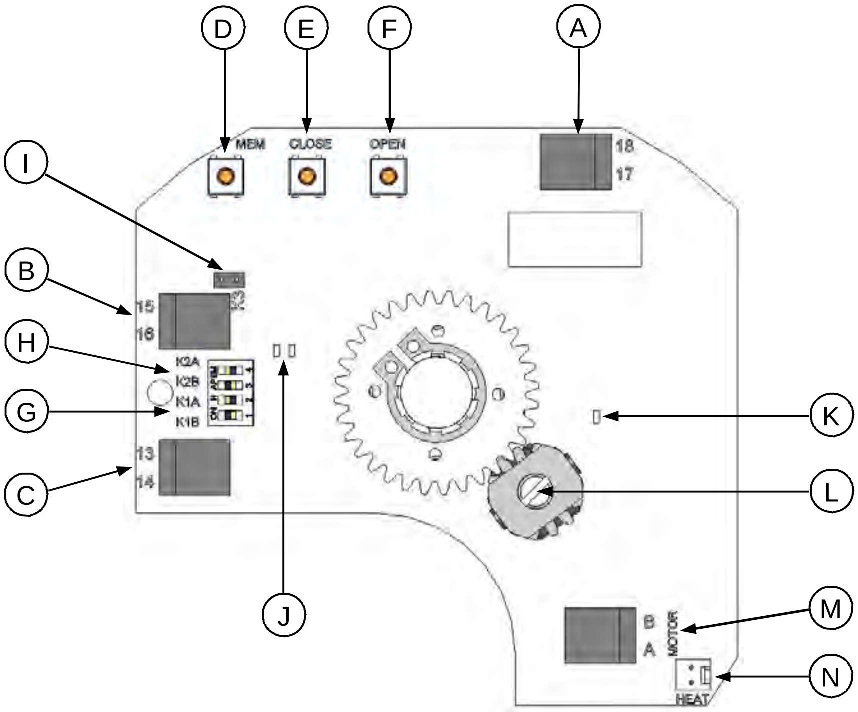
Les câbles utilisés doivent être rigides (tensions pour la recopie : 4 à 250V AC/DC)
The used wires must be rigid (feedback voltages : 4 to 250V AC/DC)
Die Anschlusskabel müssen biegesteif sein (Rückmeldespannungen 4 bis 250V AC/DC)

Modèles POSI - Carte électronique

POSI models - Electronic card

POSI Modele - Regelkarte

Carte de positionnement P5 (0-20mA / 4-20mA / 0-10V)
P5 positioning card (0-20mA / 4-20mA / 0-10V)
P5 Regelkarte (0-20mA / 4-20mA / 0-10V)

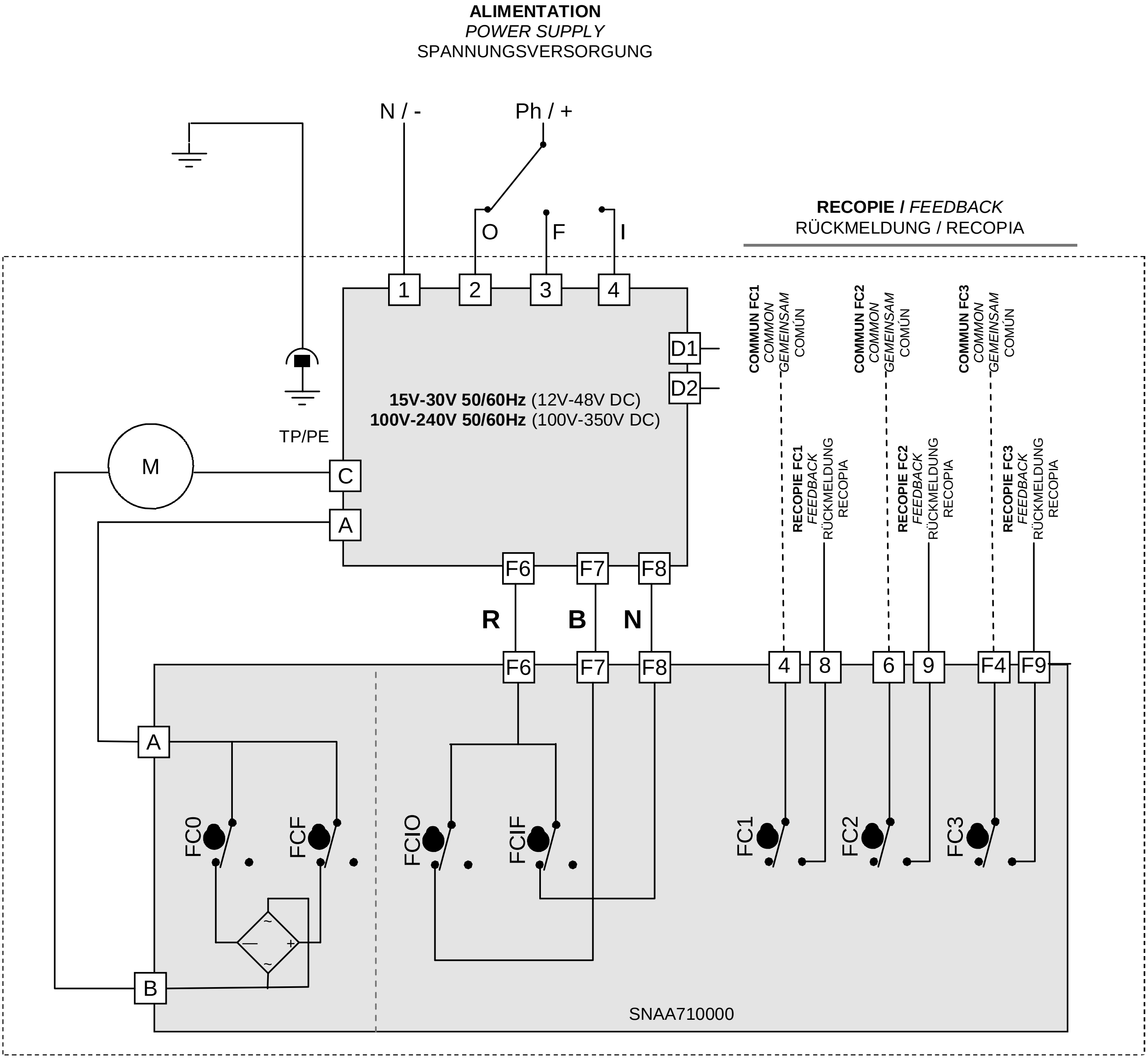


Rep.	Désignation	*Designation*	Bezeichnung
A	Bornier d'alimentation 24V AC/DC	*24V AC/DC power supply terminal trip*	24V AC/DC Spannungsversorgung
B	Bornier de consigne	*Instruction terminal trip*	Anschlussklemmen des Signalgebers
C	Bornier de recopie	*Feed back terminal trip*	Anschlussklemmen der Rückmeldung
D	Bouton de réglage MEM	*Adjustment button MEM*	Einstellknopf MEM
E	Bouton de réglage CLOSE	*Adjustment button CLOSE*	Einstellknopf CLOSE
F	Bouton de réglage OPEN	*Adjustment button OPEN*	Einstellknopf OPEN
G	Cavalier K1	*K1 shunt*	K1 Steckbrücke
H	Cavalier K2	*K2 shunt*	K2 Steckbrücke
I	Cavalier K3	*K3 shunt*	K3 Steckbrücke
J	LEDs verte et rouge	*Green and red LEDs*	Grüne und rote LEDs
K	LED jaune : présence tension	*Yellow LED : power supply indication*	Gelb LED : Stromversorgung Anzeige
L	Potentiomètre	*Potentiometer*	Potentiometer
M	Connexion moteur	*Motor connexion*	Motor Zusammenhang
N	Connecteur résistance de réchauffage	*Heating resistor connector*	Heizwiderstandsverbindung

Modèles GF3 - Carte électronique

GF3 models - Electronic card

GF3 Modele - Regelkarte



REP	DESIGNATION / BESCHREIBUNG	REP	DESIGNATION / BESCHREIBUNG
FCO	**Fin de course ouverture** *Open limit switch* Endschalter AUF	FC1	**Fin de course auxiliaire 1** *Auxiliary limit switch 1* Zusätzlicher Endschalter 1
FCF	**Fin de course fermeture** *Close limit switch* Endschalter ZU	FC2	**Fin de course auxiliaire 2** *Auxiliary limit switch 2* Zusätzlicher Endschalter 2
FCIO	**Fin de course intermédiaire ouverture** *Intermediate open limit switch* Zwischenendschalter AUF	FC3	**Fin de course auxiliaire 3** *Auxiliary limit switch 3* Zusätzlicher Endschalter 3
FCIF	**Fin de course intermédiaire fermeture** *Intermediate close limit switch* Zwischenendschalter ZU	**D1/D2**	**Bornier report défaut (24V DC / 3A max)** *Failure report Terminal strip (24V DC / 3A max)* Fehlermeldung Klemmleiste (24V DC / 3A max)

Données techniques

Technical data
Besondere Bedingungen

DONNEES TECHNIQUES / *TECHNICAL DATA*			
Type (actionneur électrique 1/4 tour) *Type (1/4 turn electric actuator)*	VRX25	VRX45	VRX75
Protection IP / *IP protection* (EN60529)	IP67		
Résistance à la corrosion (utilisation en intérieur et extérieur) *Corrosion resistance (outdoor and indoor use)*	Enveloppe : Aluminium + peinture EPOXY / *Housing : Aluminium + EPOXY paint* Entraîneur : acier + traitement Zn / *Drive : Steel + Zn treatment* Axes et vis : inox / *Axles and screws : Stainless steel*		
Température / *Temperature*	-10°C à/*to* +55°C (FAILSAFE : -10°C à/*to* +40°C)		
Hydrométrie / *Hydrometry*	< 81% à 31°C (88°F) avec décroissance linéaire jusqu'à 50% à 40°C(selon EN61010-1) < 81% to 31°C (88°F) with lineary decrease down to 50% at 40°C (according EN61010-1)		
Degré de pollution / *Pollution degree*	Classe 2 / *Class 2*		
Altitude / *Altitude*	0 à/*to* 2000m		
Poids / *Weight*	4kg max		
DONNEES MECANIQUES / *MECHANICAL DATA*			
Couple nominal / *Nominal torque*	20Nm	35Nm	60Nm
Couple maximal / *Maximal torque*	25Nm	45Nm	75Nm
Temps de manœuvre / *1/4 turn travel time*	7s à/*to* 20s		
Embase de fixation / *Mounting actuator base* (ISO5211)	Etoile/*Star* 17 F05-F07 (Etoile/*Star* 14 F03 sur demande/*on request*)	Etoile/*Star* 17 F05-F07	Etoile/*Star* 17 F05-F07
Angle de rotation / *Swing angle*	90° (autres sur demande / *others on request*)		
Butées mécaniques / *Mechanical end stops*	90° ou/*or* 180°		
Commande manuelle / *Manual override*	Axe sortant / *Out axle*		
Sens de rotation / *Direction of rotation*	Sens antihoraire pour ouvrir / *Anticlockwise to open*		
DONNEES ELECTRIQUES / *ELECTRICAL DATA*			
Tension / *Voltage*	15V à/to 30V AC (12V à/to 48V DC) ou/*or 100V à/to 240V AC (100V à/to 350V DC)* (400V triphase sur demande / *400V three-phase on request*)		
Fréquence / *Frequency*	50/60Hz		
Puissance consommée / *Power consumption*	20W à/*to* 52W*		
Catégorie surtension / *Overvoltage category*	Catégorie II / *Category II*		
Classe d'isolement des moteurs *Insulation motor class*	Classe F pour les moteurs 80% et 400V, classe B pour les autres Class F for 80% duty cycle and 400V motors, class B for others		
Limiteur de couple / *Torque limiter*	Limiteur électronique / *Electronic limiter*		
Durée sous tension / *Duty cycle* (CEI34)	50%		
Tension maximale contacts fins de course *Limit switches maximal voltage*	250V AC/DC (Surtension catégorie II / *Overvoltage category II*)		
Courant maximal contacts fins de course *Limit switches maximal current*	5A (16A sur demande / *16A on request*)		
Puissance résistance de réchauffage régulée *Regulated heating resistor power*	10W		
Courrant de démarrage *Inrush current*	35A		

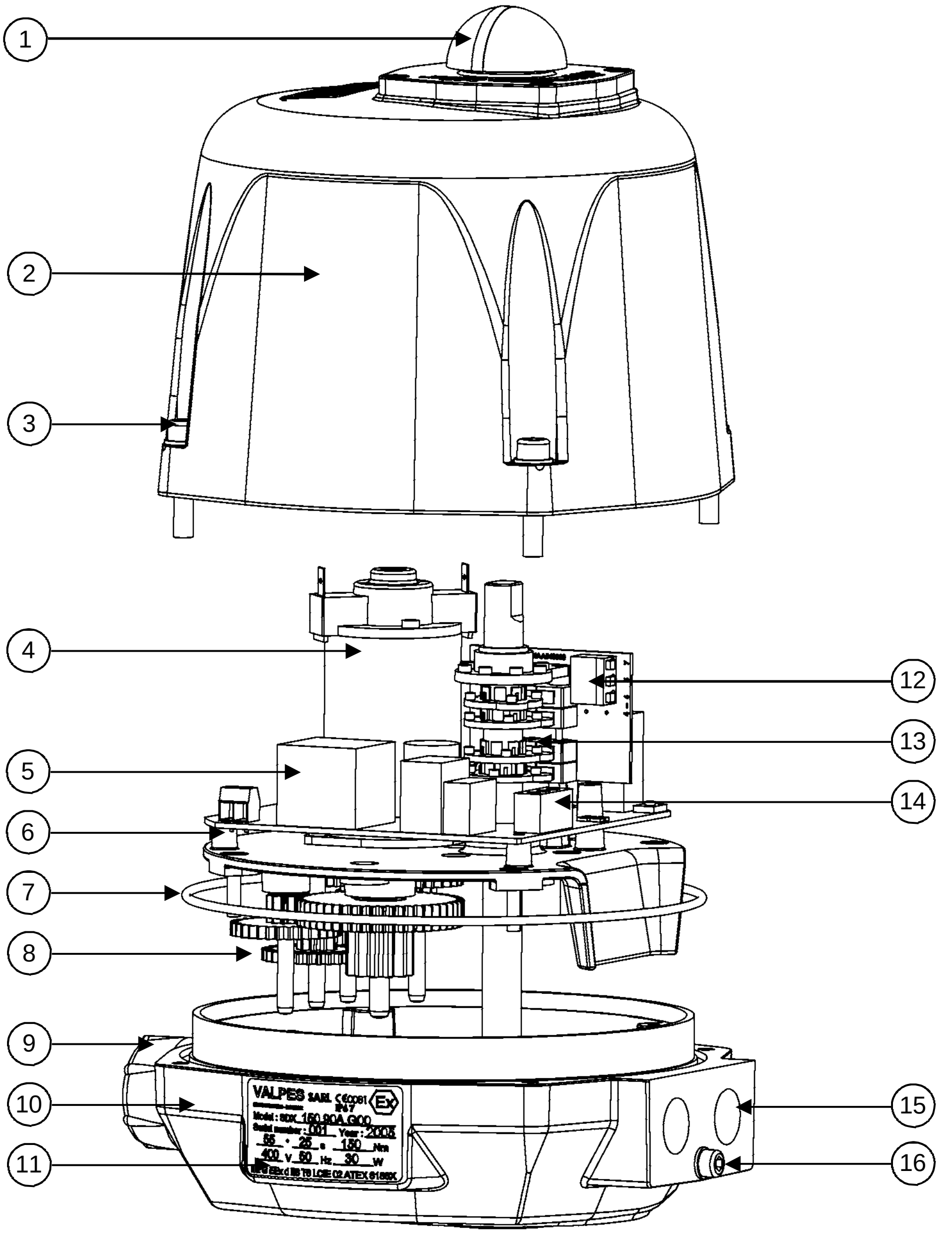
Technical data
Besondere Bedingungen

DONNEES TECHNIQUES / *TECHNICAL DATA*			
Type (actionneur électrique 1/4 tour) *Type (1/4 turn electric actuator)*	VSX100	VSX150	VSX300
Protection IP / *IP protection* (EN60529)	IP67		
Résistance à la corrosion (utilisation en intérieur et extérieur) *Corrosion resistance (outdoor and indoor use)*	Enveloppe : Aluminium + peinture EPOXY / *Housing : Aluminium + EPOXY paint* Entraîneur : acier + traitement Zn / *Drive : Steel + Zn treatment* Axes et vis : inox / *Axles and screws : Stainless steel*		
Température / *Temperature*	-10°C à/*to* +55°C (FAILSAFE : -10°C à/*to* +40°C)		
Hydrométrie / *Hydrometry*	< 81% à 31°C (88°F) avec décroissance linéaire jusqu'à 50% à 40°C(selon EN61010-1) < 81% to 31°C (88°F) with lineary decrease down to 50% at 40°C (according EN61010-1)		
Degré de pollution / *Pollution degree*	Classe 2 / *Class 2*		
Altitude / *Altitude*	0 à/*to* 2000m		
Poids / *Weight*	6,5kg max		
DONNEES MECANIQUES / *MECHANICAL DATA*			
Couple nominal / *Nominal torque*	75Nm	125Nm	250Nm
Couple maximal / *Maximal torque*	100Nm	150Nm	300Nm
Temps de manœuvre / *1/4 turn travel time*	10s à/*to* 60s		
Embase de fixation / *Mounting actuator base* (ISO5211)	Etoile/*Star* 22 F07-F10 (Etoile/*Star* 17 F05 sur demande/*on request*)	Etoile/*Star* 22 F07-F10	Etoile/*Star* 22 F07-F10
Angle de rotation / *Swing angle*	90° (autres sur demande / *others on request*)		
Butées mécaniques / *Mechanical end stops*	90°		
Commande manuelle / *Manual override*	Volant / *Hand wheel*		
Sens de rotation / *Direction of rotation*	Sens antihoraire pour ouvrir / *Anticlockwise to open*		
DONNEES ELECTRIQUES / *ELECTRICAL DATA*			
Tension (tolérance ±10%) *Voltage (tolerance ±10%)*	15V à/to 30V AC (12V à/to 48V DC) ou/*or 100V à/to 240V AC (100V à/to 350V DC)* (400V triphase sur demande / *400V three-phase on request*)		
Fréquence / *Frequency*	50/60Hz		
Puissance consommée / *Power consumption*	45W à/*to* 135W*		
Catégorie surtension / *Overvoltage category*	Catégorie II / *Category II*		
Classe d'isolement des moteurs *Insulation motor class*	Classe F pour les moteurs 80% et 400V, classe B pour les autres Class F for 80% duty cycle and 400V motors, class B for others		
Limiteur de couple / *Torque limiter*	Limiteur électronique / *Electronic limiter*		
Durée sous tension / *Duty cycle* (CEI34)	50%		
Tension maximale contacts fins de course *Limit switches maximal voltage*	250V AC/DC (Surtension catégorie II / *Overvoltage category II*)		
Courant maximal contacts fins de course *Limit switches maximal current*	5A (16A sur demande / *16A on request*)		
Puissance résistance de réchauffage régulée *Regulated heating resistor power*	10W		
Courrant de démarrage *Inrush current* *Einschaltstromspitze*	35A		

Spare parts list

Ersatzteilliste

VRX25-45-75



Rep.	Désignation	*Designation*	Bezeichnung
1	**Indicateur visuel de position**	*Visual position indicator*	Stellungsanzeige
2	**Capot**	*Cover*	Haube
3	**Vis inox**	*Stainless steel screws*	Edelstahl Schrauben
4	**Moteur**	*Motor*	Motor
5	**Carte alimentation et commande**	*Pilot and power supply card*	Steuerung und Stromversorgung Karte
6	**Plaque réducteur**	*Gear box plate*	Getriebeplatte
7	**Joint torique**	*O ring*	O Ringdichtung
8	**Réducteur**	*Reductor*	Getriebe
9	**Bouton de débrayage**	*Clutch knob*	Kupplung
10	**Carter**	*Housing*	Gehäuse
11	**Étiquette d'identification**	*Identification label*	Identifizierungsetikett
12	**Bornier fin de course auxiliaire**	*Auxiliary limit switch terminal strip*	Zusätzlicher Endschalter
13	**Cames**	*Cams*	Nocken
14	**Bornier alimentation et commande**	*Pilot and power supply terminal strip*	Steuerung und Stromversorgung Verbindung
15	**Trous taraudés M20x1,5**	*M20x1.5 threaded openings*	Innengewinde M20x1.5
16	**Vis de terre**	*Earth screw*	Erde Schraube

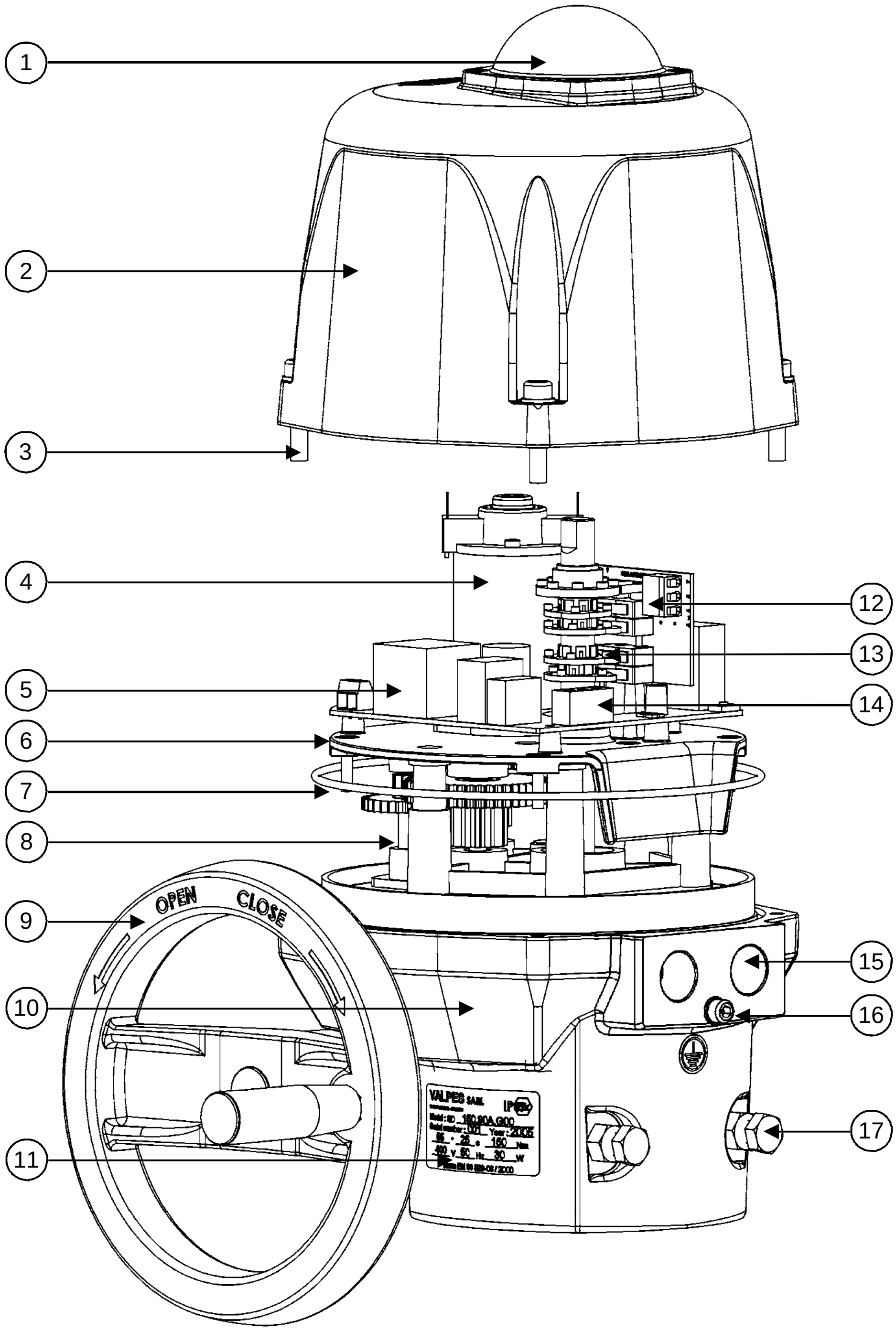
Liste des pièces détachées

FR GB D

Spare parts list

Ersatzteilliste

VSX100-150-300



Rep.	Désignation	*Designation*	Bezeichnung
1	**Indicateur visuel de position**	*Visual position indicator*	Stellungsanzeige
2	**Capot**	*Cover*	Haube
3	**Vis inox**	*Stainless steel screws*	Edelstahl Schrauben
4	**Moteur**	*Motor*	Motor
5	**Carte alimentation et commande**	*Pilot and power supply card*	Steuerung und Stromversorgung Karte
6	**Plaque réducteur**	*Gear box plate*	Getriebeplatte
7	**Joint torique**	*O ring*	O Ringdichtung
8	**Réducteur**	*Gear box*	Getriebe
9	**Volant**	*Hand wheel*	Handrad
10	**Carter**	*Housing*	Gehäuse
11	**Étiquette d'identification**	*Identification label*	Identifizierungsetikett
12	**Bornier fin de course auxiliaire**	*Auxiliary limit switch terminal*	Zusätzlicher Endschalter Verbindung
13	**Cames**	*Cams*	Nocken
14	**Bornier alimentation et commande**	*Pilot and power supply terminal*	Steuerung und Stromversorgung Ver-bindung
15	**Trous taraudés M20x1,5**	*M20x1.5 threaded openings*	Innengewinde M20x1.5
16	**Vis de terre**	*Earth screw*	Erde Schraube
17	**Butées mécaniques**	*Mechanical end stops*	Mechanische Endhalterung

EC
Declaration of conformity

VALPES company - 89, rue de Etangs - 38430 Moirans - France, gives evidence that his 1/4 turn electric actuators

VRX25 - VRX45 - VRX75
VSX100 - VSX150 - VSX300

are produced, in compliance with the ATEX 94/9/CE directive intended to be used in explosive atmosphere, are in compliance with the certificate of exam type LCIE 06 ATEX 6006X (available on demand) and have a production quality notification LCIE 04 ATEX Q8010.

The conditions to use of our actuators VRX and VSX are defined with their ATEX classification :

II 2 GD
Ex d IIB T6 - tD A21 IP67 T80°C

For 400V actuators and actuators with EBS.24 :
II 2 GD Ex d IIB T5 - tD A21 IP67 T95°C

II : Group II, devices intended to be used in places, others than mines or fire-damp installations susceptible to be put in danger by explosive atmospheres.
2 : Category 2, likely, but coincidental presence of explosive atmospheres.
GD : Presence of Gas or vapors and/or dust.
EX: Electric material foreseen for explosive atmospheres.
d : Protection by explosion proof housing.
IIB : Places where explosive hydrocarbon atmosphere is established (constituted) (Ethylene, nitrogenous products, oxygenated, halogens).
T5 : Maximal surface Temperature 100°C. Ambient temperature of use : -20°C in +70°C
T6 : Maximal surface Temperature 85°C. Ambient temperature of use : -20°C in +70°C.
tD A21 IP67 T80°C : IP67 protection assured, maximal surface temperature for dust atmospheres 80°C.
tD A21 IP67 T95°C : IP67 protection assured, maximal surface temperature for dust atmospheres 95°C

The devices are in comliance with the following norms :
EN 60079-0 (2004) et EN 60079-1 (2004) : Electric Material for exploding gaseous atmospheres (gas-filled)
EN 61241-0 (2006) et EN 61241-1 (2004) : Electric Material for usage in the presence of de poussières flammable dusts

The electric connecting has to respect current ATEX recommendations (BE3 conditions of NF C-15100 and EN 60079-14).

The notified body in charge of the production quality surveillance is LCIE (N° CE0038) :
LRQA France - Lioyd's Register Quality Assurance - Tour Swiss Life - 1, Boulevard Vivier Merle - 69443 Lyon Cedex 03 - France.

The VALPES company, as the manufacturer declares herewith, that the above mentioned electric VALPES part-turn actuators are in compliance with the following directives :

- Directive on Electromagnetic Compatibility (EMC)(2004/108/CE)
EN 61000-6-2 (2005) : Immunity
EN 61000-6-4 (2007) : Emissions

- Low-voltage Equipment Directive (2006/95/CE)
EN 61010-1 (2001)

- Machinery Directive (2006/42/CE)

VALPES part-turn actuators covered by this Declaration must not be put into service until the entire machine, into which they are incorporated, has been declared in conformity with the provisions of the directive.

Moirans, le 07/06/2010

VALPES Valve Control System
ZI CENTR'ALP - 89 rue des Étangs - F 38430 MOIRANS
Tél. : (+33) 04-76-35-06-06 Fax : (+33) 04-76-35-14-34
E-mail : info@valpes.com / Site web : www.valpes.com

P. GUILLAUD-SAUMUR, ATEX responsible

We declare under our responsibility that the products noted have been designed and manufactured in accordance with requirements of the directive. Mounting and connecting instructions defined in catalogues and technical data sheets must be adhered to by the user. This declaration does not include any guarantee or certain characteristics.

DSBA1509 rév.07/06/2010

SERIES-ER PLUS STANDARD

The ultimate actuator with more standard features & options

Technical Specifications…..

MULTI-VOLTAGE OPERATION:

TWO VERSIONS

- 90 to 240 VAC 50-60 Hz version also used for 90 to 350 VDC
- 12 to 48 VDC or 15 to 30 VAC 50-60 Hz

DESCRIPTION

Quarter turn electric actuator in plastic housing with manual override by drive shaft
For torques of 89 to 885 lb-in (10 to100 Nm)

STANDARD EQUIPMENT

Internal 24 VDC motor
ERI.B Regulated 10 watt anti-condensation heater
Two auxiliary limit switches for 5 amp service
Removable mounting plates for three mount choices F03-F04-F05 or F05-F07
Female Star drive 14 mm or 22 mm
Manual override
Electronic torque limiter
Mechanical limit stops 0° and 90° + 5°
Electric connections: One DIN 43650 Connector and one Cord Grip Connector

OPTIONS

EPR.B Feedback potentiometer 100-1K-5K-10K Ohms
EPT.C 4-20 mA / 0-20 mA / 0-10 volt position feedback
EFC.2 Two extra limit switches
ECD.1A Dual DIN 43650 Connectors
180° or 270° without mechanical stops
ECM.1 One Cord Grip Electrical Connector
ECM.1 One Cord Grip Electrical Connector
Third Position Electronics & Switch Card

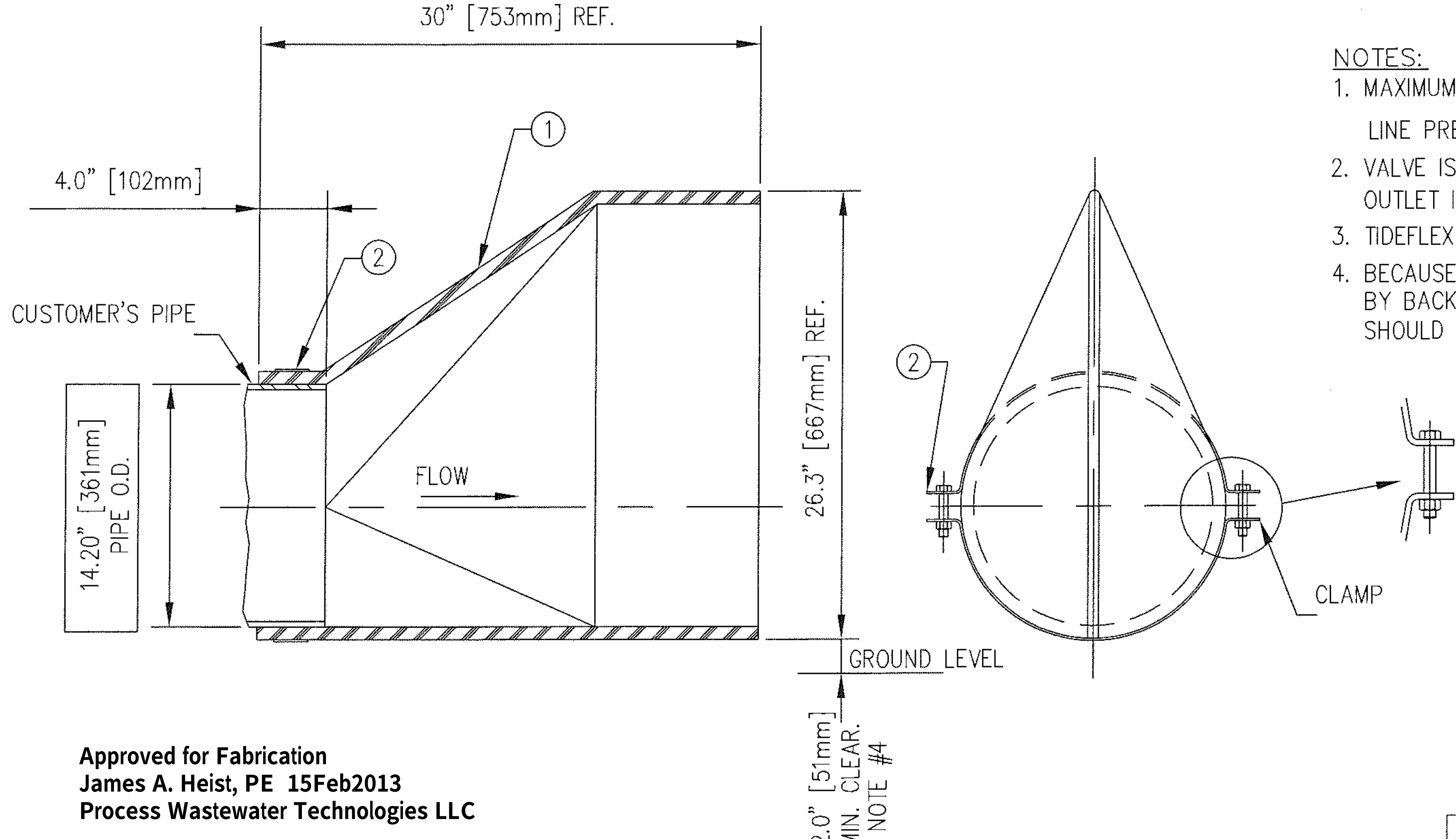
TECHNICAL DATA

Duty cycle rating at maximum torque = 50% of operating time (CE134).
Working temperature: +14°F to +131°F (-10°C to +55°C)
Enclosure: Sealed IP66 / NEMA 4 Equivalent
Weight: ER10, 20 & 35: 2.9 lbs (1.34 kg)
ER35, 60 & 100: 6.9 lbs (3.14 kg)

Model Number CODEmmO	Star/Mount	Torque	Voltages *	Power	Travel Time****
ER10.X0A.G00***	14/F03-F04-F05**	89 lb-in/10 Nm	90 - 240 VAC	15 W	9 / 11 s
ER10.X0B.G00***	14/F03-F04-F05**	89 lb-in/10 Nm	12-48 VDC & 15-30 VAC	15 W	9 / 11 s
ER20.X0A.G00***	14/F03-F04-F05**	177 lb-in/20 Nm	90 - 240 VAC	15 W	9 / 12 s
ER20.X0B.G00***	14/F03-F04-F05**	177 lb-in/20 Nm	12-48 VDC & 15-30 VAC	15 W	9 / 12 s
ER35.X0A.G00***	14/F03-F04-F05**	310 lb-in/35 Nm	90 - 240 VAC	15 W	19 / 26 s
ER35.X0B.G00***	14/F03-F04-F05**	310 lb-in/35 Nm	12-48 VDC & 15-30 VAC	15 W	19 / 24 s
ER35.90A.G00	22/F05-F07	310 lb-in/35 Nm	90 - 240 VAC	45 W	6 / 7 s
ER35.90B.G00	22/F05-F07	310 lb-in/35 Nm	12-48 VDC & 15-30 VAC	45 W	6 / 7 s
ER60.90A.G00	22/F05-F07	531 lb-in/60 Nm	90 - 240 VAC	45 W	10 / 12 s
ER60.90B.G00	22/F05-F07	531 lb-in/60 Nm	12-48 VDC & 15-30 VAC	45 W	10 / 12 s
ER100.90A.G00	22/F05-F07	885 lb-in/100 Nm	90 - 240 VAC	45 W	20 / 23 s
ER100.90B.G00	22/F05-F07	885 lb-in/100 Nm	12-48 VDC & 15-30 VAC	45 W	19 / 22 s

* 90 to 240 VAC 50/60 Hz and also 90 to 350 VDC.
12 to 48 VDC and 15 to 30 VAC 50/60 Hz
** Reducing sleeves star for 14 mm to square 9 mm and 11 mm included. For other sizes contact CR-TEC.
*** X = Removable plate F03 or F04 or F05, can be ordered mounted; Specify the star & mount needed.
**** Times with load and without load.

ITEM	QTY.	DESCRIPTION	MAT'L
1	1	CHECK VALVE SLEEVE	NEOPRENE
2	1	MOUNTING CLAMP	304 S/STEEL



NOTES:
1. MAXIMUM BACK PRESSURE: 20 FEET
   LINE PRESSURE: 20 FEET
2. VALVE IS TO BE MOUNTED WITH THE OUTLET IN THE VERTICAL POSITION
3. TIDEFLEX TO FIT ON A 14.20 O.D. PIPE
4. BECAUSE OF SAND, ROCK AND OTHER DEBRIS ACCUMULATION BY BACKFLOW OF WATER THE SUGGESTED BOTTOM CLEARANCE SHOULD BE PROVIDED

Approved for Fabrication
James A. Heist, PE 15Feb2013
Process Wastewater Technologies LLC

CUSTOMER APPROVAL

SIGNED ______________ DATE ________

OPPORTUNITY No: 11215 | SALES ORDER No: 28714

Tideflex® Technologies
A Division of Red Valve Company, Inc.

600 N. BELL AVE.
CARNEGIE, PA. 15106
info@tideflex.com
412.279.0044
fax 412.279.5410

TT PRODUCT: 14.25" TF-1 TIDEFLEX CHECK VALVE

TT PART No: TF1-140-22-14200-M

DR. BY: TLM DATE: 2-14-13 CHKD. BY: DJM DATE: 2/14/13

CAD SCALE: FULL

PLOT SCALE: .125

DWG No: TTS-37998 REV

CUSTOMER: R.M. HEADLEE CO., INC.

ORDER No: 101345

Tideflex Technologies
Division of Red Valve,Inc.

TIDEFLEX® TF-1 AND TF-2
ALL-RUBBER CHECK VALVES

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

TF-1

The revolutionary design of the all rubber Tideflex® Check Valve provides reliable backflow protection. This unique “duck bill” design eliminates costly back-flow from oceans, rivers or storm water and is the ideal valve for effluent diffuser systems.

Tideflex® Valves seal on entrapped solids and debris without jamming. Unlike traditional flap gates there are no hinged gates to hang open and no warping or freezing. It’s virtually maintenance-free.

The Tideflex® Check Valve is available in a wide variety of elastomers and is designed to meet your exact flow specifications.

TF-2

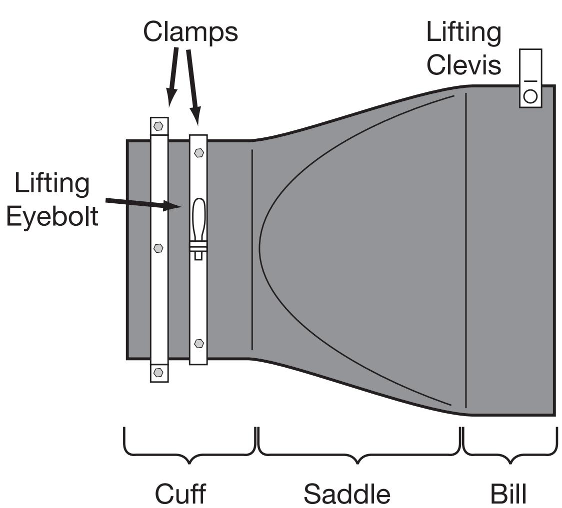
IMPORTANT

Please take a moment to **review this manual. Before performing any maintenance on the valve be sure the pipeline has been de-pressurized.** The improper installation or use of this product may result in personal injury, product failure, or reduced product life. Tideflex® Technologies can accept NO liability resulting from the improper use or installation of this product. If you have any questions or problems, please call the customer service department at (412) 279-0044. We appreciate your comments. Thank you for choosing Tideflex® Technologies.

GENERAL DESCRIPTION

The Tideflex® Technologies' Tideflex® Check Valve is an all-elastomer, one-piece check valve. Terms used in this I.O.M. to refer to various parts of the valve are described below.

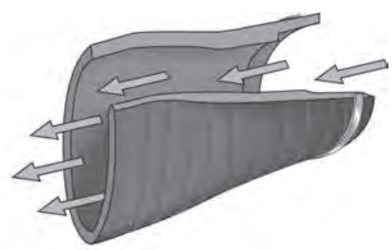
1. **Cuff** The Cuff is designed with a full round bore and slips over the end of the pipe.
2. **Saddle** The Saddle is the middle part of the valve, tapering from the round cuff to the flat bill. The Saddle directs the flow to the bill, and is flexible to sustain increased flow conditions.
3. **Bill** The Bill is the discharge end of the valve. The Bill flexes to allow flow to discharge, yet is stiff enough to prevent the valve from opening without line pressure. Back pressure – pressure created on the exterior of the valve by reverse flow or submersion – will seal the lips of the bill tightly together, preventing backflow into the valve.
4. **Clamps** The clamps are tightened around the Cuff after the Cuff has been slipped over the end of the discharge pipe. These clamps are normally furnished by Red Valve Company, Inc. Hose clamps are supplied for valves up to 12". Valves 14" and up are supplied with fabricated clamps. 14"-20" are supplied with one set, 20"-54" are supplied with two sets and sizes 60" and up are supplied with three sets.
5. **Lifting Clevis** A lifting clevis is attached to the Bill of the Check Valve for valves 36" and up. This clevis is used during installation to assist in lifting the valve, and may be used to attach a line to the bill to help support the valve after installation.



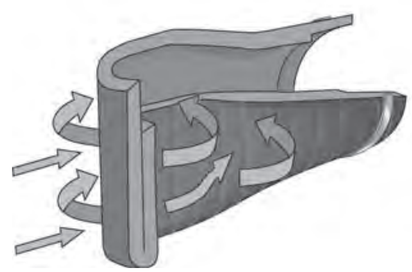
OPERATION

Tideflex® Check Valves are custom made products intended for a specific application and have been designed to respond to criteria unique to that purpose, such as line pressure, minimum and maximum back pressure and chemical compatibility. Should the conditions for which the valve has been designed be altered or change in any way, it could affect the normal operation of the valve.

Tideflex® Check Valves work on backpressure exerted on the bill area to seal the valve. The bill may appear to be slightly open when installed. This slight opening does not affect the operation of the valve, as the valve depends on backpressure to seal.



Forward Pressure Opens Valve



Reverse Pressure Seals Valve

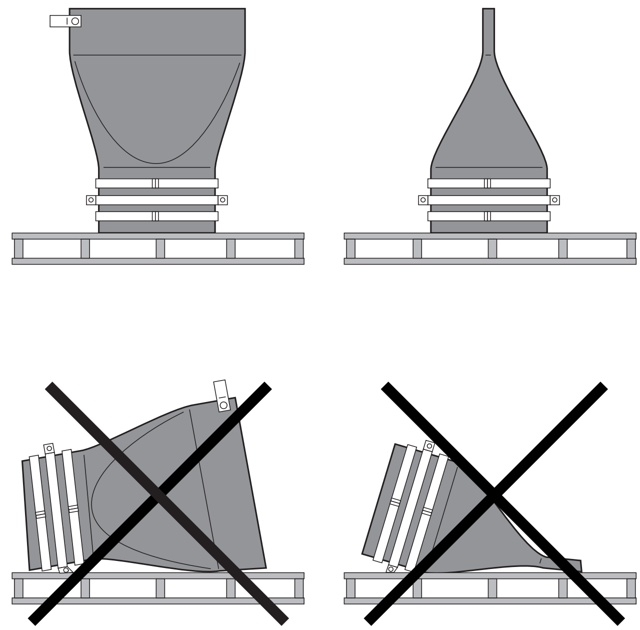
NEVER...	DO...	DO...	DO...
Cut or modify check valve.	Use a soapy water solution to slide Tideflex® on pipe.	Keep valve on pallet until ready to install.	Tighten clamp bolts evenly.

STORAGE

Tideflex® Check Valves should be stored in a cool, dry location on original shipping pallet with the bill facing upward (not on side) (Figure # 2). Do not drop, bend or twist Check Valve or damage may occur.

1. Store valve in a cool, clean, dry location.
2. Avoid exposure to light, electric motors, dirt or chemicals. Resilient Check Valves are subject to deterioration when exposed to ozones and non-compatible chemicals. Ozone especially causes age hardening of the elastomer.
3. Store Installation Operation Manual with pro-duct so it will be readily available for installation.
4. Do not remove wooden brace or metal "shipping ring" (36"+) until valve is installed.

FIGURE 2



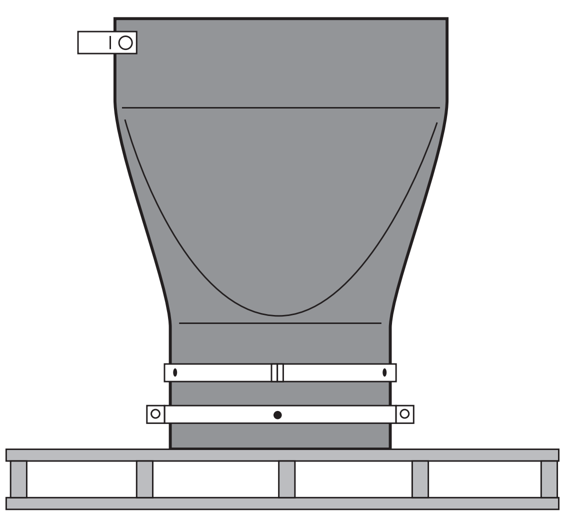
NEVER STORE HORIZONTALLY

INSTALLATION INSTRUCTIONS – LARGE DIAMETER TIDEFLEX® CHECK VALVES 24" AND OVER

1. INSPECTION OF CHECK VALVE:

Check the inside diameter of the Cuff of the Tideflex® Check Valve to compare it to the O.D. of the outfall pipe. Inspect the outfall pipe for sharp or damaged areas. The Pipeline should be in a smooth condition to prevent cutting the Rubber Check Valve. Lifting clevis and Lifting Eye Bolts are provided only for sizes 36" vided only for sizes 36" and over.

Imperfections on the inside of the cuff area can be filled with a silicone sealant prior to installing the valve on the pipe. This will ensure a seal in the cuff area after clamps are tightened.

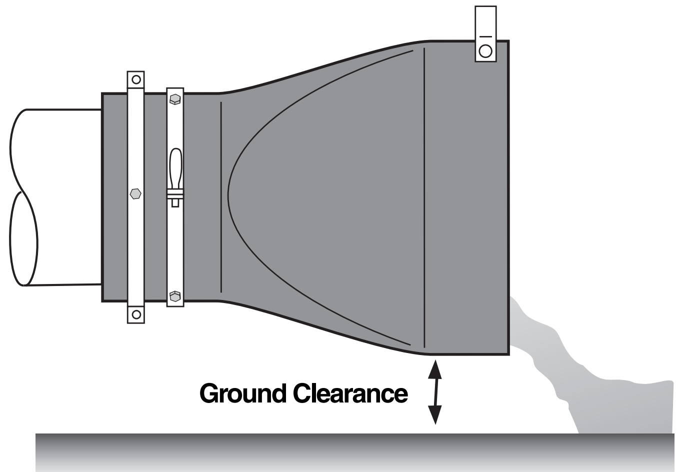


2. INSPECTION OF THE PIPE

Check the outside diameter of the pipe to determine if it matches the I.D. of the Cuff of the Tideflex® Check Valve. The Cuff of the Check Valve is usually made slightly larger to permit ease of installation.

3. CLEARANCE

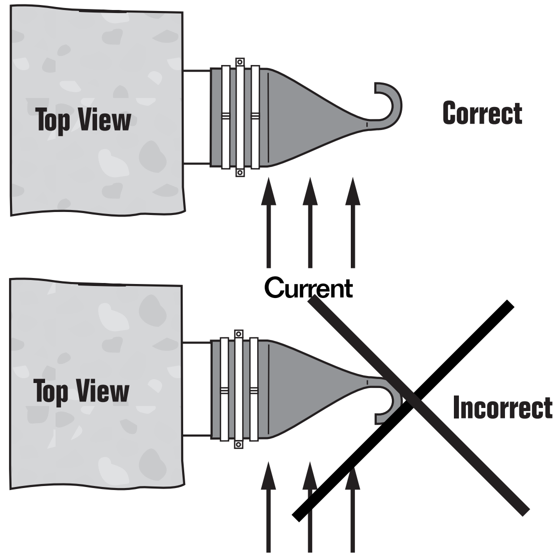
Make certain that sufficient ground clearance exists below the valve, at least 10% of the valve diameter. (I.E. 6" for a 60" valve)



IMPORTANT

4A. TIDEFLEX® WITH CURVED BILL INSTALLATION IN CURRENT

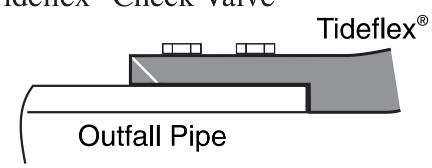
For Tideflex® fabricated with a curved bill, the valve should be installed so the bill points in the direction of the current, not facing the current which may cause the bill to be forced open.



4B. FITTING TIDEFLEX® ON PIPE

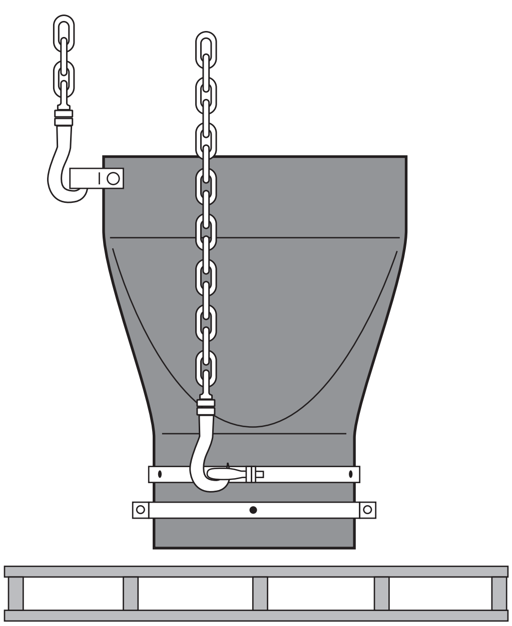
A. To facilitate the insertion of the pipe into the Tideflex® Check Valve, it might be necessary to grind a bevel on the inside cuff diameter.

B. Sometimes it is necessary to grind the inside of the cuff or add gasket material to the O.D. of the pipe to properly fit the Tideflex® Check Valve



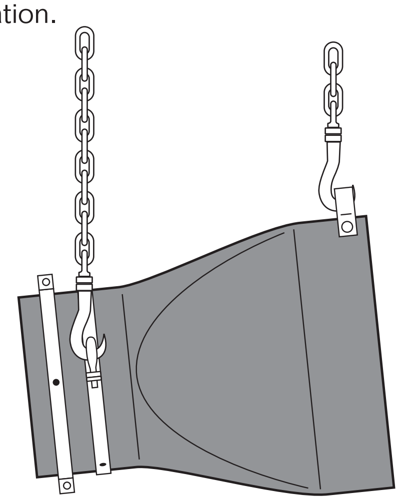
5. REMOVING THE VALVE FROM PALLET OR CRATING

A lifting clevis is provided at the top end of the Tideflex® Check Valve. Lifting eye bolts are provided on the clamps. Remove the cuff retainer "Shipping Ring" or wooden brace located inside the Cuff of the valve. The valve should be lifted from the pallet using both the clevis and the lifting eye bolts.



6. LIFTING THE VALVE

Do not discard the metal clamps holding the valve onto the pallet; THESE CLAMPS ARE NEEDED to install the Tideflex® Check Valve. In lifting the Tideflex® Check Valve from the pallet, keep the bill end of the Tideflex® higher than the cuff for ease of installation.



7. POSITIONING THE VALVE

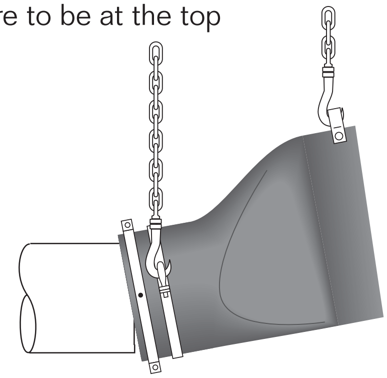
Apply a soap/water solution to the outside of the pipe in which the check valve is being installed on, to ease installation.

TF-2

With the bill end of the Tideflex® lifted higher than the cuff end start to fit cuff on the outfall line. The Tideflex® Check Valve should fit snugly against the outfall pipe, leaving no gap.

TF-1

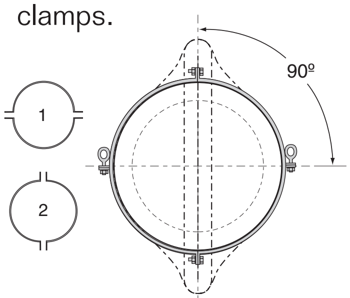
Flat portion of the valve to be at the bottom of the pipe. Flare to be at the top

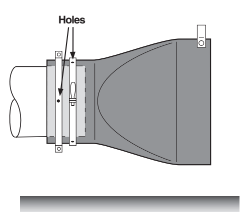


After the unit is securely pegged into position, proceed to install and tighten the first clamp. A mild lubricant may be applied to the I.D. of the **clamp** to prevent a brake shoe effect when tightening down clamps.

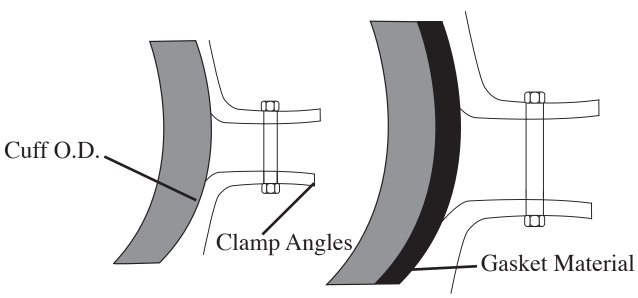
9. POSITIONING FOR 2 CLAMPS

Install the second clamp on the cuff of the Tideflex®. Rotating the clamp 90° in relation to the first clamp will ensure even pressure around the valve and pipe, thus increasing the effectiveness of the clamps.



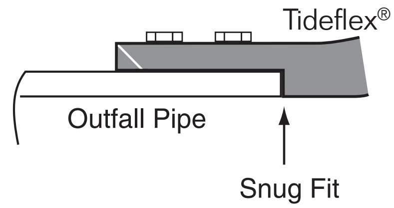


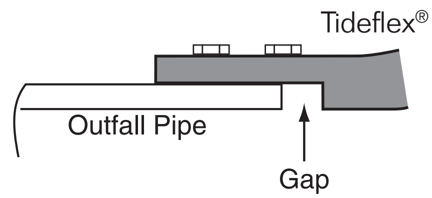
If a greater distance between the "angles" of the clamps is required to provide more range for tightening the bolts (especially if angles are bottoming out), gasket material can be wrapped around the OD of the cuff as shown.



8. SEAT TIDEFLEX® ON PIPE

The Tideflex® Check Valve should fit snugly against the outfall pipe, leaving no gap. If possible, inspect installation from the inlet end of the Tideflex® Check Valve to insure that the Check Valve Cuff fits snugly on the pipe. Do not allow a gap between the cuff and the end face of the outfall pipe. A gap will create an imbalance which will not provide proper support for the Tideflex® Check Valve. For more information, see troubleshooting.

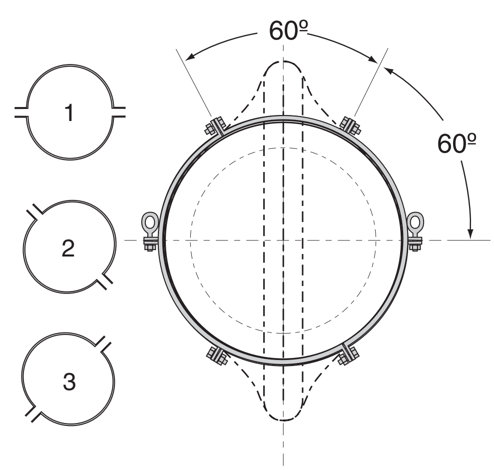




10. POSITIONING FOR 3 CLAMPS

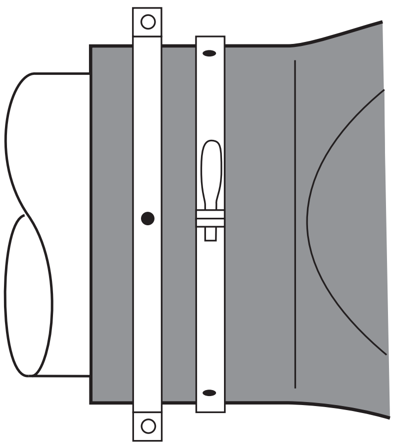
After the unit is securely pegged into position, proceed to install and tighten the first clamp. A mild lubricant may be applied to the I.D. of the **clamp** to prevent a brake shoe effect when tightening down clamps.

Install the second and third clamps on the cuff of the Tideflex®. Rotating the first and second clamps 60° and 120°, respectively, in relation to the first clamp will ensure even pressure around the valve and pipe, thus increasing the effectiveness of the clamps.



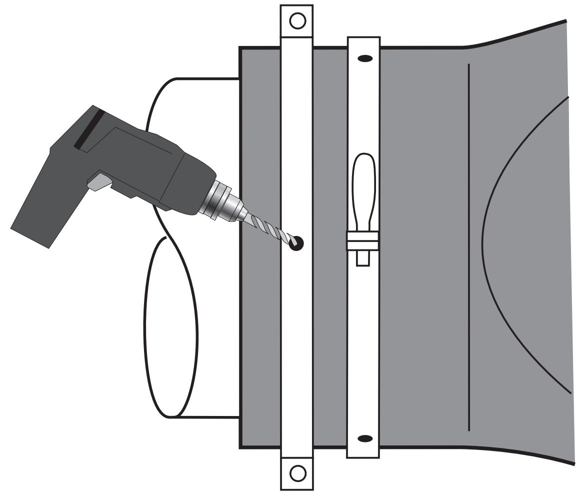
11. POSITIONING BLANK HOLES IN CLAMPS

Tighten all clamps and bolts once all components have been positioned properly. Pre-drilled holes are drilled in each clamp. These are provided so as to secure the Tideflex® Check Valve with "holding pins" to the outfall pipe. This will secure the Tideflex® Check Valve to the pipe and assure a long, trouble-free service life. After tightening the clamps, the pre-drilled holes should be staggered. Holes are not drilled in the rubber cuff of the Tideflex® at the factory since they would **not** line up to the tightened clamps.



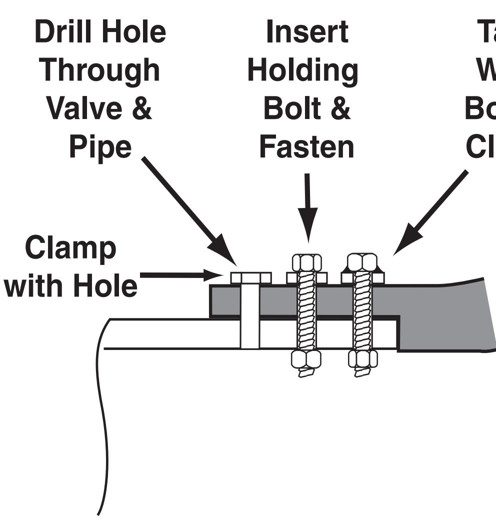
12. TACK WELDING HOLDING BOLTS TO CLAMPS

Once clamps are secure use a standard steel drill bit and drill holes through the rubber cuff. Insert holding bolts through the cuff and secure opposite side with nut, if possible. Holding bolts should be stainless steel. **Steel bolts can corrode and break off, causing the Check Valve to slip off the pipe**. Holding bolts are not provided because of various widths of the outfall pipe.



13. BOLTS TACK WELDED TO CLAMPS

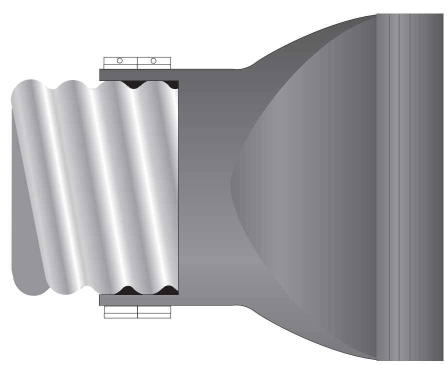
After tightening, heads of holding bolts can be tack welded to the clamps using small tacks. Certain installations will not permit installing of nuts to bolts. In these situations, the tightness of the clamps and tack weld of the bolts will assure good support.



14. CORRUGATED PIPE AND SMOOTH WALL (PVC, HDPE) PIPE INSTALLATION

For installation on corrugated pipe it is recommended that the corrugations be filled with hydraulic cement (or similar material) that will provide a smooth O.D.

For smooth wall pipe it is recommended that the valve be pinned.



TROUBLESHOOTING

Valve will not fit to pipe

- Make certain that the inside cuff retainer ring has been removed prior to fitting the valve to the pipe.
- Verify that the valve has enough area to fit over the pipe.
- If the pipe can be removed, or if an adapter ring which bolts to the wall or inside a vault is used, a crane or high-lift may be used to lower the valve onto the ring with the valve turned on end and the bill facing up.

Valve will not close fully, or check flow in opposing direction

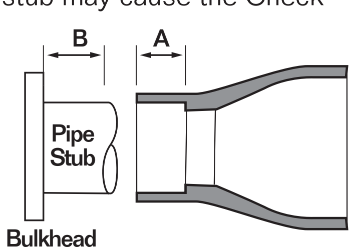
- Possible obstruction in line. Inspect the valve for entrapped foreign objects which may have lodged between the lips of the valve.
- Valve may not be installed high enough to clear the ground under the bill. Ensure that there is enough space between the bottom of the valve and the ground in order to prevent contact of the two or debris build-up.
- Back-pressure may not be sufficient to completely seal the valve.
- The Valve may not have been installed in a vertical position.

Valve will not stay on pipe

- Check all clamp bolts to assure that all bolts are tightened sufficiently.
- Valve may not be fully seated onto outfall line.
- Clamps are not rotated 90° from each other in order to provide adequate holding power.
- Valve cuff has a much larger I.D. in relation to pipe O.D.
- Make sure holding pins are used on 42" and larger Check Valves in order to prevent the valve from slipping off the line.

TF-2 Check Valves are designed to slide over a pipe stub. Too short of a pipe stub may cause the Check Valve to slip off or cause the Check Valve to gap open.

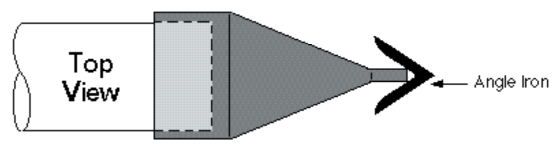
For valves up to 4", the pipe stub length "B" should be a minimum of 1/2" longer than cuff depth "A".

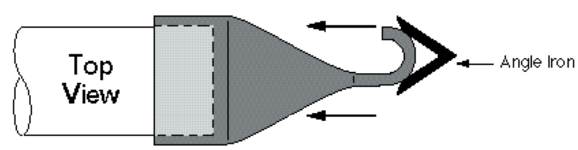


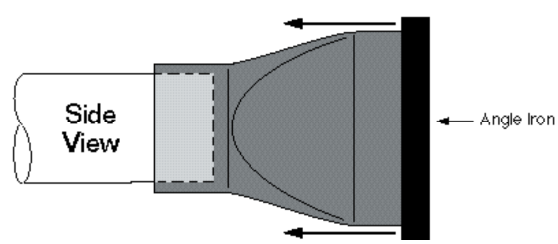
6"-14"	1" longer
16"-24"	2" longer
30"-60"	2 1/2" longer
72" and up	3" longer

*** Hints to install large diameter check valves**

During the installation of the check valve, if force is needed to seat the valve to the cuff stop on large diameter check valves, the force required should be induced equally around the cuff of the check valve, never at only the top, bottom or in the center. The force required to push the check valve onto the pipe can be placed on the bill but it should be distributed evenly over the entire length of the bill. Failure to distribute the pressure equally may cause improper performance of the check valve. Use a wide angle iron or large wooden planks across the bill to distribute the force equally.







MAINTENANCE

Line pressure should flush the valve clean of debris in most cases. Periodic inspections for trapped debris should be conducted.

In vacation seashore areas quart size plastic bottles have a tendency to float on top and not flush through except during a major storm.

A feathered 1" x 4", 1-1/2" x 12", or suitable plank inserted into the bill of the valve and turned 90° is a simple method of clearing the Check Valve of small debris which may be trapped between the lips.

CAUTION: Sharp objects should not be used on the Tideflex® as there is a chance of cutting the rubber and damaging the protective fabric covering.

Any gouges in the cover wrap that occur should be sealed to safeguard against ozone or chemical attack. This is best done with rubber cement or a good brand of silicone or polyurethane rubber sealer made by the major manufacturers.

Tideflex® Technologies Warranty

WARRANTIES - REMEDIES - DISCLAIMERS - LIMITATION OF LIABILITY
Unless otherwise agreed to in writing signed by Tideflex® Technologies, all Products supplied by Tideflex® Technologies will be described in the specifications set forth on the face hereof.

THE WARRANTIES SET FORTH IN THIS PROVISION ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED (INCLUDING ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OR TRADE).

Tideflex® Technologies Products are guaranteed for a period of one year from date of shipment, against defective workmanship and material only, when properly installed, operated and serviced in accordance with Tideflex® Technologies' recommendations. Replacement for items of Red Valve's manufacture will be made free of charge if proved to be defective within such year; but not claim for transportation, labor or consequential damages shall be allowed. We shall have the option of requiring the return of the defective product to our factory, with transportation charges prepaid, to establish the claim and our liability shall be limited to the repair or replacement of the defective product, F.O.B. our factory. Tideflex® Technologies will not assume costs incurred to remove or install defective products nor shall we incur backcharges or liquidated damages as a result of warranty work. Tideflex® Technologies does not guarantee resistance to corrosion erosion, abrasion or other sources of failure, nor does Tideflex® Technologies guarantee a minimum length of service, or that the product shall be fit for any particular service. Failure of purchaser to give prompt written notice of any alleged defect under this guarantee forthwith upon its discovery, or use, and possession thereof after an attempt has been made and completed to remedy defects therein, or failure to return product or part for replacement as herein provided, or failure to install and operate said products and parts according to instructions furnished by Tideflex® Technologies, or failure to pay entire contract price when due, shall be a waiver by purchaser of all rights under these representations. All orders accepted shall be deemed accepted subject to this warranty which shall be exclusive of any other or previous warranty, and shall be the only effective guarantee or warranty binding on Tideflex® Technologies, anything on the contrary contained in purchaser's order, or represented by any agent or employee of Tideflex® Technologies in writing or otherwise, not withstanding implied warranties. Tideflex® Technologies MAKES NO WARRANTY THAT THE PRODUCTS, AUXILIARIES AND PARTS ARE MERCHANTABLE OR FIT FOR ANY PARTICULAR PURPOSE.

Tideflex Technologies

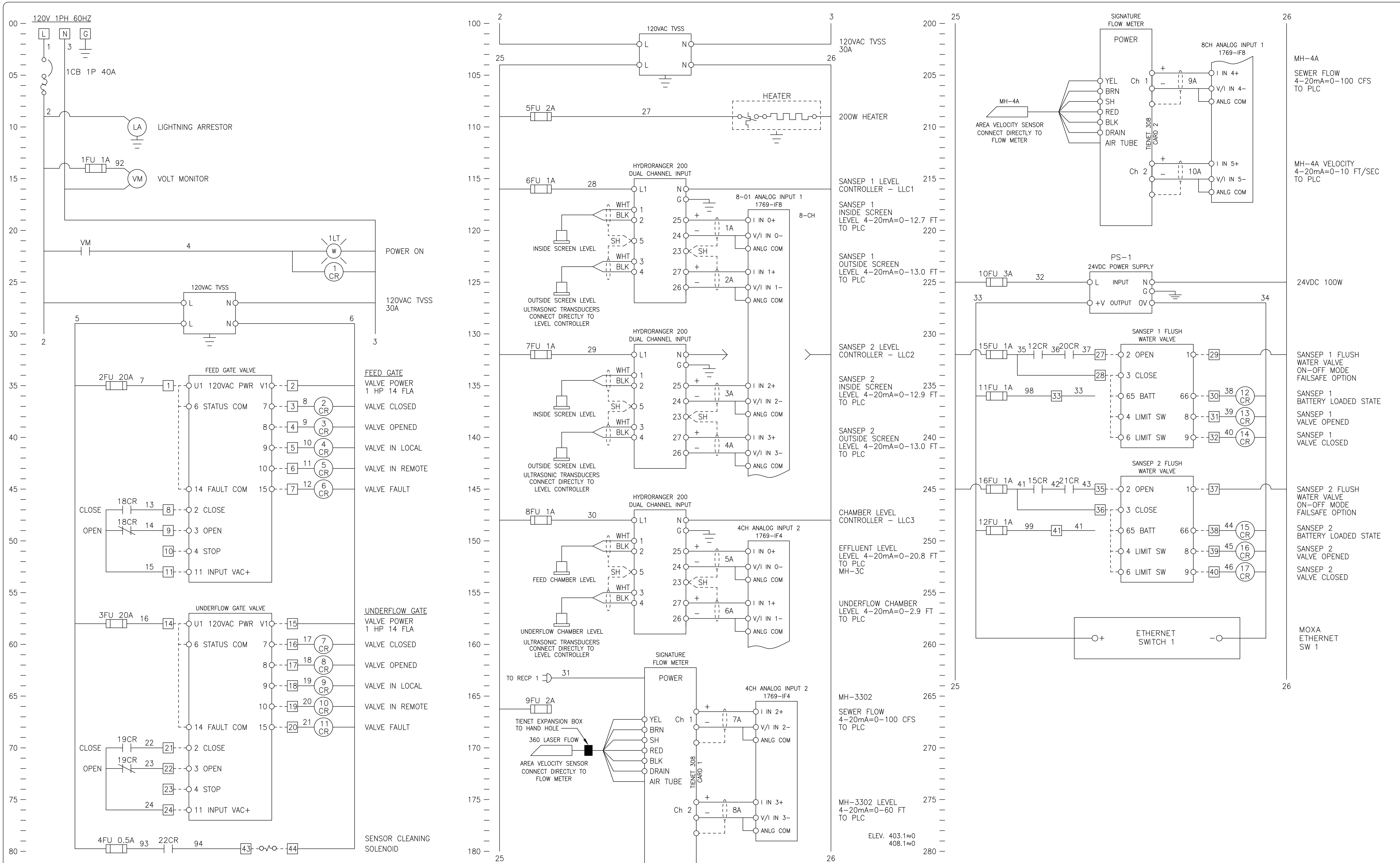
700 North Bell Avenue

Carnegie, PA 15106

phone: 412 279-0044

fax: 412 279-7878

WEB: www.tideflex.com



CONTROL INTERFACE, INC.
CINCINNATI, OHIO

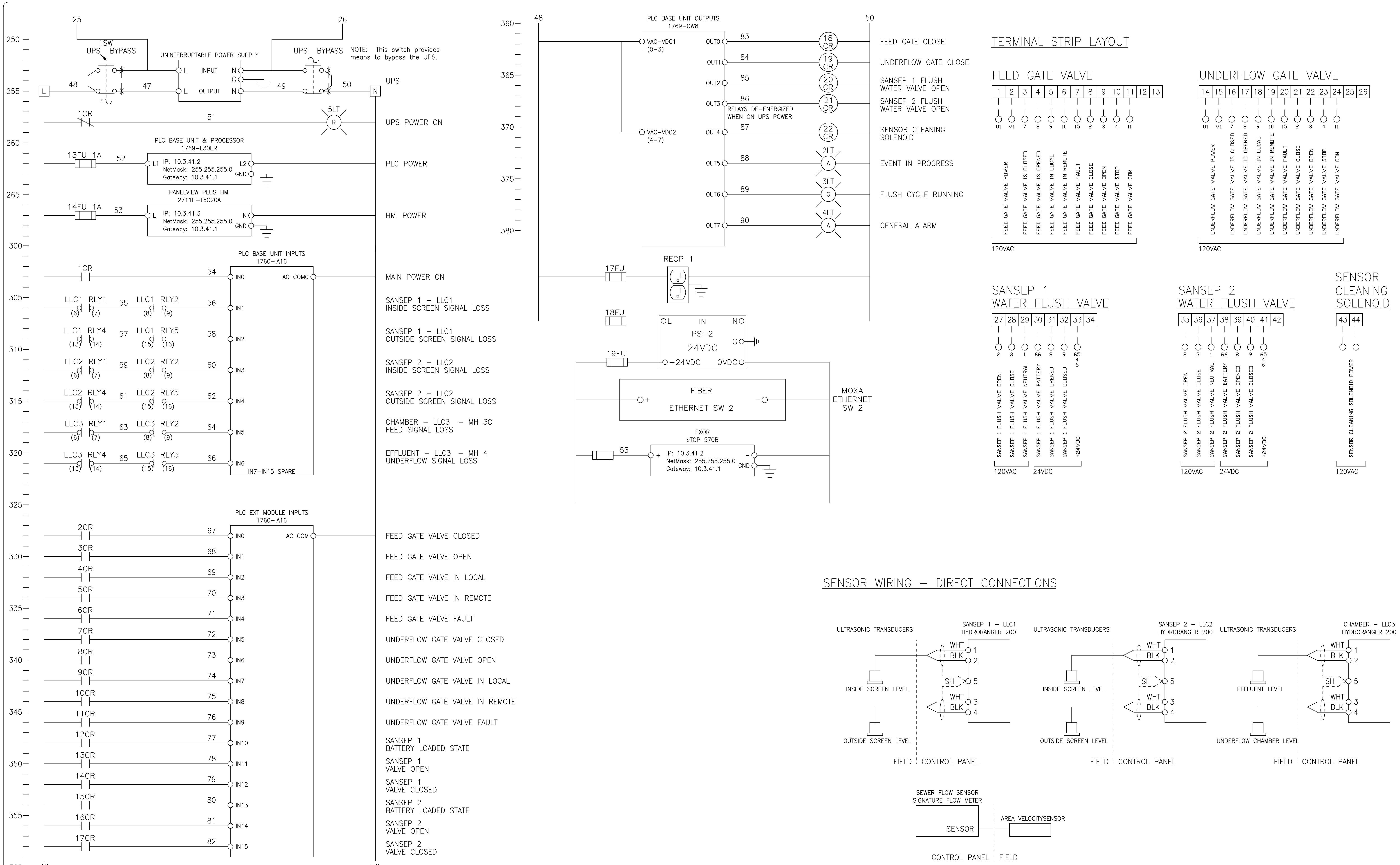
NOTES:

UNDERWRITERS LABORITORIES INC.® LISTED
ENCLOSED INDUSTRIAL CONTROL PANEL

☐ - INDICATES FIELD WIRING TERMINALS FOR CONNECTIONS MADE BY INSTALLER
X00 - INDICATES PLC TERMINALS
(----) - INDICATES REMOTE WIRING
(3) - INDICATES COMPONENT TERMINALS

DATE	BY	REVISION
03-2017	ZM	AS BUILTS

DESC: SANSEP CONTROL PANEL A
MODEL NUMBER: NPPPUF-000-11-11-04
SCALE:
BY: CI
DATE: 06-14-2013
CLIENT: PWTECH
JOB NAME: HARBOR BROOK CSO
DRAWING NUMBER: J-071A
STATUS: AS BUILTS-FIELD

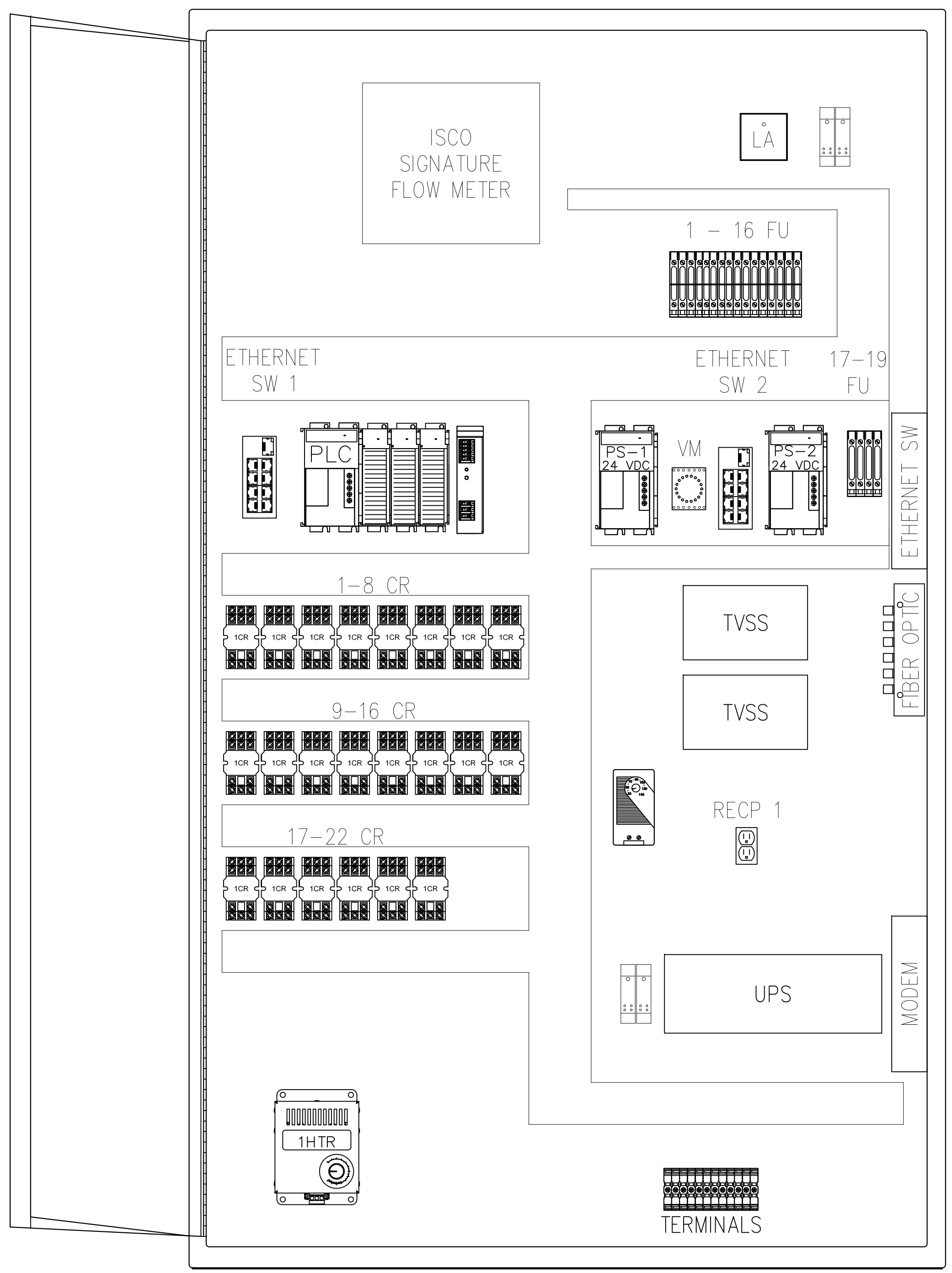


CONTROL INTERFACE, INC. CINCINNATI, OHIO	NOTES: UNDERWRITERS LABORATORIES INC. LISTED ENCLOSED INDUSTRIAL CONTROL PANEL	☐ – INDICATES FIELD WIRING TERMINALS FOR CONNECTIONS MADE BY INSTALLER; X00 – INDICATES PLC TERMINALS; (----) – INDICATES REMOTE WIRING; (3) – INDICATES COMPONENT TERMINALS

DATE	BY	REVISION
03-2017	ZM	AS BUILTS

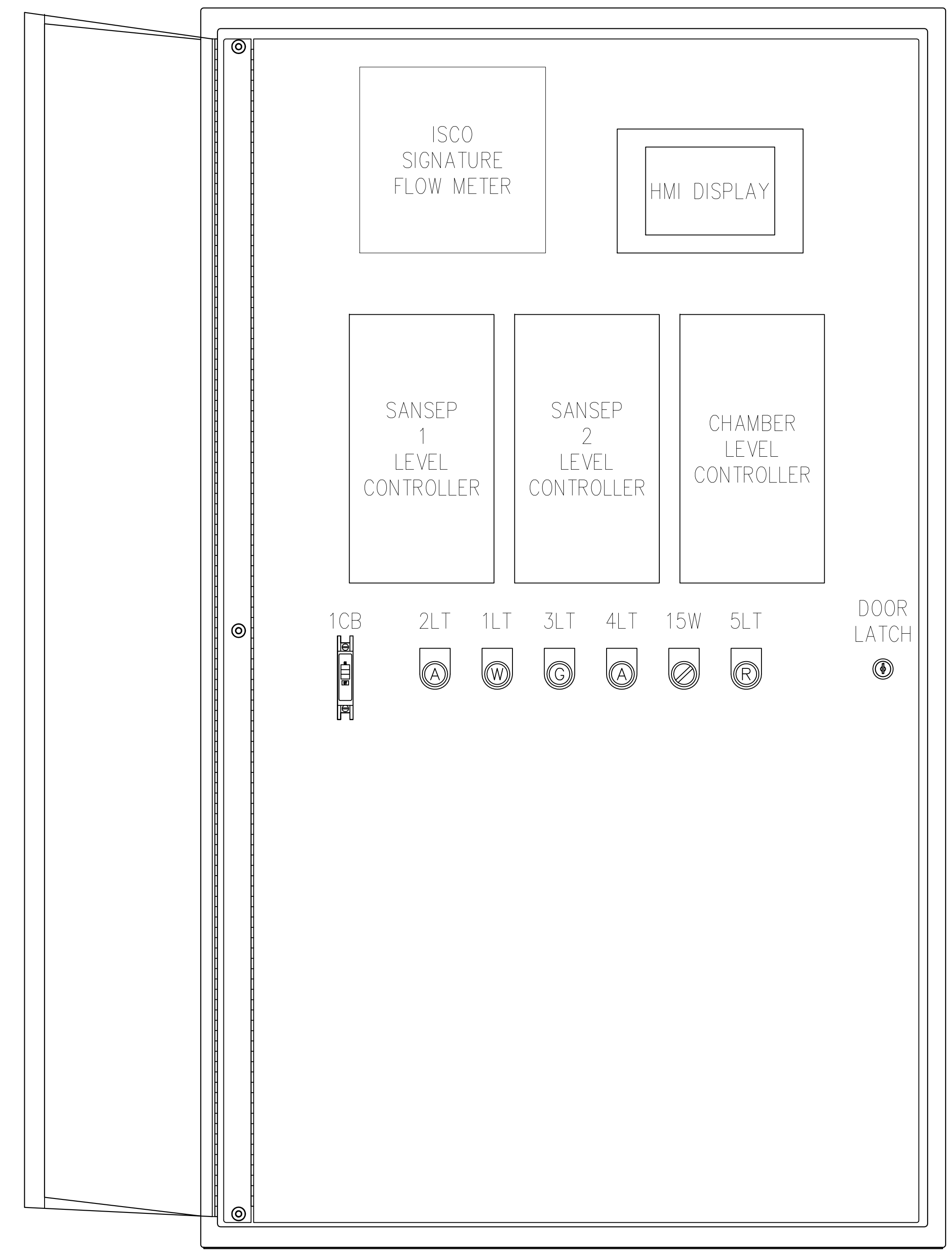
DESC: SANSEP CONTROL PANEL
MODEL NUMBER: NPPPUF-000-11-11-04
SCALE: BY: CI DATE: 06-14-2013
CLIENT: PWTECH
JOB NAME: HARBOR BROOK CSO
DRAWING NUMBER: J-071B
STATUS: AS BUILTS-FIELD

SUBPANEL LAYOUT



NEMA 4X SS ENC: 60" X 36" X 16"

INNER DOOR LAYOUT



CONTROL INTERFACE, INC.
CINCINNATI, OHIO

NOTES:
UNDERWRITERS LABORITORIES INC. LISTED
ENCLOSED INDUSTRIAL CONTROL PANEL

☐ – INDICATES FIELD WIRING TERMINALS FOR CONNECTIONS MADE BY INSTALLER
X00 – INDICATES PLC TERMINALS
(----) – INDICATES REMOTE WIRING
(3) – INDICATES COMPONENT TERMINALS

DATE	BY	REVISION	DATE	BY	REVISION
08-2015	ZM	AS BUILT CONDITIONS			

SCALE: | BY: CI | DATE: 06-14-2013

DESC: SANSEP CONTROL PANEL A
MODEL NUMBER: NPPPUF-000-11-11-04
CLIENT: PWTECH
JOB NAME: HARBOR BROOK CSO
DRAWING NUMBER: J-071C
STATUS: AS BUILTS-SHIP

Control Interface, Inc.
517 Commercial Drive
Fairfield, OH 45014
ph/fax: (513) 874-2062/(513) 874-2099
email: engineering@controlinterface.com

Control Panel Data Sheet

Job Data

Job Number:	**J-071** Rev: **0.0** ***(Submittal)***
Job Name:	**LOWER HARBOR BROOK**
District:	**NY**
Client:	**PROCESS WASTEWATER TECHNOLOGIES**
Engineer:	**CH2MHILL**

Electrical Data

Supply Voltage:	**115/120V**
Service:	**1 PHASE, 2 WIRE**
Control Voltage:	**DUAL 24V-115/120V**
Total FLA:	**12.00**

Panel Data

Panel Type:	**PROCESS CONTROL NEMA PANEL**
Control Type:	**PLC, ULTRASONIC, FULL VOLTAGE**
Model Number:	**NPPPUF-000-11-11-04** Qty: **1**
Options:	**SANSEP**

Control Panel

Qty	Name	Description	Manufacturer	Part Number	Sym
1	Breaker	120/240V 20A 1P Q Frame	Square D	QOU120	CB
2	Contact	30MM NO Fingersafe	Square D	9001KA2	
2	Contact	30MM NC Fingersafe	Square D	9001KA3	
2	Dist Block	600V 115A 2P (1-4)	Marathon	1412400	DIST
1	Enclosure	NEMA 4X 60X36X16 SS w/3PT Latch	Hoffman	A60H3616SSLP3PT	
2	Flow Meter	Laserflow Module	Teledyne Isco	2160 LASERFLOW MODULE	
1	Flow Meter - Assessory	3 4-20mA Analog Output	Teledyne Isco	2108 ANALOG OUTPUT MODULE	
2	Flow Meter Sensor	Laserflow Velocity Sensor	Teledyne Isco	TIENET LASERFLOW DEVICE	
12	Fuse	500V 1A Time-Dly Midget	Bussman	FNQ-1	FU
5	Fuse	500V 2A Time-Dly Midget	Bussman	FNQ-2	FU
3	Fuse	500V 3A Time-Dly Midget	Bussman	FNQ-3	FU
20	Fuse Block	600V 30A 1P Midget Rail Mnt Trip Ind	Marathon	6SM30A1I	
1	Heater	115/120V 200 Watt w/ Thermostat	Hoffman	DAH2001A	
1	Insulation Kit	1 IN	Control Interface	CI-IN1	
3	Level Controller	115/120V Hydroranger 200 Dual Point Panel Mnt	Siemens Milltronics	7ML5034-3AB01	
1	Level Controller Programmer	Hydro200/Multi	Siemens Milltronics	7ML18302-AK	
1	Light - Pilot	NEMA 4X 115/120V FV Amber	Square D	9001SKP38A9	LT
1	Light - Pilot	NEMA 4X 115/120V FV Green	Square D	9001SKP38G9	LT

Control Panel (continued)

Qty	Name	Description	Manufacturer	Part Number	Sym
1	Light - Pilot	NEMA 4X 115/120V FV Red	Square D	9001SKP38R9	LT
1	Light - Pilot	NEMA 4X 115/120V FV White	Square D	9001SKP38W9	LT
1	Lightning Arrestor	1P	Square D	SDSA1175	LA
1	Monitor - Volt	115/120V Plug In 1PH	Diversified	UOA-120-ALA	VM
1	Operator - SW	NEMA 4X 30MM 2 Pos Cam E	Square D	9001SKS11B	SW
1	PLC - Accessory	Micrologix 1500 Right End Cap	Allen Bradley	1764-ECR	PLC
2	PLC - Analog I/O	Compactlogix 1500 4 In	Allen Bradley	1769-IF4	PLC
1	PLC - Base Unit	115/120V 24 I/O Micrologix 1500 12-120VAC In/12 Relay Out	Allen Bradley	1764-24AWA	PLC
1	PLC - Data Access	Micrologix 1500 Data Access Tool	Allen Bradley	1764-DAT	PLC
1	PLC - Digital I/O	16 PTS Compactlogix AC Input	Allen Bradley	1769-IA16	PLC
1	PLC - HMI	115/120V PV Plus 600 Color Touch Ethernet/RS232	Allen Bradley	2711P-T6C20A	
1	PLC - Memory	Micrologix 1500 16k Mem/Real Time Clock	Allen Bradley	1764-MM2RTC	PLC
1	PLC - Processor	Micrologix 1500 RS232	Allen Bradley	1764-LRP	PLC
1	Panel	60X36 Steel	Hoffman	A60P36	
1	Power Supply	24VDC 4.2A (100W) Din Rail Mount	Puls	ML100.100	
1	Power Supply	12VDC 4.5A (60W) Din Rail Mount	Puls	ML60.121	
19	Relay	115/120V 2P 8 Blade Ind Light	Idec	RR2BA-ULAC120V	CR
19	Socket	300V 2P 8 Pin Double Tier	Idec	SR2P-05	
1	Socket	300V 2P 8 Pin	Idec	SR2P-06	
1	Uninterruptable Power Supply	115/120V 500VA	Sola	SDU500	UPS

Remote Mounted

Qty	Name	Description	Manufacturer	Part Number	Sym
3	Level Transducer	XPS15 Ultrasonic 50M Cable	Siemens Milltronics	7ML1118-0FA30	

Select MicroLogix 1500 Controllers

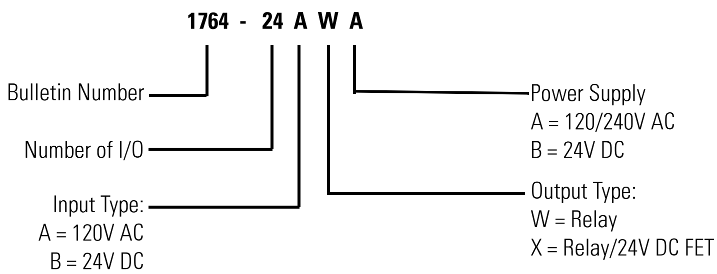
Step 12 - Select:

- base unit - review power and I/O configurations to select a catalog number; see power supply and I/O specifications for more detailed information
- processor - see notes at Step 1
- accessories - data access tool; real-time clock and memory modules
- record your selections in the Selection Record (start on page 86)

MicroLogix 1500 Base Units

The base unit houses embedded inputs, outputs, power supply, and the channel 0 communication port. The base unit also provides the interface to expansion I/O when required by an application.

MicroLogix 1500 Controller Catalog Number Detail



MicroLogix 1500 Controller Power and I/O Configuration

Cat. No.	Line Voltage	Number of Inputs	Number of Outputs	High Speed I/O
1764-24AWA	120/240V AC	(12) 120V AC	(12) Relay, 2 isolated relays per unit	N/A
1764-24BWA	120/240V AC	(8) Standard 24V DC (4) Fast 24V DC	(12) Relay, 2 isolated relays per unit	(4) 20 kHz input
1764-28BXB	24V DC	(8) Standard 24V DC (8) Fast 24V DC	(6) Relay, 2 isolated relays per unit (4) Standard 24V DC FET (2) Fast 24V DC FET	(8) 20 kHz input (2) 20 kHz output

MicroLogix 1500 Base Unit Power Supply Specifications

Attribute		1764-24AWA	1764-24BWA	1764-28BXB
Power Supply Voltage		85…265V AC at 47…63 Hz	85…265V AC at 47…63 Hz	20.4…30V DC
Power Consumption		70 VA	88 VA	30 W
Power Supply Inrush Current, max		120V AC: 25 A for 8 ms 240V AC: 40 A for 4 ms	120V AC: 25 A for 8 ms 240V AC: 40 A for 4 ms	24V DC: 4 A for 150 ms
Load Current(1), max	5V DC	2250 mA	2250 mA(2)	2250 mA
	24V DC	400 mA	400 mA(2)	400 mA
Load Power, max		16 W	22 W	16 W
24V DC Sensor Power		N/A	400 mA(2), 400 µF capacitance, max	N/A

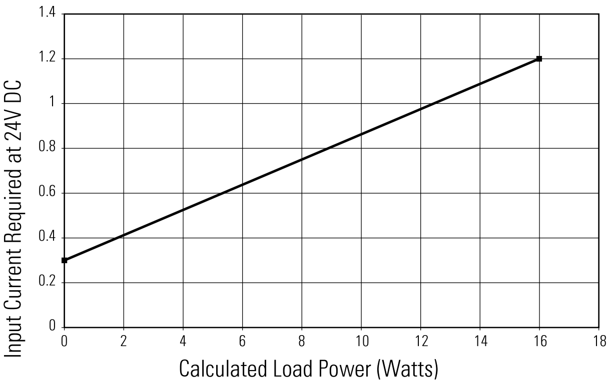
(1) See Perform MicroLogix 1500 System Expansion Calculations on page 78 for an example system validation worksheet to calculate expansion I/O power usage.

(2) Do not allow the total load power consumed by the 5V DC, 24V DC, and sensor power outputs to exceed 22 W.

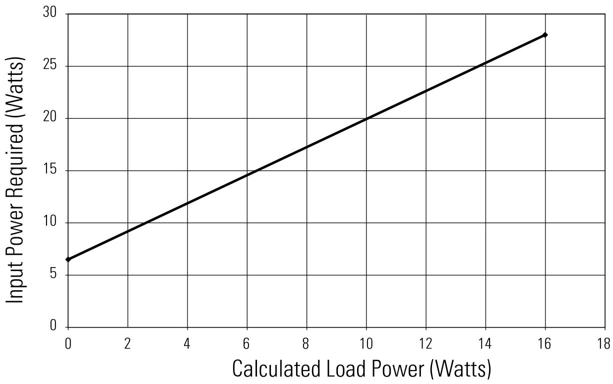
Choosing a Power Supply for the 1764-28BXB

This figure contains information for selecting a power supply for applications using a 1764-28BXB base unit. Use the worksheets on page 78 to calculate the total power (Watts) consumed by the system. With that information, use the graphs below to choose a power supply. You can use either current or power, depending on how the power supply is rated.

Input Current Required



Input Power Required



MicroLogix 1500 Base Unit Input Specifications

Attribute	1764-24AWA	1764-24BWA and 1764-28BXB	
		Inputs 0…7	Inputs 8 and Higher
On-state Voltage Range	79…132V AC at 47 Hz…63 Hz	14…30.0 V DC at 30 °C (86 °F) 14…26.4 V DC at 55 °C (131 °F)	10…30.0 V DC at 30 °C (86 °F) 10…26.4 V DC at 55 °C (131 °F)
Off-state Voltage Range	0…20V AC	0 to 5V DC	0…5V DC
Operating Frequency	N/A	1 kHz…20 kHz	1 Hz…500 Hz
Signal Delay	ON Delay = 20 ms OFF Delay = 20 ms	standard inputs: selectable from 0.5 to 16 ms high-speed inputs: selectable from 0.025 to 16 ms	
On-state Current min nom max	 5.0 mA at 79V AC 12.0 mA at 120V AC 16.0 mA at 132V AC	 2.5 mA at 14V DC 7.3 mA at 24V DC 12.0 mA at 30V DC	 2.0 mA at 10V DC 8.9 mA at 24V DC 12.0 mA at 30V DC
Off-state Leakage Current	2.5 mA, min	1.5 mA, min	1.5 mA, min
Impedance, nom	12 kΩ at 50 hZ 10 kΩ at 60 Hz	3.3 kΩ	2.7 kΩ
Inrush Current, max	250 mA at 120V AC	N/A	N/A

MicroLogix 1500 Base Unit Output Specifications

Attribute	1764-24AWA,1764 -24BWA, 1764-28BXB	1764-28BXB	
	Relay	**FET Standard Operation**	**FET High-speed Operation (Outputs 2 and 3 only)**
Operating Voltage Range	5…125V DC 5…264V AC	20.4…26.4V DC	
Continuous Current per Point, max	See MicroLogix 1500 Controller Relay Contact Rating on page 72.	1 A @ 55 °C (131 °F) 1.5 A @ 30 °C (86 °F)	100 mA
Continuous Current per Common, max	8.0 A	6.0 A	
Continuous Current per Controller, max	24 A @ 150V 20 A @ 240V	18 A @ 150V 18 A @ 240V	
On-state Current, min	5.0 mA @ 79V AC	2.5 mA @ 14V DC	2.0 mA at 10V DC
Off-state Leakage Current, max	0 mA	1 mA	
Signal Delay, max - resistive load	ON Delay = 10 ms OFF Delay = 10 ms	ON Delay = 0.1 ms OFF Delay = 1.0 ms	ON Delay = 6 µs OFF Delay = 18 µs
Surge Current per Point (peak)	N/A	4 A for 10 ms(1)	

(1) Repeatability is once every 2 seconds at 55 °C (131 °F), once every 1 second at 30 °C (86 °F).

MicroLogix 1500 Controller Relay Contact Rating

Voltage, max	Amperes		Amperes Continuous	Voltamperes	
	Make	**Break**		**Make**	**Break**
240V AC	7.5 A	0.75 A	2.5 A	1800 VA	180 VA
120V AC	15 A	1.5 A			
125V DC	0.22 A(1)		1.0 A	28 VA	
24V DC	1.2 A(1)		2.0 A		

(1) For DC voltage applications, the make/break ampere rating for relay contacts can be determined by dividing 28 VA by the applied DC voltage. For example, 28 VA/48V DC = 0.58 A. For DC voltage applications less than 48V, the make/break ratings for relay contacts cannot exceed 2 A. For DC voltage applications greater than 48V, the make/break ratings for relay contact cannot exceed 1 A.

MicroLogix 1500 Processors

In the controller system, the processor unit provides logic processing, trim potentiometers, Run/Remote/Program mode switch, communication toggle push button and (using the 1764-LRP processor) an electrically isolated RS-232 port. The processor also provides the interface to the DAT, real-time clock, and memory modules.

There are two processor units: 1764-LSP and 1764-LRP.

MicroLogix 1500 Data Access Tool (1764-DAT)

The DAT plug-in tool provides an interface for on-the-fly data monitoring and adjustments. The DAT has five primary features:

- Direct access to 48 bit elements
- Direct access to 48 integer elements
- Two function keys
- Display of controller faults
- Removal and insertion under power

MicroLogix 1500 Real-Time Clock and Memory Modules

These optional modules attach to the processor unit. Both types of modules can be inserted or removed while the unit is under power.

1764 Real-Time Clock Modules

Real-time clock modules establish a time-base for controller functions that need to be coordinated with real-time events. They provide year, month, day of month, day of week, hour, minute, and second information to the controller by using the RTC function file.

1764 Memory Modules

Memory modules allow:

- user programs and data to be stored as backup.
- transport programs for use with other controllers.
- safety/security for press control and other critical applications.
- auto recovery, through a power cycle, after a controller fault.
- comparison of programs.
- data file and memory module write protection.

MicroLogix 1500 Memory and Real-Time Clock Modules

Cat. No.	Description
1764-RTC	MicroLogix 1500 Real-Time Clock Module
1764-MM1	MicroLogix 1500 8 KB Memory Module
1764-MM1RTC	MicroLogix 1500 8 KB Memory Module with Real-Time Clock
1764-MM2(1)	MicroLogix 1500 16 KB Memory Module
1764-MM2RTC(1)	MicroLogix 1500 16 KB Memory Module with Real-Time Clock
1764-MM3(2)	MicroLogix 1500 16 KB Memory Module
1764-MM3RTC(2)	MicroLogix 1500 16 KB Memory Module with Real-Time Clock

(1) Use with the 1764-LRP processor to support larger program and data requirements.

(2) The 1764-MM3*xxx* modules have the same user memory as the 1764-MM2*xxx* modules except recipe data size. Recipe data which was stored to the Data Log Queue are in the MicroLogix 1500 LRP can be stored to the 1764-MM3*xxx* modules. There is no difference in functionality between the 1764-MM2*xxx* and 1764-MM3*xxx* modules except the 1764-MM3*xxx* modules can save recipe data from the Data Log Queue area.

1769-IA16

Compact 120V AC input module

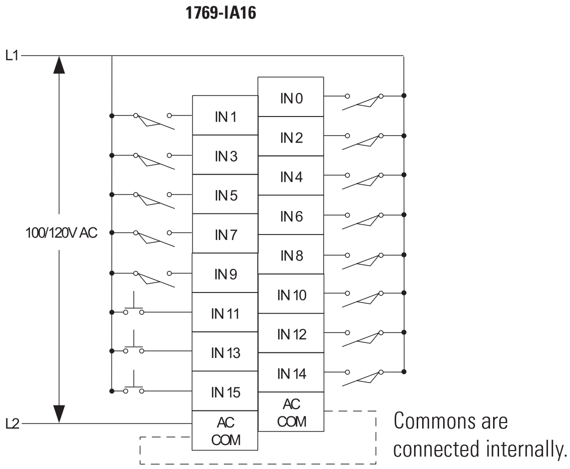


Table 4 - Technical Specifications - 1769-IA16

Attribute	1769-IA16
Inputs	16 (16 points/group, internally connected commons)
Voltage category	100/120V AC
Operating voltage range	79…132V AC, 47…63 Hz
Input delay, on	20 ms
Input delay, off	20 ms
Current draw @ 5.1V	115 mA
Heat dissipation, max	3.30 W
Off-state voltage, max	20V AC
Off-state current, max	2.5 mA
On-state voltage, min	79V AC
On-state current, min	5 mA @ 74V AC
On-state current, max	12 mA @ 120V AC
Inrush current, max[1]	250 mA
Input impedance, max	12 kΩ @ 50 Hz 10 kΩ @ 60 Hz
Isolation voltage	Verified by one of the following dielectric tests: 1517V AC for 1 s or 2145V DC for 1 s, input point to bus 132V AC working voltage (IEC Class 2 reinforced insulation)
Weight, approx	280 g (0.61 lb)
Dimensions (HxWxD), approx	118 x 35 x 87 mm (4.65 x 1.38 x 3.43 in.) Height with mounting tabs 138 mm (5.43 in.)
Slot width	1
Module location	DIN rail or panel mount

Table 4 - Technical Specifications - 1769-IA16

Attribute	1769-IA16
Power supply	1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4
Power supply distance rating	8 modules
Terminal screw torque	0.68 N•m (6 lb•in)
Retaining screw torque	0.46 N•m (4.1 lb•in)
Wire size	(22…14 AWG) solid (22…16 AWG) stranded
Wire type	Cu-90 °C (194 °F)
IEC input compatibility	Type 1+
Replacement terminal block	1769-RTBN18 (1 per kit)
Replacement door label	1769-RL1 (2 per kit)
Replacement door	1769-RD (2 per kit)
Vendor ID code	1
Product type code	7
Product code	82
Enclosure type rating	None (open-style)

(1) A current limiting resistor can be used to limit inrush current; however, the operating characteristics of the AC input circuit will be affected. If a 6.8 kΩ (2.5 W minimum) resistor is placed in series with the input, the inrush current is reduced to 35 mA. In this configuration, the minimum on-state voltage increases to 92V AC. Before adding the resistor in a hazardous environment, be sure to consider the operating temperature of the resistor and the temperature limits of the environment. The operating temperature of the resistor must remain below the temperature limit of the environment.

Table 5 - Certifications - 1769-IA16

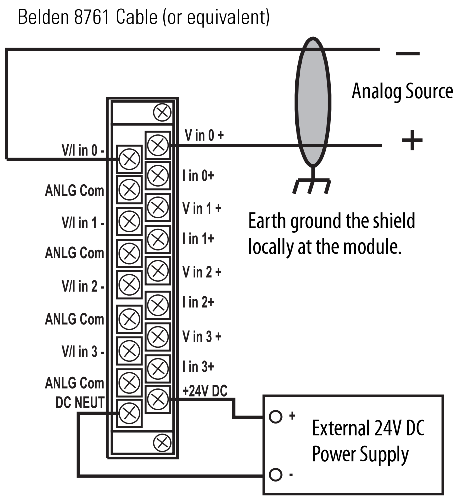
Certification(1)	1769-IA16
c-UL	C-UL certified (under CSA C22.2 No. 142) UL 508 listed Class I, Division 2 Group A,B,C,D Hazardous Locations (UL 1604, C-UL under CSA C22.2 No. 213)
CE	CE compliant for all applicable directives
C-Tick	AustralianRadiocommunications Act, compliant with: • AS/NZS cispr 11; Industrial Enclosure

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1769-IF4

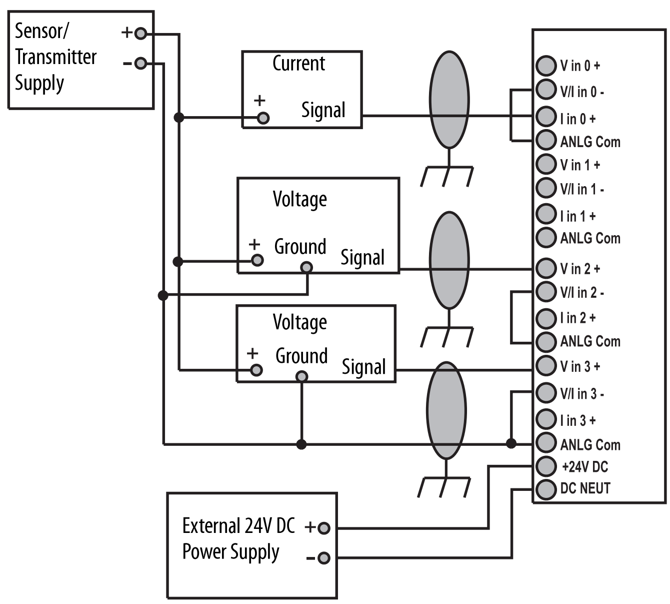
Compact voltage/current analog input module

1769-IF4 Differential Inputs



The external power supply must be rated Class 2, with a 24V DC range of 20.4…26.4V DC and 60 mA minimum. Series B and later modules support this option.

1769-IF4 Single-ended Sensor/Transmitter Inputs



1769-IF4 Mixed Transmitter Inputs

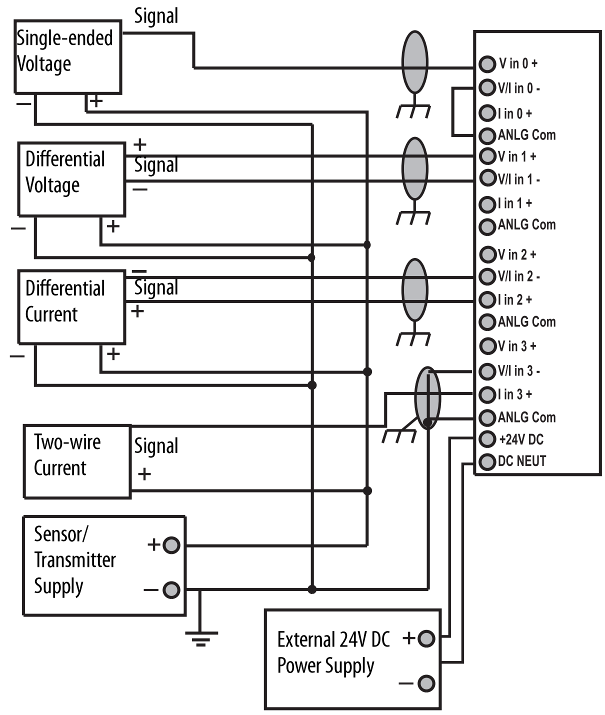


Table 6 - Technical Specifications - 1769-IF4

Attribute	1769-IF4
Inputs	4 differential or single-ended
Input range	±10V 0…10V 0…5V 1…5V 0…20 mA 4…20 mA
Full scale range(1)	±10.5V -0.5…10.5V -0.5…5.25V 0.5…5.25V 0…21 mA 3.2…21 mA
Current draw @ 5.1V	120 mA
Current draw @ 24V	60 mA
Heat dissipation, max	2.52 W
Converter type	Delta Sigma
Resolution (2)	14 bits (unipolar) 14 bits plus sign (bipolar)
Rated working voltage(3)	30V AC/30V DC
Common mode voltage range(4)	±10V DC max per channel
Common mode rejection	> 60 dB @ 50 and 60 Hz with the 50 or 60 Hz filter selected, respectively
Normal mode rejection ratio	-50 dB @ 50 and 60 Hz with the 50 or 60 Hz filter selected, respectively
Input impedance	Voltage: 220 kΩ Current: 250 Ω
Accuracy(5)	Voltage: ±0.2% full scale @ 25 °C (77 °F) Current: ±0.35% full scale @ 25 °C (77 °F)
Accuracy drift with temperature	Voltage: ±0.003% per °C Current: ±0.0045% per °C
Nonlinearity	±0.03%
Repeatability(6)	±0.03%
Module error	Voltage: ±0.3% Current: ±0.5%
Overload at input terminals, max(7)	Voltage: ±30V DC continuous, 0.1 mA Current: ±32 mA continuous, ±7.6V DC
Isolation voltage	500V AC or 710V DC for 1 minute (qualification test), group to bus 30V AC/30V DC working voltage (IEC Class 2 reinforced insulation)
Weight, approx	300 g (0.65 lb)
Dimensions (HxWxD), approx	118 x 35 x 87 mm (4.65 x 1.38 x 3.43 in.) Height with mounting tabs 138 mm (5.43 in.)
Slot width	1
Module location	DIN rail or panel mount
Power supply	1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4
Optional 24V DC Class 2 power supply voltage range(8)	20.4…26.4V DC
Power supply distance rating	8 modules

Table 6 - Technical Specifications - 1769-IF4

Attribute	1769-IF4
Terminal screw torque	0.68 N•m (6 lb•in)
Retaining screw torque	0.46 N•m (4.1 lb•in)
Wire size	(22…14 AWG) solid (22…16 AWG) stranded
Wire type	Cu-90 °C (194 °F)
Replacement terminal block	1769-RTBN18 (1 per kit)
Replacement door label	1769-RL2 series B (2 per kit)
Replacement door	1769-RD (2 per kit)
Vendor ID code	1
Product type code	10
Product code	35
Enclosure type rating	None (open-style)

(1) The over- or under-range flag will come on when the normal operating range (over/under) is exceeded. The module will continue to convert the analog input up to the maximum full scale range. The flag automatically resets when within the normal operating range.

(2) Resolution is dependent upon your filter selection. The maximum resolution is achieved with either the 50 or 60 Hz filter selected.

(3) Rated working voltage is the maximum continuous voltage that can be applied at the input terminal, including the input signal and the value that floats above ground potential (for example, 10V DC input signal and 20V DC potential above ground).

(4) For proper operation, both the plus and minus input terminals must be within ±10V DC of analog common.

(5) Includes offset, gain, nonlinearity, and repeatability error terms.

(6) Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.

(7) Damage may occur to the input circuit if this value is exceeded.

(8) If the optional 24V DC Class 2 power supply is used, the 24V DC current draw from the bus is 0 mA.

Table 7 - Response Speed - 1769-IF4

Filter Frequency	Cut-off Frequency	Step Response	Channel Update
50 Hz	13.1 Hz	60 ms	22 ms
60 Hz	15.7 Hz	50 ms	19 ms
250 Hz	65.5 Hz	12 ms	6 ms
500 Hz	131 Hz	6 ms	4 ms

Table 8 - Certifications - 1769-IF4

Certification(1)	1769-IF4
c-UL	C-UL certified (under CSA C22.2 No. 142) UL 508 listed Class I, Division 2 Group A,B,C,D Hazardous Locations (UL 1604, C-UL under CSA C22.2 No. 213)
CE	CE compliant for all applicable directives
C-Tick	AustralianRadiocommunications Act, compliant with: • AS/NZS cispr 11; Industrial Enclosure

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

– Support for the .NET compact framework

Some of the above software applications are included on the PanelView Plus CE Accessory CD.

PanelView Plus 400 and 600 Terminals

The PanelView Plus 400 and 600 terminals offer:

- base-configured units.
- communication modules.
- power supply, AC or DC.
- grayscale and color displays.

The PanelView Plus 400 and 600 terminals are HMI devices that provide these features:

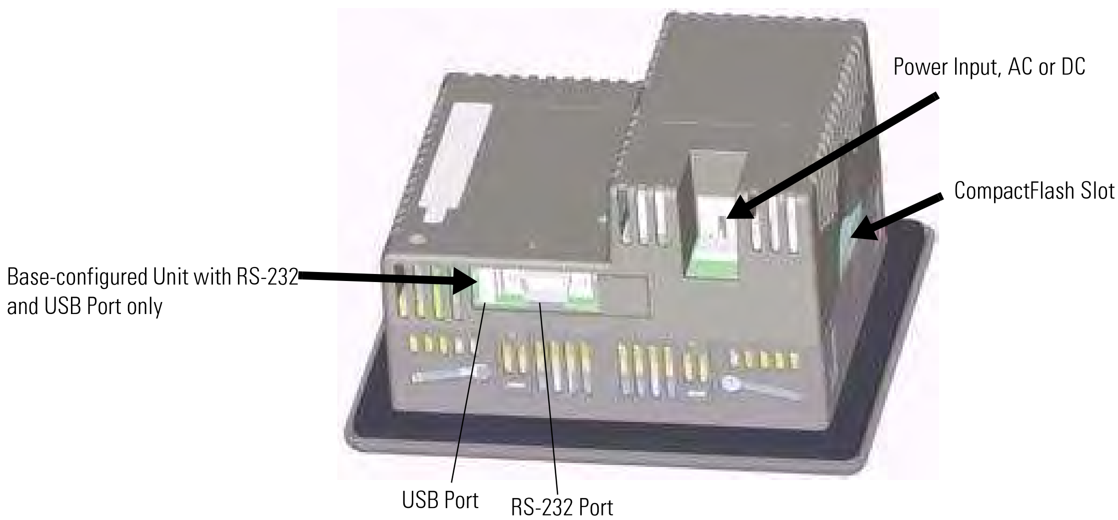
- PanelView Plus 400 terminals
  – Color or grayscale graphic displays
  – Keypad or keypad and touch screen input support
- PanelView Plus 600 terminals
  – Color or grayscale graphic displays
  – Keypad, touch screen, or keypad and touch screen input
- Base-configured unit
  – RS-232 only
  – RS-232, Ethernet, and modular communications interface
- Communication modules provide add-on capability to base-configured units with a modular communications interface
- Power input, AC (85…264V) or DC (18…30V)
- CompactFlash card slot supports Type 1 CompactFlash cards
- USB port for attaching mouse, keyboard, printer, bar code scanner, and other devices
- Same panel cutouts as the PanelView Standard 550 terminals

Base-configured Units

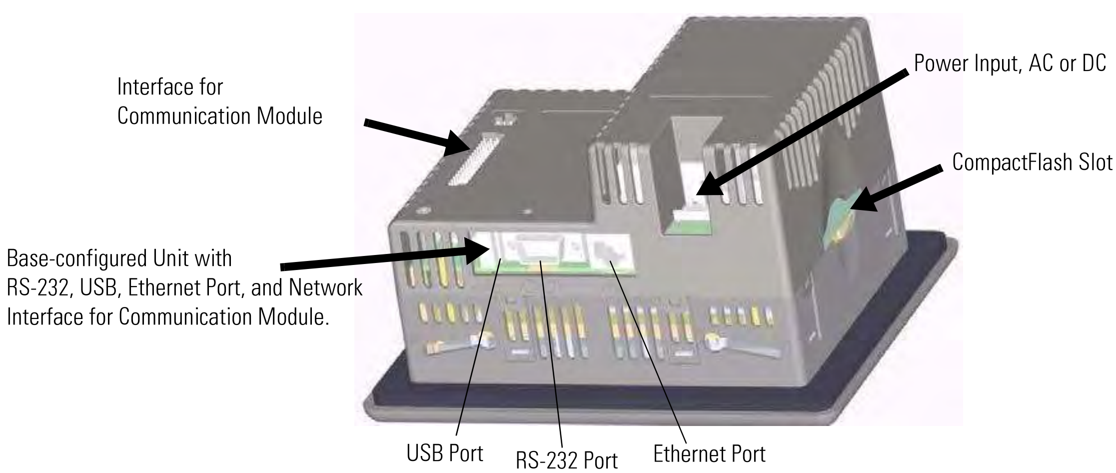
The base-configured unit of the 400 and 600 terminals is available in two versions.

- Base unit with RS-232 port and one USB port
- Base unit with RS-232 port, 10/100BaseT Ethernet port, one USB port, and a network interface for a communication module

Base Unit with RS-232 Only



Base Unit with RS-232, Ethernet Port, and Modular Communications Interface



Specifications

Electrical

Attribute	Value
400 and 600 Input voltage, DC Power consumption, DC 700 to 1500 Input voltage, DC Power consumption, DC	 24V DC nom (18…30V DC) 25 W max (1.0 A at 24V DC) 24V DC nom (18…32V DC) 70 W max (2.9 A at 24V DC) 39 W typical (1.6A @ 24V DC)
400 and 600 Input voltage, AC Line frequency Power consumption, AC 700 to 1500 Input voltage, AC Line frequency Power consumption, AC Remote power 700 to 1500 (2711P-RSAC) Input voltage, AC Line frequency Power consumption, AC	 85…264V AC 47…63 Hz 60V A max 85…264V AC 47…63 Hz 160V A max, 65 VA typical 85…264V AC 47…63 Hz 120V A max
PCI slot max available power Supply, DC Supply, AC	 11 W 5 W

Environmental

Attribute	Value
Temperature, operating	0…55 °C (32…131 °F)
Temperature, non-operating	-25…70 °C (-13…158 °F)
Heat dissipation 400 and 600 700 to 1500	 85 BTU/hr 240 BTU/hr
Relative humidity	5…95% without condensation
Altitude, operating	2000 m (6561 ft)
Shock, operating	15 g at 11 ms
Shock, nonoperating	30 g at 11 ms

Vibration	10…57 Hz, 0.012 pk-pk displacement 57…500 Hz, 2 g pk acceleration
Enclosure Ratings	NEMA Type 12, 13, 4X (Indoor use only), IP54, IP65
Airborne Contaminants	For PVP/PVP-CE conformal-coated PCBA level products: ANSI/ISA S71.04 - 1985 Severity Level G3 EN60654-4:1998 Class 3

Display

Attribute	**Value**
Display type 400 and 600 grayscale 400…1500 color	 Grayscale passive matrix, film compensated super-twist nematic (FSTN) Color active matrix, thin-film transistor (TFT) with liquid crystal display (LCD)
Display size, diagonal 400 grayscale 400 color 600 700 1000 1250 and 1250 high-bright 1500	 3.8 in. 3.5 in. 5.5 in. 6.5 in. 10.4 in. 12.1 in. 15.0 in.
Display area (WxH) 400 grayscale 400 color 600 grayscale and color 700 1000 1250 and 1250 high-bright 1500	 77 x 58 mm (3.0 x 2.3 in.) 71 x 53 mm (2.8 x 2.1 in.) 112 x 84 mm (4.4 x 3.3 in.) 132 x 99 mm (5.2 x 3.9 in.) 211 x 158 mm (8.3 x 6.2 in.) 246 x 184 mm (9.7 x 7.2 in.) 304 x 228 mm (12.0 x 9.0 in.)
Resolution 400 grayscale and 400 color 600 700 1000 1250 and 1250 high-bright 1500	 320 x 240 320 x 240 640 x 480 640 x 480 800 x 600 1024 x 768
Luminance (typical) 400 grayscale 400 color 600 700 to 1500 1250 high-bright	 120 cd/m^2 Nits 200 cd/m^2 Nits 300 cd/m^2 Nits 300 cd/m^2 Nits 1000 cd/m^2 Nits

Backlight 400 600…1500 1250 High-bright	 LED CCFL 50,000 hours life, min. Backlight not replaceable
Touch screen Actuation rating Operating force	Analog resistive 1 million presses 10…110 g
Keypad function keys[1] Actuation rating Operating force	Function keys, numeric and navigation 1 million presses 340 g

[1] Number of function keys varies by terminal size.

Mechanical

Attribute	Value
Weight, approx., HxWxD (for base unit without modules)	
400 keypad[1] or keypad and touch 600 keypad or keypad and touch[1] 600 touch[1] 700 keypad or keypad and touch 700 Touch 1000 keypad or keypad and touch 1000 touch 1250 keypad or keypad and touch 1250 touch and 1250 high-bright touch 1500 keypad or keypad and touch 1500 touch	562 g (1.24 lb) 930 g (2.05 lb) 789 g (1.74 lb) 1.9 kg (4.2 lb) 1.7 kg (3.8 lb) 2.9 kg (6.3 lb) 2.6 kg (5.7 lb) 3.4 kg (7.6 lb) 3.2 kg (7.1 lb) 4.6 kg (10.0 lb) 4.2 kg (9.3 lb)
Dimensions, approx. HxWxD (for base unit without communication module)	
400 keypad or keypad and touch	152 x 185 x 90 mm (6.0 x 7.28 x 3.54 in.)
600 keypad or keypad and touch	167 x 266 x 98 mm (6.58 x 10.47 x 3.86 in.)
600 touch	152 x 185 x 98 mm (6.0 x 7.28 x 3.86 in.)
700 keypad or keypad and touch	193 x 290 x 55 mm (7.58 x 11.40 x 2.18 in.)
700 touch	179 x 246 x 55 mm (7.04 x 9.68 x 2.18 in.)
1000 keypad or keypad and touch	248 x 399 x 55 mm (9.77 x 15.72 x 2.18 in.)
1000 touch	248 x 329 x 55 mm (9.77 x 12.97 x 2.18 in.)
1250 keypad or keypad and touch	282 x 416 x 55 mm (11.12 x 16.36 x 2.18 in.)
1250 touch	282 x 363 x 55 mm (11.12 x 14.30 x 2.18 in.)
1250 touch High-bright	282 x 363 x 74 mm (11.12 x 14.30 x 2.90 in.)
1500 keypad or keypad and touch	330 x 469 x 65 mm (12.97 x 18.46 x 2.55 in.)
1500 touch	330 x 416 x 65 mm (12.97 x 16.37 x 2.55 in.)

[1] Add approximately 95 g (0.21 lb) for communication module.

General

Attribute	Value
Battery life 400 and 600 700 to 1500	 5 years min. at 25 °C (77 °F) 4 years min. at 25 °C (77 °F)
Clock	Battery-backed, +/-2 minutes per month
LED indicators	COMM (Green), Fault (Red)
Application flash memory 400 and 600, series A 400 and 600, series B or later 700 to 1500 logic modules, series A to D 700 to 1500 logic modules, series E or later 2711P-RW1 2711P-RW2 2711P-RW3 700-1500 CE logic modules, series E or later 2711P-RW6 2711P-RW7 2711P-RW8	 5 MB 10 MB 20 MB 26 MB 72 MB 195 MB 80 MB 203 MB 446 MB
External CompactFlash storage	512 MB max

Agency Certifications

Certifications [1]	Value
c-UL-us	UL Listed Industrial Control Equipment, certified for use in US and Canada. See File E10314. UL Listed Industrial Control Equipment for use in: • Class I, Div 2, Group A, B, C, D • Class I, Zone 2, Group IIC [2] • Class II, Div 2 Groups F, G • Class III Hazardous Locations
CE (EMC)	European Union 2004/108/EC Directive, compliant with: EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions
CE (LVD)	European Union 2006/95/EC Low Voltage Directive, compliant with: EN 61131-2; Programmable Controllers
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Marine [1]	Products identified with the suffix M in the catalog number, are certified to the requirements of one or more marine societies.

(1) See the Product Certification link on http://ab.com for declarations of conformity, certificates, and other certification details.

(2) Applies only to the 1250 high-bright display module.

HARBOR BROOK CSO 018 CONSTRUCTED WETLANDS PANEL A – EXOR HMI USER MANUAL

CH2M Syracuse

Revised March 2017

Table of Contents

Introduction

This document provides guidance on the operation of the replacement EXOR panel within Panel A at the CSO 018 Constructed Wetlands Facility. This document is not intended to provide comprehensive training. This document is intended to provide guidance on specific functions as programmed into this panel.

The panel is designed based on standard tools provided by EXOR International. Refer to the EXOR programming manual additional information on components in the programming. The design of the individual screens was based off of the original PanelView Plus HMI that ceased functionings due to water damage.

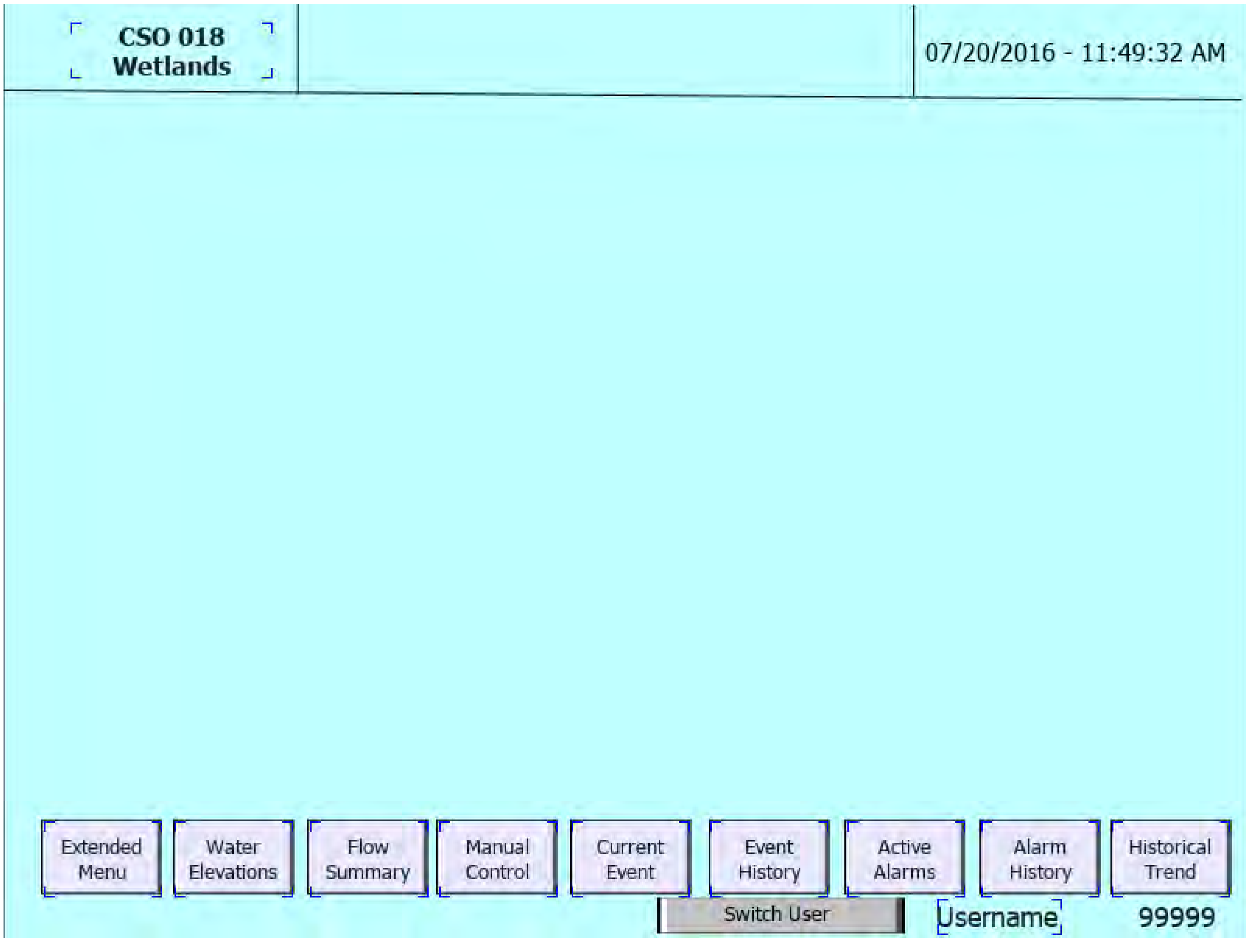
Screens

The following screens are included for display:

1. Extended Menu
2. Water Elevations (Displayed as bar graphs)
3. Flow Summary
4. Manual Control (Box 1A and MH-3C Gates, and SS1 and SS2 Washdown Sprays)
5. Current Event (Information only)
6. History Event (3 pages, historical data related to past events)
7. Active Alarms (Alarms that are currently active in the system)
8. Historical Alarms (Historical records of current and past alarms)
9. Historical Trend (MH-3302 and MH-3C levels)
10. HMI Maintenance (Screen displaying system status and ability to set HMI time)
11. Setup 01 (Inputs for influent event setpoints)
12. Setup 02 (Various PLC data device setup parameters)
13. Panel B Data (Data associated with devices at Panel B: MH-5A, MH-18, MH-19, and Cell 1 and 2 level sensors)

Background graphic

There is a background graphic that is common to all pages. This graphic contains a set of navigation buttons across the bottom, the current user and a button to allow switching users.



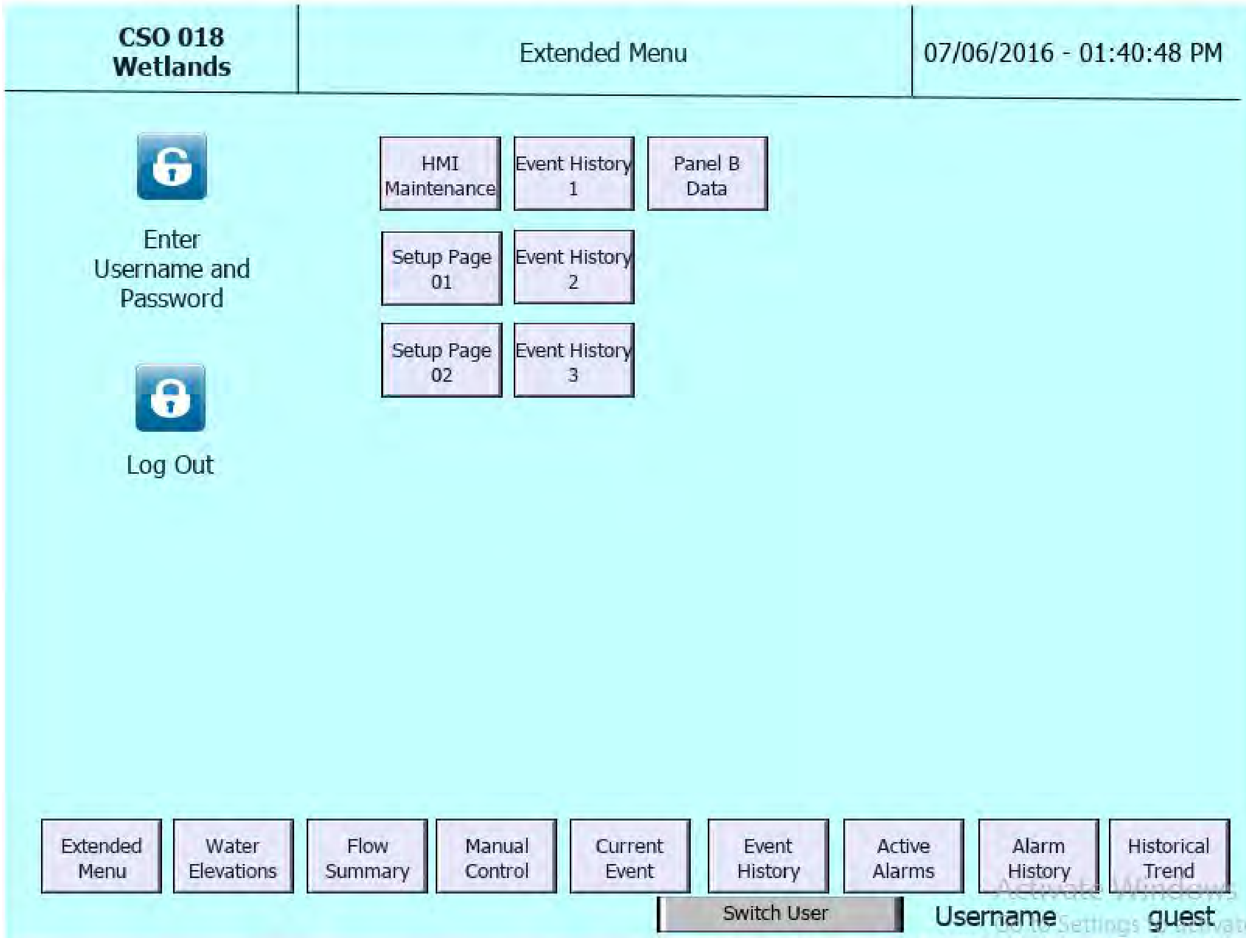
Security

Security has been applied to the system. There are three available users:

Username	Password	Rights
admin	admin	Full access to all elements
operator	Cuse1870	Access to all input fields
guest	guest	May view information, but cannot change values

Extended Menu

When the system is booted up, the guest account is loaded, as this is the default account. The typical display is shown below.



When a user clicks on either the icon above "Enter Username and Password" or "Switch User" the following screen will be shown.

Enter the username and password, and select "Sign In" to change users.

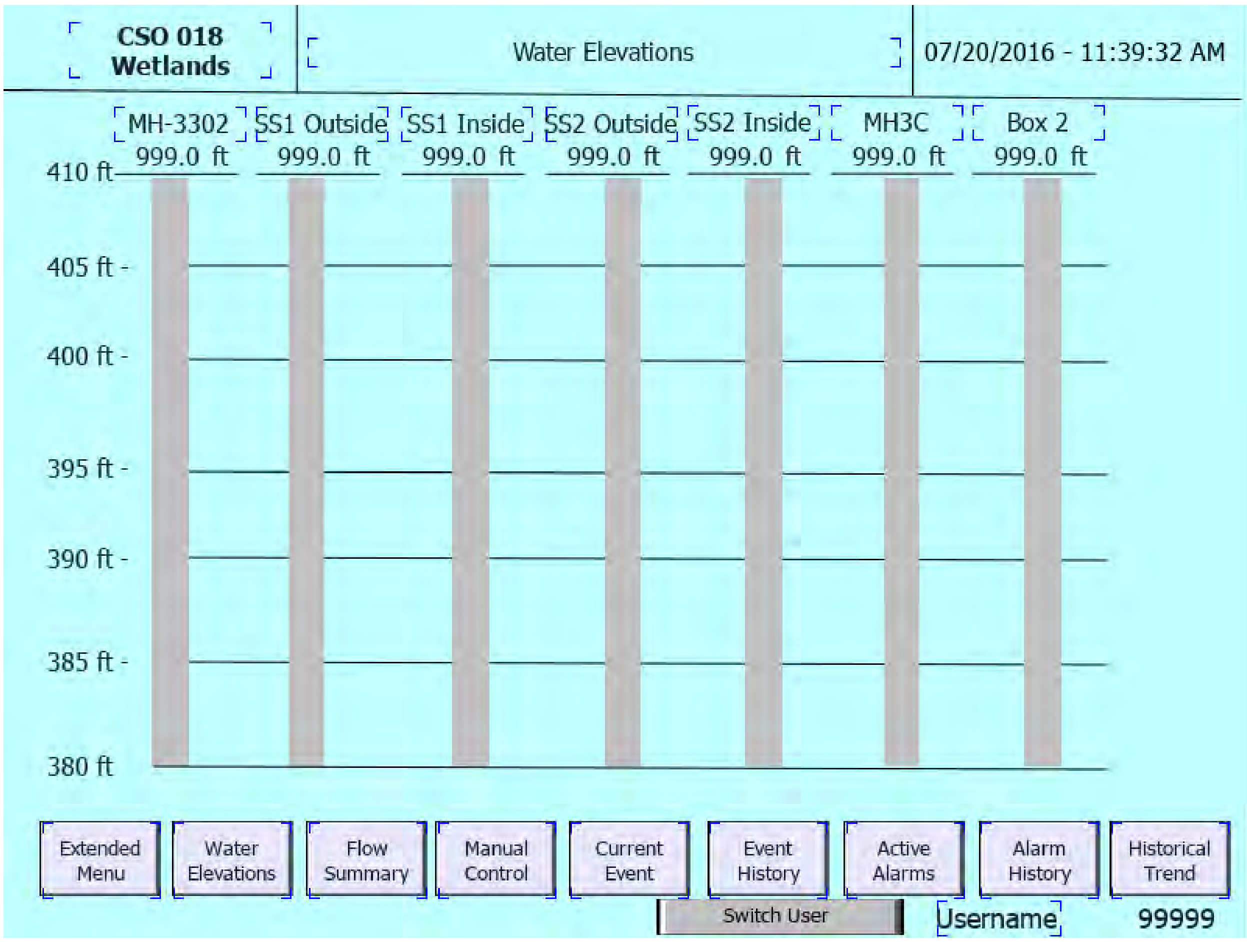
Select the "Log Out" icon to lock the system.
After 10 minutes of inactivity, the system will load a screen saver.
After 30 minutes of inactivity, the system will turn off the backlight and go dark.

After 60 minutes of inactivity, the system will default to the guest account.

Touch the screen at any time to return to normal operation.

Water Elevations

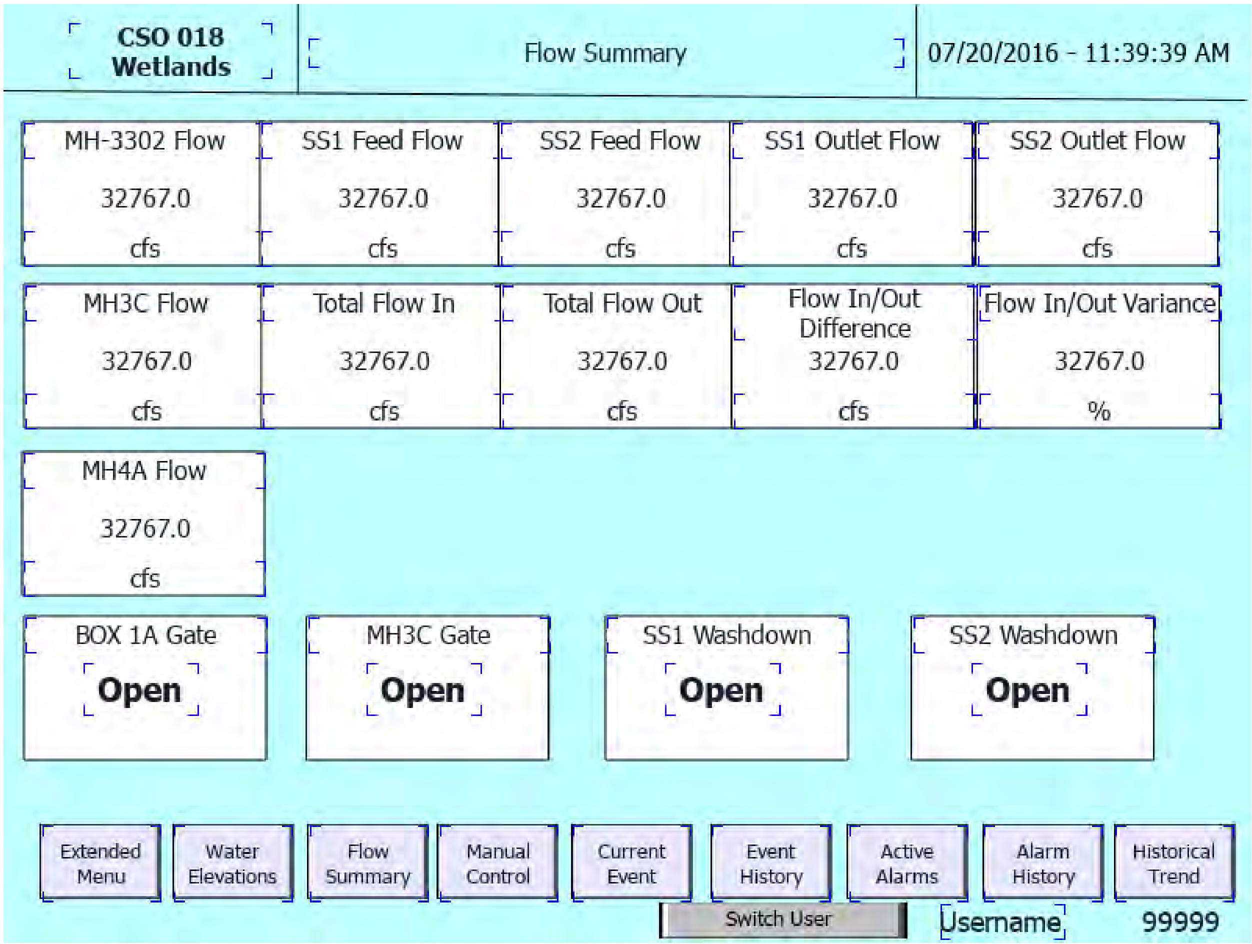
The Water Elevation Screen is as follows.



Real-time water elevations for MH-3302, SS1 and SS2 inside and outside the screens, MH-3C, and Box 2 are provided. Data is in mean sea elevations (MSEL).

Flow Summary

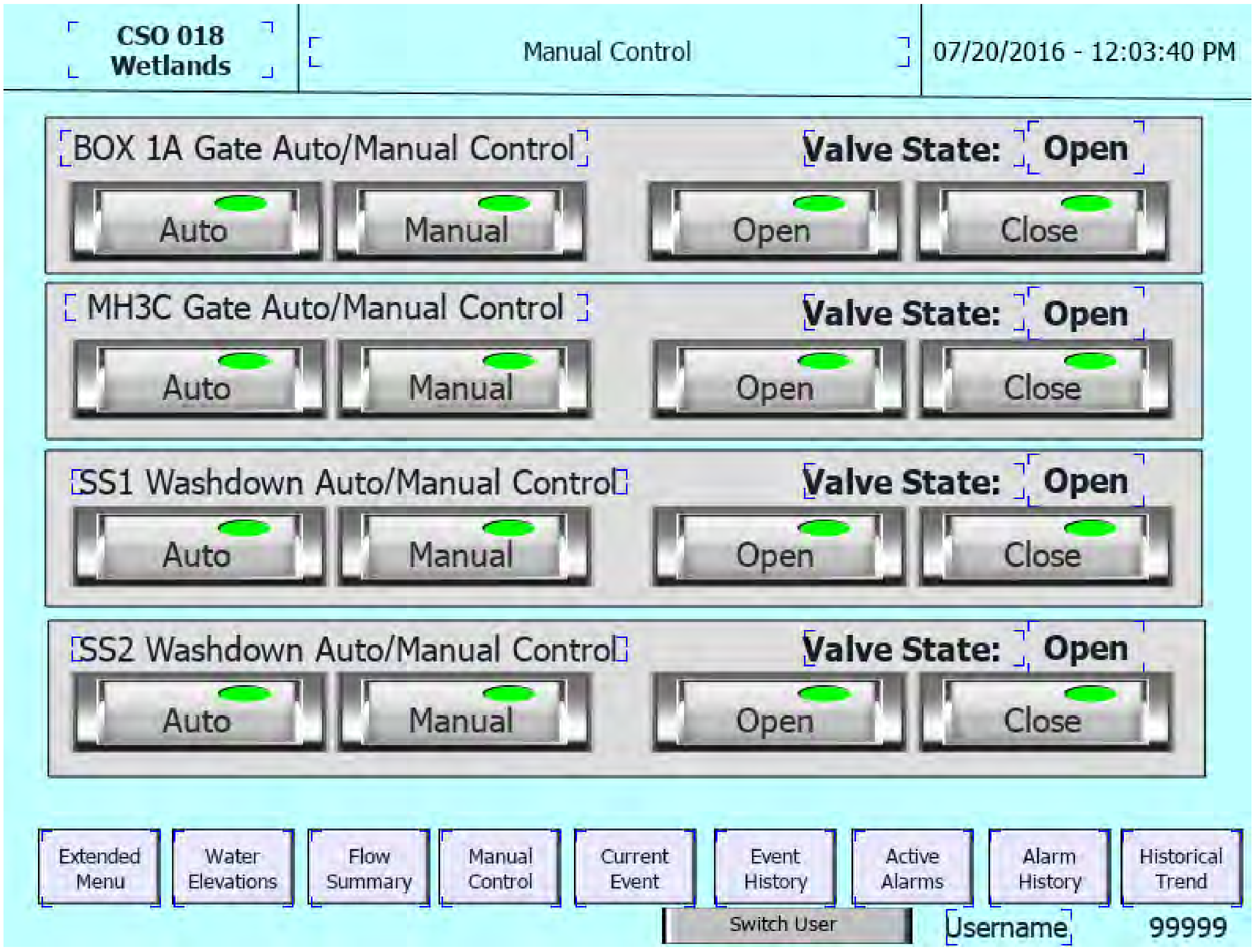
The Flow Summary Screen is as follows.



Real-time flow data in cubic feet per second (CFS) are provided for MH-3302, SS1 and SS2 feed and outflow, MH-3C, and MH-4A are provided along with the total flow in, total flow out, flow in/out difference, and flow in/out variance (percentage). Also listed are the status of the Box 1A gate, MH-3C gate, and SS1 and SS2 washdown spray valves.

Manual Control

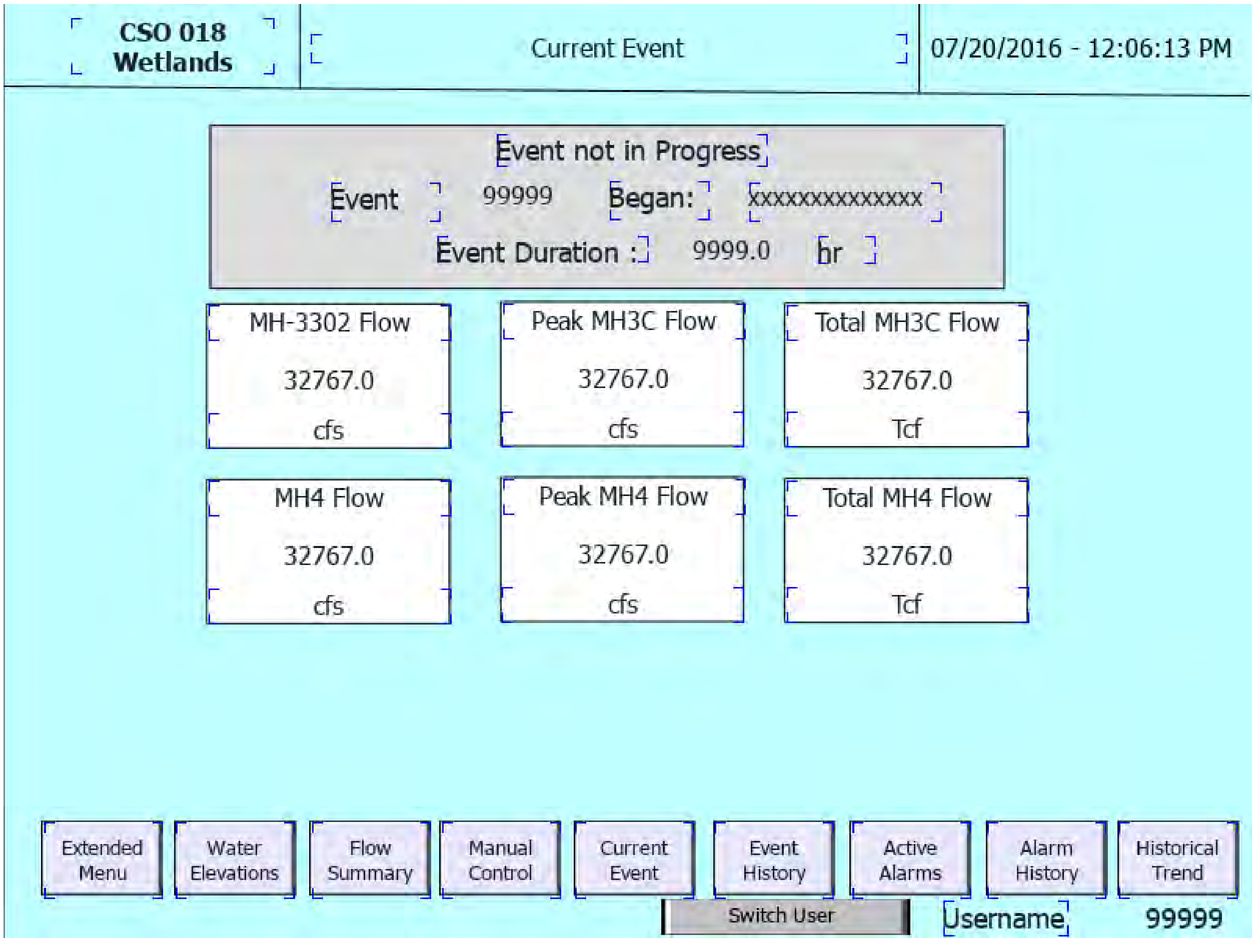
The Manual Control screen is as follows.



The Box 1A and MH-3C gate valves, and SS1 and SS2 washdown spray valves can be controlled manually from this screen. Each “auto,” “manual,” “open,” and “close” button can be pushed to change the valve state.

Current Event

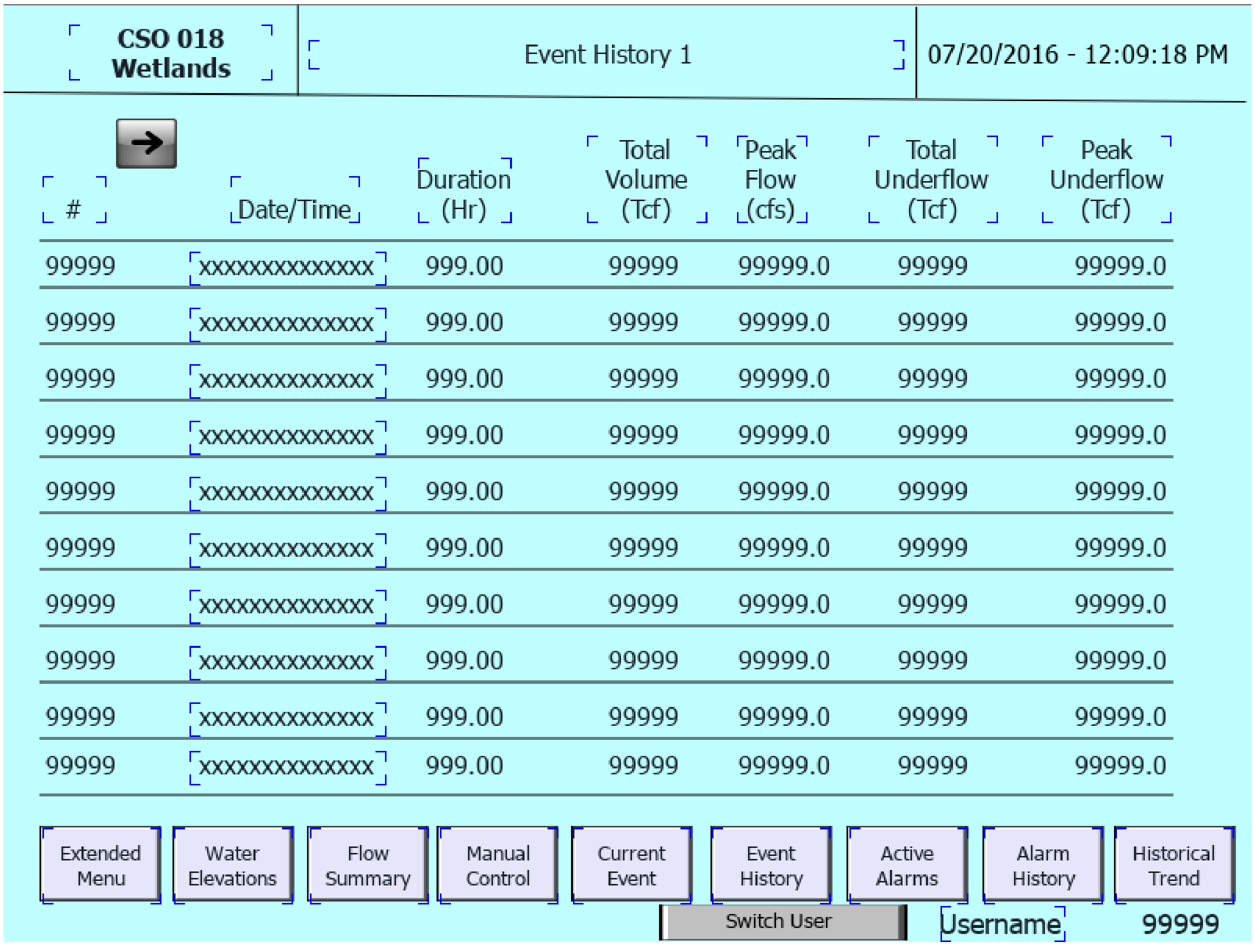
The Current Event screen is as follows.



The current event screen displays the influent diversion event status. If an influent diversion is not occurring, “Event not in Progress” is displayed. When influent diversions are underway, the event number will be displayed along with the start time, and duration (at the time of viewing). The current MH-3302 flow, peak and total MH-3C flows, and current, peak, and total MH-4A flows are also displayed.

Event History

The Event History screen is as follows.

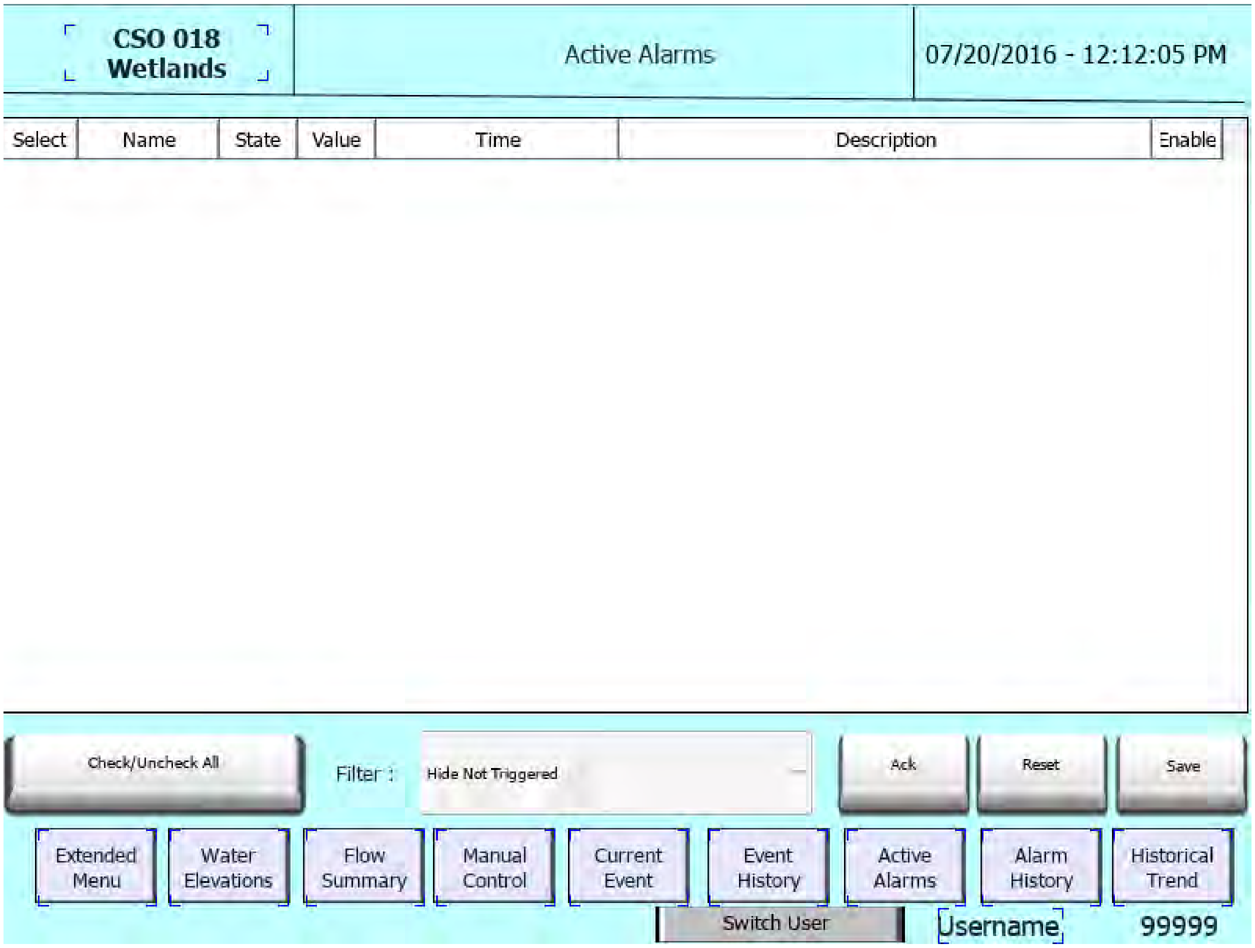


#	Date/Time	Duration (Hr)	Total Volume (Tcf)	Peak Flow (cfs)	Total Underflow (Tcf)	Peak Underflow (Tcf)
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0
99999	xxxxxxxxxxxxxx	999.00	99999	99999.0	99999	99999.0

The event history provides 3 pages worth of influent diversion historical data. Data for up to 30 influent diversions is stored. For each influent diversion, the diversion number, date and time, duration, total volume diverted, peak flow rate, total underflow volume, and peak underflow flow rate are displayed.

Active Alarms

The Active Alarms screen is as follows.



The active alarm screen displays any active alarms at the time of viewing. Active alarms can be acknowledged or reset by pressing the respective buttons.

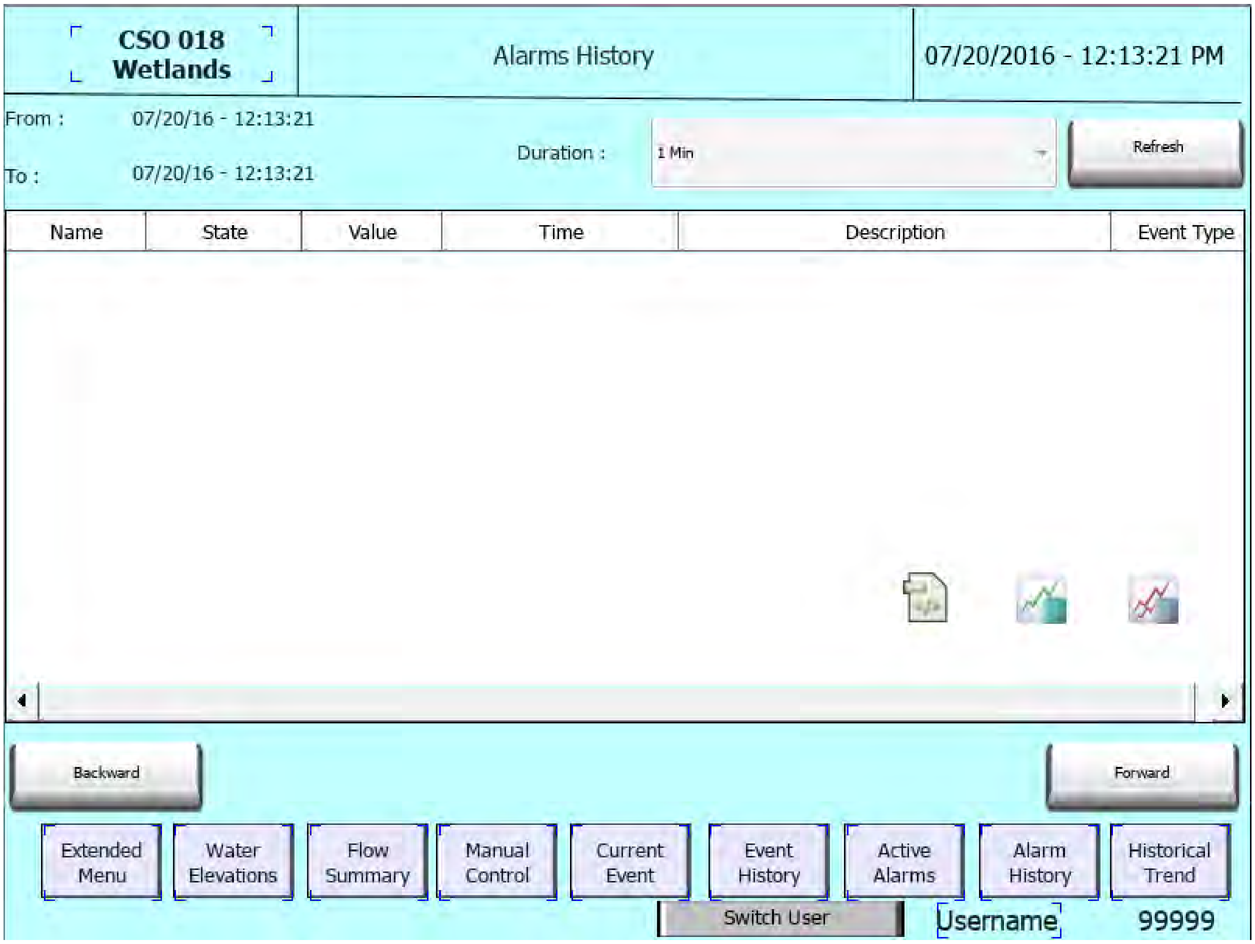
The following alarms are included in the alarm system. Acknowledgement of alarms is NOT required.

Tag	***Alarm***
UHB_E06/ControllerTags/Alarm_misc/CleanFailtoComplete	Washdown Spray Cycle Failed to Complete
UHB_E06/ControllerTags/Alarm_misc/PowerFail	Power Fail
UHB_E06/ControllerTags/Box1A/Valve/Alarm_FailtoClose	Box 1A Gate Fail to Close
UHB_E06/ControllerTags/Box1A/Valve/Alarm_FailtoOpen	Box 1A Gate Fail to Open
UHB_E06/ControllerTags/MH3C/Valve/Alarm_FailtoClose	MH-3C Gate Fail to Close
UHB_E06/ControllerTags/MH3C/Valve/Alarm_FailtoOpen	MH-3C Gate Fail to Open
UHB_E06/ControllerTags/SS1/Valve/Alarm_FailtoClose	SS1 Washdown Spray Fail to End
UHB_E06/ControllerTags/SS1/Valve/Alarm_FailtoOpen	SS1 Washdown Spray Fail to Start
UHB_E06/ControllerTags/SS2/Valve/Alarm_FailtoClose	SS2 Washdown Spray Fail to End
UHB_E06/ControllerTags/SS2/Valve/Alarm_FailtoOpen	SS1 Washdown Spray Faill to Start
UHB_E06/ControllerTags/Box1A/Level/sigFail	MH-3302 Level Sensor Fail
UHB_E06/ControllerTags/MH3C/Level/sigFail	MH-3C Level Sensor Fail
UHB_E06/ControllerTags/MH4/Level/sigFail	MH4A Level Signal Fail

UHB_E06/ControllerTags/Box1A/Valve/inLocal	Box 1A Gate is not in Remote Control
UHB_E06/ControllerTags/MH3C/Valve/inLocal	MH-3C Gate is not in Remote Control
ControllerTags/E07_Eff_EventStart	MH-19 Effluent Alarm Active

Alarm History

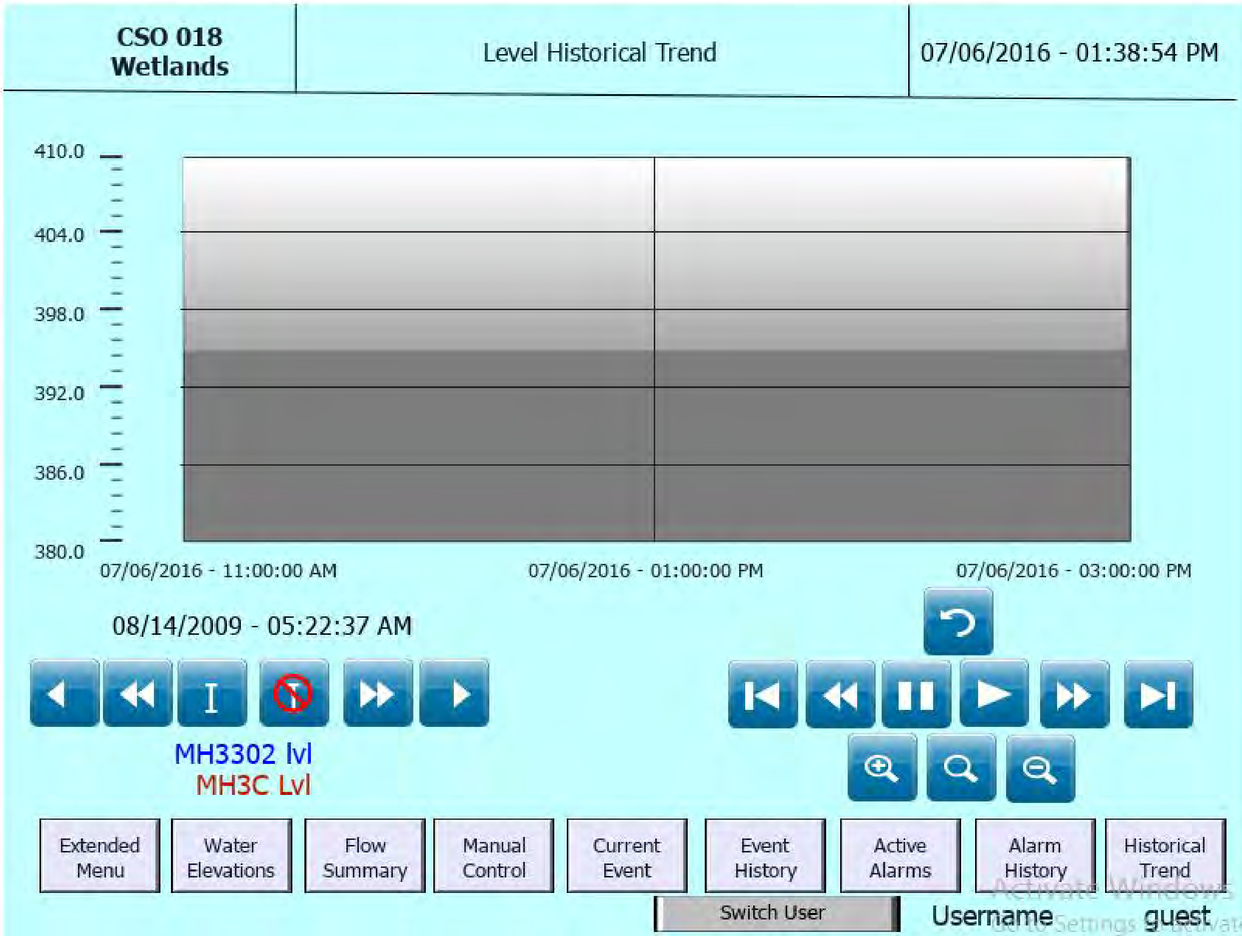
The Alarm History screen is as follows.



The alarm history can be viewed over a selected timeframe by using the dropdown menu in the upper right corner of the screen and pushing refresh. Alarms over the selected timeframe will display for reference purposes only.

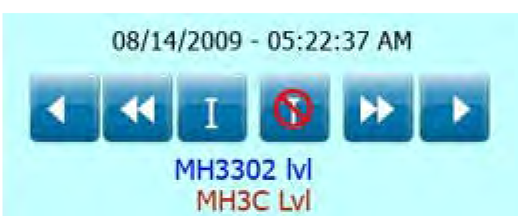
Historical Trend

The Historical Trend Screen is as follows.

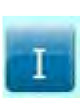


The default screen shows 4 hours of data. Data points are collected at 60 second intervals and up to 40,000 points are stored for each trend. There are two sets of controls located at the bottom. One set allows addition and control of a cursor. The second allows one to change the display of the historical display.

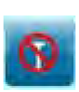
Cursor Control



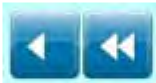
This set of controls accesses the cursor by the following functions

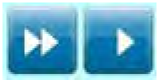


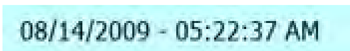
Display the cursor



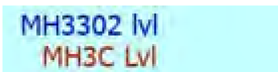
Hide the cursor

 Move the cursor left. The single is fine tuning and moves the cursor each tie it is depressed. The double moves the cursor when depressed and held down. Release when the cursor is located near the point to be observed, then use the fine tune keys.

 Move the cursor right. The single is fine tuning and moves the cursor each tie it is depressed. The double moves the cursor when depressed and held down. Release when the cursor is located near the point to be observed, then use the fine tune keys.

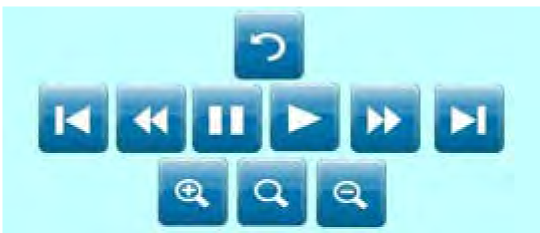


This will display the current curser time.



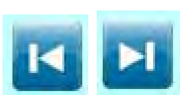
This will display the values for the trend lines for each trend where the cursor crosses the trend.

Trend Control



This set of controls accesses the trend display.

 This will bring the trend to the current time.

 These buttons will page the trend right or left.

 These buttons will scroll the trend right or left.

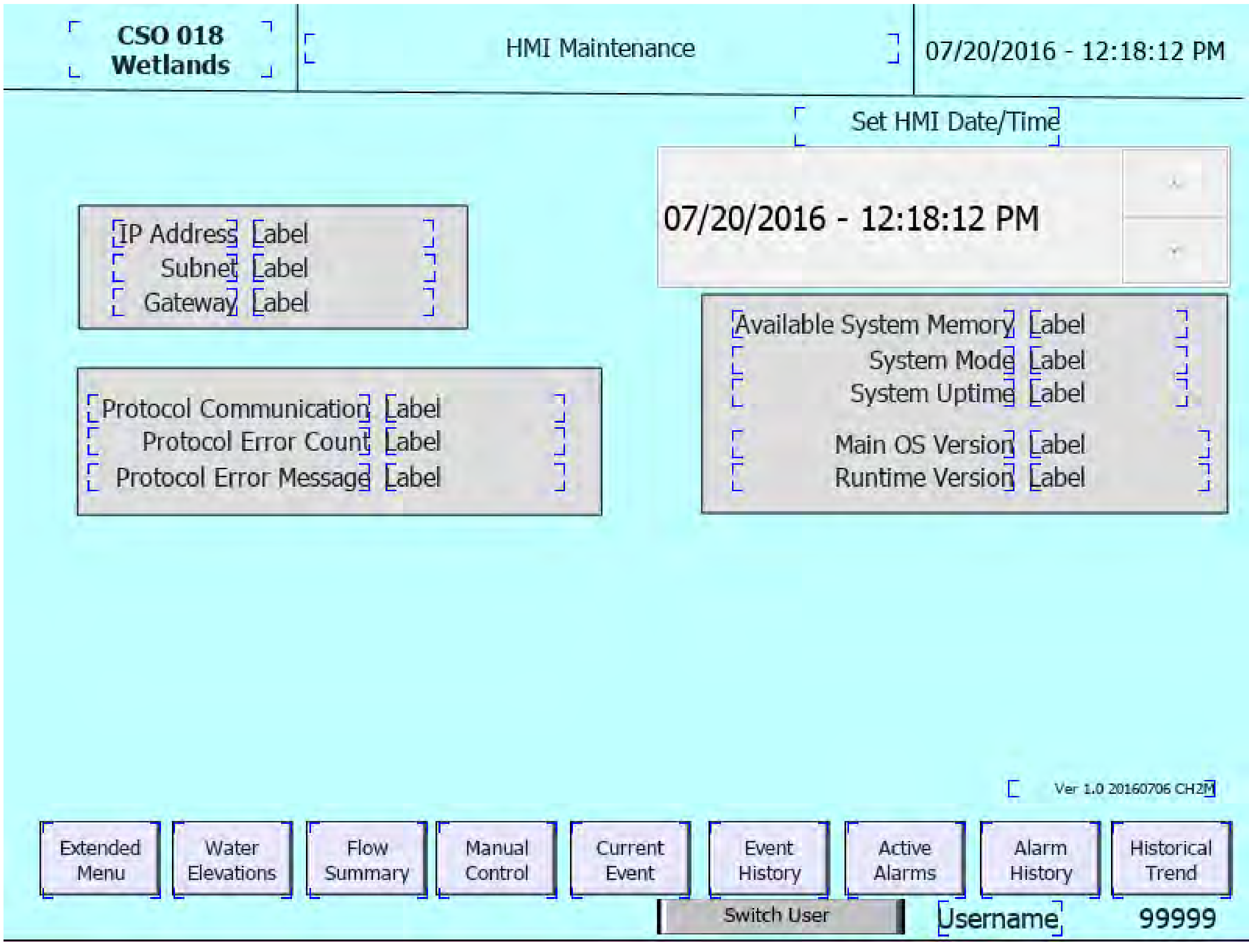
 This button will zoom in on the trend.

 This button will zoom out on the trend.

 This button will reset the trend zoom.

HMI Maintenance

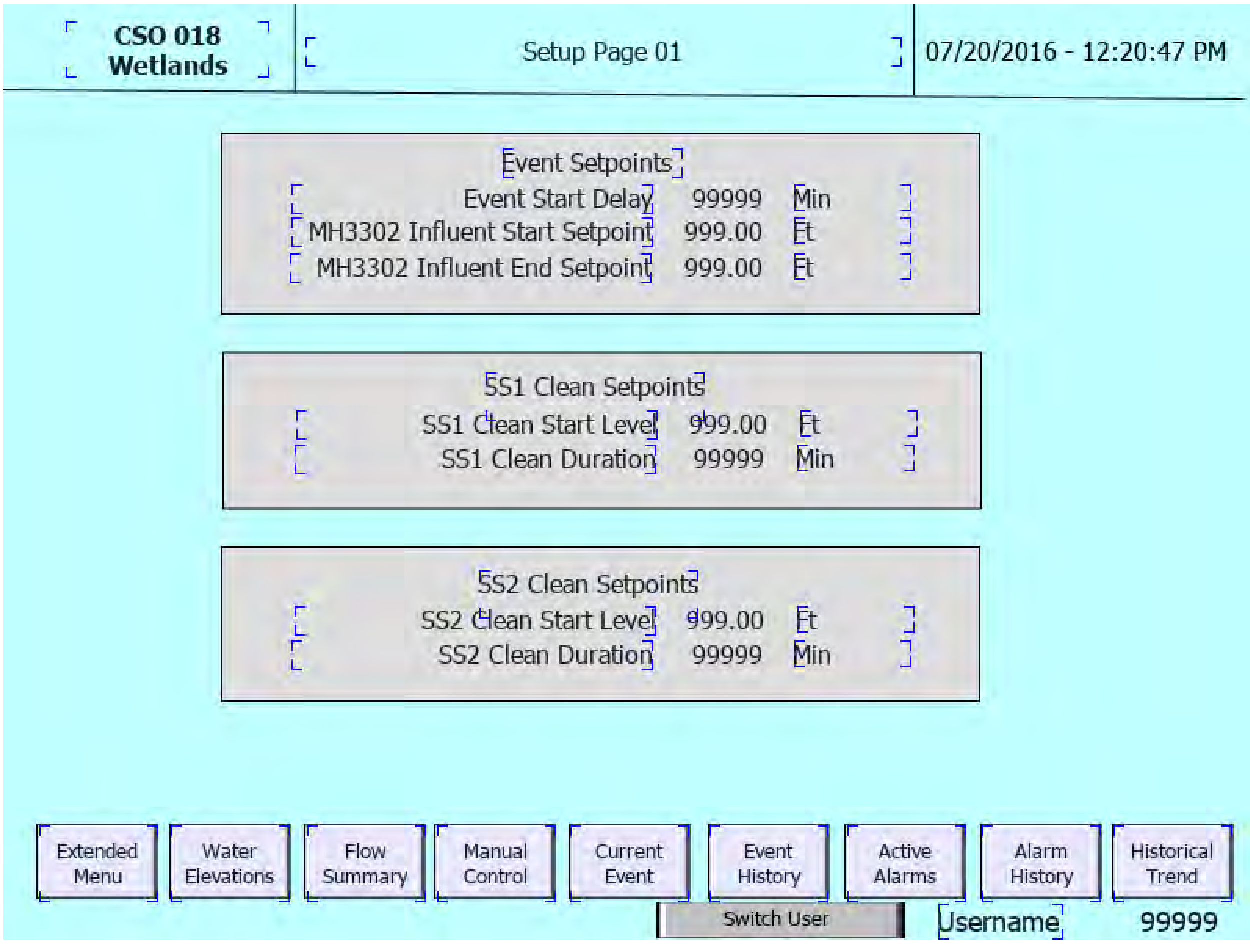
The HMI Maintenance screen is as follows.



The HMI time can be adjusted on the HMI Maintenance screen by utilizing the up and down arrows in the upper right corner. Other HMI-related messages are displayed for reference purposes only. Actual maintenance to the HMI program would need to be conducted utilizing a computer with EXOR software.

Setup 01

The Setup 01 screen is as follows.

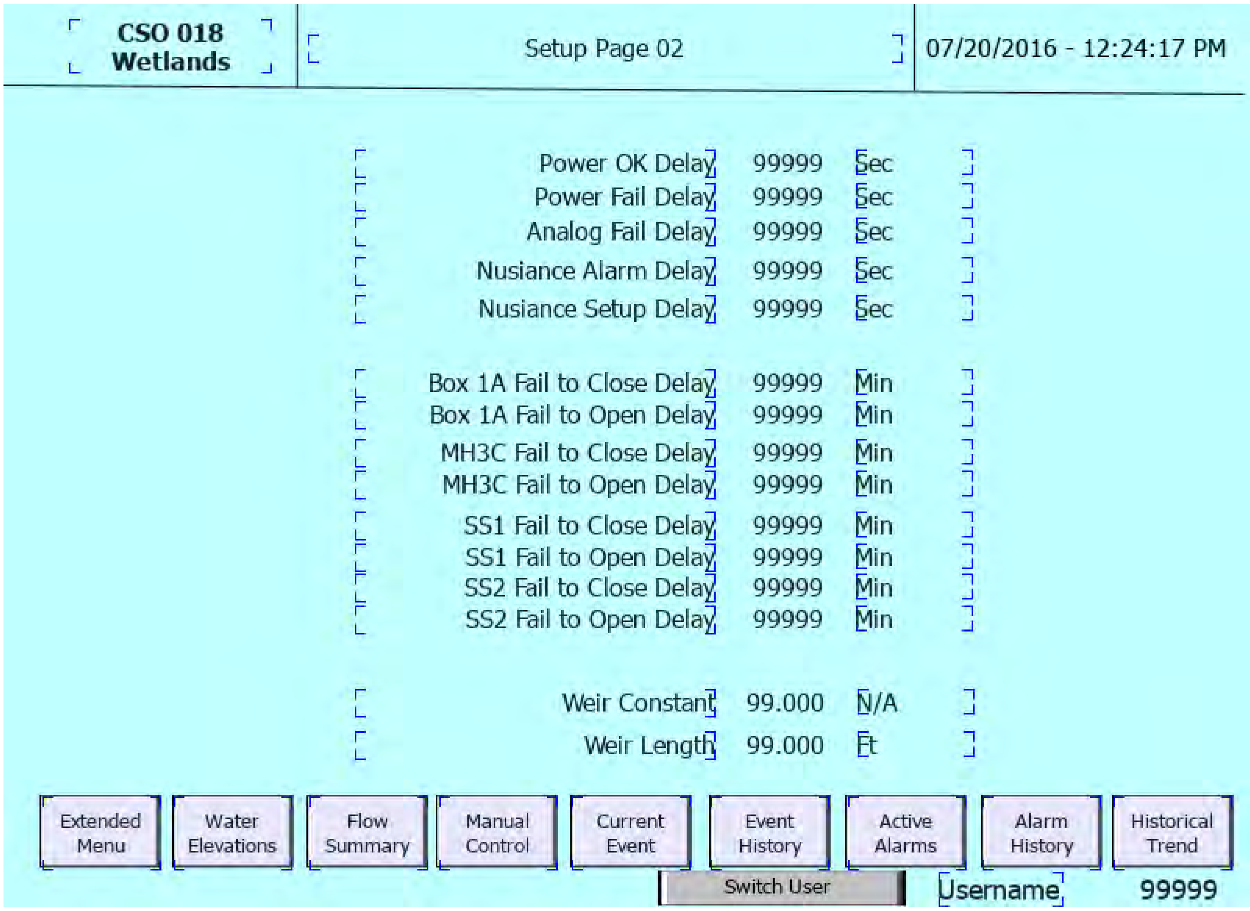


The Setup 01 screen allows for editing the following. Edits can be made by pushing the respective value to be changed.

- Event Setpoints
  - Event Start Delay (10 minutes)
  - MH-3302 Influent Start Setpoint (403.52 MSEL)
  - MH-3302 Influent End Setpoint (404.59 MSEL)
- SS1/SS2 Clean Setpoints
  - SS1/SS2 Clean Start Level (395.00 MSEL)
  - SS1/SS2 Clean Duration (20 minutes)

Setup 02

The Setup 02 screen is as follows.

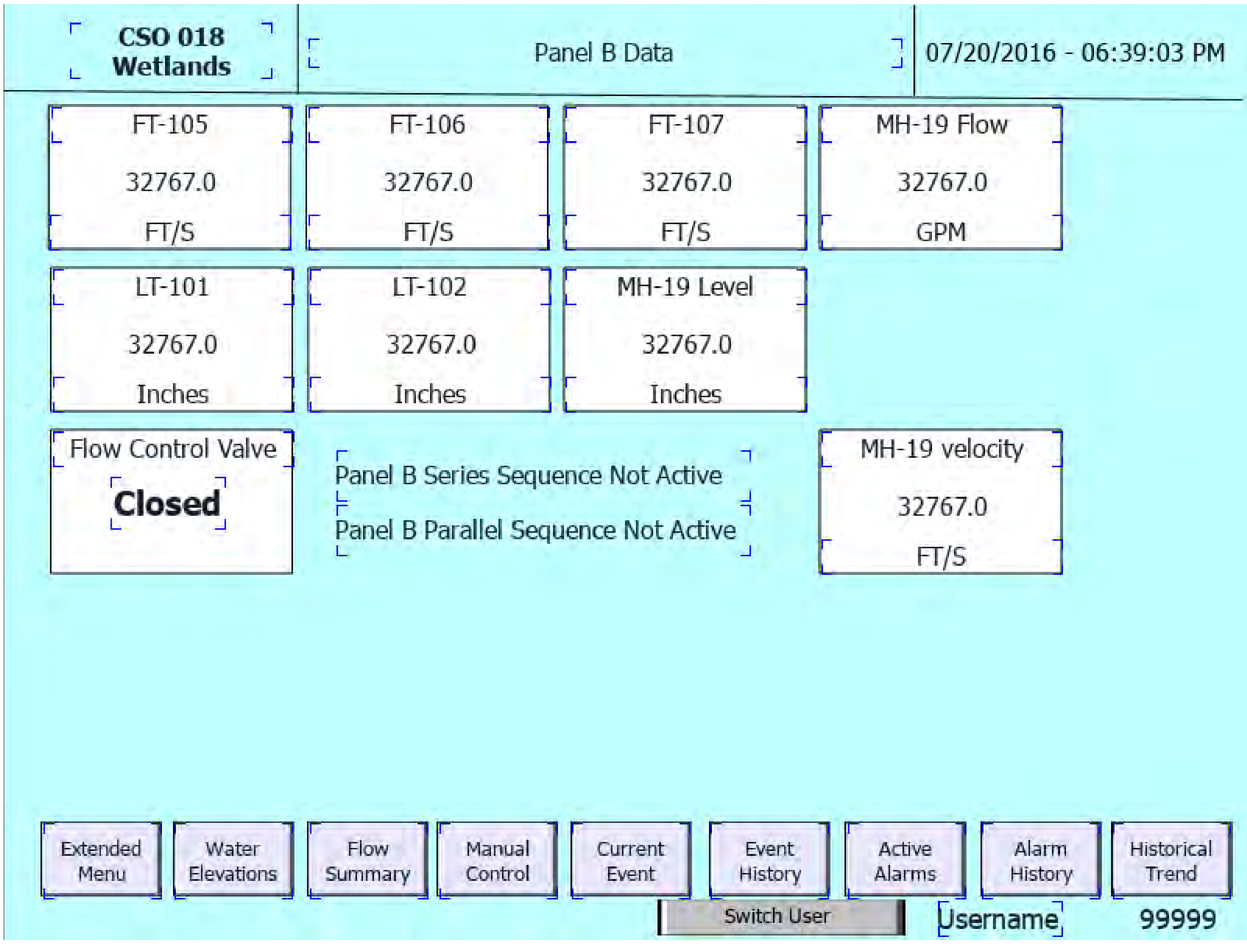


The Setup 02 screen contains the following variables necessary for facility operation, but likely to never be modified or changed.

- Power Ok Delay = 10 second
- Power Fail Delay = 2 seconds
- Analog Fail Delay = 5 seconds
- Nuisance Alarm Delay = 30 seconds
- Nuisance Setup Delay = 30 seconds
- Box 1A Fail to Close Delay = 5 minutes
- Box 1A Fail to Open Delay = 5 minutes
- MH-3C Fail to Close Delay = 5 minutes
- MH-3C Fail to Open Delay = 5 minutes
- SS1/SS2 Fail to Close Delay = 5 minutes
- SS1/SS2 Fail to Open Delay = 5 minutes
- Weir Constant = 3.2
- Weir Length = 5 feet

Panel B Data

The Panel B Data screen is as follows.



The following data are available from Panel B:

- FT-105 (MH-5A) Velocity
- FT-106 (MH-18) Velocity
- FT-107 (MH-19) Velocity
- MH-19 Flow
- LT-101 (Cell 1) Level
- LT-102 (Cell 2) Level
- MH-19 Level
- MH-19 Velocity
- Flow Control Valve (Dosing Valve) Postion (Open/Closed)
- Status of Wetland Cells (Series or Parallel)

HOME | SELECT UNITS | SELECT APPLICATION | SELECT SERIES | QUOTE CHECKOUT | CONTACT BETE

BETE NF Nozzle Models

Nozzle Flow Rate:	5	gpm
Pressure:	30	psi
Spray Pattern:	Fan	
Specific Gravity:	1.00	

GO >

BETE Model	Pipe Size(s)	Conn. Type	Spray Angle	Flow Rate at 30 psi	Est. Drop Size	Pressure at 5 gpm	Free Passage
NF50	1/4,3/8	Male	0°	4.3 gpm	N/A	40.0 psi	0.00 in
NF50	1/4,3/8	Male	15°	4.3 gpm	744 µm	40.0 psi	0.00 in
NF50	1/4,3/8	Male	30°	4.3 gpm	623 µm	40.0 psi	0.00 in
NF50	1/4,3/8	Male	50°	4.3 gpm	542 µm	40.0 psi	0.00 in
NF50	**1/4,3/8**	**Male**	**65°**	**4.3 gpm**	**501 µm**	**40.0 psi**	**0.00 in**
NF50	1/4,3/8	Male	80°	4.3 gpm	468 µm	40.0 psi	0.00 in
NF50	1/4,3/8	Male	90°	4.3 gpm	448 µm	40.0 psi	0.00 in
NF50	1/4,3/8	Male	110°	4.3 gpm	410 µm	40.0 psi	0.00 in
NF50	1/4,3/8	Male	120°	4.3 gpm	390 µm	40.0 psi	0.00 in
NF60	1/4,3/8	Male	0°	5.2 gpm	N/A	27.8 psi	0.00 in
NF60	1/4,3/8	Male	15°	5.2 gpm	800 µm	27.8 psi	0.00 in
NF60	1/4,3/8	Male	30°	5.2 gpm	670 µm	27.8 psi	0.00 in
NF60	1/4,3/8	Male	50°	5.2 gpm	583 µm	27.8 psi	0.00 in
NF60	1/4,3/8	Male	65°	5.2 gpm	539 µm	27.8 psi	0.00 in
NF60	1/4,3/8	Male	80°	5.2 gpm	503 µm	27.8 psi	0.00 in
NF60	1/4,3/8	Male	90°	5.2 gpm	482 µm	27.8 psi	0.00 in
NF60	1/4,3/8	Male	110°	5.2 gpm	441 µm	27.8 psi	0.00 in
NF60	1/4,3/8	Male	120°	5.2 gpm	420 µm	27.8 psi	0.00 in
NF60	3/8,1/2	Male	0°	5.2 gpm	N/A	27.8 psi	0.00 in
NF60	3/8,1/2	Male	15°	5.2 gpm	800 µm	27.8 psi	0.00 in
NF60	3/8,1/2	Male	30°	5.2 gpm	670 µm	27.8 psi	0.00 in
NF60	3/8,1/2	Male	50°	5.2 gpm	583 µm	27.8 psi	0.00 in
NF60	3/8,1/2	Male	65°	5.2 gpm	539 µm	27.8 psi	0.00 in
NF60	3/8,1/2	Male	80°	5.2 gpm	503 µm	27.8 psi	0.00 in
NF60	3/8,1/2	Male	90°	5.2 gpm	482 µm	27.8 psi	0.00 in
NF60	3/8,1/2	Male	110°	5.2 gpm	441 µm	27.8 psi	0.00 in
NF60	3/8,1/2	Male	120°	5.2 gpm	420 µm	27.8 psi	0.00 in

Select Connector: 1/4 M npt **Select Material:** 303 Stainless Steel GO >

Click here for material specifications

SKU #	BETE Product Code	Length	Hex Dia.	Weight	Mat Trade Name	Max Temp	Mat DIN	Mat Spec
006545	1/4NF5065@5	1.06 in	0.56 in	1.50 oz	n/a	800° F	1.4305	A582 S30300

Click here to Add a Request for Quote

SJ

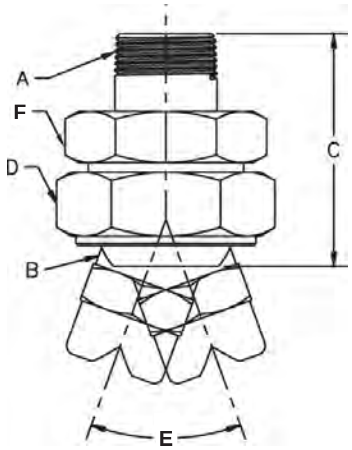
Swivel Joints

DESIGN FEATURES
- Adjustable swivel joints allow custom alignment of spray nozzles without expensive piping changes
- Leak-proof design
- Standard materials are brass and stainless steel
- Other materials available upon request

SPRAY CHARACTERISTICS
- **Adjustment angles:** From 30° to 45°
- Greater control of spray direction for precise coverage

Adjustable Swivel Joints aid in aligning spray nozzles

(Optional NF nozzle shown, choose nozzle when ordering)



Dimensions are approximate. Check with BETE for critical dimension applications.

Swivel Joint Dimensions

Part Number	A Inlet Pipe Conn. BSP or NPT	B Outlet Pipe Conn. BSP or NPT	C Overall Length (in.)	D Hex Size (in.)	E Angle of Adjustment	F Hex Size	Net Wt.* (oz.)
1/8 x 1/8 SJ	1/8 M	1/8 F	1.25	0.813	45°	0.813	2.0
1/4 x 1/4 SJ	1/4 M	1/4 F	1.50	1.13	45°	1.00	3.9
3/8 x 1/4 SJ	3/8 M	1/4 F	1.75	1.50	45°	1.38	8.6
3/8 x 3/8 SJ	3/8 M	3/8 F	1.75	1.50	45°	1.38	8.6
1/2 x 3/8 SJ	1/2 M	3/8 F	2.00	1.75	45°	1.63	12.9
1/2 x 1/2 SJ	1/2 M	1/2 F	2.00	1.75	45°	1.63	12.2
3/4 x 1/2 SJ	3/4 M	1/2 F	2.13	2.00	45°	1.88	17.8
3/4 x 3/4 SJ	3/4 M	3/4 F	2.13	2.00	45°	1.88	16.4
1x1 SJ	1 M	1 F	3.00	2.44	45°	2.25	34.1
1 1/4 x 1 1/4 SJ	1 1/4 M	1 1/4 F	3.50	3.13	30°	2.88	67.0
1 1/2 x 1 1/2 SJ	1 1/2 M	1 1/2 F	3.88	3.38	30°	3.38	94.5
2 x 2 SJ	2	2	4.13	4.00	40°	3.50	103

* Weights are based on brass and represent one of the heavier materials

SPECIAL PURPOSE

CALL 413-772-0846

Call for the name of your nearest BETE representative.

Instruction Manual • January 2006

million in one

hydroranger 200

MILLTRONICS

Safety Guidelines: Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel: This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Unit Repair and Excluded Liability:

- The user is responsible for all changes and repairs made to the device by the user or the user's agent.
- All new components are to be provided by Siemens Milltronics Process Instruments Inc.
- Restrict repair to faulty components only.
- Do not reuse faulty components.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

	Disclaimer of Liability
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- For a selection of Siemens Milltronics level measurement manuals, go to: **www. siemens.com/processautomation**. Under Process Instrumentation, select *Level Measurement* and then go to the manual archive listed under the product family.
- For a selection of Siemens Milltronics weighing manuals, go to: **www. siemens.com/processautomation**. Under Weighing Technology, select *Continuous Weighing Systems* and then go to the manual archive listed under the product family.

Table of Contents

The HydroRanger 200

The HydroRanger 200 is an ultrasonic level controller for up to six pumps, and provides control, differential control and open channel flow monitoring. It is available as a single or dual-point device, includes a larger number of advanced pump control algorithms, and is equipped with digital communications. It offers the latest in echo processing technology and diagnostic features.

The HydroRanger 200 is designed for a variety of applications:

- water and wastewater
- storage tanks, for measuring liquids, slurries, and solids
- hoppers, ore bunkers, flotation cells

The Manual

The manual provides instruction for HydroRanger 200 models.

The manual is designed to help you get the most out of your HydroRanger, and it provides information on the following:

- How to program the unit
- Example applications
- Principles of operation
- Parameter values
- Parameter uses
- Outline diagrams
- Wiring diagrams
- Installation requirements
- Modbus® [1] register mapping
- Modem configuration

1. Modbus is a registered trademark of Schneider Electric.

If you have any questions, comments, or suggestions about the manual contents, please email us at techpubs.smpi@siemens.com.

For the complete library of Siemens Milltronics manuals, go to www.siemens.com/processautomation.

Manual Symbols

Please note their use carefully.

∼	Alternating Current
⎓	Direct Current
⏚	Earth (ground) Terminal
	Protective Conductor Terminal
⚠	Caution (refer to instructions)
	Infra-red communication port on front of instrument
	RJ-11 communications port
	No co-axial cable connections

Configuration Examples

The configuration examples used in this manual illustrate the versatility of the HydroRanger 200. Because there is often a range of ways to approach an application, other configurations may also apply.

In all examples, substitute your own application details. If the examples do not apply to your application, check the applicable parameter reference for the available options.

Should you require more information, please contact your Siemens Milltronics representative. For a complete list of Siemens Milltronics representatives, go to www.siemens.com/processautomation.

Specifications

Power

AC version

- 100-230 V AC ± 15%, 50 / 60 Hz, 36 VA (17W)[1]
- fuse: F3: 2 AG, Slow Blow, 0.375A, 250V

DC version

- 12-30 V DC, 20W[1]
- fuse: F3: 2 AG, Slow Blow, 2A, 250V

Transmitter fuse

- F1: Belling Lee, L754, 4000A HRC, ceramic type, 100mA, 250V

Temperature Sensor fuse

- F2: Belling Lee, L754, 4000A HRC, ceramic type, 50mA, 250V

Mounting

Location

- indoor / outdoor

Altitude

- 2000 m max.

Ambient temperature

- -20 to 50 °C (-5 to 122 °F)

Relative humidity

- Wall Mount: suitable for outdoors (Type 4X / Nema 4X, IP65 Enclosure)
- Panel Mount: suitable for outdoors (Type 3 / Nema 3, IP54 Enclosure)

Installation category

- II

Pollution degree

- 4

Range

- 0.3 m (1 ft) to 15 m (50 ft), dependent on transducer

1. Power consumption is listed at maximum.

Accuracy

- 0.25% of maximum range or 6 mm (0.24”), whichever is greater

Resolution

- 0.1% of program range[1] or 2 mm (0.08”), whichever is greater

Memory

- 1 MB static RAM with battery backup
- 512 kB flash EPROM

Programming

Primary

- handheld programmer

Secondary

- PC running SIMATIC PDM
- PC running Dolphin Plus software

Display

- back lit LCD

Temperature Compensation

- Range: -50 to 150 °C (-58 to 302 °F)

Source

- integral transducer sensor
- TS-3 temperature sensor
- programmable fixed temperature

Temperature Error

Sensor

- 0.09 % of range

Fixed

- 0.17 % per °C deviation from programmed value

1. Program range is defined as the empty distance from the face of the transducer (P006) plus any range extension (P801).

Outputs

Transducer drive

- 315 V peak

mA Analog

- 0-20 mA
- 4-20 mA
- 750 ohm maximum
- Resolution of 0.1%
- Isolated

Relays[1]

- Six:
  - 4 control
  - 2 alarm control
- All relays rated 5A at 250 V AC, non-inductive

Control Relays

- 4 Form **A**, **NO** relays (numbers 1, 2, 4, 5)

Alarm Relay

- 2 Form **C**, **NO**, or **NC** relay (numbers 3, 6)

Communication

- RS-232 running Modbus RTU and ASCII via RJ-11 connector
- RS-485 running Modbus RTU and ASCII via terminal blocks

Optional

- SmartLinx® compatible

Inputs

mA (analog) (1)

- 0-20 or 4-20 mA, from alternate device, scalable

Discrete (2)

- 10-50 V DC switching level
- logical 0 = < 0.5 V DC
- logical 1 = 10 to 50 V DC
- 3 mA maximum draw

1. All relays are certified only for use with equipment that fails in a state at or under the rated maximums of the relays.

Enclosure

Wall Mount

- 240 mm (9.5") x 175 mm (6.9"). Width dimension includes hinges.
- Type 4X / NEMA 4X / IP 65[1]
- Polycarbonate

Panel Mount

- 278 mm (10.93") x 198 mm (7.8") Width dimension includes flange.
- Type 3 / Nema 3 / IP54
- Polycarbonate

Weight

- Wall mount: 1.37 kg (3.02 lb)
- Panel mount: 1.5 kg (3.3 lb)

Approvals

- See product nameplate for hazardous approval information
- MERTS Class 1 open channel flow device with environment operation limits at 35 °C (95 °F) at 93% relative humidity

SIRA MC 050057/01

Compatible Transducers

- Echomax series and STH series

Transducer Frequency

- 44 kHz

1. For watertight applications, use only approved, suitable size hubs in the enclosure's conduit holes.

Cable

- Do not use coaxial cable for transducer (see General Appendix F: Upgrading on page 248 for more information)
- 2 copper conductors, twisted with shield/drain wire, 300 Vrms, 0.5 mm^2 (22-18AWG), nominal capacitance between adjacent conductors @ 1kHz = 62.3 pF/m (19 pF/ft). Nominal capacitance between conductor and shield @ 1kHz = 108.3 pF/m (33 pF/ft) (Belden® [1] 8760 is acceptable)
- 365 m maximum

Note: The HydroRanger 200 is to be used only in the manner outlined in this instruction manual or protection provided by the equipment may be impaired.

1. Belden is a registered trademark of Belden Wire & Cable Company.

Installation

> **Notes:**
> - Installation must only be performed by qualified personnel, and in accordance with local governing regulations.
> - This product is susceptible to electrostatic shock. Follow proper grounding procedures.
>
> ⚠ **All field wiring must have insulation suitable for at least 250 V.**
>
> ⚠ **Hazardous voltage present on transducer terminals during operation.**
>
> ⚠ **DC terminals shall be supplied from an SELV source in accordance with IEC 1010-1 Annex H.**
> - The non-metallic enclosure does not provide grounding between conduit connections. Use grounding type bushings and jumpers.

Mounting

Mounting Locations

Recommended

- Ambient temperature is always within -20 to 50 °C (-5 to 122 °F)
- HydroRanger 200 display window is at shoulder level, unless most interaction is through a SCADA system
- Easy access for hand programmer is provided
- Cable length requirements are minimal
- Mounting surface is free from vibration
- Leave is sufficient room to swing unit lid open and have clear access.
- A place for a laptop computer is provided for on-site Dolphin Plus configuration

Avoid

- Exposure to direct sunlight. (Provide a sun shield to avoid direct sunlight.)
- Proximity to high voltage/current runs, contacts, SCR or variable frequency motor speed controllers

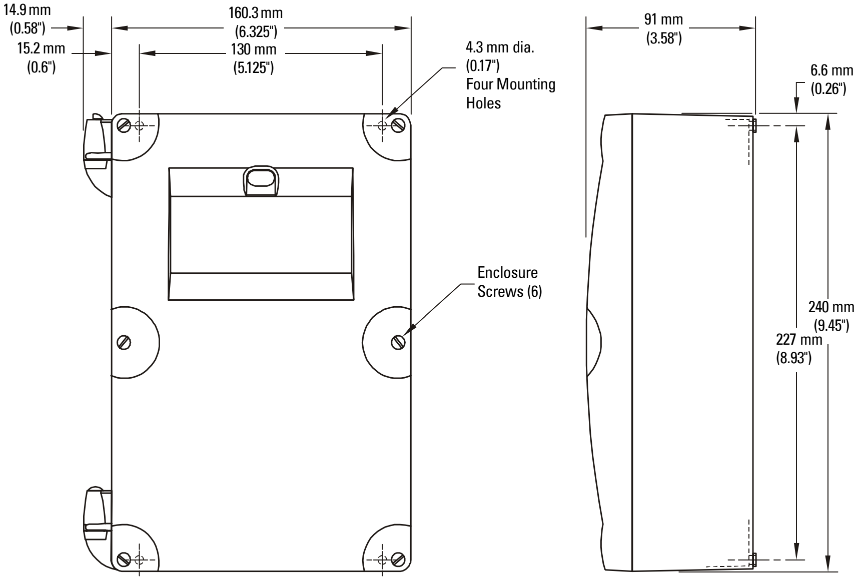
Mounting Instructions

The wall mount and panel mount units install differently. Please follow the specific instructions for your unit.

> **Note:** When routing cable through a conduit, please follow the Cable Routing instructions on page 9 before mounting the HydroRanger 200.

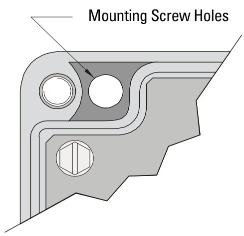
Wall Mount

Enclosure Dimensions



Mounting the Enclosure

1. Remove the lid screws and open the lid to reveal the mounting screw holes.



2. Mark and drill four holes in the mounting surface for the four screws (customer supplied).
3. Fasten with a long screwdriver.

Please note:

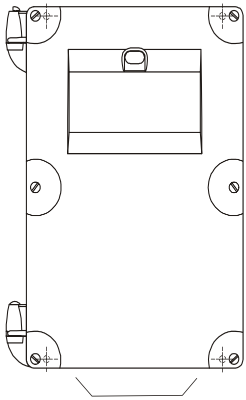
- Recommended mounting: directly to wall or to electrical cabinet back panel
- Recommended mounting screws: #6
- If alternate mounting surface is used, it MUST be able to support four times the weight of the unit.

Cable routed through a conduit:

1. Remove the four mounting screws holding the motherboard to the enclosure.
2. Be careful not to damage the electronics with static electricity. Remove the motherboard from the enclosure by pulling the board straight out.
3. Drill the required cable entry holes. Make sure conduit holes do not interfere with the lower areas on the terminal block, circuit board, or SmartLinx card.
4. Attach the conduit to the enclosure using only approved suitable size hubs for watertight application.

Installation

5. Reinstall the motherboard with the mounting screws.



suitable location for conduit entrances

> **Note**: For conduit locations and assembly for hazardous mounting in Class 1 Div 2 applications, please see Drawing 23650314 in *General Appendix G: Conduit Entry for Class 1, Div 2 Applications* on page 251.

Cable exposed and entering through the cable glands:

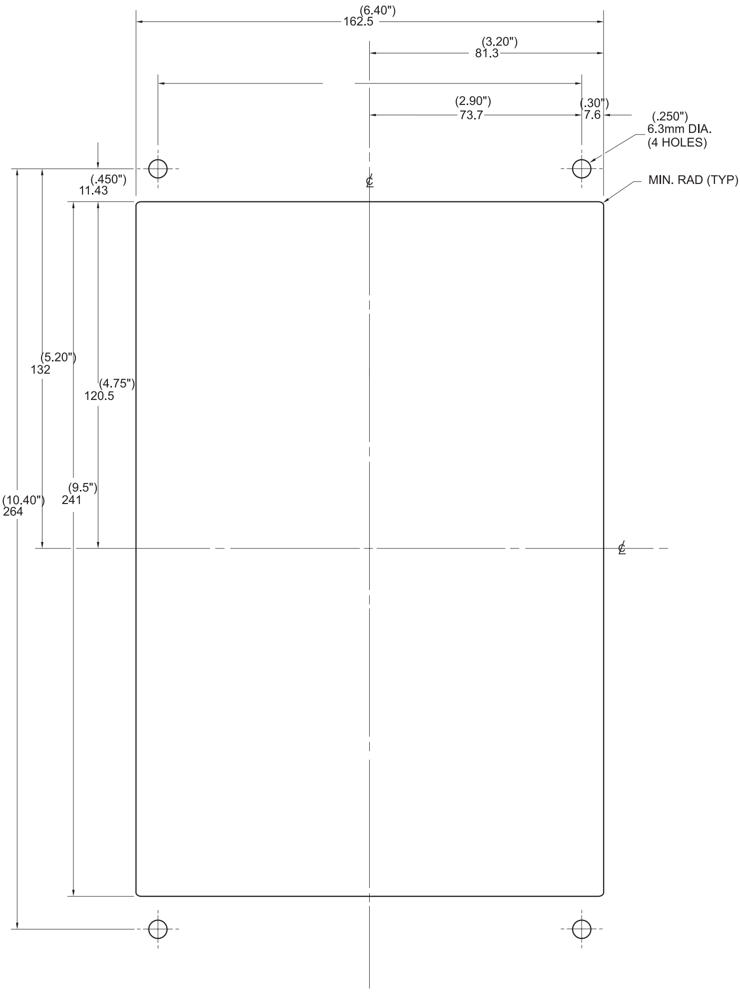
1. Unscrew the glands and attach them loosely to the enclosure.
2. Thread the cables through the glands. Ensure the power cable is kept separated from the signal cables and then wire the cables to the terminal blocks.
3. Tighten the glands to form a good seal.

> **Note:** Where more holes are required than are supplied in the enclosure, follow the *Cable routed through a conduit* steps.

Panel Mount

Installing the panel mount unit requires making a cutout in the panel. The dimensions for the cutout are provided in the illustration below. A full size cutout template is provided with your unit or may be downloaded from www.siemens.com/processautomation.

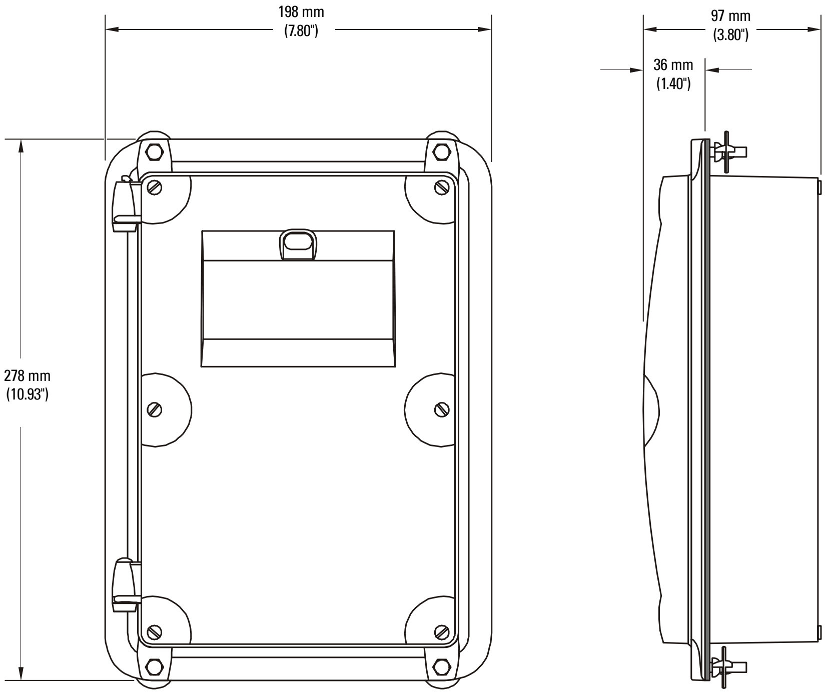
Cutout Dimensions



Cutout Instructions

1. Select a place for the unit and fasten the template onto the panel (use tape or tacks).
2. Drill the four fastener holes.
3. Make the cutout using the appropriate tools.
4. Mount unit according to the instructions in this manual.

Panel Mount Dimensions



Mounting the Enclosure

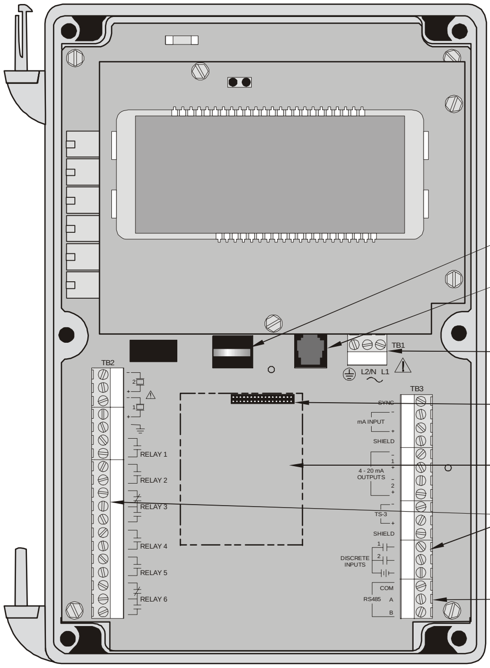
Once cutout is complete and mounting holes are drilled, follow these steps:

1. Remove lid from unit by undoing the six lidscrews and lifting it off its hinges.
2. Remove the four screws holding the motherboard to the enclosure.
3. Be careful not to damage the electronics with static electricity. Remove the motherboard from the enclosure by pulling the board straight out.
4. Drill the required cable entry holes. Be sure to compensate for panel door dimensions and make sure conduit holes do not interfere with the lower areas on the terminal block, circuit board, or SmartLinx card.
5. Replace board and fasten the four screws.
6. Place the unit into the panel and insert hexogonal fasteners through bevel slots and predrilled panel holes.
7. Fasten with wingnuts and hand tighten.
8. Add conduit or glands and wire as required, then replace the lid.

Helpful hint:

- Use tape to hold hexogonal heads in slots while attaching wingnuts.

HydroRanger 200 Board



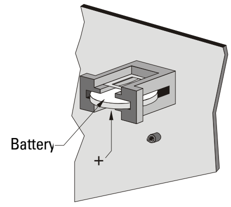
Installing the Battery

The battery (Rayovac BR2032) has a ten-year life expectancy. Please note the life expectancy may be reduced by ambient temperature. If the unit loses external and battery power, a capacitor will power the RAM for about ten minutes.

Disconnect power before replacing the battery.

Installation Steps

1. Open the enclosure lid.
2. Slide the battery into the holder. Be sure to align the + and – terminals correctly.
3. Close and secure enclosure lid.



Note: All parameter values are written to the EEPROM once every hour. The battery is used to backup Standard Data Logging parameters (P300-P321) between writes, in case of power failure.

Installing SmartLinx Card

SmartLinx cards are generally pre-installed. If unit does not have a SmartLinx card, follow these steps to install one.

1. Align card with the two mounting posts and then press-fit with the female connector.
2. Use the screws supplied with the card to attach it to the mounting posts.
3. Wire in the SmartLinx card according to SmartLinx Manual.

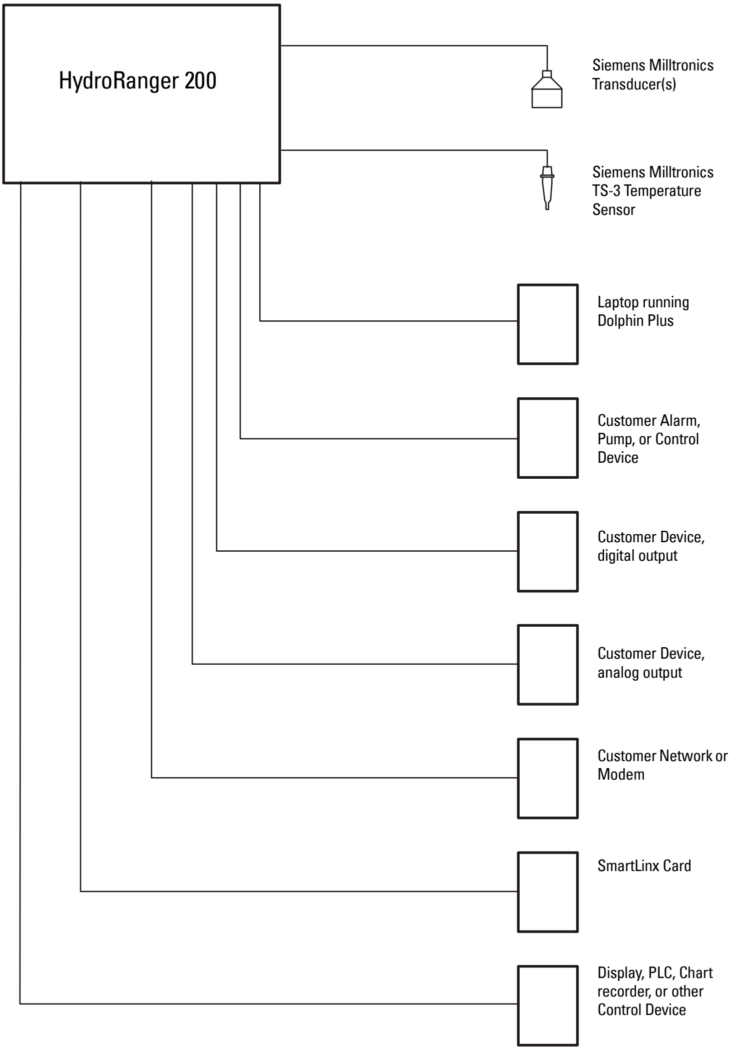
Optional Equipment

To communicate with equipment requiring RS-485 capability, Siemens Milltronics offers the RS-485 External Modem Kit. For more information, go to www.siemens.com/processautomation.

Wiring

Please note:

- Verify that all system components are installed in accordance with instructions.
- Connect all cable shields to the HydroRanger 200 Shield Terminals. Avoid differential ground potentials by not connecting cable shields to ground (earth) anywhere.
- Keep exposed conductors on shielded cables as short as possible to reduce noise on the line caused by stray transmissions and noise pickup.



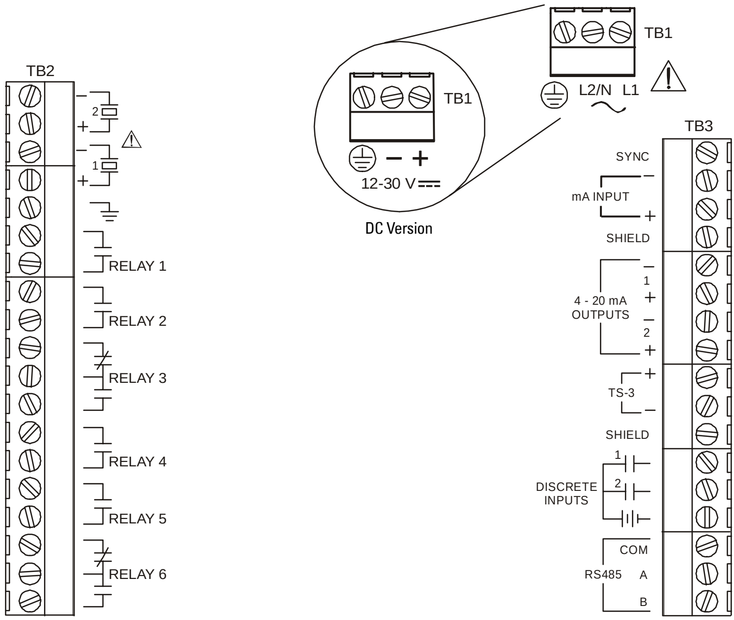
Wiring

Terminal Board

The terminal board on the HydroRanger 200 allows all inputs and outputs to be connected simultaneously.

Note: Recommended torque on terminal clamping screws.
- 0.56 - 0.79 Nm
- 5 - 7 in.lbs

Please do not overtighten the screws.



Cables

The HydroRanger 200 transceiver requires a shielded two-wire connection to the transducer.

Connection	Cable Type
mA input and mA output sync, Temperature sensor, discrete input, dc input Transducer	2 copper conductors, twisted, with shield[1]/drain wire, 300V 0.5-0.75 mm^2 (22 - 18 AWG) **Maximum length**: 365 m
	**Do not use a coaxial transducer cable extension with the HydroRanger 200. Electrical noise interference affects performance.**
Relay output AC input	Relay to be copper conductors per local requirements to meet 250 V 5A contact rating.

1. Preferred shielding is braided screen.

Wiring

Transducers

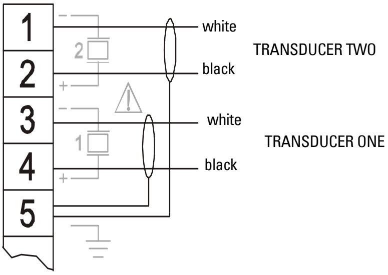
Warning: Hazardous voltage present on transducer terminals during operation.

Run the transducer cable in a grounded metal conduit, separate from other wiring (except TS-3 temperature sensor wiring, if applicable).

Notes:

- Do not use coaxial cable because of electrical noise interference
- Do not connect the shield and white transducer wires together; wire to separate terminals

Disregard older transducer manuals that recommend these practices



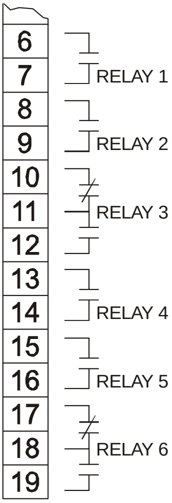
A 0.1 µF (100V or greater) capacitor is included with the HydroRanger 200 for retrofitting old HydroRanger 200 Plus installations. Please see *HydroRanger 200 Installation (for retrofitting MultiRanger Plus Installations)* on page 249.

Relays

Relay contacts are shown in the de-energized position. All relays are handled identically and can be configured as positive or negative logic using P118.

Relay Ratings

- four Form **A**, NO relays(1,2,4,5)
- two Form **C**, NO or NC relays (3,6)
- 5A at 250 V AC, non-inductive



Power Failure

Relays 1, 2, 4, and 5 are normally open and will fail in the normal state.

Relays 3 and 6 can be wired either normally open or normally closed, and will fail in their de-energized states.

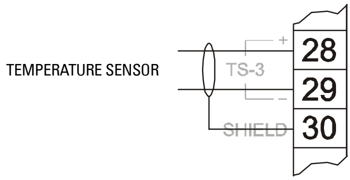
Wiring

Temperature Sensor

Accurate temperature readings are critical to accurate level measurements because the speed of sound changes, depending on air temperature, and all Siemens Milltronics Echomax and ST-H transducers have an internal temperature sensor.

If the following conditions apply, a separate TS-3 temperature sensor will ensure optimum accuracy:

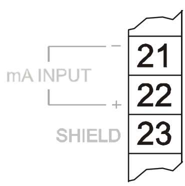
- the transducer is exposed to direct sunlight (or other radiant heat source)
- the transducer face and monitored surface temperature differs
- faster response to temperature changes is required



Note
Use a T-S3 Temperature Sensor only. Leave terminals open (unused) if TS-3 is not deployed.

mA Input

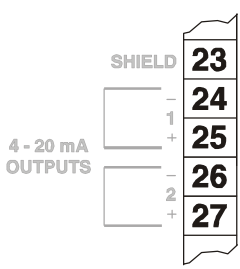
For more information, consult the Transducer (P004) and mA Input Parameters (P250, P251, and P252) in the parameter reference section.



Wiring

mA Output

For more information, consult the mA output parameters (P200 to P219) in the parameter reference section.

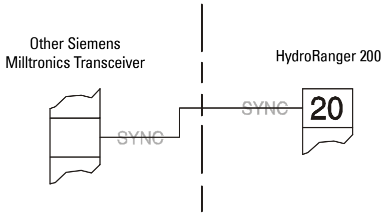


Level System Synchronization

> **Note:** The HydroRanger 200 CANNOT be synchronized with the MultiRanger Plus or the HydroRanger.

When using multiple ultrasonic level monitors, be sure to run the transducer cables in separate grounded metal conduits.

When separate conduits are not possible, synchronize the level monitors so that no unit transmits while another is waiting for echo reception.



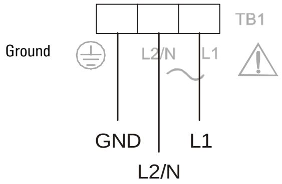
Synchronizing with another HydroRanger 200, or other Siemens Milltronics instruments (DPL+, SPL, XPL+, Hydro+, EnviroRanger, MiniRanger):

- Mount the level monitors together in one cabinet
- Use a common power (mains) supply and ground (earth) for all units
- Interconnect the SYNC terminals of all level monitors
- Contact Siemens Milltronics or your local distributor. Go to www.siemens.com/processautomation.

Power

> **Important!**
>
> Before applying power to the HydroRanger 200 for the first time, ensure any connected alarm/control equipment is disabled until satisfactory system operation and performance is verified.
>
> **Notes for AC power connections**
>
> - The equipment must be protected by a 15 A fuse, or circuit breaker in the building installation.
> - A circuit breaker or switch in the building installation, marked as the disconnect switch, must be in close proximity to the equipment and within easy reach of the operator.

Note: Make sure unit is connected to a reliable ground.



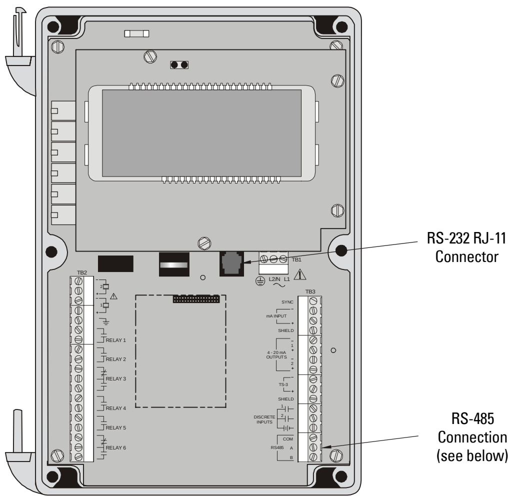
Wiring

Digital Communications

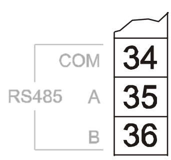
Wiring the HydroRanger 200 for communications allows it to be integrated into a full SCADA system or an industrial LAN.

The HydroRanger 200 can also be directly connected to a computer running Dolphin Plus.

RS-232 Serial Connection

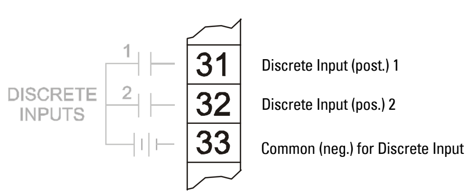


RS-485 Serial Connection



Discrete Inputs

Discrete inputs have a positive and negative terminal. Requires an external power supply.



Operating the HydroRanger 200

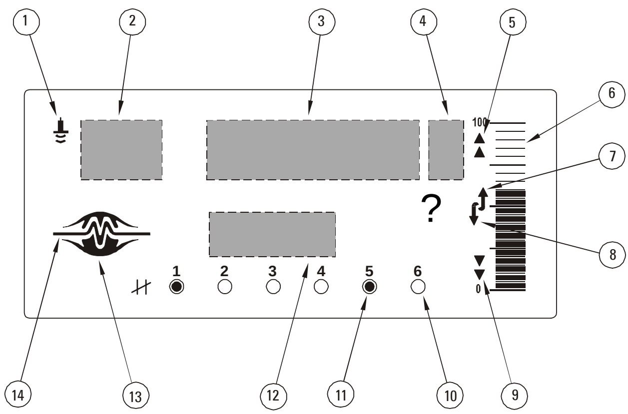
The HydroRanger 200 has two modes of operation: RUN and PROGRAM.

RUN Mode

In RUN mode, the HydroRanger 200 detects material level and provides control functions. The HydroRanger 200 automatically starts in RUN mode when power is applied.

System status is shown on the unit's LCD, or on a remote communications terminal.

Display



Indicator Functions

	RUN Mode	PROGRAM Mode
1	index type (see below)	index type (see next table)
2	index	index
3	primary reading	parameter value
4	units	units
5	hi and hi hi alarm designation	auxiliary function
6	level display	n/a
7	filling display	scroll access tag
8	emptying display	scroll access tag
9	lo and lo lo alarm designation	n/a
10	relay # programmed	relay # programmed
11	relay # activated	relay # activated
12	auxiliary reading	parameter number
13	normal operation:	n/a
14	failsafe operation:	n/a

Operation

Icons indicating index type (Item 1) edited in PROGRAM mode:

Icon	Index Type
	measurement point or transducer
	relay
	secondary index
mA	mA input or output

Readings in RUN Mode

Change the displayed values with the keys on the hand programmer. All readings are shown in the Auxiliary field, except for the totalizer and P920.

Key	Function	P#
%	Toggle Readings between percent and units: • Level: 0 – 100% • Space or Distance:[1] 100% – 0	P920
2 + 1 2 3 4 5 mA 6	Accumulated pump running hours[2] for numbered pump.	P310
2 + 1 2 3 4 5 mA 6	Hold number key for five seconds to display the number of accumulated pump starts[2] for numbered pump.	P311
1	Eight-digit totalizer, uses index and reading areas, press again to toggle, P737 sets default. Used for OCM and Pumped Volume.	P322 P323 P920
3	Head measurement	P926
4	Instantaneous flow based on head (OCM)	P925
5 mA	mA Output value	P203
6	Temperature	P664
7	Rate of level change	P707
8	Failsafe Time Left (in %). When the Reading is updated, this value (Auxiliary Reading) resets to 100 and begins to decrease until the next valid measurement is made. If the Failsafe Time Left reaches 0, **LOE** flashes in the display.	
8	Hold for four seconds to show echo confidence	P805
P___ + ###	Display the value of the entered parameter which is global or indexed by transducer	
Pxxx	Auxiliary reading displays parameter specified in P731	P731
	Distance	P923

1. Distances less than 0.3 m (1 ft) from the transducer face cannot be measured reliably. Therefore, a 0% reading is not possible during **Distance** operation.
2. If the associated relay is programmed for pump control.

Status Parameters

Status parameters give the operating status of the HydroRanger 200. You can access parameters with the hand programmer (see page 30) or with Dolphin Plus (see page 26). Remote SCADA system access is also possible.

Parameter		Values
P203	mA Output Value	0 to 22 – Current mA output
P254	Scaled mA Input Value	0 to 9999 – Current mA input after scaling
P275	Scaled Discrete Input Value	Shows current value of discrete input, values vary by DI function
P322	LCD Total Low	The last four digits of the totalizer
P323	LCD Total High	The first four digits of the totalizer
P341	Run Time	The number of days the HydroRanger 200 has been operating
P342	Start Ups	The number of times power has been cycled
P664	Temperature	Current temperature measured by transducer
P707	Rate Value	Current rate of material level change
P708	Volume Rate Display	Current rate of material volume change
P729	Scan Time	Seconds since last level scan
P806	Echo Strength	Strength of primary echo
P920	Reading Measurement	Current primary reading
P921	Material Measurement	Current level from P007–Span
P922	Space Measurement	Empty space above the material level
P924	Volume Measurement	Current volume value, if programmed
P925	Flow Measurement (OCM)	Current flow value, if OCM programmed
P926	Head Measurement (OCM)	Current level, if OCM programmed
P927	Distance Measurement	Distance from transducer face to material

Controlling the Display

RUN mode provides numerous parameters and variables that you can track on the display (see *Display* on page 21).

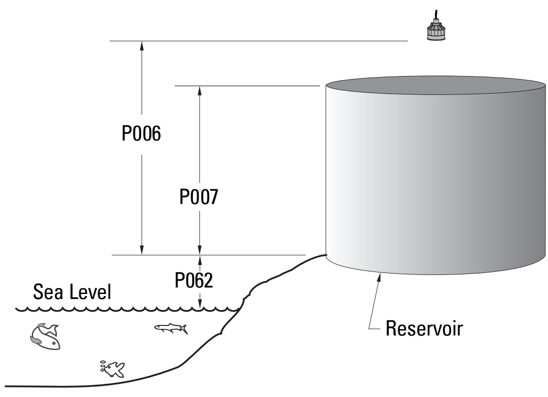
The LCD displays **EEEE** if a value is too long.

Adjusting the primary reading for four-digit LCD readout:

Parameter		Action
P060	Decimal Position	Sets maximum number of decimals
P061	Convert Reading	Scales the reading to fit
P062	Offset Reading	Shifts the reading up or down by a fixed amount

Example

To reference the displayed level to sea level, enter the distance in Units (P005), between Empty (P006) and sea level. (Enter a negative value if Empty is below sea level.)



P062 is the distance between sea level and Empty.

Auxiliary Reading

The Auxiliary Reading area of the LCD displays parameter values while leaving the primary reading on screen.

Note: The parameters shown in the auxiliary reading field are indexed as follows:
- global
- by transducer
- by level point

Operation

Setting the Default Auxiliary Reading

To maintain a constant variable display in the auxiliary reading area, set the default.

Example:

To leave the level reading on the screen and view the echo confidence in the auxiliary reading field, set the following parameter:

Parameter	Index	Value	Description
P730	G	805	Auxiliary field defaults to P805

Setting a Specific Auxiliary Reading

To display a second auxiliary reading, press Pxxx in RUN mode.

Example: To set Pxxx to display current temperature, go to P731:

Parameter	Index	Value	Description
P731	G	912	Shows P912–Transducer Temperature

Multiple Readings

During **differential** or **average** operation (P001 = 4 /5), the display scrolls sequentially through Point Numbers 1, 2, and 3. Point 3 is the difference between (or average of) Points 1 and 2.

Changing Number Scrolling Speed

Parameter	Index	Value	Description
P732	G	5	Hold each value for 5 seconds

See *Parameter Indexing* on page 36. All the instructions in the following procedures apply to the hand programmer and assume that the HydroRanger 200 is activated.

PROGRAM Mode

The HydroRanger 200 is programmed by setting its parameters to match your specific application. Most parameters are indexed, allowing you to set the parameter to specific conditions and to more than one input or output. When the HydroRanger 200 is in PROGRAM mode, you can change these parameter values and set operating conditions.

Please refer to the *Parameter Reference* section on page 114 for a full listing and explanatios of parameter values.

The HydroRanger 200's primary programming is by the hand programmer. Other access is available through Dolphin Plus software (purchased separately).

Notes

- To activate PROGRAM from RUN mode, press PROGRAM and then DISPLAY
- The display briefly reads ---- while the measurement reading is verified. Reading level and other data is displayed and programmed relays are operated.
- Placing a programmed unit that is in normal operation into PROGRAM mode de-energizes all control relay outputs. Be sure to bypass the HydroRanger 200 while programming it.

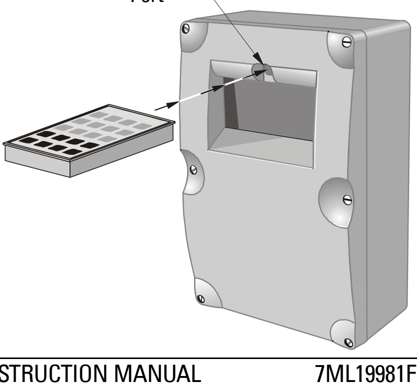
Starting PROGRAM Mode

Hand Programmer

The hand programmer gives you direct access to the HydroRanger 200.

Aim the hand programmer and press PROGRAM key.

Notes:
- The battery in the programmer is not replacable
- The hand programmer is ordered separately from Siemens Milltronics



For your convenience, the programmer has a magnetic mounting strip on the back. Keep programmer nearby for easy access.

Point the programmer at the IR port above the display and press the keys.

Unless otherwise noted, each valid key press should produce a change in the LCD. Verify when programming the unit.

Operation

Programmer Keys

Keys	Programming Mode	Run Mode
1	1	8-digit Totalizer (toggle)
2	2	Pump Running Time
3	3	Head
4	4	Flow based on Head
5 mA	5	mA Output
6	6	Temperature
7	7	Rate of Change
8	8	Failsafe Time Left
9	9	N/A
0	0	N/A
• P___	Decimal Point (TVT left)	Parameter Value
– Pxxx	Negative Value (TVT right)	Material Level (P731)
	Fire Transducer	Distance
	Run Mode	Program Mode (Key 1)
%	Units or %	Units or % (Program Mode) (Key 2)
	Next Display Field	Pause Display Toggle
	Increase Value	Next Index
	Decrease Value	Previous Index
	Enter Value	
C	Clear to Preset	

Operation

Dolphin Plus

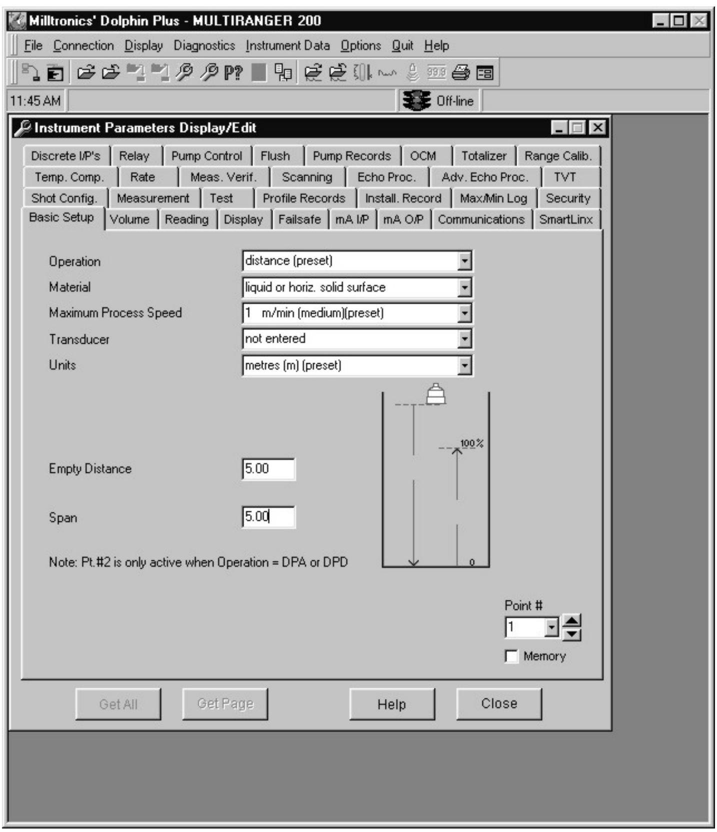
(compatible with product software versions 1.06 and earlier)[1]

Use Dolphin Plus software to configure, monitor, tune, and diagnose the HydroRanger 200 from a PC or directly in the field with a laptop.

Dolphin Plus is easy to install and easy to use. Just load the software from the CD onto a desktop PC or Laptop and then set up or modify complete parameter configurations in a Windows® [2]environment.

After configuration, you can edit parameters, upload and download parameter sets to and from disk, and use parameter sets saved from other instruments. You can also work with echo profiles for fine tuning without the need for special instruments. Built-in Quick Start features and Help files guide you through the entire process.

Note: Dolphin Plus is ordered separately from Siemens Milltronics.



1. See P900 for Software Revision Number.
2. Windows is a registered trademark of Microsoft Corporation.

Dolphin Plus Toolbar Buttons

The toolbar buttons provide quick access to Dolphin Plus features.

Button	Action
	communicate with instrument–toggle online versus offline
	monitor communications
	send parameter set to instrument
	save parameter set to file
	open the quick start wizard
	open the tabbed parameters window
	find a parameter in the tabbed parameters window
	toggle PROGRAM mode and RUN mode
	open the reporting windows
	load an echo profile from a file
	save the current echo profile to a file
	open the vertical echo profile and tank mimic window
	open the horizontal echo profile window
	take a measurement with the current transducer
	open the reading values (distance measurement) window
	print current echo profile
	open the Echo Info Editor window

SIMATIC Process Device Manager (PDM)

(compatible with product software versions 1.07 and later)[1]

SIMATIC PDM is a software package for parameterizing, commissioning, diagnosing and maintaining process devices. For the HydroRanger 200, SIMATIC PDM connects directly to the device using Modbus over Port 1 or Port 2.
The HydroRanger 200 comes with Port 1 set for communications to SIMATIC PDM.

SIMATIC PDM contains a simple process monitor of the process values, alarms and status signals of the device. Using SIMATIC PDM you can

- display,
- set,
- change,
- compare,
- check the plausibility of,
- manage, and
- simulate

process device data.

More information about SIMATIC PDM is available at www.siemens.com/processinstrumentation: go to Products and Solutions > Products and Systems > Process Device Manager. Please consult the operating instructions or online help for details on using SIMATIC PDM. An Application Guide on using HydroRanger 200 with PDM and Modbus is available on our website: www.siemens.com/processautomation.

Device Description

To use Process Device Manager (PDM) with HydroRanger 200, you need the Device Description for HydroRanger 200, which will be included with new versions of PDM. You can locate the Device Description in **Device Catalog**, under **Sensors/Level/ Echo/Siemens Milltronics**. If you do not see HydroRanger 200 under Siemens Milltronics, you can download it from our website: www.siemens.com/processautomation. Go to the HydroRanger 200 product page and click Downloads. After downloading the DD file, you need to execute DeviceInstall.

Activating the HydroRanger 200

All the instructions in the following procedures apply to the hand programmer and assume that the HydroRanger 200 is activated.

1. Power the HydroRanger 200.
2. Point the programmer at the unit and press PROGRAM .
3. Press DISPLAY .

1. See P900 for Software Revision Number.

Operation

Note: Power up display

- Single Point Model
    - preset to display distance from the face of the transducer to the material
    - transducer selection is preset for the XPS-10
    - empty distance is preset to 5m
- Dual Point Model
    - starts in an OFF state and does not take level measurements
    - to set up measurement, the quick start parameters must be configured
    - See Quick Start parameters on page 116

Changing Parameters

Note: If Parameter Value alteration is not permitted, access the Lock parameter (P000) and enter the security code, (see *Security* below).

1. Starting in RUN mode, press PROGRAM and then press DISPLAY to put the unit into PROGRAM mode.
2. Press DISPLAY to select the Parameter Number field.
3. Enter the Parameter Number (e.g. 110). After the third digit is entered, the parameter value is shown.
4. Enter the new value, and press ENTER. The HydroRanger 200 interprets the value, either accepting or replacing it with a valid value.

Helpful Hints

- For parameters P001 to P007, press a single digit (1–7) and then press DISPLAY to show that parameter.
- The **?** icon indicates that the HydroRanger 200 has accepted the value but that it conflicts with other values entered. Double-check your programming.
- By default, the SCROLL arrows show only the Quick Start parameters and any that have been changed.
- P733 sets all parameters to be scroll-accessed.

Security

The Lock parameter P000 secures the HydroRanger 200 against parameter changes. The unit can still be put into PROGRAM mode when locked, and parameter values can be viewed, but no parameter values can be changed.

When P000 is set to **1954**, programming is enabled. To disable programming, enter another value.

P000 (1954) is a fixed value password. Therefore, you should use other means to secure the HydroRanger 200 if security is a concern.

Simulation

P000 Lock also controls how simulations affect control relays. By default, control relays are unaffected by simulation levels. But if P000 is set to –**1**, they react to the simulated level. See *Parameters P925–P927* on page 213 for running a simulation.

Using Units or Percent (%)

Many parameters can be viewed either in measurement units (P005) or as a percentage. View the parameter and then press MODE to toggle between units and percentage. The LCD shows the selected measurement type, either units (m, ft) or percentage (%).

Percentage is also available when showing flow and volume with 100%, based on the parameter that defines the maximum.

Measurement	Maximum
Volume	P051
Flow	P604

Parameters Types

View Only Parameters

Parameter values indicating status only. They cannot be altered.

Global Values

Parameter values common to all inputs and outputs on the HydroRanger 200.

When a global parameter is accessed, the index display automatically disappears. When a non-global parameter is accessed, the index display reappears showing the last index number.

Default Values

Parameter default values are indicated with an * in the parameter tables.

P000 Lock

Primary Index	Global		
Value	1954	*	OFF: programming permitted
	-1		Simulation Controls (relays energize based on simulated level)
	other		ON: Lock activated and programming not permitted

The asterix identifies **1954** as the default value.

Operation

Parameter Reset

Returning a parameter to factory default.

1. Display the appropriate parameter number.
2. Display the appropriate index value (if required).
3. Press CLEAR C.
4. Press ENTER ↵.

Master Reset (P999)

Returns all parameters to original values.

Use Conditions:

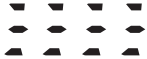
- before initial system installation
- following a software upgrade

If complete reprogramming is required, use Dolphin Plus to store and retrieve parameters.

When the dual point option is enabled, P999 is indexed by transducer. Use index **00** to reset the entire HydroRanger 200.

Display Readout

The following readouts are shown when the HydroRanger 200 cannot display a number.

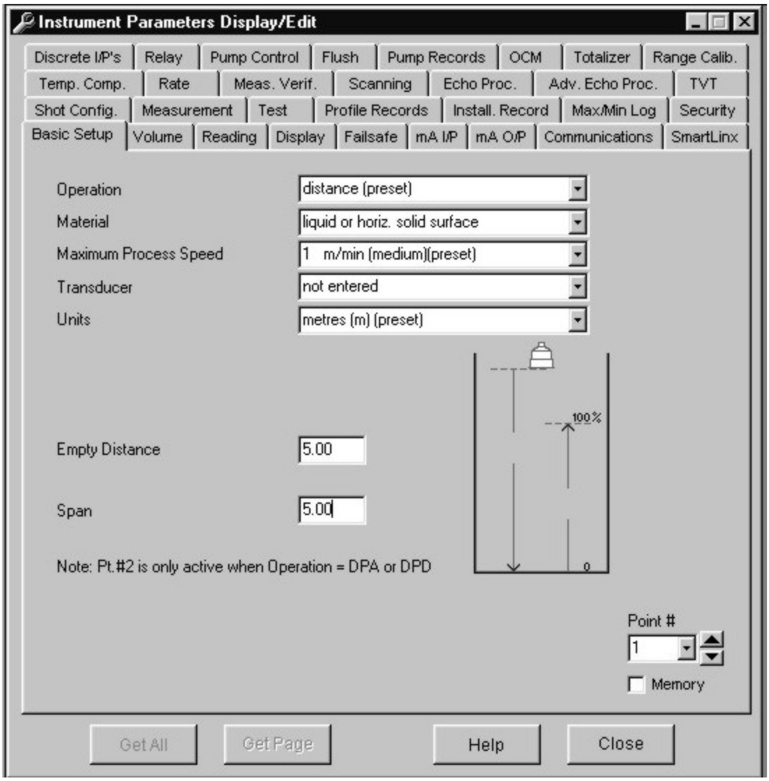
Display	Definition
	Parameter has not been set
	All values not same when viewing index **0**
	Value too large for four-digit display

Operation

Changing Parameters(Dolphin Plus)

The other method for changing parameter values is with Dolphin Plus software. It lets you access the HydroRanger 200 from a PC or on site with a laptop and change HydroRanger 200 parameters.

Most examples in this manual use the icons from the hand programmer but nearly all functions are also available through Dolphin Plus.



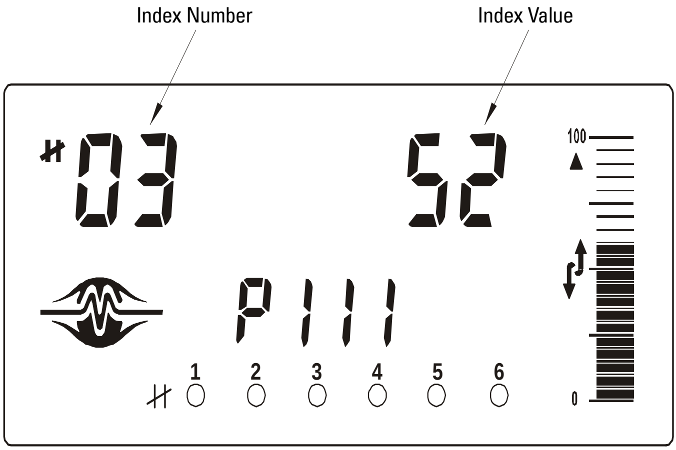
Operation

Parameter Indexing

Parameters are indexed when they apply to more than one input or output. The index value defines the input/output for that parameter. Indexed parameters contain a value for each index, even if that index is not used.

HydroRanger 200 Display

The index number and the index values are displayed above the parameter indicator on the LCD.



Notes

- Transducers are always indexed when the dual point option is enabled.
- An indexed transducer is commonly referred to as a Point (short for 'Measurement Point'). **Point Number** refers to indexed transducers.
- To set all indexed values for a parameter to the same value, use index **0**.
- Transducer parameters are indexed only if Operation (P001) is set to **Difference** (value=4) or **Average** (value=5) on a single point HydroRanger 200.

Accessing a Parameter Index

1. Press DISPLAY once to clear current parameter field.
2. Enter the new parameter number.
3. Press DISPLAY twice.
4. Press the number of the required index. Or press ARROW keys to scroll through the available values.

Note: For optimum performance, set values accurately for indexed parameters. Ensure that the correct index value is being changed for each parameter value.

Operation

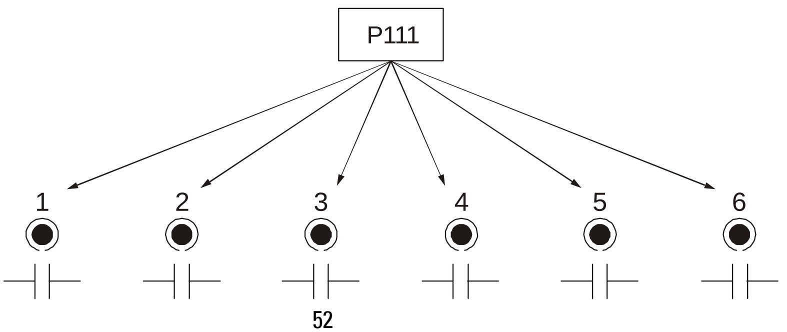
Primary and Secondary Indexes

Primary Index: relates to direct input or output and can refer to relays, communications ports, and other parameters. In parameters that allow secondary indexes, the primary index is often referred to as a **point**.

Secondary Index: relates to previously indexed parameters where the parameter requires a second index, permitting multiple values on an indexed input or output.

Primary Index

Example Setting: P111[3] = 52



- P111 sets the Relay Control Function
- P111(3) = 52 sets Relay #**3** to a value of **52**.

Secondary Index

Parameters with a secondary index permit multiple values for a primary index (point). For example, a volume calculation based on vessel characterization breakpoints requires a distinct set of breakpoints for each measured point.

Thus the primary index refers to the measurement point, and each secondary index refers to a characterization breakpoint value.

Accessing a Secondary Index

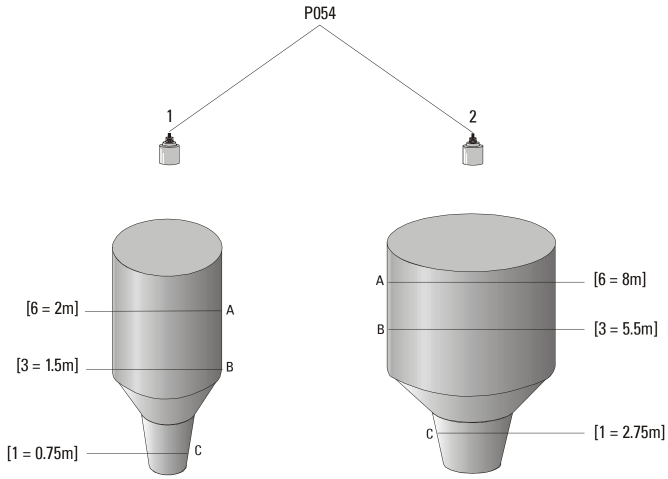
1. Press MODE and then press DISPLAY to activate secondary index. The → icon appears under the index field.
2. Enter the secondary index, and then enter the values to set the secondary index.

Operation

Example

P054 provides up to 32 breakpoint levels used with P055 (Volume Breakpoint) for universal volume calculation. The illustration indicates how you can set secondary indexes to specific functions.

A	B	C
P054 [1.6] = 2m	P054 [1,3] = 1.5m	P054 [1,1] = .75m
P054 [2.6] = 8m	P054 [2.3] = 5.5m	P054 [2.1] = 2.75m



- *P054 [1,1] = .75m* sets breakpoint **1** on transducer **1** to **.75m.**
- *P054 [2.1] = 8m* sets breakpoint **1** on transducer **2** to **2.75m**.

Starting Measurement

The HydroRanger 200 startup varies between single and dual point models.

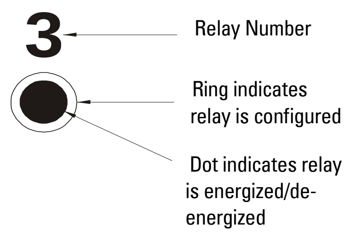
Single Point Models

The HydroRanger 200 starts in DISTANCE mode with the transducer preset for the XPS-10 and an empty distance of 5 meters. Change the following parameters to reflect your application parameters.

Parameter	Index	Value	Description
P001	G	1	Operation = level
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	104	Transducer = XPS-15
P005	G	1	Units = meters
P006	G	12	Empty = 12m
P007	G	10	Span = 10m

Average or Differential

For differential or average operation with a single-point HydroRanger 200, set P001 to **4** (differential) or **5** (average) and connect two transducers of the same type. All of the relevant parameters then become indexed by the correct transducer:



Index	Description
2	indexed by Transducer One or Two
3	indexed by level measurement 1 = Transducer One 2 = Transducer Two 3 = Calculated Level (average or difference)

Dual Point Models

The HydroRanger 200 starts in an OFF state and does not take level measurements. For measurement setup, configure these basic parameters:

If the application uses two measurement points, provide the basic information for each measurement point separately:

Parameter	Index	Value	Description
P001	1	1	Operation = level
	2	3	Operation = distance
P002	1	1	Material = Liquid
	2	1	
P003	1	2	Max. Process Speed = medium
	2	3	Max. Process Speed = fast
P004	1	104	Transducer = XPS - 15
	2	102	Transducer = XPS - 10
P005	G	1	Units = meters
P006	1	12	Empty = 12m
	2	4	Empty = 4m
P007	1	11	Span = 11m
	2	3.5	Span = 3.5m

Average or Differential

For differential or average operation dual-point HydroRanger 200, set P001 to **4** (differential) or **5** (average) and connect two transducers of the same type.

All the relevant parameters are then indexed by the correct number:

Index	Description
2	indexed by Transducer One or Two
3	indexed by level measurement 1 = Transducer One 2 = Transducer Two 3 = Calculated Level (average or difference)

Measurement Conditions

The following information will help you configure your HydroRanger 200 for optimal performance and reliability.

Response Rate

The response rate of the device influences the measurement reliability. Use the slowest rate possible with the application requirements.

The response rate is also important to functions connected to the filling or emptying indicators.

Dimensions

The dimensions of the vessel, wet well, or reservoir (except empty and span) are only important if you require volume.

Volume is required to report the level value in terms of volume. The pumped volume function can also report pumped volume or pump efficiencies.

Failsafe

The failsafe parameters ensure that the devices controlled by the HydroRanger 200 default to an appropriate state when a valid level reading is not available.

- P070 – Failsafe Timer activates if an error condition is detected. Upon expiration of the timer, relay status defaults to values based on P071.
- P071 – Failsafe Material Level determines the level reading if the Failsafe Timer expires and the unit is still in an error condition.
- P129 – Relay Failsafe controls the reaction of each relay. See *Relay Failsafe* on page 44 for more information.

If Failsafe Operation activates frequently, see the *Troubleshooting Appendix* on page 232.

Relays

Relays are the primary controls of external devices such as pumps or alarms.

The HydroRanger 200 comes with extensive control and alarm functions.

General Introduction

Six onboard multi-purpose relays are provided on the HydroRanger 200. Each relay may be independently assigned to one function and has a corresponding status icon on the LCD.

The relay functions fall under three modes of operation:

Mode	Function
alarm	alarm ON = LCD Icon ON = relay coil de-energized
pump	pump ON = LCD Icon ON = relay coil energized
miscellaneous	contact closed = LCD Icon ON = relay coil energized

Relay Function

Alarm

Level

In high alarm, the function goes on when the level rises to the ON setpoint and goes off when the level lowers to the OFF setpoint. In low alarm, the function goes on when the level lowers to the ON setpoint and goes off when the level rises to the OFF setpoint.

In Bounds

The relay will be in alarm if the level is inside the zone between the setpoints.

Out of Bounds

The relay will be in alarm if the level is outside the zone between the setpoints.

Rate of Change

In filling alarm, the function goes on when the rate of filling increases to the ON setpoint and goes off when the rate of filling drops to the OFF setpoint. In emptying alarm, the function goes on when the rate of emptying increases to the ON setpoint and goes OFF when the rate of emptying drops to the OFF setpoint. For emptying alarm, the setpoints must be entered as negative values.

Temperature

In high alarm, the function goes on when the temperature rises to the ON setpoint and goes off when the temperature lowers to the OFF setpoint. In low alarm, the function goes on when the temperature lowers to the ON setpoint and goes off when the temperature rises to the OFF setpoint.

Loss of Echo

The function goes on when the fail-safe timer expires. The function goes OFF when a valid echo is received (fail-safe timer is reset).

Pump

Level

In pump down, the function goes on when the level rises to the ON setpoint and goes off when the level lowers to the OFF setpoint. In pump up, the function goes on when the level lowers to the ON setpoint and goes off when the level rises to the OFF setpoint.

Miscellaneous

Totalizer and Samplers

Refer to *Totalizing Pumped Volume* on page 63. Relays are normally de-energized, contact closure is approximately 200 mSec duration.

Setpoint - ON / OFF

If the ON setpoint is higher than the OFF setpoint, the relay operates as:

- high alarm
- pump down control

If the ON setpoint is lower than the OFF setpoint, the relay operates as:

- low alarm
- pump up control

The ON and OFF setpoints can not be the same on an individual relay but may be common to other relays. The dead band or hysteresis is the difference between the ON and OFF setpoints. For in and out of bounds level alarms, the hysteresis is set at ± 2 % of span from either boundary.

Relay Status – Non Run Modes

When the fail-safe timer expires, pump control relays respond as previously described. However, alarm relays will respond in the following manner:

Fail-Safe Mode	Relay Status	
	High Alarm	Low Alarm
Fail-Safe High	ON	OFF
Fail-Safe Low	OFF	ON
Fail- Safe Hold	HOLD	HOLD

Upon entering the program mode, all pump control relays will be turned OFF. Alarm relays will hold their prior status.

Cautions:

- If the relay status can affect plant operation or personnel safety, it is advisable to override the relay functions or disconnect the relay wiring during calibration or simulation.
- Keep power disconnected at main breaker when HydroRanger 200 cover is opened.

Relay States

The relays on the HydroRanger 200 are completely programmable, allowing for any control scheme.

Relay Types
Relay 1,2,4,5 – NO (Form A)
Relay 3,6 – NO / NC (Form C)

Relay Related Parameters

Some parameters affect how relays react during normal conditions:

P100–Preset Applications

Sets the HydroRanger 200 to a preset application. These preset applications quickly set up the HydroRanger 200 with a minimum number of parameters.

P111–Relay Control Function

Sets the default state differently, depending on whether the relay is programmed as an alarm or a control.

P111–Alarm Functions

The alarm function de-energizes the relay coils. During normal operation (no alarms), the relay coils are energized.

P111–Control Functions

The control function energizes the relay coils. When the instrument is at rest (no controls operating) the relay coils are de- energized.

P112–Relay ON Setpoint

Sets the process point at which the relay is tripped.

P113–Relay OFF Setpoint

Sets the process point at which the relay is reset.

P118–Relay Output Logic

Affects relay reaction. Reverses the logic (normally-open to normally-closed or vice versa).

P129–Relay Failsafe

Changes how individual relays react to a failsafe condition on the instrument.

Relay Wiring Test

P119–Relay Logic Test

Checks the application wiring by forcing a relay control function, such as a level alarm or pump control setpoint. Ensure all the relay programming and wiring works properly.

Please verify that **ON** and **OFF** respond correctly. Use P119 as a final test once all of the relay programming is done.

Relay Activation

The flexibility of the relay functions ensures that the HydroRanger 200 can support relay wiring for different systems and applications. Use the following as a guide to the most common parameters.

Relay Setpoints and Functionality

The setpoint can be an ON or OFF setpoint related to a process variable, or a timed setpoint based on interval and duration.

Functions affected by setpoint are configured by parameters that determine the application requirements such as timing. *P111 Pump and Control functions* (see page 131 sets the function requirements. Other function parameters:

- P132–Pump Start Delay
- P133–Pump Power Resumption Delay
- P645–Relay Duration

Relay Logic is Modified

Normal operating conditions means that alarms are off and pumps are on. This can be reversed using P118–Relay Output Logic.

Relay Failsafe

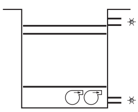
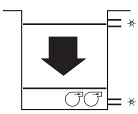
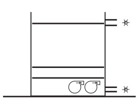
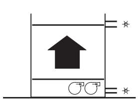
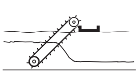
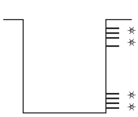
P129–Relay Failsafe

Adjusts how individual relays react to a failsafe condition. Relays can be set to:

- OFF Control is by P071–Failsafe Material Level
- HOLd Keeps the relay in the current state
- dE De-energizes the relay (default for pump controls)
- En Energizes the relay

Preset Applications (P100)

Preset applications set up the relay parameters to predetermined values shown below:

Value	#	Parameters Affected						
Off	0	All relays set to **OFF**						
Wet Well 1 	1	Pump down with the following settings:						
		Parameter	Relay # 1	2	3	4	5	6
		P111	52	52	1(H)	1(L)	0	0
		P112	70%	80%	90%	10%	–	–
		P113	20%	20%	85%	15%	–	–
Wet Well 2 	2	Pump down with the following level and rate settings:						
		Parameter	Relay # 1	2	3	4	5	6
		P111	52	52	1(H)	1(L)	0	0
		P112	70%	80%	90%	10%	–	–
		P113	20%	20%	85%	15%	–	–
		P121	1					
		Because the pumps are started by rate, you must change P703 to desired empty rate.						
Reservoir 1 	3	Pump up with the following level settings:						
		Parameter	Relay # 1	2	3	4	5	6
		P111	52	52	1(H)	1(L)	0	0
		P112	30%	20%	90%	10%	–	–
		P113	80%	80%	85%	15%	–	–
Reservoir 2 	4	Pump up with the following level and rate settings:						
		Parameter	Relay # 1	2	3	4	5	6
		P111	52	52	1(H)	1(L)	0	0
		P112	20%	20%	90%	10%	–	–
		P113	80%	80%	85%	15%	–	–
		P121	1					
		Because the pumps are started by rate you must change P702 to desired fill rate.						
Screen 	5	Differential control of a screen or rake:						
		Parameter	Relay # 1	2	3	4	5	6
		P110	3	1	2	3	0	0
		P111	50	1(H)	1(L)	1(H)	–	–
		P112	80%	90%	10%	90%	–	–
		P113	20%	85%	15%	10%	–	–
Alarms 	6	General alarms at four setpoints:						
		Parameter	Relay # 1	2	3	4	5	6
		P111	1(H)	1(L)	1(HH)	1(LL)	0	0
		P112	80%	20%	90%	10%	–	–
		P113	75%	25%	85%	15%	–	–

Backup Level Override

Backup level override provides the option of overriding the ultrasonic input with another contacting point level device, for example, the Pointek CLS 200. The ultrasonic reading is fixed at the programmed switch level until the discrete input is released and the ultrasonic device makes its decisions based on the override value.

Backup Level Override Parameters

P064: Reading Override Enable

Sets the discrete input as the source of a level reading override.

P065: Reading Override Value

Substitutes value for current reading when the discrete input (P064) is enabled. Value is added in current units and is valid only for the following:

- level
- space
- distance
- difference
- average modes of operation
- head level in OCM mode

Example:

A high level backup switch is connected to Digital Input Two in the same application as Transducer One at level value 4.3 m.

Settings

Parameter	Index	Value
P064	1	2
P064	2	0
P065	1	4.3
P065	2	–

When the level rises to 4.3 m and the switch is activated, the reading is forced to 4.3 m where it stays until the switch is de-activated.

P066: Override Time Delay

Sets the time (in seconds) used to calm the override condition input.

Discrete Inputs

Wiring the Discrete Inputs

Normal state is standard operation, with the HydroRanger 200 sensing the material level and controlling the pumps.

The discrete input contacts are either **normally-open** or **normally-closed** when the system state is normal.

Example:

Normal state for a backup high level switch is **open**, and the contacts on the discrete input are wired as **normally-open**.

See *Discrete Inputs* on page 20 for complete details on wiring the discrete inputs. To override a level using a discrete input, see *Backup Level Override* on page 45.

Programming the Discrete Input Logic

The P270 series of parameters permits control over the discrete input.

DI State	P270 Setting
Normally Open	P270 = 2
Normally Closed	P270 = 3

The current value of the discrete input is reported in P275:

P275 Setting	HydroRanger 200 State
0	Normal State
1	Exception State

mA I/O

To integrate the HydroRanger 200 with other equipment, use the mA input and outputs.

Note: When a mA input parameter is accessed, a **mA** symbol appears in the upper left corner of the LCD display.

The mA input can be used as a level measurement or can be passed on to a SCADA system.

mA Input

Level Reading Parameters

Parameter	Index	Value	Description
P004	1	250	Transducer = mA input 1
P250	1	2	Scale = 4 to 20 mA
P251	1	0	4 mA = 0% of span
P252	1	100	20 mA = 100% of span
P253	1	0	Do not damp the input signal

To pass the mA input on to a SCADA system, read the value from the appropriate communication registers. For more information, go to the *HydroRanger 200 Communications* section on page 83.

mA Output

The HydroRanger 200 has two mA outputs, used to send measurements to other devices.

Configuring the mA output to send a 4 to 20 mA signal scaled from 10% to 90% of span of the second transducer:

Parameter	Index	Value	Description
P200	1	2	set to 4 to 20 range
P201	1	1	send mA proportional to level reading
P202	1	2	base mA on level point 2
P210	1	10	set 4 mA at 10% of span[1]
P211	1	90	set 20 mA at 90% of span[2]
P219	1	0	set failsafe action as 0 mA

1. If the level reading drops below 10% of span, the mA output drops below 4 mA.
2. If the level reading rises above 90% of span, the mA output rises above 20 mA.

Calibrating 4 mA Output

1. Connect the mA receiving device to the HydroRanger 200.
2. Put the HydroRanger 200 into PROGRAM mode.
3. Set P911–mA Output Value to 4.0.
4. View the mA level on the receiving device.
5. If there is a discrepancy,
   a. Attach ammeter to HydroRanger 200 mA output.
   b. Access P214, Index 1 (for mA output 1) or 2 (for mA output 2). Press CLEAR and ENTER [C] [↵]. The ammeter should show a value near 4 mA.
   c. Enter the exact value displayed on the ammeter into P214 (Index 1 or 2).
   d. The ammeter should then read exactly 4.00 mA.

The unit is now calibrated for 4 mA for the receiving device.

Calibrating 20 mA Output

1. Connect the mA receiving device to the HydroRanger 200.
2. Put the HydroRanger 200 into PROGRAM mode.
3. Set P911–mA Output Value to 20.0.
4. View the mA level on the receiving device.
5. If there is a discrepancy,
   a. Attach ammeter to HydroRanger 200 mA output.
   b. Access P215, Index 1 (for mA output 1) or 2 (for mA output 2). Press CLEAR and ENTER [C] [↵]. The ammeter should show a value near 20 mA.
   c. Enter the exact value displayed on the ammeter into P215 (Index 1 or 2).
   d. The ammeter should then read exactly 20.00 mA.

The unit is now calibrated for 20 mA for the receiving device.

Verifying the mA Range

Checks that the external device can track the entire 4 to 20 mA range sent by the HydroRanger 200.

1. Use P920 to put the HydroRanger 200 into Simulation mode (see page 110).
2. Run the simulation through one complete fill / empty cycle.
3. View P911–mA Output Value to verify that it tracks to the simulation.
4. View the mA value reported on the external equipment to verify that it also tracks to the simulation.

Volume

Volume is used in two situations:

1. Calculate and display volume instead of level. For programming all setpoint parameters in terms of volume units rather than level units.
2. Calculate pumped volume to accomplish the following:
   - Totalize the volume of material that is pumped out of the wet well
   - Set an alarm on pump efficiency

If you require this functionality, please contact your local Siemens Milltronics representative at www.siemens.com/processautomation .

Readings

When using volume, readings are given in arbitrary units specified in P051.

The default is 100, which gives a reading in percent of total. Use whatever units you want here. If the value is too large for the four-digit LCD, use a larger unit.

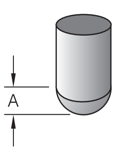
Example

If a wet well has a maximum capacity of 250,000 liters, use the value 250.0 for P051 and set the reading in 1000s of liters.

Tank Shape and Dimensions

There are many common tank shapes to select from. (See P050. If possible, use one of these.) Each tank shape uses the Empty distance (P006) in its calculations of volume.

Some tank shapes also require extra dimensions to calculate the volumes. Do not estimate these values. They must be correct to ensure the accuracy of your volume calculations.



To configure volume for a tank with a half-sphere bottom, set the following:

Parameter	Index	Value	Description
P050	1	4	selects the correct tank shape
P051	1	100	sets maximum volume at 100 (percent)
P052	1	1.3	sets **A** to 1.3m

Notes:
- The default reading changes to a range from 0 to 100 (the value in P051)
- Empty (P006) is still measured to the bottom of the tank, not the top of **A**.

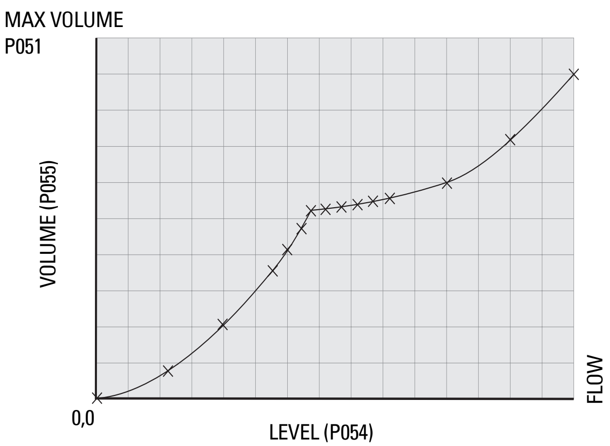
Characterization Chart

If you cannot use a pre-defined tank, then use one of the universal tank shapes and program the characterization curve.

1. Plot a volume to height chart. Usually a tank supplier will provide this chart. However, if you have a custom-built wet well then you will need access to complete drawings of the well or accurate measurements.
2. Enter the curve values from this chart into P054 and P055.
3. Ensure extra points are added around sharp transitions in the wet well volume (e.g: as steps in the well wall).

Note: The end points in the curve are **0,0** (fixed) and the point defined by P007–Span and P051–Maximum Volume.

Example Chart



Volume

Parameter	Transducer	Index	Value	Description
P054	1	1	0.0	Determines the Level breakpoints at which the volumes are known.
		2	0.8	
		3	2.0	
		4	3.5	
		5	4.1	
		6	4.7	
		7	5.1	
		8	5.2	
		9	5.3	
		10	5.4	
		11	5.5	
		12	5.6	
		13	6.0	
		14	7.2	
		15	9.0	
P055	1	1	0.0	Determines the volumes which correspond to the level breakpoints. The universal calculations interpret between the breakpoints to produce an accurate model of the volume at all level readings. **Settings** P050 = 9 for linear approximation P050 = 10 for curved approximation Linear approximation uses a linear algorithm; curved approximation uses a cubic spline algorithm.
		2	2.1	
		3	4.0	
		4	5.6	
		5	5.9	
		6	6.3	
		7	6.7	
		8	7.1	
		9	7.8	
		10	8.2	
		11	8.8	
		12	9.2	
		13	10.9	
		14	13.0	
		15	15.0	

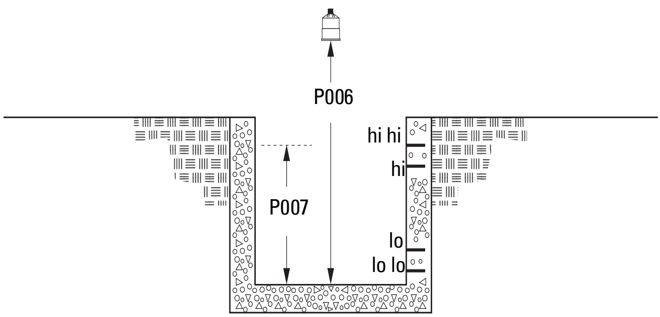
Alarms

Level

The level alarm is the most common. Use this alarm to warn you when your process is in danger of being upset due to high or low levels.

Generally, the four alarms used are Hi, Hi Hi, Lo, and Lo Lo.

Set the Common Parameters



Prerequisite: You must know the details of your application and substitute the values for the sample values provided. If you are bench testing the unit, then set your test values to be the same as the sample values.

Parameter	Index[1]	Value	Description
P001	G	1	Operation = level
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	G	1.8	Empty = 1.8m
P007	G	1.4	Span = 1.4m

1. This example assumes a base, single measurement unit. If your unit has optional dual point software installed then some parameters are indexed by two.

Setting Simple Level Alarms

To set Relay Five to a standard level alarm (Hi Hi, Hi, Lo, Lo Lo) do the following:

Parameter	Index	Value	Description
P111	5	1	• Set P111, indexed to relay, to the value **1** for level alarm • Press UNIT [▲%] to display the Auxiliary Function symbol. • Press ARROW keys [▲] [▼] as required to scroll to the alarm designation (▲▲, ▲, ▼, or ▼▼). • Press ENTER [↵] to enter the value.
P112	5	1.2m	• Set the **ON** setpoint
P113	5	1.15m	• Set the **OFF** setpoint

Available designations:

Alarm	Designation
Hi Hi	▲▲
Hi	▲
Lo	▼
Lo Lo	▼▼

Rate

Rate alarms can trigger an alarm if the vessel is filling/emptying too quickly.

Setting a Filling Rate Alarm

Parameter	Index	Value	Description
P111	5	4	These settings trip the alarm when the reservoir is filling faster than 1m per minute and reset it at 0.9m per minute.
P112	5	1m	
P113	5	0.9m	

Setting an Emptying Rate Alarm

Parameter	Index	Value	Description
P111	5	4	These settings trip the alarm when the reservoir is emptying faster than 10% of span per minute and reset the alarm when emptying falls to 5%.
P112	5	-10%	
P113	5	-5%	

In Bounds/ Out of Bounds Range

Use the bounded range alarms to detect when the level is inside or outside of the range. By using a bounded range alarm, you can effectively put two level alarms (high and low) on one relay.

Setting an Out of Bounds Alarm

Parameter	Index	Value
P111	5	3
P112	5	1.3
P113	5	0.3
P116	5	0.05

Results:

- Trips alarm above 1.35 m and below 0.25m
- Resets alarm below 1.25 m and above 0.35m

Setting an In Bounds Alarm

Parameter	Index	Value
P111	5	2
P112	5	1.3
P113	5	0.3
P116	5	0.05

Results:

- Trips alarm below 1.25 m and above 0.35 m
- Resets alarm above 1.35 m and below 0.25 m

Cable Fault

Activates an alarm if transducer cable circuit enters a shorted or opened state.

Parameter	Index	Value	Description
P111	5	7	Alarm on transducer cable fault
P110	5	1	Alarm on Transducer One

Temperature

Use the temperature alarm to activate an alarm when the temperature reaches the ON setpoint (P112). This alarm uses the same setpoint parameters as the level alarms (P112 and P113).

With P112 and P113, you can set a high alarm (**P112 > P113**) or a low alarm (**P112 < P113**).

This shows a high alarm:

Parameter	Index	Value	Description
P111	5	5	Alarm on temperature
P112	5	45	**ON** setpoint at 45 °C
P113	5	43	**OFF** setpoint at 43 °C
P110	5	1	Take the temperature reading from Transducer One

The temperature source can be the temperature sensor built into the transducer or an external TS-3, as set by P660.

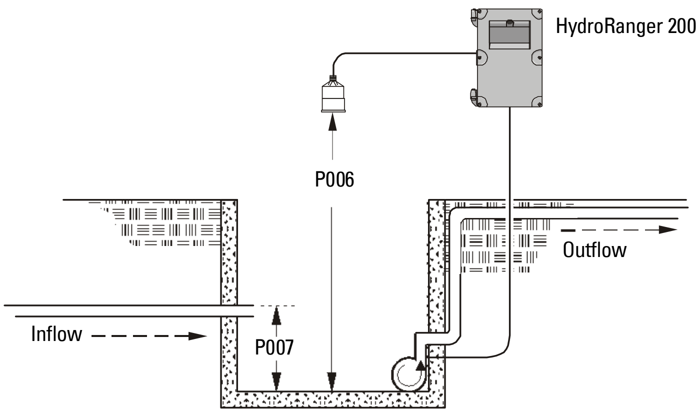
Loss of Echo (LOE)

Parameter	Index	Value	Description
P110	5	1	Alarm on LOE for Transducer One
P111	5	6	Alarm on LOE
P070	G	0.5	Trip alarm when 0.5 minutes (30 seconds) pass without detecting a valid echo.

Setting a Pump Down Group

Example: Sewage Wet Well

Setting a group of three pumps to pump down a wet well.



Set the Common Parameters

Prerequisite: Substitute the details of your application in place of the sample values provided. If you are bench testing the unit, set your test values to be the same as the sample values.

Parameter	Index[1]	Value	Description
P001	G	1	Operation = level
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	G	1.8	Empty = 1.8m
P007	G	1.4	Span = 1.4m

1. Example assumes a single measurement unit. If your HydroRanger 200 has dual point software installed then some parameters are indexed by two.

Set Relays to ALTERNATE DUTY ASSIST

Parameter	Index	Value	Description
P111	1	52	Sets the pump relays (index 1, 2, and 3) to ALTERNATE DUTY ASSIST.
P111	2	52	
P111	3	52	

Set the ON Setpoints

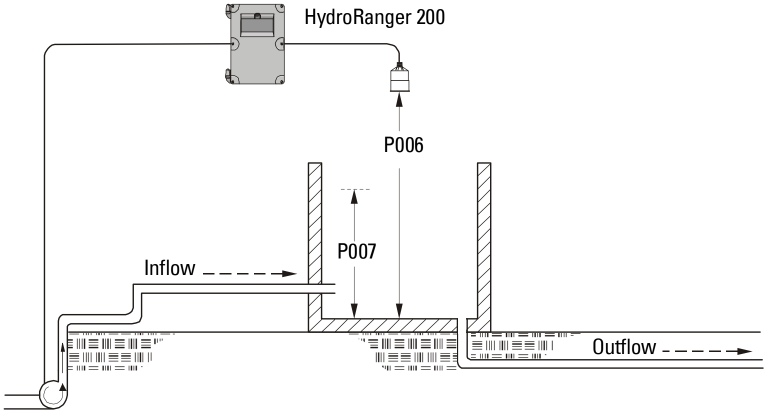
Parameter	Index	Value	Description
P112	1	1.0m	Sets the three setpoints for the pump relays. The first cycle will use these setpoints. Subsequent cycles rotate the setpoints among the pumps.
P112	2	1.1m	
P112	3	1.2m	

Set the OFF Setpoints

Parameter	Index	Value	Description
P113	0	0.5m	By using index **0** all six relays are set at the same time, **including any alarm relays**. Use with caution.

Setting a Pump Up (Reservoir) Group

Sets a group of three pumps to pump up a reservoir.



Pump Control

Set the Common Parameters

Prerequisite: Substitute the details of your application in place of the sample values provided. If you are bench testing the unit, set your test values to be the same as the sample values.

Parameter	Index[1]	Value	Description
P001	G	1	Operation = level
P002	G	1	Material = liquid
P003	G	2	Maximum Process Speed = medium
P004	G	102	Transducer = XPS-10
P005	G	1	Units = meters
P006	G	1.8	Empty = 1.8m
P007	G	1.4	Span = 1.4m

1. Example assumes a single measurement unit. If your HydroRanger 200 has dual point software installed, some parameters are indexed by two.

Set Relays to ALTERNATE DUTY ASSIST

Parameter	Index	Value	Description
P111	1	52	Sets the pump relays (index 1, 2, and 3) to ALTERNATE DUTY ASSIST.
P111	2	52	
P111	3	52	

Set the Relay ON Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The first cycle will use these setpoints. Subsequent cycles rotate the setpoints among the pumps.
P112	2	0.3m	
P112	3	0.2m	

Set the Relay OFF Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index **0** all six relays are set at the same time, **including any alarm relays**. Use with caution.

For more information, see *Appendix D: Pump Control Reference* on page 241.

Other Pump Control Algorithms

Set Relays to ALTERNATE DUTY BACKUP

Parameter	Index	Value	Description
P111	1	53	Sets the pump relays (index 1, 2, and 3) to ALTERNATE DUTY BACKUP.
P111	2	53	
P111	3	53	

Set the Relay ON Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The first cycle will use these setpoints. Subsequent cycles rotate the setpoints among the pumps.
P112	2	0.3m	
P112	3	0.2m	

Set the Relay OFF Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index **0** all six relays are set at the same time, **including any alarm relays**. Use with caution.

Set Relays to FIXED DUTY ASSIST

Parameter	Index	Value	Description
P111	1	50	Sets the pump relays (index 1, 2, and 3) to FIXED DUTY ASSIST. Multiple pumps can run simultaneously.
P111	2	50	
P111	3	50	

Set the Relay ON Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The first cycle will use these setpoints. Subsequent cycles rotate the setpoints among the pumps.
P112	2	0.3m	
P112	3	0.2m	

Set the Relay OFF Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index **0** all six relays are set at the same time, **including any alarm relays**. Use with caution.

Set Relays to FIXED DUTY BACKUP

Parameter	Index	Value	Description
P111	1	51	Sets the pump relays (index 1, 2, and 3) to FIXED DUTY BACKUP. Only one pump will ever run at one time.
P111	2	51	
P111	3	51	

Set the Relay ON Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The setpoints remain attached to the pump relays.
P112	2	0.3m	
P112	3	0.2m	

Set the Relay OFF Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index **0** all six relays are set at the same time, **including any alarm relays**. Use with caution.

Set Relays to ALTERNATE DUTY SERVICE

Parameter	Index	Value	Description
P111	1	54	Sets the pump relays (index 1, 2, and 3) to SERVICE RATIO DUTY ASSIST
P111	2	54	
P111	3	54	
P122	1	25	Sets the ratio to: 25% – Pump One
P122	2	50	50% – Pump Two
P122	3	25	25% – Pump Three

Set the Relay ON Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The first cycle will use these setpoints. Subsequent cycles rotate the setpoints among the pumps.
P112	2	0.3m	
P112	3	0.2m	

Set the Relay OFF Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index **0** all six relays are set at the same time, **including any alarm relays.** Use with caution.

Set Relays to FIRST IN FIRST OUT (FIFO) ASSIST

Parameter	Index	Value	Description
P111	1	56	Sets the pump relays (index 1, 2, and 3) to FIFO DUTY ASSIST.
P111	2	56	
P111	3	56	

Set the Relay ON Setpoints

Parameter	Index	Value	Description
P112	1	0.4m	Sets the three setpoints for the pump relays. The first cycle will use these setpoints. Subsequent cycles rotate the setpoints among the pumps.
P112	2	0.3m	
P112	3	0.2m	

Set the Relay OFF Setpoints

Parameter	Index	Value	Description
P113	0	1.3m	By using index **0** all six relays are set at the same time, **including any alarm relays**. Use with caution.

Pump Control

Optional Pump Controls

Starting Pumps by Rate of Level Change

Use this function when multiple pumps will be controlled by rate of level change rather than setpoints. Pumping costs can be reduced because only the highest ON setpoint needs to be programmed. This results in a lower difference in head to the next wet well which, in turn, results in less energy being used to pump out the well.

Parameter	Index	Value	Description
P112	1	1.35	Starting pumps by rate allows all setpoints to be set higher to save money by pumping from the highest safe level of the wet well.
P112	2	1.35	
P112	3	1.35	
P113	1	0.5m	Notice that all indexed relays for both P112 and P113 are set to the same levels.
P113	2	0.5m	
P113	3	0.5m	
P121	1	1	The pumps will start on 20 second intervals until the rate set in P703 is met.
P121	2	1	
P121	3	1	
P132	G	20.0	

When the first ON setpoint is reached, the pumps will start, one by one, until the material level rate of change is set at the same value or greater than the value in:

- P703 – Emptying Indicator (pump down applications)
- P702 – Filling Indicator (pump up applications)

Set delay between pump starts using P132 – Pump Start Delay.

Single and Dual Point

- Single Point Mode: one pump by rate control available that affects all pumps.
- Dual Point Mode: a single pump by rate control can be set up for each of the three available level points. Set Operation for difference or average (P001 = 4 or 5).

Notes:

- Set all pump control relay ON and OFF setpoints to the same value
- If the level is within 5% of Span (P007) of the OFF setpoint, then the next pump is not started

Pump Control

Rotating Pumps by Service Ratio

Prerequisite: Set pump relays to a service ratio value (P111 = 54 or 55).

Parameter	Index	Value	Description
P122	1	1	These values will start Pump Two 50% of the time and Pumps One and Three each 25% of the time.
P122	2	2	
P122	3	1	

Notes:

- The HydroRanger 200 will not sacrifice other pumping strategies to ensure that the ratio is held true
- If the pump relays are set to the same value, then the ratio equals 1:1 and all pumps are used equally (preset)

When more than one pump is assigned a Pump Service Ratio value (in any time units) and a pump start is required (P112 Relay Setpoint ON), the pump with the fewest running hours (with respect to the assigned ratio values) starts.

Conversely, when a pump stop is required (113 Relay Setpoint OFF), the pump with the most running hours (as compared to the assigned ratio values) stops.

Totalizing Pumped Volume

Prerequisite: the volume of the vessel must be known.

Parameter	Index	Value	Description
P001	G	7	Operation = pumped volume
P002	G	1	These parameters are as shown above.
P003	G	2	
P004	G	102	
P005	G	1	
P006	G	1.8	
P007	G	1.4	
P050	G	1	Tank shape is **Flat Bottom**.
P051	G	17.6	Max volume is 17.6m^3 or 17,600 liters.
P111	1	52	Sets relays 1, 2, and 3 as a pump group using ALTERNATE DUTY ASSIST CONTROL.
P111	2	52	
P111	3	52	
P112	1	1.0	Sets the **ON** setpoints for the pump group.
P112	2	1.2	
P112	3	1.4	
P113	0	0.2	Sets the **OFF** setpoints for the pump group.

Set in RUN Mode

1. Press PROGRAM for RUN mode.
2. Press TOGGLE to display pumped volume on the totalizer.
3. Press AUXILIARY to display current level in the auxiliary reading area.

Setting Independent Failsafe Controls

Independent failsafe controls allow you to vary an individual relay from the global failsafe controls programmed in P070 to P072.

Example:

The global failsafe controls are set to hold and Relay Five is set to trigger an alarm bell.

Parameter	Index	Value	Description
P071	G	HOLd	Keep level at last known value.
P129	5	dE	De-energize Relay Five, and trigger alarm.

Setting a Pump to Run On

When you need to pump below the normal OFF setpoint, use P130 (Pump Run-On Interval) and P131 (Pump Run-On Duration) to control this event.

Example:

The pump connected to Relay Three is set to pump for an extra 60 seconds every five times it is triggered.

Parameter	Index	Value	Description
P130	3	5	Wait for Relay Three to pump five times and then run-on.
P131	3	60	Run-on for 60 seconds.

Note: P130 counts when the indexed relay is tripped, not the number of pump cycles. If the indexed relay only trips once every four pump cycles then the actual interval of the run-on will be 20 pump cycles, or five cycles of Relay Three.

Setting the Pump Start Delays

The pump start delay ensures that all of the pumps do not start at once to avoid power surges. There are two parameters used here: P132–Pump Start Delay and P133–Pump Power Resumption Delay. The default is 10 seconds but you can increase this if your pumps take longer to spin up.

Example:

The delay between pumps is set to 20 seconds and the delay of the first pump is set to 30 seconds.

Parameter	Index	Value	Description
P132	G	20	Wait at least 20 seconds between pump starts.
P133	G	30	Wait for 30 seconds when power is restored.

Reducing Wall Cling

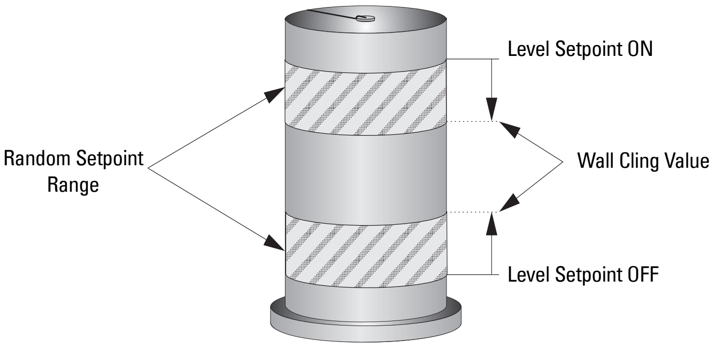
Use the Wall Cling parameter to randomly alter the ON and OFF setpoints over a range. This eliminates the ridge of material that builds up at the setpoint that can give false echoes.

This setting may increase the number of days between trips to clean the wet well.

Wall cling reduction is set by P136. The relay setpoints ON and OFF are randomly varied inside a range so the material level does not stop at the same point.

Example:

A range of 0.5 meters is used to vary the setpoint. The randomly-selected setpoints are always inside the ON and OFF setpoints.



Pump Control

Grouping Pumps

You can group pumps and use the same pumping algorithm separately on each group. If you specify different pumping algorithms then the pumps are already grouped by algorithm and you do not need to use this parameter.

Group pumps only when four pumps are using the same algorithm and you want to split them into two groups.

Example:

Pumps One and Two can operate as a group and Pumps Three and Four can operate as another group.

Parameter	Index	Value	Description
P137	1	1	Groups Pumps One and Two
P137	2	1	
P137	3	2	Groups Pumps Three and Four
P137	4	2	

Setting a Flush Valve

A flush valve stirs up the sediment on the bottom of the well during pumping so that it doesn't accumulate. These parameters will control any relays set with P111 = 64 (Flush Valve).

Most sets of parameters will work with only one or two changes; however, for these parameters to work, all of them must be set to a value.

Example:

The flush valve connects to Relay Four and the watched pump is on Relay One.

Parameter	Index	Value	Description
P170	G	1	Watch Relay One to count pump cycles.
P171	G	3	Open the flush valve for 3 cycles.
P172	G	10	Use the flush value every 10 cycles.
P173	G	120	Open the flush valve for 120 seconds.

Relay Controlled by Communications

A relay can be controlled directly by a remote system through communications. No other control schemes can then be used with a relay configured this way. Communications can be used to force status of some control relays, such as pumps.

Settings:

Parameter	Index	Value	Description
P111	5	65	Sets Relay Five to communications control.

Tracking Pump Usage

You can find out how much an individual pump has been used by viewing the pump records parameters.

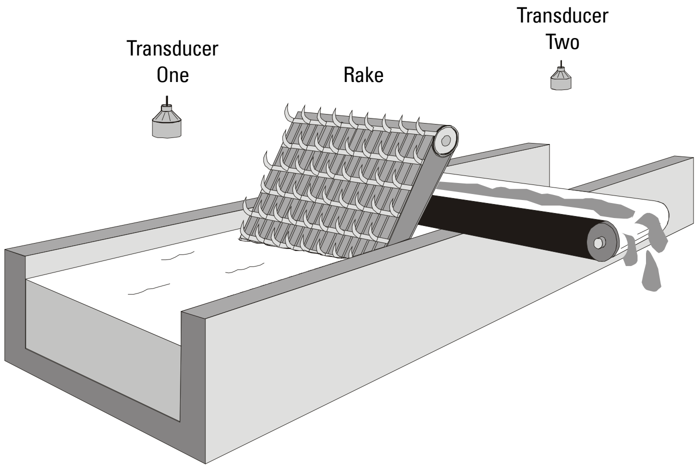
Information Available	Parameter Access
Current RUN time	P309
Total pump hours	P310
Total pump starts	P311
Total pump RUN on occurrences	P312

Rake (Screen) Control

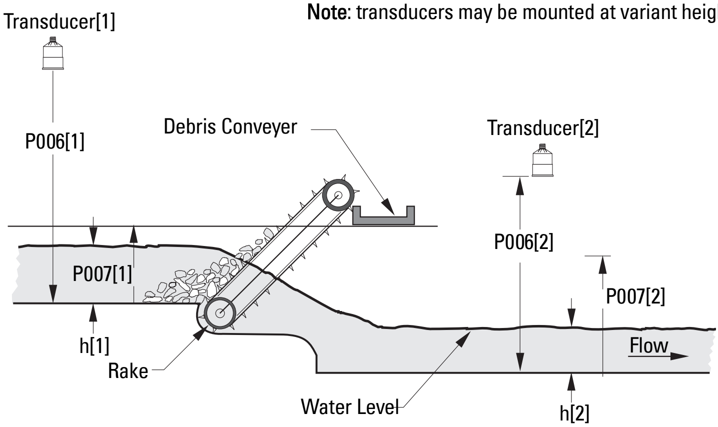
Screens or rakes are mounted on the inflow channel of the wastewater treatment plant to prevent debris from clogging the equipment.

When material builds up on the screen, a level differential is created, and the water level is higher in front of the screen than behind it. When this differential reaches the programmed setpoint, the HydroRanger 200 activates a relay to operate mechanical rakes that clean the screen and ensure a steady flow.

Setting a Rake Control



Note: transducers may be mounted at variant heights.



Point Three: Level Distance = h[1] –h[2]

Setting the Common Parameters

Prerequisite: Substitute the details of your application in place of the sample values provided. If you are bench testing the unit, set your test values to be the same as the sample values.

Parameter	Index	Value	Description	
P001	G	4	Operation	= Differential
P002	G	1	Material	= liquid
P003	1,2	2	Max. Process Speed	= medium
P004	1,2	102	Transducer	= XPS-10
P005	G	1	Units	= meters
P006	1	1.8	Empty	= 1.8m
	2	2.2	Empty	= 2.2m
P007	1	1.4	Span	= 1.4m
	2	1.4	Span	= 1.4m

Set Relay 1 (Operate Rake)

Parameter	Index	Value	Description
P110	1	3	Starts the rake when the difference between the two levels rises above 0.4m and stop the rake when the difference falls below 0.1m.
P111	1	50	
P112	1	0.4	
P113	1	0.1	

Set Relays 2 to 4 (Level Alarms)

P110	2	1	Description
P110	2	1	Sets Relay Two as a high level alarm for Transducer One with an ON setpoint of 1.3m and an OFF setpoint of 1.2m.
P111	2	1	
P112	2	1.3	
P113	2	1.2	
P110	3	2	Sets Relay Three as a low level alarm for Transducer Two with an ON setpoint of 0.2m and an OFF setpoint of 0.4m.
P111	3	1	
P112	3	0.2	
P113	3	0.4	
P110	4	3	Sets Relay Four as a **rake failure** alarm as it uses the differential level point (3) with an ON setpoint of 1.0m and an OFF setpoint of 0.9m.
P111	4	1	
P112	4	1.0	
P113	4	0.9	

External Totalizers and Flow Samplers

External totalizers are simple counters which count the number of relay clicks produced by the HydroRanger 200. This is generally used to keep track of OCM or pumped volume totals. Note that both of these values are also stored in the HydroRanger 200 and are available through communications.

Flow samplers are devices which take a sample of liquid when triggered by a relay click. These samples are used to monitor water quality over time. Flow samplers can be driven by OCM volume or by relay click volume settings depending on the application requirements.

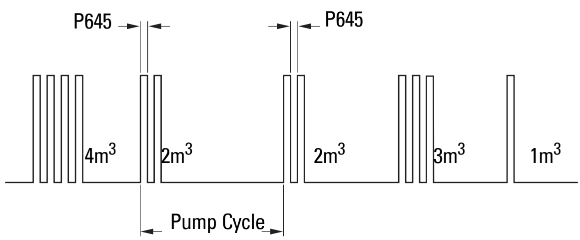
Relay Contacts

Pumped volume is calculated at the end of the pump cycle. Totalized volume given through a relay set up for totalizer (P111[r]=40) will be given in bursts at this time.

Both the open and closed times for the relay contact are provided by P645 and are preset to 0.2 seconds. Partial units are added to the next pump cycle.

Example:

Shows a relay set up to make one contact for every cubic metre (m^3) of liquid.



Totalizer

To set the totalizer to provide relay contact to an external counter, use the following:

Counter Formula	
1 Contact per 10^{P640} units	P640 is preset to **0** so the default number of contacts for a pumped volume cycle is equivalent to the number of volume units.

The source of units depends on the operation:

Operation	Units Source Parameter
OCM (P001=6)	P604–Maximum Flow, or P608–Flowrate Units
Pumped Volume (P001=7)	P051–Max Volume

External Totalizers and Flow Samplers

Flow Sampler

Based on Volume and Time

To trigger a flow sampler relay based on flow, use P111[r]=41 and set the other parameters:

Counter Formula
1 Contact per P641 x 10^{P642} units

Operation	Units Source Parameter
OCM (P001=6)	P604 – Maximum Flow, or P608 – Flowrate Units

By using a mantissa (P641) and an exponent (P642), the relay contacts can be based on a volume other than a multiple of ten.

During the periods of low flow, the sampler may be idle for lengths of time. Program P115 to a time interval in hours to drive the sampler. The sampler will operate based on the volume of flow or the time interval, whichever comes first.

Open Channel Monitoring (OCM)

An OCM installation is defined one of three ways, based on the Primary Measuring Device (PMD):

1. Dimensional (P600 = 2,3,6,7)

For some common weir and flume types. PMD dimensions (P602) are entered directly.

- BS-3680 / ISO 1438/1 Thin plate V notch weir on page 73
- BS-3680 / ISO 4359 Rectangular Flume on page 74
- Palmer Bowlus Flume on page 75
- H Flume on page 76

2. Exponential (P600 = 1)

For most other weir and flume types. PMD exponents provided by the manufacturer are entered. Flow is calculated using the exponent (P601) and the maximum values (P603 and P604).

- Standard Weirs on page 77
- Parshall Flume on page 78
- Leoplod Lagco on page 79
- Cut Throat Flume on page 80

3. Universal (P600 = 4,5)

For all other PMDs, the head-to-flow curve can be plotted based on known breakpoints, usually supplied by the PMD manufacturer.

- Typical Flow Characterization on page 81
- Example Flumes on page 82
- Example Weirs on page 82

Common Parameters

These Quick Start parameters are required for all installations (This setup is for a single point model HydroRanger 200).

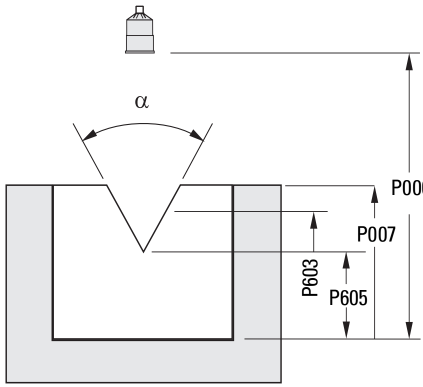
Parameter	Index	Value	Description	
P001	G	6	Operation	= OCM
P002	G	1	Material	= liquid
P003	G	2	Max. Process Speed	= medium
P004	G	102	Transducer	= XPS-10
P005	G	1	Units	= meters
P006	G	1.8	Empty	= 1.8m
P007	G	1.0	Span	= 1.4m
P801	G	0.8	Range Extension to avoid LOE	

Setting Zero Head

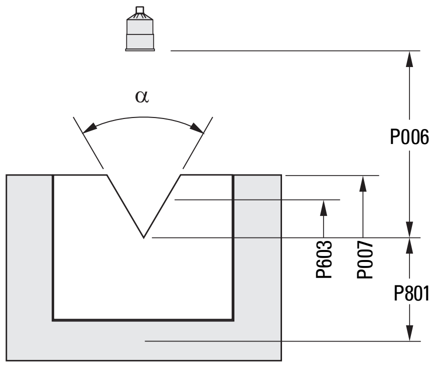
Many PMDs start flowing higher than the traditional empty distance of the application. You can account for the flow in one of two ways:

1. Use P605 (Zero Head) to have OCM calculations ignore levels below that value. Possible head = P007 minus P605.

Note: P603 (Max. Head) is preset to P007 and is not updated when P605 is used. Make sure you set P603 to the correct value when using P605.



2. Use P801 Range Extension where the Empty level is set to the bottom of the weir, and above the bottom of the channel. It should be used if the surface monitored can fall past the Empty (P006) level in normal operation without reporting an LOE. The value is added to Empty (P006) and can be greater than the range of the transducer.



The examples on the following pages show both methods.

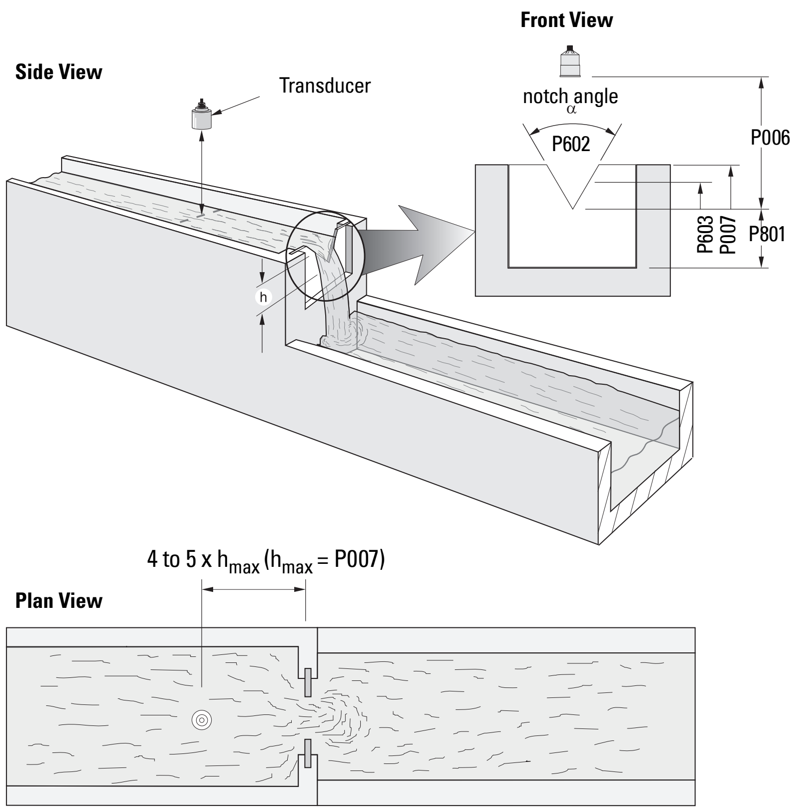
Setting Totalized Volume

To display the totalized volume on the LCD use the following parameters:

Parameter	Index	Value	Description
P737	G	2	Show the eight digit totalizer in the primary display

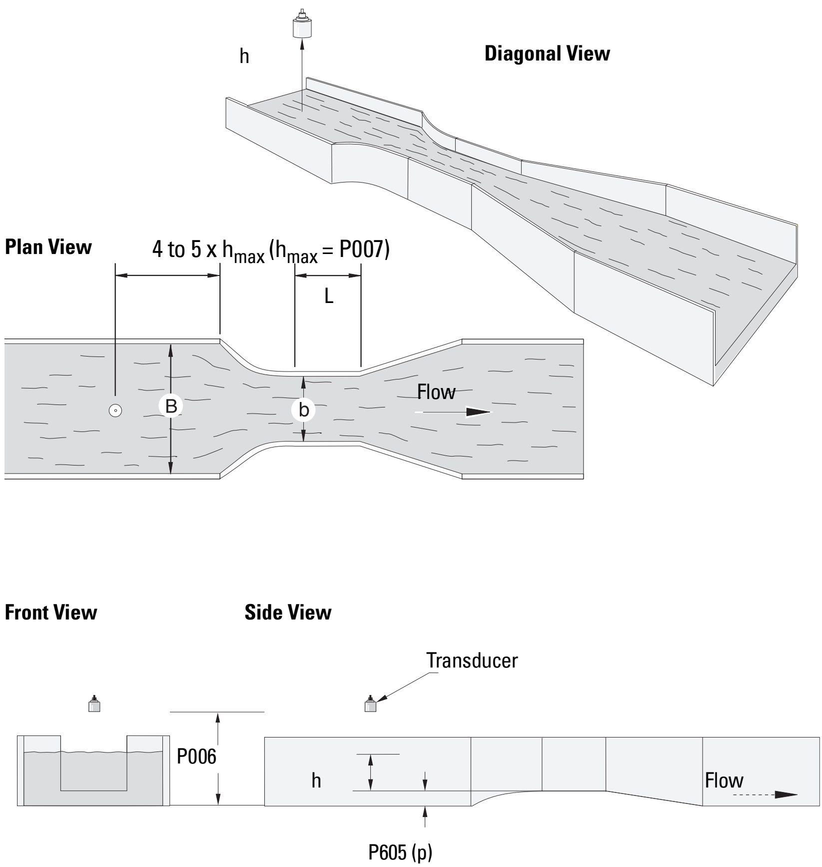
Applications Supported by HydroRanger 200

BS-3680 / ISO 1438/1 Thin plate V notch weir



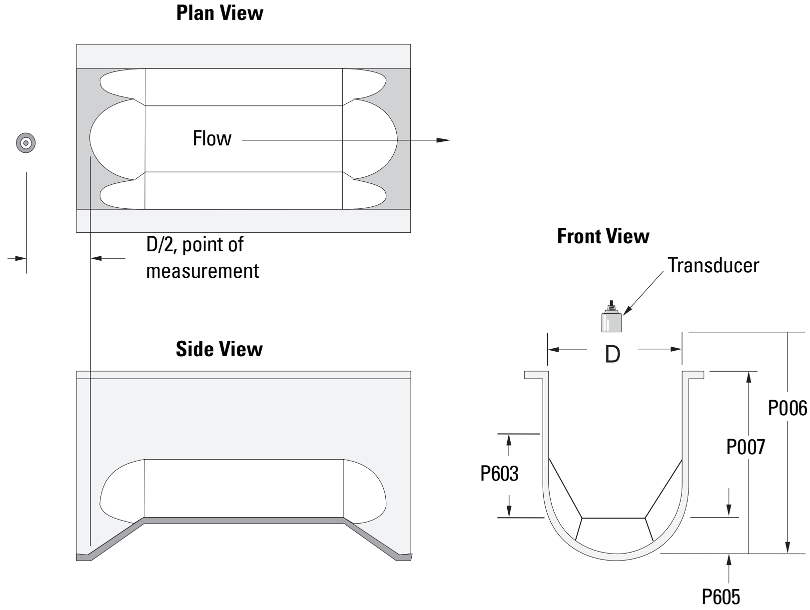
Parameter	Index	Value
P600	G	7–ISO 1438/1 V Notch Weir
P602	1	Notch angle
(view only)	2	Discharge coefficient (Ce)
P603	G	Maximum Head (preset to P007)
P801	G	Range Extension
P608	G	Flowrate Units

BS-3680 / ISO 4359 Rectangular Flume



Parameter	Index	Value
P600	G	6–ISO 4359 Rectangular Flume
P602	1	Approach width (B)
	2	Throat width (b)
	3	Hump Height (p)
	4	Throat length (L)
(view only)	5	Velocity coefficient (Cv)
(view only)	6	Discharge coefficient (Cd)
(view only)	7	Cross sectional area
P605	G	Zero Head
P608	G	Flowrate Units

Palmer Bowlus Flume

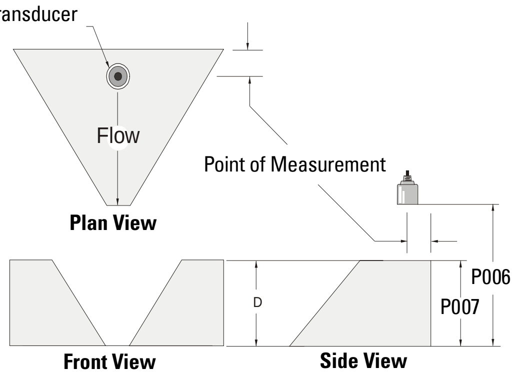


Parameter	Index	Value
P600	G	2–Palmer Bowlus Flume
P602	1	Flume width (D)
P603	G	Maximum Head (preset = P007)
P604	G	Maximum Flow
P605	G	Zero Head
P606	G	Time Units

Application Information

- Sized by pipe diameter D
- Flume relief is trapezoidal
- Designed to install directly into pipelines and manholes
- Head is referenced to bottom of the throat, not bottom of the pipe
- For rated flows under free flow conditions, the head is measured at a distance of D/2 upstream from the beginning of the converging section

H Flume



Parameter	Index	Value
P600	G	3–H Flume
P602	1	Flume height (D)
P603	G	Maximum Head (preset = P007)
P604	G	Maximum Flow
P606	G	Time Units

- Sized by maximum depth of flume
- Approach is preferably rectangular, matching width and depth for distance 3 to 5 times the depth of the flume
- May be installed in channels under partial submergence (ratio of downstream level to head). Typical errors are:
  - 1% @ 30% submergence
  - 3% @ 50% submergence
- For rated flows under free flow conditions, the head is measured at a point downstream from the flume entrance

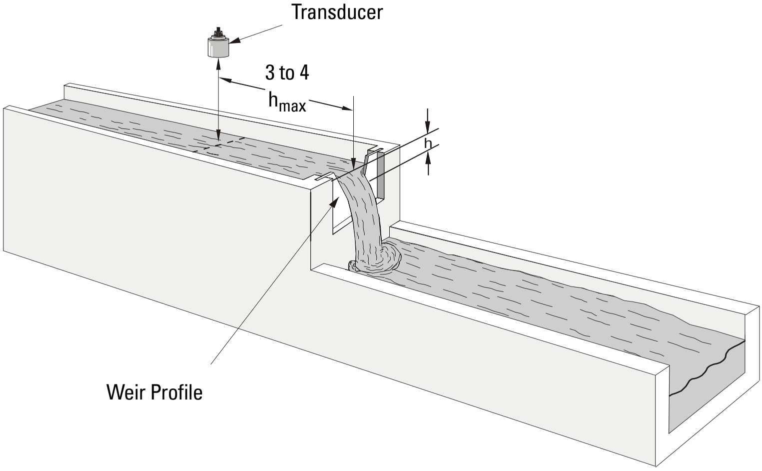
Flume Size (Diameter in feet)	Point of Measurement cm	inches
0.5	5	1¾
0.75	7	2¾
1.0	9	3¾
1.5	14	5½
2.0	18	7¼
2.5	23	9
3.0	28	10¾
4.5	41	16¼

- H flumes come with a flat or sloping floor. The same flow table can be used because error is less than 1%.

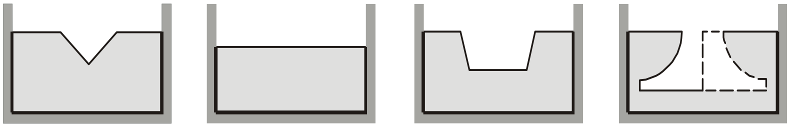
PMDs with Exponential Flow to Head Function

For Primary Measuring Devices (PMDs) that measure flow by an exponential equation, use these parameters. Ensure that you use the correct exponent for your PMD; the values below are samples only.

Standard Weirs



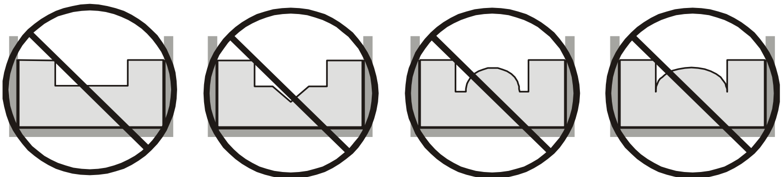
Applicable Weir Profiles



Parameter	Index	Value	
P600	G	1 - Exponential Function	
P601	G	**Weir Type**	**Value[1]**
		V-notch	2.50
		Suppressed rectangular	1.50
		Cipolletti or trapezoidal	1.50
		Sutro or proportional	1.00
P603	G	Maximum Head	
P604	G	Maximum Flow	
P606	G	Time Units	
P801	G	Range Extension	

1. Values are samples only. Consult weir manufacturer's documentation for correct flow exponent.

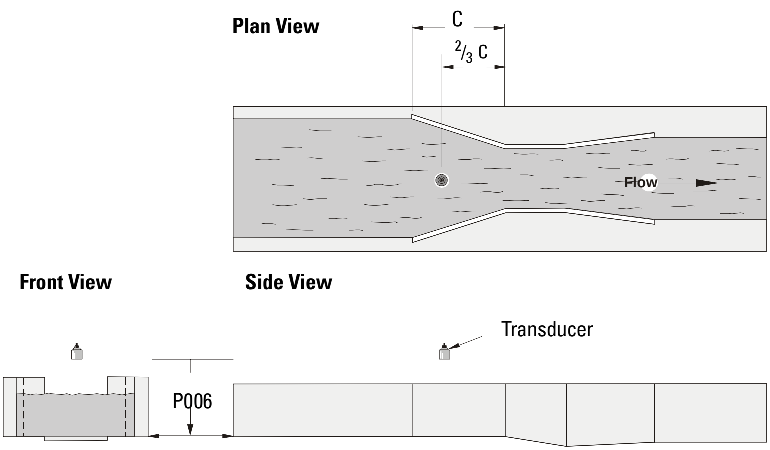
Non-Applicable Weir Profiles



Flows through these weirs can be measured using the Universal Flow Calculation P600 = 4 or 5. See *Universal Calculation Support* on page 81.

Parshall Flume

Note: C = Converging Dimension.

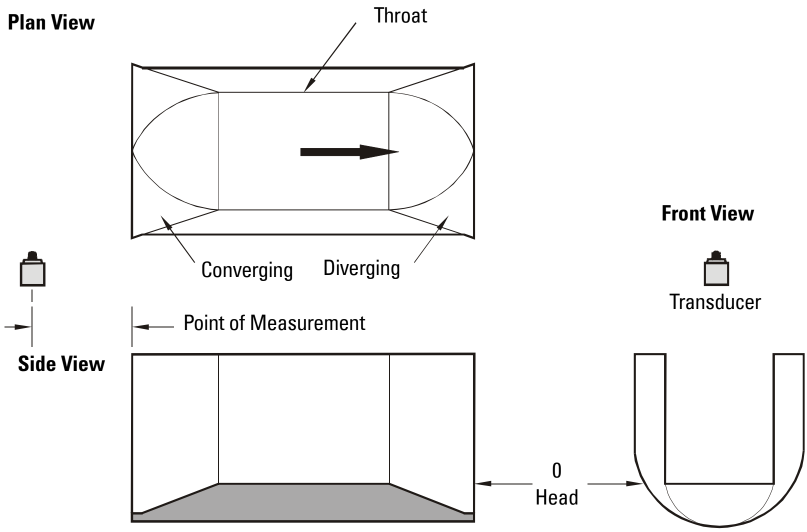


Application Information

- Sized by throat width
- Set on solid foundation
- For rated flows under free flow conditions, the head is measured at $^{2}/_{3}$ the length of the converging section from the beginning of the throat section

Parameter	Index	Value
P600	G	1–Parshall Flume
P601	G	1.22–1.607 (consult your flume documentation)
P603	G	Maximum Head
P604	G	Maximum Flow (Q)
P606	G	Time Units

Leopold Lagco Flume



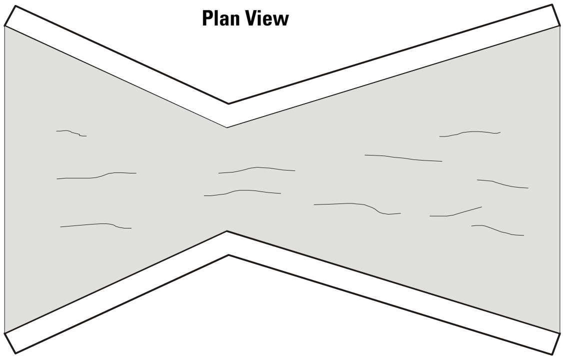
Parameter	Index	Value
P600	G	1–Leopold Lagco Flume
P601	G	1.55
P603	G	Maximum Head (preset P007)
P604	G	Maximum Flow
P605	G	Zero Head
P606	G	Time Units

Application Information

- Designed to be installed directly into pipelines and manholes
- Leopold Lagco may be classed as a rectangular Palmer-Bowlus flume
- Sized by pipe (sewer) diameter
- For rated flows under free flow conditions, the head is measured at a point upstream referenced to the beginning of the converging section. Refer to the following table:

Flume Size (pipe diameter in inches)	Point of Measurement cm	inches
4-12	2.5	1
15	3.2	1¼
18	4.4	1¾
21	5.1	2
24	6.4	2½
30	7.6	3
42	8.9	3½
48	10.2	4
54	11.4	4½
60	12.7	5
66	14.0	5½
72	15.2	6

Cut Throat Flume



Application Information

- Similar to Parshall flume except that the floor is flat bottomed and throat has no virtual length.
- Refer to manufacturer's specifications for flow equation and point of head measurement.

Parameter	Index	Value
P600	G	1–Cut Throat Flume
P601	G	1.55
P603	G	Maximum Head (preset P007)
P604	G	Maximum Flow
P606	G	Time Units

Universal Calculation Support

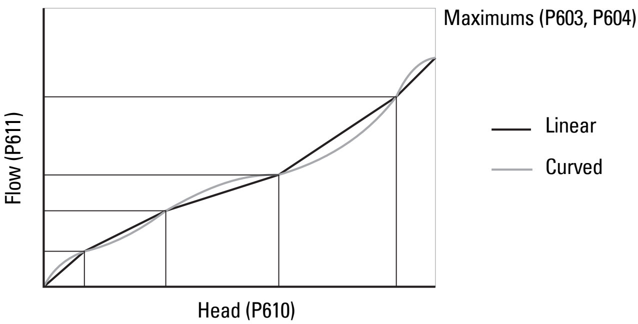
When the primary measuring device (PMD) doesn't fit one of the standard types, it can be programmed using a universal characterization. When Universal is selected as the PMD type (P600), then both P610 and P611 must be entered to define the flow.

Two curve types are supported:

- P600 = 4–linear (piece wise linear)
- P600 = 5–curved (cubic spline)

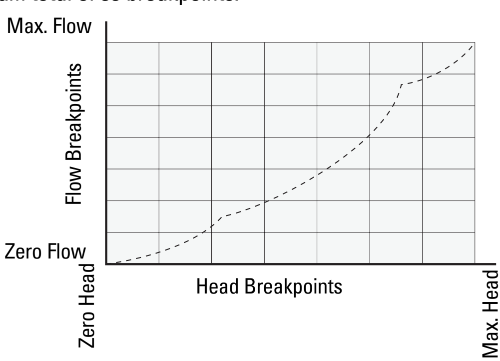
Both are shown in the following chart.

Typical Flow Characterization



Characterization is achieved by entering the head (P610) and corresponding flow (P611), either from empirical measurement or from the manufacturer's specification. Increasing the number of defined breakpoints will increase the accuracy of the flow measurement.

Breakpoints should be concentrated in areas exhibiting the higher degrees of non linear flow. A maximum of 32 breakpoints can be defined. The curve's end point is always specified by the parameters Maximum Head (P603) and Maximum Flow (P604) for a maximum total of 33 breakpoints.



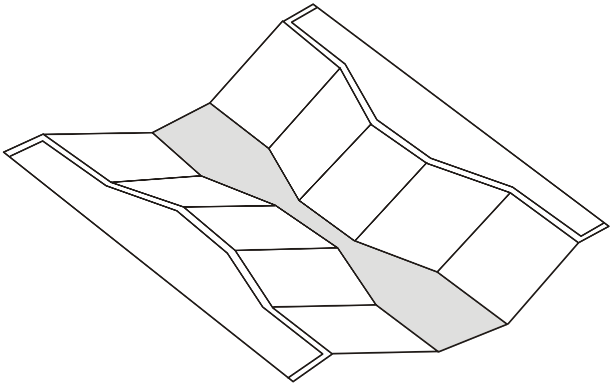
Use as many breakpoints as required by the complexity of your PMD.

See *Volume* on page 49 for more information and parameters P610 and P611 for characterization.

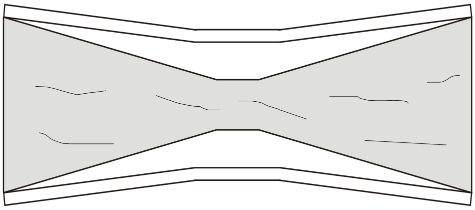
Example Flumes

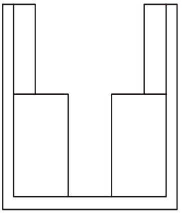
These example flumes would both require a universal calculation.

Trapezoidal



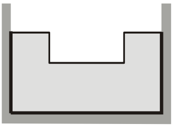
Dual Range (nested) Parshall



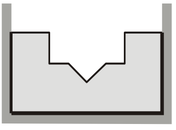


Example Weirs

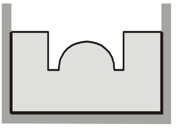
These weirs could require universal calculation.



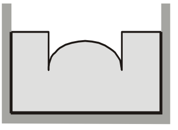
contracted rectangular



compound



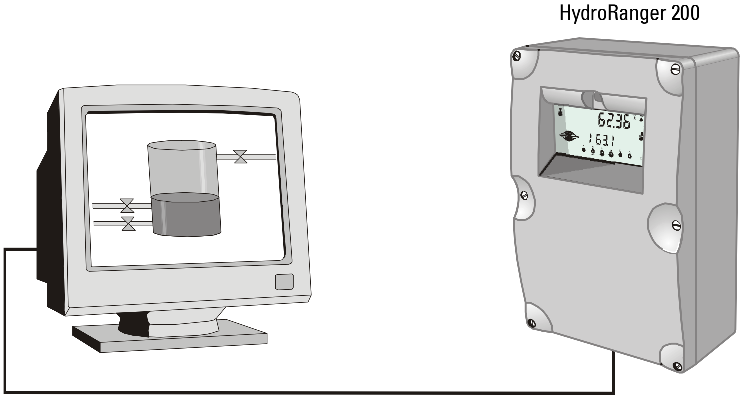
Poebing



approximate exponential

HydroRanger 200 Communication Systems

The HydroRanger 200 is an integrated level controller capable of communicating process information to a Supervisory Control and Data Acquisition (SCADA) system, via a serial device such as a radio modem, leased line, or dial-up modem.



The standard HydroRanger 200 supports the following two communication protocols:

Modbus

Modbus is an industry standard protocol used by SCADA and HMI systems. The HydroRanger 200 uses Modbus to communicate via the RS-485 port. For a description of the Modbus protocol, contact your local Schneider representative.

Dolphin

Dolphin is a proprietary Siemens Milltronics protocol designed to be used with Dolphin Plus. For more information on Dolphin Plus or to obtain a copy of the software, please go to www.siemens.com/processautomation to contact your Siemens Milltronics representative.

Optional SmartLinx® Cards

The standard HydroRanger 200 unit may also be enhanced with Siemens Milltronics SmartLinx® communication modules that provide an interface to popular industrial communication systems.

This manual only describes the built-in communications. For more information on SmartLinx, please consult the appropriate SmartLinx manual.

Communication Systems

The HydroRanger 200 is capable of communicating with most SCADA systems, PLCs, and PCs. The supported protocols are:

- Modbus RTU/ASCII – base unit on RS-232 or RS-485 transport
- PROFIBUS DP – optional SmartLinx® module
- Allen-Bradley® [1] Remote I/O – optional SmartLinx module
- DeviceNet® – optional SmartLinx module

Communication Ports

The HydroRanger 200 comes with two communication ports on the base unit.

Port	Connection	Location	Interface
1	RJ-11 connector	inside enclosure on main board	RS-232
2	terminal block	terminal block	RS-485

RS-232

The RJ-11 jack connects to a laptop computer for the following:

- initial setup
- configuration
- troubleshooting
- periodic maintenance

RS-485

The RS-485 port on the terminal blocks connects into industrial communications wiring and has the following advantages:

- runs communications cable farther
- allows multiple slave units on the network, addressed by P771 – Network Address

To communicate with equipment requiring RS-485 capability, Siemens Milltronics offers the RS-485 External Modem Kit. For more information, go to www.siemens.com/processautomation.

1. Allen-Bradley is a registered trademark of Rockwell Automation.
DeviceNet is a registered trademark of Open DeviceNet Vendor Association.

Modbus

The Modbus protocol is supported in the base unit and can be configured using the Communications parameters P770 to P782.

To set up communications with a Modbus RTU master device on port 2 using RS-485, set the following parameters:

Parameter	Index	Value	Description
P770	2	3	Modbus RTU slave
P771	2	1	Network address, only used for RS-485
P772	2	9.6	Data rate of 9600 baud
P773	2	0	No parity, common setting
P774	2	8	8 data bits, common setting
P775	2	1	1 stop bit, common setting
P778	2	0	No modem connected
P782	2	0	Index parameter values globally

SmartLinx

Other protocols are available through optional SmartLinx communications modules. Details on how to install and program these modules are contained in the SmartLinx documentation.

Dolphin Plus

Dolphin Plus software makes it easy to record and compare parameter sets for all the HydroRanger 200s in your company. Dolphin Plus uses a proprietary protocol called *Dolphin* to communicate with Siemens Milltronics instruments. This protocol is set when P770 = 1.

By default the settings for port 1 (RJ-11 connection) and Dolphin Plus match. These settings are:

Parameter	Index	Value	Description
P700	1	1	Dolphin
P772	1	115.2	Data rate of 115.2 Kilo baud
P773	1	0	No parity, common setting
P774	1	8	8 data bits, common setting
P775	1	1	1 stop bit, common setting

Wiring Guidelines

- the RJ-11 cable maximum length is 3 meters
- RS-485 maximum length is 1,200 meters (4,000 feet)
- use 24 AWG (minimum)
- use good quality communication grade (shielded twisted pairs) cable that is recommended for RS-485 for port 2 (Belden 9842)
- run the communication cable separately from power and control cables (do not tie wrap your RS-232 or RS-485 cable to the power cable or have them in the same conduit)
- use shielded cable and connect to ground at one end only
- follow proper grounding guidelines for all devices on the bus

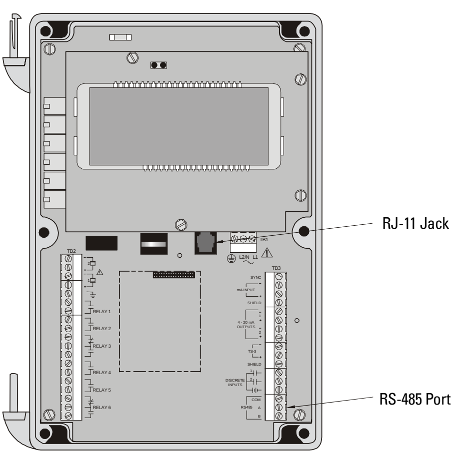
Note: Improper wiring and incorrect choice of cables are two of the most common causes of communication problems.

Ports 1 and 2

Port	Wall Mount
1	RS-232 port (RJ-11 modular telephone jack) is on the motherboard and is generally used with a laptop computer or modem.
2	Connections for the RS-485 port are on the terminal block.

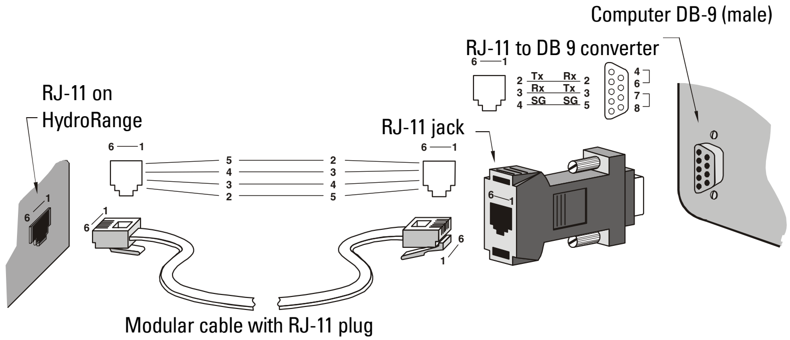
Ports 1 and 2: RS-232 RJ-11 Jack and RS-485 Locations

The RJ-11 jack and the RS-485 port are inside the enclosure of the unit.



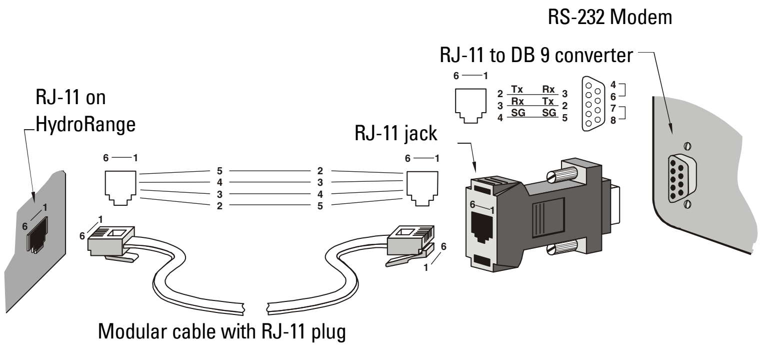
Port 1: RS-232 RJ-11 Jack

To connect the unit to a PC using an RS-232 jack, use the cable as shown:



Note: Jumper pins 4-6 and 7-8 at the DB-9.

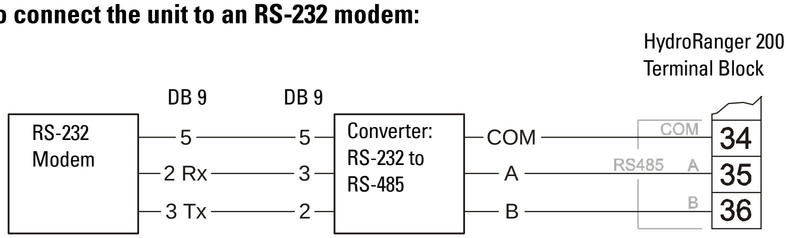
To connect the unit to a modem using an RS-232 jack:

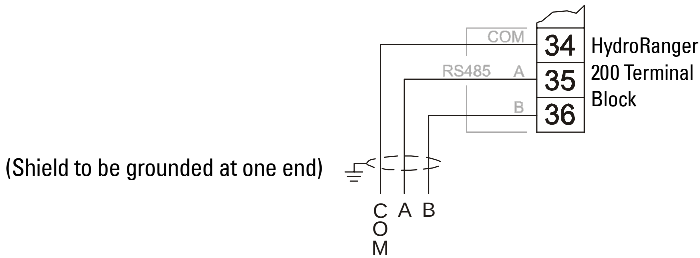


Note: Jumper pins 4-6 and 7-8 at the DB-9.

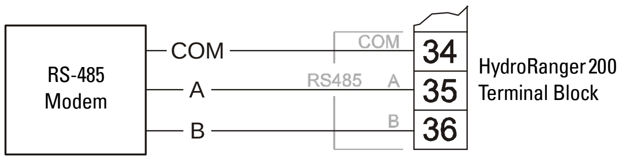
Port 2: RS-485

To connect the unit to an RS-232 modem:





To connect the unit to a modem using an RS-485 port:



Configuring Communication Ports (Parameters)

The 11 parameters listed are indexed to the two communication ports, unless otherwise noted: An asterisk (*) identifies the preset value.

Port	Description
1	RS-232 port (RJ-11 modular telephone)
2	The RS-485 port is on the terminal blocks

P770 Port Protocol

The communications protocol used between the HydroRanger 200 and other devices.

Primary Index	Communications Port		
Values	0		Communications port disabled
	1	*	Siemens Milltronics Dolphin protocol (preset for port 1)
	2		Modbus ASCII slave serial protocol
	3	*	Modbus RTU slave serial protocol (preset for port 2)

The HydroRanger 200 supports the Siemens Milltronics Dolphin format (www.siemens.com/processautomation), and the internationally recognized Modbus standard in both ASCII and RTU formats. Other protocols are available with optional SmartLinx cards.

P771 Network Address

The unique identifier of the HydroRanger 200 on the network.

Primary Index	Communications Port		
Values	Range: 0 to 9999		
	1	*	Preset

For devices connected with the Siemens Milltronics protocol, this parameter is ignored. For devices connected with a serial Modbus slave protocol, this parameter is a number from 1-247. The network administrator must ensure that all devices on the network have unique addresses. Do not use the value **0** for Modbus communications as this is the broadcast address and is inappropriate for a slave device.

P772 Baud Rate

The communication rate with the master device.

Primary Index	Communications Port		
Values	4.8		4800 baud
	9.6		9600 baud
	19.2	*	19,200 baud (preset for port 2)
	115.2	*	115,200 baud (preset for port 1)

This specifies the rate of communication in Kbaud. Any value may be entered, but the only values supported are those shown above. The baud rate should reflect the speed of the connected hardware and protocol used.

P773 Parity

The serial port parity.

Primary Index	Communications Port		
Values	0	*	No Parity
	1		Odd Parity
	2		Even Parity

Ensure that the communications parameters are identical between the HydroRanger 200 and all connected devices, as many modems default to N-8-1.

P774 Data Bits

The number of data bits per character.

Primary Index	Communications Port		
Values	Range: 5 to 8		
	8	*	Modbus RTU
	7 or 8		Modbus ASCII
	7 or 8		Dolphin Plus

P775 Stop Bits

The number of bits between the data bits.

Primary Index	Communications Port		
Values	Range: 1 or 2		
	1	*	Preset

P778 Modem Available

Sets the HydroRanger 200 to use an external modem.

Primary Index	Communications Port		
Values	0	*	No modem connected
	1		Answer only

P779 Modem Inactivity Timeout

Sets the time that the unit will keep the modem connected with no activity.

Primary Index	Communications Port		
Values	Range: 0-9999 seconds		
	0	*	No timeout

To use this parameter, ensure that P778 (Modem Available) =1. Ensure that the value is low enough to avoid unnecessary delays when an unexpected disconnect occurs but long enough to avoid timeout while you are still legitimately connected. This parameter value is ignored by the Modbus Master Drivers as they automatically disconnect when done communicating.

Hanging Up

If the line is idle and the P779 Modem Inactivity Timeout expires, then the modem is directed to hang up the line. Ensure that P779 is set longer than the standard polling time of the connected master device. Set P779 to **0** to disable the inactivity timer.

P782 Parameter Index Location

Determines where index information is stored for the parameter access area for the Modbus register map.

Primary Index	Global		
Values	0	*	Global
	1		Parameter-Specific

For more on Parameter Index Location, see *Parameter Access* on page 96.

Modbus Register Map

The memory map of the HydroRanger 200 occupies the Modbus holding registers (R40,001 and up). This map is used when the protocol is Modbus RTU slave or Modbus ASCII slave.

Register Map for Most Common Data

Legend	
Type	The type of data held in the group of registers.
Start	The first register to hold the referenced data.
Data Type	The possible values of the data in the register. See *Data Types* on page 100 for more information.
Description	The type of data held in the individual registers.
#R	The number of registers used for the referenced data.
Read/Write	Indicates whether the register is readable, writeable or both.

Type	Description	Start	#R [1]	Data Type	Read/ Write
	Word Order	40,062		0/1	R/W
Map ID	Register Map Type	40,063	1	0/1 = P782	R/W
ID	Siemens Milltronics Product Code	40,064	1	4 = Model 200	R
Single Parameter Access (SPA)		R40,090	7	see *Appendix A* on page 107	
Point Data	Reading (3)[2]	41,010	2	-20,000 to 20,000	R
	Volume (2)[3]	41,020	2	-20,000 to 20,000	R

1. Maximum registers shown; fewer may be used depending on options installed.
2. Varies according to model.
   Available as reading 1, reading 2, and Average or Difference when in either Standard or Dual Point Mode. In Single Point Mode, point 2 and 3 are only available if P001 = Average or Difference. In Dual Point Mode, reading 1 and reading 2 are always available. Point 3 is only available if P001[3]= Average or Difference.
3. 2nd volume available in Dual Point Mode only.

Modbus Register Types

Type	Description	Start	#R [1]	Data Type	Read/ Write
Point Data	Temperature (2)	41,030	2	–50 to 150	R
	Totalizer for points 1 and 2	41,040	4	UINT32	R/W
I/O	Discrete Inputs (2)	41,070	1	Bit Mapped	R
	Relay Outputs (3 or 6)	41,080	1	Bit Mapped	R/W
	mA Input (1)	41,090	1	0000 to 20,000	R
	mA Output (2)	41,110	2	0000 to 20,000	R/W
Pump Control	Pump on Setpoint (3 or 6)	41,420	6	0000 to 10,000	R/W
	Pump off Setpoint (3 or 6)	41,430	6	0000 to 10,000	R/W
	Pumped Volume (2)	41,440	4	UINT32	R
	Pump Hours (3 or 6)	41,450	12	UINT32	R
	Pump Starts (3 or 6)	41,470	6	0000 to 10,000	R
Parameter Access		43,998 to 46999			R/W

1. Maximum registers shown; fewer may be used depending on options installed.

The HydroRanger 200 was designed to make it easy for master devices to get useful information via Modbus. This chart gives an overview of the different sections. A more detailed explanation of each section follows below.

Word Order (R40,062)

This determines the format of unsigned, double-register integers (UINT32).

- **0** indicates that the most significant word (MSW) is given first
- **1** indicates that the least significant word (LSW) is given first

See *Unsigned Double Precision Integer (UINT32)* on page 100 for more information.

Note: Additional information is available from our Web site at www.siemens.com/processautomation

Map ID (R40,063)

This value identifies the register map used by the HydroRanger 200. See *P782 Parameter Index Location* on page 90.

See also *Parameter Access (R43,998 – R46,999)* on page 96 for details.

Product ID (R40,064)

This value identifies the Siemens device type:

Device Type	Value
HydroRanger 200	4

Point Data (R41,010 – R41,031)

Measurement point data contain the current instrument readings. These are the values shown for the reading measurement for each measurement point. The reading is based on the setting for P001 (operation). P001 can be set to **level**, **distance**, **OCM flow**, or **volume**. See *Parameter Reference* section on page 114 for details.

The measurement registers are 41,010 to 41,012. The HydroRanger 200 uses 41,010 when configured with a single transducer and 41,010 to 41,012 when configured with two transducers (P111=4 or 5 only). Two transducers can create three readings because they can generate an average or differential reading (R41,012) as well as the two level readings (R41,010 and R41,011).

Available registers:

Data	Registers	Parameter
Reading	41,010 to 41,012	P920
Volume	41,020, 41,021	P924
Temperature	41,030 and 41,031	P912

The reading is expressed as a percentage of full scale, multiplied by 100:

Reading	Value
0	0.00%
5000	50.00%
7564	75.64%
20,000	200.00%

Totalizer (R41,040 – R41,043)

The totalizers are stored as 32 bit integers using two registers. The totalizers can be read with R41,040 and R41,041 as totalizer for Point 1, and R41,042 and R41,043 as totalizer for Point 2. The totalizer values can be reset to any value by writing that value to the registers. The values can be cleared by writing zero (0) to the registers.

Input/Output (R41,070 – R41,143)

The HydroRanger 200 has discrete inputs, mA inputs, mA outputs and relay outputs. See below for details for each I/O type.

Discrete Inputs (R41,070)

This table shows the current status of the discrete inputs. Only register 41,070 is used.

Discrete Input	Data Address
1	41,070, bit 1
2	41,070, bit 2

Relay Outputs (R41,080)

This table shows the current status of the relays. A reading of **0** means that the relay function is not asserted and a **1** means that it is asserted. For example, a **1** for a pump relay means that the pump is running.

Relay	Data Address
1	41,080, bit 1
2	41,080, bit 2
3	41,080, bit 3
4	41,080, bit 4
5	41,080, bit 5
6	41,080, bit 6

Values are written to control a relay only if the Relay Control Function (P111) is set to **communications** (**65**). See *Relay Function Codes (P111 Only)* on page 103.

mA Input (R41,090)

The mA input is scaled from 0 to 2,000 (0 to 20 mA multiplied by 100). P254 displays the value of the input. This parameter is indexed by the input number.

mA Output (R41,110-41,111)

The mA output is scaled from 0 to 2,000 (0 to 20 mA multiplied by 100). This is displayed in P911.

Pump Control (R41,400 – R41,474)

Only relays set for pump control (P111 = 50 to 52) are available. These registers have no effect on relays programmed for other uses.

Pump ON Setpoint (R41,420 – R41,425)

The **ON** setpoint level (P112) for the referenced pump relay.

The setpoint is scaled from 0 to 10,000 (0 to 100% of span multiplied by 100). So 54.02% is shown in the register as 5402.

Pump OFF Setpoint (R41,430 – R41,435)

The **OFF** setpoint level (P113) for the referenced pump relay.

The setpoint is scaled from 0 to 10,000 (0 to 100% of span multiplied by 100). So 54.02% is shown in the register as 5402.

Pumped Volume (R41,440 – R41,443)

The pumped volume registers hold the current total for all of the pumps associated with a level point. These registers are available only if operation is set to **pumped volume** (P001 = 7).

These volumes can become very large. Therefore, two registers are used to hold the value. See *Unsigned Double Precision Integer (UINT32)* on page 100 for more information.

The value in the registers is given as an integer value but must be interpreted as having the number of decimals set in P633 (LCD Totalized Decimal Position): this number can be **0** to **3**. Ensure that your software accounts for these decimal places before you report the pumped volume totals.

Pump Hours (R41,450 – R41,461)

The number of running hours for the referenced pump relay. The hours are given to three decimal places, so the integer must be divided by 1000 to get the correct value. For example 12,340 represents 12.34 hours.

This value comes from parameter P310. See page *151* of the *Parameter Reference* section for details.

Pump Starts (R41,470 – R41,475)

The number of pump starts for the referenced pump relay.

This value comes from parameter P311. See page 152 of the *Parameter Reference* section for details.

Parameter Access (R43,998 – R46,999)

Parameter values are given as integers in the range of registers from R44,000 to R44,999. The last three numbers of the register correspond to the parameter number.

Parameter Register #	Format Register #	Parameter #
44,000	46,000	P000
44,001	46,001	P001
44,002	46002	P002
...	...	...
44,999	46,999	P999

Usually, the parameters are all **read / write**.

Note:

- Parameters P000 and P999 are **read only**. If P000 is set to **lock activated** then all of the parameters are **read only**
- Parameter P999 (Master Reset) cannot be used via Modbus
- See *Data Types* on page 100 for a description of the different types of data associated with different parameters

Each parameter register has a corresponding format register that holds the format information required to interpret the value. See *Format Words (R46,000 to R46,999)* on page 98.

Parameter Indexing

Many parameters are indexed. There are two possible indexes: a primary index and a secondary index. A secondary index is a sub-address of the primary index. Some indexed parameters affect multiple I/O devices.

The following is an example of a primary index:

P111 is the Relay Control Function. This parameter determines how a relay is controlled by the HydroRanger 200 (used as an alarm, for pump control, etc.). Because there are six relays on the HydroRanger 200, P111 is indexed by six to allow each relay to be programmed independently.

A few parameters also have a secondary index. While a secondary index is important for setting up the HydroRanger 200, it is almost never needed through remote communications.

Indexing the Parameter Access Area

Each parameter communicates its value to only one register. You must know the index(es) for the parameter in order to interpret the information in the register correctly.

For example, to make use of the value returned in register R44,111 you must know which relay it is referring to. See *Relay Function Codes (P111 Only)* on page 103 for details on P111 values.

To determine the index values, the primary and secondary index must be **read** or **write**. The two possible methods of handling these index values are described in the following paragraphs: *Global Index Method* and *Parameter Specific Index Method*.

Reading Parameters

To read parameter values, follow the steps listed in either the Global or the Parameter Specific Index Method that follow. You must be able to program your HMI or SCADA system before completing these methods.

Global Index Method (P782 = 0)

Global format method sets index values for all parameters simultaneously. Use this method to read multiple values set to the same index values.

1. Write the primary index value into R43,999.

   This is a value between **0** and **40** which specifies the input or output indexed by the parameter.

Examples are:

- Transducer 1 is index 1
- Discrete input 2 is index 2
- Relay 5 is index 5

2. Write the secondary index value into R43,998.

   This is a value between **0** and **40** that specifies the secondary index on the parameter. This value is usually **0**.

3. Write the desired format value into the appropriate format register. Because the primary and secondary indexes are already specified, these portions of the format word are ignored and only the last digit is significant.

   See *Format Registers* on page 108 for details.
4. Read the value from the appropriate parameter register.

Types of values are:

- *Numeric Values*, on page 100
- *Bit Values*, on page 100
- *Split Values*, on page 101
- *Text Messages*, on page 102
- *Relay Function Codes (P111 Only)*, on page 103

A value of 22,222 indicates that an error has occurred. Specify a different format type and try again.

Parameter Specific Index Method (P782 = 1)

The Parameter Specific index method sets the index values for each parameter independently. Use this method to read multiple parameters with different index values.

1. Write the primary index, secondary index, and data format values into the appropriate format register.

   For example, to read the following information:
   - measured level (P921)
   - in units with three decimal places
   - from Transducer One

   Send the integer value 01008 to register 46,921.

2. Read the value from the appropriate parameter register (the example uses 44,921).

   Types of values are:
   - *Numeric Values* on page 100
   - *Bit Values* on page 100
   - *Split Values* on page 101
   - *Text Messages* on page 102
   - *Relay Function Codes (P111 Only)* on page 103

   A value of 22,222 indicates that an error occurred. Specify a different format type and try again.

Writing Parameters

The method of writing parameters is similar to the method of reading them. Become familiar with *Reading Parameters*, page 97, before attempting to write any parameters.

To write parameter values to the HydroRanger 200, follow the steps on the next page:

Global Index Method (P782 = 0)

1. Write the primary index value into R43,999.
2. Write the secondary index value into R43,998.
3. Write the desired format value into the appropriate format register.
4. Write the value to the appropriate parameter register.

Parameter Specific Index Method (P782 = 1)

1. Write the primary index, secondary index, and data format values into the appropriate format register.
2. Write the value to the appropriate parameter register.

Format Words (R46,000 to R46,999)

Format words are unsigned integers that contain up to three values (described below). The number of values used in the format words depends on the Parameter Index Location (P782) that is used.

Parameter P782 Parameter Index Location, described on page 90, determines which of two methods is used to access the format words: Global Index Method or Parameter Specific Index Method.

Global Index Method (P782 = 0)

Only the final digit of the format word determines the decimal offset (below).

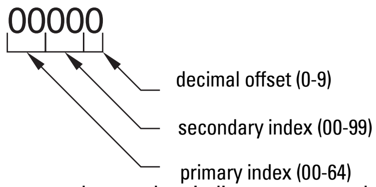
Parameter-Specific Index Method (P782 = 1)

All three decimal fields are used to determine the parameter value's primary index, secondary index, and decimal offset.

Format Registers

Each format register is made up of three decimal fields:

- decimal offset
- secondary index
- primary index



The primary and secondary indices correspond to those that are used by the parameter.

The decimal offset indicates how the remote system must interpret the integer value that is stored in the parameter access register. The following table shows how different parameter values can be shown based on a register value (integer) of **1234**.

Decimal	Offset	Example
0	0	1,234
1	–1	12,340
2	–2	123,400
3	–3	1,234,000
4	–4	12,340,000
5	–5	123,400,000
6	+1	123.4
7	+2	12.34
8	+3	1.234
9	Percent	12.34%

Examples of using the format word for both the index values and the decimal offset value are shown below:

Format	Primary Index	Secondary Index	Decimal
00000	00	00	0
01003	01	00	3 right
02038	02	03	3 left
05159	05	15	percent

To write these values you can use a decimal offset as follows: format word = (primary index x 1000) + (secondary index x 10) + (decimal).

Data Types

The HydroRanger 200 parameters do not always use integers to hold values. For the convenience of the programmer, those values are converted to and from a 16-bit integer number. This section describes the conversion process. The sections that follow describe where those values are in the discrete I/O and block transfer addresses, and how to get the parameters you need.

Numeric Values

Numeric parameter values are the most common. For example, parameter P920 (Reading) returns a number that represents the current reading (either level or volume, depending on the HydroRanger 200 configuration).

Numeric values are requested or set in units or percent of span, and may be specified with a number of decimal places.

Numeric values must be in the range –20,000 to +20,000 to be valid. If a parameter is requested and its value is more than +20,000, the number 32,767 is returned; if it is less than –20,000, the number –32,768 is returned. If this overflow happens, decrease the number of decimal places.

If a parameter cannot be expressed in terms of percent of span, or has no meaningful value, the number 22,222 is returned. Try requesting the parameter in units, or refer to P005 in the *Parameter Reference* section on page 119.

Bit Values

Bits are packed into registers in groups of 16 bits (1 word). In this manual, the bits are numbered from 1 to 16, with bit 1 as the least significant bit (LSB) and bit 16 as the most significant bit (MSB).

16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01
MSB															LSB

Unsigned Double Precision Integer (UINT32)

Large numbers are put into unsigned 32 bit integers. By default, they are set up so that the first word (register) is the most significant word (MSW) and the second word (register) is the least significant word (LSW).

For example, if R41,442 is read as a UINT32, the 32 bits would look like this:

R41,442			R41,443		
16	MSW	1	16	LSW	1
32		32-bit integer value (UINT32)			1

The two registers are read as a 32-bit integer.

The most significant word (MSW) and least significant word (LSW) can be reversed to accommodate some Modbus drivers. See *Word Order (R40,062)* on page 92 for details.

The position of the decimal place is dependent on the register. For more details see the description of the register.

Split Values

Certain parameters are actually a pair of numbers separated by a colon, using this format: xx:yy.

One example is P807, Transducer Noise, where:

xx = the average noise value in dB

yy = the peak noise in dB

The number which corresponds to xx:yy, either for reading or setting a parameter, is determined by the following formula:

For storing to the device:
value = (xx + 128) x 256 + (yy + 128)

For reading from the device:
xx = (value / 256) – 128
yy = (value % 256) – 128
where % is the modulus operator.

The modulus can be computed by following these steps:
$value_1$ = value / 256
$value_2$ = remainder of $value_1$
$value_3$ = $value_2$ x 256
yy = $value_3$ – 128

It may simplify Parameter to notice:
xx = (most significant byte of value) – 128
yy = (least significant byte of value) – 128

Data Types

Text Messages

If a device parameter returns a text message, that message is converted to an integer and provided in the register. The numbers are shown in the following table:

Number	Text Message as displayed on LCD
22222	Invalid value
30000	Off
30001	On
30002	≡≡≡≡
30003	[- -] (parameter does not exist)
30004	Err
30005	Err1
30006	Open
30007	Short
30008	Pass
30009	Fail
30010	Hold
30011	Lo
30012	Hi
30013	De
30014	En
30015	---- (parameter has not been set)
-32768	Value is less than –20,000
32767	Value is greater than 20,000

Relay Function Codes (P111 Only)

If a device parameter returns a relay function code, that message is converted to a number and is then provided in the register. The numbers are shown in the following table:

Control	Relay Function Code	Number	P111
General	OFF, relay not used	0	0
	Undesignated Level Alarm	1	1
	Low-Low Level Alarm	2	1 – LL
	Low Level Alarm	3	1 – L
	High Level Alarm	4	1 – H
	High-High Level Alarm	5	1 – HH
	In Bounds Alarm	6	2
	Out of Bounds Alarm	9	3
	Rate of Level Change Alarm	12	4
	Temperature Alarm	15	5
	Loss of Echo (LOE) Alarm	20	6
	Transducer Cable Fault Alarm	16	7
Pump	Totalizer	22	40
	Flow Sampler	23	41
	Fixed Duty Assist	25	50
	Fixed Duty Backup	26	51
	Alternate Duty Assist	30	52
Pump (con't)	Alternate Duty Backup	31	53
	Service Ratio Duty Assist	35	54
	Service Ratio Duty Backup	36	55
	First In First Out (FIFO)	40	56
Control	Flush Valve	65	64
	Communication	66	65

See P111 on page 131 of the *Parameter Reference* section.

Data Types

Error Handling

Modbus Responses

When polled by a Modbus Master, a slave device will do one of the following:

1. Not reply. This means that something went wrong with the transmission of the message.
2. Echo back the command with the correct response (see the Modbus specification for more details). This is the normal response.
3. Return an Exception Code. This reflects an error in the message.

HydroRanger 200 uses the following exception codes:

Code	Name	Meaning
01	Illegal Function	The function code received in the query is not an allowable action for the slave.
02	Illegal Data Address	The data address received in the query is not an allowable address for the slave.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the slave.

Error Handling

Errors can be traced to two general sources:

1. There is an error in transmission.

   OR

2. The host tries to do something that is not a valid action.

In the first case, the HydroRanger 200 does not respond and the master waits for a **response time out** error, which causes the master to re-send the message.

In the second case, the response depends on what the host tries to do. In general, HydroRanger 200 will not give an error to the host request. Various actions and the expected outcome are as follows:

- If the host reads an invalid register, the host will get an undetermined value back.
- If the host writes an invalid register (a non-existing parameter or a **read only** parameter), the value will be ignored and no error response will be made. However, the current value will not reflect the desired new value.
- If the host writes a **read only** register, then the value will be ignored and no error response will be made. However, the current value will not reflect the desired new value.

- If P000 is activated, then the value will be ignored and no error response will be made. However, the current value will not reflect the desired new value.
- If the host attempts to write one or more registers that are out of range, an exception response code **2** or **3** is generated, depending if the start address is valid.
- If the host used an unsupported function code, an exception response code of **01** should be generated. However, this is not guaranteed and there may be no response.

Communication Troubleshooting

Generally

1. Check the following:
   - There is power at the unit
   - The LCD is showing the relevant data
   - The device can be programmed using the hand programmer
2. Check the wiring pin outs and verify that the connection is correct.
3. Verify that values in the set-up parameters (P770 to P779) match the settings in the computer used to communicate with the unit.
4. Check that the port on the computer is correct. Sometimes trying a different Modbus driver will solve the problem. An easy stand-alone driver called ModScan32 is available from Win-Tech at www.win-tech.com. This driver is helpful for testing communications.

Specifically

1. The HydroRanger 200 is set to communicate via a modem but no communication is returning to the master.
   - Check that the parameters are set up correctly and that the correct port is configured
   - Verify the wiring diagram. Note that there is a difference between wiring directly to a computer and wiring to a modem. Verify that the modem is set up correctly. Siemens Milltronics has a series of Application Guides that may help. Please contact your local Siemens Milltronics representative for more information on Application Guides.
2. A HydroRanger 200 parameter is set via remote communications, but the parameter remains unchanged.
   - Some parameters can only be changed when the device is not scanning. Try putting the device in program mode, using the operating mode function.
   - Try setting the parameter from the keypad. If it can not be set using the keypad, check the lock parameter and set it to **1954**.

Communication Appendix A: Single Parameter Access (SPA)

This Appendix is intended to provide someone with advanced communications knowledge the ability to access any parameter value in any available format.

Built into HydroRanger 200 is an advanced handshaking area that can be used to read and write single registers to the HydroRanger 200. This section performs a similar function to the Parameter access section. The differences are:

1. Advanced section is more powerful and harder to program.
2. Advanced section only gives you access to one parameter at a time.

Mapping

Parameter Read and Write (40,090 – 40,097) is a series of eight registers used for reading and writing parameter values to and from the HydroRanger 200. The first three registers are always unsigned integers representing parameters and index values. The second five registers are the format and value(s) of the parameter.

All parameters normally accessed through the hand-held programmer are available through these registers.

Address	Description
40,090	Parameter (integer)
40,091	Primary Index (integer)
40,092	Secondary Index (integer)
40,093	Format word (bit mapped)
40,094	Read value, word 1
40,095	Read value, word 2
40,096	Write value, word 1
40,097	Write value, word 2

Reading Parameters

To read parameters through Modbus do the following steps:

1. Send the parameter, its primary index, and its secondary index (usually 0), and format to registers 40,090 to 40,093.
2. Wait until you can read the written values from the registers (40,090 to 40,093) to confirm that the operation is complete.
3. Read the value from registers 40,094 and 40,095.

Writing Parameters

To set parameters through Modbus do the following steps:

1. Send the parameter, its primary index, and its secondary index (usually **0**) to registers 40,090, 40,091, and 40,092.
2. Write the value to registers 40,096 and 40,097.
3. Write the desired format word to register 40,093 to enable the HydroRanger 200 to interpret the value correctly.

Format Register

Bits	Values	Description
1-8	0-2	Error Code
9-11	0-7	3-bit number representing decimal offset
12	0/1	direction of offset (0 = right, 1 = left)
13	0/1	Numeric format: Fixed (0) or Float (1)
14	0/1	Read or Write of data, Read (0), Write (1)
15	0/1	Word order: Most Significant Word first (0), Least Significant Word first (1)
16		Reserved

For example, to format the level reading so that it is shown in percent with two decimal places shifted left, the format bits would look like this:

Bit Numbers	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01
Bit Values	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	reserved	most significant first	read	fixed format	offset direction to right	decimal offset of 2			no error code							

The value sent to the HydroRanger 200 is 0001001000000000 binary or 512 decimal. The value **512** is sent as an integer to register 40,093 to format the output words 40,094 and 40,095 accordingly.

If the numeric data type is set for integer and the value contains decimal places, they are ignored. In this situation, use the decimal offset to ensure that you have an integer value and then write your code to recognize and handle the decimal offset.

Error Codes

The error codes returned in the format area are 8-bit integers found in the lowest eight bits of the format word. This allows for 256 potential error codes.

Currently the HydroRanger 200 has two error codes available.

Values	Description
0	No error
1	Data not available as percent (available as units)
2-255	Reserved

Testing the Configuration

After programming the unit, you must test the device to ensure that it performs to your specifications. This test can be run in simulation mode or by varying the level in the application. The latter is preferred as it more accurately represents running conditions. However, if it is not possible to do a physical test, a simulation will ensure that control programming is correct.

Simulation

In simulation mode, the LCD display reacts to the simulated level changes. Alarm relays will also react to the simulation, but any pump or control relays will not react.

To allow pump or control relays to operate on the simulated level, set P000 to –1.

Simulating a Single Measurement

Access the appropriate parameter: (press PROGRAM and then key in the parameter number). Press TRANSDUCER five times to overcome Echo Lock (P711) if applicable: the associated Reading is displayed in the Parameter Value field, and any **alarm** relays are set accordingly.

To verify Reading calculations (P920 to P926)

1. Key in a material level in Units (P005) or % of Span (P007).
2. Press ENTER to display the calculated Reading.
3. Verify the calculated Reading.
4. To start a simulation from the level entered, press ARROW or .

Simulating a Level Cycle

Starting a (P920, P921, P922, or P923) simulation when level = 0:

1. Press ENTER to simulate level rise and fall. At the start of a simulation, the default rate is 1% of Span / second.
2. Press the ARROW or to adjust the simulated rate of rise or fall. The maximum rate is 4% of Span / second.

The effect of the ARROW key is determined by the state (rate of rise or fall) immediately before the key is pressed.

Action	State (prior to pressing key)	Effect
Press ▲	Stop	Rise at 1% of Span / second
	Rise at 1% of Span / second	Rise at 4% of Span / second (max.)
	Rise at 4% of Span / second (max.)	No effect
	Fall at 1% of Span / second	Stop
	Fall at 4% of Span / second	Fall at 1% of Span / second
Press ▼	Stop	Fall at 1% of Span / second
	Rise at 1% of Span / second	Stop
	Rise at 4% of Span / second (max.)	Rise at 1% of Span / second
	Fall at 1% of Span / second	Fall at 4% of Span / second (max.)
	Fall at 4% of Span / second (max.)	No effect

When the level rises to 100% or falls to 0%, it reverses direction at the same rate.

Checking Volume Characterization

To confirm universal volume calculations (P050 = 9, 10) are correct:

1. Go to P920.
2. Key in a level associated with a known volume.
3. Press ENTER ↵.
4. Check the returned volume against the manufacturer's chart.
5. Change parameters P054 and P055, as required.
6. Repeat steps 2 to 5 until the volume curve is verified.

Checking OCM Flow Characterization

To confirm universal flow calculations (P600 = 4, 5) are accurate:

1. Go to P925.
2. Enter a level with a known flow.
3. Press ENTER ↵.
4. Check the returned flow against the manufacturer's chart.
5. Change parameters P610 and P611, as required.
6. Repeat steps 2 to 5 until the flow curve is verified.

I/O Checkout

After the unit is installed, test to verify the wiring.

Relays

Use P119 to force a state change and verify that the results are as expected (pump starts, alarm sounds, etc.).

Discrete Inputs

Use P270 to force the input value and verify that the results are as expected.

1. Go to P270 [DI] where DI = the discrete input to be tested
2. Set P270 to **0** (**forced OFF**)
3. Go to P275 [DI] to verify that the value is forced
4. Check the state of outputs to ensure that they respond as expected
5. Go to P270 [DI]
6. Set P270 to **1** (**forced ON**)
7. Go to P275 [DI] to verify that the value is forced
8. Check the state of outputs to ensure that they respond as expected

For further information see *Discrete Inputs* section on page 46.

mA Input

Use P254 to test the mA input value against a true level. Use a trusted external mA source to generate the signal required for testing, and verify the incoming signal with P260. Check that the system responds as expected when the mA level is changed.

mA Output

Use an external device to test the mA output against the measured level. Check that the mA value changes to reflect the changes in the measured level.

Application Test

If you are testing the application by varying the material level (the preferred test method) make sure that none of the control devices is connected (or at least that no power is available to them).

If you are testing the application in simulation mode (and P000 is not –1), then control relays are not energized and the control devices can remain connected.

While the level is being cycled, check the results of the discrete inputs either by closing the circuit externally (preferred) or by using P270 Discrete Input Function to force the input ON or OFF. Try all possible combinations to thoroughly test the setup. For each combination, run a complete cycle to verify that the relays operate as expected.

Monitor system performance carefully, under all anticipated operating conditions.

1. When the HydroRanger 200 performs exactly as required, programming is complete.
2. If alternate Reading units, Failsafe action, or relay operation is desired, update the parameters for the new functionality.
3. If the system performance experiences problems, see *General Appendix C: Troubleshooting*, on page 232.

If you cannot observe all possible operating conditions during the System Performance Evaluation, use the level simulation (see page 110) to verify programming.

When a simulation is run, alarm relays will react to the simulated level changes, but control relays will not react. You can set P000 to value –1 to trigger the control relays based on the simulated level.

Retest the system every time you adjust any control parameters.

Notes

Parameters

Parameter Reference

The HydroRanger 200 is configured through its parameters, and the application determines the parameter values which are entered into the unit.

Please check your value entries carefully before operating the HydroRanger 200 to ensure optimum performance.

Helpful Hints

Please note the following:

- **Default** values are always indicated with an asterix **(*)**
- **Global** values are common for all inputs and outputs on the unit
- **Indexed** parameters can apply to more than one input or output
- **Primary index** relates to an input or output
- **Secondary index** allows for multiple values on an indexed point

Accessing a Secondary Index

1. Press MODE, and then press DISPLAY to activate secondary index.
   The icon appears under the index field.
2. Enter the secondary index, and then enter the values to set the secondary index.

Parameters

P000 Lock

Secures the HydroRanger 200 from changes.

Primary Index	Global		
Values	1954	*	OFF (programming permitted)
	-1		Simulation Controls (relays energize based on simulated level)
	other		lock activated (programming secured)
Related			• Simulation on page 110

WARNING:
Use this lock as backup security only. It uses a fixed value which can be discovered by unauthorized personnel.

Access this parameter directly (type **000**) and enter any value (except 1954) to secure programming lock. To unlock the HydroRanger 200, access this parameter and enter **1954**.

Quick Start (P001 to P007)

P001 Operation

Sets the type of measurement required for the application.

Primary Index	**Single Point Model**			**Dual Point Model**
	Global			Transducer
Values	0		Out-of-service	
	1		Level – how full the vessel is (volume – P050)	
	2		Space – how empty the vessel is (ullage – P050)	
	3	*	Distance – distance from transducer to material	
	4		DPD – dual point difference	
	5		DPA – dual point average	
	6		OCM – flow rate in an open channel	
	7		Pump Totalizer – total pumped volume	
Alters	• P600 Primary Measuring Device			

Parameters

For DPD and DPA Programming

Single Point Model Use

For Dual Point Difference (DPD) or Dual Point Average (DPA), the unit requires either two transducers of the same type, or one transducer and one mA input. If two transducers are used, all transducer parameters become indexed, and a third level point is calculated.

- DPD (difference) = Point 1 - Point 2
- DPA (average) = (Point 1 + Point 2) / 2. The calculated DPD or DPA is always based on level measurements of points 1 and 2.

For these operations any of three level points (transducer 1, transducer 2, or the calculated point) can be used to trigger relays (see *P110 Level Source* on page 131).

The points must be globally set to either 4 or 5 (as required). Point 3 becomes the calculated value as shown above. See *Rake Control* example on page 67.

Dual Point Model Use

To set a dual point HydroRanger 200 for DPA or DPD functions, Point 3 must be set to either 4 or 5 (as required). Points 1 and 2 cannot be set to 4 or 5, but these points are used to calculate the value in point 3.

This table shows the available functions:

Operation [index]	Available Values
P001 [1]	1, 2, 3, 6, 7
P001 [2]	1, 2, 3, 6, 7
P001 [3]	4,5

P002 Material

Specifies material type.

Primary Index	Single Point Model			Dual Point Model
	Global			Transducer
Values	1	*	Liquid or horizontal solid surface	
	2		Solid or angled surface	
Alters	•	P830 TVT Type		

Parameters

P003 Maximum Process Speed

Determines level change reaction.

Primary Index	Transducer		
Values	1		Slow (0.1 m/min)
	2	*	Medium (1 m/min)
	3		Fast (10 m/min)
Alters	• P070 Failsafe Timer • P700 Max Fill Rate • P701 Max Empty Rate • P702 Filling Indicator • P703 Emptying Indicator • P704 Rate Filter • P710 Fuzz Filter • P713 Echo Lock Window • P727 Scan Delay • P841 Long Shot Number		
Related	• Failsafe (P070 to P072) • P121 Pump by Rate • Rate (P700 to P708) • Measurement Verification (P710 to P713) • Transducer Scanning (P726 to P729) • P905 Transmit Pulse		

Use a setting just fast enough to keep up with your process. Slower settings provide higher accuracy. Faster settings allow for more level fluctuations.

P004 Transducer

Specifies the Siemens Milltronics transducer connected to the unit.

Primary Index	**Single Point Model**		**Dual Point Model**
	Global		Transducer
Values	0	*	No transducer attached (preset for Dual Point)
	1		ST-25
	2		ST-50
	100		STH
	101		XCT-8
	102	*	XPS-10 (preset for Single Point Model)
	103		XCT-12
	104		XPS-15
	112		XRS-5
	250		mA input
Related	• mA Input (P250 to P260) • P842 Short Shot Frequency • P843 Long Shot Frequency • P844 Short Shot Width • P845 Long Shot Width • P852 Short Shot Range		

Parameters

P005 Units

Specifies measurement units used for dimensional values.

Primary Index	Global		
Values	1	*	Meters
	2		Centimeters
	3		Millimeters
	4		Feet
	5		Inches
Alters	• P006 Empty • P007 Span • P603 Maximum Head • P605 Zero Head • P620 Low Flow Cutoff • P921 Material Measurement • P926 Head Measurement • P927 Distance Measurement		

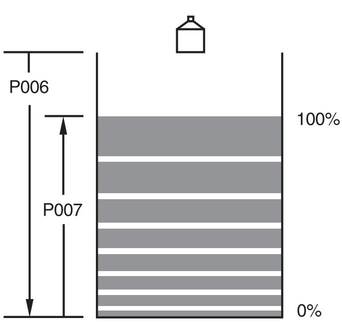
Changing this value automatically changes the units displayed for many parameters. Existing values are converted and do not have to be re-entered.

P006 Empty

*Enter distance in **units** (P005) from the face of the transducer to the process empty point.*

Primary Index	Transducer
Values	Range: 0.000 to 9999
	Preset: 5.000m (or equivalent depending on units)
Alters	• P007 Span
Altered By	• P005 Units
Related	• P800 Near Blanking • P921 material Measurement • P927 Distance Measurement

Setting this value also sets Span (P007) unless Span was already set to another value. For distance operation (P001=3), Span is preset to Empty.



Parameters

P007 Span

Sets the range levels to be measured.

Primary Index	Level
Values	Range: 0.000 to 9999
	Preset: based on Empty (P006)
Alters	• P605 Zero Head • P112 Relay ON Setpoint • P113 Relay OFF Setpoint
Altered By	• P005 Units • P006 Empty
Related	• Volume (P050 to P055) • P800 Near Blanking • P921 Material Measurement • P922 Space Measurement • P926 Head Measurement

Span is preset for a value close to the maximum available. Enter a value reflecting maximum application range.

Always prevent the monitored surface from approaching within 0.3 m (1 ft) of the transducer face as this is the minimum blanking for most Siemens Milltronics transducers (some require more blanking – see your transducer manual).

Many other parameters are set as a percentage of span (even if they are entered in units). The values of these other parameters may change if the span is altered after installation and the other parameters are measured using a level determined upward from the Empty level toward the transducer face.

All volumes are based on span so it should be set for the maximum volume point if volume calculations are needed.

Volume (P050 to P055)

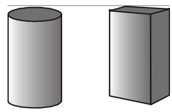
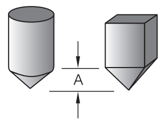
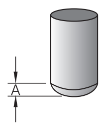
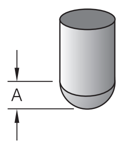
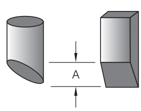
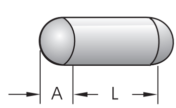
Use these parameters to enable the HydroRanger 200 to show readings based on vessel or wet well volume (rather than level)..

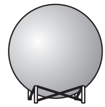
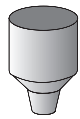
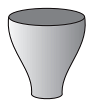
P050 Tank Shape

Enter the Tank Shape value matching the monitored vessel or wet well.

When Operation is **LEVEL** (P001 = 1), liquid (material) volume is calculated.

Alternatively, when Operation is **SPACE** (P001 = 2), remaining vessel capacity is calculated. In RUN mode, readings are displayed in percent of maximum volume. To convert readings to volumetric units, see *Maximum Volume (P051)*.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	**#**	**Shape**	**Description**
	0	*	volume calculation not required (preset)
	1		Flat Level Bottom
	2		Cone/Pyramid Bottom
	3		Parabola Bottom
	4		Half Sphere Bottom
	5		Flat Sloped Bottom
	6		Flat Ends
	7		Parabola Ends

Values	8		Sphere
	9		Universal Linear
	10		Universal Curved
Alters	• P001 Operation • P051 Maximum Volume • Pump Efficiency (P180-P186) • Pumped Volume Totalizer (P622-P623) • P920 Reading Measurement		

P051 Maximum Volume

For Readings in volumetric units (rather than percent), enter the equivalent vessel volume for Span (P007).

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	Range: 0.000 to 9999	
	Preset: 100.0	
Alters	P060 Decimal Position	
Related	• P006 Empty • P007 Span • P924 Volume Measurement	

Any volume units can be chosen because volume is calculated from empty to maximum span and is scaled according to the Tank Shape (P050) value.

Note: Make sure selected chosen units allow LCD volume display.

Examples:

- If max. volume = 3650 m^3, enter 3650
- If max. volume = 267500 gallons, enter 267.5 (thousands of gallons)

P052 Tank Dimension A

Dimension A as used in P050 Tank Shape.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.0 to 9999	
	Preset: 0.000	
Related	• P050 Tank Shape	

Enter one of the following:

- height of the tank bottom if P050 = 2,3,4, or 5

OR

- length of one end section of the tank if P050 = 7, in Units (P005)

P053 Tank Dimension L

Dimension L as used in P050 Tank Shape.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.0 to 9999	
	Preset: 0.000	
Related	• P050 Tank Shape	

Enter the following:

- tank length (excluding both end sections) if P050 = 7

P054 Level Breakpoints (Universal Volume Calculation)

When the tank shape is too complex for any of the preconfigured shapes, you can specify the volume based on segments. See "Accessing a Secondary Index" on page 114 for more information.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Secondary Index	Breakpoint	
Values	Range: 0.0 to 9999	
Related	• P055 Volume Breakpoints	

Enter the following:

- up to 32 level breakpoints (where volume is known) if P050 = 9 or 10

Entering a Level Breakpoint

1. Go to Parameter P054.
2. For each index enter a breakpoint in measurement units.
3. Ensure that each breakpoint corresponds to the same index for P055.

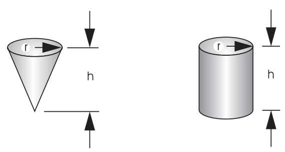
P055 Volume Breakpoints and Characterization (Universal Volume Calculation)

Each segment defined by the level breakpoints (P055) requires a volume so that the HydroRanger 200 can make the level-to-volume calculations.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Secondary Index	Breakpoint	
Values	Range: 0.0 to 9999	
Related	• P054 Breakpoints Levels (Universal Volume Calculation)	

Typical volume calculations

Cone Cylinder



V = (1/3)$\pi r^2 h$ V = $\pi r^2 h$

Entering a Volume Breakpoint

1. Go to Parameter P055.
2. For each index enter a volume.
3. Ensure that each volume corresponds to the same index for P054.

For more on *Volume Characterization*, go to page 49.

Display and Reading (P060 to P062)

These parameters are used to:

- Change the number of decimal places displayed
- Convert the Reading to alternate units
- Reference measurements to other than Empty (P006) or Span (P007)

P060 Decimal Position

Defines the maximum number of decimal places used on the LCD.

Primary Index	Level		
Values	0		No digits after the decimal point
	1		1 digit after the decimal point
	2	*	2 digits after the decimal point
	3		3 digits after the decimal point (limited by device resolution)
Alters			• P607 Flowrate Decimal
Altered by			• P051 Maximum volume
Related			• P920 Reading Measurement

In RUN mode, the decimal position adjusts to prevent the number of digits from exceeding the display capabilities. To keep the decimal place from shifting, reduce the number of decimal places to that shown at 100%.

Example:

If 100% is 15m, use two decimal places for sample readings of 15.00 or 12.15.

P061 Convert Reading

Multiplies the current value by the specified amount to allow for scaling.

Primary Index	Level
Values	Range: -999 to 9999
	Preset: 1.000
Related	• P920 Reading Measurement

Examples:

- If the measured value is in feet, enter **0.3333** to display the number of yards
- For simple linear, volume conversions set P005 to **1** (meters) and then enter the volume measurement per unit to get the correct conversion. For example, if the reservoir contains 100 litres per vertical meter, use **100** to get the reading in litres.

Notes:

- This method does not calculate volume. It must not be used in place of the volume parameters if any volume dependent features (such as pump efficiency) are used. To calculate true volumes see *Volume* (P050 to P055).
- Avoid entering a value that, when multiplied by the maximum current Reading, exceeds the display capabilities. If value exceeds four digits, **EEEE** is shown.

P062 Offset Reading

Adds the specified value to the level reading, usually to reference the reading to sea level or another datum level.

Primary Index	Level
Values	Range: -999 to 9999
	Preset: 0.000
Related	• P920 Reading Measurement

The operation of the device is not affected by the Offset Reading. This value is used for display purposes only. All control measurements are still referenced to Empty.

Backup Level Override

Use this feature to override the ultrasonic reading by a discrete input such as a contacting point device. The ultrasonic reading will be fixed at the programmed switch level until the discrete input is released.

The ultrasonic device makes decisions based on the override values.

P064 Reading Override Enable

Sets the discrete input to act as the source for a level reading override.

Primary Index	Transducer		
Values	0	*	OFF: No override.
	1-2		ON: Number = discrete input of override signal
Related	• P065 Reading Override Value • P270 Discrete Input Function		

P065 Reading Override Value

This value is substituted for the current reading when the selected discrete input is enabled and activated.

Primary Index	Transducer
Values	Range: 0.0 to 9999
Alters	Current reading
Related	• P001 Operation • P005 Units • P006 Empty • P007 Span • P064 Override Enable

Please note the following:

- enter value in current units (as selected in P005)
- valid for level, space, and distance
- volume is calculated based on the Backup level

For more information, see example on next page.

Example:

Transducer One is configured for a level measurement. Digital Input 2 is connected to a Hi Level Backup switch located a level of 4.3m.

Parameter	Index	Value
P064	1	2
P065	1	4.3

When the level rises to 4.3m, and the switch is activated, the reading is forced to 4.3m. The reading stays at 4.3m until the switch is de-activated.

P066 Override Time Delay

Defines the time used to calm (debounce) the override condition input. Set in seconds.

Primary Index	Transducer
Values	Range: 0.0 to 9999 Preset: 5.0
Related	• P064 Override Enable • P065 Reading Override Value • P270 Discrete Input Function

Note: Activation of the Level Override is subject to the measurement cycle. This can add up to four seconds to the overall response time depending on operating conditions and programming.

P069 Password

*Holds the current password for P000. Select by typing in **069**. You cannot scroll to this parameter.*

Primary Index	global
Values	Range: 0 to 9999 Default: 1954
Related	• P000 Lock

This parameter is write-only, and can only be selected by entering **069**. To change the password, unlock the device by entering the current password into P000. Then enter the new password into P069. To lock the device, enter a password other than the correct one in P000. While the device is unlocked, the password is visible in P000.

Failsafe (P070 to P072)

P070 Failsafe Timer

The time for invalid measurements to elapse before Failsafe State activates.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.0 to 9999	
	Preset 10.00 minutes	
Altered by	• P003 Maximum Process Speed	
Related	• P129 Relay Failsafe	

Once activated, the Failsafe State initiates the following:

1. The material level is reported based on P071 Failsafe Material Level.
   - The unit responds to the new level as programmed (control and alarm relays activate as defined by the programming).
   - Individual relays can have independent failsafe responses. See *P129 Relay Failsafe*.
2. The appropriate error is displayed:
   - LOE for loss of echo from the transducer
   - Short for a shorted transducer cable
   - Open for a cut transducer cable
   - Error for all other problems

When modifying the preset value, set it short enough to protect the process but long enough to avoid false alarms. Only use No Delay (0.0 Minutes) for testing.

P071 Failsafe Material Level

The material level reported when a Failsafe State is initiated.

Primary Index	Level Point		
Values	Range: -4999 to 9999		Value in units or % (-50% to 150% of span)
	HI		Level goes to maximum span
	LO		Level goes to 0 span (Empty)
	HOLd	*	Level remains at last reading
Related	• P001 Operation • P006 Empty • P007 Span • P111 Relay Control Function • P112 Relay ON Setpoint • P113 relay OFF Setpoint • P129 Relay Failsafe		

Select the Failsafe Material Level based upon the relay operation required during failsafe operation.

Parameters

Selecting HI, LO, or HOLd

1. Press FUNCTION to display the Auxiliary Function symbol.
2. Press ARROWS to scroll to the desired option.
3. Press ENTER to set the value.

Entering a Measurement

To enter a specific Failsafe Material Level within -50 to 150% of Span (P007), in Units (P005).

Relay reaction

The way in which relay programming reacts to the failsafe level depends on P129 Relay Failsafe (page 136). By default:

- Alarm relays have P129 = OFF and so react to the Failsafe Material Level.
- Control relays have P129 = **dE** and so de-energize the relay when the unit enters Failsafe mode regardless of the Failsafe Material Level.

P072 Failsafe Level Advance

Sets the speed the HydroRanger 200 advances to and returns from the Failsafe Material Level.

Primary Index	Level Point			
Values	1	*	Restricted	Advances to/from Failsafe Material Level as set by P003, P700 and P701.
	2		Immediate	Failsafe Material Level assumed right away
	3		Fast Back	Failsafe Level Advance is restricted, return is immediate
Related	• P003 Maximum Process Speed • P070 Failsafe Timer • P071 Failsafe Material Level • P700 Max Fill rate • P701 Max Empty rate			

Relays (P100 to P119)

The HydroRanger 200 has six relays (or digital outputs) used to control devices and alarms. While the number of devices is limited by the relays, all control functions are accessible through software and each parameter is indexed to the six relays. See the *Relay* section on page 40.

Preset Applications (P100)

The HydroRanger 200 makes standard applications easier to program by providing an extensive list of presets.

Control Functions (P111)

Each relay can be configured independently to take advantage of the HydroRanger 200's advanced features and flexibility. Start with a preset application and then change the required parameters to make the task more efficient.

Setpoints (P112, P113)

Each relay is triggered by one or more setpoints. The setpoints can be based on absolute level (P112, P113) or rate of change (P702, P703). Each control function specifies which setpoints are required.

P100 Preset Applications

Six preset applications to configure or bench test the unit. Refer to page 44 for examples.

Primary Index	Global		
Values	0	*	OFF
	1		Wet Well 1
	2		Wet Well 2
	3		Reservoir 1
	4		Reservoir 2
	5		Screen
	6		Alarms
Alters	• P110 Level Source • P111 Relay Control Function • P112 Relay On Setpoint • P113 Relay OFF Setpoint • P121 Pump by Rate		
Related	• P001 Operation		

Select an application that is similar to yours and change the parameters required. If none suit, then refer to P111 Relay Control Function on page 131.

Note: Programming the relays independently is the most common method used.

P110 Level Source

Sets the level source on which the indexed relay is assigned to a measurement point.

Primary Index	Relay		
Values	Range: 1 to 3		
	1	*	Point # 1 = Transducer One
	2		Point # 2 = Transducer Two
	3		Point # 3 = Difference (P001=4) or Average (P001=5)
Altered by:	• P003 Maximum Process Speed • P700 Max Fill rate • P701 Max Empty rate • P070 Failsafe Timer • P071 Failsafe Material Level		

In Single Point Model (standard):

Points 2 and 3 are available only if Operation is set for **difference** or **average** (P001 = 4 or 5).

In Dual Point Model (optional):

Point 2 is always available, and Point 3 is available only if Operation is set for **difference** or **average** (P001 = 4 or 5).

P111 Relay Control Function

Sets the control algorithm used to trip the relay.

Primary Index	Relay
Values	See chart below
Altered by	• P100 Preset Applications

Use zero **0** (preset) to disable control of the indexed relay.

Note: All relay ON/OFF points must be referenced from Empty (P006), regardless of Operation Mode selection (P001).

Parameters

Values For P111			
Control	**Type**	**#[1]**	**Relay Control**
General	Off	0*	Relay set off, no action (preset)
	Level	1	Based on level setpoints ON and OFF
	In Bounds	2	When level enters the range between ON and OFF setpoints
	Out of Bounds	3	When level exits the range between ON and OFF set-points
	Rate of Change	4	Based on rate setpoints ON and OFF
	Temperature	5	Based on temperature setpoints ON and OFF
	Loss of Echo (LOE)	6	When echo is lost
	Cable Fault	7	When the circuit to a transducer is opened

Values For P111			
Control	**Type**	**#[1]**	**Relay Control**
Flow	Totalizer	40	Every 10^y units (P641-P645)
	Flow Sampler	41	Every **y x 10^2** units (P641-P645) or time duration (P115)
Pump	Fixed Duty Assist	50	At fixed ON and OFF setpoints and allows multiple pumps to run or for rake control
	Fixed Duty Backup	51	At fixed ON and OFF setpoints and allows only one pump to run
	Alternate Duty Assist	52	At rotating ON and OFF setpoints and allows multiple pumps to run
	Alternate Duty Backup	53	At rotating ON and OFF setpoints and allows only one pump to run
	Service Ratio Duty Assist	54	On service ratio at ON and OFF setpoints and allows multiple pumps to run
	Service Ratio Duty Backup	55	On service ratio at ON and OFF setpoints and allows only one pump to run
	First In First Out (FIFO)	56	As Alternate Duty Assist, resets the relay from staggered OFF setpoints
Control	Flush Valve	64	Used to control a pump flushing device based on Flush Systems (P170 to P173)
	Communication	65	Based on input from external communications. See *Communications* section on page 83 for further reference.

1. When reading and setting this parameter through Modbus or SmartLinx communications the parameter values are mapped to different numbers. See the *HydroRanger 200 Communications* section on page 83 for Modbus information or the relevant SmartLinx® manual.

Parameters

P112 Relay ON Setpoint

Sets the process point at which the relay changes from its NORMAL state.

Primary Index	Relay
Values	Range: -999 TO 9999
	Preset: ----
Altered by	• P007 Span
Related	• P100 Preset Applications • P111 Relay Control Function • P113 Relay OFF Setpoint

For most applications, the relay is tripped at this point. For IN-BOUNDS and OUT-OF-BOUNDS alarms, it is the high point in the specified range. This parameter is set according to Span (P007) even when another reading, such as volume, is shown on the LCD.

P113 Relay OFF Setpoint

Sets the process point at which the relay returns to its NORMAL state.

Primary Index	Relay
Values	Range: -999 TO 9999
	Preset: ----
Altered by	• P007 Span
Related	• P100 Preset Applications • P111 Relay Control Function • P112 Relay ON Setpoint

For most applications, the relay is reset at this point. For IN-BOUNDS and OUT-OF-BOUNDS alarms, it is the low point in the specified range. This parameter is set to Span (P007), even when another reading, such as volume, is shown on the LCD.

P115 Relay Interval Setpoint

The length of time in hours between starts.

Primary Index	Relay
Values	Range: -999 TO 9999
	Preset: 0.000
Altered by	• P100 Preset Applications
Related	• P111 Relay Control Function

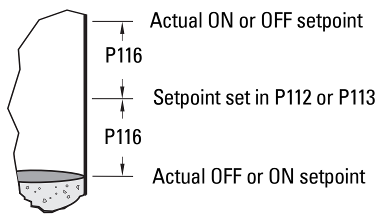
P116 Dead Band

The distance above and below the bound alarm setpoints.

Primary Index	Relay
Values	Range: 0.000 to 9999
	Preset: 2% of span
Related	• P111 Relay Control Function • P112 Relay ON Setpoint • P113 Relay OFF Setpoint

For IN-BOUNDS and OUT-OF-BOUNDS Relay Functions (P111 = 2 and 3 respectively), a dead band prevents relay chatter due to material level fluctuations at both the upper and lower setpoints.

Enter the dead band in either percent of span or units of measure (P005). The dead band value is applied both above and below the upper and lower bound setpoints as shown in the figure.



P118 Relay Output Logic

The logic applied to relays to determine the contact open or closed state.

Primary Index	Relay				
Values	**Value**		**Logic**	**Alarm Contact**	**Pump or Control Contact**
	2	*	Positive	Normally Closed	Normally Open
	3		Negative	Normally Open	Normally Closed
Related	• P111 Relay Control Function				

The relay contact operation is NORMALLY CLOSED for alarms and NORMALLY OPEN for controls. See P111 *Relay Control Function* for more information.

Power Failure

When power is cut to the HydroRanger 200, its relays fail to the following states:

Relay States	
Relay	Fail State
1,2,4,5	Open
3,6	Open or Closed[1]

1. Relays 3 and 6 are Form C types, so you can wire it either NORMALLY OPEN or NORMALLY CLOSED. Check the wiring before programming.

To use relays 3 or 6 as general alarm indicators, set P118 to **3 – negative logic** and wire the alarm for normally open operation. When an alarm event occurs (see below) or when power is cut, the circuit closes and the alarm activates.

Positive Logic

In software, all relays are programmed the same way, with ON setpoints indicating when to change the relay contact state (open or closed). This parameter allows the reversal of the operation so that relay contacts can be NORMALLY CLOSED or NORMALLY OPEN. P118 is preset to **2** which is positive logic.

Negative Logic

When P118 = 3 (negative logic), the operation for the indexed relay is reversed from normal.

P119 Relay Logic Test

Forces the relay control logic into an ACTIVATED or DE-ACTIVATED state.

Primary Index	Relay		
Values	0	*	OFF - Control from HydroRanger 200 algorithms
	1		Activate relay control
	2		De-activate relay control
Related	• P111 Relay Control Function • P910 Toggle Relays		

This parameter tests site wiring and control logic programming. Forcing the relay to an activated or de-activated state is similar to the HydroRanger 200 detecting an event and responding to it. Helpful in testing new installations and diagnosing control problems.

Pump Setpoint Modifiers (P121 and P122)

These parameters provide alternate ways of starting the pumps in the pump group. See the *Pump Control* section on page 56 for descriptions of the pump control algorithms.

P121 Pump by Rate

Sets the pump relays to accept control by rate of level change once the first ON setpoint is reached.

Primary Index	**Single Point Model**		**Dual Point Model**
	Transducer		Level
Values	0	*	OFF (pump by level)
	1		ON (pump by rate)
Related	• P007 Span • P111 Relay Control Function • P132 Pump Start Delay • Rate (P700 to P708)		

Parameters

Use this function when multiple pumps are to be controlled by rate of level change rather than by setpoints.

The delay between pump starts is set by P132 Pump Start Delay.

This only applies to any relays set to pump control (P111 = 50 to 56).

Notes:
- All pump control relay ON and OFF setpoints must be the same value
- If the level is within 5% of Span (P007) of the OFF setpoint, the next pump is not started

P122 Pump Service Ratio

Selects pump usage based on the RUN time ratio rather than last used.

Primary Index	Relay
Values	Range: 0.000 to 9999
	Preset: 20.00
Related	• P111 Relay Control Function

This parameter only relates to relays with P111 = 54 or 55.

To make this parameter useful, assign it to all of the pump relays. The number assigned to each pump relay represents the ratio applied to decide the next pump to start or stop.

Notes:
- The HydroRanger 200 will not sacrifice other pumping strategies to ensure that the ratio is held true
- If the pump relays are set to the same value then the ratio equals 1:1 and all pumps are used equally (preset)

Independent Relay Failsafe (P129)

P129 Relay Failsafe

Sets the failsafe operation per relay to allow for more flexible programming.

Primary Index	Relay		
Values	OFF	*	Response governed by P071 Failsafe Material Level
	HOLd		For LAST KNOWN relay state retention
	dE		To have the relay de-energize immediately on failsafe
	En		To have the relay energize immediately on failsafe
Altered by	• P071 Failsafe Material Level		
	• P070 Failsafe Timer • P111 Relay Control Function		

Use this for operations independent of the Failsafe Material Level (P070).

Relay Failsafe is only available for the following relay functions (P111) and is not used for any other relay control function.

Relay Function (P111)	Preset (P129)
1 – level alarm	
2 – in bounds alarm	
3 – out of bounds alarm	OFF
4 – rate of change alarm	
5 – temperature alarm	
50 to 56 – all pump controls	dE

To select an independent Relay Failsafe value:

1. Press FUNCTION to display the Auxiliary Function symbol.
2. Press ARROWS to scroll through the failsafe options.
3. Select option and press ENTER.

Advanced Pump Control Modifiers (P130 to P137)

These parameters only affect relays set to pump operation (P111 = 50 to 56).

P130 Pump Run-On Interval

Sets the number of hours between pump run-on occurrences.

Primary Index	Global
Values	Range: 0.000 to 1000
	Preset: 0.000
Related	• Advanced Pump Control Modifiers (P130 to P136)

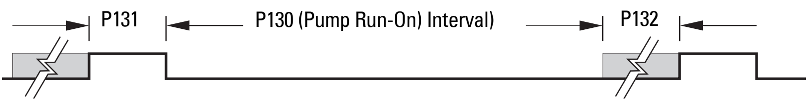
To clear sediment in a **pump-down** wet well, run the pump after the normal OFF setpoint is reached to force some solid material through. This parameter sets the time between such events. Only the last pump running can run-on.

P131 Pump Run-On Duration

Sets the number of seconds that the pump runs on.

Primary Index	Global	
Values	Range: 0.0 to 9999	
	Preset: 0.000	
Related	• Advanced Pump Control Modifiers (P130 to P136)	

Your pump capacity determines the amount of material that can be removed. Choose a value long enough to clean out the vessel bottom, yet short enough not to run the pump dry. Also be sure that this value does not overlap with P130 (Interval). The timing should look something like this:



P132 Pump Start Delay

Sets the minimum delay (in seconds) between pump starts.

Primary Index	Global
Values	Range: 0.0 to 9999
	Preset: 10 seconds
	Value is divided by 10 in simulation mode.
Related	• Advanced Pump Control Modifiers (P130 to P136) • P121 Pump by Rate

Use this feature to reduce a power surge from all pumps starting at the same time. This delay determines when the next pump is permitted to start.

P133 Pump Power Resumption Delay

Sets the minimum delay before the first pump restarts after power failure.

Primary Index	Global
Values	Range: 0.000 to 9999
	Preset: 10 seconds
Related	• Advanced Pump Control Modifiers (P130 to P136) • P132 Pump Start Delay

This reduces the surge from the first pump starting immediately on power resumption. When this delay expires, other pumps will start as per P132.

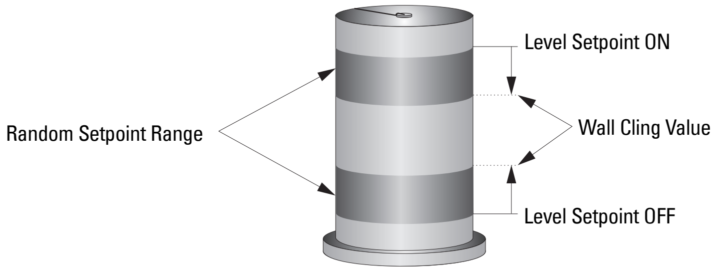
Parameters

P136 Wall Cling Reduction

Varies the upper and lower setpoints to reduce material buildup on the walls.

	Single Point Model	Dual Point Model
Primary Index	Global	transducer
Values	Range: 0.000 to 9999	
	Preset: 0.000	

This value is the range in which the setpoints are allowed to deviate in percent or units. The Relay Setpoints ON and OFF values are randomly varied inside the range to ensure that the material level does not consistently stop at the same point.



P137 Pump Group

Puts pumps into groups for multiple pump rotations on one transducer.

Primary Index	Relay		
Values	Range: 1 to 2		
	1	*	group 1
	2		group 2
Alters	• P111 Relay Control Function when P111=52 (Alternate duty assist) or 53 (Alternate duty backup)		

This feature groups pumps (relay points 1 - 6) into groups 1 or 2. It is applied to pump rotation and occurs independently within each group.

Flush Systems (P170 to P173)

Use this feature to control an electrically operated flush valve on a pump to divert some pump output back into the wet well to stir up sediment.

Notes:

- If any of the following parameters are set to **0**, this feature will not work.
- In Dual Point mode, a flush valve can be set up for each of the three available level inputs (P001 = **4** or **5**).

Parameters

Single Point Model

Enter the HydroRanger 200 relay number of the pump with the flush valve. The activation of this pump relay drives the usage of the flush system. Both P172 Flush Interval and P171 Flush Cycles are based on the operation of this relay and control any relay set to P111 = 64, Flush Valve.

Dual Point Model

The indexed relay is the one that controls the flush device. The value is the pump relay that is watched by the flush system. Enter the pump relay value into the parameter at the flush relay index.

Example

If you need to watch pump Relay One to control a flush valve on Relay Two you would set P170[2]=1.

P170 Flush Pump

Picks the number of the pump relay which triggers the flushing device.

	Single Point Model	Dual Point Model
Primary Index	Global	Relay
Values	Range: 0 to 6	
	Preset: 0	
Related	• P111 = 64, Flush Valve	

Enter the HydroRanger 200 relay number of the pump with the flush valve. The activation of this pump relay drives the usage of the flush system. Both P172 Flush Interval and P171 Flush Cycles are based on the operation of this relay and controls any relay set to P111 = 64, Flush Valve.

P171 Flush Cycles

Sets the number of pump cycles requiring flush control.

	Single Point Model	Dual Point Model
Primary Index	Global	Relay
Values	Range: 0 to 9999	
	Preset: 0	
Related	• P111 = 64, Flush Valve	

If three flush cycles are required after every ten pump cycles then:

P172 (Flush Interval) = **10**
P171 (Flush Cycles) = **3**

P172 Flush Interval

Sets the number of pump cycles before flush control is enabled.

Primary Index	Single Point Model	Dual Point Model
	Global	Relay
Values	Range: 0 to 9999	
	Preset: 0	
Related	• P111 = 64, Flush Valve	

To start a new flush cycle every ten times the pumps are run, set this to **10**.

P173 Flush Duration

The length of time for each flush cycle that the flush control is active.

Primary Index	Single Point Model	Dual Point Model
	Global	Relay
Values	Range: 0.000 to 9999 s	
	Preset: 0.000	
Related	• P111 = 64, Flush Valve	

mA Output (P200 to P219)

P200 mA Output Range

Determines the mA output range.

Primary Index	mA output		
Values	0		off
	1		0 to 20 mA
	2	*	4 to 20 mA
	3		20 to 0 mA
	4		20 to 4 mA
Related	• P911 mA Output Value		

If either **1** or **2** is selected, the mA output is directly proportional to the mA Function. If either **3** or **4** is selected, then the output is inversely proportional.

Parameters

P201 mA Output Function

Alters the mA output/measurement relationship.

Primary Index	mA output		
Values	value	mA function	Operation (P001)
	0	OFF	
	1	level	level, differential, or average
	2	space	space
	3	distance	distance
	4	volume	level or space
	5	flow	OCM
	6	head	
	7	volume rate	
	8	mA input	
	9	comms input	
Related	• P202 mA Output Allocation • P911 mA Output Value		
Altered By	• P001 Operation		

P202 mA Output Allocation

Sets the input source from which the mA output is calculated.

Primary Index	mA output		
Values	1	*	Point 1
	2		Point 2
	3		Point 3
Related	• P201 mA Output Function		

Enter the Point Number the mA output is based on. This value depends on whether mA function (P201) is set as transducer or mA input.

If P201 uses a transducer, this parameter can only be altered if P001 (Operation) is set for DPD or DPA. The values would be **1** for Single Point applications, **1-2** for Dual Point, or **1-3** for DPD or DPA configurations.

The mA output will be the average of the readings from all in service transducers assigned to the output. Out of service transducers will be ignored.

If P202 mA Output Allocation End contains the value 0, then only 1 transducer has been assigned to the milliamp output.

P203 mA Output Value / Transducer

Displays current mA output value for the Point Number.

Primary Index	Level
Values	Range: 0.000 to 22.00 (view only)

This displays as an Auxiliary Reading when 5 mA key is pressed in the RUN mode and does not include adjustments made using Trim features (P214 / P215).

Note: This parameter is applicable only if any mA output has the transducer Point Number as its input source (see P201 and P202).

Independent mA Setpoints (P210 and P211)

Use these features to reference the minimum and/or maximum mA output to any point in the measurement range.

P201—mA Function Settings	Action
Level, Space, or Distance	Enter the material level in Units (P005) or percent of Span (P007) as referenced to Empty (P006).
Volume	Enter the volume in Max Volume (P051) units or as a percent of Max Volume.
Flow	Enter the flowrate in OCM Max Flow (P604) units or as a percent of OCM Max Flow.
Head	Enter the head in level units (P005) or percent of Max Head (P603).
Volume Rate	Enter the volume rate in volume/min. Ensure the % symbol is displayed before attempting to enter a % value.
mA input or Communications Input	Not Applicable

P210 0/4 mA Output Setpoint

Sets the process level corresponding to the 0 or 4mA value.

Primary Index	mA output
Values	Range: -999 to 9999
Related	• P211 20 mA Output Setpoint

Enter the value (in applicable units or %) to correspond to 0 or 4 mA.

P211 20 mA Output Setpoint

Sets the process level that corresponds to the 20 mA value.

Primary Index	mA output
Values	Range: -999 to 9999
Related	• P210 0/4 mA Output Setpoint

Enter the value (in applicable units or %) to correspond to 20 mA.

mA Output Limits (P212 and P213)

Use these features to adjust the minimum and/or maximum mA output values, which should suit the input limit requirements of the external device.

P212 mA Output Min Limit

Sets the minimum mA output value (in mA) to be produced.

Primary Index	mA output
Values	Range: 0.000 to 22.00
	Preset: 0.0 or 3.8
Related	• P200 mA Output Range • P213 mA Output Max Limit

Preset is determined by mA Function (P200). If P200 = **1** or **3**, then the preset is **0.0**, or if P200 = **2** or **4**, then the preset is **3.8**. For P200=**1** or **3** (preset is 0.0), this parameter has no effect because the minimum limit cannot be negative, and the minimum current is always 0.0 mA.

P213 mA Output Max Limit

Sets the maximum mA output value (in mA) to be produced.

Primary Index	mA output
Values	Range: 0.000 to 22.00
	Preset: 20.2 mA
Related	• P200 mA Output Range / P212 mA Output Min LImit

mA Output Trim (P214 to P215)

This does not affect the P203 value shown, and is used when recalibration of an external device is impractical.

To adjust the value so that the device correctly indicates 4.00 (when P214 is accessed) or 20.00 mA (when P215 is accessed):

1. Attach ammeter to HydroRanger 200 mA output.
2. Access P214, Index 1 (for mA output 1) or 2 (for mA output 2). Press CLEAR and ENTER C ↵. The ammeter should show a value near 4 mA.
3. Enter the exact value displayed on the ammeter into P214 (Index 1 or 2).
4. The ammeter should then read exactly 4.00 mA.
5. Repeat steps 1 to 4 to set P215, using 20 mA as the desired value.

P214 4 mA Output Trim

Calibrates the 4 mA output.

Primary Index	mA output
Values	Range: 0 to 9999
Related	• P215 20 mA Output Trim

Adjust this value so the device indicates 4.000 mA when P214 is accessed.

P215 20 mA Output Trim

Calibrates the 20 mA output.

Primary Index	mA output
Values	Range: 0 to 16000
Related	• P214 4mA Output Trim

Adjust this value so the device indicates 20.00 mA when P215 is accessed.

mA Output Failsafe (P219)

P219 mA Output Failsafe

Use for failsafe operation, independent of the Failsafe Material Level (P071).

Primary Index	mA output		
Values	Range: 0.000 to 22.00		
	OFF	*	mA output responds to Failsafe Material Level (P071).
	HOLd		last **known** value is held until normal operation resumes
	LO		produce the **Empty** mA output immediately
	HI		produce the **Span** mA output immediately
Related	• P201 mA Output Function		

Selecting an independent mA Failsafe option:

1. Press MODE to display the Auxiliary Function symbol.
2. Press ARROWS to scroll access the failsafe options.
3. Press ENTER when the desired option displayed.

Or, to produce an mA output at a specific value, enter the value required. This is used only if mA output is allocated to a transducer (P201 = 1 to 7).

mA Input (P250 to P260)

P250 mA Input Range

Shows the mA input range of the connected mA device.

Primary Index	Global		
Values	1		0 to 20 mA
	2	*	4 to 20 mA

Ensure this range corresponds to the output range of the external device. All level measurements will equate % of Span with the % of the mA range.

P251 0 or 4 mA Input Level

Shows the process level corresponding to the 0 or 4 mA value.

Primary Index	Global	
Values	Range: -999 to 9999%	
	Preset: 0%	
Related	• P006 Empty • P007 Span	

When using an external mA signal to determine level, the input range must be scaled to give accurate results.

P252 20 mA Input Level

Shows the process level corresponding to the 20 mA value.

Primary Index	Global
Values	Range: -999 to 9999%
	Preset: 100%
Related	• P006 Empty • P007 Span

Input range is scaled for accuracy if an external mA signal calculates level.

P253 Input Filter Time Constant

Shows the time constant used in the mA input filter to dampen signal fluctuations.

Primary Index	Global
Values	Range: 0 to 9999
	Preset: 1

This number in seconds is used in the damping calculations. Larger values damp more than smaller values and **0** disables the signal filter.

P254 Scaled mA Input Value

Shows the resulting level value after scaling.

Primary Index	Global
Values	Range: -999 to 9999% (view only)
	Preset: calculated from the input mA signal

This parameter is calculated from the input mA signal.

P260 mA Raw Input

Shows the raw mA input supplied by the external device.

Primary Index	mA input
Values	Range: 0.000 to 20.00 (view only)

Discrete Input Functions (P270 to P275)

Discrete inputs can be used for the following:

- Passing other information to a remote system through communications
- Backup level override

Use the parameters listed above to have discrete inputs modify the unit's operation.

Use the following parameters to configure the discrete input itself.

See also the *Pump Control* section on page 56 for a description of the HydroRanger 200's pump control algorithms, including how the discrete inputs alter its operation.

P270 Discrete Input Function

Sets how discrete signals are interpreted by the HydroRanger 200.

Primary Index	Discrete input		
Values	0		Forced **OFF**
	1		Forced **ON**
	2	*	Normally Open – 0 (DI open), 1 (DI closed)
	3		Normally Closed – 0 (DI closed), 1 (DI open)
Related	• Pump Control section		

P275 Scaled Discrete Input Value

Shows the current value of the discrete input after any scaling is applied.

Primary Index	Discrete input	
Values	Display: view only	
	Values: dependent on the function of the discrete input	
	Range of Values	**Function (P270)**
	1	Forced **ON**
	0	Forced **OFF**
	0 (DI open), 1 (DI closed)	Normally Open
	0 (DI closed), 1 (DI open)	Normally Closed

Readings are updated continuously even in PROGRAM mode. The value signals a level override event.

Standard Data Logging (P300 to P321)

All records can be reset by pressing the CLEAR C ↵ keys.

Record Temperatures (P300 to P303)

These features display the high and/or low temperatures in °C. When a parameter relating to a TS-3 Temperature Sensor is accessed, the Point Type display changes to the TS-3 symbol .

If the unit is powered up without a temperature sensor connected, the value –50°C is displayed. This information can help trace problems with both built in and external temperature sensors.

P300 Temperature, Transducer Maximum

Shows the highest temperature encountered, as measured by the temperature sensor in the transducer (if applicable).

Primary Index	Transducer
Values	Range: - 50 to 150°C (view only)
	Preset: - 50°C
Related	• P301 Temperature, Transducer Min

Press CLEAR C ↵ keys to reset the log after a short circuit on the transducer wiring.

P301 Temperature, Transducer Minimum

View the lowest temperature encountered, as measured by the temperature sensor in the transducer (if applicable).

Primary Index	Transducer
Values	Range: - 50 to 150°C (view only)
	Preset: 150°C
Related	• P300 Temperature, Transducer Max

Press CLEAR C ↵ keys to reset the log after an open circuit on the transducer wiring.

P302 Temperature, Sensor Maximum

View the highest temperature encountered, as measured by the TS-3 Temperature Sensor (if applicable).

Primary Index	Global
Values	Range: - 50 to 150°C (view only)
	Preset: - 50°C
Related	• P303 Temperature, Sensor Min

Press CLEAR C ↵ keys to reset the log after a short circuit on the transducer wiring.

P303 Temperature, Sensor Minimum

Shows the lowest temperature encountered, as measured by the TS-3 Temperature Sensor (if applicable).

Primary Index	Global
Values	Range: - 50 to 150°C (view only)
	Preset: 150°C
Related	• P302 Temperature, Sensor Max

Press CLEAR C ↵ keys to reset the log after an open circuit on the transducer wiring.

Record Readings (P304 and P305)

This identifies the occurrence of the record high and low level readings. Press CLEAR C ↵ keys to reset these values once the installation is working correctly.

P304 Reading Max

Shows the highest Reading calculated (in normal Reading units or %).

Primary Index	Level
Values	Range: -999 to 9999 (view only)
Related	• P305 Reading Min

P305 Reading Min

Shows the lowest Reading calculated (in normal Reading units or %).

Primary Index	Level
Values	Range: -999 to 9999 (view only)
Related	• P304 Reading Max

Pump Records (P309 to P312)

These features to identify pump usage and if the associated Relay Function (P111) is set for any **pump control** feature. The value is that of the pump connected to the associated terminals.

Enter a value to set the current record to that value. Use this if a pump is added with a known number of hours logged, or the value can be reset to zero **0** after maintenance.

P309 Pump RUN Time

Displays the amount of time in minutes since a relay was last activated.

Primary Index	Relay
Values	Range: 0 to 9999 minutes
Related	• Relay Function (P111) set for any pump control feature

Parameter measures the length of time since a relay was asserted, most often to determine how long a pump has been running. Alternatively, it can monitor a relay to show how long it has been in a state of alarm. It resets every time the relay is activated.

P310 Pump Hours

View or reset the accumulate ON time for the displayed Relay Number.

Primary Index	Relay
Values	Range: 0.000 to 9999
Related	• Relay Function (P111) set for any **pump control** feature

Value is displayed with a floating decimal point (the more figures displayed before the decimal, the fewer displayed after). It is the value displayed when key is pressed in the RUN mode.

P311 Pump Starts

View or reset the accumulated number of times the Relay Number has been ON.

Primary Index	Relay
Values	Range: 0 to 9999
Related	• Relay Function (P111) set for any **pump control** feature

This value is displayed when key is pressed and held for five seconds in RUN mode.

P312 Pump Run Ons

View or reset the accumulated number of times the displayed Relay Number has been held ON via Run On Interval (P130).

Primary Index	Relay
Values	Range: 0 to 9999
Related	• Relay Function (P111) set for any **pump control** feature

Flow Records (P320 and P321)

These features are enabled if Operation is set for OCM (P001 = 6), or an OCM device is defined (P600 ≠ 0). Use them to identify the occurrence of the record high and low flow rates as displayed in OCM Max Flow (P604) units, or as a percent of OCM Max Flow. Press CLEAR C ↵ keys to reset values once the installation is working correctly.

P320 Flow Max

View the highest flow rate calculated (in units or %).

	Single Point Model	Dual Point Model
Primary Index	Global	Transducer
Values	Range: -999 to 9999 (view only)	
Related	• P604 Maximum Flow	

P321 Flow Min

View the lowest flow rate calculated (in units or %).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999 (view only)	
Related	• P604 Maximum Flow	

LCD Totalizer (P322 and P323)

Use these features to view, reset, or preset the eight-digit display totalizer when Operation is set for OCM or Pumped Volume (P001 = 6 or 7). The eight-digit totalizer is divided into two groups of four digits. The four least significant totalizer digits are stored in P322, and the four most significant digits are stored in P323. Adjust these values separately to set a new total.

Example

P323 = 0017
P322 = 6.294
Totalizer Display = 00176.294

Totalizer units are dependent upon programming. Enter zero **0** (if required) to reset the totalizer to zero. Alternatively, enter any other (applicable) value, to preset the totalizer to the necessary value.

Note: A second point is available only if the Dual Point Feature is enabled.

P322 LCD Total Low

View and/or alter the four least significant digits of the totalizer value.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
Related	• P630 LCD Totalized Multiplier • P633 LCD Totalized Decimal Position • P737 Primary Reading	

P323 LCD Total High

View and/or alter the four most significant digits of the totalizer value.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
Related	• P630 LCD Totalized Multiplier • P633 LCD Totalized Decimal Position • P737 Primary Reading	

Profile Records (P330 to P337)

WARNING:
These parameters are for authorized service personnel or technicians familiar with Siemens Milltronics echo processing techniques.

These features can record up to ten Echo profiles, initiated manually (P330), or automatically (P331 et al). Refer to SIMATIC PDM or Dolphin Plus for viewing echo profiles on a PC. If ten Profiles are already saved, addresses 1 through 10 are filled, the oldest automatically initiated record is overwritten. Manually initiated records are not automatically overwritten. All records are automatically deleted in the event of a power interruption.

When a record is displayed, results are based on current programming (which may have been altered since the record was saved). This permits the effect on the echo profile to be observed when changing an echo parameter.

P330 Profile Record

Records profiles for later viewing..

Primary Index	Echo profile	
Values	**Code**	**Description**
	----	no record
	A1	automatically recorded profile from Transducer One
	A2	automatically recorded profile from Transducer Two
	U1	manually recorded profile from Transducer One
	U2	manually recorded profile from Transducer Two

In addition to being a profile records library, this provides two functions:

- manually records and saves echo profiles
- displays an echo profile, recorded manually or automatically

To select a record address

1. Enter PROGRAM mode and press DISPLAY twice to highlight the index field. The field shows two underscores _ _.
2. Type the index number. The profile record information is shown.
3. Use ARROWS to scroll through the records.

To manually record a profile

Press TRANSDUCER to fire the transducer and record the echo profile into the internal buffer for display.

To save a manual record

Press ENTER to copy the echo profile record in the buffer and save it in the selected address in the record library. The parameter value field displays the new record information.

To display a record

Press key to enter display auxiliary mode and then:

- Press TRANSDUCER to copy the current echo profile into the buffer for display on Dolphin Plus

To delete a record

Press CLEAR and then ENTER to delete the echo profile record in the selected address. The value returns to **- - - -**.

P331 Auto Record Enable

Use to enable/disable the Auto Profile Record function.

Primary Index	Global		
Values	Range: 0 to 1		
	0	*	Off
	1		On

P332 Auto Record Transducer

Specifies the Transducer Point Number for which Auto Profile Records are saved.

Primary Index	Global		
Values	Range: 0 to 2		
	0		Any transducer
	1	*	Transducer One
	2		Transducer Two
Altered By	• P001 Operation = 4 or 5		

This feature is preset to Point Number 1. (Alteration is only required if **differential** or **average** Operation [P001 = 4 or 5] is selected.)

P333 Auto Record Interval

Enter the time to elapse after an Auto Profile Record is saved before another Auto Profile Record can be saved (subject to all other restrictions).

Primary Index	Global
Values	Range: 0.0 to 9999 (minutes)
	Preset: 120

Auto Record ON and OFF Setpoints (P334 to P337)

Use Auto Record ON Setpoint (P334) and Auto Record OFF Setpoint (P335) to define the boundaries within which the level must be, for the resultant Echo Profile to be considered for an Auto Profile Record.

If ---- is displayed for either P334 or P335, Auto Profile Records are saved regardless of current level (subject to all other restrictions).

Enter the level value in Units (P005) or percent of Span (P007) as referenced to Empty (P006).

P334 Auto Record ON Setpoint

Enter the critical level which, in conjunction with Auto Record OFF Setpoint, defines the boundaries for Auto Profile Records to be saved.

Primary Index	Global
Values	Range: -999 to 9999
Related	• P335 Auto Record OFF Setpoint • P336 Auto Record Filling / Emptying • P337 Auto Record LOE Time

P335 Auto Record OFF Setpoint

Enter the critical level which, in conjunction with Auto Record ON Setpoint, defines the boundaries for Auto Profile Records to be saved.

Primary Index	Global
Values	Range: -999 to 9999
Related	• P334 Auto Record ON Setpoint • P336 Auto Record Filling / Emptying • P337 Auto Record LOE Time

P336 Auto Record Filling / Emptying

Use this feature to restrict Auto Profile Records from being saved unless the level is rising, falling or either.

Primary Index	Global		
Values	0	*	Auto Profile Record on filling or emptying
	1		Auto Profile Record on filling only
	2		Auto Profile Record on emptying only
Related	• P334 Auto Record ON Setpoint • P335 Auto Record OFF Setpoint • P337 Auto Record LOE Time • P702 Filling Indicator • P703 Emptying Indicator		

If the level changes at a rate in excess of the corresponding Filling / Emptying Indicator (P702 / P703) values, the Echo Profile is saved subject to this and other Auto Profile Record restrictions.

P337 Auto Record LOE Time

Limits Auto Profile Records from being saved unless extended LOE occurs.

Primary Index	Global	
Values	Range: 0.0 to 9999 (seconds)	
	Preset: 0.0	
Related	• P334 Auto Record ON Setpoint • P335 Auto Record OFF Setpoint • P336 Auto Record Filling / Emptying	

If the LOE condition exceeds the period entered, the Echo Profile is saved. When set for **0** LOE is not required for an Auto Profile Record to be saved.

Installation Records (P340 to P342)

P340 Date of Manufacture

View the date of manufacture of this HydroRanger 200 unit.

Primary Index	Global
Values	Format: YY:MM:DD (view only)
Related	• P340 Date of Manufacture • P342 Start Ups

P341 RUN Time

View the number of days this HydroRanger 200 has been in operation.

Primary Index	Global
Values	Range: 0.000 to 9999 (view only)
Related	• P340 Date of Manufacture • P342 Start Ups

The RUN Time value is updated once a day, and cannot be reset. However, in the event of a power interruption, the counter won't advance. Therefore, a unit that is powered down on a regular basis will not have an accurate value.

P342 Start Ups

The number of times power has been applied since the Date Of Manufacture.

Primary Index	Global
Values	Range: 1 to 9999 (view only)
Related	• P340 Date of Manufacture • P342 Run Time

Open Channel Monitoring (P600 to P621)

If the HydroRanger 200 is used to monitor open channel flow, alter the following parameters as required and run a calibration as described in P621.

Note: See *Open Channel Monitoring* (OCM) on page 71 for application examples involving common weirs and flumes.

The HydroRanger 200 measures **head** as referenced to Empty (P006) or OCM Zero Offset (P605), when Operation is set for **OCM** (P001 = 6). Flowrate, based on head (at the **point of measure** specified by the Primary Measuring Device fabricator) is also calculated and displayed on the LCD.

Some Primary Measuring Devices require a longer Range Extension (P801) to avoid entering the LOE failure state if the water level falls below the zero point of the Primary Measuring Device. See *P801 Range Extension* on page 193 for more information.

P600 Primary Measuring Device

The type of primary measuring device (PMD) used.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	0	*	off (no calculation)
	1		Exponential (see P601)
	2		Palmer-Bowlus Flume (see P602)
	3		H-Flume (see P602)
	4		Universal Linear Flow Calculation (see P610, P611)
	5		Universal Curved Flow Calculation (see P610, P611)
	6		BS-3680/ISO 4359 Rectangular Flume (see P602)
	7		BS-3680/ISO 1438/1 Thin Plate V-Notch Weir (see P602)
Alters	• P601 Flow Exponent • P602 Primary Measuring Device Dimensions • P608 Flowrate Units		
Altered By	• P001 Operation		
Related	• P603 Maximum Head • P604 Maximum Flow • P605 Zero Head • P610 Head Breakpoints • P611 Breakpoint		

The HydroRanger 200 is pre-programmed for common PMD flow calculations. If your PMD is not listed, select the appropriate Universal Flow Calculation.

Parameters

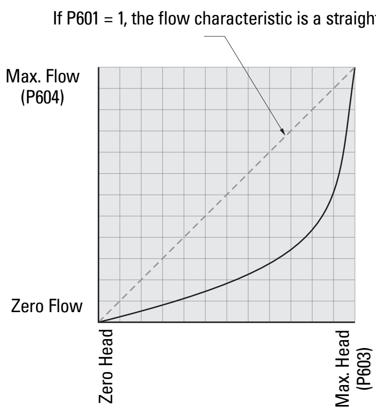
Associated parameters Max Head (P603), Max Flow (P604), and Min Head (P605) may be scroll accessed. If Operation is not set for **OCM** (P001 = 6), this value is preset to **0**. If Operation is set for **OCM**, it is preset to **1**.

P601 Flow Exponent

The Exponent for the flow calculation formula.

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	Range: -999 to 9999	
	Preset: 1.55	
Altered By	• P600 Primary Measuring Device	
Related	• P603 Maximum Head • P604 Maximum Flow • P605 Zero Head	

Use this parameter if the Primary Measuring Device (P600) is set to 1 (exponential). It creates an exponential curve with end points set by Max Head (P603) and Zero Head (P604) and with the curve based on the specified exponent.



A Word on Exponents

The exponential equation is
$$Q = KH^{P601}$$

Where:
Q = flow
K = internal constant
H = head

Use the exponent specified by the PMD manufacturer, if available, or the sample value given on next page.

Parameters

Example Exponents

PMD Type	Exponent (sample only)
Suppressed Rectangular Weir	1.50
Cipolletti Weir	1.50
Venturi Flume	1.50
Parshall Flume	1.22 to 1.607
Leopold Lagco	1.547
V-Notch Weir	2.50

P602 Primary Measuring Device Dimensions

The dimensions of the Primary Measuring Device (PMD).

<table>
<tr><td rowspan="2">Primary Index</td><td colspan="2">Single Point Model</td><td>Dual Point Model</td></tr>
<tr><td colspan="2">Global</td><td>Transducer and Dimension</td></tr>
<tr><td>Secondary Index</td><td colspan="3">Dimension</td></tr>
<tr><td rowspan="15">Index Values for Supported PMDs</td><td colspan="3">ISO 1438/1</td></tr>
<tr><td>1</td><td colspan="2">Notch Angle</td></tr>
<tr><td>2</td><td colspan="2">Discharge Coefficient</td></tr>
<tr><td colspan="3">ISO 4359</td></tr>
<tr><td>1</td><td colspan="2">Approach width</td></tr>
<tr><td>2</td><td colspan="2">Throat width</td></tr>
<tr><td>3</td><td colspan="2">Hump Height</td></tr>
<tr><td>4</td><td colspan="2">Throat Length</td></tr>
<tr><td>5</td><td colspan="2">Velocity coefficient</td></tr>
<tr><td>6</td><td colspan="2">Discharge coefficient</td></tr>
<tr><td colspan="3">Palmer Bowlus</td></tr>
<tr><td>1</td><td colspan="2">Flume width</td></tr>
<tr><td colspan="3">H Flume</td></tr>
<tr><td>1</td><td colspan="2">Flume height</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Altered By</td><td colspan="3">• P600 Primary Measuring Device</td></tr>
</table>

Use this parameter if the Primary Measuring Device is directly supported (P600=2,3,6,7). The dimensions required for each PMD vary.

For more information on PMD, see page 71.

Parameters

P603 Maximum Head

The level value associated with Maximum Flow, in Units (P005).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999	
	Preset: Span (P007) value	
Altered By	• P005 Units • P600 Primary Measuring Device	
Related	• P604 Maximum Flow • P605 Zero Head	

This represents the highest head level supported by the PMD and works in conjunction with Maximum Flow (P604) to define the highest point in the exponential curve. Use it when the Primary Measuring Device (PMD) requires a maximum head and flow reference point. This would include Exponential, Palmer Bowlus Flume, H-Flume, and Universal breakpoints.

P604 Maximum Flow

The maximum flowrate associated with Maximum Head (P603).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999	
	Preset: 1000	
Altered By	• P600 Primary Measuring Device	
Related	• P603 Maximum Head • P606 Time Units • P925 Flow Measurement	

This represents the flow at the highest head level supported by the PMD. and works in conjunction with Maximum Head (P603) to define the highest point in the exponential curve. Use it when the Primary Measuring Device (PMD) requires a maximum head and flow reference point. This would include Exponential, Palmer Bowlus Flume, H-Flume, and Universal breakpoints.

Also use this parameter with Time Units (P606) to define the flowrate units. The limitation of four digits is for the LCD only, and the flowrate value is available with greater precision through communications.

Example

Conditions	Enter
• Flowrate display: millions of gallons/day, • Maximum flowrate is 376,500,000 gallons/day	• **376.5** for Maximum Flow (P604) • and **4** for Time Units (P606).

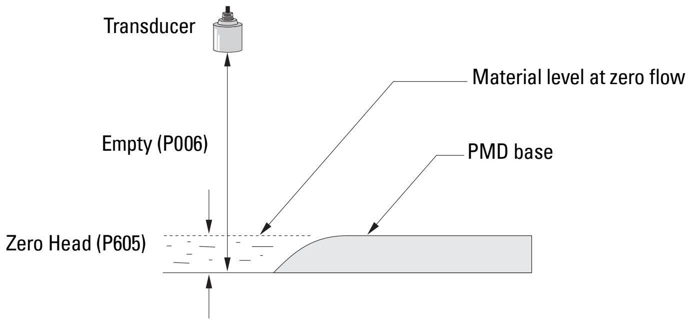
Parameters

P605 Zero Head

The distance above Empty (P006) in Units (P005) representing zero head (and zero flow).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999	
	Preset: 0.000	
Altered By	• P005 Units • P007 Span	
Related	• P006 Empty • P801 Range Extension • P926 Head Measurement	

This feature can be used for most weirs and some flumes (e.g. Palmer Bowlus) where the zero reference is at a higher elevation than the channel bottom.



P606 Time Units

Determines the units used to display current flow and logging flow values.

Primary Index	Single Point Model			Dual Point Model
	Global			Transducer
Values	1		seconds	
	2		minutes	
	3		hours	
	4	*	days	
Alters	•			
Altered By	• P608 Flowrate Units			

This is used when the Primary Measuring Device is **Ratiometric** (P608=0).

Example

Conditions	Enter
• Flowrate display: millions of gallons/day, • Maximum flowrate is 376,500,000 gallons/day	• **376.5** for Maximum Flow (P604) • and **4** for Time Units (P606).

Parameters

P607 Flowrate Decimal

The maximum number of decimal places to be displayed.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	0		no digits after the decimal point
	1		1 digit after the decimal point
	2		2 digits after the decimal point
	3		3 digits after the decimal point
Altered By	• P060 Decimal Position		

In RUN mode, the number of decimal places displayed is automatically adjusted (if necessary) to prevent the number of Flowrate digits from exceeding display capabilities.

The maximum number of head decimal places is controlled by Decimal Position (P060).

P608 Flowrate Units

The volume units used to display total flow.

Note: Set this parameter only when using BS-3680/ISO 4359 Rectangular Flume or BS-3680/ISO 1438/1 Thin Plate V-Notch Weir (P600 = 6 or 7). Use the default value of 0 for P608 when P600 = 1 to 5.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	Ratiometric (P600=all)		
	0	*	Ratiometric calculation (units defined by P604)
	Absolute (P600=6,7 only)		
	1		litres / second
	2		cubic metres / hour
	3		cubic metres / day
	4		cubic feet / second
	5		gallons / minute – Imperial
	6		million gallons / day – Imperial
Values	7		gallons / minute – U.S.
	8		million gallons / day – U.S.
Alters	• P606 Time Units		
Altered By	• P600 Primary Measuring Device		
Related	• P608 Flowrate Units		

This parameter is enabled only if the primary measuring device (PMD) supports absolute calculations (P600=6,7). For absolute PMDs (P600=6,7) volume units can be specified using this parameter. If needed, absolute PMDs can still use ratiometric (P608=0) to accommodate other units.

P610 Head Breakpoints

The head breakpoints for which flowrate is known. See "Accessing a Secondary Index" on page 114 for more information..

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Secondary Index	Breakpoint	
Values	Range: 0.000 to 9999	
Related	• P611 Breakpoint Flowrates	

The values in the Span for which flowrates are known. See *Universal Calculation Support* on page 81 for how to specify universal flows.

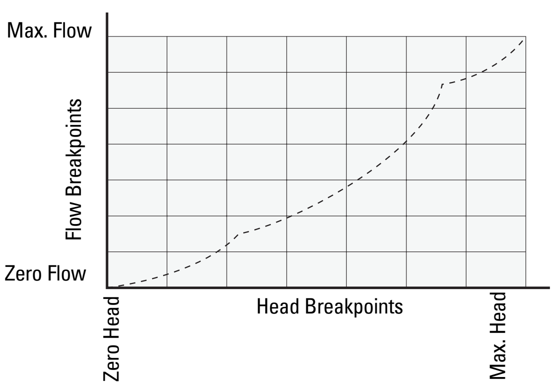
P611 Breakpoint Flowrates

The flowrate corresponding to each Head Breakpoint entered.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Secondary Index	Breakpoint	
Values	Range: 0.000 to 9999	
Related	• P610 Head Breakpoints	

These are the flowrates for the related breakpoints. See *Universal Calculation Support* on page 81 for how to specify universal flows.

Head vs. Flowrate (P610 and P611)



Parameters

P620 Low Flow Cutoff

Eliminates totalizer activity for flows at or below the cutoff value.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
	Preset = 5.000 %, or equivalent units	
Altered By	• P005 Units	
Related	• P007 Span	

Use this to enter the minimum head in units (P005) or as a percent of span.

P621 Auto Zero Head

Calibrates Zero Head (P605) based on actual head measurements.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999	
Related	• P006 Empty • P062 Offset Reading • P605 Zero Head • P664 Temperature	

Use this parameter when the reported head is consistently high or low by a fixed amount.

Before using this feature, verify the following parameters are correct:

- Empty (P006)
- Temperature (P664)
- Offset Reading (P062=0)
- Zero Head Offset (P605)

Procedure, with "head" steady

1. Press TRANSDUCER [⏚] to display the calculated head.
2. Repeat step ONE at least FIVE times to verify repeatability.
3. Measure the **actual** head (with a tape measure or solid rule).
4. Enter the **actual** head value.

The deviation between the entered Empty (P006) value and the calibrated Empty value is stored in Offset Correction (P652). Alternatively, the Empty parameter (P006) can be corrected directly.

Parameters

Pumped Volume Totalizer (P622)

If the eight-digit totalizer display or a remote totalizer contact closure are desired, alter the following parameters.

P622 Inflow / Discharge Adjust

*The method used to calculate the volume pumped, for **pumped total** Operation (P001 = 7).*

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	1 = inflow * / pump cycle When the pump is off, the HydroRanger 200 estimates the volume of inflow by recording the rate at which the liquid level changes. When the pump is operating, the estimated inflow volume is added to the pumped volume total. When the pump stops, the pumped volume of the previous pump cycle is added to the total volume pumped in the totalizer.	
	2 = inflow * ignored Inflow is assumed to be **0** while pumps are running.	
	3 = inflow * / rate (preset) Volume pumped is adjusted for inflow. Inflow rate is estimated by assuming that the rate calculated (P708) just prior to the start of the pump cycle remained constant during the pump cycle. Inflow rate is averaged using rate filter (P704), rate update time (P705) and rate update distance (P706) to control how the average rate is calculated.	
Related	• P001 Operation • P704 Rate Filter • P705 Rate Update Time • P706 Rate Update Distance • P708 Volume Rate Display	

* or discharge

Totalizer (P630 to P645)

P630 LCD Totalized Multiplier

Use this feature if the LCD Total increments by too large (or too small) an amount.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	-3		.001
	-2		.01
	-1		.1
	0	*	1
	1		10
	2		100
	3		1000
Values	4		10,000
	5		100,000
	6		1,000,000
	7		10,000,000
Related	• LCD Totalizer (P322 and P323)		

Enter the factor (powers of 10 only) by which actual volume is divided, prior to display on the LCD. Use a value such that the eight-digit totalizer doesn't roll over between readings.

Example:

For an LCD Total display in 1000s of volume units, enter **3**.

P633 LCD Totalized Decimal Position

Enter the maximum number of decimal places to be displayed.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	0		no digits after the decimal point
	1		1 digit after the decimal point
	2	*	2 digits after the decimal point
	3		3 digits after the decimal point
Related	• LCD Totalizer (P322 and P323)		

Note: Set the decimal position during initial commissioning of the HydroRanger 200. If the position is changed later, the totalizer data in P322 and P323 will be incorrect and must be reset according to the new decimal value.

In RUN mode, the number of decimal places displayed is not automatically adjusted. When the LCD Total value is so large as to exceed display capabilities, the total **rolls over** to **0** and continues incrementing.

Parameters

P640 Remote Totalized Multiplier

*Use this feature if the remote totalizer (device connected to the relay set for **totalizer operation** [relay Function, P111 = 40]), updates too slowly or rapidly.*

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	-3		.001
	-2		.01
	-1		.1
	0	*	1
Values	1		10
	2		100
	3		1000
	4		10,000
	5		100,000
	6		1,000,000
	7		10,000,000
Related	• P001 Operation • P111 Relay Control Function • P114 Relay **Duration** Setpoint • P115 Relay I**nterval** Setpoint • P645 Relay Duration		

Parameter is relevant only if Operation is set to OCM or Pumped Volume (P001 = 6 or 7).
The relays on the HydroRanger 200 have a maximum frequency of 2.5 Hz.
Enter the factor (powers of 10 only) by which actual volume is divided, prior to Remote Totalizer count increment.

Example:

For a Remote Totalizer update by 1000s of volume units, enter **3**.

P641 Flow Sampler Mantissa

Use this feature in conjunction with Flow Sampler Exponent (P642) to establish the number of flow units required to increment the Flow Sampler (device connected to the HydroRanger 200 relay set for the flow sampler operation Relay Function, P111 = 41).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.001 to 9999	
	Preset = 1.000	
Related	• P001 Operation • P111 Relay Control Function • OCM (P600 to P621) • P642 Flow Sampler Exponent	

See next page for more information about this parameter.

This parameter is relevant only if Operation is set to OCM (P001 = 6).

Enter the mantissa (Y) for the exponent (Z) in the formula:

Flow Sampler Increment = Y x 10^Z Flow units.

Example: To count once every 4310 (4.31 x 10^3) flow units:

- set P641 to **4.31** and P642 to **3**

P642 Flow Sampler Exponent

Use this feature in conjunction with Flow Sampler Mantissa (P641) to establish the number of flow units required to increment the Flow Sampler (device connected to the HydroRanger 200 relay set for the ***flow sampler operation*** *Relay Function, P111 = 41).*

	Single Point Model	Dual Point Model
Primary Index	Global	Transducer
Values	Range: -3 to +7 (integers only)	
	Preset = 0	
Related	• P001 Operation • P111 Relay Control Function • OCM (P600 to P621) • P641 Flow Sampler Mantissa	

This parameter is relevant only if Operation is set to OCM (P001 = 6).

Enter the exponent (Z) for the mantissa (Y) in the formula:

Flow Sampler Increment = Y x 10^Z Flow units.

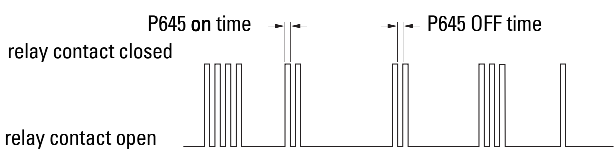
P645 Relay Duration

Use this feature (if desired) to adjust the minimum contact closure duration of a relay set as a totalizer, flow sampler, time (control), or aeration (P111 = 40, 41, 60 or 62)

Primary Index	Global
Values	Range: 0.1 to 1024
	Preset = 0.2 (sec)
Related	• P111 Relay Control Function

Enter minimum contact closure duration (in seconds) required by the device connected.

For the flow sampler function this value is used for both the ON time of the relay and the OFF time between contacts.



Range Calibration (P650 to P654)

There are two types of calibration possible:

Offset: Adjusts the measurements by a fixed amount.

Sound Velocity: Adjusts speed of sound and changes the measurement calculations.

Do Offset calibration at any steady level unless a Sound Velocity calibration is also done. If both calibrations are done then do Offset at a known high level and Sound Velocity at a known low level.

P650 Offset Calibration

Calibrates Empty (P006) if the reported level is consistently high or low by a fixed amount.

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	Range: -999 to 9999	
Related	• P006 Empty • P062 Offset Reading • P605 Zero Head	• P652 Offset Correction • P664 Temperature

Before using this feature, verify the following parameters are correct:

- Empty (P006)
- Temperature (P664)
- Offset Reading (P062)
- Zero Head Offset (P605), if using OCM

Offset Calibration

Begin with a steady level.

1. Press TRANSDUCER to display the calculated reading.
2. Repeat Step One at least five times to verify repeatability.
3. Measure the actual reading (use tape measure).
4. Enter the actual value.

The deviation between the entered Empty (P006) value and the calibrated **Empty** value is stored in Offset Correction (P652).

Parameters

P651 Sound Velocity Calibration

Changes the speed of sound constant.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999	
Related	• P653 Velocity • P654 Velocity at 20°C	

Condition for use of this feature

- The acoustic beam atmosphere is other than air
- The acoustic beam atmosphere temperature is unknown
- The Reading accuracy is acceptable at higher material levels only

For best results, calibrate with the level at a known value near empty.

Using Sound Velocity Calibration

Ensure a steady level at some low value (P653 and P654 adjusted accordingly)

1. Allow sufficient time for the vapor concentration to stabilize.
2. Press TRANSDUCER to display the calculated reading.
3. Repeat Step Two at least five times to verify repeatability.
4. Measure the actual reading (e.g. with a tape measure).
5. Enter the actual value.

Repeat this procedure if the atmosphere type, concentration, or temperature conditions are different from when the last sound velocity calibration was performed.

Note: In gasses other than air, the temperature variation may not correspond with the speed of sound variation. Turn off temperature sensor and use a fixed temperature.

P652 Offset Correction

The value altered when an Offset Calibration is performed.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 999.0	
Related	• P650 Offset Calibration	

Alternatively, if the amount of Offset Correction required is known, enter the amount to be added to the Reading before display.

P653 Velocity

The value adjusted based on the Sound Velocity at 20 °C (P654) vs. Temperature (P664) characteristics of air.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 50.01 to 2001 m/s (164.1 to 6563 ft/s)	
Related	• P651 Sound Velocity Calibration • P654 Velocity at 20°C	

Alternatively, enter the current sound velocity (if known), or perform a Sound Velocity Calibration (P651). The units used are m/s if P005 = 1, 2, or 3 (ft/s if P005 = 4 or 5).

P654 Velocity at 20°C

This value is used to automatically calculate Sound Velocity (P653).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 50.01 to 2001 m/s (164.1 to 6563 ft/s)	
Related	• P005 Units • P651 Sound Velocity Calibration • P653 Velocity	

After performing a Sound Velocity Calibration, check this value to verify the acoustic beam atmosphere is air (344.1 m/s or 1129 ft/s).

Alternatively, if the acoustic beam atmosphere sound velocity at 20°C (68 °F) is known, and the sound velocity vs. temperature characteristics are similar to that of air, enter the sound velocity.

The units used are m/s if P005 = 1, 2, or 3 (or ft/s if P005 = 4 or 5).

Temperature Compensation (P660 to P664)

P660 Temp Source

Source of the temperature reading used to adjust the speed of sound.

Primary Index	Transducer		
Values	1	*	AUTO
	2		Temp Fixed
	3		Ultrasonic/Temperature Transducer
	4		TS-3 Temperature Sensor
	5		Average (TS-3 and transducer)
Alters	• P664 Temperature		
Related	• P651 Sound Velocity • P653 Velocity • P654 Velocity at 20°C • P661 Temp Fixed		

The HydroRanger 200 uses the TS-3 temperature sensor assigned to the transducer. If one is not connected, the ultrasonic/temperature transducer is used. If the transducer does not have an internal temperature sensor, the Temp Fixed (P661) value is used.

If the acoustic beam atmosphere temperature varies with distance from the transducer, connect a TS-3 Temperature Sensor and ultrasonic / temperature transducers, and select **average**.

In gasses other than air, the temperature variation may not correspond with the speed of sound variation. In these cases turn off the temperature sensor and use a fixed temperature.

P661 Temp Fixed

Use this feature if a temperature sensing device is not used.

Primary Index	Transducer
Values	Range: -199 to 199 (preset = 20 °C)
Related	• P651 Sound Velocity Calibration • P653 Velocity • P654 Velocity at 20°C • P660 Temp Source

Enter the temperature (in °C) of the atmosphere within the transducer acoustic beam. If the temperature varies with distance from the transducer, enter the average temperature.

P663 Temperature Transducer Allocation

*This feature may only be used for **differential** or **average** Operation (P001 = 4 or 5).*

Primary Index	Transducer		
Values	1	*	Transducer One
	2		Transducer Two
	1:2		Transducer One and Two average
Related	• P651 Sound Velocity Calibration • P653 Velocity • P654 Velocity at 20°C		

As preset, the temperature measurements of Ultrasonic / Temperature Transducer One and Two are allocated to Points 1 and 2 respectively.

Use this feature if the temperature measurement from both transducers should be identical, but one is located close to a radiant heat source. Allocate the temperature measurement of the other transducer to both transducer Point Numbers.

Enter the number of the Transducer whose temperature measurement will be used for the distance calculation of the Point Number displayed. When both transducers are allocated to a Point Number, the temperature measurements from each are averaged.

P664 Temperature

View the transducer temperature in °C.

Primary Index	Transducer
Values	Range: -50 to 150 (view only)
Altered By	• P660 Temp Source
Related	• P651 Sound Velocity Calibration • P653 Velocity • P654 Velocity at 20°C • P661 Temp Fixed

Value is displayed when 6 is pressed in RUN mode (see *Readings in Run Mode* on page 22).

If Temp Source (P660) is set to any value other than Fixed Temp, the value displayed is the temperature measured. If Temp Source is set to Fixed Temp, the P661 value is displayed.

Rate (P700 to P708)

These parameters determine how material level changes are reported.

P700 Max Fill Rate

Adjusts the HydroRanger 200 response to increases in the actual material level (or advance to a higher Failsafe Material Level, P071).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
Altered by	• P003 Maximum Process Speed	
Related	• P005 Units • P007 Span • P071 Failsafe Material Level	

Enter a value slightly greater than the maximum vessel filling rate. This value, in Units (P005) or % of Span (P007) per minute, is automatically altered when Maximum Process Speed (P003) is altered.

P003 Value	Meters/Minute
1	0.1
2	1
3	10

P701 Max Empty Rate

Adjusts the HydroRanger 200 response to decreases in the actual material level (or advance to a lower Failsafe Material Level, P071).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
Altered by	• P003 Maximum Process Speed	
Related	• P005 Units • P007 Span • P071 Failsafe Material Level	

Enter a value slightly greater than the maximum vessel emptying rate. This value, in Units (P005) or % of Span (P007) per minute, is automatically altered when Maximum Process Speed (P003) is altered.

P003 Value	Meters / Minute
1	0.1
2	1
3	10

Parameters

P702 Filling Indicator

The fill rate required to activate the LCD Filling indicator (↑).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999	
Altered by	• P003 Maximum Process Speed	
Related	• P005 Units • P007 Span • P700 Max Fill Rate	

This value (in Units (P005) or % of Span (P007) per minute) is automatically set to 1/10 of the Max Fill Rate (P700).

P703 Emptying Indicator

The empty rate required to activate the LCD Emptying indicator (↓).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999	
Altered by	• P003 Maximum Process Speed	
Related	• P005 Units • P007 Span • P701 Max Empty Rate	

This value (in Units (P005) or % of Span (P007) per minute) is automatically set to 1/10 of the Max Empty Rate (P701).

P704 Rate Filter

Damps Rate Value (P707) fluctuations.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	0		Rate display not required
	Filtered Output		
	1		Continuously filtered and updated
	Interval Output		
	2		1 minute or 50 mm (2 in)
	3		5 minutes or 100 mm (3.9 in)
	4		10 minutes or 300 mm (11.8 in)
	5		10 minutes or 1000 mm (39.4 in)
Alters	• P707 Rate Value		
Altered by	• P003 Maximum Process Speed		
Related	• P705 Rate Update Time/ P706 Rate Update Distance		

Enter the time or distance interval over which the Rate Value is to be calculated before the display updates.

This is automatically altered along with Maximum Process Speed (P003).

This value automatically alters the Rate Update Time (P705) and / or Rate Update Distance (P706). Alternatively, these parameter values may be altered independently.

P705 Rate Update Time

The time period (in seconds) over which the material level rate of change is averaged before Rate Value update.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
Related	• P707 Rate Value	

Parameters

P706 Rate Update Distance

The material level change (in metres) to initiate a Rate Value update.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
Related	• P707 Rate Value	

P707 Rate Value

The rate of material level change (in Units (P005) or % of Span (P007) per minute).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999 (view only)	
Altered By	• P704 Rate Filter	
Related	• P005 Units • P007 Span	

A negative rate indicates the vessel is emptying.

This is the value displayed when [7] is pressed in the RUN mode as described in the *Readings in RUN Mode* chart on page 22.

P708 Volume Rate Display

The rate of change of volume in ***percent of maximum volume*** *per minute.*

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999 (view only)	
Related	• P622 Inflow / Discharge Adjust	

This value is used internally to calculate inflow in pumped volume applications (P622=3).

Press READING [%] to toggle between percent and volume.

Measurement Verification (P710 to P713)

P710 Fuzz Filter

Use this to stabilize the reported level, due to level fluctuations (such as a rippling or splashing liquid surface) within the Echo Lock Window (P713).

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	Range: 0 to 100 (0 = off)	
Altered by	• P003 Maximum Process Speed	
Related	• P007 Span • P713 Echo Lock Window	

This value (in % of Span, P007) is automatically altered when Maximum Process Speed (P003) is altered. The higher the value entered, the greater the fluctuation stabilized.

P711 Echo Lock

Use this feature to select the measurement verification process.

Primary Index	**Single Point Model**		**Dual Point Model**
	Global		Transducer
Values	0		Off
	1		Maximum verification
	2	*	Material agitator
	3		Total lock
Related	• P700 Max Fill Rate • P701 Max Empty Rate • P712 Echo Lock Sampling • P713 Echo Lock Window • P820 Algorithm		

If a material agitator (mixer) is used in the vessel monitored, set Echo Lock for **maximum verification** or **material agitator** to avoid agitator blade detection. Ensure the agitator is always ON while the HydroRanger 200 is monitoring the vessel to avoid stationary blade detection.

When set for **max verification** or **material agitator**, a new measurement outside of the Echo Lock Window (P713) must meet the sampling criterion (P712).

For **total lock**, Echo Lock Window (P713) is preset to zero **0**. The HydroRanger 200 continuously searches for the best echo according to the algorithm chosen (P820). If the selected echo is within the window, the window is then centered about the echo. If not, the window widens with each successive shot until the selected echo is within the window. The window then returns to its normal width.

When Echo Lock is OFF , the HydroRanger 200 responds immediately to a new measurement as restricted by the Max Fill / Empty Rate (P700 / P701); however, measurement reliability is affected.

P712 Echo Lock Sampling

The sampling criterion sets the number of consecutive echoes appearing above or below the echo currently locked onto, that must occur before the measurements are validated as the new reading (for Echo Lock P711 values: 1 or 2).

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	Range: 1:1 to 99:99	
	Format: x:y	
	x = the number of **above** echoes	
	y = the number of **below** echoes	
Related	• P711 Echo Lock	

P711 value	P712 preset value
1, max verification	5:5
2, material agitator	5:2

Example:

Setting

- P711 = 2, material agitator
- P712 = 5:2

Result

- a new reading will not be validated unlessfive consecutive measurements higher or two consecutive measurements lower than the current reading occur
- Resetting P711 returns P712 to the respective preset values

P713 Echo Lock Window

Adjusts the size of the Echo Lock Window.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
	Preset: 0.000	
Altered by	• P003 Maximum Process Speed	
Related	• P005 Units • P711 Echo Lock	

The Echo Lock Window is a **distance window** (units P005) centred on the echo and used to derive the Reading. When a new measurement is in the window, it is re-centred and the new Reading calculated. Otherwise, the new measurement is verified by Echo Lock (P711) before the reading is updated.

When **0** is entered the window is automatically calculated after each measurement. For slower P003 Maximum Process Speed values the window is narrow, for faster P003 values the window becomes wider.

Transducer Scanning (P726 to P729)

P726 Level System Sync

Enables the System Sync on the terminal block.

Primary Index	Global		
Values	0		not required
	1	*	synchronize level monitors

Use this if another level measurement system is mounted nearby, and they are wired together on the Sync terminal.

P727 Scan Delay

The delay, in seconds, between measurements from transducer points (dual point model only).

Primary Index	Global
Values	Range: 0.000 to 9999
	Preset: 5.0
Altered by	• P003 Maximum Process Speed
Related	• P001 Operation

This feature may only be used to adjust the delay before the next point is scanned. Enter the amount of delay in seconds. This value is automatically altered when Maximum Process Speed (P003) is altered.

P728 Shot Delay

The delay, in seconds, between transducer shots.

Primary Index	Transducer	
Values	Range: 0.1 to 4.0	
	Preset: 0.5	

Use this if transient acoustic noise within the vessel is causing measurement difficulties due to echoes from one shot being received on the next. If more than one ultrasonic unit is installed for redundancy, this value should be **0**.

P729 Scan Time

View the elapsed time (in seconds) since the point displayed was last scanned.

Primary Index	Level Point
Values	Range: 0.000 to 9999 (view only)
Related	• P001 Operation

This may be viewed as an Auxiliary Reading in the RUN mode.

Display (P730 to P739)

P730 Auxiliary Reading

Use this feature to display operator selected Auxiliary Readings temporarily or indefinitely (as desired).

Primary Index	Global
Values	Range: 000 to 999
	Display: OFF, HOLd

Select **OFF** to display Auxiliary Readings temporarily. Select **HOLd** to display Auxiliary Readings until another Auxiliary Reading is selected or programming mode is entered. See the *Hand Programmer* section on page 26 for RUN mode auxiliary readings.

Selecting the Auxiliary Reading operation

1. Press READING [▲%] to display the Auxiliary Function symbol.
2. Press ARROWS [▲] [▼] to access the OFF or HOLd option desired.
3. Press ENTER [↵]

If necessary, enter the Parameter Number to default in the Auxiliary Reading display. That value will show in the auxiliary reading area by default. Other values are available but will reset to the parameter defined here.

P731 Auxiliary Reading Key

Enter the Parameter Number whose value is to be displayed in the Auxiliary Reading field

Primary Index	Global	
Values	Range: 000 to 999	
	Preset: Material Reading, P921	

Pxxx is pressed in the RUN mode. See the *Hand Programmer* section on page 26 for RUN mode auxiliary readings.

P732 Display Delay

Adjusts the Point Number display scroll speed.

Primary Index	Global
Values	Range: 0.5 to 10
	Preset: 1.5 seconds
Related	• P001 Operation • P737 Primary Reading

Use this feature to adjust the delay before the display advances to the next Point Number. Display scrolling is independent from transducer scanning.

P733 Scroll Access

Use this feature to select the parameter scroll access option desired.

Primary Index	Global			
Values	0		Off	to scroll to all parameters (P001 to P999)
	1	*	Smart	for Quick Start, altered, and tagged parameters
	2		Tagged	to scroll to operator tagged parameters only

Press READING and 7 to tag / untag any accessed parameter. is displayed to indicate the parameter accessed is tagged.

Note: Quick Start parameters (P001 – P007) and those changed from factory default settings cannot be untagged.

P735 Backlight

Controls the LCD backlighting.

Primary Index	Global		
Values	0		Off
	1	*	On
	2		Keypad activated

The backlight can be forced on or off, or be controlled by a programmer, in which case it will turn OFF 30 seconds after the last key is pressed.

P737 Primary Reading

The reading shown on the primary reading display when in RUN mode.

Primary Index	Global		
Values	Range: 0 to 3		
	1	*	Default reading (P920) based on operation (P001)
	2		LCD totalizer (P322, P323)
	3		Automatically toggle between 1 and 2
Related	• LCD Totalizer (P322 and P323) • P732 Display Delay • P920 Reading Measurement		

When this value indicates TOGGLE, then both readings (default and totalizer) are shown in the time specified in display delay (P732).

P741 Communications Timeout

The maximum time allowed between receiving a request and transmitting the response.

Primary Index	Port
Values	Range: 0 to 60 000 milliseconds
	Preset: 5 000 ms

If the maximum time is exceeded, no response will be transmitted, and the action required may not be completed.

SmartLinx Reserved (750 to 769)

These parameters are reserved for optional SmartLinx communications cards and vary by card. Refer to the SmartLinx documentation to determine if any of them are used.

Communications (P770 to P782)

The HydroRanger 200 communication ports are configured by a series of parameters that are indexed by port. See the *Communications* section on page 83 for a complete description of communications set-up.

Communication parameters are indexed to these communication ports, unless otherwise noted:

Port	Description
1	RS-232 port (RJ-11 modular telephone)
2	RS 485 port on terminal block

P770 Port Protocol

The communications protocol used between the HydroRanger 200 and other devices.

Primary Index	Communications Port		
Values	0		Communications port disabled
	1		Siemens Milltronics Dolphin protocol
	2		Modbus ASCII slave serial protocol
	3	*	Modbus RTU slave serial protocol (preset for ports 1 and 2)

The HydroRanger 200 supports the internationally recognized Modbus standard in both ASCII and RTU formats. Other protocols are available with optional SmartLinx cards.

P771 Network Address

The unique identifier of the HydroRanger 200 on the network.

Primary Index	Communications Port		
Values	Range: 0 to 9999		
	1	*	Preset:

For devices connected with the Siemens Milltronics protocol this parameter is ignored. For devices connected with a serial Modbus slave protocol, this parameter is a number from 1-247. The network administrator must ensure that all devices on the network have unique addresses. Do not use the value **0** for Modbus communications as this is the broadcast address and is inappropriate for a slave device.

P772 Baud Rate

The communication rate with the master device.

Primary Index	Communications Port		
Values	4.8		4800 baud
	9.6		9600 baud
	19.2	*	19,200 baud (preset for port 2)
	115.2	*	115,200 baud (preset for port 1)

This specifies the rate of communication in Kbaud. Any value may be entered but only the values shown above are supported. The baud rate should reflect the speed of the connected hardware and protocol used.

P773 Parity

The serial port parity.

Primary Index	Communications Port		
Values	0	*	No Parity
	1		Odd Parity
	2		Even Parity

Ensure that the communications parameters are identical between the HydroRanger 200 and all connected devices. For example, many modems default to N-8-1 which is No parity, 8 data bits, and 1 stop bit.

P774 Data Bits

The number of data bits per character.

Primary Index	Communications Port		
Values	Range: 5 to 8		
	8	*	Modbus RTU
	7 or 8		Modbus ASCII
	7 or 8		Dolphin Plus

P775 Stop Bits

The number of bits between the data bits.

Primary Index	Communications Port		
Values	Range: 1 or 2		
	1	*	Preset:

P778 Modem Available

Sets the HydroRanger 200 to use an external modem..

Primary Index	Communications Port		
Values	0	*	No modem connected
	1		Answer only

P779 Modem Inactivity Timeout

Sets the time that the unit will keep the modem connected with no activity.

Primary Index	Communications Port		
Values	Range: 0-9999 seconds		
	0	*	No timeout
Related	• P778 Modem Available • P779 Modem Inactivity Timeout		

To use this parameter, ensure that P778 (Modem Available) = 1. Ensure that the value is low enough to avoid unnecessary delays when an unexpected disconnect occurs but long enough to avoid timeout while you are still legitimately connected. This parameter value is ignored by the Modbus Master Drivers, as they automatically disconnect when done.

Hanging Up

If the line is idle and the P779 Modem Inactivity Timeout expires, then the modem is directed to hang up the line. Ensure that P779 is set longer than the standard polling time of the connected master device. **0** disables the inactivity timer.

P782 Parameter Index Location

Determines where index information is stored for the parameter access area.

Primary Index	Global		
Values	0	*	Global
	1		Parameter-Specific
Altered By	• P770 Port Protocol		

Global (0)

The primary and secondary index values are global (they affect all of the parameter access area at once) and stored in:

- primary index – R43,999
- secondary index – R43,998

Parameter-Specific (1)

The primary and secondary index values are encoded into the format words found between R46,000 and R46,999. Each format work corresponds with the R44,000 series number in the parameter access map. For example, the format register R46,111 corresponds to the parameter P111 and the value is stored in R44,111. If the Modbus protocol (P770 = 2 or 3) is not used this parameter is ignored.

SmartLinx Hardware Testing

These parameters are used to test and debug a SmartLinx card (if installed).

P790 Hardware Error

The results of ongoing hardware tests in the communications circuitry.

Primary Index	Global		
Values	PASS	*	No errors
	FAIL		Error occurred communicating with card; device will try to reinitialize communications with card. If message continues, record values in P791 and P792 and contact your local Siemens Milltronics representative.
	ERR1		No module installed, or module not supported; communications have been disabled
Related	• P791 Hardware Error Code • P792 Hardware Error Count		

If **FAIL** or **ERR1** is displayed in P790 (Hardware Error), go to P791 (Hardware Error Code) and P792 (Hardware Error Count) for information about the error.

Parameters

P791 Hardware Error Code

*Indicates the precise cause of **Fail** or **ERR1** condition from P790.*

Primary Index	Global		
Values	0	*	No error
	Any other value		Error code; provide this code to your Siemens Milltronics representative for troubleshooting
Related	• P790 Hardware Error		

P792 Hardware Error Count

*A count that increments by **1** each time **Fail** is reported in P790 (Hardware Error).*

Primary Index	Global
Values	Range: 0 to 9999
	Error count; provide this number to your Siemens Milltronics representative for troubleshooting.
Related	• P790 Hardware Error

P794 SmartLinx Module Type

This parameter is used to identify the module type when SmartLinx is used. If you are not using SmartLinx, this parameter is not functional. Please see the associated SmartLinx instruction manual for a full description of this parameter.

P795 SmartLinx Protocol

This parameter is used to identify the protocol when SmartLinx is used. If you are not using SmartLinx, this parameter is not functional. Please see the associated SmartLinx instruction manual for a full description of this parameter.

P799 Communications Control

Enables the read/write access to parameters via remote communications.

Primary Index	Protocol (Index 1 controls the Modbus Master (RS-485 or RS-232); Index 2 controls the Fieldbus Master (PROFIBUS DP, DeviceNet, or Allen Bradley Remote I/O)		
Values	0		Read Only
	1	*	Read/Write
	2		Restricted Access – read only except for P799 which is read/write

Echo Processing (P800 to P807)

P800 Near Blanking

The space near the transducer face which cannot be measured.

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	Range: 0.000 to 9999	
	Preset: 0.300m (Most transducers) 0.450m (XCT-8, XCT-12)	
Related	• P006 Empty • P007 Span • P833 TVT Start Min	

Use this feature if the surface is reported to be near the transducer face but is in fact much further away. Extend this value when changing transducer location, mounting, or aiming.

Please note that changing the Near Blanking cannot correct measurement problems. Ensure that Span (P007) < Empty (P006) minus Near Blanking (P800)

P801 Range Extension

Allows the material level to fall below the Empty setting without reporting LOE.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
	Preset: 20% of Span (P007)	
Related	• P005 Units • P006 Empty • P007 Span • P004 Transducer	

This feature is useful in OCM applications where the Empty level is set to the bottom of the weir, and above the bottom of the channel, and should be used if the surface monitored can fall past the Empty (P006) level in normal operation. The value is added to Empty (P006) and can be greater than the range of the transducer. If the surface monitored can extend beyond Empty (P006), increase Range Extension (in Units (P005) or % of Span) such that Empty plus Range Extension is greater than the transducer face to furthest surface to be monitored distance. This is often the case with OCM when using weirs and some flumes.

P802 Transducer with Submergence Shield

Used when the transducer is expected to be submerged on occasion.

Primary Index	Single Point Model			Dual Point Model
	Global			Transducer
Values	0	*	Off	
	1		Submergence transducer	
Related	• P006 Empty • P071 Failsafe Material Level • Relays			

When a transducer with a submergence shield is submerged, the shield traps an air pocket that creates a special echo. The HydroRanger 200 recognizes the echo and advances the reading to the highest level and operates displays and outputs accordingly. This feature is effective for when power is returned while the transducer is submerged.

P803 Shot / Pulse Mode

Determines what type of ultrasonic shots are fired.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	1		Short
	2	*	Short and long
Related	• P006 Empty • P805 Echo Confidence • P804 Confidence Threshold • P852 Short Shot Range		

Increases HydroRanger 200 response when the monitored surface is close to the transducer face. Select **short and long** to have short and long acoustic shots fired for each measurement, regardless of the transducer to surface distance. Select **short** to have only short shots fired if the Echo Confidence (P805) produced by a short shot exceeds the short Confidence Threshold (P804) and the monitored surface is always within the Short Shot Range (P852).

P804 Confidence Threshold

Determines which echoes are evaluated by software.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0 to 99:0 to 99	
	Preset: 10:5	
Related	• P805 Echo Confidence	

The short and long shot Confidence Thresholds are preset to 10 and 5 respectively. When Echo Confidence (P805) exceeds the Confidence Threshold, the echo is evaluated by Sonic Intelligence® . Values are entered as two numbers separated by a decimal point. The first number is the short shot confidence and the second number is the long shot confidence.

Note: The decimal point is replaced with a colon **(:)** on the display.

P805 Echo Confidence

Displays the echo confidence of the measurement echo from the last shot.

Primary Index	Transducer
Values	Format: x:y (view only)
	x = short (0 to 99)
	y = long (0 to 99)
Related	• P804 Confidence Threshold • P830 TVT Type

Use this feature to monitor the effect of transducer aiming, location, and mechanical transducer / mounting isolation.

Both short and long shot Echo Confidence is displayed. (To display this value in the auxiliary display while the unit is running, press 8 for **4** seconds.)

Display	Description
x:--	short shot confidence value, (long shot not used).
--:y	long shot confidence value, (short shot not used).
x:y	short and long shot confidence values (both used).
E	transducer cable is open or short circuited.
--:--	no shots were processed for Sonic Intelligence® evaluation.

P806 Echo Strength

Displays the strength (in dB above 1 uV RMS) of the echo which was selected as the measurement echo.

Primary Index	Transducer
Values	Format: 0 to 99 (view only)

P807 Noise

Displays the average and peak ambient noise (in dB above 1 uV RMS) being processed.

Primary Index	Transducer
Values	Format: x:y (view only)
	x = average (-99 to 99)
	y = peak (-99 to 99)

The noise level is a combination of transient acoustic noise and electrical noise (induced into the transducer cable or receiving circuitry). See *Noise Problems* in the *Troubleshooting* Section on page 233.

Advanced Echo Processing (P815 to P825)

The following parameters are for authorized Siemens Milltronics Service personnel or technicians familiar with Siemens Milltronics echo processing techniques.

P815 Echo Time Filtered

The time (in ms) from the transmission of the pulse, to when it is processed.

Primary Index	Transducer
Values	Range: 0.0 to 9999 (view only)
Related	• P816 Echo Time Raw

P816 Echo Time Raw

The time (in ms) from the transmit pulse to the processed echo.

Primary Index	Transducer
Values	Range: 0.0 to 9999 (view only)
Related	• P815 Echo Time Filtered

P820 Algorithm

Chooses the algorithm to generate the measured value from the profile.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	1		ALF = flat Area, Largest, and First average
	2		A = flat Area only
	3		L = flat Largest only
	4		F = flat First only
	5		AL = flat Area and Largest average
	6		AF = flat Area and First average
	7		LF = flat Largest and First average
	8	*	bLF = smooth Largest or First
	9		bL = smooth Largest only
	10		bF = smooth First only
Related	• P805 Echo Confidence • P817 Profile Pointer Time • P818 Profile Pointer Distance • P819 Profile Pointer Amplitude • P821 Spike Filter • P822 Narrow Echo Filter • P823 Reform Echo • P825 Echo Marker Trigger		

Use this to select the algorithm(s) the Sonic Intelligence® echo selection is based on. Use P805 Echo Confidence (page 195) to determine which algorithm gives the highest confidence under all level conditions. If the wrong echo is processed, observe the echo processing displays and select an alternate algorithm, either by entering the numeric value desired, or as below:

1. Press MEASURE [▲▼%] to display the Auxiliary Function symbol.
2. Press ARROWS [▲] [▼] to access the desired Reading display symbols.
3. Press ENTER [↵] when the required algorithm is displayed.

Parameters

P821 Spike Filter

Dampens spikes in the echo profile to reduce false readings.

Primary Index	**Single Point Model**		**Dual Point Model**
	Global		Transducer
Values	0		Off
	1	*	On
Related	• P817 Profile Pointer Time • P818 Profile Pointer Distance • P819 Profile Pointer Amplitude • P820 Algorithm • P822 Narrow Echo Filter • P823 Reform Echo • P825 Echo Marker Trigger		

Use P821 if interference spikes are on the long shot Echo Profile display.

P822 Narrow Echo Filter

Filters out echoes of a specific width.

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	0 = OFF (preset)	
	greater = wider	
Related	• P817 Profile Pointer Time • P818 Profile Pointer Distance • P819 Profile Pointer Amplitude • P820 Algorithm • P821 Spike Filter • P823 Reform Echo • P825 Echo Marker Trigger	

Use this for transducer acoustic beam interference (e.g. ladder rungs). Enter the width of false echoes (in ms) to be removed from the long shot Echo Profile. When a value is keyed in, the nearest acceptable value is entered.

P823 Reform Echo

Smoothes jagged peaks in the echo profile.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	0 = OFF (preset)	
	greater = wider	
Related	• P002 Material • P817 Profile Pointer Time • P818 Profile Pointer Distance • P819 Profile Pointer Amplitude • P820 Algorithm • P821 Spike Filter • P822 Narrow Echo Filter • P825 Echo Marker Trigger	

Use this feature, when monitoring solids (P002 = **2**), if the reported level fluctuates slightly, though the monitored surface is still. Enter the amount (in ms) of long shot Echo Profile smoothing required. When a value is keyed in, the nearest acceptable value is entered.

P825 Echo Marker Trigger

The point on the primary echo on which the measured value is based.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 5 to 95%	
	Preset: 50%	
Related	• P817 Profile Pointer Time • P818 Profile Pointer Distance • P819 Profile Pointer Amplitude • P820 Algorithm • P821 Spike Filter • P822 Narrow Echo Filter • P823 Reform Echo	

Use this feature if the reported material level fluctuates slightly, due to a variable rise in the leading edge of the true echo on the Echo Profile.

Enter the value (in percent of echo height) to ensure the Echo Lock Window intersects the Echo Profile at the sharpest rising portion of the Echo Profile representing the true echo. This value is preset to 50%.

Advanced TVT Adjustment (P830 to P835)

The following parameters are for authorized Siemens Milltronics Service personnel or technicians familiar with Siemens Milltronics echo processing techniques.

Advanced TVT control applies to long shots only.

P830 TVT Type

Selects the TVT Curve used.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	1		TVT Short Curved
	2		TVT Short Flat
	3		TVT Long Flat
	4		TVT Long Smooth Front
	5		TVT Long Smooth
	6		TVT Slopes
Altered By	• P002 Material		
Related	• P805 Echo Confidence • P835 TVT Slope Min		

Select the TVT type which gives the highest confidence (P805) under all level conditions. Use this parameter with caution, and do not use TVT **Slopes** with the **bF** or **bLF** Algorithm (P820).

P831 TVT Shaper

Turns the TVT Shaper ON or OFF.

Primary Index	Single Point Model		Dual Point Model
	Global		Transducer
Values	0	*	Off
	1		On
Related	• P832 TVT Shaper Adjust		

Turn the TVT Shaper ON before using P832 and afterwards. Turn the TVT Shaper ON and OFF while monitoring the effect to pick up the true echo.

Parameters

P832 TVT Shaper Adjust

Allows manual adjustment of the TVT curve. Use this parameter in conjuction with Dolphin Plus PC software.

Primary Index	Single Point Model	Dual Point Model
	Breakpoint	Transducer and Breakpoint
Values	Range: -50 to 50	
	Preset: 0	
Related	• P831 TVT Shaper	

Use this feature to bias the shape of the TVT curve to avoid selecting false echoes from fixed objects.

Adjustment to this parameter is best done while viewing the echo profile with Dolphin Plus. Refer to the Dolphin Plus online help for details.

The TVT curve is divided into 40 breakpoints, accessible by enabling the point number as the breakpoint index field. Each breakpoint is normalized to a value of **0**, as displayed in the parameter value field. By changing the breakpoint value, up or down, the intensity of the bias applied to that breakpoint of the curve is respectively changed. By changing the value of adjacent breakpoints, the effective bias to the shaper can be broadened to suit the desired correction. In the case of multiple false echoes, shaping can be applied along different points of the curve. Shaping should be applied sparingly in order to avoid missing the true echo.

P833 TVT Start Min

Use this feature to adjust the TVT Curve height to ignore false echoes (or pick up true echoes) near the start of the Echo Profile.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -30 to 225	
	Preset: 50	
Related	• P800 Near Blanking • P834 TVT Start Duration	

Enter the minimum TVT Curve start point (in dB above 1 uV RMS).

This feature should only be used if increased Near Blanking (P800) would extend farther than desired into the measurement range.

P834 TVT Start Duration

Use this feature in conjunction with TVT Start Min (P833) to ignore false echoes (or pick up true echoes) near the start of the Echo Profile.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0 to 9999	
	Preset: 30	
Related	• P833 TVT Start Min • P835 TVT Slope Min	

Enter the time (in ms) for the TVT Curve to decrease from the TVT Start Min (P833) point to the TVT Curve baseline.

P835 TVT Slope Min

Enter the minimum slope (in dB/s) for the middle of the TVT Curve.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0 to 9999	
	Preset: 200	
Related	• P830 TVT Type • P834 TVT Start Duration	

Use this feature to adjust the slope declination, and use it in conjunction with TVT Start Duration (when a long flat TVT Type is selected) to ensure the TVT Curve remains above the false echoes in the middle of the Echo Profile. Alternatively, if TVT Type is set for **TVT Slopes** (P830 = 6), preset is 2000.

P837 Auto False-Echo Suppression

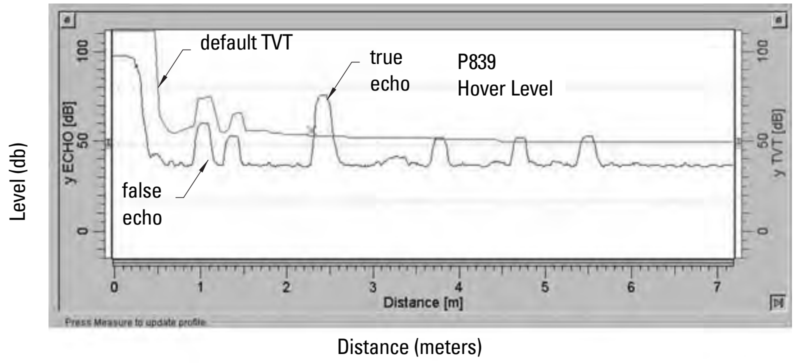
Use P837 and P838 together, to set HydroRanger 200 to ignore false echoes. Use P838 to set the Auto TVT distance first.

Notes:
- This function works best when the vessel is empty or nearly empty: use it only if there is a minimum distance of 2 meters from the transducer face to the material.
- Set P837 and P838 during start up, if possible.
- If the vessel contains an agitator, the agitator should be running.

If HydroRanger 200 displays a full level, or if the reading fluctuates between a false high level and a correct level, set P837 to elevate the TVT in this region and to de-sensitize the receiver from any 'base noise' caused by internal transducer reflections, nozzle echoes, or other vessel false echoes. Set P838 and then P837 (detailed instructions follow P838).

Values	**0**	*	Off
	1		Use 'learned' TVT. (See 'learned TVT curve' in Display after Auto False Echo Suppression on page 204.)
	2		Learn

Display before Auto False Echo Suppression (or when P837 = 0)



Parameters

P838 Auto False-Echo Suppression Distance

Defines the range of Auto False-Echo Suppression (P837) to use for ignoring false echoes. (Units are defined in P005.)

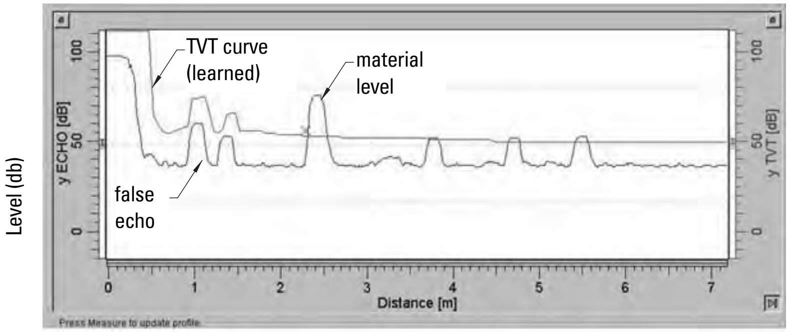
Values	Range (depends on model)	Maximum range: 0.000 to 15 m (50 ft)
	Default	1.000 m (3.28 ft)

Determine the actual distance from the transducer face to the material surface. Subtract 0.5 m from this distance, and enter the result.

Set Up:

1. Perform this function when the vessel is empty or nearly empty.
2. Determine actual distance from transducer face to material level.
3. Select P838 and key in [distance to material level minus 0.5 m].
4. Press **ENTER** .
5. Select P837.
6. Press **2** and then press **ENTER** . P837 will revert to **1** (use Learned TVT) automatically after a few seconds.

Display after Auto False Echo Suppression



Distance (meters)

P839 TVT Hover Level

Defines (in percent) how high the TVT curve is placed above the profile, relative to the largest echo. When HydroRanger 200 is located in the center of the vessel, lower this parameter to prevent multiple echo detections.

Values	Range	**0** to **100%**
	Default	**33** (%)

Parameters

Advanced Shot Adjustment (P840 to P852)

These parameters are for Siemens Milltronics service personnel only.

P840 Short Shot Number

The number of short shots to be fired (and results averaged) per transmit pulse.

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	Range: 0 to 100	
	Preset: 1	
Related	• P841 Long Shot Number • P842 Short Shot Frequency • P844 Short Shot Width • P850 Short Shot Bias • P851 Short Shot Floor • P852 Short Shot Range	

P841 Long Shot Number

Enter the number of long shots to be fired (and results averaged) per transmit pulse.

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	Range: 0 to 200	
	Preset: 5	
Altered By	• P003 Maximum Process Speed	
Related	• P840 Short Shot Number • P843 Long Shot Frequency • P845 Long Shot Width	

This value is automatically altered by Maximum Process Speed (P003).

Parameters

P842 Short Shot Frequency

Adjust the short shot transmit pulse frequency (in kHz).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 42kH to 46KH	
Altered By	• P004 Transducer	
Related	• P840 Short Shot Number • P844 Short Shot Width • P850 Short Shot Bias • P851 Short Shot Floor • P852 Short Shot Range	

This feature is automatically altered when Transducer (P004) is altered.

P843 Long Shot Frequency

Adjust the long shot transmit pulse frequency (in kHz).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 42kH to 46KH	
Altered By	• P004 Transducer	
Related	• P841 Long Shot Number • P842 Short Shot Frequency • P843 Long Shot Frequency • P845 Long Shot Width	

This feature is automatically altered when Transducer (P004) is altered.

P844 Short Shot Width

Adjust the width (in ms) of the short shot transmit pulse.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 5.000	
Altered By	• P004 Transducer	
Related	• P840 Short Shot Number • P842 Short Shot Frequency • P845 Long Shot Width • P850 Short Shot Bias • P851 Short Shot Floor • P852 Short Shot Range	

This feature is automatically altered when Transducer (P004) is altered.

P845 Long Shot Width

Adjust the width (in ms) of the long shot transmit pulse.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 5.000	
Altered By	• P004 Transducer	
Related	• P841 Long Shot Number • P844 Short Shot Width • P843 Long Shot Frequency	

This feature is automatically altered when Transducer (P004) is altered.

P850 Short Shot Bias

Use this feature to slant the echo evaluation in favour of the short shot echo when both short and long shots are evaluated (see Shot Mode, P803).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0 to 100	
	Preset: 20	
Related	• P803 Shot / Pulse Mode • P840 Short Shot Number • P842 Short Shot Frequency • P844 Short Shot Width • P851 Short Shot Floor • P852 Short Shot Range	

P851 Short Shot Floor

Enter the minimum echo strength (in dB above 1 uV) derived from a short shot to be considered for evaluation.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 30 to 100	
	Preset: 50	
Related	• P840 Short Shot Number • P842 Short Shot Frequency • P844 Short Shot Width • P850 Short Shot Bias • P852 Short Shot Range	

P852 Short Shot Range

Enter the maximum distance in Units (P005) to be measured using short shot echoes.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
Altered By	• P004 Transducer	
Related	• P840 Short Shot Number • P842 Short Shot Frequency • P844 Short Shot Width • P850 Short Shot Bias • P851 Short Shot Floor	

This feature is automatically altered when Transducer (P004) is altered.

Test (P900 to P913)

Test Parameters are intended for use by Siemens Milltronics Service personnel.

P900 Software Revision Number

View the EPROM Rev. #.

Primary Index	Global
Values	Range: 00.00 to 99.99 (view only)

P901 Memory

Press ENTER ↵ to activate the HydroRanger 200 memory test.

Primary Index	Global		
Values	Display: view only		
	PASS		(memory test successful)
	F1		RAM
	F3		FLASH data
	F4		FLASH code

Parameters

P902 Watchdog

Press ENTER to put the CPU into an infinite loop to test the watchdog timer.

On successful completion (10 seconds) the RUN mode is entered and the HydroRanger 200 is reset. Programming is kept and the unit responds as if there had been a power failure.

P903 Display

Press ENTER to activate the display test.

All LCD segments and symbols are temporarily displayed.

P904 Keypad

Press ENTER , then press each keypad key in the following sequence:

As each key is pressed, the associated keypad number is displayed. On successful test completion, PASS is displayed. FAIL is displayed if a key is pressed out of sequence or the programmer keypad malfunctions.

P905 Transmit Pulse

*Press ENTER to supply repeated transmit pulses, at the frequency entered, to the transducer and / or view the transducer operating frequency (automatically altered by **P004 Transducer**) for the Point Number displayed.*

Primary Index	**Single Point Model**	**Dual Point Model**
	Global	Transducer
Values	Range: 42kH to 46KH (view only)	
Altered By	• P004 Transducer	

P906 RS-232 Port

Press ENTER to test the RS-232 port on the RJ-11.

An external device must be connected to the RS-232 port for this test. On successful completion, PASS is displayed, otherwise it is FAIL.

P908 Scanner

Press ENTER to cycle the scanner relay while firing the transmitter.

Use this parameter to ensure that both transducers are being stimulated.

P910 Toggle Relays

Used to energize and de-energize relays directly.

Primary Index	Global
Values	0 to 6
Related	• P119 mA Relay Logic Test

Enter the relay number and then toggle between *energized* and *de-energized*, as required. Enter **0** to toggle all relays at once.

Applies only to relays with P119 = 0 (algorithm control). Use this parameter to confirm that relay contacts are opening and closing.

This feature is helpful when P119 does not give expected results even though programming was verified.

P911 mA Output Value

Access this parameter to display the current value of the mA output.

Primary Index	mA output
Values	Range: 0.10 to 25.00
Related	• P200 mA Output Range • P201 mA Output Function

Additionally, this feature may be used to enter a desired value. The mA output immediately assumes the value entered regardless of any restrictions programmed.

P912 Transducer Temperature

Use this feature to display the temperature in °C (as monitored by the connected transducer).

Primary Index	Transducer
Values	Range: -50 to 150

Err is displayed if the transducer is not equipped with an internal temperature sensor.

P913 Sensor Temperature

Access this parameter to display the temperature in °C (as monitored by the TS-3).

Primary Index	Global

Values	Range: -50 to 150

OPEn is displayed if a TS-3 is not connected.

P914 mA Input

Use this feature to display the mA input value (in mA).

Primary Index	mA input
Values	Range: 0.000 to 24.00

Measurement (P920 to P927)

All of these parameters are available in RUN mode and used to verify programming. See *Readings in RUN Mode* on page 22.

The range and values shown for each of these parameters depends on the Operation (P001) chosen. The readings for each operation are listed below.

To Access in RUN Mode

1. Ensure the device is in RUN mode.
2. Press P___ .The Auxiliary Reading field becomes underscores P_ _ _
3. Type the parameter number. The field changes to the value of the specified parameter.

These parameters are also available in simulation mode. See the *Testing the Configuration* section page 110 for instructions on how to control the simulation direction and rate.

P920 Reading Measurement

Corresponds to the final reading after all programming is applied.

In general this means that: P920 = Reading x P060 + P061.

Reading Measurements by Operation

P001	P050 = 0	P050 ≠ 0
0 – OFF	- - - -	- - - -
1 – Level	P921	P924
2 – Space	P922	100% - P924
3 – Distance	P927	P927
4 – Difference	P921 (indexed)	P921 (indexed)
5 – Average	P921 (indexed)	P921 (indexed)
6 – OCM	P925	P925
7 – Pump Totalizer	P924	P924

P921 Material Measurement

The distance in Units (P005) or % of Span (P007) between Empty (P006) and the monitored surface.

Primary Index	Level Point
Values	Range: -999 to 9999
Related	• P005 Units • P006 Empty • P007 Span

P922 Space Measurement

The distance between the monitored surface and Span (P007).

Primary Index	Transducer
Values	Range: 0.000 to 9999
Related	• P007 Span

P923 Distance Measurement

The distance between the monitored surface and the transducer face.

Primary Index	Transducer
Values	Range: 0.000 to 9999

P924 Volume Measurement

The calculated vessel capacity in Max Volume (P051) or % of Max Volume.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
Related	• P051 Maximum Volume	

P925 Flow Measurement

The calculated flowrate in Max Flow (P604) units or % of Max Flow.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	
Related	• P604 Maximum Flow	

P926 Head Measurement

Corresponds to Head (the distance from Zero Head (P605) to the monitored surface in Units (P005) or % of Span (P007).

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: -999 to 9999	
Related	• P005 Units • P007 Span • P605 Zero Head	

P927 Distance Measurement

The distance between the surface and the transducer face (displays only as % of Empty).

Primary Index	Transducer
Values	Range: 0.000 to 9999 (Displays as % of Empty)
Related	• P005 Units • P006 Empty

Use P923 unless the distance information is required in percent.

Parameters

Master Reset (P999)

This feature resets all parameters to original values.

Primary Index	Single Point Model	Dual Point Model
	Global	Transducer
Values	Range: 0.000 to 9999	

Use this feature prior to initial programming if arbitrary Parameter Values were used during a bench test, or after upgrading the software. Following a Master Reset, complete reprogramming is required.

To perform a Master Reset, access P999 and press CLEAR C ↵. C.ALL displays until the reset is complete.

In dual point units, both points can be reset at the same time by setting the index to 00 and pressing the CLEAR C ↵ keys.

CAUTION: be careful when using this feature. All data for all points will be reset. For convenience, be sure to record the values you want to re-enter.

Parameters

General Appendix A: Index Types

Index types

Name	Description	# of indexes
Global	This parameter applies to the entire unit	n/a
View only	This parameter can not be set, only viewed	n/a
Breakpoint	Indexed by breakpoint	Parameter dependent
Dimension	Indexed by PMD dimension	up to 7
Discrete Input	Indexed by discrete input	2
Echo Profile	Indexed by stored echo profile	10
Level Point[1]	Indexed by level point	1, 2 or 3
mA input[1]	Indexed by mA input	1
mA output[1]	Indexed by mA output	0 or 2
Comm. Port	Indexed by communications port	2
Relay	Indexed by relay	3 or 6
Transducer[2]	Indexed by transducer	1 or 2

1. The three level points are: transducer 1, transducer 2, and the calculated point which can be difference (P001=4) or average (P001=5).
   Level point typically has 1 index in Single Point Mode (standard), and 2 indexes in Dual Point Mode (optional). A third index is available in both modes when Operation (P001) is set for DPD (P001=4) or DPA (P001=5).
2. The number of indexes available in Single Point Mode (standard) is typically 1, but can be expanded to 2 if Operation (P001) is set for DPD (P001=4) or DPA (P001=5).
   In Dual Point Mode (optional), the number of available indexes is always 2.

General Appendix B–Technical Reference

Transmit Pulse

The transmit pulse consists of one or more electrical “shot” pulses, which are supplied to the transducer connected to the HydroRanger 200 terminals. The transducer fires an acoustic “shot” for each electrical pulse supplied. After each shot is fired, sufficient time is provided for echo (shot reflection) reception before the next (if applicable) shot is fired. After all shots of the transmit pulse are fired, the resultant echoes are processed. The transmit pulse shot number, frequency, duration, delay, and associated measurement range are defined by parameters P803 and P840 to P852.

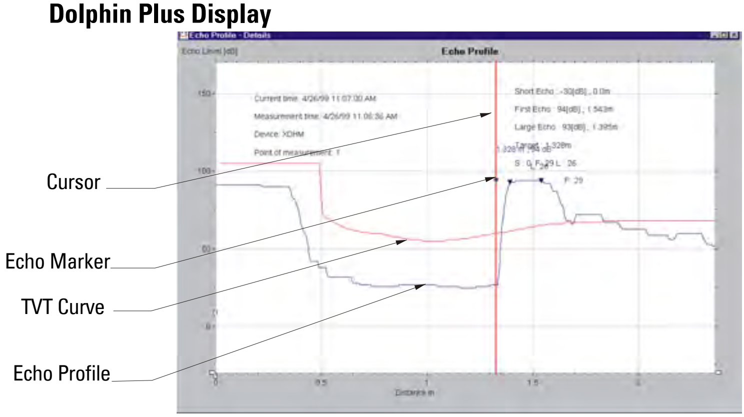
Echo Processing

Echo processing consists of echo enhancement, true echo selection, and selected echo verification.

Echo Enhancement is achieved by filtering (P821 and P822) and reforming (P823) the echo profile. The true echo (echo reflected by the intended target) is selected when that portion of the echo profile meets the evaluation criteria of Sonic Intelligence® . Insignificant portions of the echo profile outside of the measurement range (Span P006 + Range Extension P801), below the TVT Curve (P830, and P832 to P835), and less than the Confidence Threshold (P804) and Short Shot Floor (P851) are automatically disregarded. The remaining portions of the Echo Profile are evaluated using the Algorithm (P820) and Short Shot Bias (P850). The Echo Profile portion providing the best Echo Confidence (P805) is selected.

True echo verification is automatic. The position (relation in time after transmit) of the new echo is compared to that of the previously accepted echo. When the new echo is within the Echo Lock Window (P713), it is accepted and displays, outputs, and relays are updated per the Fuzz Filter (P710) and Rate Parameters (P700 to P703). If the new echo is outside of the Window, it is not accepted until Echo Lock (P711) requirements are satisfied.

Dolphin Plus Display



TVT (Time Varying Threshold) curves

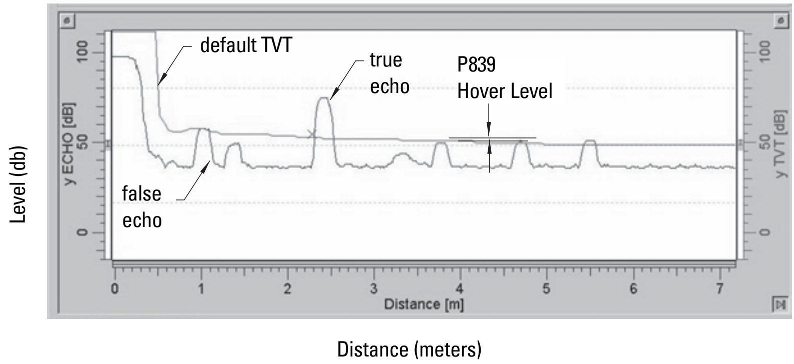
A TVT curve describes a threshold below which any echoes will be ignored. The default TVT curve is used, until P837 and P838 are used to create a new 'learned TVT curve'.

Auto False-Echo Suppression

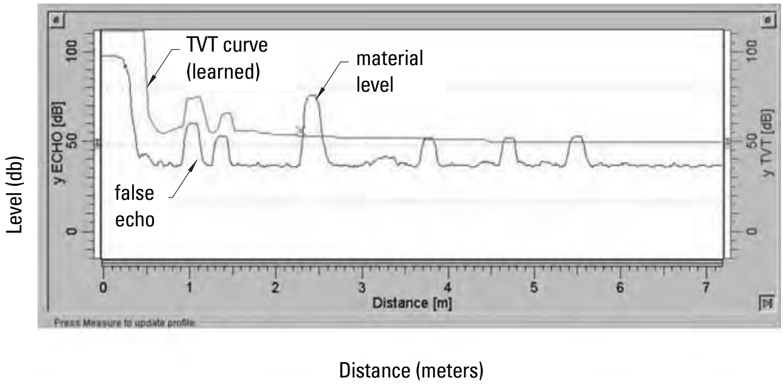
False echoes can be caused by an obstruction in the beam path (pipes, ladders, chains, and such). Such false echoes may rise above the default TVT curve.

P838 allows you to set a distance, and P837 then instructs the Probe LU to 'learn' where the obstructions/false echoes are within that distance. The new TVT curve is set above the false echoes, screening them out.

Display before Auto False Echo Suppression (or when P837 = 0)



Display after Auto False Echo Suppression



Distance Calculation

To calculate the transducer to material level (object) distance, the transmission medium (atmosphere) sound velocity (P653) is multiplied by the acoustic transmission to reception time period. This result is divided by 2 to calculate the one way distance.

Distance = Sound Velocity x Time / 2

The Reading displayed is the result of performing any additional modification to the calculated distance (as determined by Operation P001, Units P005, Volume Conversion, P050 to P054, Reading, P060 to P063, OCM, P600 to P611, and/or Totalizer P622 to P633 parameters).

Sound Velocity

The sound velocity of the transmission medium is affected by the type, temperature, and vapor pressure of the gas or vapor present. As preset, the HydroRanger 200 assumes the vessel atmosphere is air at 20°C (68°F). Unless altered, the sound velocity used for the distance calculation is 344.1 m / s (1129 ft / s).

Variable air temperature is automatically compensated when a Siemens Milltronics ultrasonic / temperature transducer is used. If the transducer is exposed to direct sunlight, use a sunshield or a separate TS-3 temperature sensor.

Also, if the temperature varies between the transducer face and the liquid monitored, use a TS-3 temperature sensor (submerged in the liquid) in combination with an ultrasonic / temperature transducer. Set Temp Source (P660) for both, to average the transducer and TS-3 measurements.

Atmosphere composition other than air can pose a challenge for ultrasonic level measurement. However, excellent results may be obtained by performing a Sound Velocity Calibration (P651) if the atmosphere is homogeneous (well mixed), at a fixed temperature, and under consistent vapor pressure.

The HydroRanger 200 automatic temperature compensation is based on the sound velocity / temperature characteristics of “air” and may not be suitable for the atmosphere present. If the atmosphere temperature is variable, perform frequent Sound Velocity Calibrations to optimize measurement accuracy.

Sound Velocity calibration frequency may be determined with experience. If the sound velocity in two or more vessels is always similar, future calibrations may be performed on one vessel and the resultant Velocity (P653) entered directly for the other vessel(s).

If the sound velocity of a vessel atmosphere is found to be repeatable at specific temperatures, a chart or curve may be developed. Then, rather than performing a Sound Velocity Calibration each time the vessel temperature changes significantly, the anticipated Velocity (P653) may be entered directly.

Scanning

When echo processing is complete (if more than 1 vessel is monitored) the scanning relay changes state to supply the transmit pulse to the other transducer after the Scan Delay (P727).

Scan Delay is automatically set by Maximum Process Speed (P003). When high speed scanning is required (sometimes the case for equipment position monitoring), the Scan Delay may be reduced. Reduce the Scan Delay only as required, otherwise premature scanning relay fatigue could occur.

Dual Point HydroRanger 200

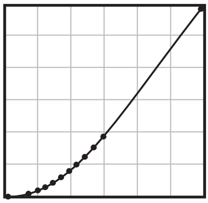
When two transducers are connected and configured in a dual point unit, the HydroRanger 200 will scan each in turn via the scanner relay. When a single point HydroRanger 200 is programmed for **differential** or **average** level Operation (P001 = 4 or 5), two transducers of the same type must be used.

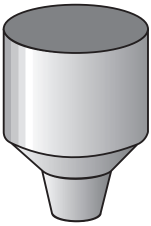
Volume Calculation

The unit provides a variety of volume calculation features (P050 to P055).

If the vessel does not match any of the eight preset Tank Shape calculations, a Universal Volume calculation may be used. Use the level/volume graph or chart provided by the vessel fabricator (or create one based on the vessel dimensions). Based on the graph, choose the Universal Volume calculation, and select the level vs. volume breakpoints to be entered (32 max). Generally, the more breakpoints entered, the greater the accuracy.

Universal, Linear (P050 = 9)





This volume calculation creates a piece-wise linear approximation of the level/volume curve. This option provides best results if the curve has sharp angles joining relatively linear sections.

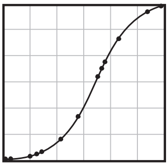
Enter a Level Breakpoint at each point where the level/volume curve bends sharply (2 minimum).

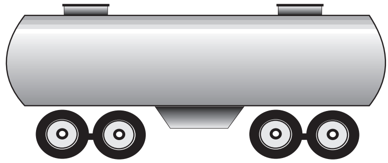
For combination curves (mostly linear but include one or more arcs), enter numerous breakpoints along the arc, for best volume calculation accuracy.

Universal, Curved

Set P050 = 10

This calculation creates a cubic spline approximation of the level/volume curve, providing best results if the curve is non-linear, and there are no sharp angles.





Select at least enough breakpoints from the curve to satisfy the following:

- two breakpoints very near the minimum level
- one breakpoint at the tangent points of each arc
- one breakpoint at each arc apex
- two breakpoints very near the maximum level

For combination curves, enter at least two breakpoints immediately before and after any sharp angle (as well as one breakpoint exactly at the angle) on the curve.

Flow Calculation

The HydroRanger 200 provides numerous OCM flow calculation features (P600 to P611).

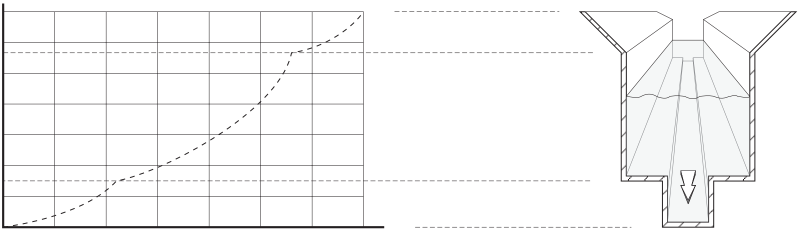
If the PMD (primary measuring device) does not match any of the eight preset PMD calculations, or if a PMD is not used, select a Universal Volume calculation. Use the head/flow graph or chart provided by the PMD fabricator (or create one based on the PMD or channel dimensions).

Based on the graph, choose the Universal Flow calculation, and select the head versus flow breakpoints to be entered (32 max). Generally, the more breakpoints entered, the greater the flow calculation accuracy.

Universal, Linear

Set P600 = 4.

This flow calculation creates a piece-wise linear approximation of the head/flow curve. This option provides best results if the curve has sharp angles joining relatively linear sections.



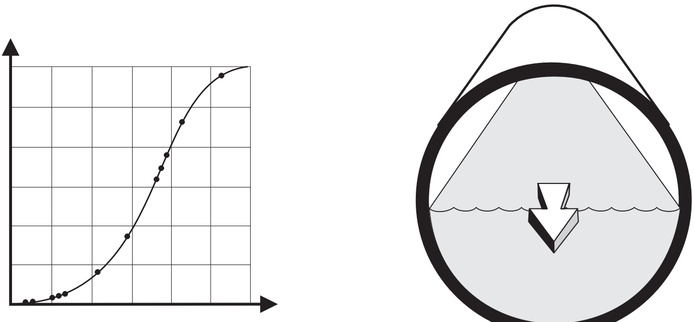
Enter a Head Breakpoint at each point where the head/flow curve bends sharply (2 minimum). For combination curves (mostly linear but include 1 or more arcs), enter numerous breakpoints along the arc, for best flow calculation accuracy.

See also *Typical Flow Characterization* on page 81.

Universal, Curved

Please note that the Universal, Curved feature is only available on the HydroRanger 200.

This calculation creates a cubic spline approximation of the head/flow curve, providing best results if the curve is non-linear, and there are no sharp angles.



Select at least enough breakpoints from the curve to satisfy the following:

- two breakpoints very near the minimum head
- one breakpoint at the tangent points of each arc
- one breakpoint at each arc apex
- two breakpoints very near the maximum head

For combination curves, enter at least 2 breakpoints immediately before and after any sharp angle (as well as 1 breakpoint exactly at the angle) on the curve. For more information, go to *Typical Flow Characterization* on page 81.

Maximum Process Speed

The HydroRanger 200's ability to respond to material level changes is designed to exceed even the most demanding installation requirements.

The Maximum Process Speed setting automatically presets various parameters affecting the HydroRanger 200 response to material level changes as follows:

Parameter	Values Dependent on Maximum Process Speed (P003)		
(units)	1 (slow)	2 (medium)	3 (fast)
P070 Failsafe Timer (min)	100	10	1
P700 Max Fill Rate (m/min)	0.1	1	10
P701 Max Empty Rate (m/min)	0.1	1	10
P702 Filling Indicator (m/min)	0.01	0.1	1
P703 Emptying Indicator (m/min)	0.01	0.1	1
P704 Rate Filter (option)	4	2	2
P710 Fuzz Filter (% of Span)	100	50	10
P713 Echo Lock Window	(per P701 / P702 and time since last valid measurement)		
P727 Scan Delay (seconds)	5	5	3
P841 Long Shot Number	10	5	2

If any of these parameters are independently altered, a Maximum Process Speed (P003) parameter alteration automatically resets the independently altered value.

Slower Maximum Process Speed (P003) provides greater measurement reliability. Faster, independently set Max Fill (P700) and Max Empty (P701). Rates may be impeded by Echo Lock (P711), Scan Delay (P727), and Shot Delay (P728) values.

General Appendix C: Troubleshooting

Note: Many of the parameters and techniques described here require extensive knowledge of ultrasonic technologies and Siemens Milltronics echo processing software. Use this information with caution.

If the setup becomes too confusing use P999 to reset and start again.

Common Problems Chart

Symptom	Cause	Action
Display blank, transducer not pulsing.	No power.	Check power supply, wiring, or power fuse.
No response to programmer.	Obstructed infrared interface, defective programmer.	Check programmer usage: 15 cm (6”) from faceplate pointed at upper target.
Displays **Short** and **tb:(#).**	Short circuited transducer cable, or defective transducer at indicated terminal block number.	Repair or replace as necessary.
Displays **Open** and **tb:(#).**	Transducer not connected or connection reversed.	Check connection to displayed terminal blocks.
	Open circuited transducer cable, or defective transducer at indicated terminal block number.	Repair or replace as necessary.
Displays **LOE.**	Weak or non-existent echo.	Relocate and/or re-aim transducer at material.
		Proceed to Measurement Difficulties.
Displays **Error** and **tb:(#)**.	Wrong transducer selected (P004).	Verify transducer type and re-enter value.
	Transducer connected in “two wire” method.	Do not tie white and shield together. Use all three terminal blocks.
	Transducer connected backwards.	Reverse black and white wires on terminal block.
Displays **EEEE**	Value too large to display in 4 or 5 characters.	Select larger Units (P005), or lower Convert Reading (P061).

Reading fluctuates while material level is still (or vice versa).	Incorrect measurement stabilization.	Alter Maximum Process Speed (P003) or damping (P704) accordingly. See *Maximum Process Speed*.
Reading is fixed, regardless of the actual material level.	Transducer acoustic beam obstructed, standpipe too narrow, or transducer ringing (reads over 100%).	Relocate and / or re-aim transducer at material level or object.
		Proceed to Measurement Difficulties below.
		See also: *Transducer Ringing*.
Material level reported is always incorrect by the same amount.	Incorrect Empty (zero) reference for level operation (P001 = 1).	See Empty (P006), Reading Offset (P063), Offset Calibration (P650), & Offset Correction (P652).
Measurement accuracy improves as level nears transducer.	Incorrect Sound Velocity used for distance calculation.	Use a transducer with a built-in temperature sensor or a TS-3 temperature sensor.
		See *Sound Velocity*.
Reading is erratic, with little or no relation to material level.	True echo too weak or wrong echo being processed.	Relocate and / or re-aim transducer at material.
		Check noise parameters. See *Noise Problems*.

Noise Problems

Incorrect readings can be the result of noise problems, either acoustic or electrical, in the application.

The noise present at the input to the ultrasonic receiver can be determined by viewing parameter P807. The display reads ##:##, where the first number is the average noise and the second is the peak noise. In general, the most useful value is the average noise.

With no transducer attached the noise is under 5 dB. This is often called the noise floor. If the value with a transducer attached is greater than 5 dB, then signal processing problems can occur. High noise decreases the maximum distance that can be measured. The exact relationship between noise and maximum distance is dependent on the transducer type and the material being measured. Any average noise level greater than 20 dB is probably cause for concern unless the distance is much shorter than the maximum for the transducer.

Determine the Noise Source

Disconnect the transducer from the HydroRanger 200. If the measured noise is below 5 dB, then continue here. If the measured noise is above 5 dB go to *Non-Transducer Noise Sources* below.

1. Connect only the shield wire of the transducer to the HydroRanger 200. If the measured noise is below 5 dB, continue with the next step. If the noise is above 5 dB, go to Common Wiring Problems.
2. Connect the white and black transducer wires to the HydroRanger 200. Record the average noise.
3. Remove the positive wire of the transducer. Record the average noise.
4. Re-connect the positive wire and remove the negative wire. Record the average noise.

Using the table below, determine the appropriate next step. The terms higher, lower and unchanged refer to the noise recorded in the previous steps.

These are guidelines only. If the suggested solution does not solve the problem, try the other options also.

	- removed	+ removed	Go to:
noise	higher	higher	Reducing Electrical Noise
		unchanged	Common Wiring Problems
		lower	Reducing Acoustical Noise
	unchanged	higher	Reducing Electrical Noise
		unchanged	Contact Siemens Milltronics
		lower	Reducing Acoustical Noise
	lower	higher	Common Wiring Problems
		unchanged	Common Wiring Problems
		lower	Reducing Acoustical Noise

Acoustical Noise

To confirm that the problem is acoustical, place several layers of cardboard over the face of the transducer. If the noise is reduced, the noise is definitely acoustical.

Non-Transducer Noise Sources

Remove all input and output cables from the HydroRanger 200 individually while monitoring the noise. If removing a cable reduces the noise, that cable may be picking up noise from adjacent electrical equipment. Check that low voltage cables are not being run adjacent to high voltage cables or near to electrical noise generators such as variable speed drives.

Filtering cables is an option but is not recommended unless all other options have been exhausted.

The HydroRanger 200 is designed to work near heavy industrial equipment such as variable speed drives. Even so, it should not be located near high voltage wires or switch gear.

Try moving the electronics to a different location. Often moving the electronics a few meters farther from the source of noise will fix the problem. Shielding the electronics is also an option, but it should be a last resort. Proper shielding is expensive and is difficult to install properly–the shielding box must enclose the HydroRanger 200 electronics completely, and all wires must be brought to the box through grounded metal conduit.

Common Wiring Problems

- Make sure that the transducer shield wire is connected at the electronics end only. Do not ground it at any other location.
- Do not connect the transducer shield wire to the white wire.
- The exposed transducer shield wire must be as short as possible.
- Connections between the wire supplied with the transducer, and any customer installed extension wire should be done in grounded metal junction boxes.

On Siemens Milltronics transducers the white wire is negative and the black wire is positive. If the extension wire is colored differently, make sure that it is wired consistently.

Extension wire must be shielded twisted pair. Older HydroRanger 200 products may have included recommendations to use co-axial cable for noise reduction purposes. This is no longer the case. Use shielded twisted pair. See the installation section for specifications.

Reducing Electrical Noise

- Ensure that the transducer cable does not run parallel to other cables carrying high voltage or current.
- Move the transducer cable away from noise generators such as variable speed drives.
- Put the transducer cable in grounded metal conduit.
- Filter the noise source.

Reducing Acoustical Noise

- Move the transducer away from the noise source.
- Use a stilling well.
- Install a rubber or foam bushing or gasket between the transducer and the mounting surface.
- Relocate or insulate the noise source.
- Change the frequency of the noise. The HydroRanger 200 is only sensitive to noise between 25 KHz and 65 KHz.

Measurement Difficulties

If the Failsafe Timer (P070) expires due to a measurement difficulty, LOE flashes alternately with the last known Reading. In rare cases, the HydroRanger 200 may lock on to a false echo and report a fixed or wrong reading.

Flashing LOE Display

The loss of echo (LOE) display appears when the echo confidence is below the threshold value set in P805 Echo Confidence.

LOE occurs when:

- The echo is lost and no echo is shown above the ambient noise. See low echo confidence (P805) and low echo strength (P806).
- Two echoes are too similar to differentiate. See low echo confidence (P805) and low echo strength (P806).

If LOE is displayed, check the following:

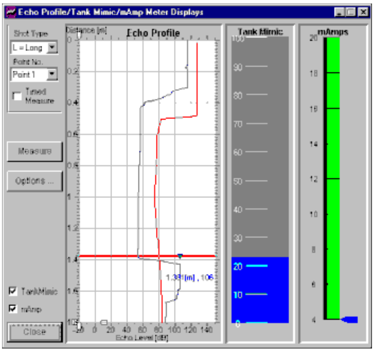
- Surface monitored is within the transducer maximum range
- Transducer model (P004) matches the transducer used
- Transducer is located and aimed properly
- Transducer is not submerged without a submergence shield

Adjust Transducer Aiming

See the transducer manual for range, mounting, and aiming details. For optimum performance, adjust transducer aiming to provide the best Echo Confidence (P805) and Echo Strength (P806) for all material levels within the measurement range.

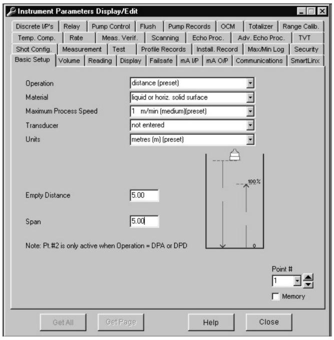
The most efficient method of checking echoes is with Siemens Milltronics Dolphin Plus software.

Displaying Echoes



Use Dolphin Plus to graphically display the echo profile at the installation. Interpret the echo profile and change relevant parameters.

Editing Parameters



Edit the parameter values. Use F1 to get online help at any time.

To display Echo Confidence in the RUN mode

Press [8] and hold for four seconds (Failsafe Time Left changes to the Short:Long Confidence display).

To display Echo Confidence in the program mode, access the Echo Confidence (P805) parameter.

To update the value displayed after each aiming adjustment..

Press [transducer key] (five times or more to verify stability and overcome any echo lock P711).

Increase Failsafe Timer Value

Increase the Failsafe Timer (P070) value, if failsafe operation will not be compromised by the larger value.

Try this only if LOE shows for short periods of time.

Install a Transducer with a Narrower Beam

Sometimes the interference echoes from the sides of a vessel can cause the HydroRanger 200 to lock onto a consistent, incorrect level. Try installing a longer range (narrower beam) transducer, enter the new transducer model (P004), and (if necessary) optimize aiming and frequency again.

Always contact your Siemens Milltronics service personnel before selecting a transducer to solve this type of problem.

Use Dolphin Plus to Debug Echo

If a narrower beam transducer is not available, use Dolphin Plus to view live sonic profiles and make adjustments to the Advanced Echo Processing parameters.

Fixed Reading

If the Reading is a fixed value, regardless of the transducer to material surface distance, ensure the:

1. Transducer acoustic beam is free from obstruction.
2. Transducer is properly aimed
3. Transducer is not in contact with any metal object.
4. Material mixer (if used) is operating while the HydroRanger 200 is operating. If it is stopped, ensure that the mixer blade is not stopped under the transducer.

Obstructions in the Sound Beam

Check for (and remove if present) any acoustic beam obstruction, or relocate the transducer.

If an obstruction cannot be removed or avoided, adjust the Time Varying Threshold (TVT) Curve to reduce the Echo Confidence derived from the sound reflected by the obstruction. Use Dolphin Plus to adjust the TVT curve .

Nozzle Mountings

If the transducer is mounted on or in a nozzle, grind smooth any burrs or welds on the inside or open end (the end that opens into the vessel). If the problem persists, install a larger diameter or shorter length nozzle, bevel the inside of the bottom end, or cut the open end of the nozzle at a 45° angle.

See the transducer manual for complete mounting instructions.

For ST-series and XPS-10 transducers use the plastic conduit / flange adapter supplied with the unit.

If the mounting hardware is over tightened, loosen it. Over tightening changes the resonance characteristics of the transducer and can cause problems.

Set the HydroRanger 200 to Ignore the Bad Echo

If the preceding remedies have not fixed the problem, the false echo has to be ignored.

If the Echo is Close to the Transducer

If there is a static, incorrect, high level reading from the HydroRanger 200 there is probably something reflecting a strong echo back to the transducer. If the material level never reaches that point extend the Near Blanking (P800) to a distance to just past the obstruction.

Adjust the TVT to Ignore the Echo

Use Auto False Echo Suppression (P837-P839) to automatically shape around false echoes.

Wrong Reading

If the Reading is erratic, or jumps to some incorrect value periodically, ensure the:

1. Surface monitored is not beyond the HydroRanger 200's programmed range or the transducer's maximum range.
2. Material is not falling into the transducer's acoustic beam.
3. Material is not inside the blanking distance of the transducer.

Types of Wrong Readings

If a periodic wrong Reading is always the same value, see *Fixed Reading*.

If the wrong Reading is random, ensure the material surface to transducer distance is less than the Empty value entered plus 20%. If the material/object monitored is outside this distance, increase Range Extension (P801) as required. This error is most common in OCM applications using weirs.

Liquid Splashing

If the material monitored is a liquid, check for splashing in the vessel. Enter a lower Maximum Process Speed (P003) value to stabilize the Reading, or install a stilling well. (Contact Siemens Milltronics or your local distributor.)

Adjust the Echo Algorithm

Use Dolphin Plus to view live sonic profiles and make adjustments to the P820 Algorithm parameter. See P820 on page 197 for details.

If the "Area" algorithm is used and narrow noise spikes are evident on the (long shot) Echo Profile, turn the Spike Filter (P821) on and/or widen the Narrow Echo Filter (P822). Also, if the true echo has jagged peaks, use Reform Echo (P823).

If multiple echoes appear on the Echo Profile, typical of a flat material profile (especially if the vessel top is domed), use the "first" Algorithm.

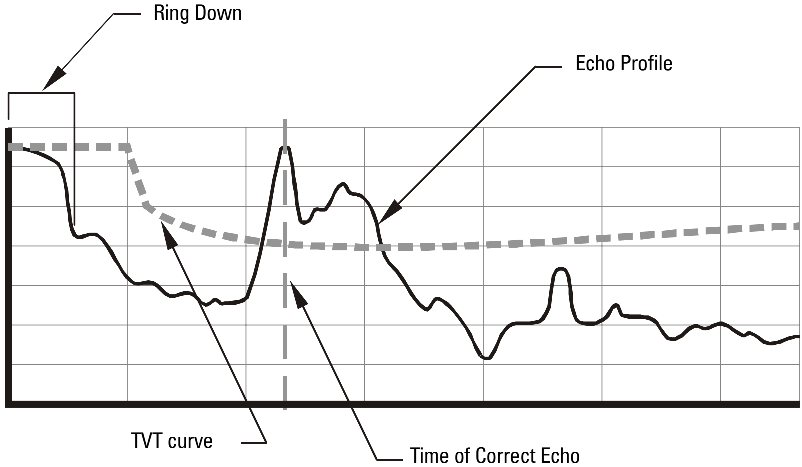
If the Echo Profile repeatedly switches from short to long, adjust the Short Shot Range (P852) to stabilize the "shot" mode used for the echo evaluation. Also, adjust the Short Shot Bias to increase (or decrease the amount of preference given to short shot echoes over long shot echoes.

Should a stable measurement still not be attainable, contact Siemens Milltronics or your local distributor.

Transducer Ringing

If the transducer is mounted too tightly, or if it is mounted so that its side touches something, its resonance characteristics change and this can cause problems.

Normal Ring Down



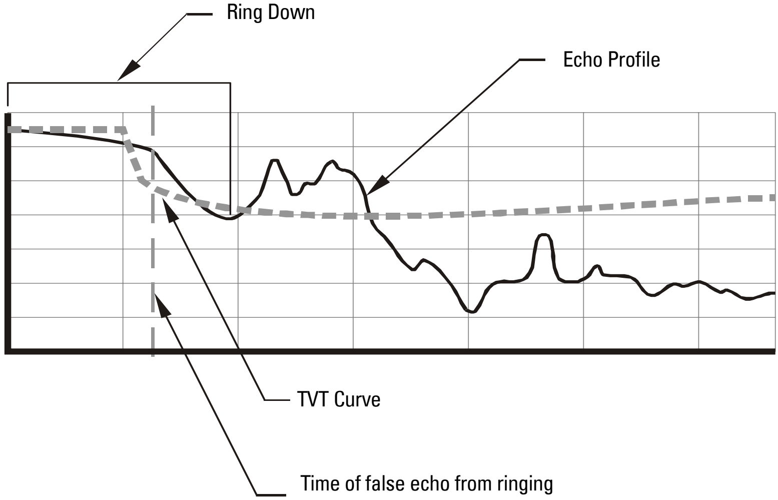
Poor Ring Down

Ring down times that extend past the near blanking area can be interpreted by the HydroRanger 200 as the material level and are characterized by a steady high level being reported.

Unit Repair and Excluded Liability

All changes and repairs must be done by qualified personnel and applicable safety regulations must be followed. Please note the following:

- The user is responsible for all changes and repairs made to the device.



- All new components must be provided by Siemens Milltronics Process Instruments Inc.
- Restrict repair to faulty components only
- Do not re-use faulty components.

General Appendix D: Pump Control Reference

The HydroRanger 200 has the pump control strategies to solve nearly any water / wastewater application. This section details these strategies for engineers requiring in-depth knowledge of the system and how it operates.

Pump Control Options

The various methods of pump control are made up of a combination of two control variables:

Pump Duty

The pump duty indicates in what sequence pumps are started.

Pump Start Method

The start method indicates whether new pumps start and run with any currently running pumps (most common) or whether new pumps start and shut off currently running pumps.

Pump Groups

The HydroRanger 200 groups pumps that use identical pumping strategies based on the value of Relay Control Function (P111). Generally, one group of pumps corresponds to one wet well or reservoir.

Pump by Rate

To trigger pump starts by the rate of change in material level use P121–Pump by Rate (P121). New pumps are started, one at a time, until the rate setpoint (Filling Indicator (P702), or Emptying Indicator(P703)) is reached.

Pump Control Algorithms

All of these algorithms can be used to start multiple pumps (assist) or one pump at a time (backup).

The HydroRanger 200 have three main methods of pump control:

Fixed

Starts pumps based on individual setpoints and always starts the same pumps in the same sequence.

Alternate

Starts pumps based on the duty schedule and always leads with a new pump.

Service Ratio

Starts pumps based on user-defined ratio of running time.

Fixed Duty Assist (P111 = 50)

Ties the indexed pump relay directly to the indexed setpoint.

Relay Operation (for P118 = 2)

The relay contact closes at the ON setpoint and opens at the OFF setpoint. Multiple relay contacts in the pump group can be closed at the same time.

Relay Table

The following table shows relay status when each setpoint is reached.

		Relays		
	Index	1	2	3
Setpoints	On 3	On	On	On
	On 2	On	On	Off
	On 1	On	Off	Off
	Off 0	Off	Off	Off

Fixed Duty Backup (P111 = 51)

Ties the indexed pump relay directly to the indexed setpoint.

Please note that this feature applies to the HydroRanger 200 only.

Relay Operation (for P118 = 2)

The relay contact closes at the ON setpoint and opens at the OFF setpoint. When a new relay trips the previously closed relay contact opens to shut down the running pump.

Only one relay contact in the pump group can be closed at any one time.

Relay Table

The following table shows relay status when each setpoint is reached.

	Relays			
	Index	1	2	3
Setpoints	On 3	Off	Off	On
	On 2	Off	On	Off
	On 1	On	Off	Off
	Off 0	Off	Off	Off

Alternate Duty Assist (P111 = 52)

Alternates the lead pump each time the material level cycles and runs all pumps together.

Relay Operation (for P118 = 2)

The setpoints associated with the relays are grouped so that they can be rotated.

Setpoint one does not relate directly to relay one. The pumping algorithm manages the mapping of setpoints to relays.

When pumps are run, they RUN in parallel.

Relay Table

Cycle 1		Relays		
		1	2	3
Setpoints	On 3	On	On	On
	On 2	On	On	Off
	On 1	On	Off	Off
	Off 0	Off	Off	Off
Cycle 2		**Relays**		
		1	2	3
Setpoints	On 3	On	On	On
	On 2	Off	On	On
	On 1	Off	On	Off
	Off 0	Off	Off	Off

Cycle 3		Relays		
		1	2	3
Setpoints	On 3	On	On	On
	On 2	On	Off	On
	On 1	Off	Off	On
	Off 0	Off	Off	Off

Alternate Duty Backup (P111 = 53)

Alternates the lead pump each time the material level cycles.

Relay Operation (for P118 = 2)

The setpoints associated with the relays are grouped so that they can be rotated. Setpoint one does not relate directly to relay one. The pumping algorithm manages the mapping of setpoints to relays. When pumps are run, they can RUN only one at a time.

Relay Table

Cycle 1		Relays		
		1	2	3
Setpoints	On 3	Off	Off	On
	On 2	Off	On	Off
	On 1	On	Off	Off
	Off 0	Off	Off	Off

Cycle 2		Relays		
		1	2	3
Setpoints	On 3	On	Off	Off
	On 2	Off	Off	On
	On 1	Off	On	Off
	Off 0	Off	Off	Off

Cycle 3		Relays		
		1	2	3
Setpoints	On 3	Off	On	Off
	On 2	On	Off	Off
	On 1	Off	Off	On
	Off 0	Off	Off	Off

Service Ratio Duty Assist (P111 = 54)

Selects the lead pump based on number of hours each pump has run and the specified ratios that each pump requires. Multiple pumps can run at one time.

Relay Operation (for P118 = 2)

The setpoints associated with the relays are grouped so they can be redistributed based on pump RUN time ratios. The next pump to start or stop is the one with the required time to actual time ratio.

Over time the number of hours demanded of each pump will conform to the ratios specified. Usually, the ratios are specified in percent values.

To create a grouping of pumps where two pumps make up 50% of the run time and the third pump makes up the other 50%.

P122 is set to these values:

P122 Index	Value
1	25
2	25
3	50

Service Ratio Duty Backup (P111 = 55)

Selects the lead pump based on number of hours each pump has RUN and the specified ratios that each pump requires. Only one pump can RUN at a time.

Please note that this feature applies to the HydroRanger 200 only.

This algorithm is the same as Service Ratio Duty Assist except that it will only RUN one pump at a time. When the next pump in the sequence starts, the previous pump stops.

First In First Out (FIFO) (P111 = 56)

*Selects the lead pump based on the **Alternate** duty but uses staggered off setpoints and shuts down pumps based on the **first in, first out** rule.*

Please note that this feature applies to the HydroRanger 200 only.

This algorithm starts pumps in the same way as Alternate Duty Assist but uses staggered OFF setpoints to shut the pumps down. When the first OFF setpoint is reached the FIFO rule shuts down the first pump started. If the pumps started in sequence 2,3,1 then they would be shut down in sequence 2,3,1.

Pump by Rate (P121)

Starts pumps until the level is changing at the rate specified in P702 or P703.

Please note that this feature applies to the HydroRanger 200 only.

Pumping costs can be less because only the highest ON setpoint needs to be programmed and this results in a lower difference in head to the next wet well which, in turn, results in less energy being used to pump out the well.

Other Pump Controls

There are a number of other controls available to modify pump behaviour.

Pump Run-On (P130, P131)

Extends the RUN period for a pump based on the number of pump starts. This allows for the wet well to be pumped lower than usual and reduces sludge build-up on the well bottom.

Wall Cling Reduction (P136)

Varies the ON and OFF setpoints to keep a fat ring from forming around the walls of the wet well.

Pump Group (P137)

Allows for two different Alternate Duty Assist or Alternate Duty Backup pump groups in the same application.

Flush Device (P170 to P173)

Operates a flush valve or special flush device based on the number of pump starts, usually to aerate wet well wastewater.

General Appendix E: Updating Software

Updating Software

To update the software in the HydroRanger 200, please contact your Siemens Milltronics representative to obtain the software. For a complete list of representatives, go to www.siemens.com/processautomation.

WARNINGS:
1. All parameter values will be lost during software upgrade. Record your current parameters manually or using Dolphin Plus before upgrade.
2. Disable all pumps and alarms before updating software, as relays can change state during the software update causing pumps to turn on or off .

To install the software, please complete the following:

1. Connect your PC or laptop to the HydroRanger 200 RJ-11 RS-232 port.
2. Run the .exe Downloader program in the software. Use this to set the RS-232 settings to match your HydroRanger 200. Please note that the software default settings will already match the default settings of the unit. Changes are only necessary if the RS-232 settings in the unit have been changed.
3. Complete the Downloader program steps.
4. Verify that Downloader confirms a succesful upgrade before exiting.
5. Complete a Master Reset (P999) after a successful upgrade, before re-entering parameters.

General Appendix F: Upgrading

The following procedure will assist you if you are upgrading from a MultiRanger Plus to a HydroRanger 200.

If the application is unchanged, copy down the parameters in the MultiRanger Plus before de-commissioning the unit.

Mounting a HydroRanger 200

Please read the HydroRanger 200 *Installation* section on page 8 before mounting the new HydroRanger 200.

Make sure the power is OFF to the unit before following these steps:

1. Remove the old MultiRanger Plus.
2. Mount the new HydroRanger 200 using the same mounting holes.

Connecting the Transducer

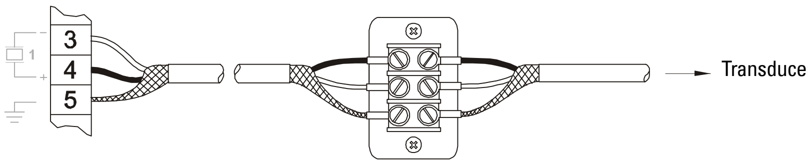
Important: Unlike the MultiRanger Plus, coaxial cable is not recommended for use with the HydroRanger 200 for transducer cable extensions. The HydroRanger 200 circuit is designed to use shielded twisted pair cable. Ideally, the coaxial cable should be replaced with twisted pair.

If this is not practical, please refer to the Coaxial Transducer Extension section below.

Coaxial Transducer Extention

The HydroRanger 200 uses a new differential input receiver that works either directly connected to the transducer lead or with a screened twisted pair extension cable via a field junction box. This arrangement, using two conductors and a screen, gives considerably better electrical noise immunity than the previous coaxial arrangement (up to 20dB) and will give reliable operation in applications where the proximity of power cables, variable speed drives etc. would have caused problems.

If you are installing a new HydroRanger 200 system we strongly recommend that you use a good quality screened, twisted pair cable if an extension is required. If the integral transducer cable is used you need only connect to the HydroRanger 200 and benefit from the superior performance.



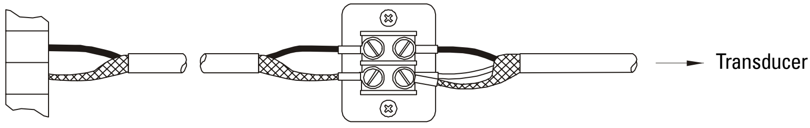
Appendix F: Upgrading

Connecting a transducer with RG62 coaxial extension cable

If you are replacing an older Siemens Milltronics Ultrasonic Level Controller with a new HydroRanger 200 where an RG62 coaxial extension is fitted and you are unable to replace the extension with a new cable, please refer to connection diagram below. Please note that the noise immunity performance will be similar to our older model ultrasonic level controllers if you use coaxial cable.

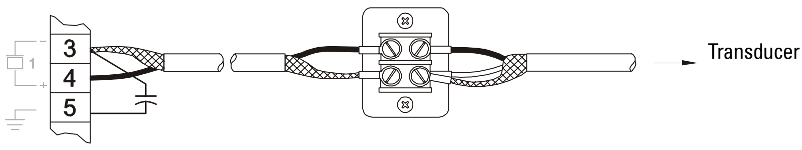
Existing installation

RG62 coaxial cable has been used to make the extension. The level controller might be a MultiRanger Plus, HydroRanger, HydroRanger Plus or one of our other level controllers.



HydroRanger 200 Installation (for retrofitting MultiRanger Plus Installations)

Connect with a 0.1µF (100v or greater) capacitor (included with HydroRanger 200) between the shield and negative terminals. Connect centre core of the coaxial to the positive terminal and the screen to the negative terminal.



Appendix F: Upgrading

MultiRanger Plus to HydroRanger 200 Parameters

The HydroRanger 200 uses the current Siemens Milltronics standard parameter set which is different than the parameter numbers used in the MultiRanger Plus.

The MultiRanger Plus parameters numbers are sequential (P-0 to P-99). The HydroRanger 200 parameters number are also sequential; however, some of the parameters are indexed.

Parameters are indexed when they apply to more than one input or output. The index value defines the input/output for that parameter. Indexed parameters contain a value for each index, even if that index is not used.

Example

In the MultiRanger Plus each relay had a dedicated parameter number for its function, ON and OFF points.

MultiRanger Plus Relay One

- P-8: Function
- P-9 : ON setpoint
- P-10: OFF setpoint

HydroRanger 200 uses P111 for all relays and indexes these parameters.

- P-111: Function
- P-112: ON
- P-113: OFF

The following tables show the differences between the MultiRanger Plus and the HydroRanger 200. They each show one relay programmed as a high alarm, and two relays programmed for pump control with alternating pump starts:

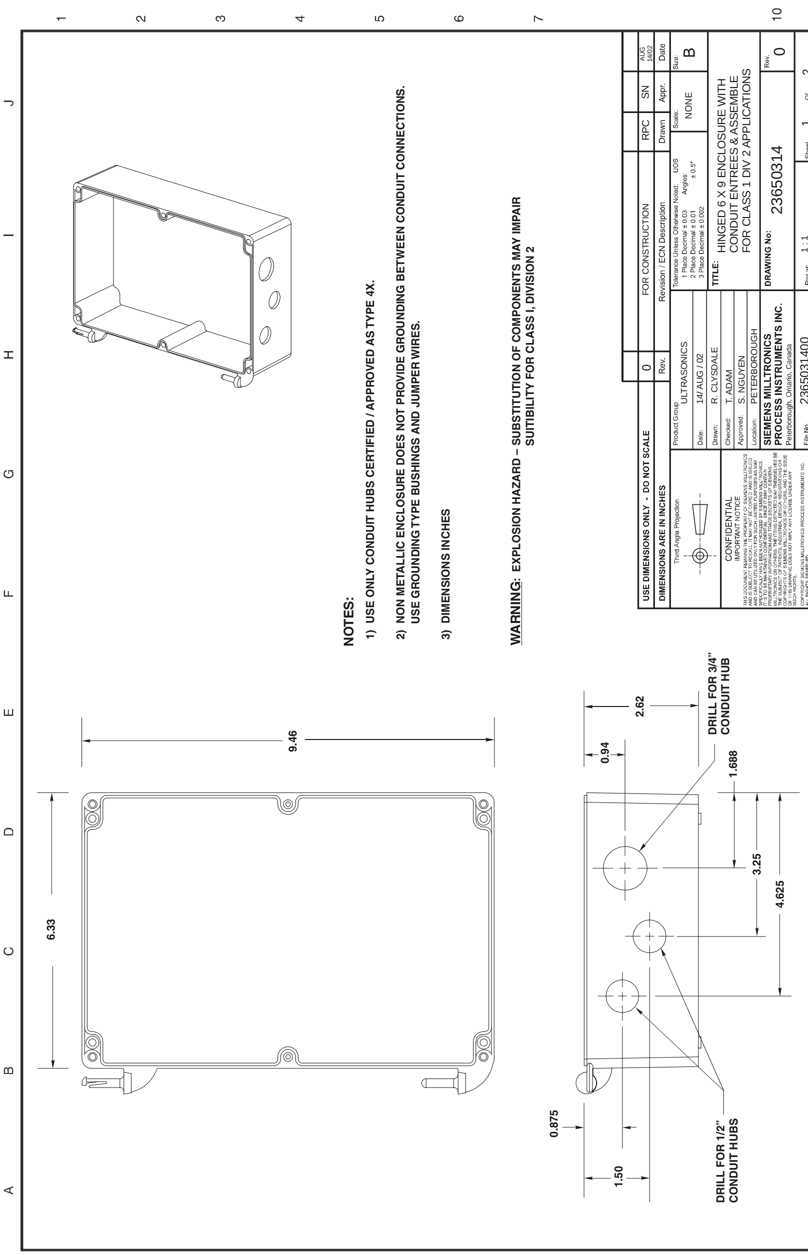
MultiRanger Plus

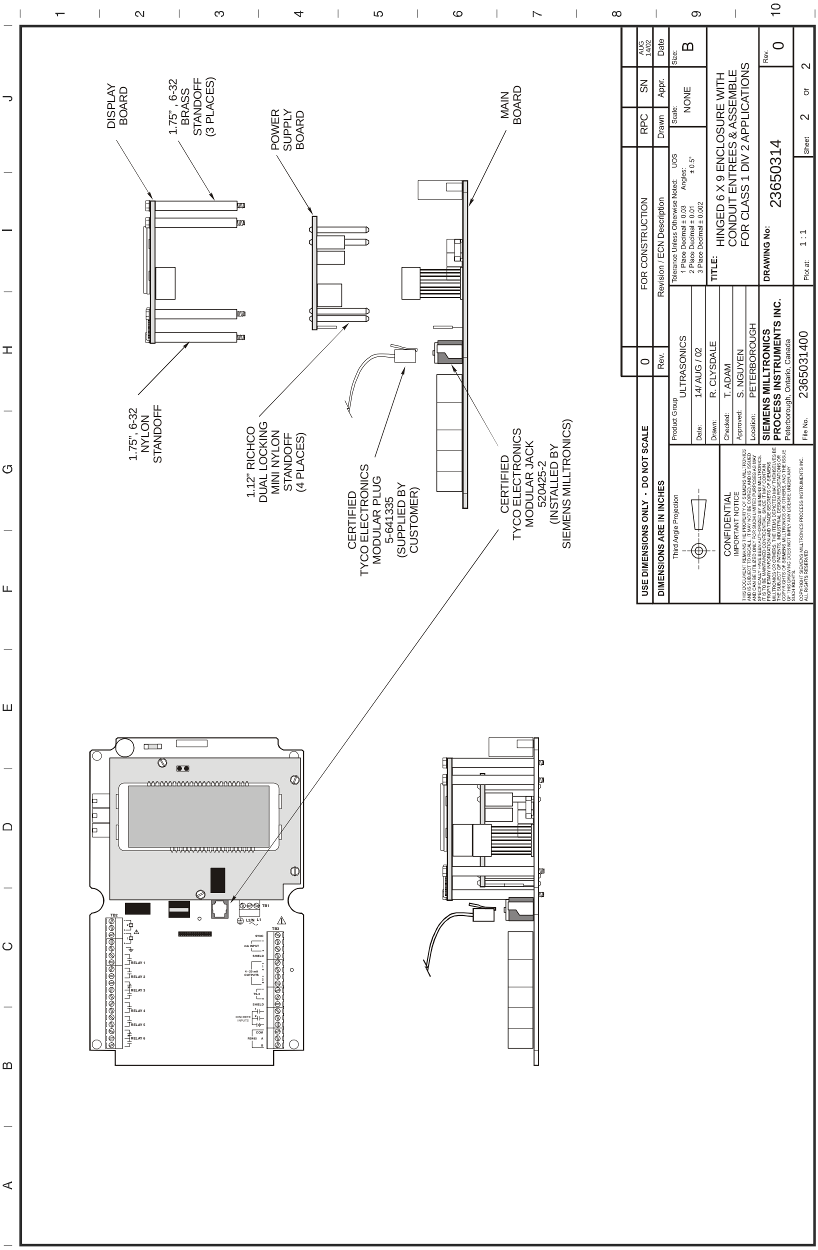
Relay	Parameter	Value
1	P-8 (relay function)	1 (alarm)
1	P-9 (ON setpoint)	4 m
1	P10 (OFF setpoint)	3.5 m
2	P-11 (relay function)	9
2	P-12 (ON setpoint)	3.2 m
2	P-13 (OFF setpoint)	0.5 m
3	P-14 (relay function)	9
3	P-15 (ON setpoint)	3.4 m
3	P-16 (OFF setpoint)	0.6 m

HydroRanger 200

Relay	Parameter	Value
1	P111 [1] (relay function)	1
1	P112 [1] (ON setpoint)	4 m
1	P113[1] (OFF setpoint)	3.5 m
2	P111[2] (relay function)	52
2	P112[2] (ON setpoint)	3.2 m
2	P113[2] (OFF setpoint)	0.5 m
3	P111[3] (relay function)	52
3	P112[3] (ON setpoint)	3.4 m
3	P113[3] (OFF setpoint)	0.6 m

General Appendix G: Conduit Entry for Class 1, Div 2 Applications




DISPLAY BOARD
1.75", 6-32 BRASS STANDOFF (3 PLACES)
POWER SUPPLY BOARD
MAIN BOARD
1.75", 6-32 NYLON STANDOFF
1.12" RICHCO DUAL LOCKING MINI NYLON STANDOFF (4 PLACES)
CERTIFIED TYCO ELECTRONICS MODULAR PLUG 5-641335 (SUPPLIED BY CUSTOMER)
CERTIFIED TYCO ELECTRONICS MODULAR JACK 520425-2 (INSTALLED BY SIEMENS MILLTRONICS)
USE DIMENSIONS ONLY - DO NOT SCALE
DIMENSIONS ARE IN INCHES
0 FOR CONSTRUCTION RPC SN AUG 14/02
Rev. Revision / ECN Description Drawn Appr. Date
Third Angle Projection
Product Group ULTRASONICS
Date: 14/ AUG / 02
Drawn: R. CLYSDALE
Checked: T. ADAM
Approved: S. NGUYEN
Location: PETERBOROUGH
SIEMENS MILLTRONICS PROCESS INSTRUMENTS INC.
Peterborough, Ontario, Canada
File No. 2365031400
Tolerance Unless Otherwise Noted: UOS
1 Place Decimal ± 0.03
2 Place Decimal ± 0.01
3 Place Decimal ± 0.002
Angles: ± 0.5°
Scale: NONE
Size: B
TITLE: HINGED 6 X 9 ENCLOSURE WITH CONDUIT ENTREES & ASSEMBLE FOR CLASS 1 DIV 2 APPLICATIONS
DRAWING No: 23650314
Rev. 0
Plot at: 1 : 1
Sheet 2 of 2
CONFIDENTIAL
IMPORTANT NOTICE
COPYRIGHT SIEMENS MILLTRONICS PROCESS INSTRUMENTS INC. ALL RIGHTS RESERVED

Appendix H: Software Revision History

HydroRanger 200

Software Rev.	Date	Changes
1.00	11/09/2001	• Pilot Release.
1.01	12/02/2001	• Initial Release.
1.02	08/20/2002	• P602 functions reduced point limit from 10 to 6. • Changed P132 to global. • P640 now accepts negative values. • Changed access mode of dialer parameters so they cannot be scrolled. • Clarified return message for factory RS232 test. • Prevent entering strings with invalid fields in Dolphin Plus. • Properly convert ft/sec to m/sec in P654. • Eliminated rogue watchdog resets when repeatedly pressing hand programmer enter while in P901-P903. • Allow 32 bit read/write as seconds. • Factory mode lock is written to flash. • Cleaned up compiler errors and Lint warnings. • Modified handling of non-quick start parameters. • Modifications for Production Testing. • Users may now configure the SmartLinx memory map. • Improved Preset Application values.
1.03	09/25/2002	• Allow files to be downloaded to the product using Dolphin+.

Software Rev.	Date	Changes
1.04 1.05	02/11/2003 02/21/2003	• Product enhancements to eliminate relay chatter on software download. • Improved functionality of receiver saturation during calibration. • Added relay functionality thru P118 to coincide with manual. • Improved product security with addition of P069. • Backup level override behaviour improvement. • Improved mA control with P210 - P213. • Improved temperature calibration in factory mode. • Improved Production Testing support. • Improved reset behaviour. • Changed default mA trim values. • Improved functionality of downloading downloading in Dolphin +.
1.06	05/27/2004	• RCVR offset limits are no longer handled in the code.
1.07	08/30/2004	• OCM Time Units improvement. • Totalizer enhancement to prevent a rounding error puting the totalizer into an unstable "mode." • Totalizer - Access to totalizer in OCM mode from Modbus map (reg 41040). • P060, P005 Dependancy removed. • Split Values - Parameters with the "xx:yy" format now being limited properly. • Temperature Spike - Temperature readings now being protected from other units' transmit pulse. • TVT Shift - A rounding error in the number of samples caused the TVT to shift position. • Auto False Echo Suppression - Device learns the shape of an empty tank to automatically suppress false echos. • SIMATIC PDM Compatability - Device uses Modbus to communicate with PDM. DDs required.

Software Rev.	Date	Changes
1.08	08/30/2004	• Improvements made as a result of Siemens systems testing: • PDM related: • -TVT display improvement to prevent it from going negative. • -MLFB number includes SMPI as well as Siemens numbering. • -Change of some enumerations in the Device Description. • Device related: • -mA output no longer resets when PAR_MA_FUNCTION (P201) is written to. • -mA trims (P214, P215) now have the property noReset. • Enhancement: • -Device Identification command allows Tag, Description, Message, and Date.
1.09	11/11/2004	• Correction for manual Shaper TVT shift due to change in velocity. • Reading some floats as decimal shifted integers would return a value off by 1 in some cases. • The submergence algorithm now implemented with the thresholds defined. • Changes to support single DUART.

Programming Charts

#	Parameter Name	Altered Values for Indices/Point Numbers 1	2	3
Security				
P000	Lock (G)			
Quickstart				
P001	Operation			
P002	Material			
P003	Max. Process Speed			
P004	Transducer			
P005	**Units**			
P006	Empty			
P007	Span			
Volume				
P050	Tank Shape			
P051	Max Volume			
P052	Tank Dimension A			
P053	Tank Dimension L			
P054	Level Breakpoints		record values on a separate sheet.	
P055	Volume Breakpoints		record values on a separate sheet.	
Display and Reading				
P060	Decimal Position			
P061	**Convert Reading**			
P062	Offset Reading			
P064	**Reading Override Enable**			
P065	**Reading Override Value**			
P066	**Override Time Delay**			
P069	**Password**			
Failsafe				
P070	Failsafe Timer			
P071	Failsafe Material Level			
P072	Failsafe Level Advance			
Relays				
P100	Preset Applications			
P110	**Level Source**			
P111	**Relay Control Function**			
P112	**Relay ON Setpoint**			

Parameter		Altered Values for Indices/Point Numbers		
#	Name	1	2	3
P113	Relay OFF Setpoint			
P115	Relay Interval Setpoint			
P116	Dead Band			
P118	Relay Output Logic			
P119	Relay Logic Test			
Pump Setpoint Modifiers				
P121	Pump by Rate			
P122	Pump Service Ratio			
Independent Relay Failsafe				
P129	Relay Failsafe			
Advanced Pump Control Modifiers				
P130	Pump Run-On Interval			
P131	Pump Run-On Duration			
P132	Pump Start Delay			
P133	Pump Power Resumption Delay			
P136	Wall Cling Reduction			
P137	Pump Group			
Flush Systems				
P170	Flush Pump			
P171	Flush Cycles			
P172	Flush Interval			
P173	Flush Duration			
mA Outputs				
P200	mA **Output** Range			
P201	mA **Output** Function			
P202	mA **Output** Allocation			
P203	mA **Output** Value / Transducer			
Independent mA Setpoints				
P210	0/4 mA **Output** Setpoint			
P211	20 mA **Output** Setpoint			
mA Output Limits				
P212	mA **Output** Min Limit			
P213	mA **Output** Max limit			
mA Output Trim				
P214	4 mA **Output** Trim			
P215	20 mA **Output** Trim			
mA Output Failsafe				

#	Parameter Name	Altered Values for Indices/Point Numbers 1	2	3
P219	mA Output Failsafe			
mA Input				
P250	mA Input Range			
P251	0 to 4 mA Input Level			
P252	20 mA Input Level			
P253	Input Filter Time Constant			
P254	Scaled mA Input Value			
P260	mA Raw Input			
Discrete Input Functions				
P270	Discrete Input Function			
P275	Scaled Discrete Input Value			
Data Logging - Record Temperatures				
P300	Temp, Transducer max			
P301	Temp, Transducer min			
P302	Temperature, Sensor max			
P303	Temperature, Sensor min			
Data Logging - Record Readings				
P304	Reading Max			
P305	Reading Min			
Data Logging - Pump Records				
P309	Pump RUN Time			
P310	Pump Hours			
P311	Pump Starts			
P312	Pump Run Ons			
Data Logging - Flow Records				
P320	Flow Max			
P321	Flow Min			
LCD Totalizer				
P322	LCD Total Low			
P323	LCD Total High			
Profile Records				
P330	Profile Record			
P331	Auto Record Enable			
P332	Auto Record Transducer			
P333	Auto Record Interval			
Auto Record ON and OFF Setpoints				
P334	Auto Record ON Setpoint			

#	Parameter Name	Altered Values for Indices/Point Numbers 1	2	3
P335	Auto Record **OFF** Setpoint			
P336	Auto Record Filling/Emptying			
P337	Auto Record LOE Time			
Installation Records				
P340	Date of Manufacture			
P341	RUN Time			
P342	Start Ups			
Open Channel Monitoring				
P600	**Primary Measuring Device**			
P601	**Flow Exponent**			
P602	**Primary Measuring Device Dimensions**			
P603	**Maximum Head**			
P604	**Maximum Flow**			
P605	**Zero Head**			
P606	**Time Units**			
P607	**Flowrate Decimal**			
P608	**Flowrate Units**			
P610	**Head Breakpoints**			
P611	**Breakpoint Flowrates**			
P620	**Low Flow Cutoff**			
P621	**Auto Zero Head**			
Pumped Volume Totalizer				
P622	**Inflow / Discharge Adjust**			
Totalizer				
P630	**LCD Totalized Multiplier**			
P633	**LCD Totalized Decimal Postion**			
P640	**Remote Totalized Multiplier**			
P641	**Flow Sampler Mantissa**			
P642	**Flow Sampler Exponent**			
P645	**Relay Duration**			
Range Calibration				
P650	Offset Calibration			
P651	Sound Velocity Calibration			
P652	Offset Correction			
P653	Velocity			
P654	Velocity @ 20° C			

Programming Chart

#	Parameter Name	Altered Values for Indices/Point Numbers 1	2	3
Temperature Compensation				
P660	Temp Source			
P661	Temp Fixed			
P663	Temp Transducer Allocation			
P664	Temperature			
Rate				
P700	Max Fill Rate			
P701	Max Empty Rate			
P702	Filling Indicator			
P703	Emptying Indicator			
P704	Rate **Filter**			
P705	Rate Update Time			
P706	Rate Update Distance			
P707	Rate Value			
P708	**Volume Rate Display**			
Measurement Verification				
P710	Fuzz Filter			
P711	Echo Lock			
P712	**Echo Lock Sampling**			
P713	Echo Lock Window			
Transducer Scanning				
P726	Level System Sync			
P727	Scan Delay			
P728	Shot Delay			
P729	Scan Time			
Display				
P730	Auxiliary Reading			
P731	Auxiliary Reading Key			
P732	Display Delay			
P733	Scroll Access			
P735	**Backlight**			
P737	**Primary Reading**			
P741	**Communications TImeout**			
SmartLinx Reserved - Communications				
P770	**Port Protocol**			
P771	**Network Address**			
P772	Baud Rate			

Programming Chart

#	Parameter Name	Altered Values for Indices/Point Numbers 1	2	3
P773	**Parity**			
P774	**Data Bits**			
P775	**Stop Bits**			
P778	**Modem Available**			
P779	**Modem Inactivity Timeout**			
P782	**Parameter Index Location**			
SmartLinx Hardware Testing				
P790	Hardware Error			
P791	**Hardware Error Code**			
P792	**Hardware Error Count**			
P794	**SmartLinx Module Type**			
P795	**SmartLinx Protocol**			
P799	**Communications Control**			
Echo Processing				
P800	Near Blanking			
P801	Range Extension			
P802	**Transducer with Submergence Shield**			
P803	Shot / Pulse Mode			
P804	Confidence Threshold			
P805	Echo Confidence			
P806	Echo Strength			
P807	Noise			
Advanced Echo Processing				
P815	**Echo Time Filtered**			
P816	**Echo Time Raw**			
P820	Algorithm			
P821	Spike Filter			
P822	Narrow Echo Filter			
P823	Reform Echo			
P825	Echo Marker Trigger			
Advanced TVT Adjustment				
P830	TVT Type			
P831	TVT Shaper			
P832	TVT Shaper Adjust			
P833	TVT Start Min			
P834	TVT Start **Duration**			

Programming Chart

#	Parameter Name	Altered Values for Indices/Point Numbers 1	2	3
P835	TVT Slope Min			
P837	Auto-False Echo Suppression			
P838	Auto-False Echo Suppression-Distance			
P839	TVT Hover Level			
Advanced Shot Adjustment				
P840	Short Shot Number			
P841	Long Shot Number			
P842	Short Shot Frequency			
P843	Long Shot Frequency			
P844	Short Shot Width			
P845	Long Shot Width			
P850	Short Shot Bias			
P851	Short Shot Floor			
P852	Short Shot Range			
Test				
P900	Software Revision Number			
P901	Memory			
P902	Watchdog			
P903	Display			
P904	Keypad			
P905	Transmit Pulse			
P906	RS-232 Port			
P908	Scanner			
P910	Toggle Relays			
P911	mA Output Value			
P912	Transducer Temperature			
P913	Sensor Temperature			
P914	mA Input			
Measurement				
P920	Reading Measurement			
P921	Material Measurement			
P922	Space Measurement			
P923	Distance Measurement			
P924	Volume Measurement			

#	Parameter Name	Altered Values for Indices/Point Numbers 1	2	3
P925	Flow Measurement			
P926	Head Measurement			
P927	Distance Measurement			
P999	Master Reset			

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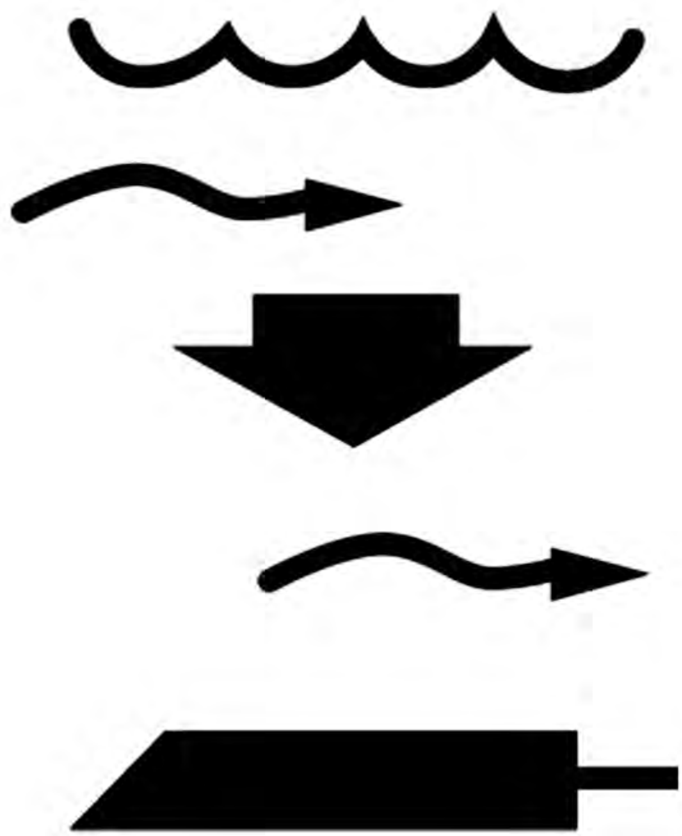
TIENet™ 350
Area Velocity Sensor

Installation and Operation Guide



TELEDYNE ISCO
Everywhereyoulook™

Manual Body #69-4353-024

Revision C, October 2013

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If a problem persists, call or e-mail the Teledyne Isco Technical Service Department for assistance. Simple difficulties can often be diagnosed over the phone.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by the Customer Service Department, including the use of the **Return Authorization Number** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

Contact Information

Customer Service

Phone:	(800) 228-4373	(USA, Canada, Mexico)
	(402) 464-0231	(Outside North America)
Fax:	(402) 465-3022	
Email:	IscoCSR@teledyne.com	

Technical Support

Phone:	Toll Free (866) 298-6174	(Samplers and Flow Meters)
	Toll Free (800) 775-2965	(Syringe Pumps and Liquid Chromatography)
Email:	IscoService@teledyne.com	
Return equipment to:	4700 Superior Street, Lincoln, NE 68504-1398	

Other Correspondence

Mail to:	P.O. Box 82531, Lincoln, NE 68501-2531
Email:	IscoInfo@teledyne.com

General Warnings

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed of the following general warnings:

⚠ WARNING

Avoid hazardous practices! If you use this instrument in any way not specified in this manual, the protection provided by the instrument may be impaired.

⚠ AVERTISSEMENT

Éviter les usages périlleux! Si vous utilisez cet instrument d'une manière autre que celles qui sont specifiées dans ce manuel, la protection fournie de l'instrument peut être affaiblie; cela augmentera votre risque de blessure.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

⚠ CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

⚠ WARNING

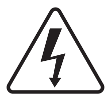
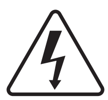
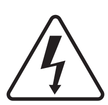
Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

⚠ DANGER

DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.

Hazard Symbols

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
Advertencias y Precauciones	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.
	Esta señal alerta sobre la presencia de alto voltaje en el interior del producto.

TIENet™ Model 350 Area Velocity Sensor

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Section 1 Introduction

Section 2 Installation

Section 3 Setup and Programming

Section 4 Maintenance

Appendix A Replacement Parts List

Appendix B Velocity Error Codes

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TIENet™ Model 350 Area Velocity Sensor

Section 1 Introduction

The Teledyne Isco TIENet 350 Area Velocity Sensor measures flow stream average area velocity and liquid level. The Signature® Flow Meter uses this information to calculate the flow rate and total flow of the stream. To operate with the 350 sensor, the Signature requires software version **1.18** or later.

1.1 Description

The 350 sensor is mounted in the flow stream, normally at the bottom of the channel. It measures average velocity using continuous ultrasonic sound waves to produce a Doppler effect, in which the frequency of a wave (such as sound) passed between two bodies is relative to the motion of each. As they move nearer to each other, the frequency increases; as they move apart, the frequency decreases.

The 350 sensor measures liquid level using an internal differential pressure transducer.

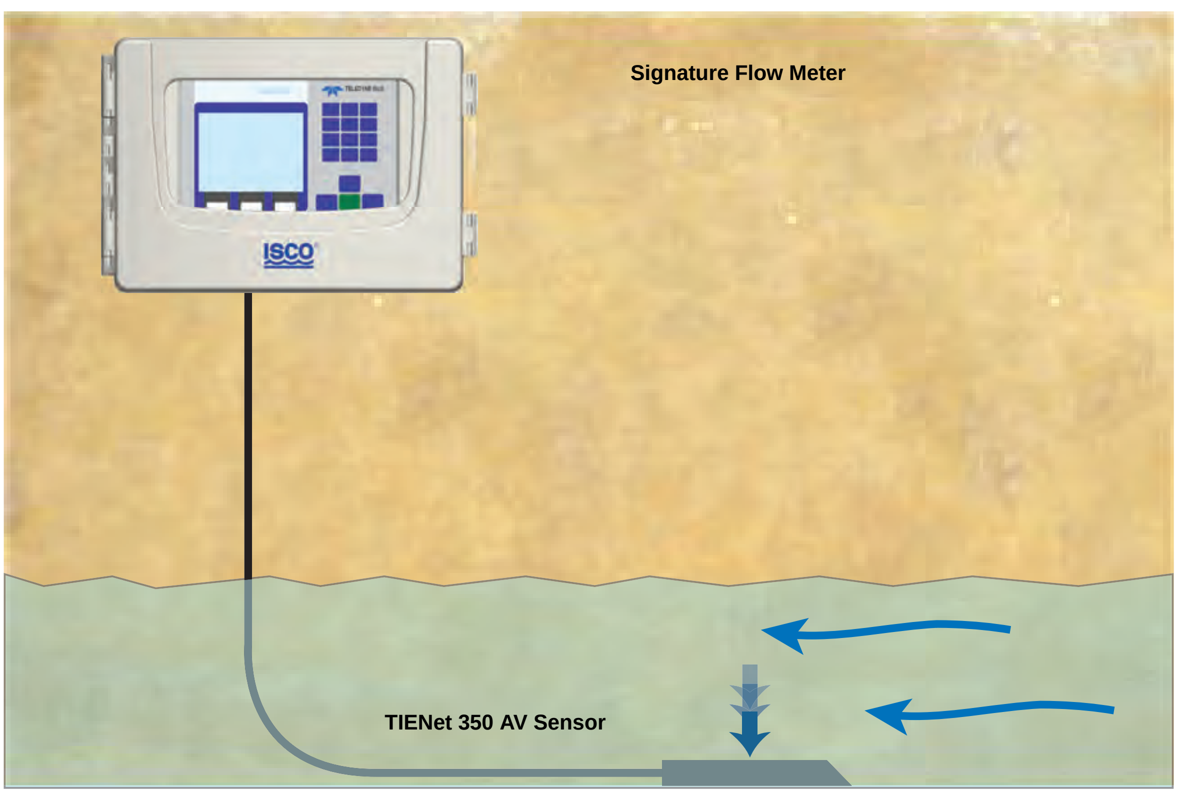
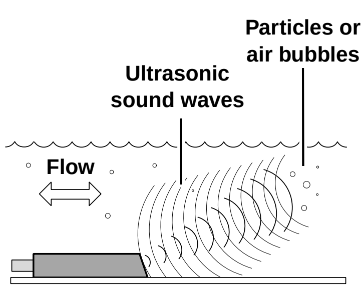


Figure 1-1 Basic Signature monitoring system with 350 (mounting hardware not shown)

The 350 AV sensor is available with a 5m, 10m, or 23m cable. For greater distances, external connection via conduit, and connection of additional TIENet devices, the TIENet Expansion Box is available. Bulk TIENet cable may also be used for greater distances.

Figure 1-2 TIENet Model 350 Area Velocity Sensor

1.1.1 350 Velocity Operation



The 350 area velocity sensor contains a pair of ultrasonic transducers. One transducer transmits the ultrasonic sound wave. As the transmitted wave travels through the stream, particles and bubbles carried by the stream reflect the sound wave back at the sensor. The second transducer receives the reflected wave.

The sensor determines the frequency shift between the transmitted and received waves. An increase or decrease in the frequency of the reflected wave indicates forward or reverse flow. The degree of change is proportional to the velocity of the flow stream.

1.1.2 350 Level Operation

The 350 sensor's internal differential pressure transducer measures the liquid level. The transducer is a small piezo-resistive chip that detects the difference of the pressures felt on the inner and outer face.

The stainless steel outer diaphragm is exposed to the flow stream through the ports under the sensor. The pressure felt on the outer diaphragm is transferred to the outer face of the transducer. The inner face of the transducer is referenced to the atmosphere through the internal vent tube that runs the full length of the sensor cable.

The difference between the pressures exerted on the transducer is the hydrostatic pressure, which is proportional to the level of the stream. The analog representation of the hydrostatic pressure is digitized and sent to the Signature as an RS-485 half-duplex signal.

1.2 Technical Specifications

Table 1-1 350 TIENet Sensor Specifications[a]		
Sensor Dimensions	1.9 × 3.3 × 15.2 cm	0.75 × 1.31 × 6.00 in
Standard Cable Length	5, 10, or 23 m	16.4, 32.8, or 75.5 ft
Cable Diameter	10.2mm ±0.254mm	0.402 in ±0.010 in
Minimum Bend Radius	15.24 cm	6 in
Maximum Cabling from Signature Flow Meter	305 m	1,000 ft
Typical Weight w/ 5 m Cable w/ 10 m Cable w/ 23 m Cable	0.88 kg 1.68 kg 3.10 kg	1.95 lb 3.70 lb 6.84lb
Body Materials	Epoxy, PC, SST	
Cable Materials	UV-Rated PVC	
Temperature Range Operation Storage	0 to 70 °C -40 to 70 °C	32 to 158 °F -40 to 158 °F
Power Input Voltage Supply Current @ 12VDC Nominal	7 to 14VDC Measurement: 100mA	
Level Measurement		
Technology	Submerged differential linear pressure transducer with integral digital temperature compensation coefficients.	
Range[b]	0.010 to 3.05 m	0.033 to 10 ft.
Pressure Rating	5 PSI	
Maximum Submersible Depth	10.55 m	34.6 ft
Accuracy[c]	± 0.10% FS	
Typical Long Term Stability	± 0.007m/yr	± 0.023 ft/yr
Compensated Temperature Range	0 to 70°C	32 to 158°F
Velocity Measurement		
Technology	Continuous wave Doppler ultrasonic	
Frequency	500 kHz	
Transmission Angle	20° from horizontal	
Velocity Direction	Bi-Directional (User selectable)	
Typical Minimum Depth for Velocity Measurement	2.5 cm	1.0 in
Range	-1.5 to +6.1 m/s	-5 to +20 ft./s
Accuracy[d]	Velocity Error -5 to +5 ft./s: -1.5 to +1.5 m/s 5 to 20 ft./s: 1.5 to 6.1 m/s	 ±0.1 ft./s (±0.03 m/s) ±2% of reading

a. All specifications are subject to change without notice.
b. Actual vertical distance between the area velocity sensor and the liquid surface
c. Maximum non-linearity, hysteresis, and temperature error from actual liquid level
d. Uniform velocity profile, speed of sound 1480 m/s (4850 ft/s)

1.3 Optional LaserFlow Applications

Some applications using the Teledyne Isco LaserFlow™ remote-sensing velocity sensor require provisions for continued measurement in the event of submersion, or for redundant flow measurement of the same flow stream.

The 350 sensor can be added to a LaserFlow system to fill either of these requirements. For more information, refer to the LaserFlow user manual.

1.4 Accessories

Accessories used in sensor installation are briefly described below. Refer to the next section for ordering information.

The 350 Area Velocity Sensor can be installed using Isco's mounting rings listed below. A Low Profile Carrier is optional when attaching the 350 to a mounting ring (not for use with the Street Level Installation System).

TIENet 350 AV Sensor w/ 5m Cable........ 60-4354-012
TIENet 350 AV Sensor w/ 10m Cable........ 60-4354-013
TIENet 350 AV Sensor w/ 23m Cable........ 60-4354-014
TIENet 350 AV Sensor w/ 2ft Cable & TIENet Plug Connector........ 60-4354-017

Cord grip fitting, 3/4" NPT, for TIENet cable........ 209-0073-12
Bulk TIENet Cable, Cut to Length........ 60-4304-050
TIENet Expansion Box........ 60-4307-023
TIENet Expansion Box with reference line support........ 60-4357-018

Signature Flow Meter Exterior desiccator
(required for use with 330 and 350 TIENet devices)........ 60-4354-019
Silica gel desiccant, 1.5-lb container........ 099-0011-03

Low Profile Carrier
(attaches the 350 sensor to a standard-size ring or plate)........ 60-3204-029
Mounting Ring Hardware Kit
(Do not use w/ Street Level Installation System)........ 60-2504-035
Extra Mounting Screws for use with Mounting Rings........ 231-5113-06

Standard Spring Rings
(Includes plastic cable ties to fasten the cable and a manual)
6" Dia........ 68-3200-007
8" Dia........ 68-3200-008
10" Dia........ 68-3200-009
12" Dia........ 68-3200-010
15" Dia........ 68-3200-011

Standard Scissors Rings
(Includes a base section, scissors mechanism, extensions, plastic cable ties, and manual)
16-24" Pipe........ 68-3000-042
26-38" Pipe........ 68-3000-043
38-44" Pipe........ 68-3000-044
44-48" Pipe........ 68-3000-045
60" Pipe........ 68-3000-046
72" Pipe........ 68-3000-047
16-60" Pipe........ 68-3000-048
Base Section *(with plastic cable ties and manual)*........ 60-3004-169

Street Level Installation System Multi-section Pole *(Includes manual. To complete your system, you must also order a Street Level Mounting Ring)* 60-3204-012
Street Level Mounting Ring for 6" dia. pipe 60-3204-014
Street Level Mounting Ring for 8" dia. pipe 60-3204-015
Street Level Mounting Ring for 10" dia. pipe 60-3204-016
Street Level Mounting Ring for 12" dia. pipe 60-3204-017
Street Level Mounting Ring for 15" dia. pipe 60-3204-018

Sensor Mounting Plate *(With plastic ties & instructions)* 60-3253-077
Ground Lug kit 60-2007-476

1.4.1 Ordering Information

Options and accessories can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: 800 228-4373
402 464-0231
FAX: 402 465-3022

E-mail: IscoInfo@teledyne.com

> **Note**
> Teledyne Isco uses FreeRTOS version 5.4.2 in its TIENet devices. In accordance with the FreeRTOS license, FreeRTOS source code is available on request. For more information, visit www.FreeRTOS.org.

1.5 Unpacking Instructions

When the system arrives, inspect the outside packing for any damage. Then carefully inspect the contents for damage. If there is damage, contact the delivery company and Teledyne Isco (or its agent) immediately.

> **⚠ WARNING**
> **If there is any evidence that any items may have been damaged in shipping, do not attempt to install the unit. Please contact Teledyne Isco (or its agent) for assistance.**

When you unpack the system, check the items against the packing list. If any parts are missing, contact the delivery company and Teledyne Isco's Customer Service Department. When you report missing part(s), please indicate them by part number. In addition to the main packing list, there may be other packing lists for various sub-components.

It is recommended that you retain the shipping cartons as they can be used to ship the unit in the event that it is necessary to transport the system.

Please complete the registration card and return it to Teledyne Isco.

TIENet™ Model 350 Area Velocity Sensor

Section 2 Installation

The Signature Flow Meter does not have to be mounted near the flow stream. You can install the flow meter itself at a convenient, protected location and route the sensor cable to the measurement point (maximum length of 305 meters or 1,000 feet). Proper installation of the 350 sensor is critical for accurate measurement.

2.1 Safety

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood.

2.1.1 Site Conditions

Components are often installed in confined spaces. Some examples of confined spaces include manholes, pipelines, digesters, and storage tanks. These spaces may become hazardous environments that can prove fatal for those unprepared. These spaces are governed by OSHA 1910.146 and require a permit before entering.

⚠ WARNING

The installation and use of this product may subject you to hazardous working conditions that can cause you serious or fatal injuries. Take any necessary precautions before entering a worksite. Install and operate this product in accordance with all applicable safety and health regulations, and local ordinances.

2.2 Reference Line Support

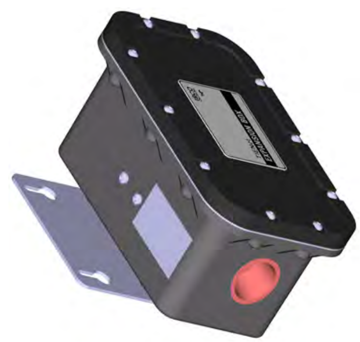
The optional water-tight Signature Expansion Box enables a variety of configurations for adding length, as well as connecting multiple devices at once. The Expansion Box connects to a TIENet™ terminal strip in the Signature, and contains three additional strips inside, as well as a TIENet connection for an option card.

Adding Length Between Signature and Sensors

Distance can increased by installing the Expansion Box closer to the field-mounted TIENet device(s) and adding a custom-length TIENet cable between the box and the Signature. The maximum recommended distance between system components is 305 meters (1,000 feet). Longer distances may result in signal degradation and drops in voltage.

Distance of 100 Feet or Less

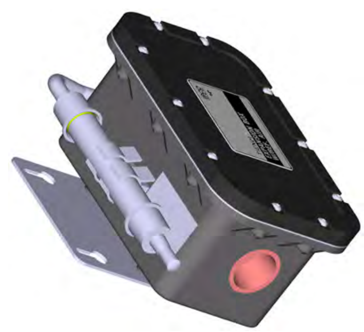
The un-vented TIENet expansion box can be used if the total distance is 30.5 meters (100 feet) or less. The Signature's air system will normally supply adequate desiccated air through the TIENet cable air line to the interior of the expansion box. This means the 350 AV sensor is referenced at the Signature's installation location.



Distances Greater than 100 Feet

If the total distance is greater than 30.5 meters (100 feet), or a different reference location is required, the reference air line must be vented outside the expansion box.

The TIENet expansion box with reference air is designed for this purpose. The desiccator tube mounted on the side vents dried air to its interior.



2.3 Preparing the Signature Flow Meter

In order to operate with the 350 AV sensor, the Signature must have an external desiccator installed.

2.3.1 External Desiccator

For Signature systems using the 330 Bubbler Module and/or the TIENet 350 Area Velocity Sensor, the external desiccator dries the reference air for a pressure transducer and air supply for the bubbler.

Signature bubbler systems will already have a desiccator installed. If you are adding a 350 AV sensor to a non-bubbler system, you will also need to add an external desiccator.

Remove the two red protective end caps from the ports before installing a new cartridge.

Figure 2-1 Remove red caps before installing external desiccant cartridge

The desiccant cartridge is held in place by a spring tab on the side of the flow meter. Slide the cartridge onto the tab, engaging the two ports with the openings in the side of the Signature.

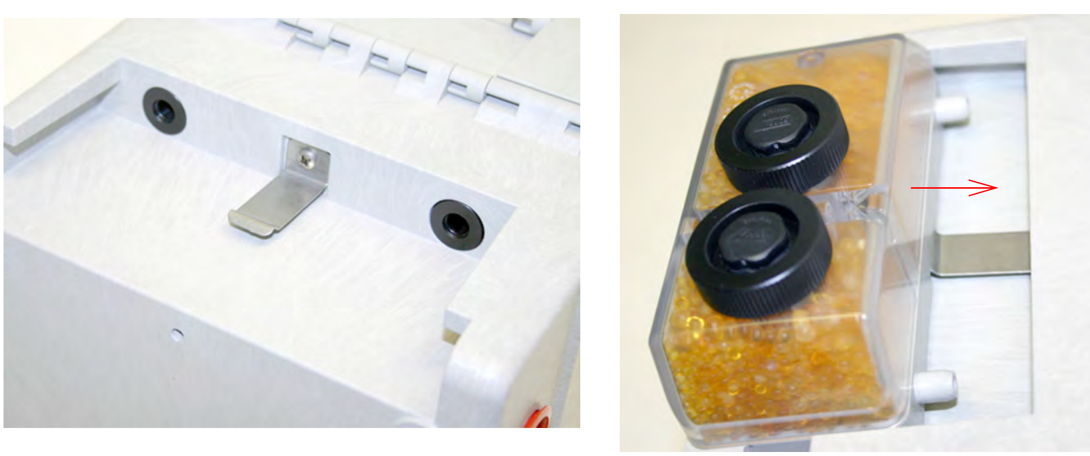


Figure 2-2 Installing the external desiccant cartridge

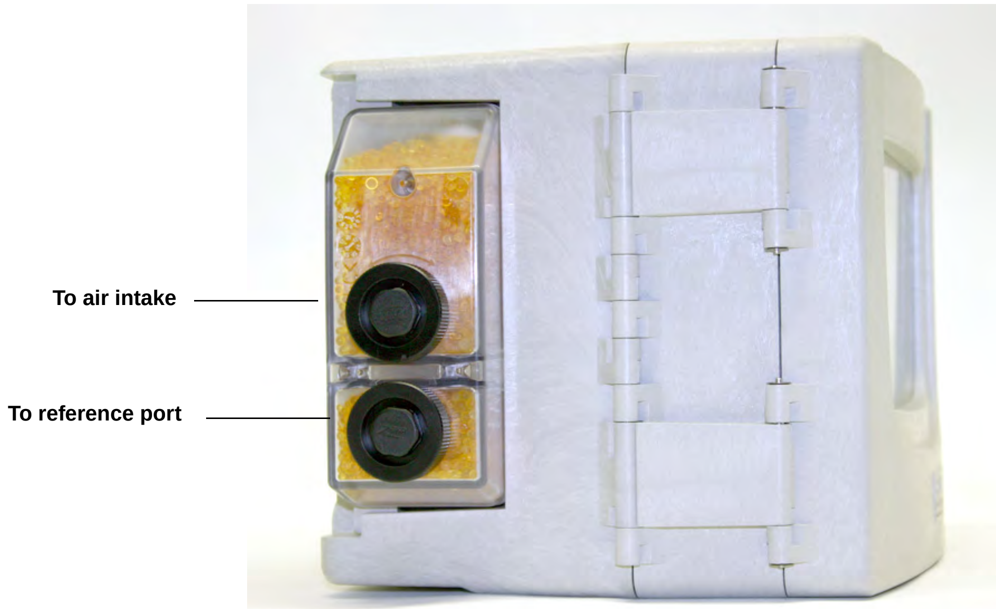


Figure 2-3 External desiccator, installed

The desiccant cartridge requires periodic maintenance. Refer to Section 4.2 *External Desiccator* for instructions.

Optimizing drying power

Some Signature flow meters have a single piece of tubing installed between the reference port and the humidity connector, and a cap plug on the intake port. While a Signature with this tubing configuration will operate satisfactorily with the 350 AV sensor in most situations, you can configure the tubing to utilize both chambers of the external desiccator to increase drying power.

Items required:

- Plastic 'Y' Fitting (Part #209-0167-49)
- 0.25 x 0.125 silicone tubing (Part #029-1353-02: Two 2-inch pieces)

Procedure:

1. Remove the cap plug.
2. Disconnect the tubing from the humidity connector and reroute it behind the ribbon cable.
3. Connect both the reference port tubing and the intake port tubing to the 'Y' connector.
4. Connect the 'Y' connector to the humidity connector (Figure 2-4).

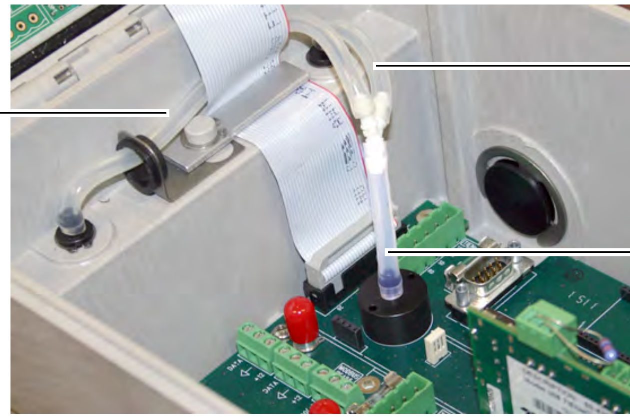


Figure 2-4 Tubing configuration for optimal drying power

2.4 Connecting the Cable

External TIENet devices such as the 350 are all electrically connected to the Signature flow meter in the same manner, usually using conduit or cord-grip cable fittings. Multiple external TIENet devices can be connected simultaneously.

Refer to your Signature flow meter manual for instructions on accessing the instrument's interior components.

⚠ WARNING

Before proceeding, ensure that the flow meter has been disconnected from mains power.

☑ *Note*

The steps that follow include instructions for installing cord-grip fittings. Some applications will use user-supplied $^3/_4$" ID conduit for cable routing.

⚠ CAUTION

If you are using conduit instead of the cord-grip fitting, the conduit must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

1. Remove one of the 6-position plug-in terminal strip connectors from the case board.

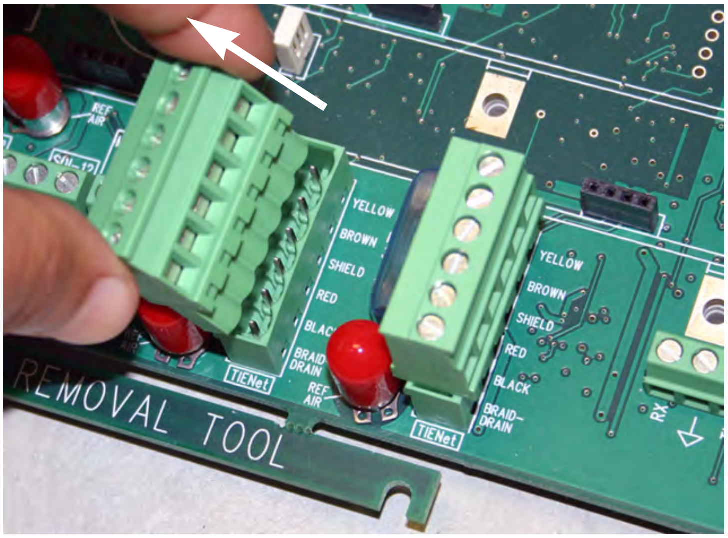


Figure 2-5 TIENet Device terminal strips

2. If using a cord-grip fitting, install the cable nut in the appropriate opening on the bottom of the Signature enclosure, securing it to the wall with the lock nut (concave side facing wall).
3. Feed the TIENet device cable end through the sealing nut and seal, and through the cable nut. Lightly tighten the sealing nut, just enough to hold the cable in place while installing the connector.

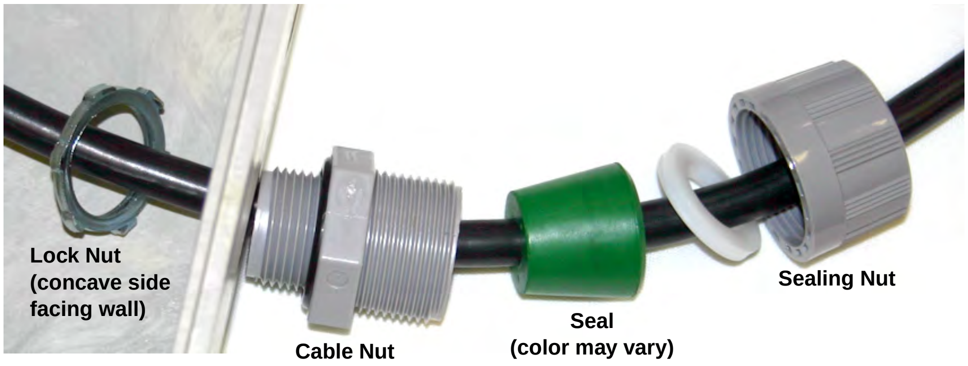


Figure 2-6 Installing cable with a cord-grip fitting

4. Attach the wire ends to the terminal strip as shown in Figure 2-7, then press the terminal strip back down into its socket on the case board, as shown in Figure 2-8, taking

care not to strain any wire connections. Gently tug each wire when finished, to verify secure connection to the screw terminals.

> ☑ **Note**
>
> The SHIELD wire is the bare drain emerging from the foil shield around the YELLOW and BROWN wires. The BRAID-DRAIN wire is the bare drain emerging from the surrounding braided shield inside the cable jacket. It is not necessary to prevent the two braids from coming into contact with each other.

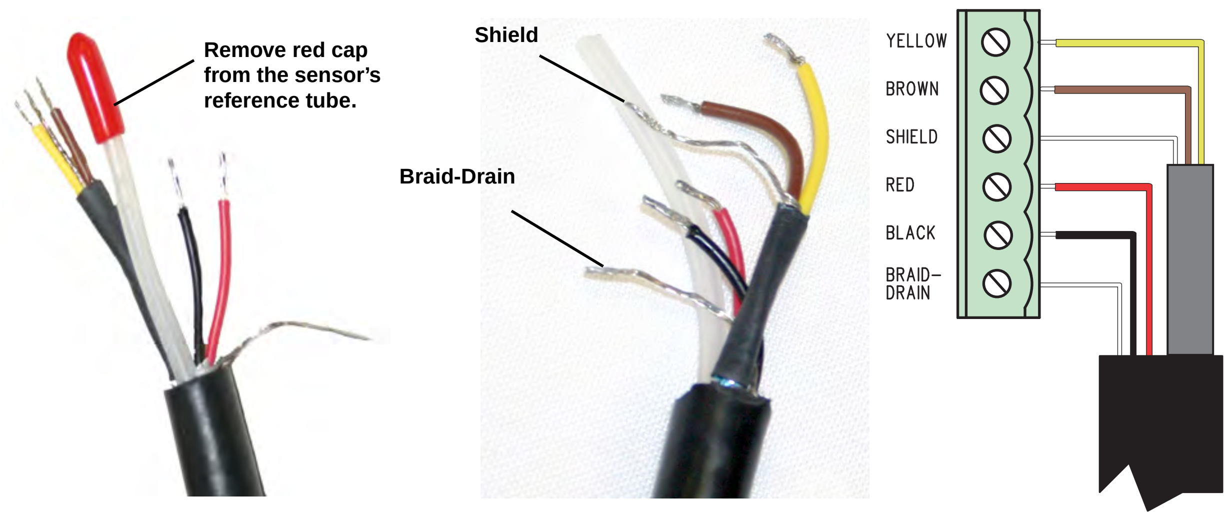


Figure 2-7 TIENet Device terminal connections

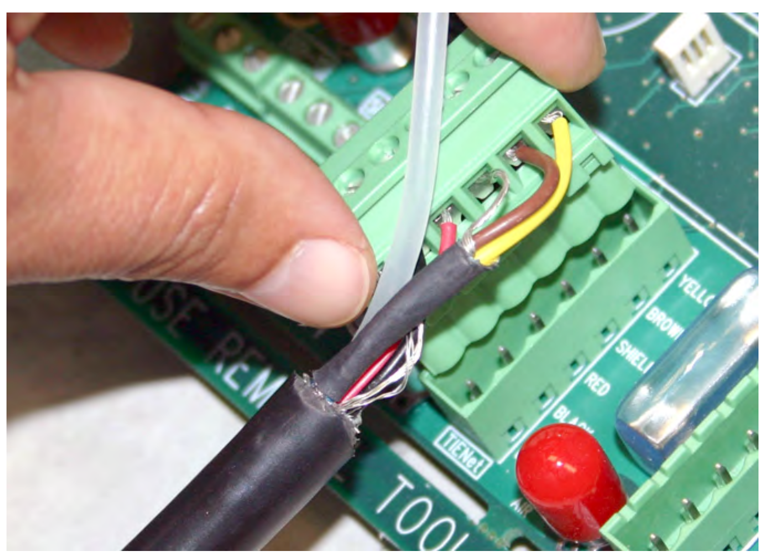


Figure 2-8 Attach wired terminal strip to case board socket

5. Insert the reference tubing into the REF AIR port on the case board, pushing it down inside the silicon tubing. B**e careful not to kink the reference tubing.**

Note:
Remove the red cap from the reference port, on the case board next to the TIENet connector, being used by the 350 sensor.

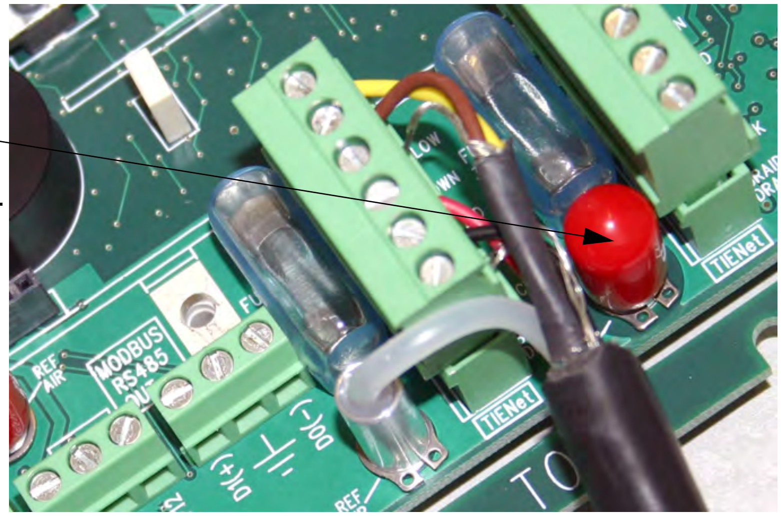


Figure 2-9   Insert the cable reference tubing into the case board reference port

6. Gently tug the cable downward, to remove any slack within the enclosure, taking care not to put any stress on the connections.
7. Tighten the cord grip sealing nut (Figure 2-10).

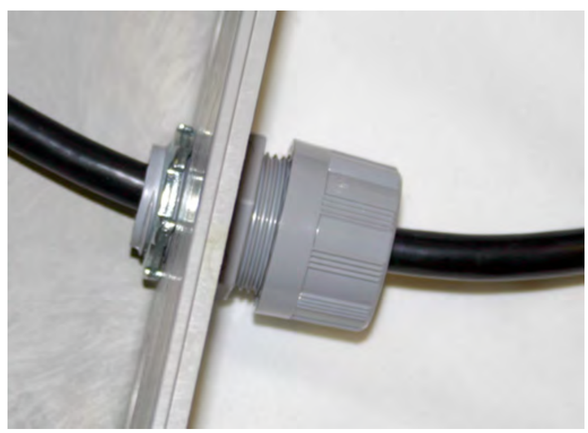


Figure 2-10 Position and secure the cable

8. Close the front panel and fasten it shut with the two Phillips screws.

⚠ CAUTION

If you are using conduit instead of the cord-grip fitting, the conduit must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

2.5 Installing the 350 AV Sensor

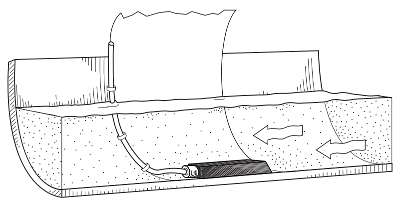
Prior to mounting the sensor in the flow stream, check the displayed level reading. In open air, the reading should be zero. If not, adjust the level to zero from the Level Adjustment screen (refer to “Setting the 350 Level” on page 3-6).

☑ Note

If the 350 sensor is part of the optional submerged functionality for a LaserFlow system, the initial level setting is the measured distance from the bottom of the channel to the bottom of the LaserFlow sensor.

2.5.1 Installation Considerations

See Section 2.5.2 for a summary of sensor mounting options for round pipe installations. Sensor installation is discussed in detail in *Isco’s Mounting Rings Instruction Manual*, which explains how to mount the 350 sensor in flow streams using spring rings, scissors rings, a street level installation tool, and mounting plates.



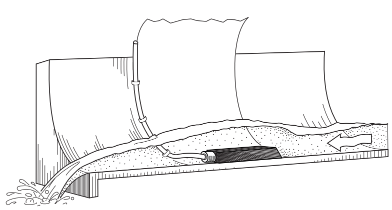
Ideal Conditions - Uniform Flow

Several factors concerning installation may affect your system’s performance. Please review the following to understand how to obtain the best results:

Uniform flow - The 350 sensor provides the best results in flow streams with uniform flow. An example of uniform flow is shown at left.

Avoid poor channel conditions - Poor channel conditions may cause incorrect or erratic readings. Areas to avoid are:

- Outfalls or channel intersections
- Flow streams at very low levels with high flow rates
- Turbulence
- Channel sections that are apt to collect debris or silt
- Depths that consistently run below 25 mm (1 inch)



Poor Conditions

The 350 sensor can detect levels above approximately 1.0 cm (0.4 inch) and typically can measure velocities in streams as low as 25 mm (1 inch). Streams that run consistently below 1 inch are not a good application for the 350 sensor.

The example at left shows a few of these poor conditions. The outfall is drawing down the liquid level and the 350 sensor is disturbing the flow. In this example, the 350 sensor should be moved forward to avoid the drawdown near the outfall.

Liquid properties - Velocity measurements depend on the presence of some particles in the stream, such as suspended solids or air bubbles. If the stream lacks particles, it may be necessary to aerate the water upstream from the sensor.

Handle with care - Abusive handling will damage the 350 sensor. Although the 350 sensor will survive normal handling and installation, treat the sensor with reasonable care. The internal components cannot be repaired.

Protect the cable - The vent tube inside the cable must remain open. Do not kink the cable or overtighten the plastic ties while securing the cable. Never allow water to enter the unterminated end of the cable or the vent tube.

Secure the cable - Secure the cable in place. Tying off the cable prevents lost equipment if excessive flow dislodges the sensor and its mounting.

2.5.2 Mounting Rings

Consult your Isco Mounting Rings Installation and Operation Guide for detailed hardware information.

The following sections describe sensor installation using the two options available for mounting the 350 sensor in pipes or round-bottomed flow streams. For pipes up to 15" (38 cm) in diameter, **stainless steel self-expanding mounting rings** (**Spring Rings**) are available. For pipes larger than 15" in diameter, Teledyne Isco offers the **Scissors Rings (Universal Mounting Rings)**. Area velocity sensors can also be installed using primary measuring devices.

⚠ CAUTION

Use gloves and eye protection when assembling and installing the rings in a pipe. Though deburred, the edges of the stainless steel can cut if improperly handled. *Please read the information in the Isco Mounting Rings Manual on how best to install this device.*

2.5.3 Spring Rings

To install a spring ring, compress the ring, slip it inside the pipe, and then allow it to spring out to contact the inside diameter of the pipe. The inherent outward spring force of the ring firmly secures it in place. A typical self-expanding mounting ring (with a probe mounted on it) is shown in Figure 2-11.

These mounting rings are available for use in pipes with inside diameters of 15.2 cm (6"), 20.3 cm (8"), 25.4 cm (10"), 30.5 cm (12"), and 38.1 cm (15"). The Isco part numbers for the various size mounting rings available are listed in Appendix B. These part numbers include not only the ring, but also the miscellaneous hardware necessary to mount the sensor on the ring.

⚠ CAUTION

Always wear leather gloves when handling the rings (either type). The metal is finished, but there is still a possibility of cutting your hands on the edges.

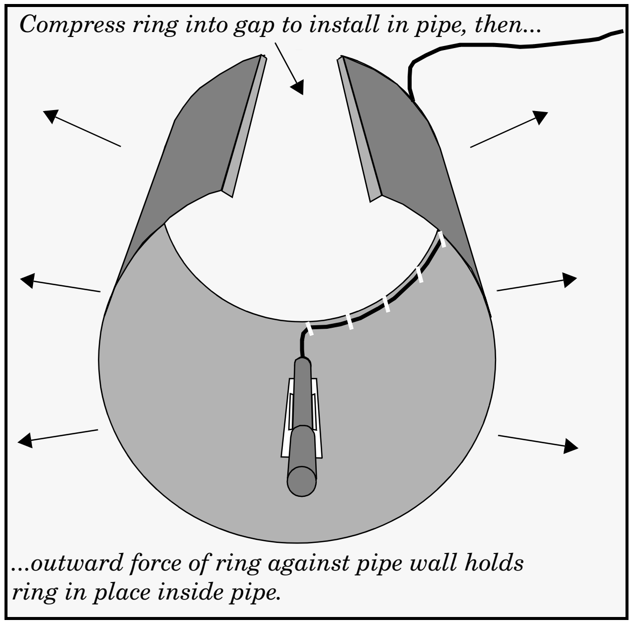


Figure 2-11 Sensor Installed on a Spring Ring

Attaching the Sensor to the Ring

Attach the 350 sensor to the ring either by using two 4-40x3/8 countersink screws or by snapping the optional probe carrier to the ring. This second method of attaching the sensor allows for easy removal in case service is needed later.

⚠ CAUTION

Make sure the slots on the sensor carrier are completely pressed into the tabs on the ring. This is particularly important where there is any possibility of reverse flows, or where flows are of high velocity. If the AV sensor is not fully pressed into the mounting ring tabs, it might come loose in the stream, and could possibly be damaged or lost.

Make sure the sensor cable is securely fastened along the back (downstream) edge of the ring. Otherwise, the sensor may provide **inaccurate level readings** under conditions of high velocity.

To complete the sensor-spring ring assembly procedure, attach the sensor cable to the downstream edge of the ring. Follow the cable routing shown in Figure 2-11. Other routing may affect measurement accuracy. The cable can create a stilling well downstream from the sensor, causing the level to read low. Use the self-locking plastic ties supplied with the ring. Install the ring in the pipe by compressing it. Press inward on both sides and slide the ring into the pipe.

Route the sensor cable out of the stream and secure it in position by placing the ties through the holes in the mounting ring and then locking them around the cable, as shown in Figure 2-11.

⚠ CAUTION

Do not overtighten the plastic cable ties; they should be tightened just enough to secure the cable in place, without greatly indenting the cable. Overtightening the plastic ties may collapse the reference tube in the cable, blocking it.

The spring ring may need anchoring. Under conditions of high velocity (greater than 1.5 meters per second or 5 feet per second), the ring may not have sufficient outward spring force to maintain a tight fit inside the pipe. The ring may start to lift off the bottom of the pipe, or may even be carried downstream.

This problem is more prevalent in the larger diameter pipes and in pipes with smooth inside surfaces, such as plastic pipes. If any of these conditions are present, or if movement of the mounting ring is detected or suspected, you must anchor the ring in place. You can do this by setting screws through the ring into the pipe, or by other appropriate means. If there is a problem with the smaller diameter rings, it may be sufficient to simply increase the outward spring force of the ring by bending it into a less round configuration.

2.5.4 Scissors Mounting Ring

For pipes larger than 15" in diameter, Teledyne Isco offers the adjustable Scissors Ring (also known as the Universal Mounting Ring). This device consists of two or more metal strips that lock together with tabs to form a single assembly. There is a base section where the sensors are mounted, two or more extension sections (usually), and a scissors section at the top that expands the entire assembly and tightens it inside the pipe. The scissors section contains a long bolt that increases the length of the section as it is tightened.

The assembled scissors rings fit pipe diameters from 16" to 80". Secure the unit in place by tightening the scissors mechanism with a 5/8" socket wrench or other suitable tool. Ring sections are .040" thick half-hard 301 stainless steel sheet. All other parts are also stainless steel, except for the plastic cable ties in the hardware kit.

Each extension, 1, 2, 3, and 4, adds 9.0", 21.5", 31.5", or 41.5", respectively, to the circumference of the ring. Used alone, the base section fits a pipe that is approximately 16" to 19" in diameter. The 9.0" (smallest) extensions can be used to take up or remove slack, to bring the scissors mechanism into a position where it can be effectively tightened.

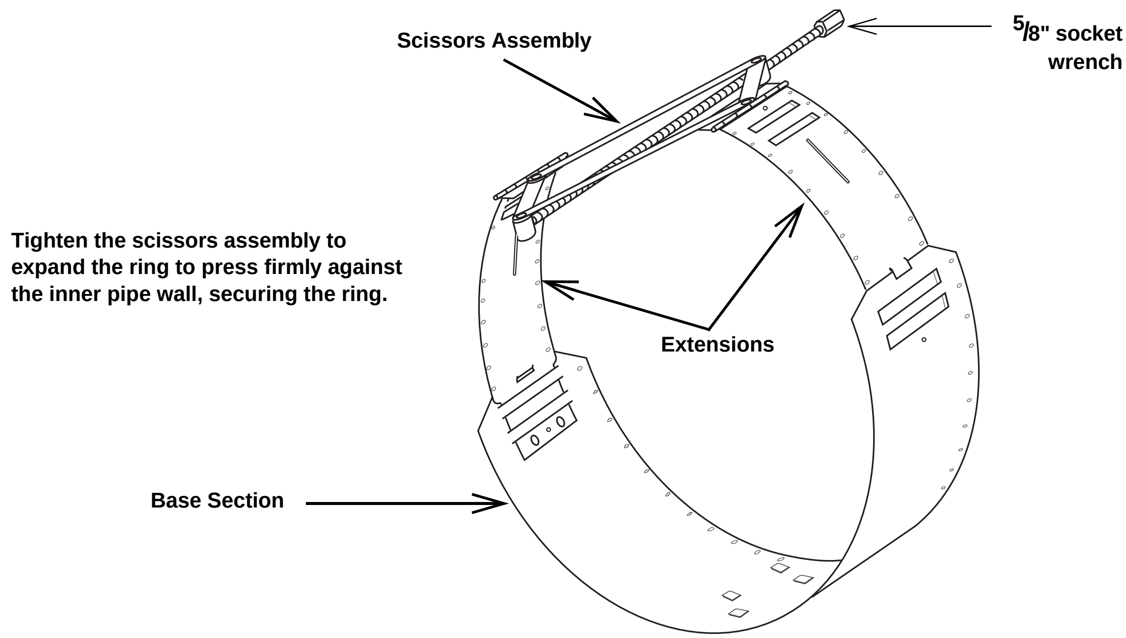


Figure 2-12 Scissors Ring adjustment

☑ **Note**

The hardware kit includes flat head bolts and nuts.Teledyne Isco strongly recommends bolting the assembled sections together before installation, using the holes provided for that purpose. This can greatly increase safety and prevent the assembly from being torn apart.

Do not overtighten the mechanism. It is designed to flex somewhat to provide a positive lock, once moderately tightened.

For installations in larger channels and/or high flow, extensions 2, 3, and 4 have slots for attaching the ring to the channel wall using appropriate anchoring hardware.

To prevent debris from catching on the probe cable, it is important to attach the cable to the mounting ring so it offers as little resistance to the flow as possible. Attach the sensor cable to the downstream edge of the ring, using the self-locking plastic ties supplied with the ring. Place the ties through the holes in the mounting ring and then lock them around the cable.

⚠ **CAUTION**

Do not overtighten the plastic cable ties; they should be tightened just enough to secure the cable in place, without greatly indenting the cable. Overtightening the plastic ties may collapse the reference tube in the cable, blocking it.

2.5.5 Completing the Sensor Installation

The 350 sensor installation is finished by securing any excess sensor cable using cable clamps or other means.

The reference tube inside the cable can be restricted or blocked if the cable is kinked, sharply bent, coiled, or otherwise pinched. The sensor cable should be handled and mounted with care.

A damaged cable can affect the operation of the sensor, particularly if the reference air tube inside the cable is collapsed or blocked.

⚠ CAUTION

If there is any distance between the point where the sensor cable leaves the mounting apparatus and the location of the flow meter, *be sure* to attach the cable to the flow stream wall to prevent it from moving, tangling, and trapping debris. Install the cable so that it is not at risk of damage resulting from other activity taking place in the area.

2.6 Street Level Installation System

The Street Level Installation System provides a way to install Isco sensors in round pipe sewers without having to enter the manhole. The system includes an insertion tool with a multi-section pole and five differently-sized expansion rings (6", 8", 10", 12", and 15") with an adjustable strap for each ring. The six pole extensions and the adjustable strap allow installation of the expansion rings in manholes as deep as 15 feet.

For more information about the Street Level Installation System, contact your Teledyne Isco representative.

2.7 Grounding Kit for Surge Protection

Added protection from lightning damage is available with the grounding lug kit. This kit consists of a stainless steel terminal for connecting a grounding conductor, and hardware to fasten it to a sensor mounting ring.

TIENet™ Model 350 Area Velocity Sensor

Section 3 Setup and Programming

3.1 Configuring the System

To configure the Signature flow meter for operation with the TIENet 350 sensor, press MENU (B) to access the top menu, and select Hardware Setup. For all TIENet devices including the 350, select Smart Sensor Setup (TIENet).

3.1.1 Updating the Device List

When the 350 is physically added to the system, select Perform Scan so that the flow meter detects it. When the scan is complete, the 350 appears in the list of connected devices, ready to be configured with the steps shown in Figure 3-2 on the following page.

> **Note**
> From the Hardware Setup menu, “Configure” refers to defining and selecting the parameters for each connected device.

The parameters that will appear for the 350 sensor are:

350 Level	350 Temperature
350 Velocity	350 Velocity Signal
350 Velocity Spectrum	350 Vel Spectrum Ratio
350 Sense Voltage	

The name of any parameter can be customized by highlighting it and pressing Enter ( ) to display the character grid. Navigate the grid using the arrow keys. Select characters with Enter and clear characters with Delete ( ).

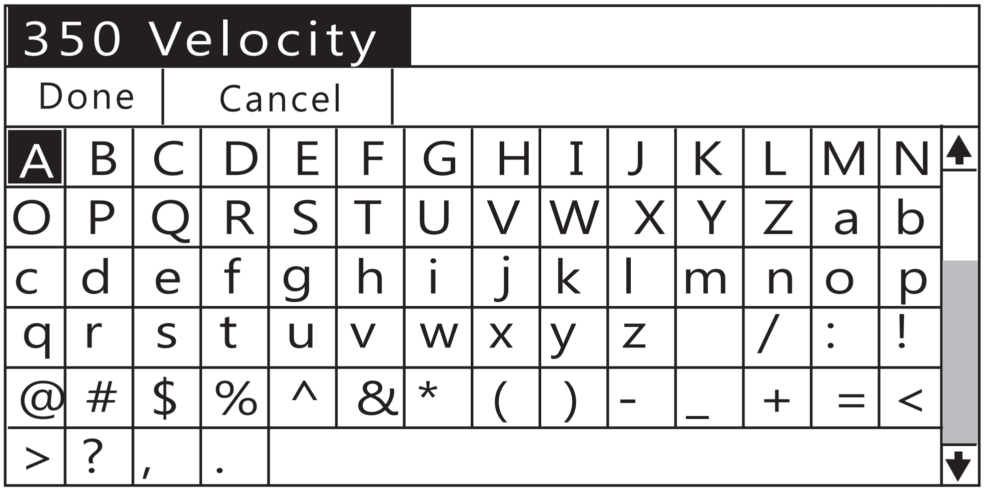
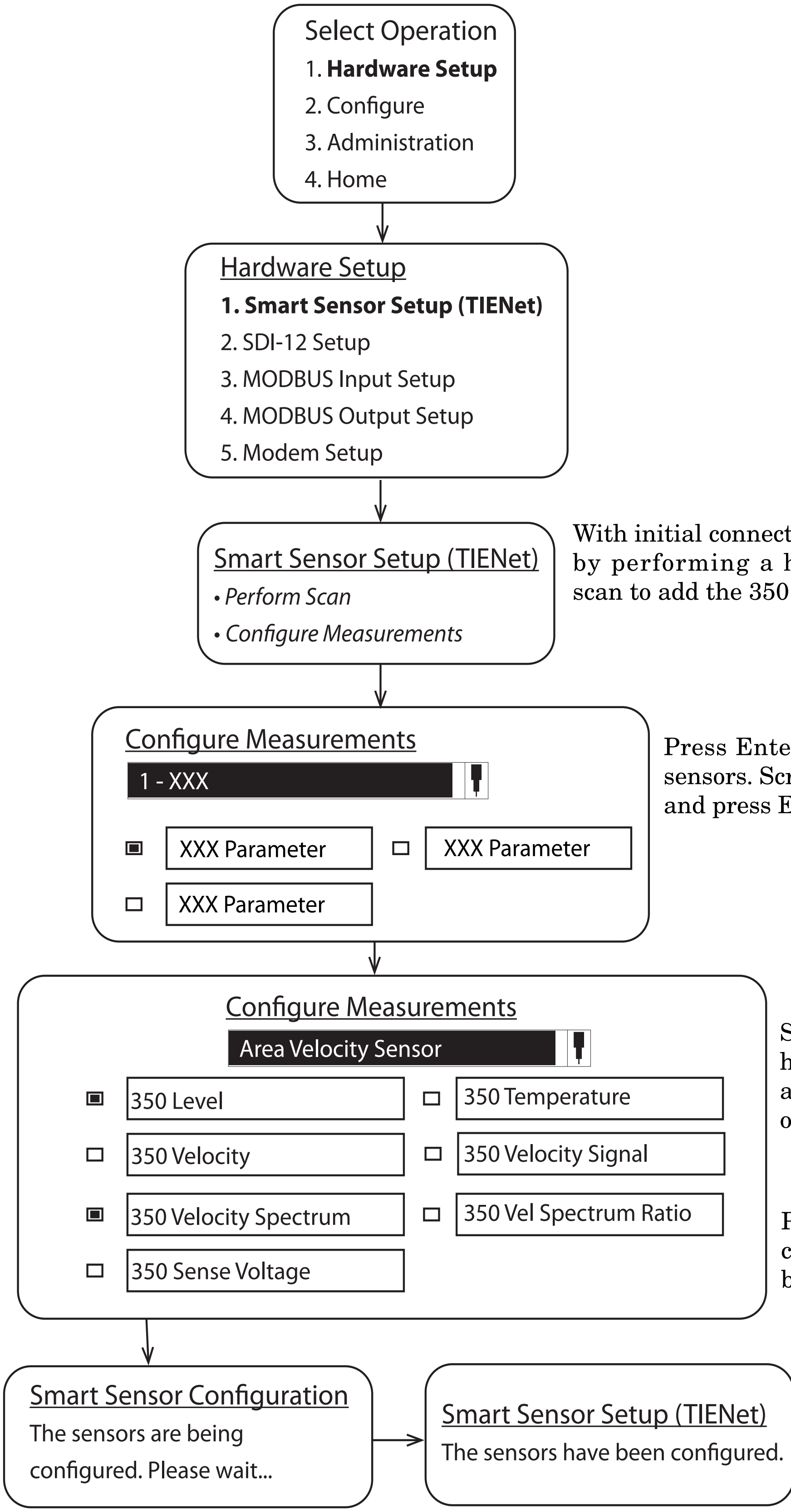


Figure 3-1 Character grid



With initial connection, begin by performing a hardware scan to add the 350.

Press Enter for a list of sensors. Scroll to the 350 and press Enter to select

Scroll with arrow keys to highlight / select / deselect any displayed parameter or edit its name.

Press NEXT to confirm configuration. There may be a slight delay.

Figure 3-2 Menu Tree: 350 Configuration

3.2 Measurement Setup

From Measurement Setup (Figure 3-3), you can set up velocity measurement or make changes to the advanced settings.

> ☑ **Note**
> Refer to your Signature user manual for information about Flow Rate Input Setup and Volume Input Setup.

3.2.1 350 Velocity

The *Measure positive velocity only* setting causes any negative readings to be discarded in the average velocity calculation. If this is set to false, both positive and negative readings are reported.

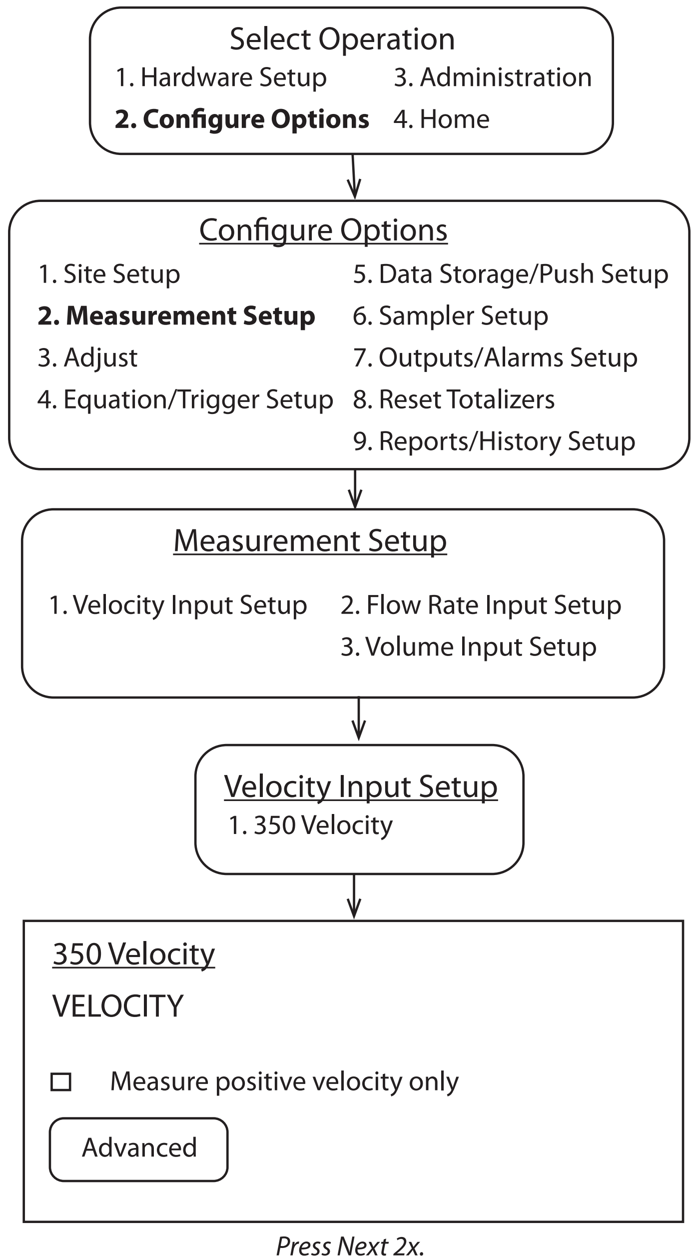


Figure 3-3 Configuring level and velocity measurement

3.2.2 Advanced Settings

The sensor is pre-programmed at the factory with the **Advanced Settings** for your application. Should your application require the addition of any correction factors, the Advanced button opens the Advanced settings window (Figure 3-4).

Prior to making any changes to the Advanced settings, record the factory settings in case you need to restore them later.

Input velocity coefficients can be adjusted for A, B, and C, where:

V = A (offset) + BV (slope) + CV^2 (second-order parameter).

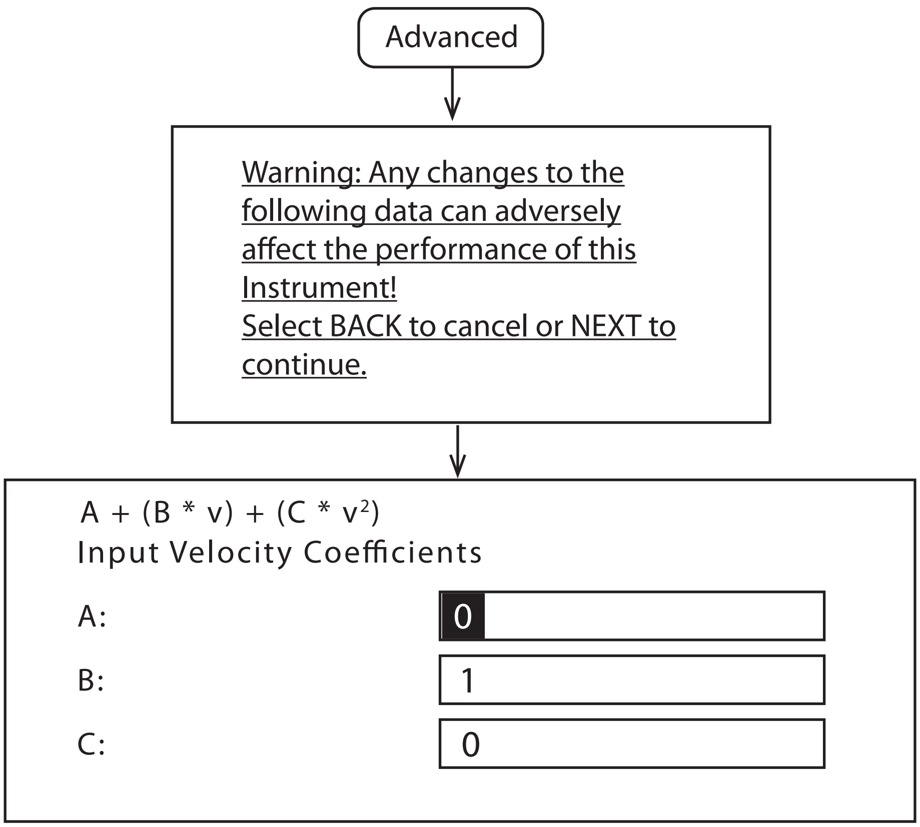


Figure 3-4 Measurement setup: Advanced settings for 350 AV sensor

3.2.3 Setting the 350 Level

The Level Adjustment screen is accessed via the Shortcuts menu on the Signature. From this screen, you can also update the display to show the current level of the stream.

Press SHORTCUTS (A) and select Adjust Level.

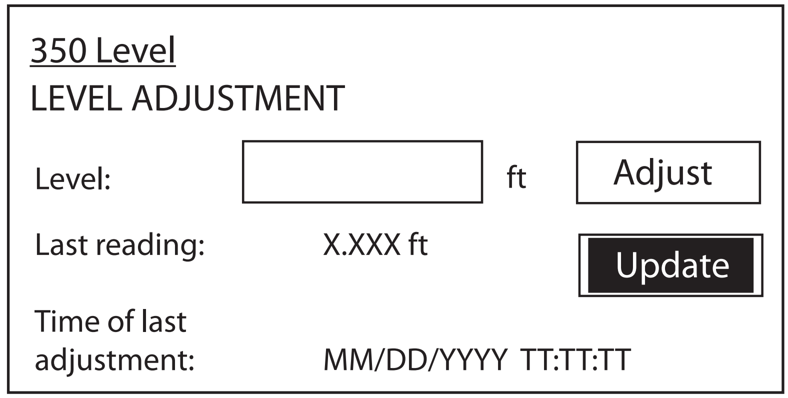


Figure 3-5 350 Level adjustment screen

To set an initial or new level, enter the value in the field next to **Level**, and select **Adjust**. To update the current reading, select **Update**.

Prior to mounting the sensor in the flow stream, check the displayed level reading. In open air, the reading should be zero. If not, adjust the level to zero.

Note

If the 350 sensor is part of the optional submerged functionality for a LaserFlow system, the initial level setting is the measured distance from the bottom of the channel to the bottom of the LaserFlow sensor.

Following the 350 sensor installation in the flow stream, another measurement device can be used to verify the 350 level reading. Allow the sensor to operate in the stream for approximately 30 minutes prior to verifying the level.

TIENet™ Model 350 Area Velocity Sensor

Section 4 Maintenance

4.1 Firmware Updates

The TIENet device's firmware is updated via the USB port on the front panel of the Signature Flow Meter. Step-by-step instructions for updating the firmware can be found in Section 2 of the Signature user manual.

If your system uses a 2160 LaserFlow module, the sensor firmware can also be updated using the "Update Isco Instrument Software" tool included with Flowlink software. Refer to the software help windows for step-by-step instructions.

4.2 External Desiccator

When dry, the loose silica gel desiccant inside the chambers is orange or yellow. When the desiccant becomes saturated with moisture, it turns green or blue, indicating that the intake air and reference line are no longer protected from humidity.

☑ Note

Teledyne Isco recommends checking the desiccant at least every 6 months, and changing/renewing the desiccant before the entire compartment has changed color.

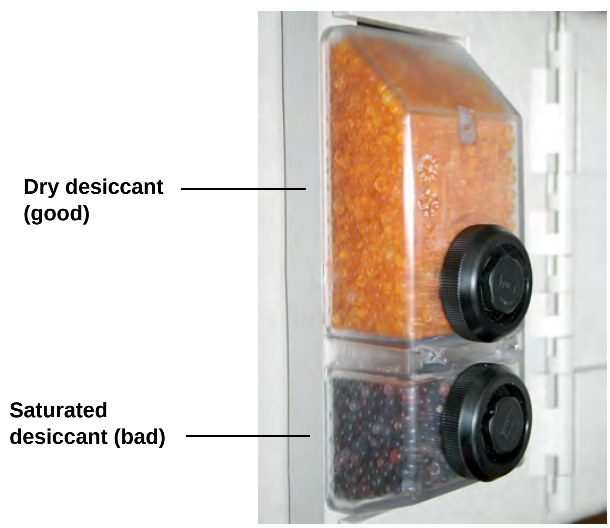


Figure 4-1 Desiccant indicating saturation

The desiccant cartridge is held in place by a spring tab on the side of the flow meter. Press against the front of the cartridge to disengage it from the unit.

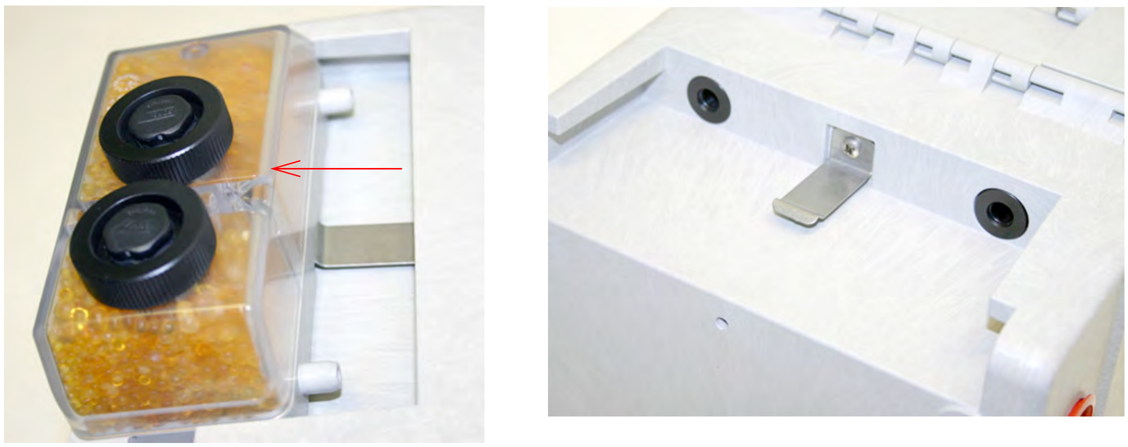


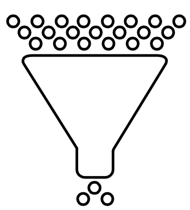
Figure 4-2 Removing the external desiccant cartridge

Unscrew the two black caps and carefully pour the desiccant out.

If removal is difficult, screw the caps back in and unscrew again.

Gently knock the caps and the cartridge against a hard surface to free any small particles in the threads, as these can hinder proper sealing and cause wear.

Using a funnel, fill both chambers with dry desiccant, replace the caps, ensuring that they are fully engaged. Press the cartridge back into place on the side of the flow meter.



Use a funnel to refill the desiccator.

☑ *Note*

If this is a new desiccant cartridge, remove the two red protective end caps from the ports before installing a new cartridge.

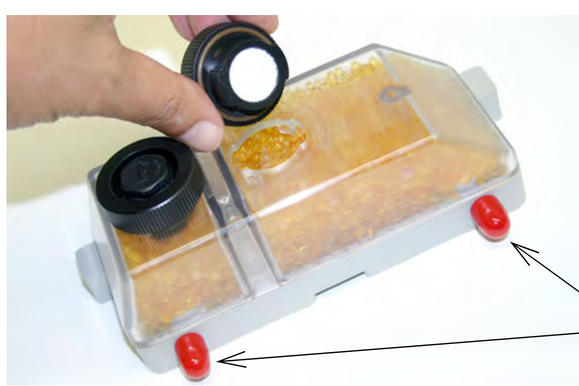


Figure 4-3 Opening the desiccant cartridge chambers

Renewing loose desiccant

To renew the desiccant, spread it in a single layer on a flat metal tray. Place in a vented, circulating forced air, conventional oven in a well ventilated room, and heat at 100 - 175°C (212 - 350°F) for about three hours, or until the color has returned to orange or yellow.

4.3 Cleaning

The cable and outer surfaces of the 350 sensor can be cleaned with mild detergent and warm water.

⚠ CAUTION

Never allow water to enter the unterminated end of the sensor cable or reference tube.

If the flow stream carries a great deal of debris, beware of organic materials that may collect beneath the 350 sensor. This material swells as it becomes saturated with water and may exert pressure on the outer diaphragm. This can damage the transducer and permanently disable the 350 sensor. Keeping the ports clean not only prevents damage, but ensures that the 350 sensor will respond to the hydrostatic pressure above instead of the pressure created by swollen material.

If the ports become blocked:

1. Remove the sensor from its mounting ring, plate, or carrier.
2. Gently scrape any accumulated solids off the exterior of the sensor. Use a brush and flowing water.
3. Remove debris that has accumulated in the ports.
4. The outer diaphragm is behind the small metal cover on the bottom of the sensor. It should be visible through the two small openings at the center of the cover. Gently flush the cover and holes with water to remove debris.

⚠ CAUTION

Never remove the protective diaphragm cover. Avoid using tools near the cover openings. Direct or indirect contact with the outer diaphragm can permanently damage the 350 sensor.

4.4 Contact Teledyne Isco

If you have further questions about the installation, operation, and maintenance of your TIENet device, please contact our service department at:

Teledyne Isco
4700 Superior St.
Lincoln, NE 68504

Phone: 866 298-6174 or 402 464-0231
Fax: 402 465-3022
E-mail: IscoService@teledyne.com

TIENet™ Model 350 Area Velocity Sensor

Appendix A Replacement Parts List

A.1 Replacement Parts Diagrams and Listings

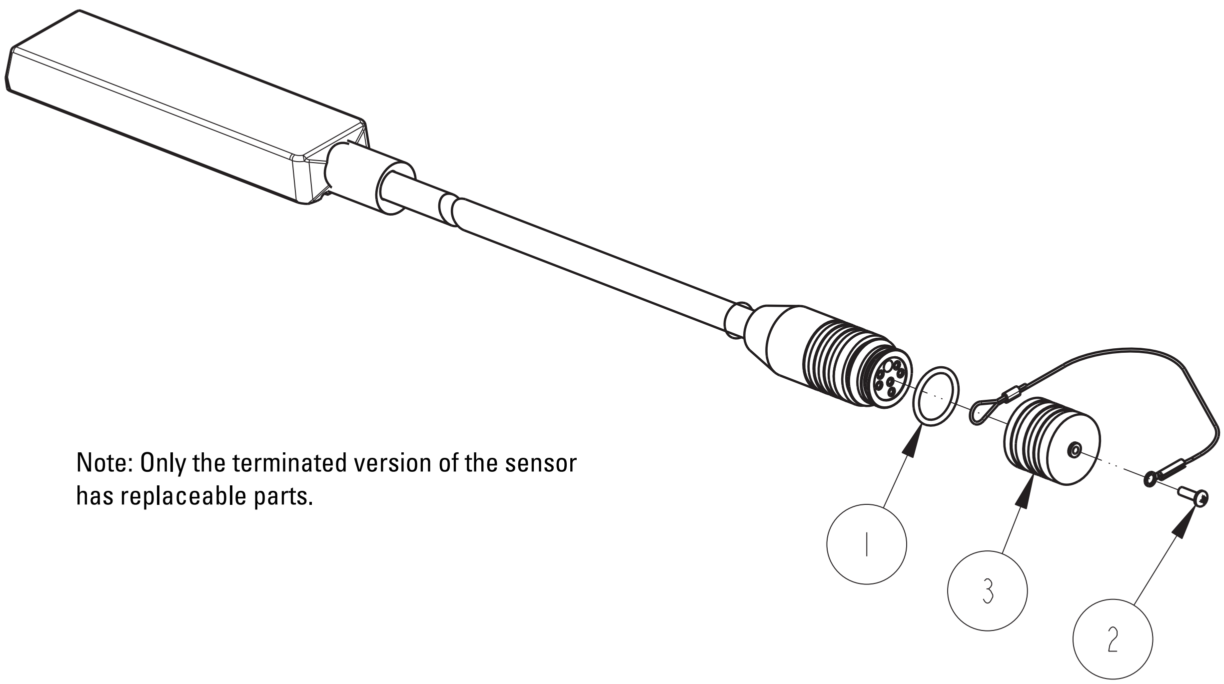
Replacement parts are called out in illustrations in this section. Reference the call-outs in the accompanying tables to determine the part number for the item.

Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Department
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX:(402) 465-3022

E-mail:IscoInfo@teledyne.com



Note: Only the terminated version of the sensor has replaceable parts.

REPLACEMENT PARTS LIST,
350 AREA VELOCITY SENSOR

DRAWING NO.
604352023
SHEET 1 OF 2

604352023

REPLACEMENT PARTS LIST

SHEET: 2 OF 2

TELEDYNE ISCO

REV:

ITEM NO.	PART NUMBER	DESCRIPTION
1	202100669	O-RING, .669ID, .079 CROSS SECTION
2	231310140	SCREW, #4X3/8 SELF TAPPING
3	602003075	CAP, MALE PROBE

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

TIENet™ Model 350 Area Velocity Sensor

Appendix B Velocity Error Codes

B.1 Introduction

Erroneous flow data can result from a number of factors. The area velocity system provides numbered error codes associated with the 350 Velocity data to assist in troubleshooting.

The error codes are viewable using Isco Flowlink® software. Definitions of the error codes are provided in Table B-1. For further assistance, contact the factory.

B.2 Importing Data Dump (.ddp) Files

Flow data from the Signature Flow Meter can be downloaded onto a USB flash drive in the form of a .ddp (Data Dump) file.

To download the data:

1. Connect a flash drive to the USB port on the front panel of the Signature. From the USB Options menu, select Retrieve Data.
2. Select “All data,” or specify a start date or date range, and press NEXT. The data will be stored on the connected flash drive in a folder called “ISCO.”
3. Connect the flash drive to a computer running Flowlink.
4. In Flowlink, select File > Import. When the import window appears, browse to the folder containing the desired .ddp file. Select the file and click Open.

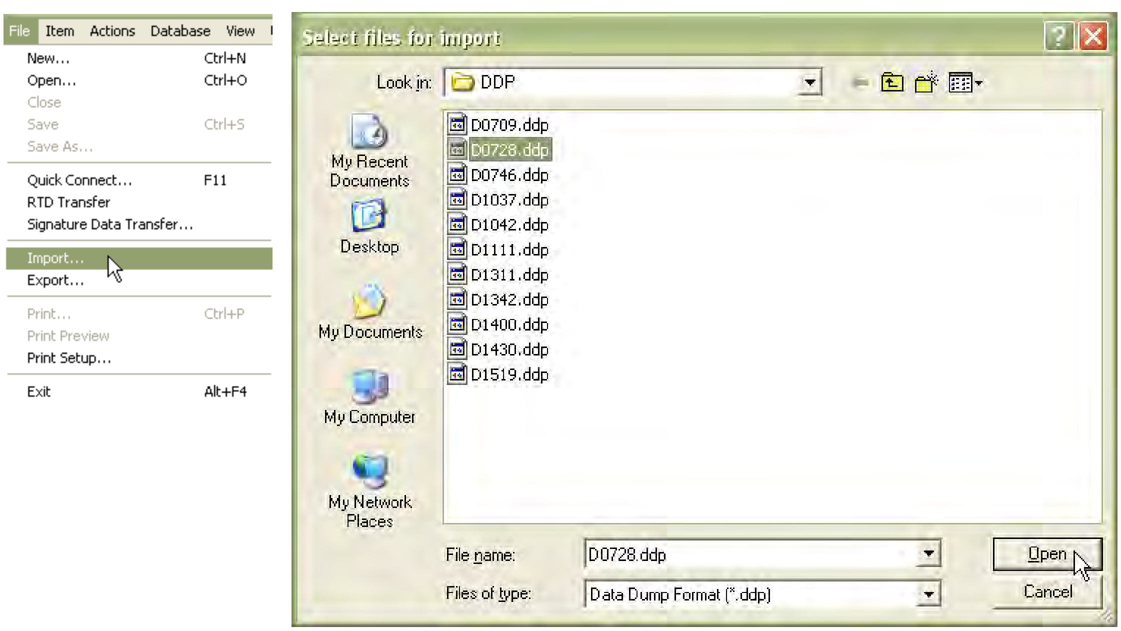


Figure B-1 Signature flow data: Selecting the .ddp file(s)

A progress window will appear, displaying the filename, site name, device type, number of data types in the site file, and progress of the download.

5. When the two progress bars have completed, click Done to close the window.

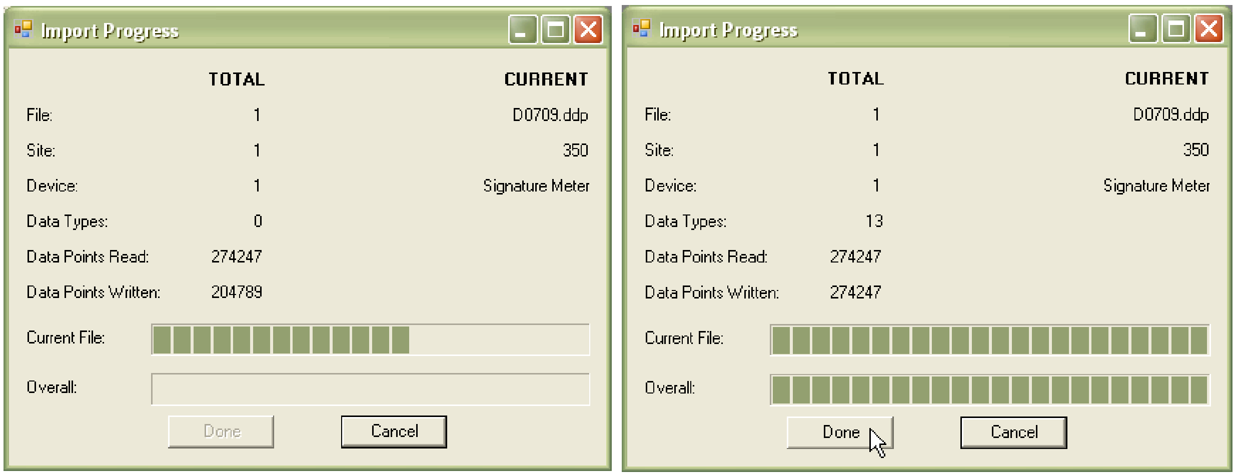
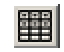


Figure B-2 Signature flow data: Importing the .ddp file

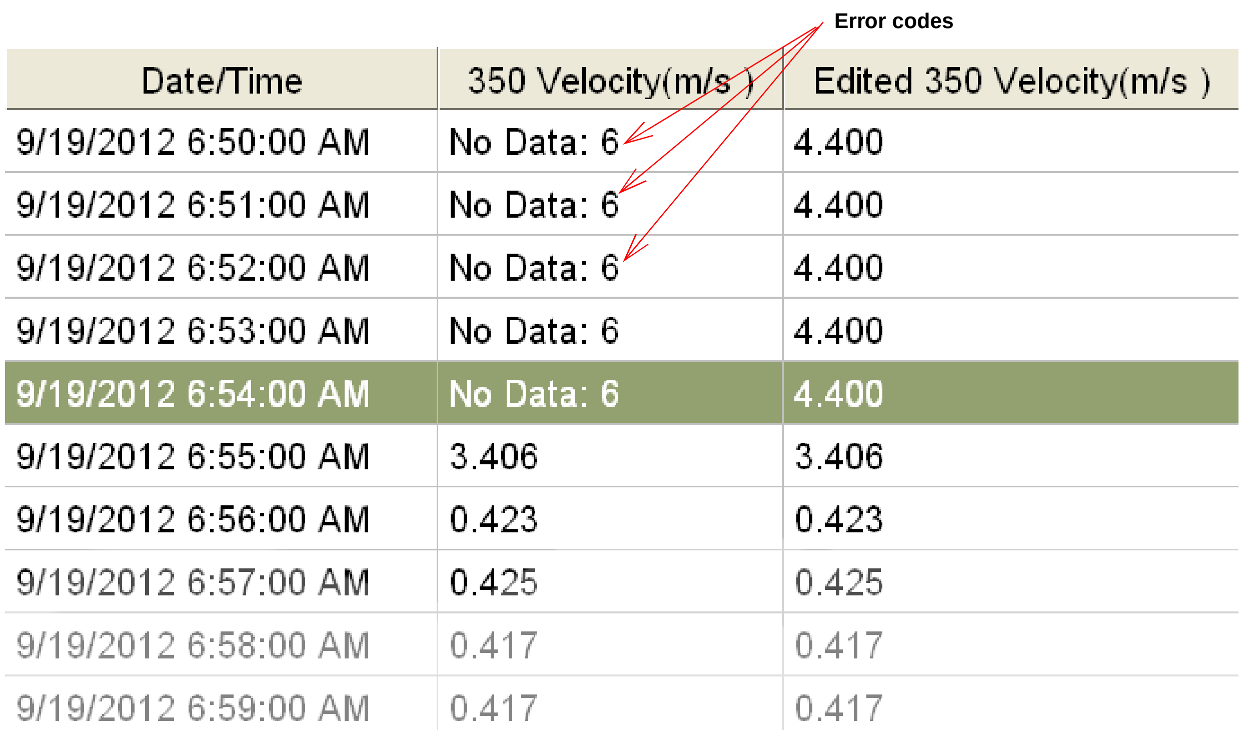
Upon completion, a new site file will appear in the Flowlink workspace.

B.3 Viewing Velocity Error Codes in Flowlink

In order to view error codes for velocity readings:

1. In the Flowlink workspace, double-click the 350 Velocity data set. When the graph appears, click the Table View button. 
2. When the table appears, click the Edit/View button. 

Any error codes will appear in the 350 Velocity column following the words “No Data.” Definitions of the error codes are provided in Table B-1.



Date/Time	350 Velocity(m/s)	Edited 350 Velocity(m/s)
9/19/2012 6:50:00 AM	No Data: 6	4.400
9/19/2012 6:51:00 AM	No Data: 6	4.400
9/19/2012 6:52:00 AM	No Data: 6	4.400
9/19/2012 6:53:00 AM	No Data: 6	4.400
9/19/2012 6:54:00 AM	No Data: 6	4.400
9/19/2012 6:55:00 AM	3.406	3.406
9/19/2012 6:56:00 AM	0.423	0.423
9/19/2012 6:57:00 AM	0.425	0.425
9/19/2012 6:58:00 AM	0.417	0.417
9/19/2012 6:59:00 AM	0.417	0.417

Figure B-3 Identifying error codes in the 360 Velocity data set

Table B-1 Definitions of 350 Velocity Error Codes

Error Code	Definitions
1: Measurement Error	Unable to get valid velocity reading after a specific number of retries.
3: Velocity Filter Error	Unable to get valid velocity spectrum to determine what frequency range is sampled for the velocity reading. This could be an indication of debris or silt-ing.
5: Velocity Gain Error	The average gain required from the amplifier in order to see reflected Doppler information is too high, indicating a weak signal.This could be an indication of fouling of the sensor
6: Velocity level too low	Velocity measurement was attempted while liquid level was less than one inch.
7 w/ non-zero (#.###) Edited Velocity:	Measurement time-out. Edited Velocity will be last valid measurement reported by sensor.
7 w/ zero (0.000) Edited Velocity:	No sensor response to request for Take Reading or Report Measurement.

产品中有毒有害物质或元素的名称及含量

Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	O
显示 Display	X	O	O	O	O	O
接线 Wiring	O	O	O	O	O	X
内部电缆 Internal Cables	O	O	O	O	O	X
直流电机 DC Motor	X	O	O	O	O	X
接头 Connectors	O	O	X	O	O	O
电池 Battery	X	X	X	O	O	O
电磁阀 Solenoid valve	X	O	O	O	O	X

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component’s any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打“X” 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component’s at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the “X”marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January, "B" is February and so on.

Teledyne Isco One Year Limited Factory Service Warranty*

This warranty exclusively covers Teledyne Isco instruments, providing a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period due to faulty parts or workmanship will be repaired at the factory at no charge to the customer. Teledyne Isco's exclusive liability is limited to repair or replacement of defective instruments. Teledyne Isco is not liable for consequential damages.

Teledyne Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Teledyne Isco, and Teledyne Isco will pay surface transportation to return the repaired instrument to the customer. Teledyne Isco will not pay air freight or customer's packing and crating charges. This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

The warranty for any instrument is the one in effect on date of shipment. The warranty period begins on the shipping date, unless Teledyne Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as pH sensors, charts, ribbon, lamps, tubing, and glassware; fittings and wetted parts of valves; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover products not sold under the Teledyne Isco trademark or for which any other warranty is specifically stated.

No item may be returned for warranty service without a return authorization number issued by Teledyne Isco.

This warranty is expressly in lieu of all other warranties and obligations and Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

The warrantor is Teledyne Isco, 4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to the USA and countries where Teledyne Isco does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.**

Before returning any instrument for repair, please call, fax, or e-mail the Teledyne Isco Service Department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE PROBLEM.**

Shipping Address: Teledyne Isco - Attention Repair Service
4700 Superior Street
Lincoln, NE 68504 USA

Mailing Address: Teledyne Isco
PO Box 82531
Lincoln, NE 68501 USA

Phone: Repair service: (800) 775-2965 (lab instruments)
(866) 298-6174 (samplers & flow meters)
Sales & General Information: (800) 228-4373 (USA & Canada)

Fax: (402) 465-3001

Email: IscoService@teledyne.com

October 11, 2013 P/N 60-1002-040 Rev H

TIENet™ 360 LaserFlow™ Velocity Sensor

Installation and Operation Guide

Part #69-4363-043

Revision D, February 2015

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If a problem persists, call or e-mail Teledyne Isco technical support for assistance. Simple difficulties can often be diagnosed over the phone. For faster service, please have your serial number ready.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by technical support, including the use of the **Return Merchandise Authorization (RMA)** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

Contact Information

Customer Service

Phone: (800) 228-4373 (USA, Canada, Mexico)

(402) 464-0231 (Outside North America)

Fax: (402) 465-3022

Email: IscoCSR@teledyne.com

Technical Support

Phone: Toll Free (866) 298-6174 (Samplers, Flow Meters and Multi-parameter Probes)

Toll Free (800) 775-2965 (Syringe Pumps and Liquid Chromatography)

Email: IscoService@teledyne.com

Return equipment to: 4700 Superior Street, Lincoln, NE 68504-1398

Other Correspondence

Mail to: P.O. Box 82531, Lincoln, NE 68501-2531

Email: IscoInfo@teledyne.com

General Warnings

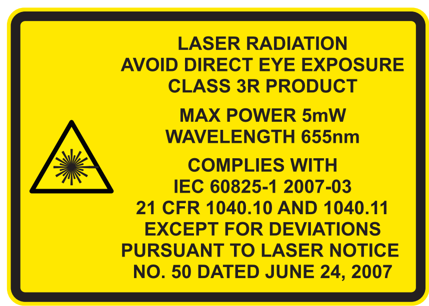
⚠ WARNING

Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Wavelength: 655 nm

Maximum Power: 5 mW

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed of the following general warnings:



⚠ WARNING

Avoid hazardous practices! If you use this instrument in any way not specified in this manual, the protection provided by the instrument may be impaired.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

⚠ CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

⚠ WARNING

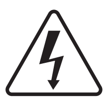
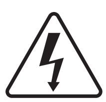
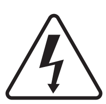
Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

⚠ DANGER

DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.

Hazard Symbols

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
Advertencias y Precauciones	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.
	Esta señal alerta sobre la presencia de alto voltaje en el interior del producto.

TIENet™ 360 LaserFlow™ Velocity Sensor

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Section 1 Introduction

Section 2 Preparation and Installation

Section 3 Setup with Signature® Flow Meter

Section 4 Setup with 2160 LaserFlow Module

Section 5 Maintenance and Optional Kits

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Appendix B Installation Checklist

Appendix C Velocity Error Codes

Appendix D Material Safety Data Sheets

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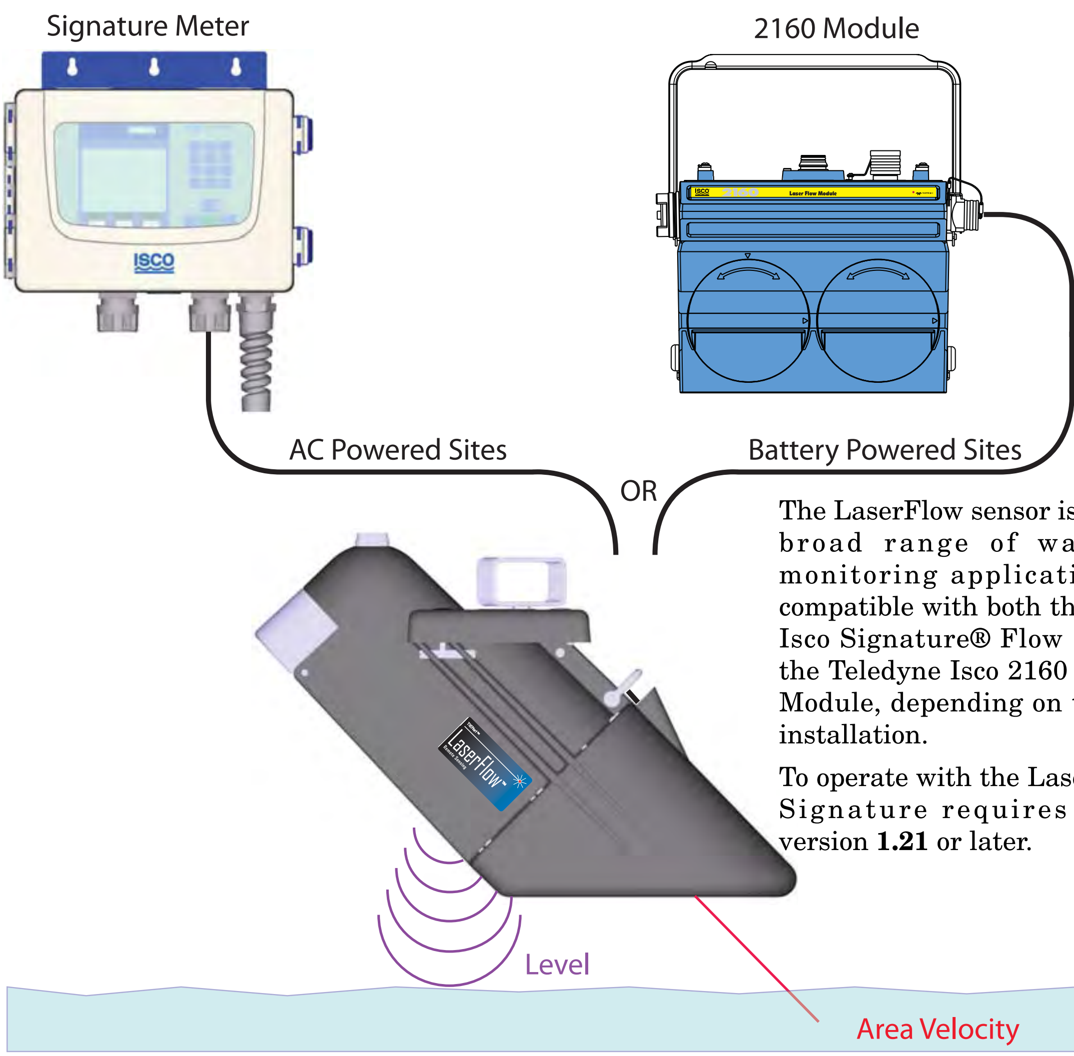
TIENet™ 360 LaserFlow™ Velocity Sensor

Section 1 Introduction

1.1 Description

The TIENet™ 360 LaserFlow sensor is an Area Velocity flow measurement device that remotely measures flow in open channels with non-contact Laser Doppler Velocity Sensing and non-contact Ultrasonic Level Sensing technologies. The sensor uses advanced technology to measure velocity with a laser beam at single or multiple points below the surface of the wastewater stream.



The LaserFlow sensor is ideal for a broad range of wastewater monitoring applications. It is compatible with both the Teledyne Isco Signature® Flow Meter and the Teledyne Isco 2160 LaserFlow Module, depending on the type of installation.

To operate with the LaserFlow, the Signature requires software version **1.21** or later.

Figure 1-1 Basic LaserFlow system (showing both AC and battery-powered options)

1.2 Design

The LaserFlow sensor consists of a housing with two measurement technologies working together.

1.2.1 Measurement Technology

The **laser velocimeter** has a laser diode that serves as both transmitter and receiver of a laser light beam. The Doppler-shifted signal frequency is used to determine flow stream velocity.

The **ultrasonic level transducer** determines the stream's level by emitting an ultrasonic pulse and measuring the time it takes for the echo to return from the stream's surface. The transducer is both pulse transmitter and echo receiver.

1.2.2 Cabling

The LaserFlow sensor is available with a 10m or 23m standard length cable. Custom cable length is also available. For greater distances, external connection via conduit, and connection of additional TIENet™ devices, the TIENet™ Expansion Box is available.

Distance can be increased by installing the TIENet™ Expansion Box closer to the installed sensor and adding a custom-length TIENet™ cable between the box and the Signature® flow meter. The maximum recommended distance between the LaserFlow and the Signature® flow meter is 45.7 meters (150 feet). The maximum recommended distance between the LaserFlow and the 2160 LaserFlow module is 22.9 meters (75 feet).

1.3 Operation

The **laser velocimeter** uses a laser beam to generate a source frequency light, which is focused at points below the surface of the flow stream. The light is scattered back to the laser. The returned light is frequency shifted due to the Doppler effect and the motion of the flow. The lens that focused the laser light below the surface of the flow stream now focuses the returned light back into the laser. The source light and shifted light frequencies are mixed to determine a Doppler shift, which is then used to calculate flow stream velocity.

The LaserFlow is able to move the laser beam transverse to the flow in order to obtain readings at multiple points in the flow, with automatic compensation to maintain precise focus at all times.

The **ultrasonic level transducer** emits multiple ultrasonic pulses per second. Between pulses, the transducer switches from transmitter to receiver. When the transducer receives the echo from the water's surface, the sound energy is converted into an electrical signal. The signal is then amplified and processed by the flow meter into an "echo-received" signal. The time between the transmitted pulse and the echo-received signal is proportional to the distance between the transducer and the liquid surface, which is then translated into a level reading. Because the speed of the pulse through the air varies with temperature, compensation is built-in. A temperature sensor inside the

LaserFlow measures ambient temperature. The microprocessor program automatically compensates for speed-of-sound changes caused by air-temperature changes.

The LaserFlow operates with no deadband from the measurement point for both level and velocity measurement.

1.4 Optional Submerged Functionality

During submerged conditions, flow measurement continues without interruption with the optional TIENet™ 350 AV sensor, which combines continuous wave Doppler to measure area velocity with a differential pressure transducer to measure level.

The 350 AV sensor is factory-installed on the bottom of the LaserFlow sensor, and is also available as a kit for installation in an existing system. Refer to Section 5.7 for kit installation instructions.

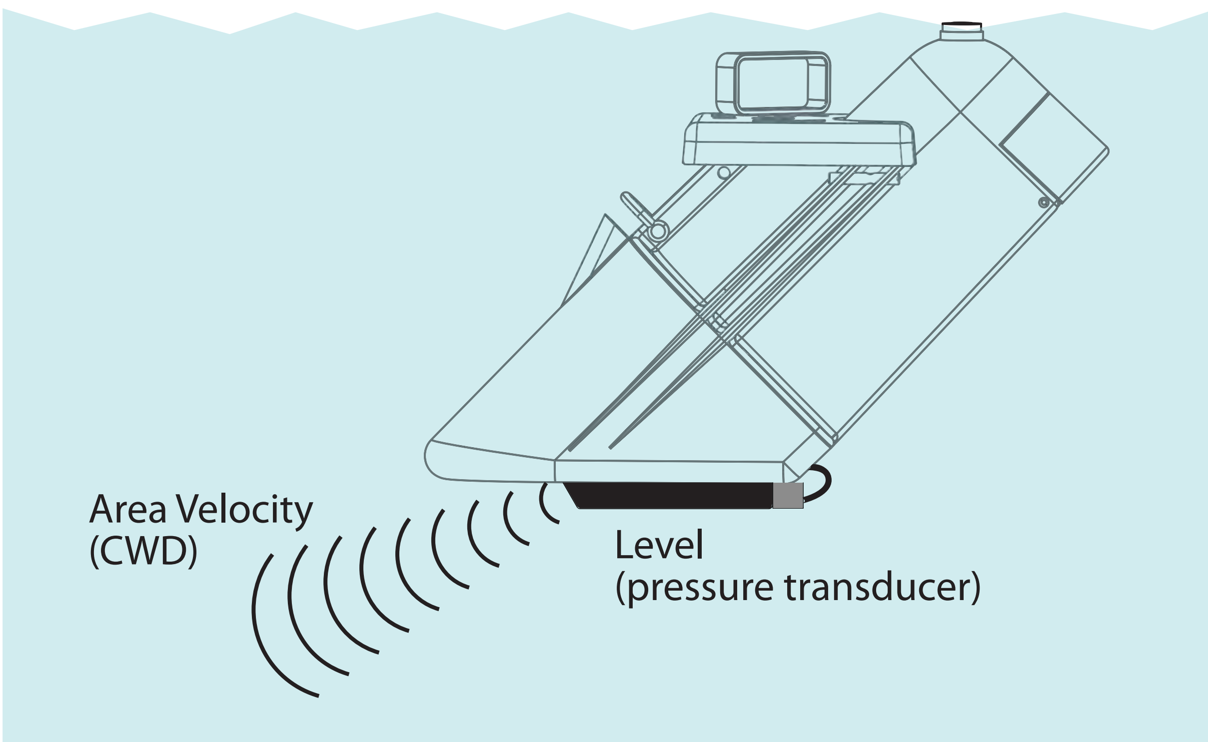


Figure 1-2 Optional submerged functionality

1.5 Technical Specifications

Table 1-1 provides technical specifications for the LaserFlow.

Table 1-1 LaserFlow Sensor Specifications[a]

Size (H x W x D)	38.01 x 26.21 x 56.7 cm	14.96 x 10.3 x 22.32 in
Cable Lengths[b]	10 or 23 m The maximum recommended distance between the LaserFlow and the Signature® flow meter is 45.7 meters (150 feet). The maximum recommended distance between the LaserFlow and the 2160 LaserFlow module is 23 meters (75.5 feet).	32.8 or 75.5 ft
Weight (LaserFlow w/ built-in sensor, 10 m cable) Sensor w/o built-in sensor, 10 m cable LaserFlow w/ built-in sensor, 350 AV Sensor	8.7 kg 8.25 kg 9 kg	19.2 lbs 18.2 lbs 20 lbs
Materials	Conductive Carbon Filled ABS Plastic, SST, Conductive Kynar®[c], Anodized Aluminum, UV Rated PVC	
Enclosure (self-certified)	IP68 (Submerged @ 2 m depth for 72 hrs)	
Certifications	CE EN61326; FDA CDRH 21CFR1040; IEC 60825-1	
Laser Class	Class 3R	
Laser Wavelength	655 nm	
Laser Exit Angle	45° ±3°	
Power (from connected flow meter/module)	Input voltage range: 8 to 26VDC; 12VDC Nominal	
Electrical Connections	Signature Flow Meter 2160 LaserFlow Module	Screw Terminal TIENet™ Plug
Temperature Range	Operating: -20 to 60 °C -4 to 140 °F Storage: -40 to 60 °C -40 to 140 °F	
Flow Accuracy	±4% of Reading (Typical under normal flow conditions)	
Velocity Measurement		
Technology	Non-Contact, Subsurface Laser Doppler Velocity (U.S. patent 8,339,584 and patents pending)	
Measurement Range	-4.6 to + 4.6 m/sec	-15 to +15 ft/sec
Number of velocity readings per measurement	1 to 15 (selectable measurement points)	
Maximum distance: liquid surface to bottom of sensor	3m (10 ft)	
Minimum depth for velocity measurement	0.01m (0.5 in)	
Direction	Selectable Bi-Directional Measurement[d]	
Minimum Velocity	0.15 m/s	0.5 ft/s
Deadband	Zero deadband from bottom of LaserFlow sensor[d]	
Accuracy	±0.5% of reading ±0.03 m/s (0.1 ft/s)	

Table 1-1 LaserFlow Sensor Specifications[a] (Continued)	
Level Measurement	
Technology	Non-Contact Ultrasonic Signal
Measurement Range	0 to 3 m (0 to 10 ft) from measurement point
Accuracy @ 22 °C	±0.006m (0.02 ft) at < 1ft level change; ±0.012m (0.04 ft) at > 1ft level change
Ultrasonic Temperature Coefficient	± 0.0002 x D (m) per °C (± 0.00011 x D (ft) per °F) (Where D is the distance from transducer to liquid surface)
Ultrasonic Beam Angle	10° (5° from center line)
Ultrasonic Signal	50KHz
Deadband	Zero deadband from bottom of LaserFlow sensor[e]

a. All specifications are subject to change without notice.
b. Custom cable lengths also available.
c. Kynar® is a registered trademark of Arkema, Inc.
d. Turbidity > 20 NTU. Distance < 48 inches.
e. Deadband for 310 remote ultrasonic sensor varies due to the type of mounting hardware.

1.6 Accessories

Accessories used in sensor installation are briefly described below. Refer to the next section for ordering information.

1.6.1 Ordering Information

Options and accessories can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: 800 228-4373
402 464-0231
FAX: 402 465-3022

E-mail: IscoInfo@teledyne.com

TIENet™ Expansion Box 60-4307-023

Cord grip fitting, 3/4" NPT, for TIENet™ cable 209-0073-12
Integrated 350 AV Kit for surcharge functionality........ 60-4354-017
Signature Flow Meter Exterior desiccator
(required for use with 330 and 350 TIENet™ devices) 60-4354-019
Silica gel desiccant, 1.5-lb container 099-0011-03

Note

Guidelines for Area Velocity reference line support and networking with the expansion box can be downloaded in the Teledyne Isco application note Signature Flow Meter Expansion Box, available on the company website. Contact the factory for more information.

LaserFlow Instruction Manual........ 69-4363-043
Signature Flow Meter Instruction Manual........ 69-4303-070
Signature Bubbler Flow Meter Instruction Manual 69-4333-004

Permanent Wall Mounting Hardware Kit........ 60-4364-003
Refer to Section 2.6.1 *Wall Mount Installation* for additional information.

Temp Mount Cargo Bar, 48-55" Variable Range........ 60-4364-032
Temp Mount Cargo Bar, 54-66" Variable Range........ 60-4364-034
Temp Mount Cargo Bar, 63-84" Variable Range........ 60-4364-035
Temp Mount Cargo Bar, 83-114" Variable Range........ 60-4364-036
Temp Mount Hardware Assembly........ 60-4364-038
Temp Mount Kit, 48-55" Variable Range 62-4364-032
Temp Mount Kit, 54-66" Variable Range 62-4364-034
Temp Mount Kit, 63-84" Variable Range 62-4364-035
Temp Mount Kit, 83-114" Variable Range 62-4364-036
Temp Mount Elbow Pipe for Offset 60-4368-016
Refer to Section 2.7.1 *Temporary Mounting Installation* for additional information.

Horizontal Sensor Mount Bracket........ 60-4368-020
Sensor retrieval arm for sensor retrieval, replacement, and locking
(Maximum extension of 23 feet) 60-4364-033

ProHanger SST Bracket for suspending equipment in manhole
(Up to 24 inches) 69-2003-599

Note

Teledyne Isco uses FreeRTOS version 5.4.2 in its TIENet™ devices. In accordance with the FreeRTOS license, FreeRTOS source code is available on request. For more information, visit www.FreeRTOS.org.

1.7 Unpacking Instructions

When the system arrives, inspect the outside packing for any damage. Then carefully inspect the contents for damage. If there is damage, contact the delivery company and Teledyne Isco (or its agent) immediately.

⚠ WARNING

If there is any evidence that any items may have been damaged in shipping, do not attempt to install the unit. Please contact Teledyne Isco (or its agent) for assistance.

When you unpack the system, check the items against the packing list. If any parts are missing, contact the delivery company and Teledyne Isco's Customer Service Department. When you report missing part(s), please indicate them by part number. In addition to the main packing list, there may be other packing lists for various sub-components.

It is recommended that you retain the shipping cartons as they can be used to ship the unit in the event that it is necessary to transport the system. Please complete the registration card and return it to Teledyne Isco.

1.7.1 Protective Window Cap

Leave the protective window cap in place until the sensor is ready to be installed.

Before installation, remove the cap. The sensor will not be able to measure velocity with the cap in place. Retain the cap for use during cleaning, storage, or shipment, to protect the laser window from damage.

⚠ CAUTION

Be sure the protective window cap is installed during cleaning, storage, or shipment.

Figure 1-3 Remove protective window cap before installation

TIENet™ 360 LaserFlow™ Velocity Sensor

Section 2 Preparation and Installation

2.1 Safety

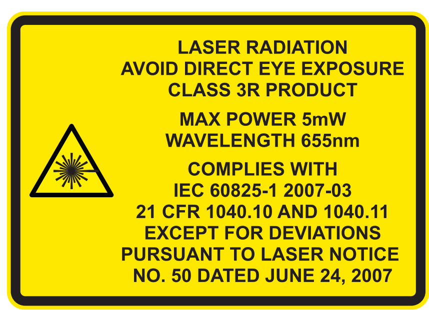
Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood.

2.1.1 Site Conditions

Components are often installed in confined spaces. Some examples of confined spaces include manholes, pipelines, digesters, and storage tanks. These spaces may become hazardous environments that can prove fatal for those unprepared. These spaces are governed by OSHA 1910.146 and require a permit before entering.

⚠ WARNING

The installation and use of this product may subject you to hazardous working conditions that can cause you serious or fatal injuries. Take any necessary precautions before entering a worksite. Install and operate this product in accordance with all applicable safety and health regulations, and local ordinances.



2.2 Sensor Installation Considerations

Measurement accuracy can be affected by a number of site factors that should be taken into consideration when selecting the location for the sensor.

These factors may affect the laser velocity or the ultrasonic level, or both.

If the laser velocimeter or ultrasonic transducer cannot obtain a valid reading at any measurement point, an asterisk (*) will appear next to the displayed reading, indicating there is an error.

2.2.1 Ultrasonic Beam Angle

The ultrasonic level transducer has a 10° beam angle (5° from center line), forming a cone in which the apex is the transducer. The transducer can only detect surfaces within this cone.

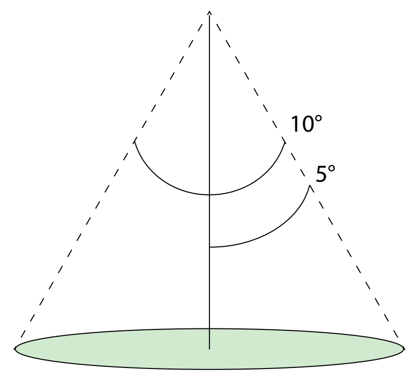


Figure 2-1 Ultrasonic level sensor beam angle

The ultrasonic beam narrows as elevation decreases, which can increase difficulty in detecting the return echo. Narrow channels can result in false echoes and incorrect level readings from the walls and sides of the channel.

The beam widens as elevation increases. If the beam is too wide, the sensor may pick up signals from unwanted surfaces, such as the walls of the channel.

2.2.2 High Water Levels

In most open channel installations where the level may exceed one-half of the full pipe, mount the sensor as near as possible to the midpoint between the entrance and exit to measure over the least turbulent flow.

2.2.3 Submersion and Fouling

Fouling by grease or solids can cause the LaserFlow sensor to malfunction. The LaserFlow is sealed, so unless it is exposed to corrosive substances, submersion will not harm it. Upon retrieval, ensure that the surfaces of the laser window and ultrasonic sensor are clean.

Cleaning instructions are provided in Section 5.

2.2.4 Humidity

Conditions of extremely high or low humidity can cause ultrasonic level detection to occur either earlier or later than normal conditions. A drop in water level, normally compensated for by the sensor's interval-based amplifier, may produce errors in echo detection.

2.2.5 Surface

Solids, foam, oil, and turbulence can all absorb or weaken the ultrasonic and laser signals, causing errors in detection. Foam or oil on the surface of the stream can also produce false level readings.

2.2.6 Temperature

Changes in ambient temperature significantly affect the velocity of sound. If ambient temperature changes rapidly, there may be a delay before the temperature sensor of the ultrasonic transducer can activate temperature compensation.

> ☑ **Note**
>
> If the sensor will be installed outdoors in direct sunlight, use a sunshade to prevent heating of the sensor housing.

2.2.7 Waves

Waves on the surface of the flow stream can deflect the ultrasonic signal, causing erroneous readings or total loss of signal. The flow meter software rejects occasional readings that deviate substantially from normal.

2.2.8 Wind

Strong winds can significantly reduce the strength of the ultrasonic return echo. Narrow beams can result in the sound being blown away; likewise, greater distances to the flow stream surface are more subject to distortion in strong winds.

2.3 Installation Checklist

Prior to installing the system, ensure that you have all supplies and site information readily available.

To assist you in this preparation, this manual includes the *Installation Checklist*, page B-1. Teledyne Isco recommends that you print this appendix and fill in the relevant information.

2.4 Connecting the Cable

The LaserFlow cable will have one of two different connector types: Unterminated for the Signature® Flow Meter (Section 2.4.1), and TIENet plug for the 2160 LaserFlow Module (Section 2.4.3).

Distance can be increased by installing the TIENet Expansion Box closer to the installed sensor and adding a custom-length TIENet cable between the box and the Signature® flow meter. The maximum recommended distance between the LaserFlow and the Signature® flow meter is 45.7 meters (150 feet). The maximum recommended distance between the LaserFlow and the 2160 LaserFlow module is 23 meters (75.5 feet).

2.4.1 Cable Connection: Signature Flow Meter

External TIENet devices such as the LaserFlow sensor are connected to the Signature flow meter in the same manner, usually using conduit or cord-grip cable fittings. Multiple external TIENet devices can be connected simultaneously.

Refer to the Signature flow meter manual for instructions on accessing the instrument's interior components.

⚠ WARNING

Before proceeding, ensure that the flow meter has been disconnected from mains power.

Note

The following steps include instructions for installing cord-grip fittings. Some applications may use user-supplied 3/4" ID conduit for cable routing.

1. Remove one of the 6-position plug-in terminal strip connectors from the case board.

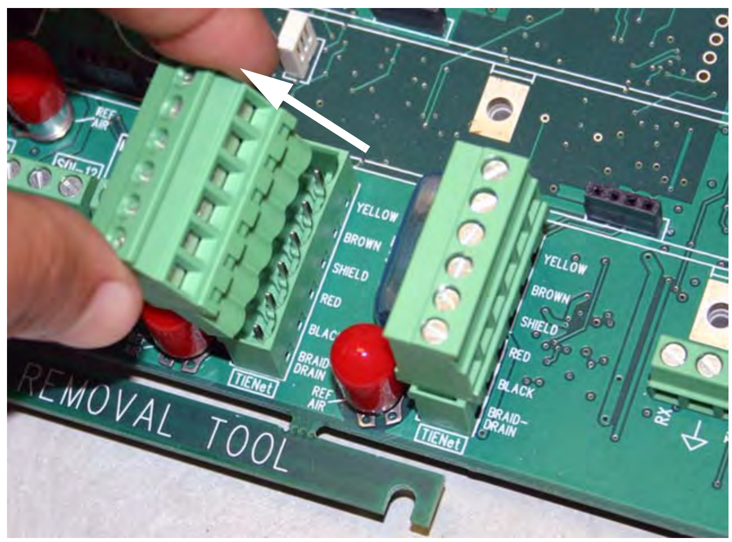


Figure 2-2   TIENet Device terminal strips

2. If using a cord-grip fitting, install the cable nut in the appropriate opening on the bottom of the Signature enclosure, securing it to the wall with the lock nut (concave side facing wall).

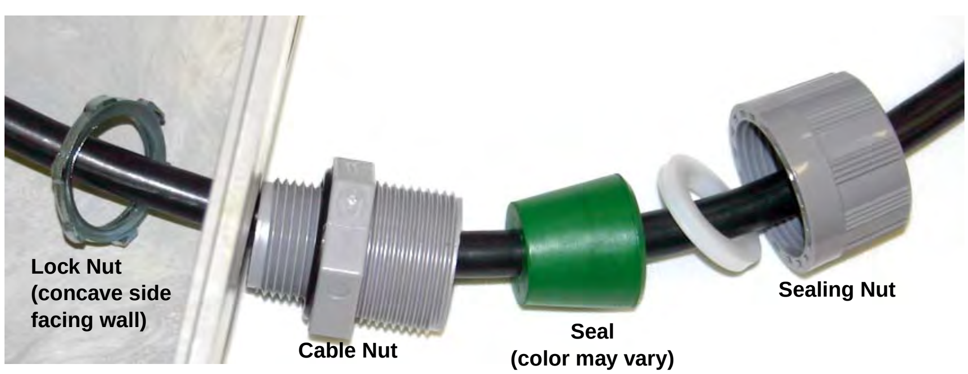


Figure 2-3   Installing cable with a cord-grip fitting

3. Feed the TIENet device cable end through the sealing nut and seal and through the cable nut. Lightly tighten the sealing nut, just enough to hold the cable in place while installing the connector.
4. Attach the wire ends to the terminal strip as shown in Figure 2-4), then press the terminal strip back down into its socket on the case board, as shown in Figure 2-5, ensuring no wire connections are strained. Gently tug each wire when finished, to verify secure connection to the screw terminals.

Note

The SHIELD wire is the bare drain emerging from the foil shield around the YELLOW and BROWN wires. The BRAID-DRAIN wire is the bare drain emerging from the surrounding braided shield inside the cable jacket. It is not necessary to prevent the two braids from coming into contact with each other.

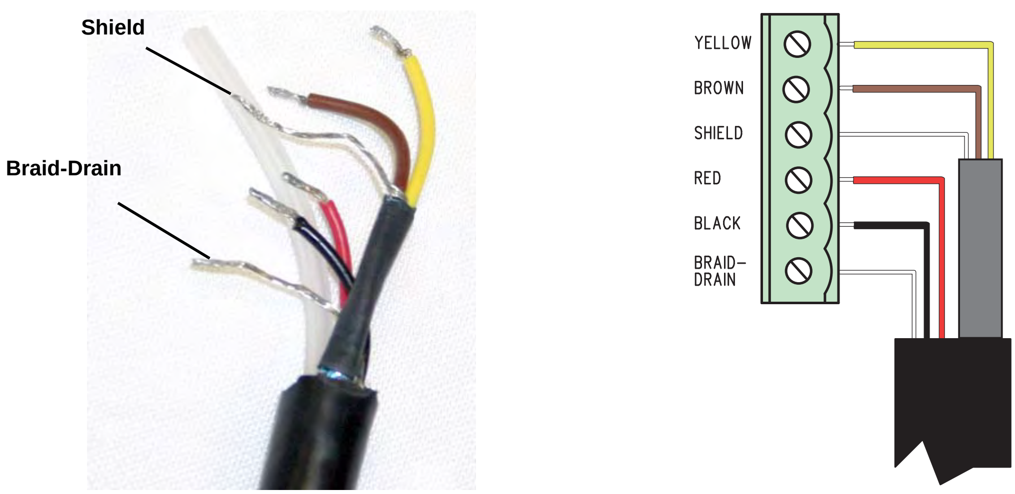


Figure 2-4 TIENet Device terminal connections

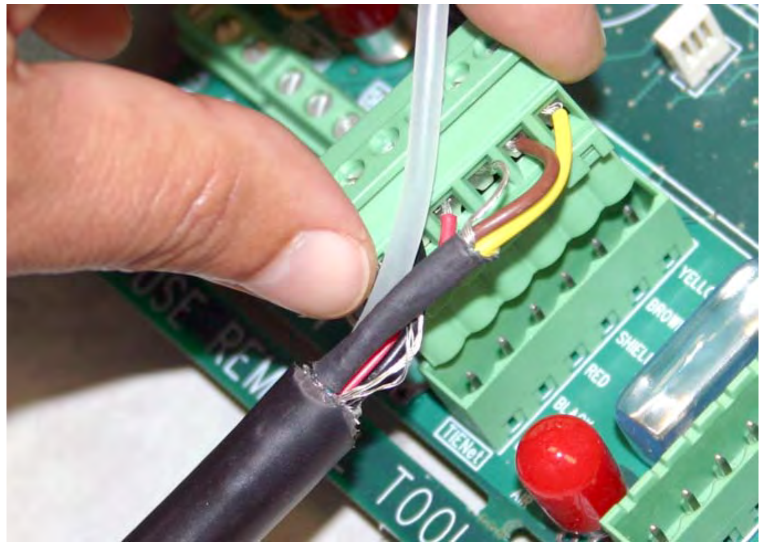


Figure 2-5   Attach wired terminal strip to case board socket

5. Insert the reference tubing into the REF AIR port on the case board, pushing it down inside the silicon tubing. **Take precaution not to bend or kink the reference tubing.**

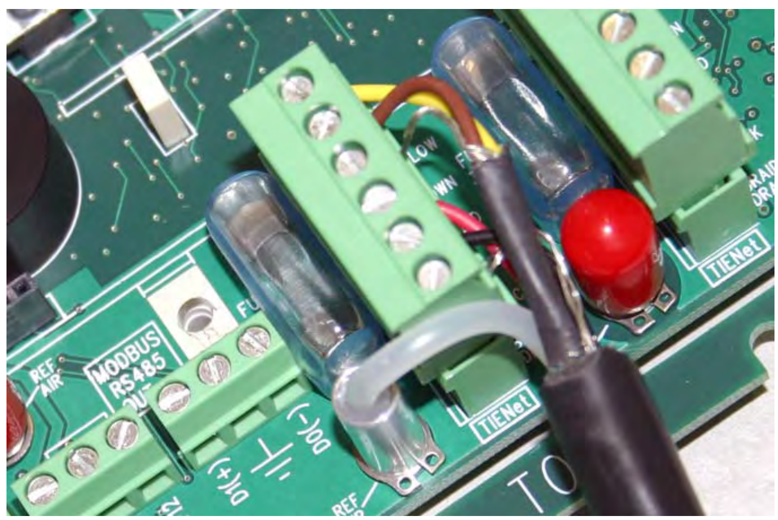


Figure 2-6   Insert the cable reference tubing into the case board reference port

6. Gently tug the cable downward to remove any slack within the enclosure, taking care not to put any stress on the connections.

7. Tighten the cord grip sealing nut (Figure 2-7).

Figure 2-7 Position and secure the cable

⚠ CAUTION

If using conduit instead of the cord-grip fitting, the conduit must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal the conduit may reduce equipment life.

8. Close the front panel and fasten with the two Phillips screws.

2.4.2 Remote Ultrasonic Cable Connection: 310 Ultrasonic Sensor

1. Prepare the LaserFlow connector receptacle by removing the cap (press down on the spring clip and pull out the cap).

Figure 2-8 Preparing the LaserFlow connector receptacle

2. Remove the stainless steel cap from the 310 ultrasonic plug and push the protective caps from the LaserFlow module and ultrasonic together.
3. Aligning the pins on the 310 ultrasonic plug with those in the connector receptacle, push the ultrasonic plug into the receptacle until the spring release "clicks."

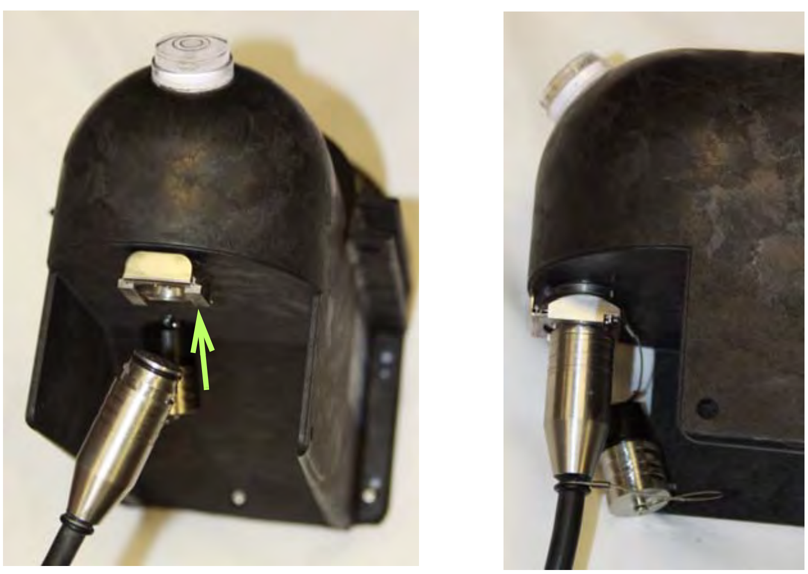


Figure 2-9 Secure caps and connect 310 ultrasonic plug to LaserFlow

To be certain that the connectors are locked, lightly pull on the cable connector; the cable should be held in place by the spring release clip.

2.4.3 Cable Connection: 2160 LaserFlow Module

1. Prepare the 2160 receptacle by removing the cap (press down on the spring clip and pull out the cap).

Figure 2-10 Preparing the 2160 connector receptacle

2. Remove the cap from the LaserFlow TIENet plug and push the protective caps on the module and sensor together.
3. Aligning the pins on the LaserFlow cable with those in the connector receptacle, push the sensor connector into the receptacle until the spring release "clicks."

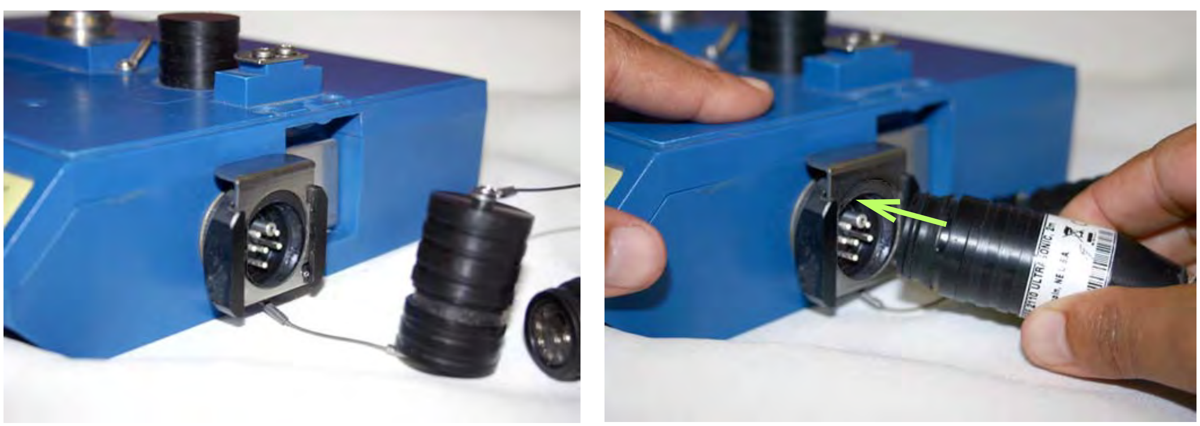


Figure 2-11 Secure caps and connect LaserFlow to 2160

4. To be certain that the connectors are locked, lightly pull on the cable connector; the cable should be held in place by the spring release clip.

2.5 Sensor Installation Tools and Requirements

The Signature flow meter or 2160 LaserFlow Module does not have to be mounted near the flow stream. The flow meter can be installed at a convenient, protected location and the sensor cable can be routed through user-provided conduit back to the flow meter.

Proper installation of the LaserFlow is critical for accurate measurement.

2.5.1 Tools Required

See Appendix B.2 Equipment and Recommended Tools.

2.5.2 Sensor and Mounting Equipment Dimensions

Complete mounting assembly dimensions are provided in Figures 2-12 through 2-15.

Refer to the appropriate drawing(s) when planning the installation and adjusting the mounting hardware.

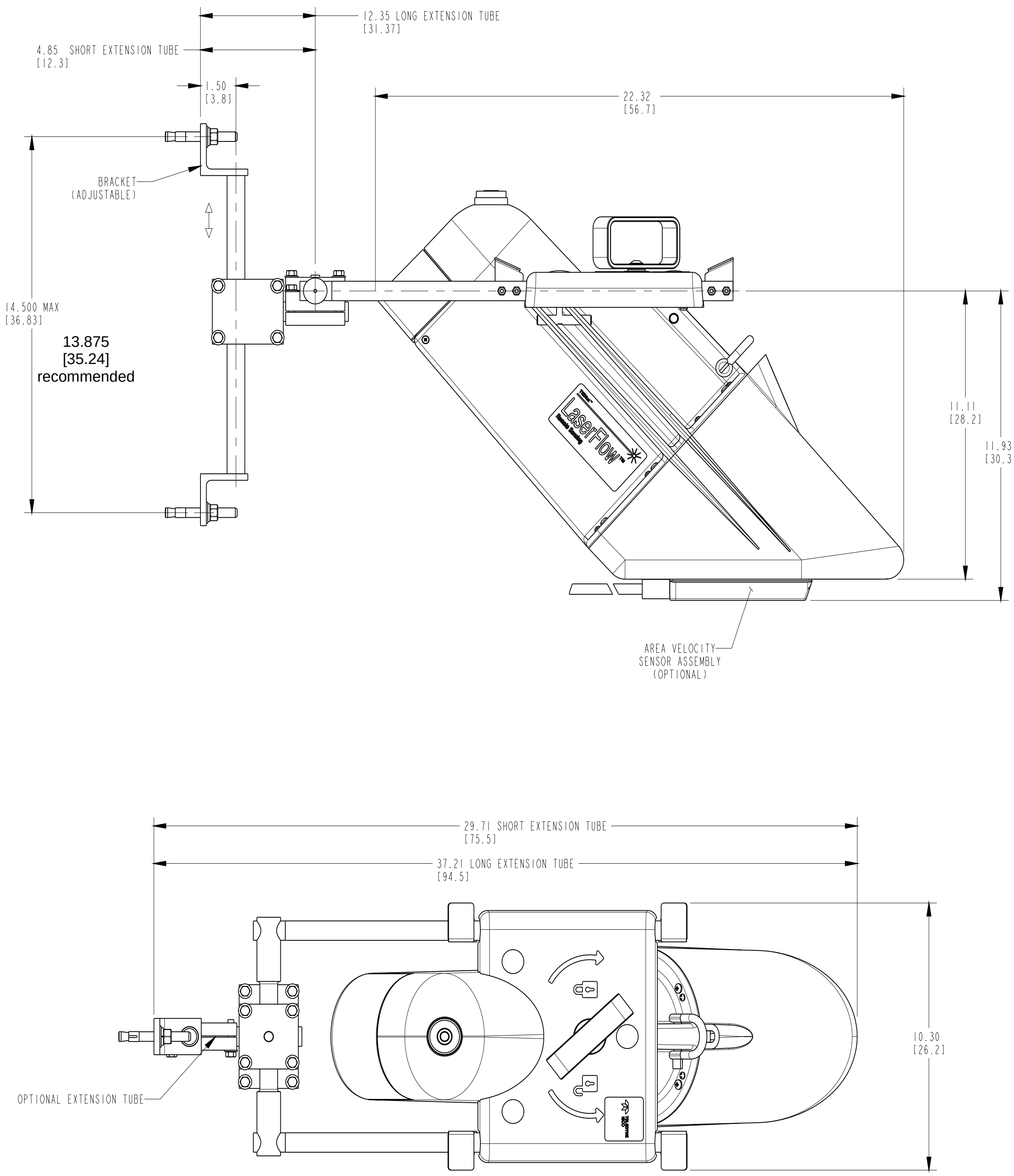


Figure 2-12 Overall dimensions including wall mounting hardware (part 1)

LaserFlow SENSOR SPECIFICATIONS	
WEIGHT	
MOUNT	11.5 LBS [5.2 KG]
LaserFLow SENSOR 10M	19.2 LBS [8.7 KG]
LaserFlow SNSR + AREA VELOCITY	20 LBS [9 KG]
ENCLOSURE MATERIAL	
HOUSING LaserFlow	CONDUCTIVE CARBON FILLED ABS
HOUSING ULTRASONIC	ANNODIZED ALUMINUM 6061
ULTRASONIC SENSOR	Kynar 340 RESIN PVDF GRADE
MOUNTING HARDWARE	STAINLESS STEEL
ALL OTHER EXTERIOR METAL PARTS	STAINLESS STEEL
ELECTRICAL	
POWER SUPPLY	TIENet BUS POWERED 8-26 VDC
ELECTRICAL CONNECTIONS	
TIENet DEVICE	SREW TERMINAL CONNECTION OR TIENet PLUG
LASER CLASS	CLASS 3R

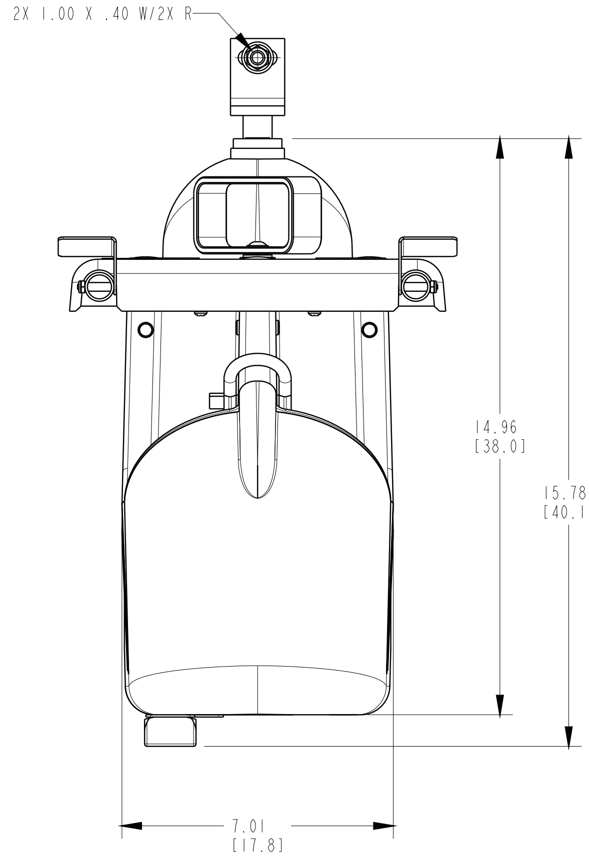
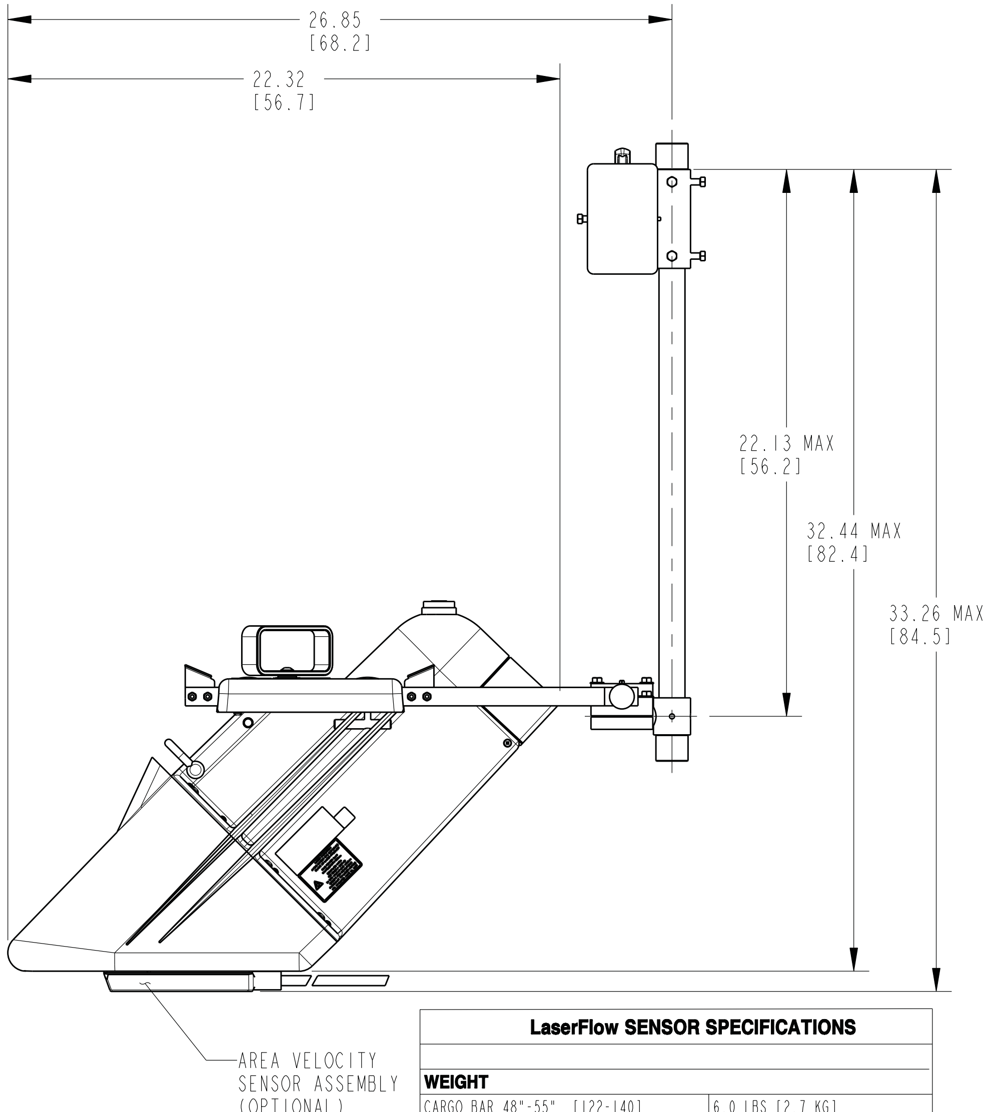


Figure 2-13 Overall dimensions including wall mounting hardware (part 2)



NOTES:

1. SECONDARY DIMENSIONS IN BRACKETS ARE IN CENTIMETERS [CM], UNLESS OTHERWISE SPECIFIED.

LaserFlow SENSOR SPECIFICATIONS	
WEIGHT	
CARGO BAR 48"-55" [122-140]	6.0 LBS [2.7 KG]
CARGO BAR 54"-66" [137-168]	6.5 LBS [2.9 KG]
CARGO BAR 63"-84" [160-213]	7.4 LBS [3.4 KG]
CARGO BAR 83"-114" [211-290] (SHOWN)	9.0 LBS [4.1 KG]
MOUNT	11.7 LBS [5.3 KG]
LaserFLow SENSOR 10M	19.2 LBS [8.7 KG]
LaserFlow SNSR + AREA VELOCITY	20 LBS [9 KG]
FORCES	
TOTAL FORCE	350 LBS [158.8 KG]
MAX LOAD	45 LBS [20.4 KG]
ENCLOSURE MATERIAL	
CARGO BAR	ALUMINUM
HANDLE & HYDRAULIC HOUSING	NYLON
FOOT	RUBBER
HOUSING LaserFlow	CONDUCTIVE CARBON FILLED ABS
HOUSING ULTRASONIC	ANNODIZED ALUMINUM 6061
ULTRASONIC SENSOR	Kynar 340 RESIN PVDF GRADE
MOUNTING HARDWARE	STAINLESS STEEL
ALL OTHER EXTERIOR METAL PARTS	STAINLESS STEEL

Figure 2-14 Overall dimensions including temporary mounting hardware (part 1)

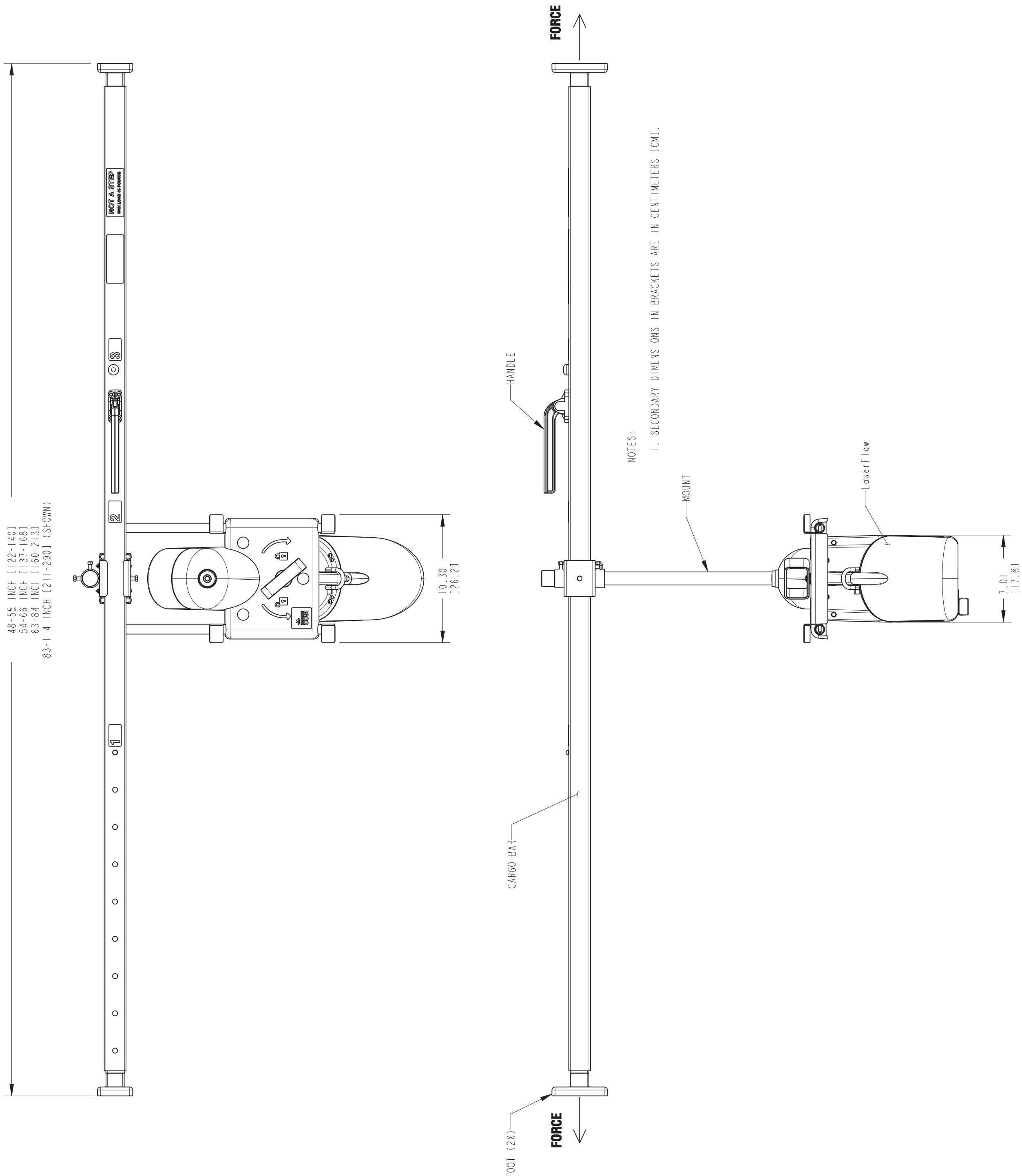


Figure 2-15 Overall dimensions including temporary mounting hardware (part 2)

2.5.3 Sensor Positioning and Requirements

Figure 2-16, at left, shows constants that serve as reference points when planning the positioning of the sensor.

Figure 2-17, shows a typical LaserFlow manhole installation.

> ⚠ **CAUTION**
>
> For proper function, the requirements listed here must be followed exactly.

Requirements:

- Permanent Installation: Install the wall bracket perpendicular to the x-axis.
  Temporary Installation: Install the cargo bar perpendicular to the y-axis.
- Always center the LaserFlow (and middle laser beam) relative to the pipe walls, and always use the attached circular bubble level for vertical alignment.
- Mount the LaserFlow sensor with the bottom parallel with the water surface.
- Align the bottom of the LaserFlow with the top of the inside wall of the inlet pipe, and as close as possible to the pipe mouth without obstructing the laser.
  To accomplish this, refer to Figure 2-16 at left, Figure 2-17 on the next page, and the following important figures:
  - The point at which the laser exits the sensor mouth is **3.3" (8.4 cm)** from the front tip of the sensor, or the center of the opening.
  - The distance from the bottom of the Laserflow sensor to the center of the coupling tube is **10.375"** (**26.35 cm**).
  - The laser beam exits the sensor mouth at a **45° angle**.
    (If the sensor bottom is parallel with the water surface, the laser beam will also strike the water surface at a 45° angle.)

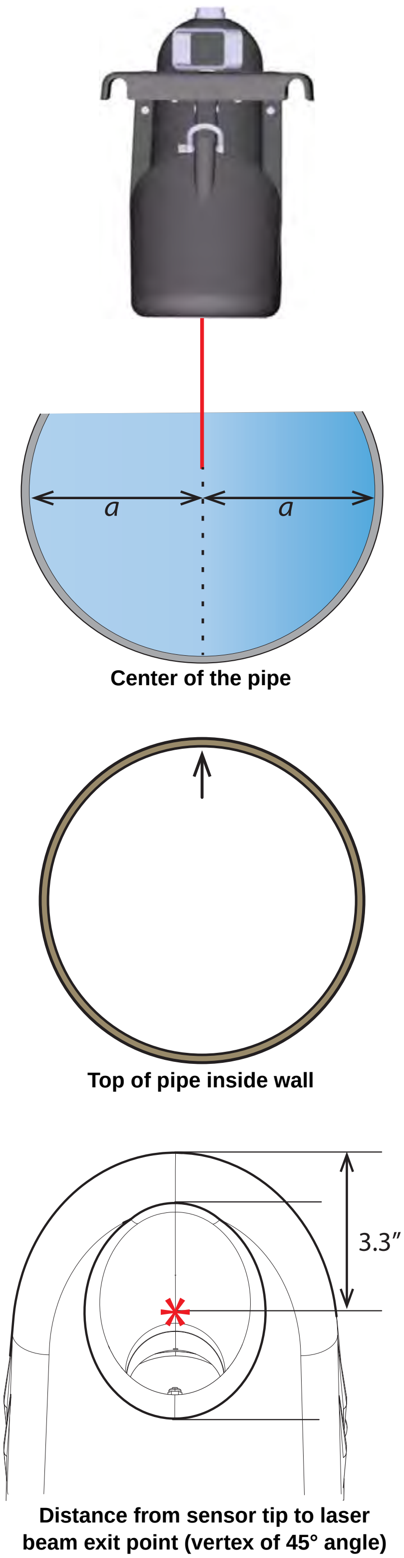


Figure 2-16 Sensor installation constants

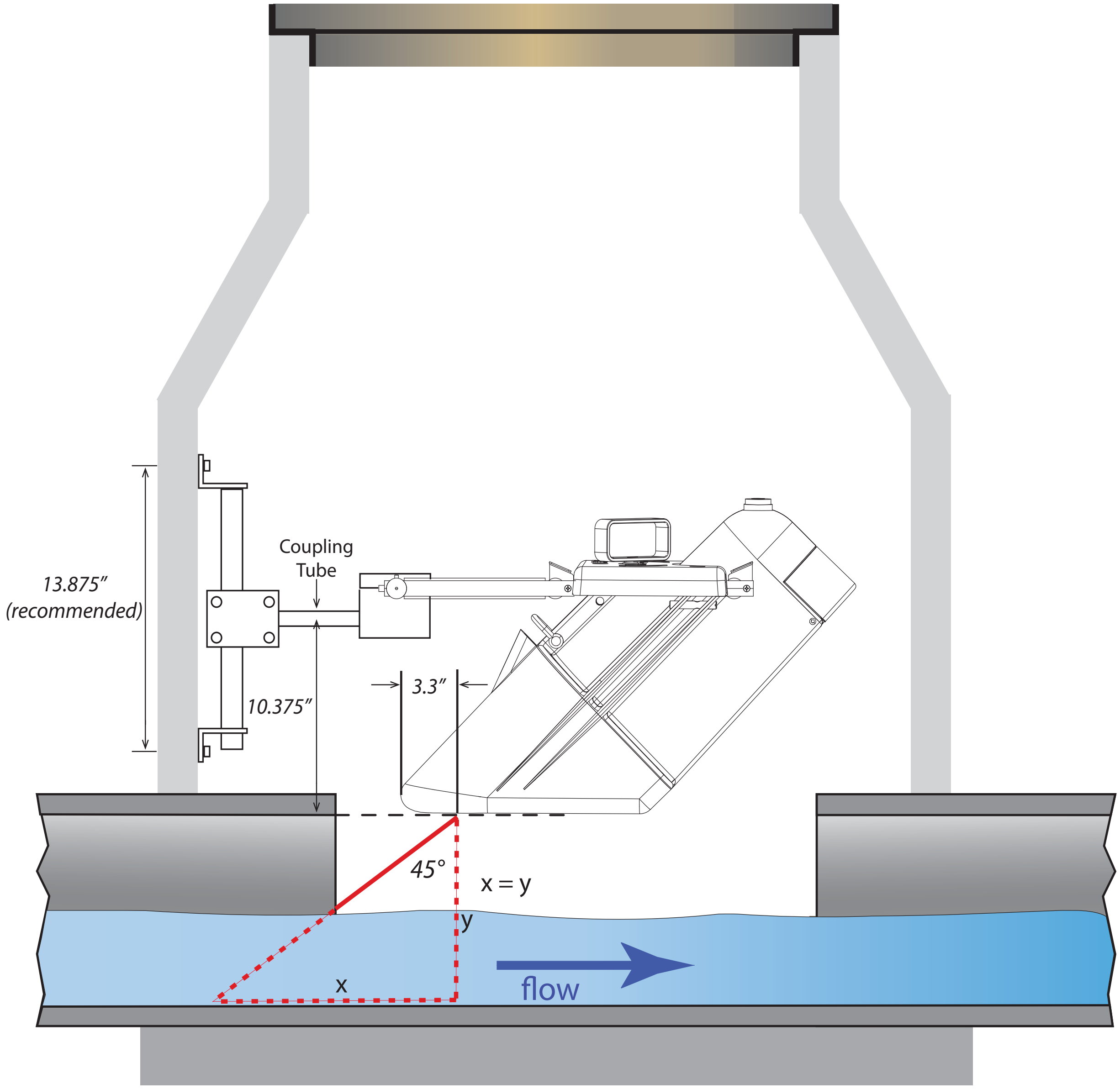


Figure 2-17 Typical manhole installation

2.6 Wall Mounting Kit

For wall mounting, identify the components listed in Figure 2-18 and Table 2-1, and perform the steps that follow. Order numbers for parts and fasteners are provided in Appendix A.

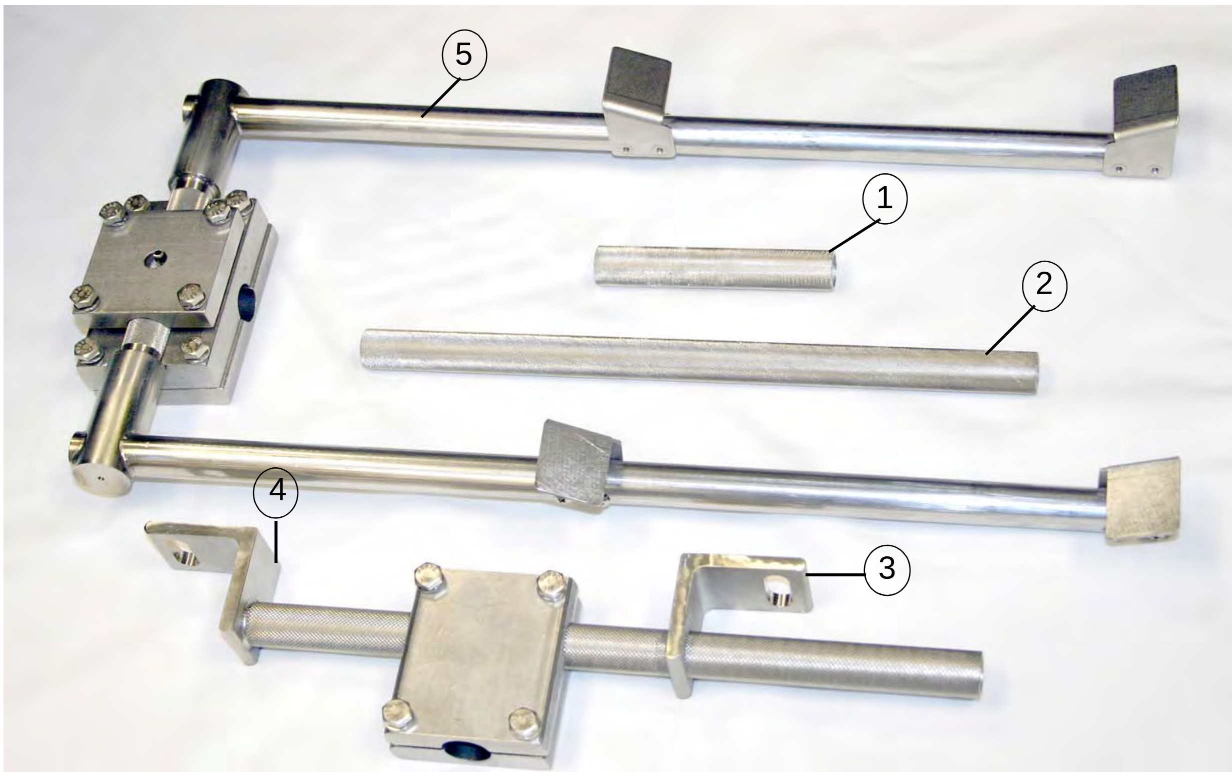


Figure 2-18 Wall mounting kit (Numbers correspond with Table 2-1)

Table 2-1 Wall Mounting Kit	
Item (Callout #)	**Description**
1	Tube Coupler (short)
2	Tube Coupler (long)
3	Bottom Wall Mount Angle Bracket (adjustable)
4	Mounting Shaft
5	Sensor Carrier
	SST Anchor Stud Assembly & Spring Lock Washers (for fastening brackets to wall)

2.6.1 Wall Mount Installation

Refer to the dimensions and requirements in Figure 2-17 while performing the following steps.

> **☑ Note**
> Stud anchors for concrete are provided in the mounting kit. It is recommended to drill a hole 2" (5.08 cm) deep, leaving 1" (2.54 cm) of the stud exposed.

1. Bolt or anchor the bottom angle bracket to the wall.
2. Slide the mounting shaft into the bottom angle bracket and bolt or anchor the mounting shaft to the wall.
3. Insert either the long or short tube coupler into the hole formed by the vertical clamp. Adjust the clamps to the desired height and cross-tighten the four bolts evenly until the clamp and tube coupler are firmly attached.

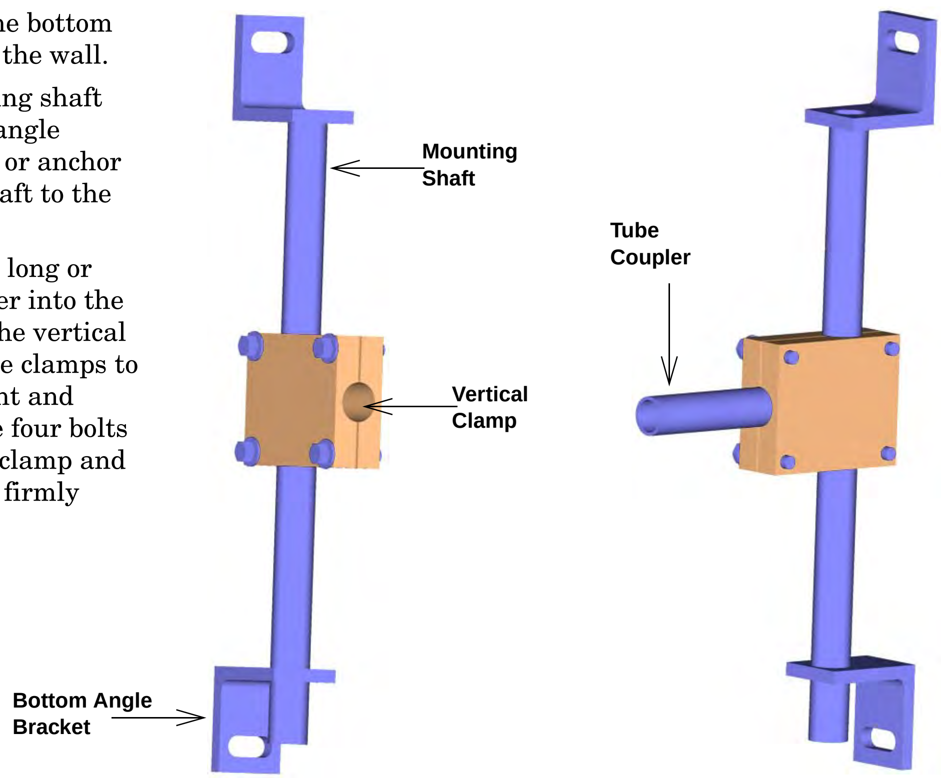


Figure 2-19 Wall Mount: Vertical clamp and vertical clamp with tube coupler inserted

4. Push the sensor carrier clamp onto the tube coupler until the coupler appears on the other side of the clamp. Align the carrier with both arms parallel to the flow surface and cross-tighten the bolts so the carrier is held firmly in position. Ensure the alignment tabs are facing up (see Figure 2-20).

   Note that some realignment will be necessary following installation of the LaserFlow sensor; ensure that all hardware is tightened following final alignment.

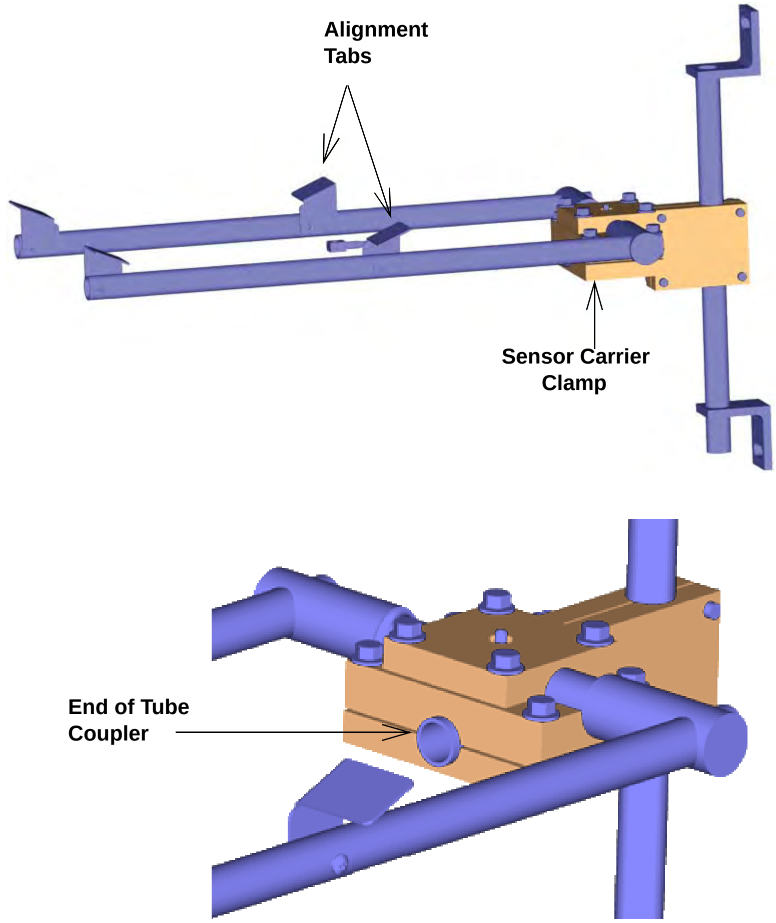


Figure 2-20 Wall Mount: Sensor carrier installed on tube coupler

☑ *Note*

After initial installation and sensor alignment, the remaining steps are often possible to perform from above ground, with the optional sensor retrieval arm.

⚠ WARNING

If lowering the LaserFlow from above ground, ensure that it does not become dislodged while being lowered, possibly endangering any personnel who may still be below ground.

5. Lower the LaserFlow sensor onto the mounting bracket between the front and rear alignment tabs, with the two mounting block grooves resting on the two carrier arms. The sensor can be installed on the carrier facing inward or outward, depending on installation requirements.

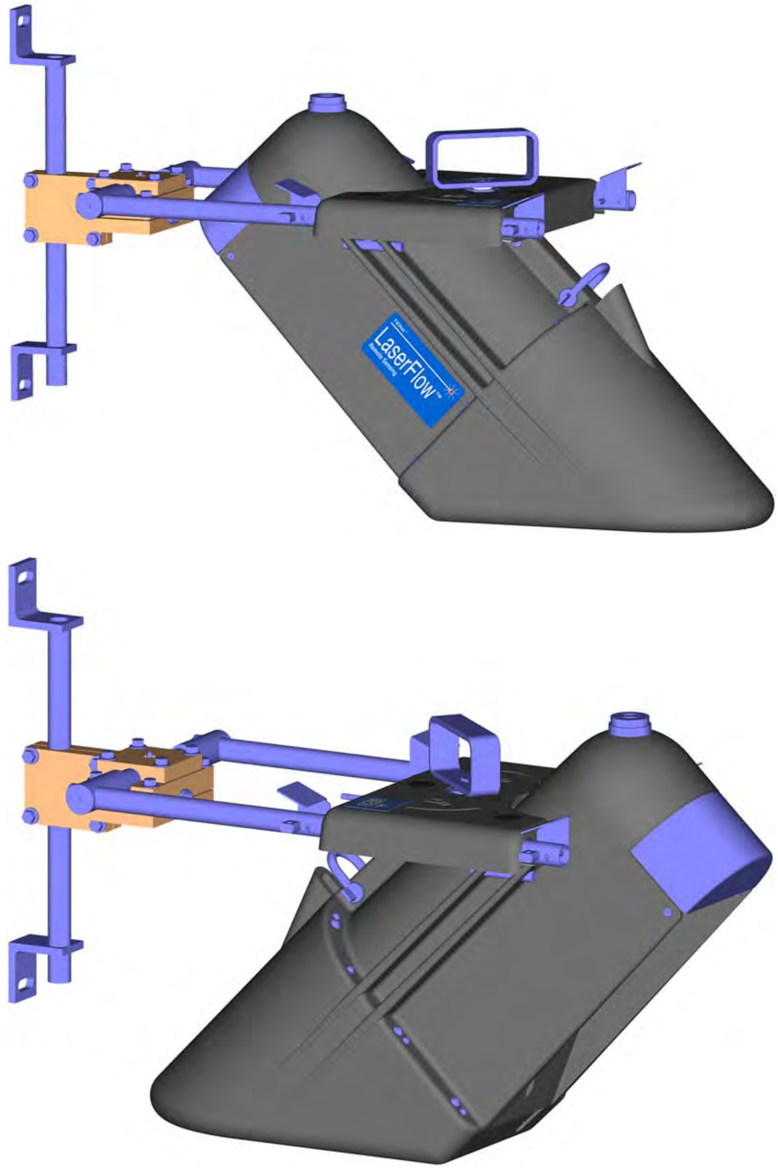


Figure 2-21 Wall Mount: Place the sensor on the carrier

6. Turn the locking handle clockwise until it locks the sensor in place.

Figure 2-22 Turn the locking handle clockwise until sensor is locked into place (shown with optional sensor retrieval arm, described in Section 2.8)

7. Using the bubble level on top of the sensor as a guide, adjust the carrier by loosening the appropriate bolts in the sensor carrier clamp so that the bubble in the level falls within the concentric rings.
8. Turn the laser on to make final adjustments so that the laser beam hits the flow stream at the exact center of the pipe (refer to Section 3.4 for Signature or Section 4.3 for 2160).

☑ Note

Additional assistance in adjusting the sensor's position may be obtained by activating and observing the 360 X-Axis (roll) and 360 Y-Axis (pitch) parameters.

9. Following final adjustments, ensure that all mounting bracket fasteners are tightened.

2.7 Temporary Mounting Kit

For temporary applications, refer to the components listed in Figure 2-23 and Table 2-2, and perform the steps that follow. Parts can be ordered separately or as a kit. Order numbers for parts and fasteners are provided in Appendix A.

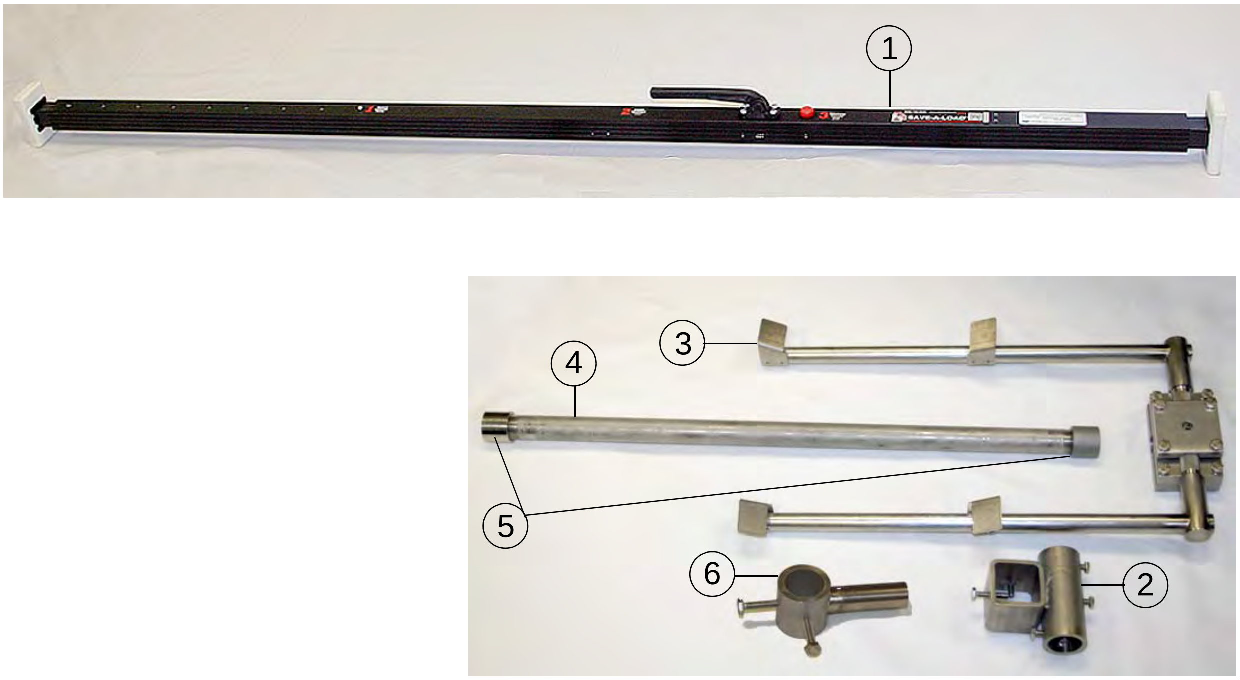


Figure 2-23 Temporary mounting kit (Numbers correspond with Table 2-2)

Table 2-2 Temporary Mounting Kit

Item (Callout #)	Description
1	Cargo Bar
2	Coupler Assembly
3	Sensor Carrier
4	24" Pipe
5	Cap (2)
6	Knuckle Assembly

2.7.1 Temporary Mounting Installation

The temporary mounting kit is rated for up to 45 lbs (20.5 kg).

When installing the sensor with the temporary mounting kit, ensure that the sensor carrier is positioned for easy installation and removal of the sensor.

1. Slide the foot out of the stationary end of the cargo bar.

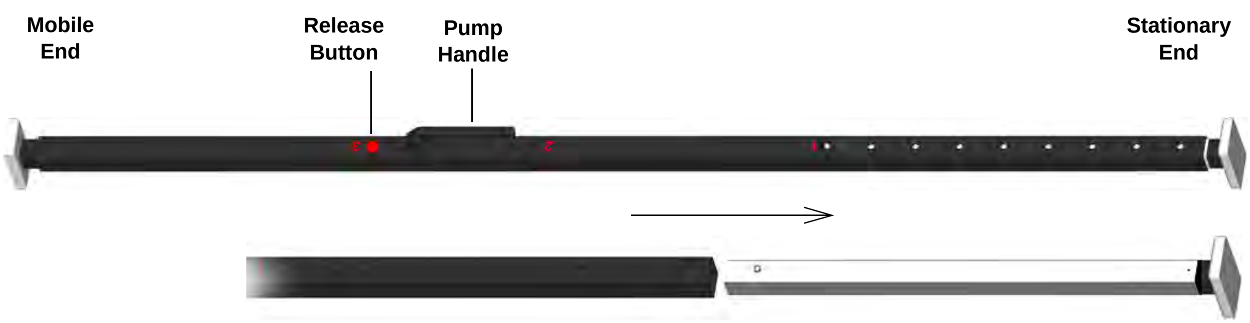


Figure 2-24 Temporary Mount: Remove stationary foot

2. Slide the coupler onto the bar, tightening the two coupler bolts (see Figure 2-26) enough to prevent it from sliding around during the rest of the installation.
3. Reinsert the foot in the stationary end of the cargo bar.

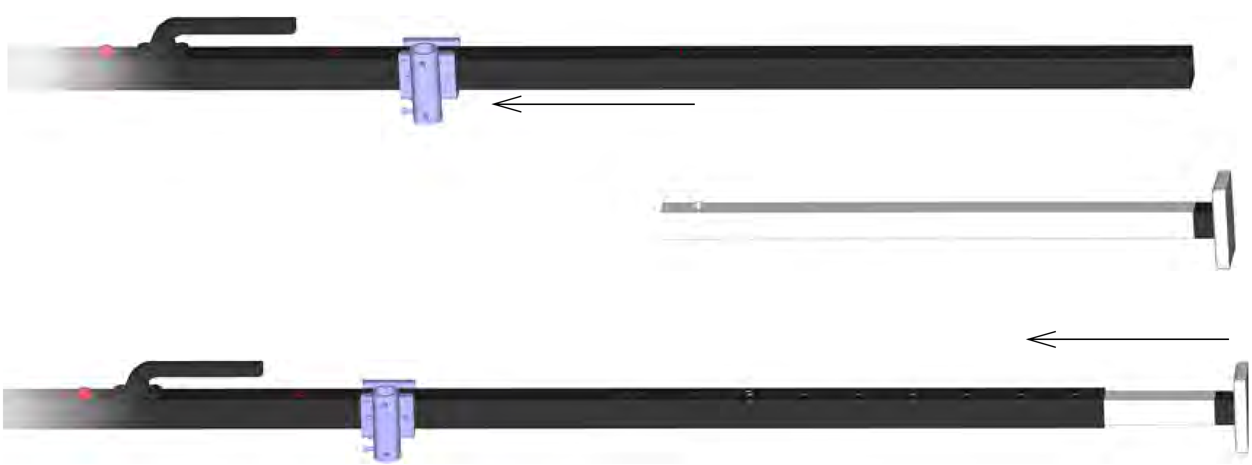


Figure 2-25 Temporary Mount: Install coupler, replace stationary foot

4. In the manhole or vault, position the cargo bar for installation. Place the mobile end against the wall. and extend the stationary end as far as possible.
5. Pump the handle fully up and down approximately 10 times, until the hydraulic tension presses the stationary foot firmly against the opposite wall.

☑ Note

To release the hydraulic pressure, press the red rubber button next to the pump handle.

6. Position the coupler over the center of the flow stream and tighten the coupler bolts on the back and bottom.

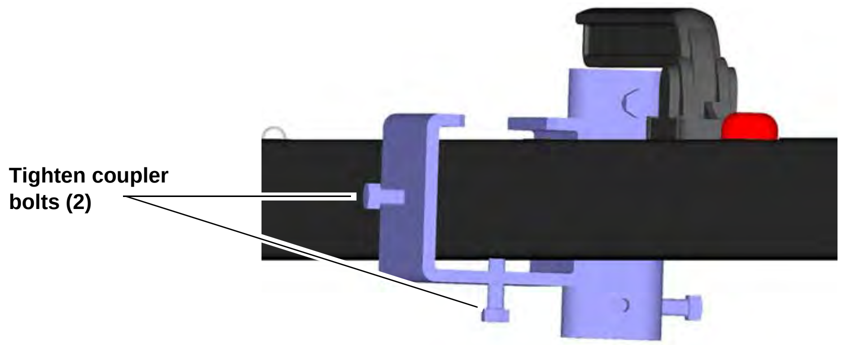


Figure 2-26 Temp Mount: Securing the coupler

7. Remove the end caps from the 24" pipe and slide one end through the knuckle on the sensor carrier.
8. Reinstall the cap on the bottom end. Turn the assembly top-side up and slide the knuckle down to rest on the bottom cap.

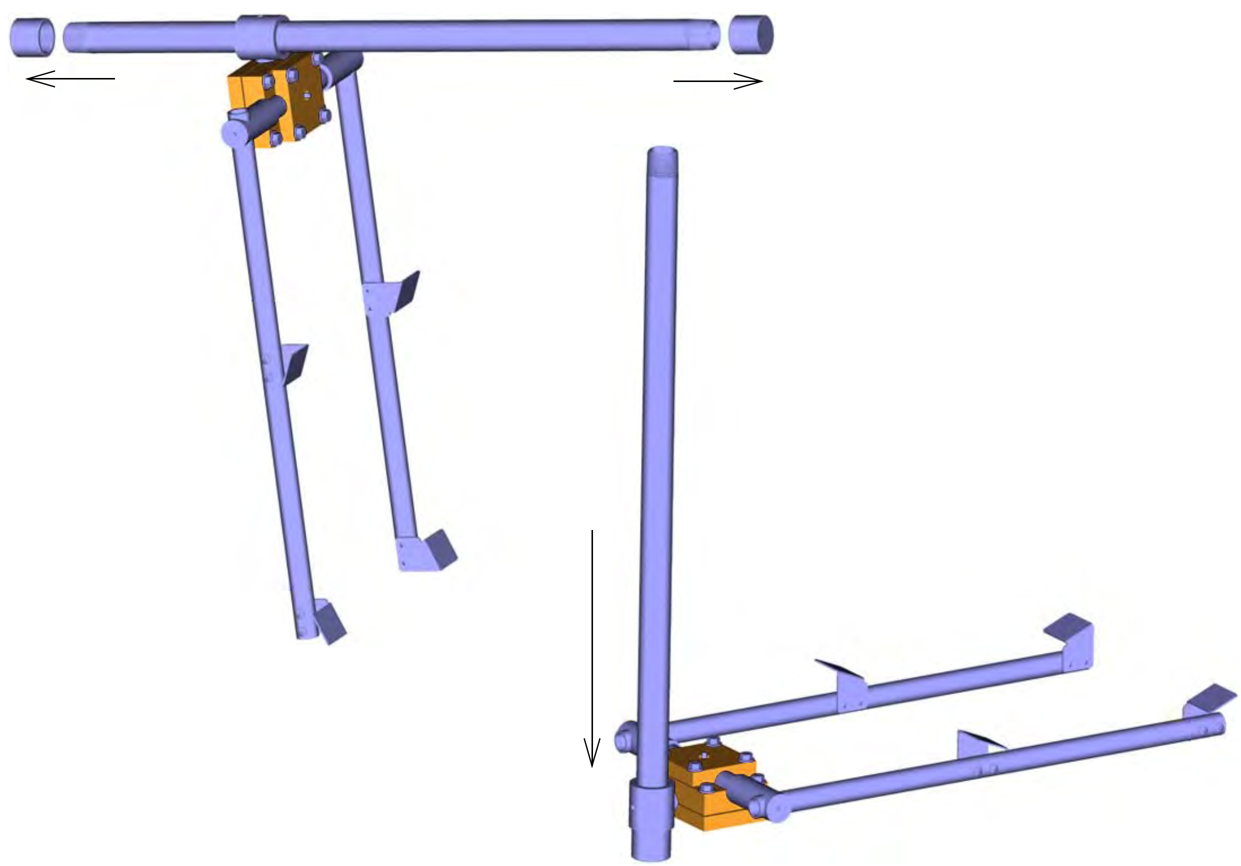


Figure 2-27 Temporary Mount: Install sensor carrier/knuckle onto 24" pipe

9. Slide the pipe up through the coupler tube. Replace the other pipe cap.
10. Rotate the carrier to proper orientation and tighten the 4 bolts on the coupler tube.
11. Fine-tune the carrier orientation and tighten the 2 bolts on the carrier knuckle.

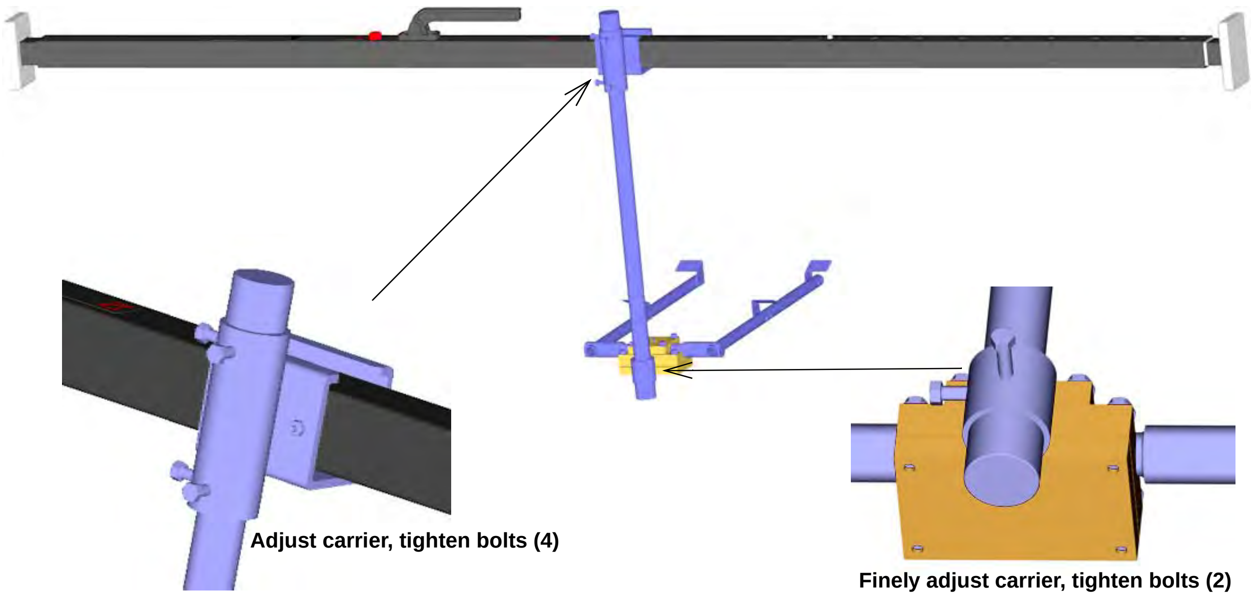


Figure 2-28 Installing the sensor carrier

☑ Note

After initial installation and sensor alignment, the remaining steps are often possible to perform from above ground with the optional sensor retrieval arm.

⚠ WARNING

If lowering the LaserFlow from above ground, ensure that it does not become dislodged while being lowered, possibly endangering any personnel who may still be below ground.

12. Lower the LaserFlow sensor onto the mounting bracket between the front and rear alignment tabs, with the two mounting block grooves resting on the two carrier arms. The sensor can be installed on the carrier facing inward or outward, depending on installation requirements.

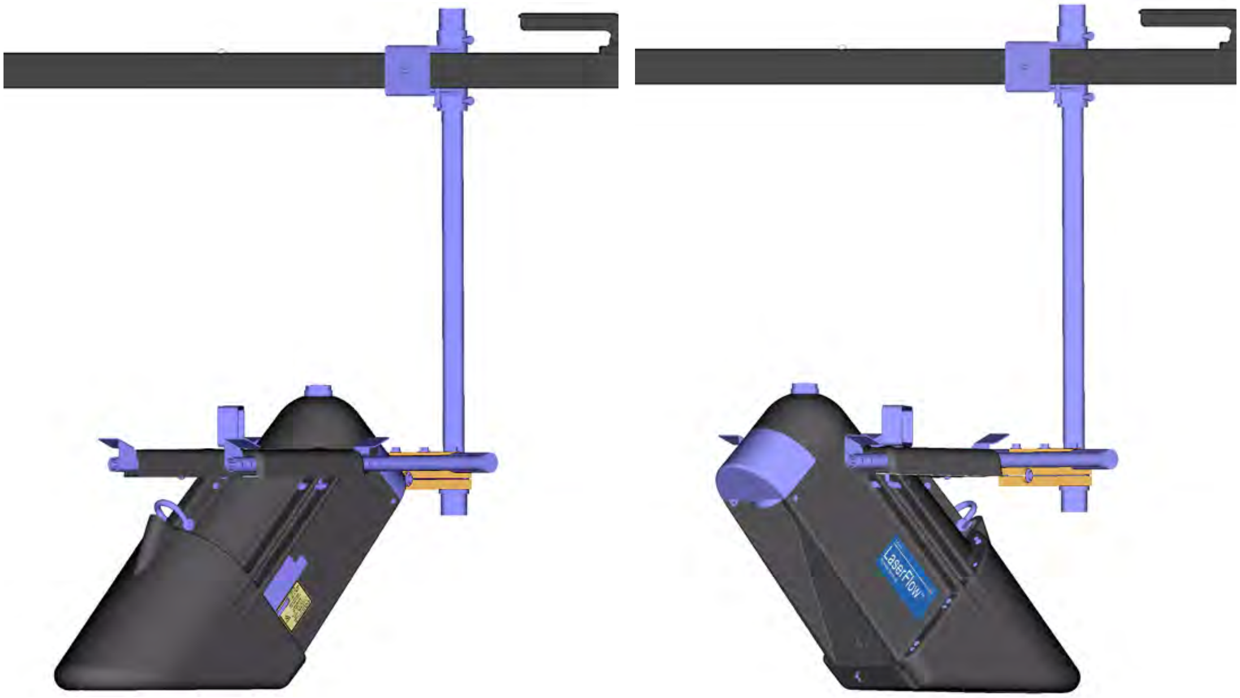


Figure 2-29 Temporary Mount: Place the sensor on the carrier

13. Turn the locking handle clockwise until it locks the sensor in place.

Figure 2-30 Turn the locking handle clockwise until sensor is locked into place (shown with the optional sensor retrieval arm, described in Section 2.8)

14. Using the bubble level on top of the sensor as a guide, adjust the carrier by loosening the appropriate bolts in the sensor carrier clamp such that the bubble in the level falls within the concentric rings.
15. Turn the laser on to make final adjustments so that the laser beam hits the flow stream at the exact center of the pipe (refer to Section 3.4 for Signature or Section 4.3 for 2160).
16. Following final adjustments, ensure that all mounting bracket fasteners are tightened.

2.7.2 Offset Carrier from Cargo Bar

For installations where the temporary mount assembly alone cannot suspend the sensor directly over the center of the flow, an optional elbow pipe is available to create an offset of 6" from the cargo arm.

Simply install it between the 24" pipe and the knuckle, as shown below.

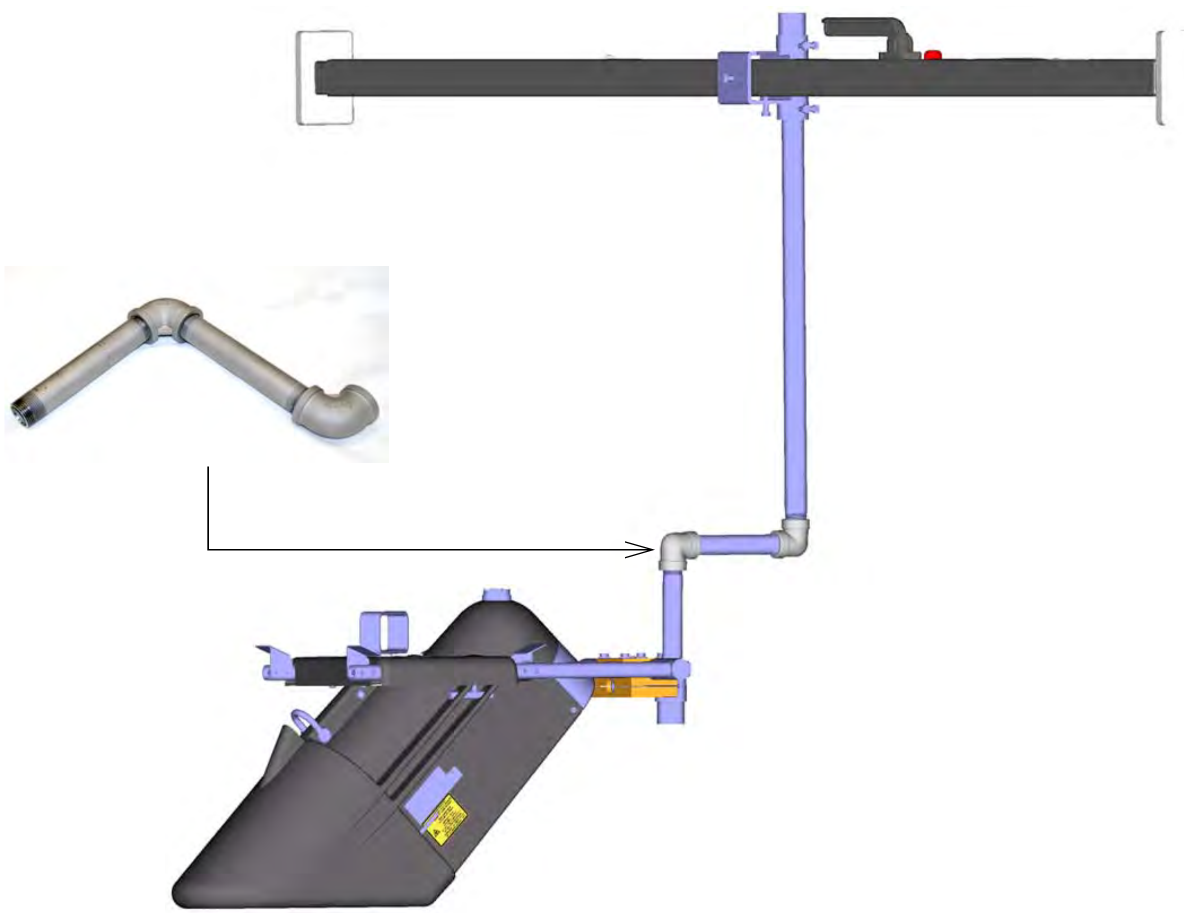


Figure 2-31 Temporary Mount: Optional elbow pipe for offset

2.8 Optional Sensor Retrieval Arm

Following initial installation and adjustment, the sensor can be installed or removed as needed without manhole entry in most situations, using the optional retrieval arm to grasp the handle. See Figure 2-33.

The sensor retrieval arm can extend to a maximum of 23 ft.

When using temporary mounting hardware with the sensor retrieval arm, Teledyne Isco recommends mounting the LaserFlow module at a 45° angle to lessen the effective rotational torque applied to the mounting feet of the cargo bar. See Figure 2-32.

⚠ DANGER

Explosion hazard. The retrieval arm is not intrinsically safe. Do not use in hazardous locations.

⚠ DANGER

Electrocution hazard. Maintain a minimum of 10 feet from power lines.

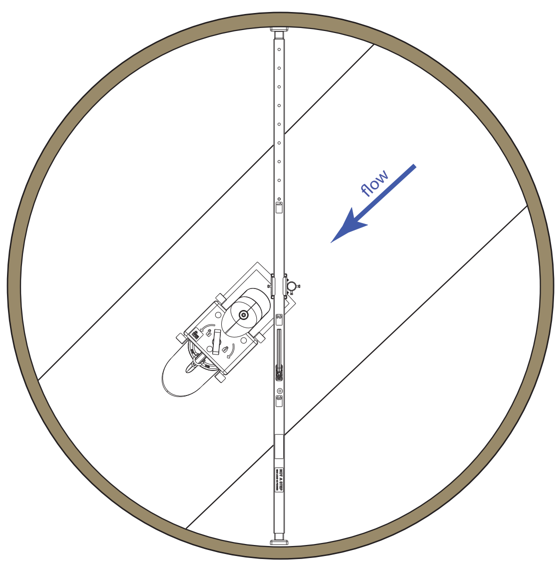


Figure 2-32 Suggested placement of Laserflow sensor when using temporary mounting hardware and the sensor retrieval bar

Figure 2-33 Optional Sensor Retrieval Arm

2.9 Optional Sunshade

The sunshade is an optional accessory for use when the Laserflow sensor is installed in an outdoor location in direct sunlight. The purpose of the sunshade is to prevent sunlight from striking the case of the sensor directly and heating it to a higher temperature than that of the surrounding air.

This heating, caused by the absorption of sunlight, should be avoided, as it introduces an error factor into the flow meter's level calculations.

1. Loosen the four tee knobs (two on each side of the sunshade) and slide the two adjustable mounting blocks to the rear of the slots on each side of the sunshade.
2. Position the sunshade on top of the Laserflow sensor mount and slide the sunshade toward the rear until the four stationary mounting blocks (two on each side of the sunshade) fit under the two front alignment tabs of the Laserflow sensor carrier. See Figure 2-34.

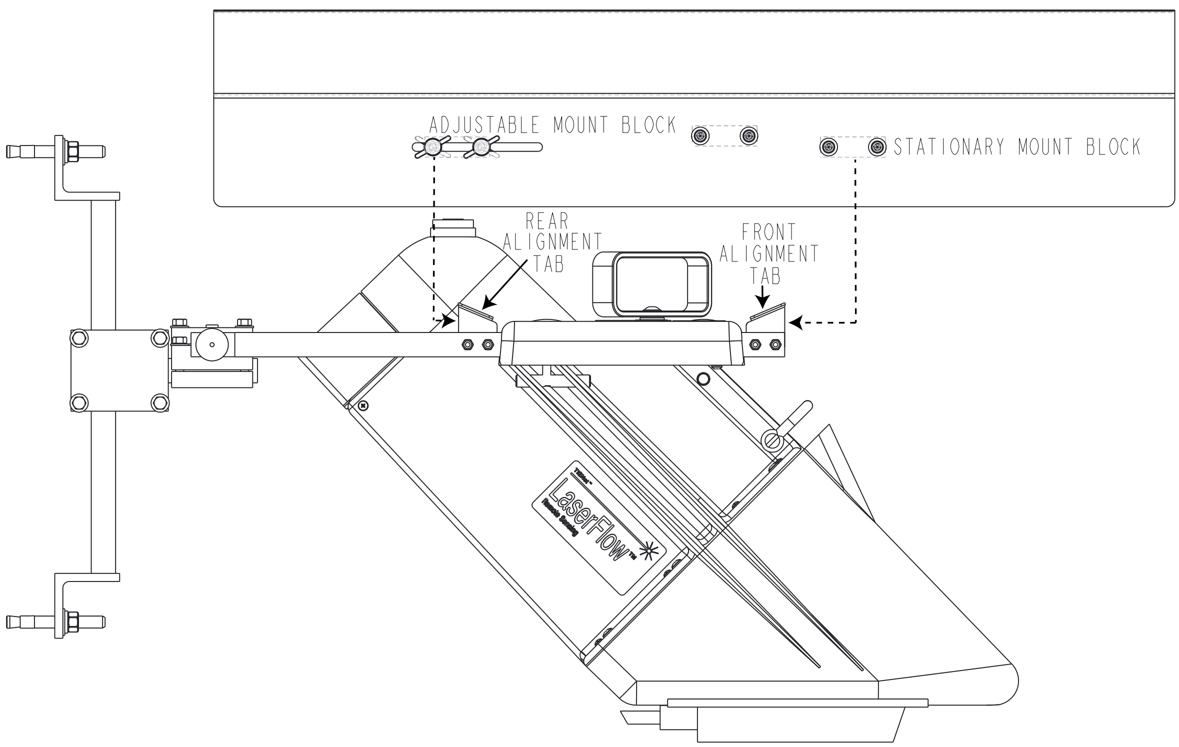


Figure 2-34 Mounting the sunshade

3. Slide the two adjustable mounting blocks (connected to the tee knobs) until they fit under the rear alignment tabs of the Laserflow sensor carrier. See Figure 2-34.

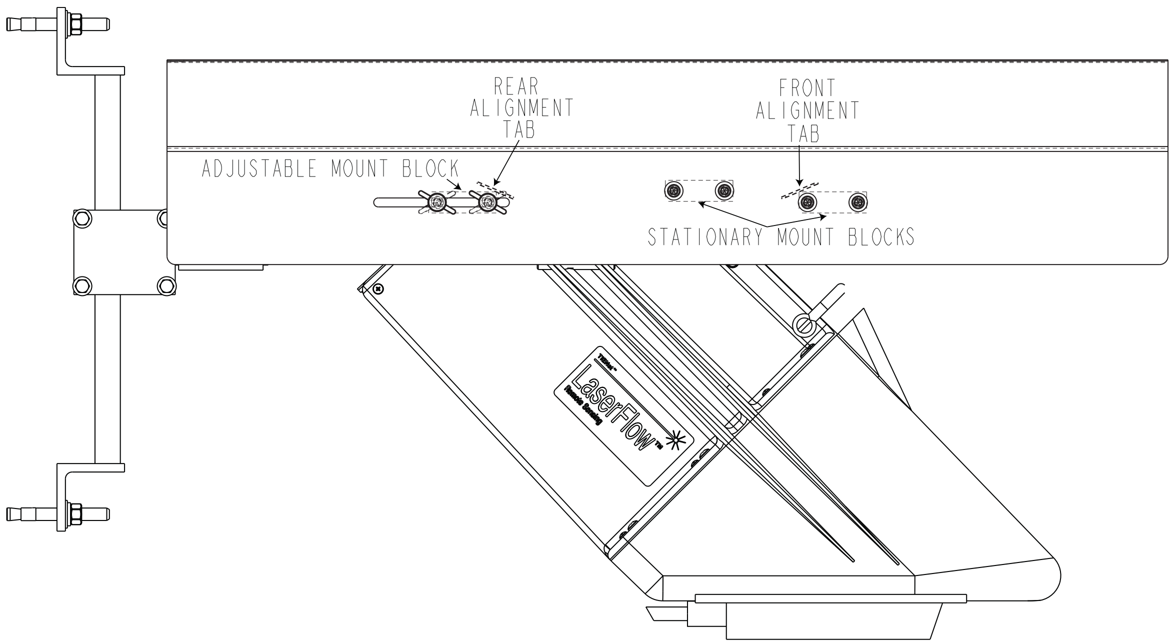


Figure 2-35 Mounted sunshade

4. Tighten the four tee knobs.

2.10 Remote TIENet™ Model 310 Ultrasonic Level Sensor

Refer to the TIENet™ 310 Ultrasonic Level Sensor Installation and Operation Guide for details.

TIENet™ 360 LaserFlow™ Velocity Sensor

Section 3 Setup with Signature® Flow Meter

The LaserFlow velocity sensor is compatible with both the Teledyne Isco Signature Flow Meter and the Teledyne Isco 2160 LaserFlow Module. For 2160 setup instructions, refer to Section 4. For complete information about the Signature Flow Meter, refer to the Signature Flow Meter user manual.

3.1 Configuring the System

To configure the Signature flow meter for operation with the LaserFlow sensor, press the "**Menu**" button (B) to access the top menu, and then select "**Hardware Setup**". For all TIENet devices including the LaserFlow sensor, select "**Smart Sensor Setup (TIENet)**".

3.1.1 Updating the Device List

When the LaserFlow sensor has been physically added to the system, select "**Perform Scan**" so that the flow meter detects it. When the scan is complete, the LaserFlow sensor (model number 360) appears in the list of connected devices, ready to be configured with the steps shown in Figure 3-2.

☑ **Note**

From the Hardware Setup menu, "Configure Measurements" refers to defining and selecting the parameters for each connected device.

The LaserFlow sensor parameters are:

360 Distance – Distance between the bottom of the sensor and the surface of the flow stream (refer to Section 3.2.2).

360 Velocity – Average velocity of the flow stream

360 Laser Temperature – Temperature of the laser assembly

360 Y-Axis – Tilt about the 'y' axis (pitch)

360 Ultrasonic Signal – Strength of the ultrasonic return echo

360 Sense Voltage – Measurement of window clarity (under 100 mV) –

360 Doppler Power – Strength of the laser Doppler signal for velocity

360 Level – Level of the flow stream surface

360 Case Temperature – Internal temperature of the LaserFlow sensor housing

360 X-Axis – Tilt about the 'x' axis (roll)

360 Laser Diode Current – Current draw of the laser diode

360 Temperature – Temperature of the window

360 Air Temperature – Temperature of surrounding (ambient) air

360 Window Temp – Temperature of the window

If your system includes the optional submerged functionality for redundant measurement, the TIENet 350 Area Velocity sensor is also displayed in the list of connected devices, with its own list of parameters.

The name of any parameter can be customized by highlighting it and pressing the "**Enter**" button ( ) to display the character grid. Navigate the grid using the arrow keys. Select characters by pressing the "**Enter**" button and clear characters by pressing the "**Delete**" button ( ).

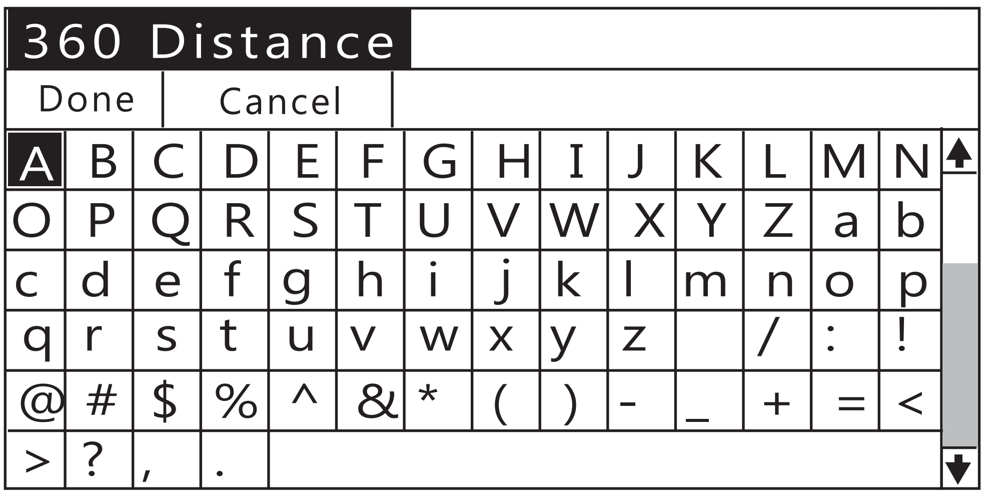


Figure 3-1   Character grid

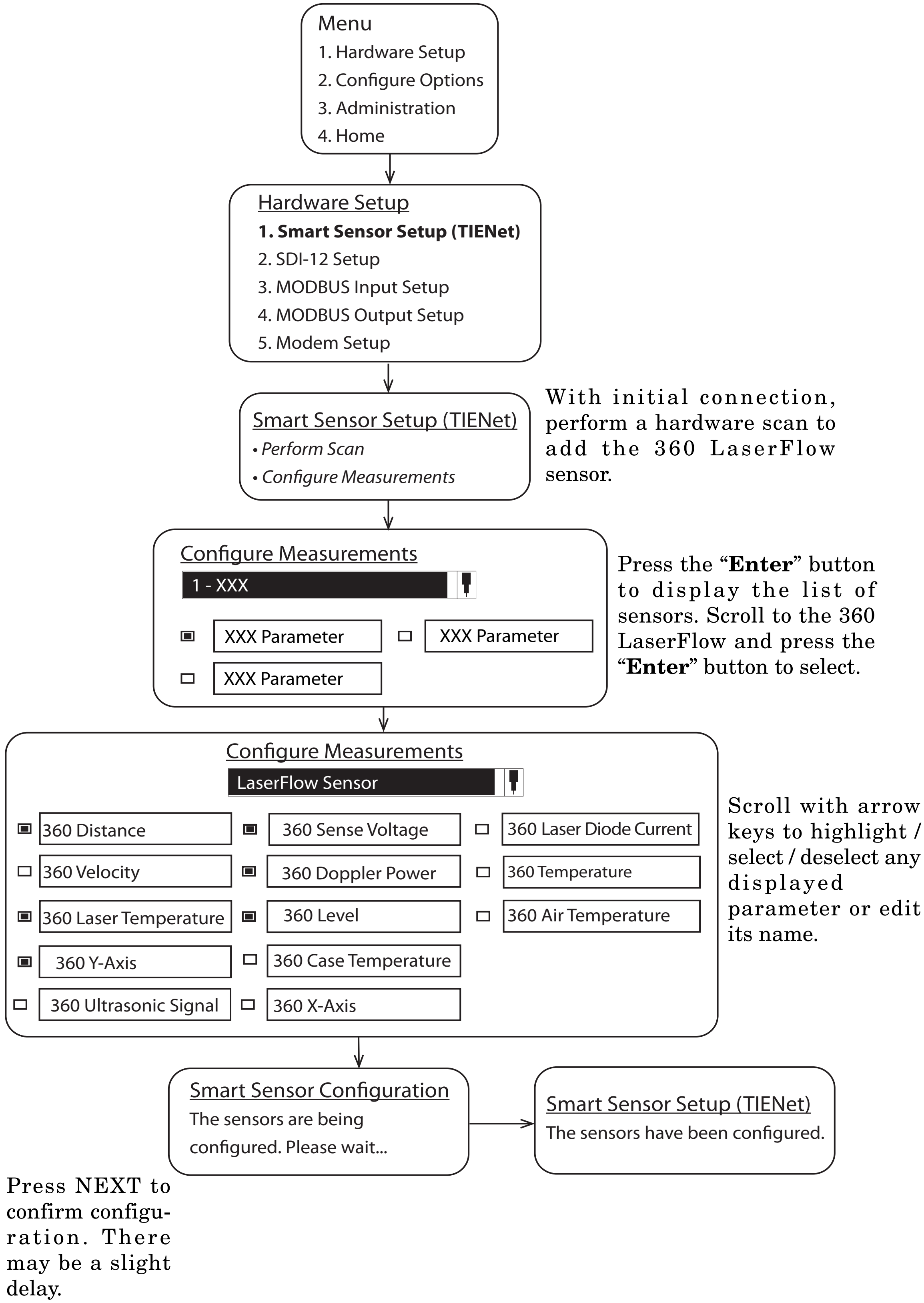


Figure 3-2 Menu Tree: LaserFlow Configuration

3.2 Measurement Setup

From Measurement Setup (Figure 3-3), select Level Input Setup to define the blanking distances and Velocity Input Setup to set velocity direction and access advanced settings.

> **Note**
> Refer to the Signature user manual for information about Flow Rate Input Setup and Volume Input Setup.

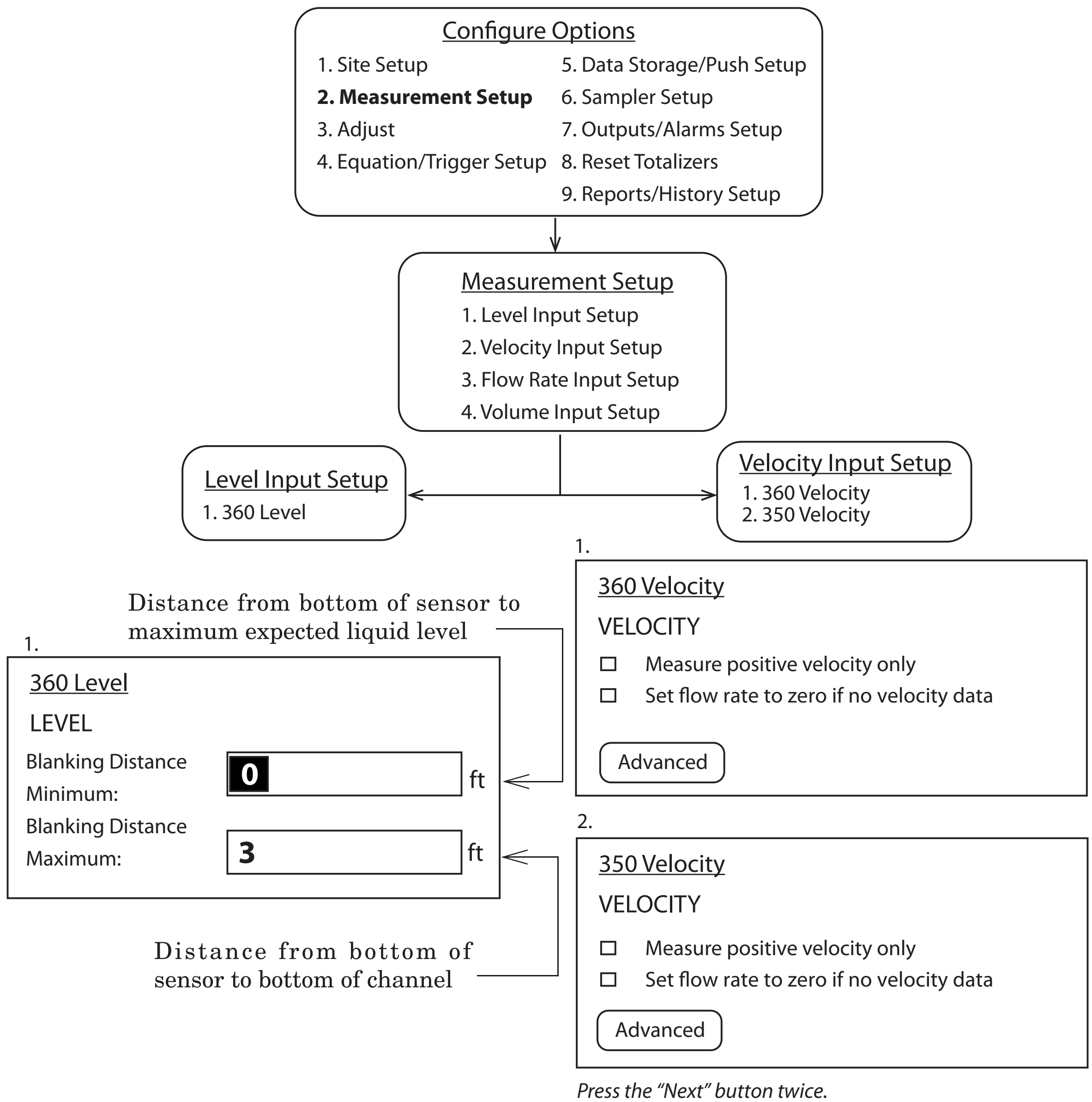


Figure 3-3   Measurement Setup: Sensor input settings (optional 350 AV Sensor also shown)

3.2.1 360 Level

The **Minimum Blanking Distance** is the distance from the bottom of the sensor to the liquid surface at the highest expected level. Depending on the elevation of your sensor, this value may be increased to help ensure that echoes read by the flow meter come only from the surface of the flow stream, and not off the walls or sides of the channel.

The **Maximum Blanking Distance** is the distance between the bottom of the sensor and the bottom of the channel (i.e., zero level). A larger value than calculated can be entered.

If using the LaserFlow module with the 310 remote ultrasonic sensor and horizontal sensor mounting bracket, the maximum blanking distance is the distance between the bottom of the mounting bracket and the bottom of the channel.

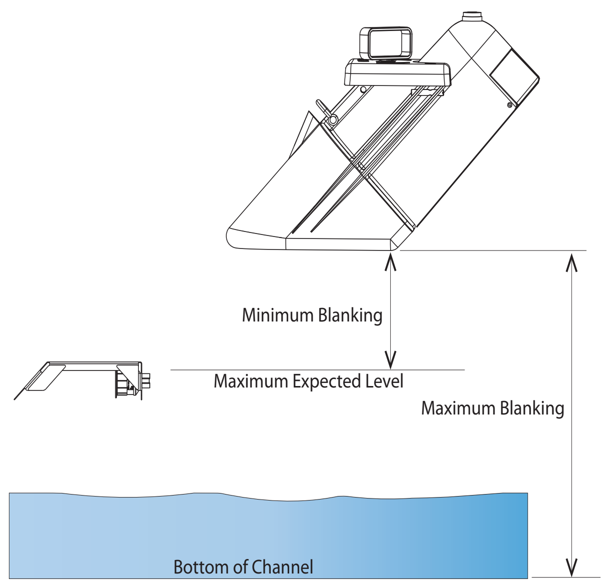


Figure 3-4 Blanking distance for LaserFlow with built-in sensor or with remote ultrasonic sensor

3.2.2 360 Velocity

When the **Measure Positive Velocity only** option is selected, the LaserFlow will not attempt to determine flow direction and negative readings are discarded in the average velocity calculation. Selecting this setting will save power. By default, this options is selected.

When the Positive Velocity option is deselected, a second velocity measurement is taken to determine the direction of the flow.

3.2.3 LaserFlow Velocity Advanced Settings

The LaserFlow **Advanced Settings** are pre-programmed into the sensor. However, if your application requires any custom configuration, the Advanced button opens the Advanced settings window (refer to Figure 3-5).

Input Velocity Coefficients – The relationship of the three Input Velocity Coefficients A, B and C can be expressed as:

$\overline{V} = A\ (offset) + B^*(Measured\ Velocity) + C^*(Measured\ Velocity)^2$

Coefficient A is an additive offset value to correct the Measured Velocity for any additive bias. The value for A must be expressed in units of meters/second. The default is “0”.

Coefficient B is a multiplicative scalar for correcting the Measured Velocity for any linear multiplicative bias. The value for B is unitless. The default is “0.9”.

Coefficient C is another scalar to correct the Measured Velocity for any nonlinear bias. The value for C must be expressed in units of seconds/meter, so that the resulting value for the Reported Velocity Reading will be in units of meters/second. The default is “0”.

Spectral Averages – The value for Spectral Averages may be used to reduce noise and improve signal strength. The default is “5000”. If persistent low signal strength or velocity dropouts are indicated, enter a high value, such as 10000. If signal quality and measurement improve, try entering a lower value, such as 7500, observing the signal quality. The lower the value for Spectral Average, the less time required for each complete measurement, reducing power usage. Adjust the value to determine a number that balances power usage with satisfactory signal quality and readings.

Re-home Count – For testing purposes only. For more information, contact Environmental Products Support.

Peak Detect – The Peak Detect function scans across the user-defined row to locate the peak velocity. To enable Peak Detect functionality, select the “**Peak Detect**” box.

Adaptive Focus – Adaptive Focus enables the LaserFlow module to scan above and below the standard focus point, then adjust the focus to the point with the best signal strength. To enable Adaptive Focus functionality, select the “**Adaptive Focus**” box.

Positive Downstream – Select the “**Positive Downstream**” box when the LaserFlow sensor is pointed downstream.

Maximum Distance – The Maximum Distance is the greatest distance (e.g., inches) the LaserFlow sensor will take a directional velocity reading. The default is “48”. Units of measurement are based on user settings.

Maximum Velocity – The Maximum Velocity is the greatest velocity (e.g., ft/s) the LaserFlow sensor will take a directional velocity reading. The default is “1”. Units of measurement are based on user settings.

Steep Slope LaserFlow Focusing – If the pipe is on a slope greater than 1%, select the “**Enable Slope Setting**” box. By default, this option is disabled.

Parallel to Channel Slope – If the sensor is parallel to the channel slope, select “**Parallel to Channel Slope**”. Measure from the front of the sensor carrier to the bottom of the channel. Then measure from the back of the sensor carrier to the bottom of the channel. Ensure the distance is equal. Adjust the sensor carrier as necessary. By default, this option is enabled when the "Enable Slope Setting" box is selected. See Figure 4-11 in Section 4.

Slope Percentage – If the slope of the pipe is known, mount the sensor level with the Earth, using the bubble level mounted on the top of the sensor and then enter the Slope Percentage in the field. By default, this option is disabled when the "Enable Slope Setting" box is selected. See Figure 4-12 in Section 4.

Optical Clarity – Sense voltage detects fog on the window of the LaserFlow sensor. When the sense voltage is greater than 100 mV, the defogger is activated. The defogger is enabled from 1 to 5 minutes, depending on the severity of the fog.

Note

In locations with severe fogging potential, Teledyne Isco recommends increasing battery capacity or monitoring the site more frequently.

To enable Optical Clarity, select "**Active**". To disable Optical Clarity, select "**Passive**". The default is "Active".

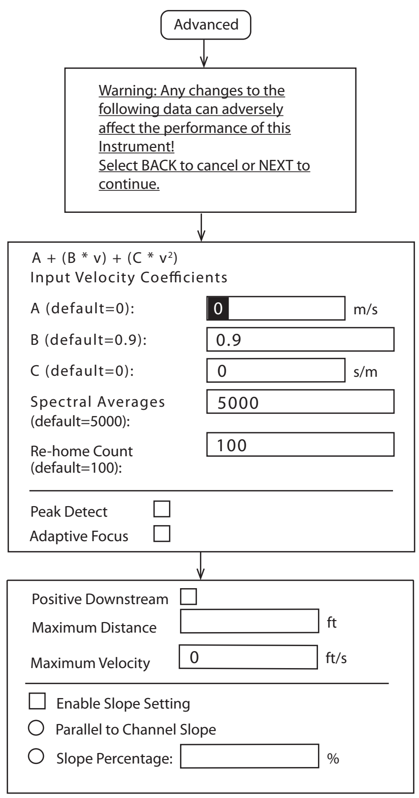


Figure 3-5 Measurement setup: Advanced settings for LaserFlow sensor

3.2.4 Adjust 350 Level (Optional)

If your system includes the optional surcharge sensor, it is also capable of measuring level with a pressure differential transducer.

The Level Adjustment screen is accessed via the Shortcuts menu on the Signature. From this screen, you can also update the display to show the current level of the stream.

Press SHORTCUTS (A) and select Adjust Level.

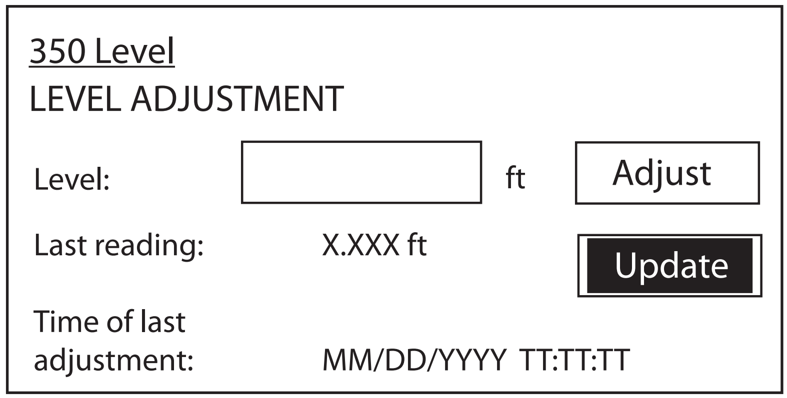


Figure 3-6   350 Level adjustment screen

To set an initial or new level, enter the value in the field next to **Level**, and select **Adjust**. To update the current reading, select **Update**.

Following installation, measure the distance between the bottom of the channel and the bottom of the LaserFlow to obtain the initial value for 350 Level (Figure 3-7).

It is recommended that the variable data storage rate function be used to trigger 350 velocity and level measurement based on a Level threshold.

Alarm setup and activation are explained in the Signature user manual under Outputs/Alarms Setup.

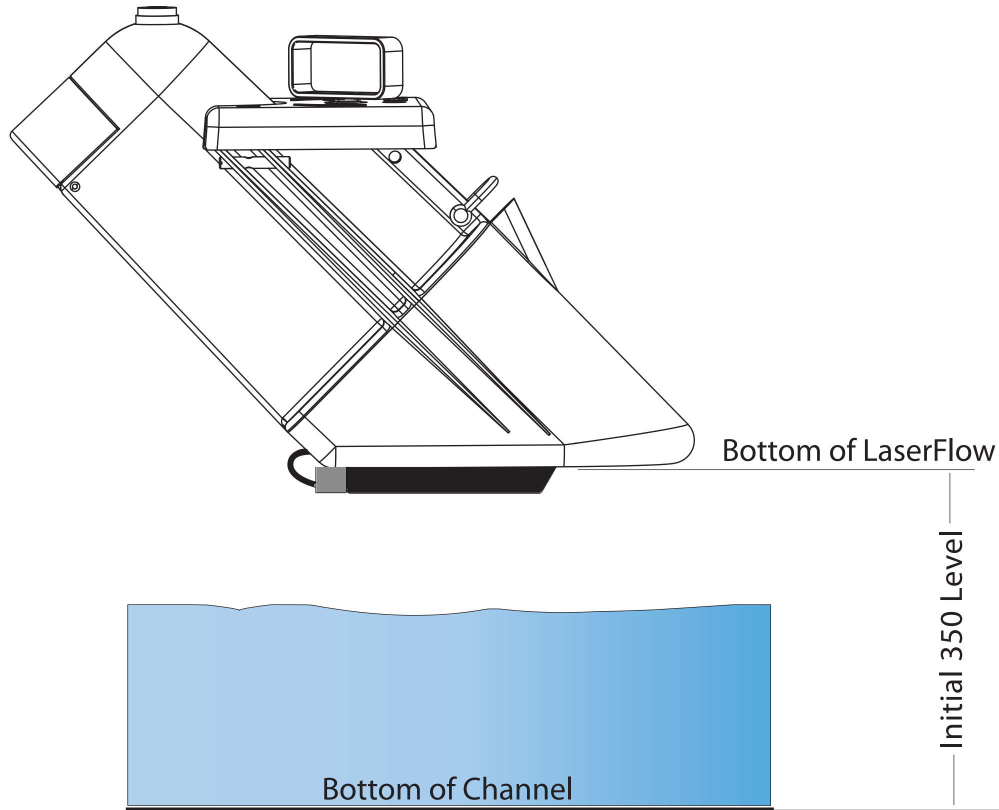


Figure 3-7 Submerged functionality: Initial 350 Level setting

3.2.5 350 Velocity (Optional)

If your system includes the optional submerged functionality or redundant measurement, it is also capable of measuring velocity with a continuous wave Doppler sensor.

The *Measure positive velocity only* setting causes any negative readings to be discarded in the average velocity calculation. If this is set to false, both positive and negative readings are used.

3.2.6 350 Advanced Settings (Optional)

The LaserFlow **Advanced Settings** are pre-programmed into the sensor. However, if your application requires any custom configuration, the Advanced button opens the Advanced settings window (refer to Figure 3-5).

Input Velocity Coefficients – The relationship of the three Input Velocity Coefficients A, B and C can be expressed as:

$\overline{V} = A\ (offset) + B^*(Measured\ Velocity) + C^*(Measured\ Velocity)^2$

Coefficient A is an additive offset value to correct the Measured Velocity for any additive bias. The value for A must be expressed in units of meters/second. The default is “0”.

Coefficient B is a multiplicative scalar for correcting the Measured Velocity for any linear multiplicative bias. The value for B is unitless. The default is “0.9”.

Coefficient C is another scalar to correct the Measured Velocity for any nonlinear bias. The value for C must be expressed in units of seconds/meter, so that the resulting value for the Reported Velocity Reading will be in units of meters/second. The default is “0”.

The sensor is pre-programmed at the factory with the **Advanced Settings** for your application. Should your application require the addition of any correction factors, the Advanced button opens the Advanced settings window (Figure 3-8).

Input velocity coefficients can be adjusted for A, B, and C, where: $\overline{V}$ = A (offset) + BV (slope) + CV^2 (second-order parameter).

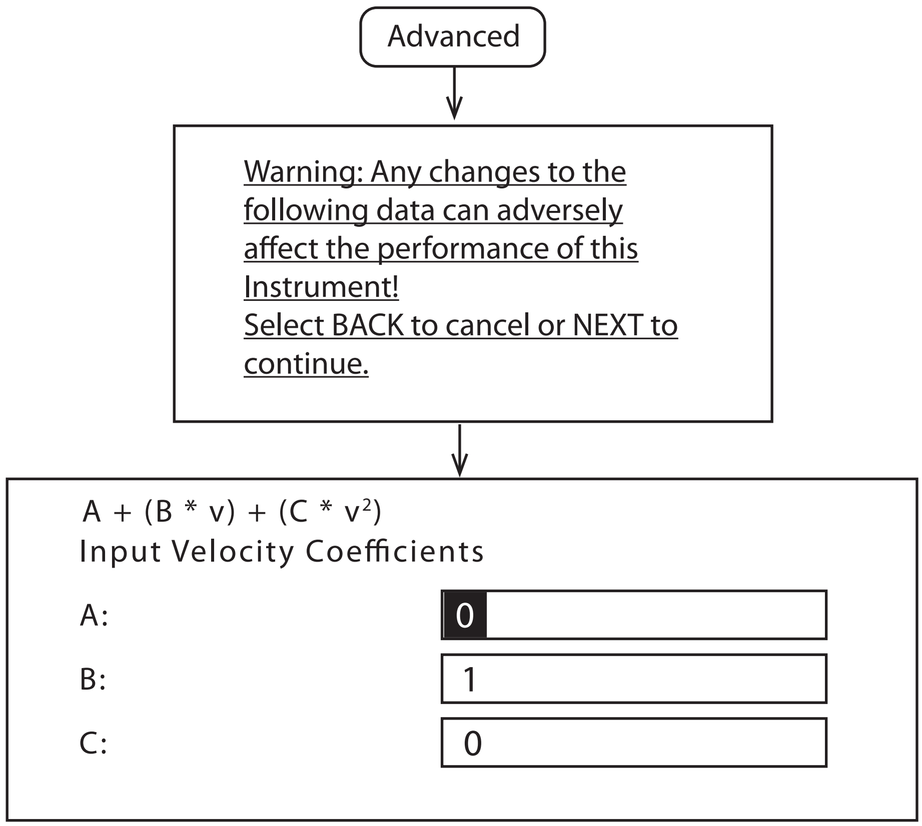


Figure 3-8 Measurement setup: Advanced settings for 350 AV sensor

3.3 360 Velocity Grid

The 360 Velocity screen has a grid containing 15 possible measurement points. Use the Shortcuts > Adjust function to navigate to this screen (refer to Figure 3-9).

The measurement points are activated and deactivated with the arrow and Enter keys. To save the measurement settings, highlight Update and press Enter.

As the LaserFlow begins to take readings, the grid becomes populated with a velocity reading and time stamp for each active measurement point (points where a valid reading could not be obtained will display the word “invalid”).

Prior to operation, the LaserFlow sensor must be set up for measurement using the 360 Velocity grid. Refer to Section 3.4.

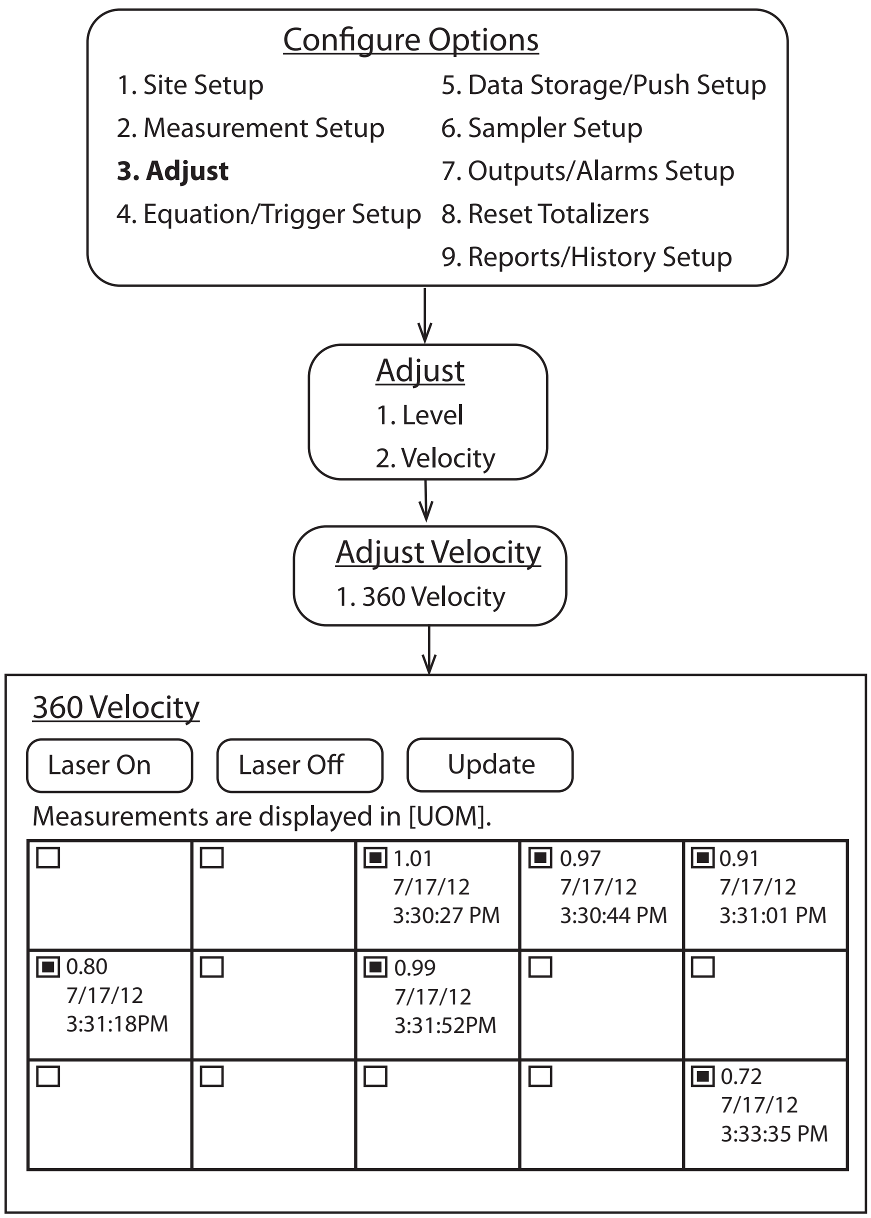
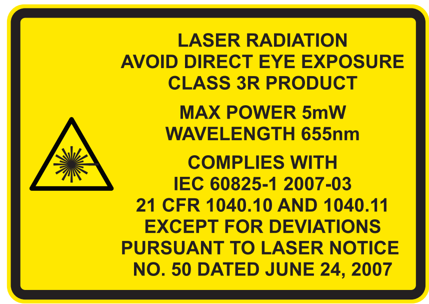


Figure 3-9   360 Velocity grid

3.4 Sensor Positioning and Adjustment



3.4.1 Centering the LaserFlow Sensor

Proper positioning of the LaserFlow sensor is critical for optimal velocity measurement. In center position, the laser beam must strike the flow stream precisely in the center.

The beam automatically moves to the top center position.

Laser On

Select Laser On and press Enter. This will keep the laser beam on continuously for 10 minutes or until Laser Off is selected, allowing the beam to be used for fine-tuning the sensor's position.

☑ Note

When sensor positioning is completed, securely tighten all mounting hardware.

3.4.2 Laser Velocity Measurement Point Selection

Once the LaserFlow sensor is installed over the flow stream, some installations may only require the center laser position for velocity measurement.

For installations requiring multiple measurement points, the next step is to determine which points will be used. To do so, activate all 15 points and wait for all of them to display their readings. This process may take up to 15 minutes.

Each point will display a velocity reading and time stamp, or "Invalid." Deselect "Invalid" and undesired points. The fewer points selected, the less time required to complete one velocity measurement.

Select all 15 measurement points and Update.

360 Velocity

Laser On | Laser Off | Update

Measurements are displayed in [UOM].

▣ Invalid	▣ Invalid	▣ 1.01 7/17/12 3:30:27 PM	▣ 0.97 7/17/12 3:30:44 PM	▣ 0.91 7/17/12 3:31:01 PM
▣ 0.80 7/17/12 3:31:18PM	▣ Invalid	▣ 0.99 7/17/12 3:31:52PM	▣ Invalid	▣ Invalid
▣ Invalid	▣ Invalid	▣ Invalid	▣ Invalid	▣ 0.72 7/17/12 3:33:35 PM

Deselect invalid (and undesired) points and Update.

360 Velocity

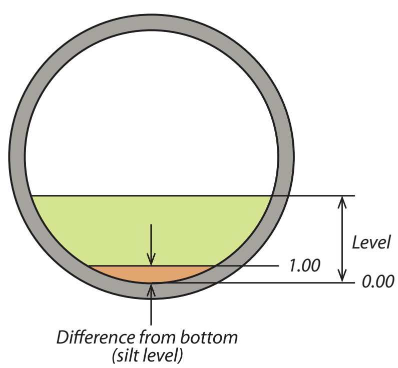
Laser On | Laser Off | Update

Measurements are displayed in [UOM].

☐	☐	▣ 1.01 7/17/12 3:30:27 PM	▣ 0.97 7/17/12 3:30:44 PM	▣ 0.91 7/17/12 3:31:01 PM
▣ 0.80 7/17/12 3:31:18PM	☐	▣ 0.99 7/17/12 3:31:52PM	☐	☐
☐	☐	☐	☐	▣ 0.72 7/17/12 3:33:35 PM

Figure 3-10 Selection of velocity measurement points

3.4.3 Ultrasonic Level Adjustment



Once the LaserFlow sensor is installed over the flow stream, measure the present liquid level from the bottom of the channel (if there is a difference between the bottom of the channel and zero level, save this value for reference in flow calculation) and enter this value for Level, under Adjust options. Then highlight **Adjust** and press Enter to confirm.

From this screen, you can also update the display to show the current level of the stream.

☑ Note

Level adjustment of a newly installed and activated sensor should be performed only after the sensor is allowed to stabilize under site conditions (allow approximately one hour per 10 °F difference between storage and operating environments).

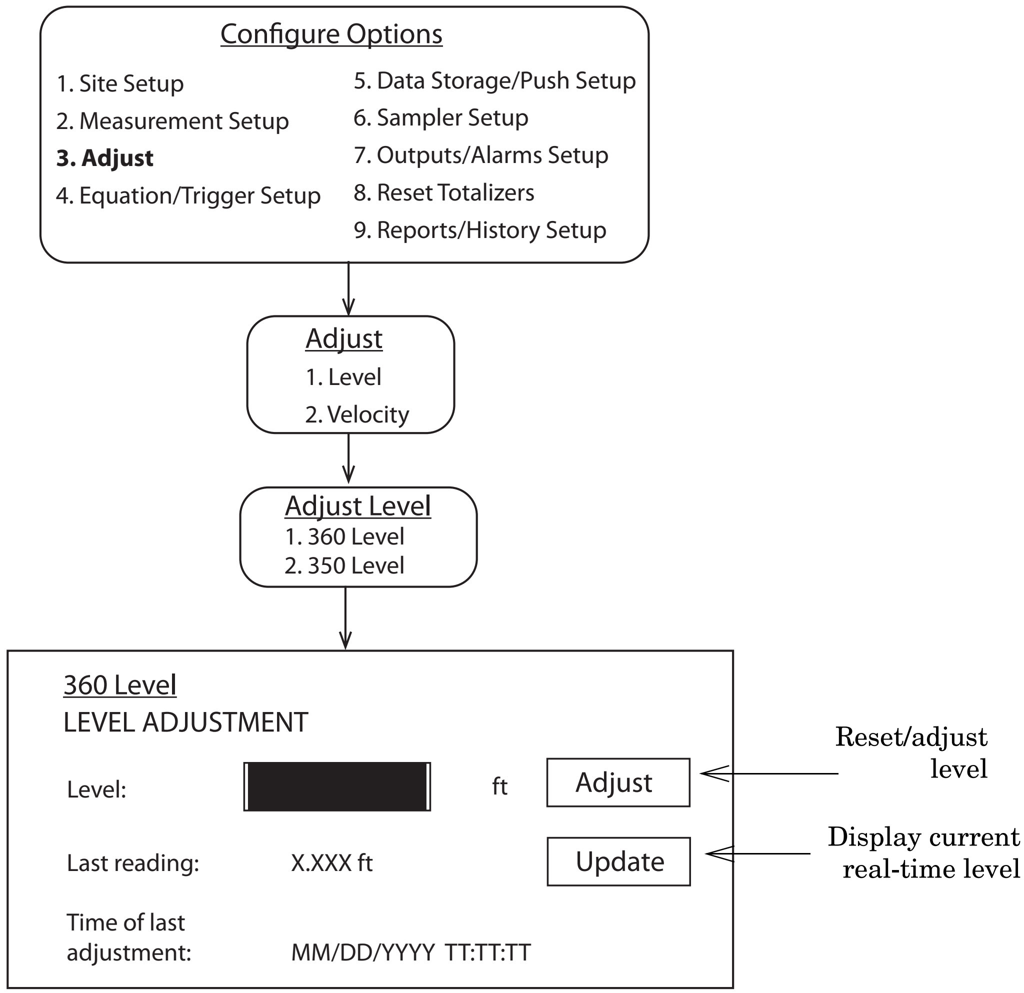


Figure 3-11 Ultrasonic level adjustment

3.5 Contact Teledyne Isco

If you have further questions about the installation, operation, and maintenance of your TIENet device, please contact Environmental Product Support at:

Teledyne Isco
4700 Superior St.
Lincoln, NE 68504

Phone: 866 298-6174 or 402 464-0231
Fax: 402 465-3022
E-mail: IscoService@teledyne.com

TIENet™ 360 LaserFlow™ Velocity Sensor

Section 4 Setup with 2160 LaserFlow Module

The LaserFlow sensor is compatible with both the Teledyne Isco 2160 LaserFlow Module and the Teledyne Isco Signature Flow Meter. For Signature setup instructions, refer to Section 3.

The 2160 module is programmed and set up using Teledyne Isco Flowlink® software. This section of the manual describes activation of connected sensors, and basic LaserFlow and optional TIENet 350 level and velocity measurement setup.

This section of the manual assumes the 2160 site is already configured in Flowlink, and the 2160 module is connected to Flowlink. Detailed Flowlink instructions are available in the Flowlink Windows Help and also in the Flowlink software user manual. For complete information about the 2160 LaserFlow Module, refer to the 2160 LaserFlow Module Installation and Operation Guide.

4.1 Activating Connected Sensors

To add an available (connected) LaserFlow sensor or optional 350 AV sensor and to activate in Flowlink, select the **TIENet** tab (Figure 4-1), then highlight the appropriate LaserFlow module 2160 module, and click the “**Configure**” button.

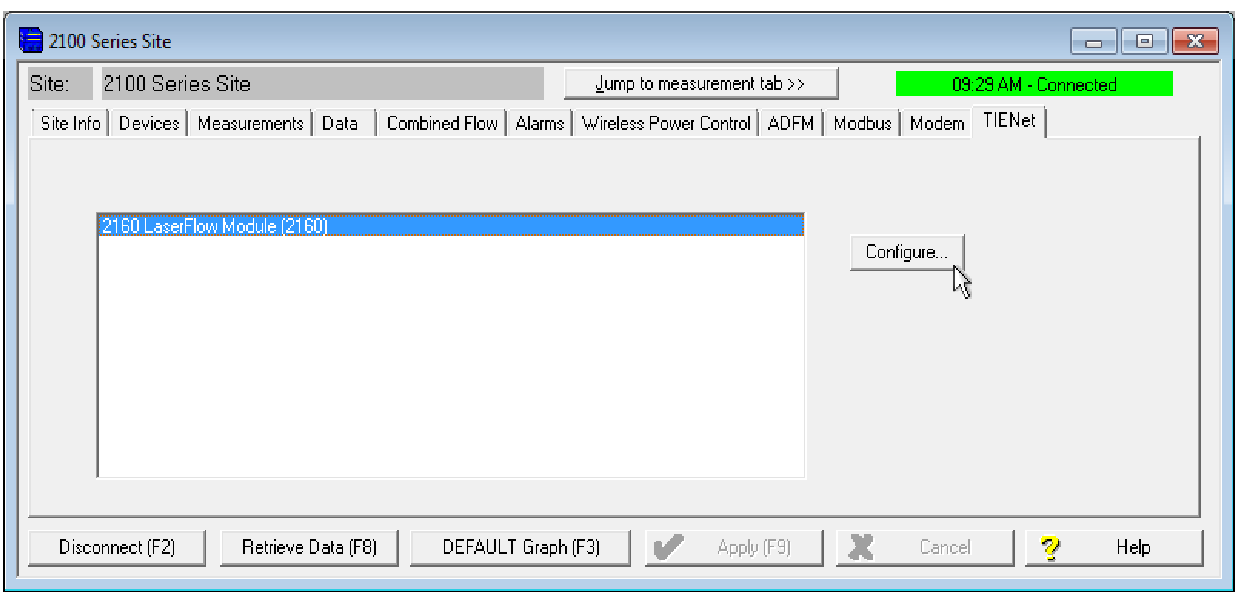


Figure 4-1 Activate connected sensors in Flowlink

A box is displayed, listing active and available TIENet Devices. Click the “**Scan**” button to detect any newly connected LaserFlow or 350 Area Velocity sensors. Devices will appear in the Available TIENet Devices pane.

Highlight the appropriate device(s) and click the “**Add**” button to activate. Active TIENet devices will appear in the Active TIENet Devices pane. Click the “**OK**” button.

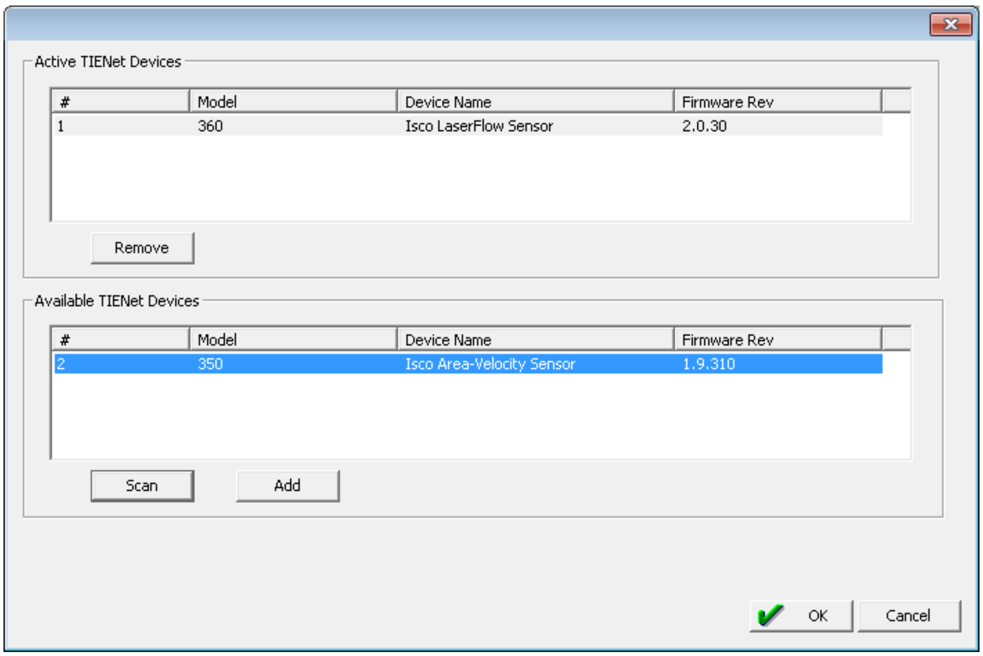


Figure 4-2 Activating connected sensors in Flowlink

4.2 Measurement Display and Settings

The **Measurements** tab in the Site window lists the data types being measured by the 2160 module and displays real-time measurements.

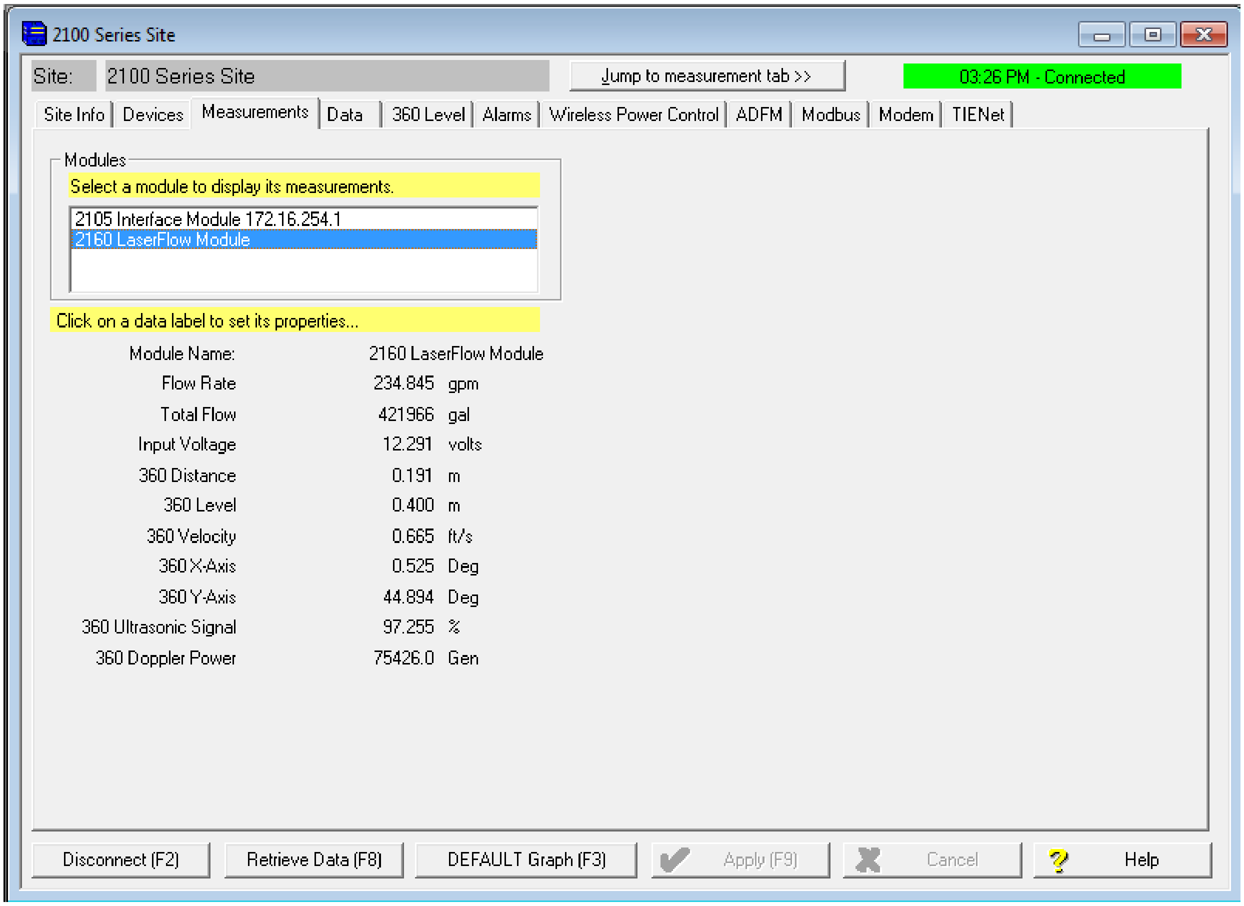


Figure 4-3 Measurements tab: Displays real-time measurements

To select and configure any parameter for your connected devices, click the “**Jump to measurement tab**” button at the top of the Site window and hover over the 2160 LaserFlow Module. If your system includes the optional submerged functionality for redundant measurement, additional parameters may appear for the connected TIENet 350 Area Velocity sensor. Explanations for the listed measurements are provided in Figure 4-4.

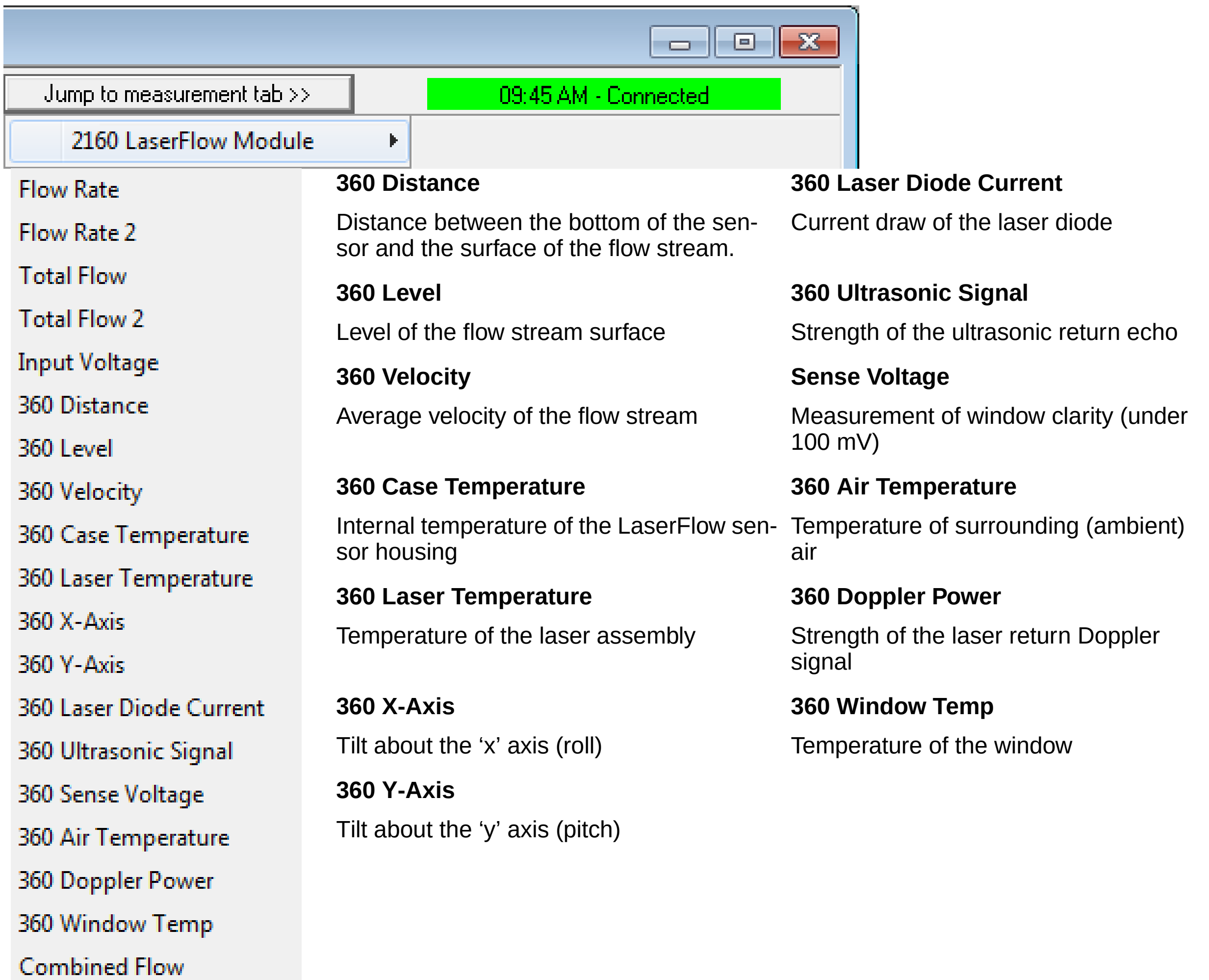


Figure 4-4 Drop down list of measurements for 2160 Module

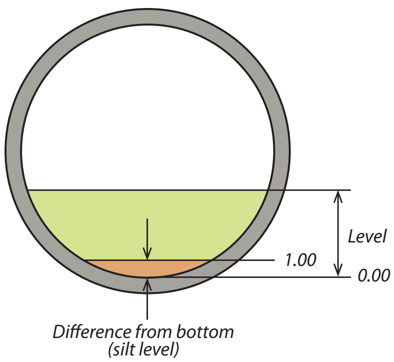
Click on any parameter on the Measurements tab or in the Jump to Measurements tab list to open a dedicated tab to view details or set up data storage.

To prevent a parameter from being displayed on the Measurements tab, select the **Hide in Measurements** box.

The settings for level and velocity input are defined on their respective tabs in Flowlink. To save any changes made to the settings, click the “**Apply**” button.

4.2.1 360 Level

Ultrasonic Level Adjustment



The **Measurement** field displays the most recent level reading.

Once the LaserFlow sensor is installed over the flow stream, measure the present liquid level from the bottom of the channel (if there is a difference between the bottom of the channel and zero level, save this value for reference in flow calculation). Enter this value in the Adjust level field. After the "**Apply**" button is clicked, the level you entered will appear in the Measurement field.

☑ Note

Level adjustment of a newly installed and activated sensor should be performed only after the sensor is allowed to stabilize under site conditions (allow approximately one hour per 10 °F difference between storage and operating environments).

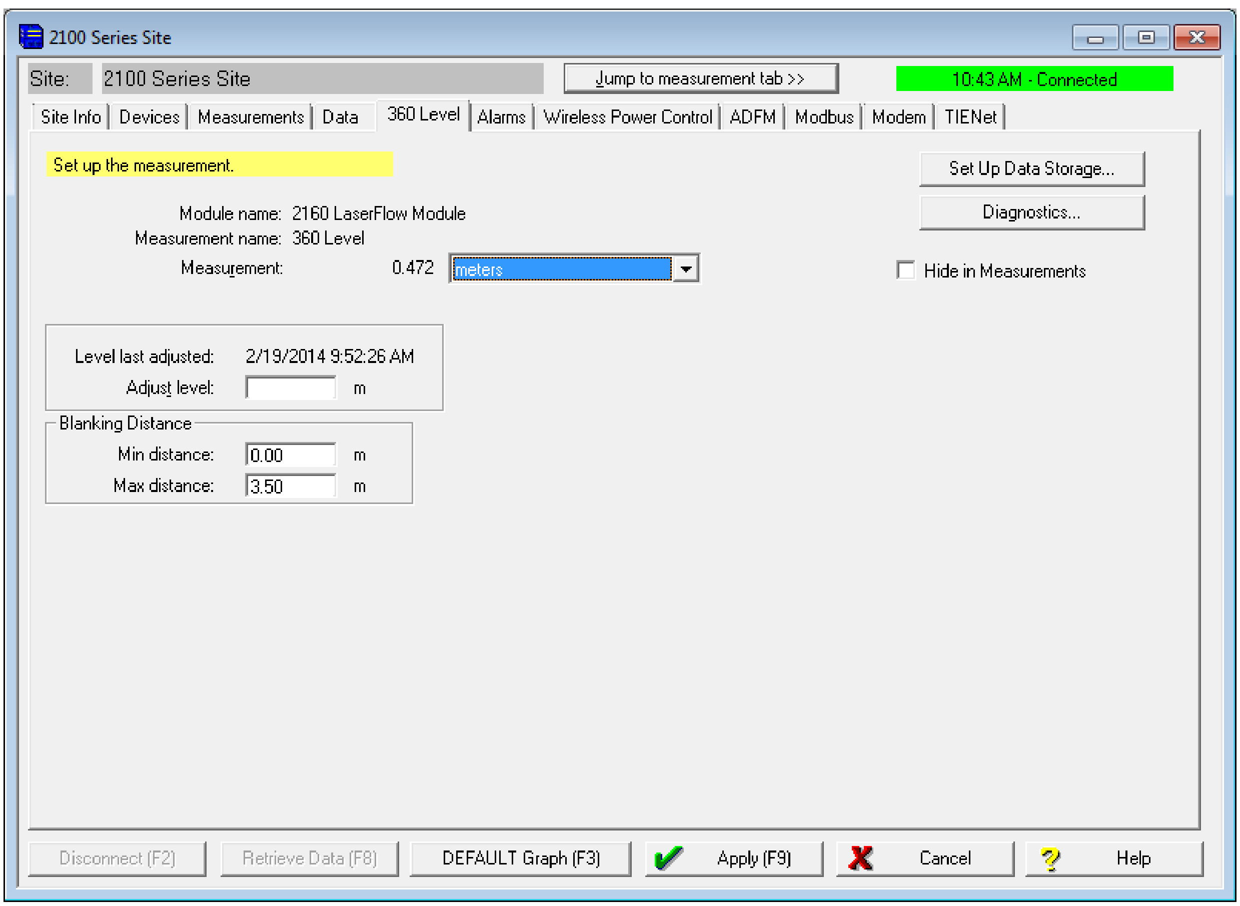


Figure 4-5 360 Level Measurement tab in Flowlink

The **Minimum Blanking Distance** is the distance from the bottom of the sensor to the liquid surface at the highest expected level. Depending on the elevation of the sensor, this value may be increased to help ensure that echoes read by the flow meter come only from the surface of the flow stream, and not off the walls or sides of the channel.

The **Maximum Blanking Distance** is the distance between the bottom of the sensor and the bottom of the channel (i.e., zero level). A larger value than calculated can be entered.

If using the LaserFlow module with the 310 remote ultrasonic sensor and horizontal sensor mounting bracket, the maximum blanking distance is the distance between the bottom of the mounting bracket and the bottom of the channel.

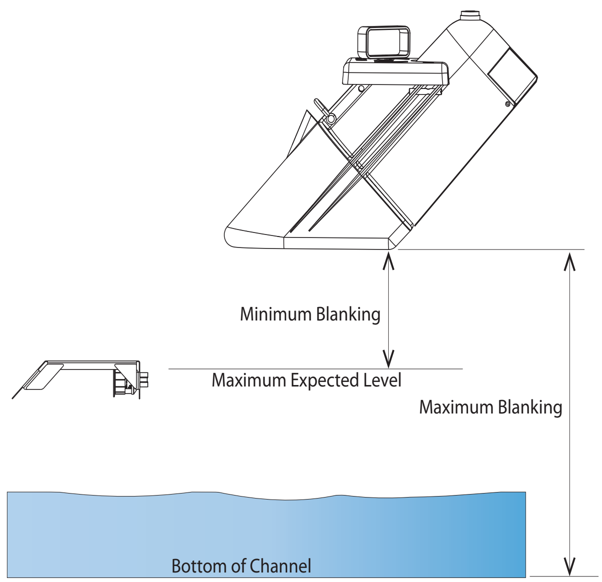


Figure 4-6   Blanking distance for LaserFlow with built-in sensor or 310 remote ultrasonic sensor

4.2.2 360 Velocity

The 360 Velocity measurement tab has a grid containing 15 possible measurement points. The measurement points are activated and deactivated by selecting or deselecting the appropriate check box. To save the measurement settings, click the "**Apply**" button (F9).

As the LaserFlow begins to take readings, the grid becomes populated with a velocity reading and time stamp for each active measurement point (points where a valid reading could not be obtained will display the word "invalid").

Prior to operation, the LaserFlow sensor must be set up for measurement using the 360 Velocity grid. Refer to Section 4.3 *Sensor Positioning and Adjustment*

When the **Positive Velocity** option is "true", the LaserFlow will not attempt to determine flow direction and negative readings are discarded in the average velocity calculation. Selecting this setting will save power. The default is "true".

When the Positive Velocity option is "false", a second velocity measurement is taken to determine the direction of the flow.

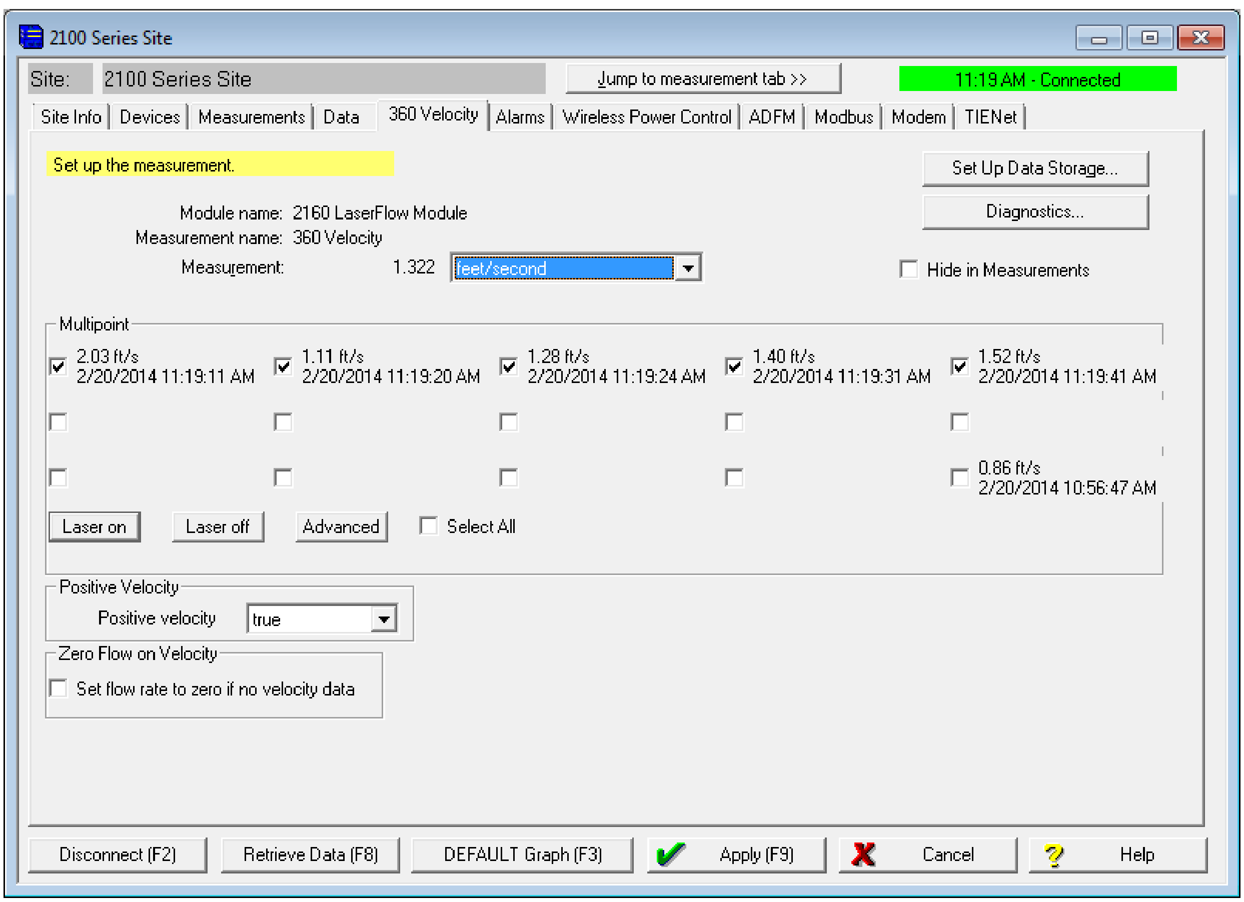


Figure 4-7 360 Velocity Measurement tab in Flowlink

4.2.3 Advanced Settings

The LaserFlow Advanced Settings are pre-programmed into the sensor. However, if your application requires the any custom configuration, the "**Advanced**" button opens the Velocity Coefficients window (refer to Figure 4-8).

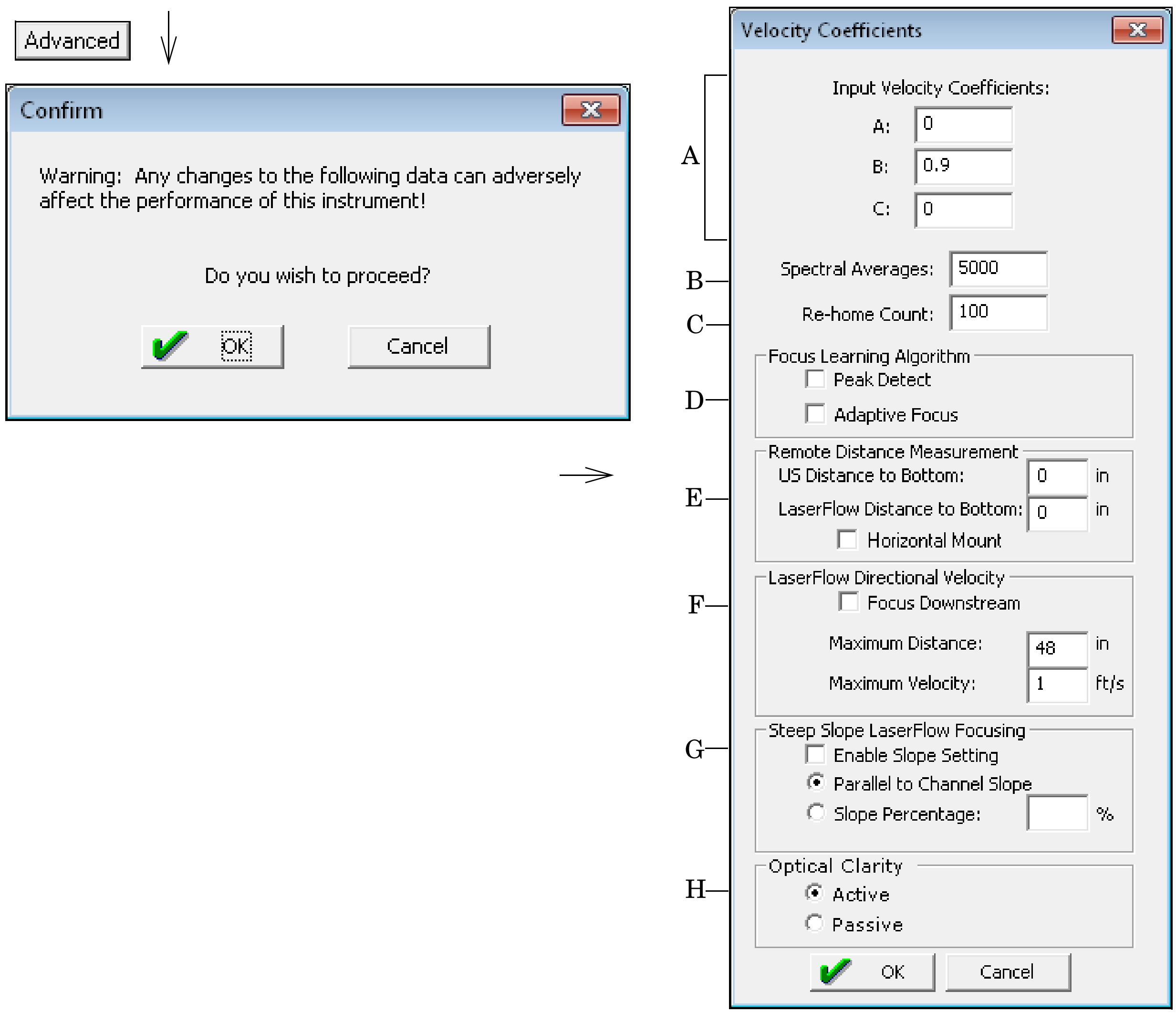
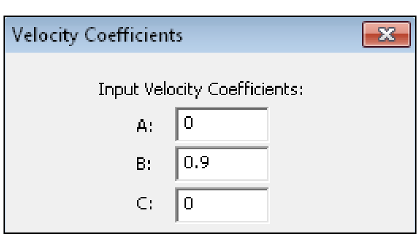


Figure 4-8 360 Velocity Tab: Advanced settings



A - Input Velocity Coefficients

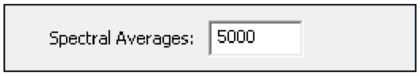
Input Velocity Coefficients – The relationship of the three Input Velocity Coefficients A, B and C can be expressed as:

$\overline{V} = A\ (offset) + B*(Measured\ Velocity) + C*(Measured\ Velocity)^2$

Coefficient A is an additive offset value to correct the Measured Velocity for any additive bias. The value for A must be expressed in units of meters/second. The default is "0".

Coefficient B is a multiplicative scalar for correcting the Measured Velocity for any linear multiplicative bias. The value for B is unitless. The default is "0.9".

Coefficient C is another scalar to correct the Measured Velocity for any nonlinear bias. The value for C must be expressed in units of seconds/meter, so that the resulting value for the Reported Velocity Reading will be in units of meters/second. The default is "0".

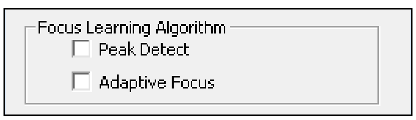


B - Spectral Averages

Spectral Averages – The value for Spectral Averages may be used to reduce noise and improve signal strength. The default is "5000". If persistent low signal strength or velocity dropouts are indicated, enter a high value, such as 10000. If signal quality and measurement improve, try entering a lower value, such as 7500, observing the signal quality. The lower the value for Spectral Average, the less time required for each complete measurement, reducing power usage. Adjust the value to determine a number that balances power usage with satisfactory signal quality and readings.

C - Re-home Count

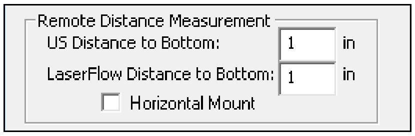
Re-home Count – For testing purposes only. For more information, contact Environmental Products Support.



D - Focus Learning Algorithm

Focus Learning Algorithm – The Peak Detect function scans across the user-defined row to locate the peak velocity. To enable Peak Detect functionality, select the "**Peak Detect**" check box.

Adaptive Focus enables the LaserFlow module to scan above and below the standard focus point, then adjust the focus to the point with the best signal strength. To enable Adaptive Focus functionality, select the "**Adaptive Focus**" check box.



E - Remote Distance Measurement

Remote Distance Measurement – The Remote Distance Measurement options are active only when the LaserFlow module is connected to the TIENet 310 remote ultrasonic sensor.

The **US Distance to Bottom** is the distance (e.g., inches) from the 310 remote ultrasonic sensor to the bottom of the channel. See Figure 4-9. Units of measurement are based on user settings.

☑ Note

When using the horizontal sensor mount bracket, the US Distance to Bottom is measured from the bottom of the horizontal sensor mount bracket to the bottom of the channel. See Figure Figure 4-10.

The **LaserFlow Distance to Bottom** is the distance (e.g., inches) from the bottom of the LaserFlow sensor the bottom of the channel. Units of measurement are based on user settings.

Select the "**Horizontal Mount**" check box if using the optional horizontal sensor mount bracket. See Figure 4-10.

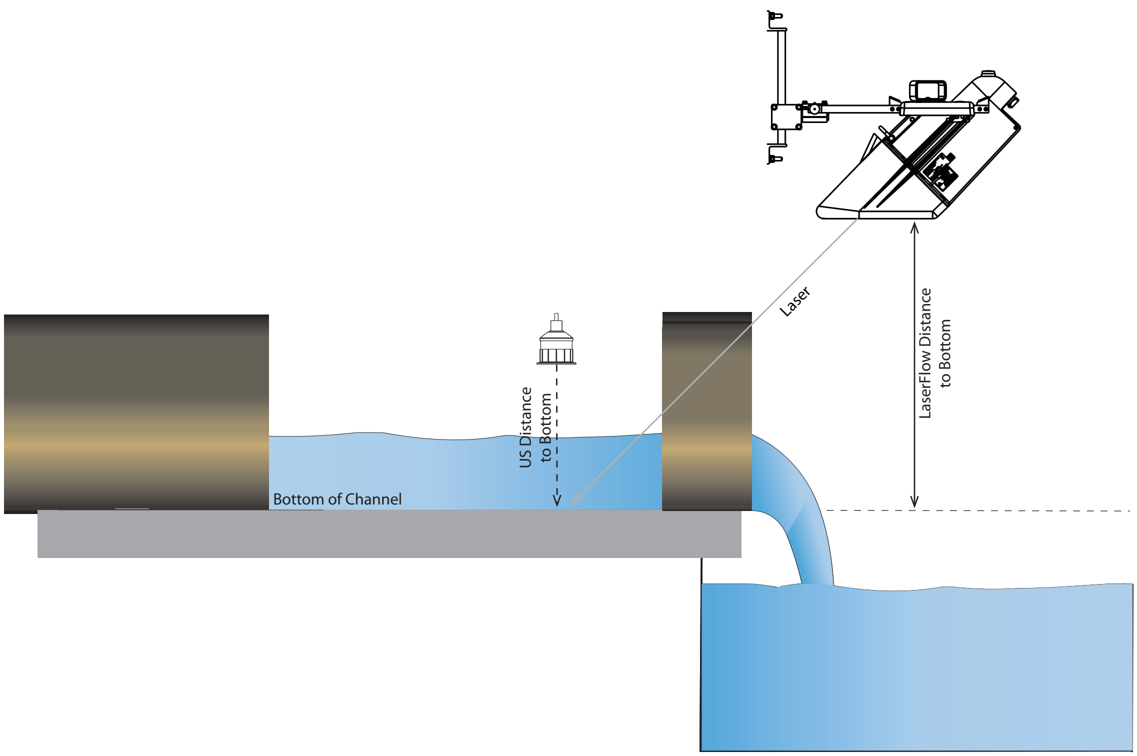


Figure 4-9 . Remote distance measurement with the 310 remote ultrasonic sensor

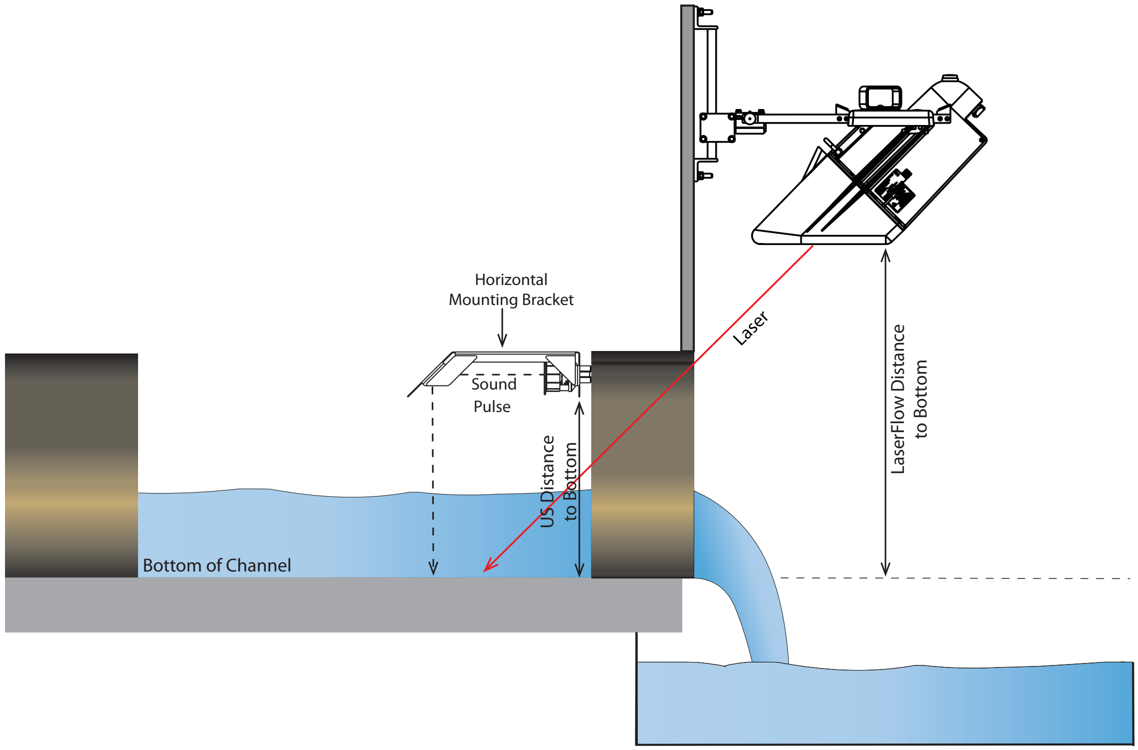
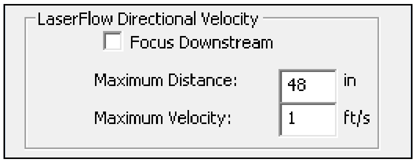


Figure 4-10 Remote distance measurement with the 310 remote ultrasonic sensor and horizontal sensor mount bracket



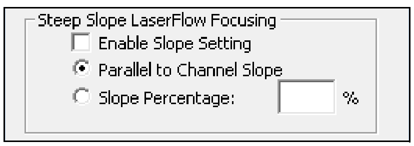
F - LaserFlow Directional Velocity

LaserFlow Directional Velocity – The LaserFlow Directional Velocity options are active only when the Positive Velocity option is “false”.

Select the “**Focus Downstream**” check box when the LaserFlow sensor is pointed downstream.

The **Maximum Distance** is the greatest distance (e.g., inches) the LaserFlow sensor will take a directional velocity reading. The default is “48”. Units of measurement are based on user settings.

The **Maximum Velocity** is the greatest velocity (e.g., ft/s) the LaserFlow sensor will take a directional velocity reading. The default is “1”. Units of measurement are based on user settings.



G - Steep Slope LaserFlow Focusing

Steep Slope LaserFlow Focusing – If the sensor is on a slope greater than 1%, select the “**Enable Slope Setting**” check box. By default, this option is disabled.

If the sensor is parallel to the channel slope, select “**Parallel to Channel Slope**”. Measure from the front of the sensor carrier to the bottom of the channel. Then measure from the back of the sensor carrier to the bottom of the channel. Ensure the distance is equal. Adjust the sensor carrier as necessary. See Figure 4-11. By default, this option is enabled.

If the slope of the pipe is known, mount the sensor level with the Earth, using the bubble level mounted on the top of the sensor and then enter the **Slope Percentage** in the field. See Figure 4-12. By default, this option is disabled.

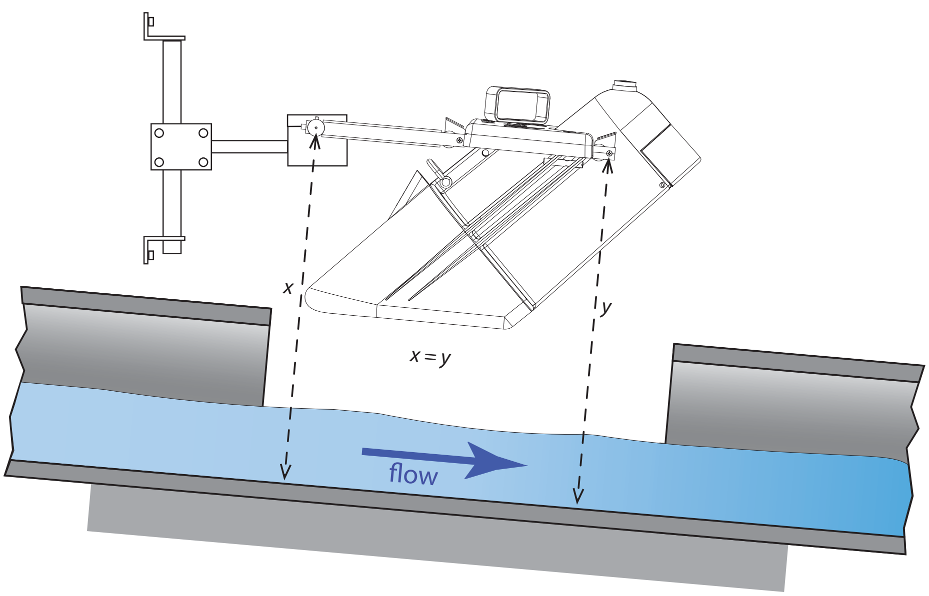


Figure 4-11 LaserFlow placement using Parallel to Channel Slope option

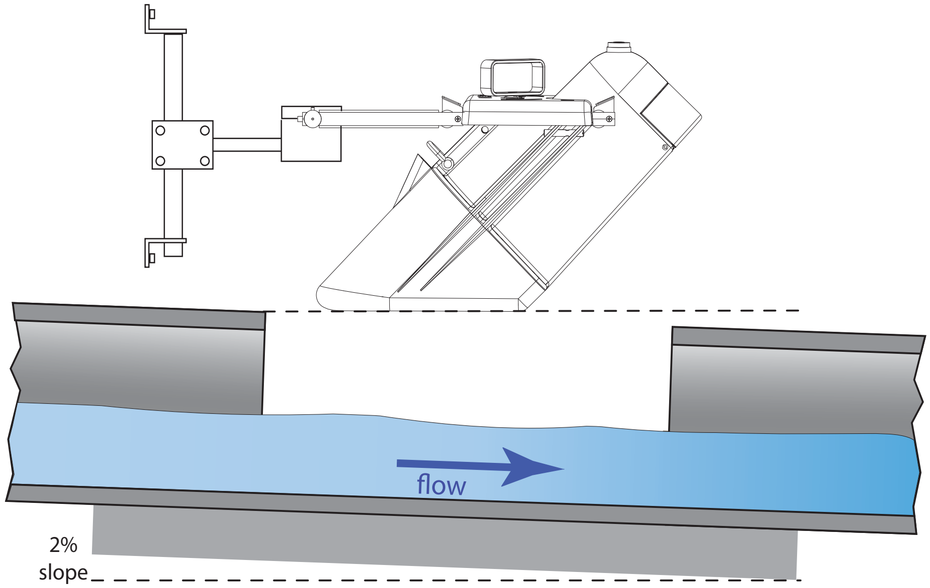
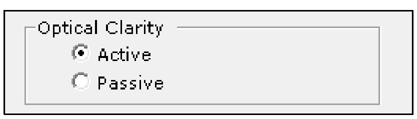


Figure 4-12 LaserFlow placement using Slope Percentage option



H - Optical Clarity

Optical Clarity – Sense voltage detects fog on the window of the LaserFlow sensor. When the sense voltage is greater than 100 mV, the defogger is activated. The defogger is enabled from 1 to 5 minutes, depending on the severity of the fog.

Note

In locations with severe fogging potential, Teledyne Isco recommends increasing battery capacity or monitoring the site more frequently.

To enable Optical Clarity, click “**Active**”. To disable Optical Clarity, click “**Passive**”. The default is “Active”.

4.2.4 350 Level (Optional)

If your system includes the optional surcharge sensor, it is also capable of measuring level with a pressure differential transducer. To set an initial or new level, enter the value in the **Adjust level** field. After you click Apply, the level you entered will appear in the Measurement field.

During setup for the optional surcharge functionality, measure the distance from the bottom of the channel to the bottom of the LaserFlow to set the initial level reading. Refer to Figure 4-14.

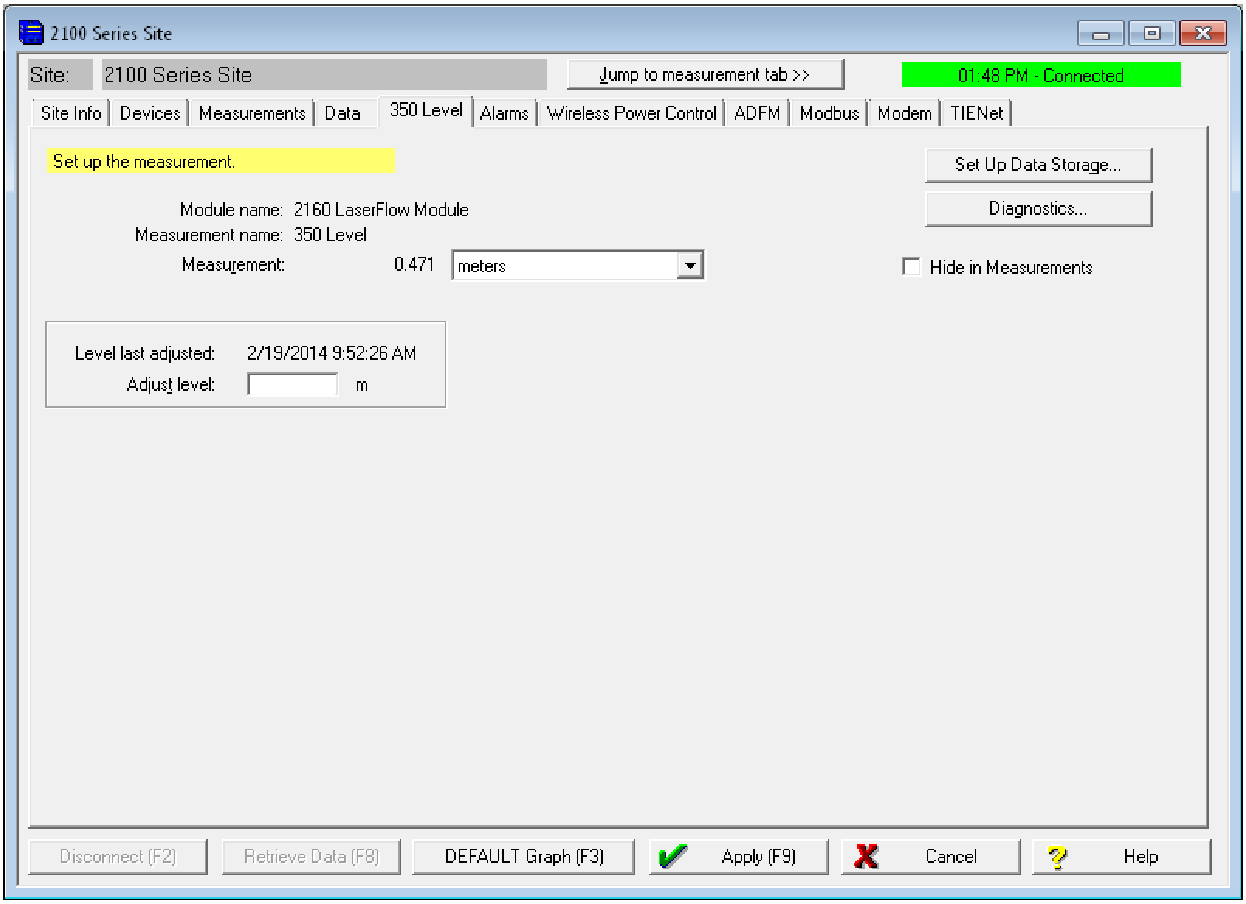


Figure 4-13 350 Level Measurement tab in Flowlink

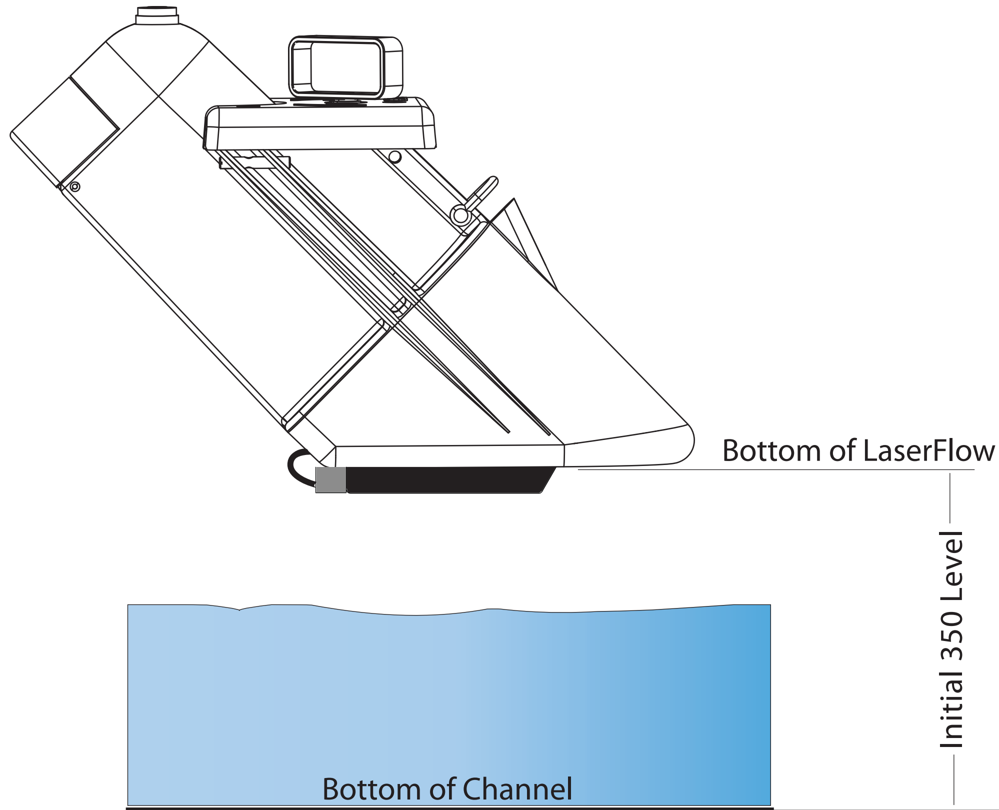


Figure 4-14 Submerged functionality: Initial 350 Level setting

Surcharge alarming

It is recommended that the variable data storage rate function be used to trigger 350 velocity and level measurement based on a Level threshold.

Alarm setup and activation are explained in the Flowlink software user manual and help windows, under Equation Builder, Condition Builder, and Threshold.

4.2.5 350 Velocity (Optional)

If your system includes the optional submerged functionality or redundant measurement, it is also capable of measuring velocity with a continuous wave Doppler sensor.

In the case of the submerged functionality, measure the distance between the bottom of the channel and the face of the pressure transducer (bottom of the LaserFlow) to obtain the initial value for 350 Level.

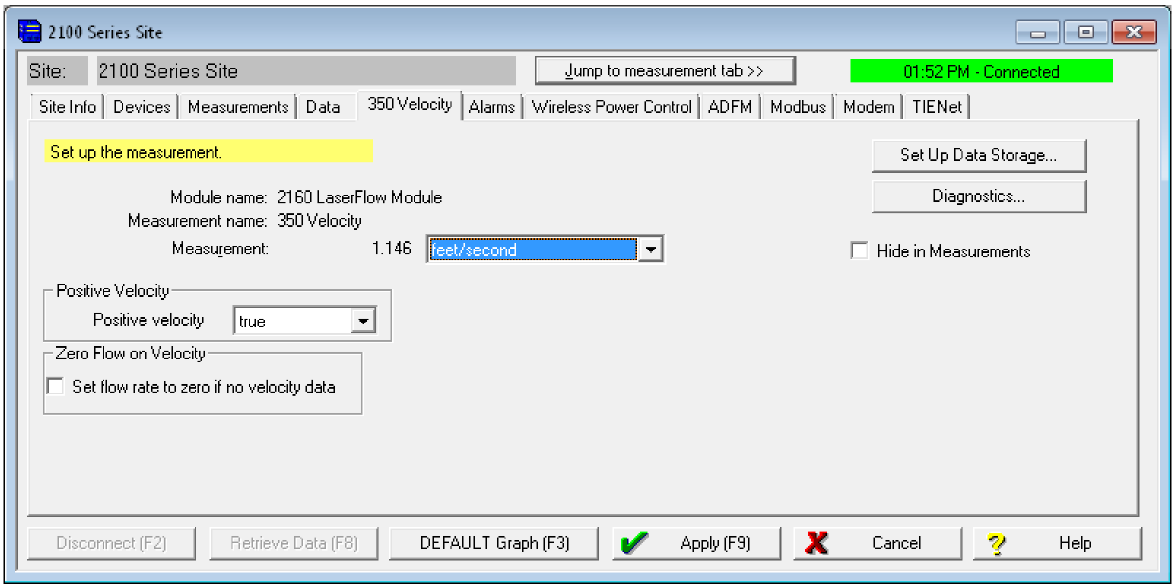


Figure 4-15 350 Velocity Measurement tab in Flowlink

The **Positive Velocity** setting, when set to “true”, the LaserFlow will not attempt to determine flow direction and negative readings are discarded in the average velocity calculation. Selecting this setting will save power. This setting is set to “true” by default.

The **350 Advanced Settings** are pre-programmed into the sensor. However, if your application requires the addition of any correction factors, the Advanced button opens the Advanced settings window (refer to Figure 4-16).

Input velocity coefficients can be adjusted for A, B, and C, where:

$\overline{V} = A\ (offset) + B^{*}(Measured\ Velocity) + C^{*}(Measured\ Velocity)^2$

Coefficient A is an additive offset value to correct the Measured Velocity for any additive bias. The value for A must be expressed in units of meters/second.

Coefficient B is a multiplicative scalar for correcting the Measured Velocity for any linear multiplicative bias. The value for B is unitless.

Coefficient C is another scalar to correct the Measured Velocity for any nonlinear bias. The value for C must be expressed in units of seconds/meter, so that the resulting value for the Reported Velocity Reading will be in units of meters/second.

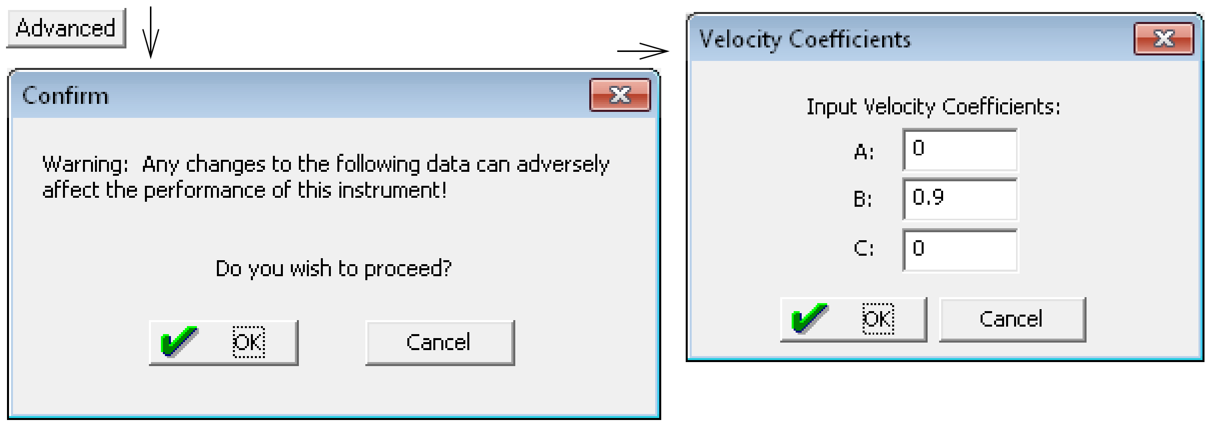
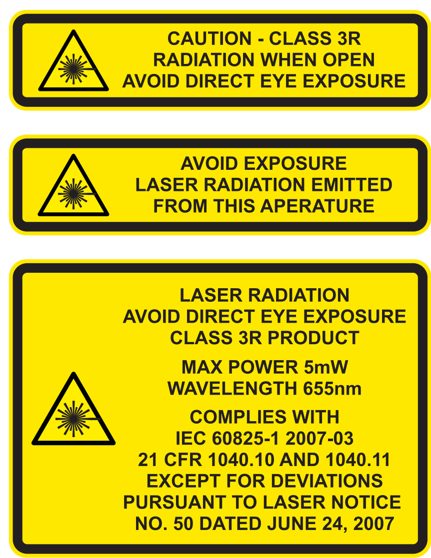


Figure 4-16 350 Velocity tab: Advanced settings for optional TIENet 350 AV sensor

4.3 Sensor Positioning and Adjustment

To set the initial level values, refer to Sections 4.2.1 (LaserFlow) and 4.2.4 (optional 350).



4.3.1 Centering the LaserFlow Sensor

Proper positioning of the LaserFlow sensor is critical for optimal velocity measurement. In center position, the laser beam must strike the flow stream precisely in the center.

The beam automatically moves to the top center position.

Laser on

Select the “**Laser on**” button and click the “**Apply**” button. This will keep the laser beam on continuously for 10 minutes or until the “**Laser off**” button is clicked, allowing the beam to be used for fine-tuning the sensor’s position.

> **Note**
> When sensor positioning is completed, securely tighten all mounting hardware.

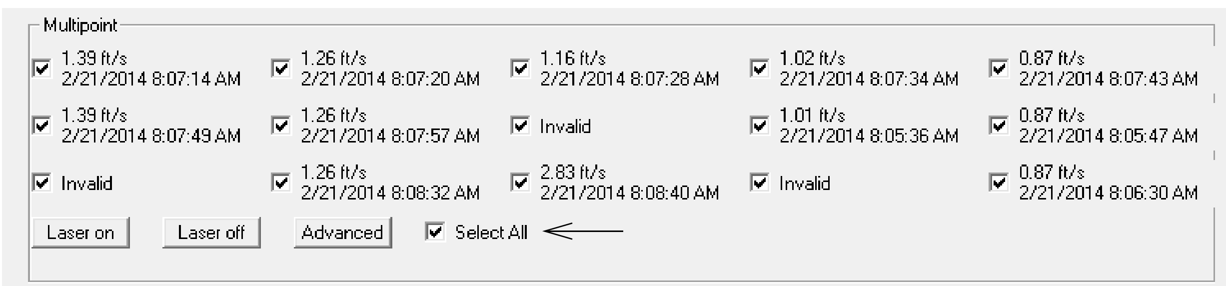
4.3.2 Laser Velocity Measurement Point Selection

Once the LaserFlow sensor is installed over the flow stream, some installations may only require the center laser position for velocity measurement.

For installations requiring multiple measurement points, determine which points will be used. To do so, activate all 15 points and wait for all of them to display their readings. This process may take up to 15 minutes.

Each point will display a velocity reading and time stamp, or "Invalid." Deselect "Invalid" and undesired points. The fewer points selected, the less time required to complete one velocity measurement.

Select the "**Select All**" check box to activate all 15 points, then click the "**Apply**" button.



Deselect "Invalid" and undesired points, then click the "**Apply**" button.

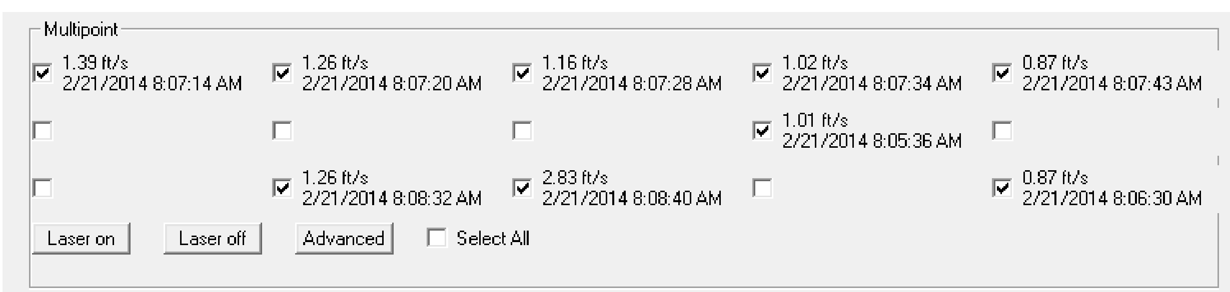


Figure 4-17 Selection of velocity measurement points

TIENet™ 360 LaserFlow™ Velocity Sensor

Section 5 Maintenance and Optional Kits

5.1 Maintenance

The following tables are recommended maintenance checks to ensure proper operation. As site conditions may vary, increase the frequency of inspections as needed.

Table 5-1 Recommended Maintenance (Accessible Locations)

Action	Recommended Frequency	Location
Check Ultrasonic level sensor (built-in or remote) for obstructions (e.g., spider webs, debris)	Monthly	On-site
Check Horn for obstructions (e.g., spider webs, debris)	Monthly	On-site
Check 350 Area Velocity sensor (if applicable) for debris	Monthly or following surcharge event	On-site
Ensure suitable alignment - check x-axis (roll) and y-axis (pitch)	Weekly	Via Flowlink application or Signature™ flow meter
Check Doppler Power and assess historical trend	Weekly	Via Flowlink application or Signature™ flow meter
Check Ultrasonic Signal and assess historical trend	Weekly	Via Flowlink application or Signature™ flow meter

Table 5-2 Recommended Maintenance (Difficult-to-Access Locations)

Action	Recommended Frequency	Location
Check Ultrasonic level sensor (built-in or remote) for obstructions (e.g., spider webs, debris)	Every 6 months or following surcharge event	On-site
Check Horn for obstructions (e.g., spider webs, debris)	Every 6 months or following surcharge event	On-site
Check 350 Area Velocity sensor (if applicable) for debris	Every 6 months or following surcharge event	On-site
Ensure suitable alignment - check x-axis (roll) and y-axis (pitch)	Weekly	Via Flowlink application or Signature™ flow meter
Check Doppler Power and assess historical trend	Weekly	Via Flowlink application or Signature™ flow meter
Check Ultrasonic Signal and assess historical trend	Weekly	Via Flowlink application or Signature™ flow meter

5.2 Firmware Updates

When firmware updates become available, they can be downloaded from www.isco.com or via email from the factory.

5.2.1 With Signature Flow Meter

The TIENet device's firmware is updated via the USB port on the front panel of the Signature Flow Meter. Step-by-step instructions for updating the firmware can be found in Section 2 of the Signature user manual.

5.2.2 With 2160 LaserFlow Module

The TIENet device's firmware is updated via the "Update Isco Instrument Software" tool from Flowlink for the 2160 module. Step-by-step instructions for updating the firmware can be found in the Help text of the update application.

5.3 Cleaning the Sensor Housing

The LaserFlow sensor's outer housing and ultrasonic transducer can be cleaned with warm water, mild soap, and a soft, lint-free cloth. Do not spray water on the laser window; install the protective window cap prior to cleaning.

⚠ CAUTION

Never use ordinary cloth or abrasives to clean the LaserFlow.

⚠ CAUTION

Be sure the protective window cap is installed during cleaning, storage, or shipment (refer to Section 1.7.1).

5.4 Accessing the LaserFlow's Nose Piece

Several procedures for maintenance and options require accessing the interior of the sensor by separating the nose piece from the body, and subsequent reassembly. Refer back to this section when performing these procedures.

⚠ WARNING

Disconnect power from the LaserFlow sensor before opening the sensor housing.

Tools required

- #2 Phillips straight screwdriver less than 4" (right-angled if available)

5.4.1 Removing the Nose Piece

The screws that attach the nose piece to the body are difficult to access with a straight screwdriver, being somewhat obstructed by the mounting block.

1. Remove the 6 large Phillips screws on the LaserFlow nose piece, and separate the nose from the body. **Do not remove any other screws.**

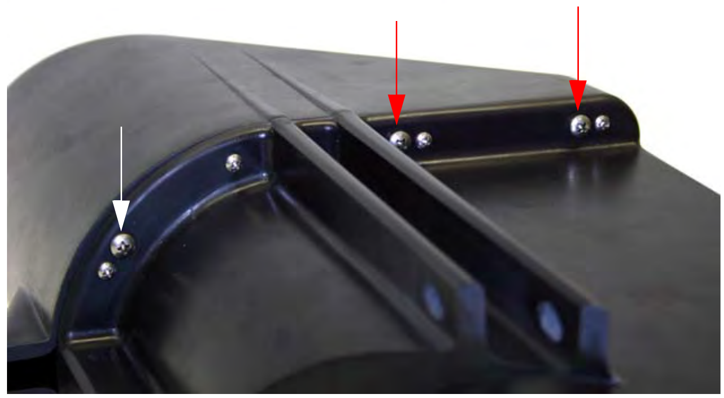


Figure 5-1 Remove large screws and nose piece (3 on each side)

5.4.2 Replacing the Nose Piece

1. Fasten the sensor back together by cross-tightening the 6 large Phillips screws in diagonal order until the two sections are flush against each other.

⚠ CAUTION

When reinstalling all self-tapping screws, avoid destroying the plastic threads. First seat each screw in its hole and, without pressing down, rotate the screw counter-clockwise until it falls into its thread groove with a "click". Then tighten the screw.

2. If applicable, reinstall the mounting block, ensuring that both flat and split washers are included.

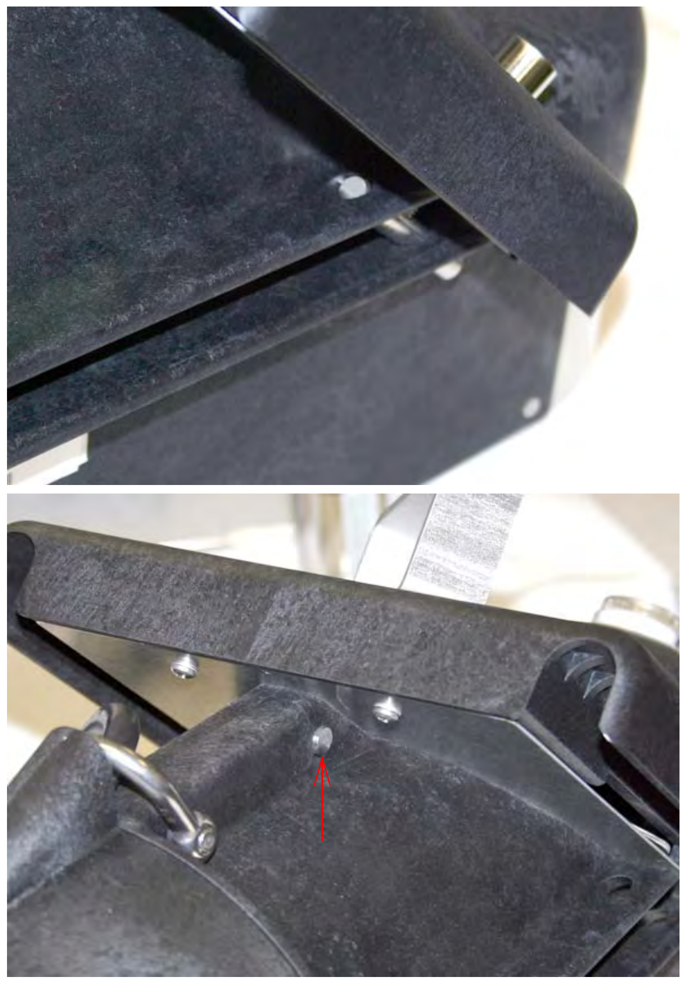


Figure 5-2   Location and orientation of cross-pins for mounting block installation

5.5 Velocity Readings and the Laser Window

Invalid or inconsistent velocity readings may indicate debris or moisture condensation on the window protecting the laser.

The laser window is crucial for focusing and should never be touched. Smudging or scratches can degrade the performance of the sensor. **For these reasons, cleaning the window is NOT recommended unless absolutely necessary.**

If cleaning must be performed, follow the instructions provided in Section 5.6 exactly.

5.6 Cleaning the Laser Window

The laser window is crucial for focusing and should never be touched. Smudging or scratches can degrade the performance of the sensor. **For these reasons, cleaning the window is NOT recommended unless absolutely necessary.**

⚠ CAUTION

Never touch the laser window. Never use ordinary cloth or water to clean the surface of the laser window.

Items required for cleaning

- Pre-packaged, pre-IPA-moistened, single-use, lint-free tissue, such as Zeiss Lens Cleaning Wipes or Bausch & Lomb Sight Savers®[1] Pre-Moistened Lens Cleaning Tissues.
- Kimwipes®[2] dry tissues
- Rain-X®[3] Original Glass Treatment

⚠ CAUTION

Never moisten the tissue with IPA or other solution *after* removing it from its package.

Procedure

You must access the LaserFlow's interior to clean the window. Instructions for opening and reassembling the LaserFlow are provided in Section 5.4 *Accessing the LaserFlow's Nose Piece*.

⚠ WARNING

Disconnect power from the LaserFlow sensor before opening the sensor housing.

⚠ CAUTION

Do not attempt to clean the laser window without opening the sensor housing. Serious damage can result.

1. Remove the folded tissue from its package and use the corners to lightly brush any abrasive material from the surface.

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1. Sight Savers® is a registered trademark of Bausch & Lomb, Inc.
2. Kimwipes® is a registered trademark of Kimberly-Clark Corporation.
3. Rain-X® is a registered trademark of Illinois Tool Works, Inc.

2. Unfold the tissue and gently clean the surface with downward strokes only, **keeping the tissue between your finger and the glass at all times**.
3. Examine the window closely under good lighting from all directions to ensure there are no smudges, streaks, or film on the surface.
   If the window is smudged, streaked, or still dirty, get a fresh pre-packaged tissue and repeat.
4. Next, fold a clean, dry Kimwipe tissue four times to reinforce its thickness, and gently clean the window surface with downward strokes only, **keeping the tissue between your finger and the glass at all times.**
5. Examine the window closely under good lighting from all directions to ensure there are no smudges, streaks, or film on the surface.
   If the window is smudged, streaked, or still dirty, get a fresh pre-packaged tissue and repeat.
6. Fold a fresh Kimwipe tissue as previously described and spray the closed end of it with Rain-X.

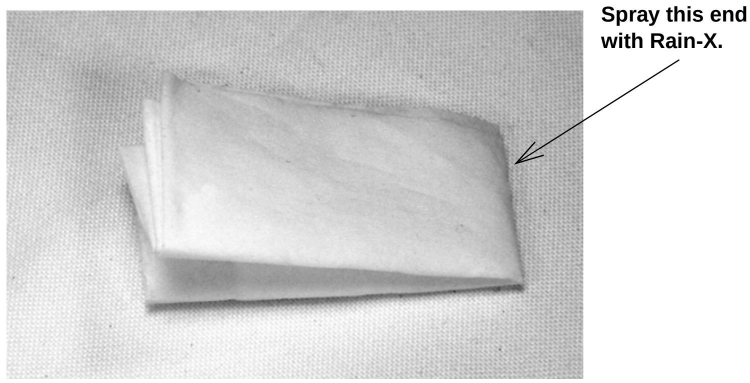


Figure 5-3 Cleaning the laser window: Moisten Kimwipe tissue w/ Rain-X

7. Apply the Rain-X to the entire window surface using downward strokes only.
8. After allowing 30 minutes for the Rain-X treatment to dry, wipe the window with another dry Kimwipe tissue, as described in step 4.
9. Carefully examine the window as previously described, and continue polishing the surface with fresh dry tissues until no streaks or film are visible.

Reassemble the sensor, following the steps provided in Section 5.4.2 *Replacing the Nose Piece*.

5.7 Installing the Optional Submerged Measurement Kit

The submerged functionality consists of a TIENet 350 Area Velocity sensor mounted on the bottom of the LaserFlow sensor. This option is normally pre-assembled and installed at the factory before shipment. However, it can also be installed by the user in existing systems.

Tools Required

To install the submerged measurement kit, you will need:

- Integrated 350 Kit from Teledyne Isco
  - TIENet 350 AV Sensor with 28" cable
  - Sensor mounting plate
  - 2 Flathead screws
  - 2 Lock nuts
  - 2 Flat washers
- 1/4" Nut driver or open wrench

5.7.1 Installation Procedure

You must access the LaserFlow's interior to install this option. Instructions for opening and reassembling the LaserFlow are provided in Section 5.4 *Accessing the LaserFlow's Nose Piece*.

⚠ WARNING

Disconnect power from the LaserFlow sensor before opening the sensor housing.

⚠ CAUTION

NEVER touch the window or get it dirty.

Figure 5-4 350 AV sensor with mounting plate

1. Using the flat washers and lock nuts, attach the mounting plate to the rectangular mounting holes in the bottom of the LaserFlow interior, with the tip of the 350 sensor facing front.

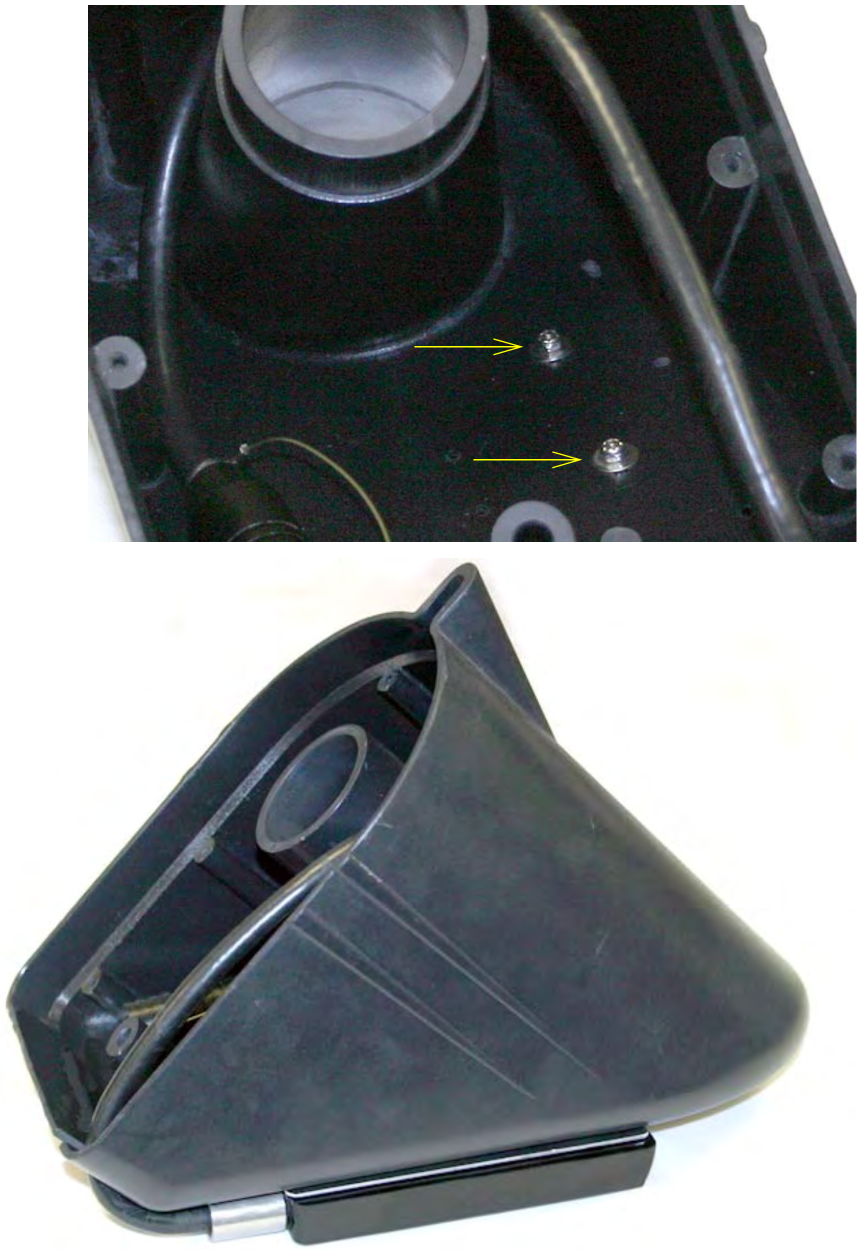
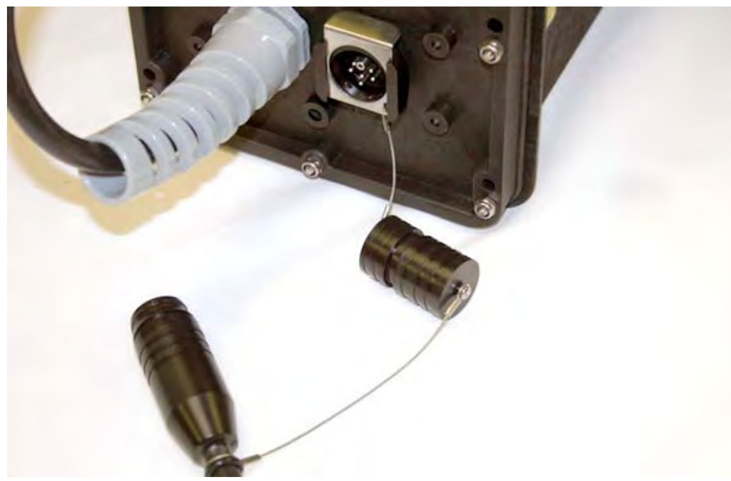


Figure 5-5 Mounting the integrated 350 AV sensor on the LaserFlow

2. Prepare the LaserFlow receptacle by removing the cap (press down on the spring release and pull out the cap).

3. Remove the cap from the 350 TIENet plug and push the protective caps of the two sensors together.



4. Aligning the pins on the LaserFlow cable with those in the connector receptacle, push the 350 connector into the receptacle on the inner wall of the LaserFlow until the spring release clicks.

Figure 5-6 Connecting the 350 AV sensor to the LaserFlow

5. Route the 350 sensor cable through the slot in the bottom of the nose piece. Route the LaserFlow cable through its slot in the top of the nose piece.
   Taking care not to pinch or bind the cables, bring the two sections of the sensor housing back together.

Figure 5-7 Reassembling the LaserFlow w/ AV sensor installed

6. Reassemble the LaserFlow housing, following the steps provided in Section 5.4.2 *Replacing the Nose Piece*.

⚠ CAUTION

When reinstalling all self-tapping screws, avoid destroying the plastic threads. First seat each screw in its hole and, without pressing down, rotate the screw counter-clockwise until it falls into its thread groove with a "click." Then tighten the screw.

5.8 Installing the Remote TIENet™ 310 Ultrasonic Level Sensor

Refer to the TIENet™ 310 Ultrasonic Level Sensor Installation and Operation Guide for details.

TIENet™ 360 LaserFlow™ Velocity Sensor

Appendix A Replacement Parts

A.1 Replacement Parts Diagrams and Listings

Replacement parts are called out in illustrations in this section. Reference the call-outs in the accompanying tables to determine the part number for the item.

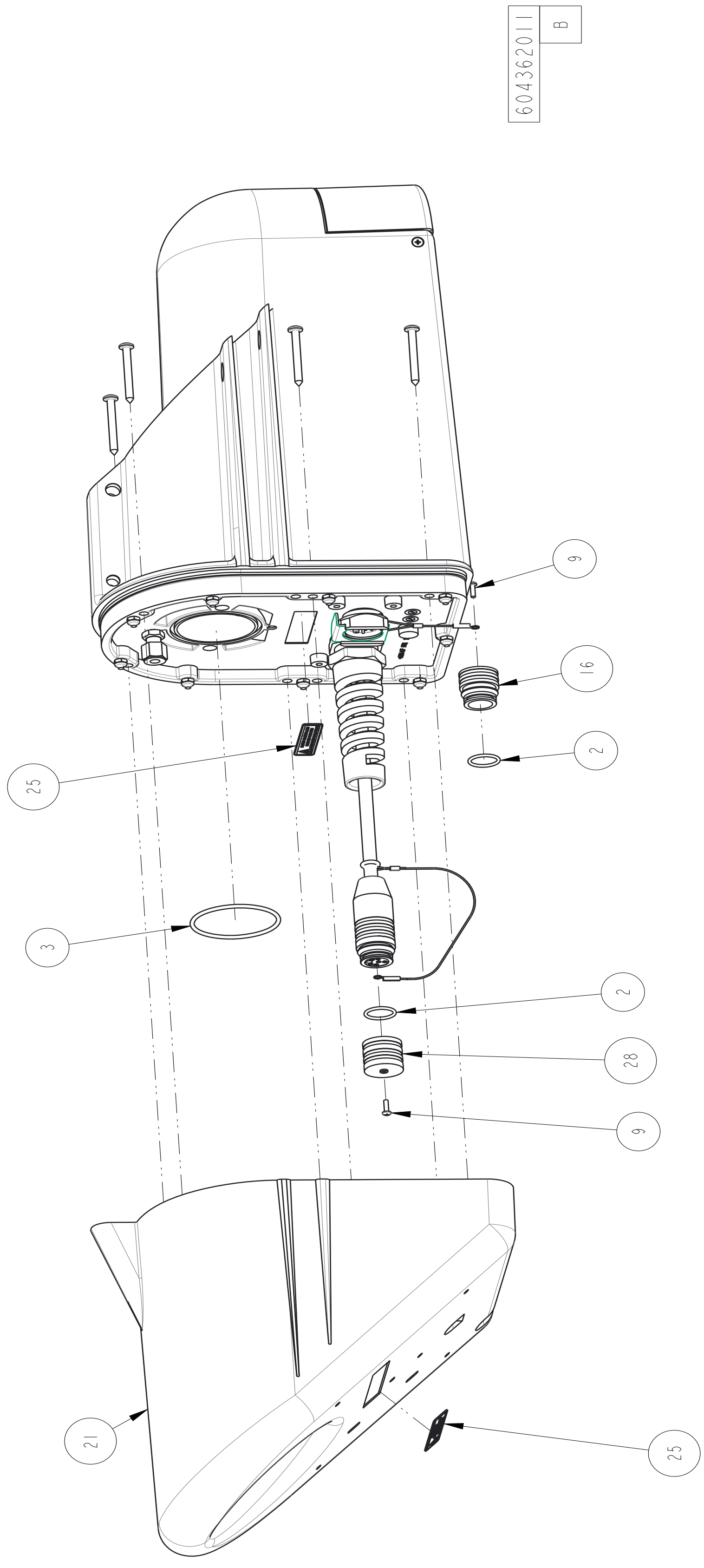
Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Department
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX:(402) 465-3022

E-mail:IscoInfo@teledyne.com

A.2 LaserFlow Sensor



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REPLACEMENT PARTS LIST

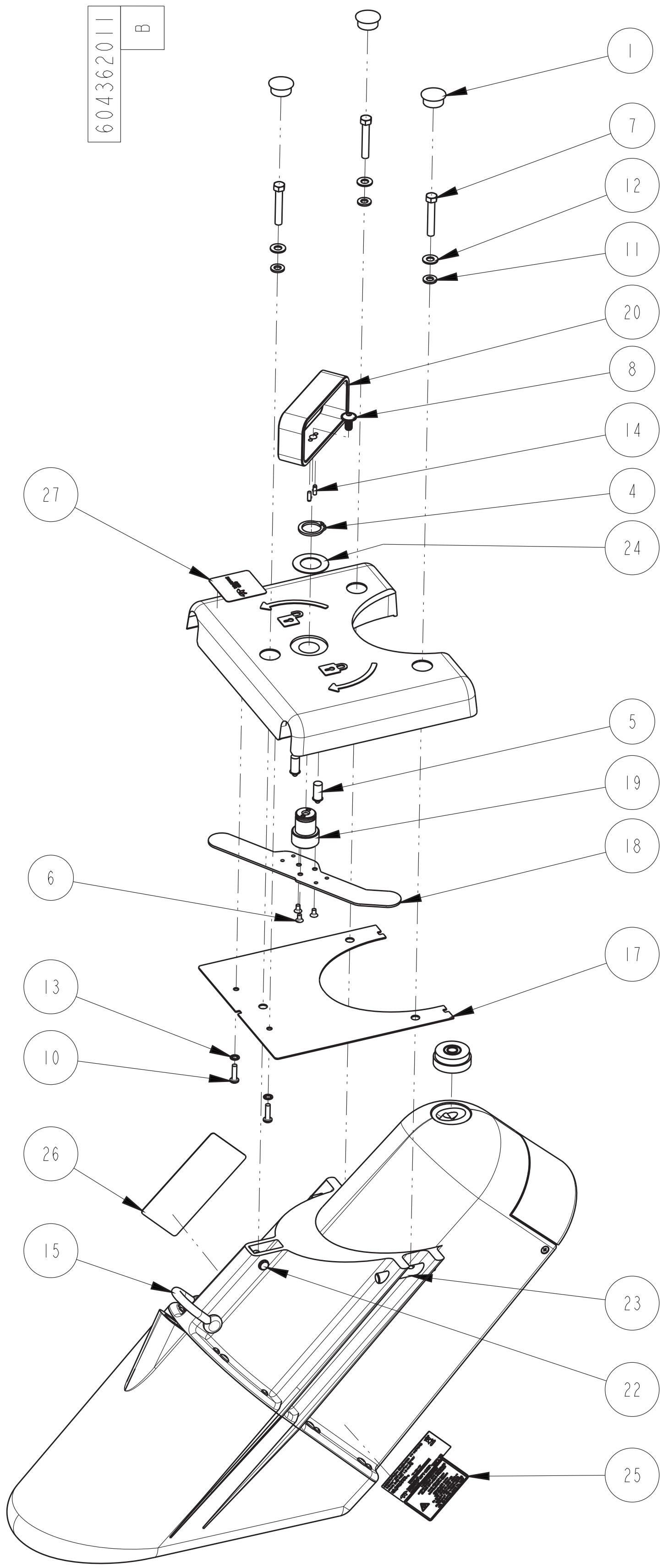
SHEET: 2 OF 6

TELEDYNE ISCO

REV: B

ITEM NO.	PART NUMBER	DESCRIPTION
2	202100669	O-RING .669ID .079 CROSS SECTION
3	202472112	O-RING 2.112ID .103 SILICONE
9	231310140	SCREW, SELF-TAPPING #4X3/8
16	602003076	PLUG, FEMALE PROBE
21	604363014	HORN
25	694363024	LABEL SET, LASER WARNING
28	602003075	CAP, MALE PROBE

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.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604362011

REPLACEMENT PARTS LIST

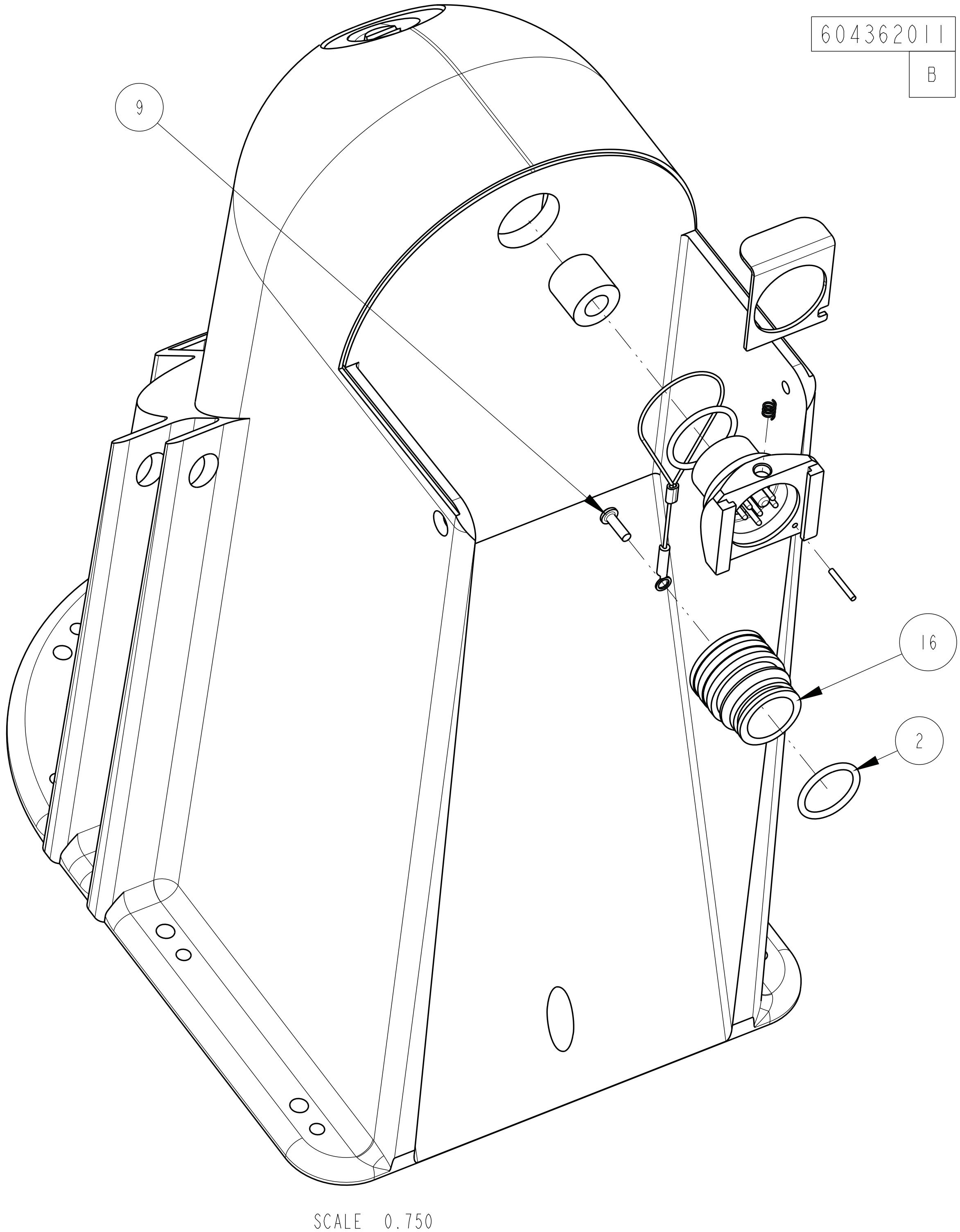
SHEET: 4 OF 6

TELEDYNE ISCO

REV: B

ITEM NO.	PART NUMBER	DESCRIPTION
1	109030841	PLUG, DOME, .75 DIAMETER
4	209000276	RETAINING RING, EXTERNAL
5	209909900	SPRING PLUNGER, PUSH-FIT
6	231011404	SCREW, FLATHEAD 6-32 X 1/4
7	231115924	SCREW, CAP, 1/4-20 X 1-1/2
8	231119908	SCREW, CAP, FLANGE BUTTON HEAD
10	231310310	SCREW, SELF-TAPPING, #8X5/8
11	233011008	WASHER, FLAT, .263ID X .500OD
12	233112800	SPRING LOCK WASHER, 1/4
13	233211200	LOCK WASHER, INTERNAL TOOTH, #8
14	236210806	DOWEL PIN .13 X .38
15	239000001	SHACKLE WITH SCREW PIN, SST
17	604363008	PLATE, MOUNTING BLOCK
18	604363009	LOCKING TAB
19	604363010	MOUNTING SHAFT
20	604363011	MOUNTING HANDLE
22	604363019	CROSS PIN, TOP
23	604363020	CROSS PIN, SIDE
24	233015700	WASHER, FLAT, .765ID X 1.318OD
25	694363024	LABEL SET, LASER WARNING
26	694363040	LABEL, LaserFlow SENSOR
27	694363041	LABEL, TELEDYNE ISCO LOGO

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.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REPLACEMENT PARTS LIST

SHEET: 6 OF 6

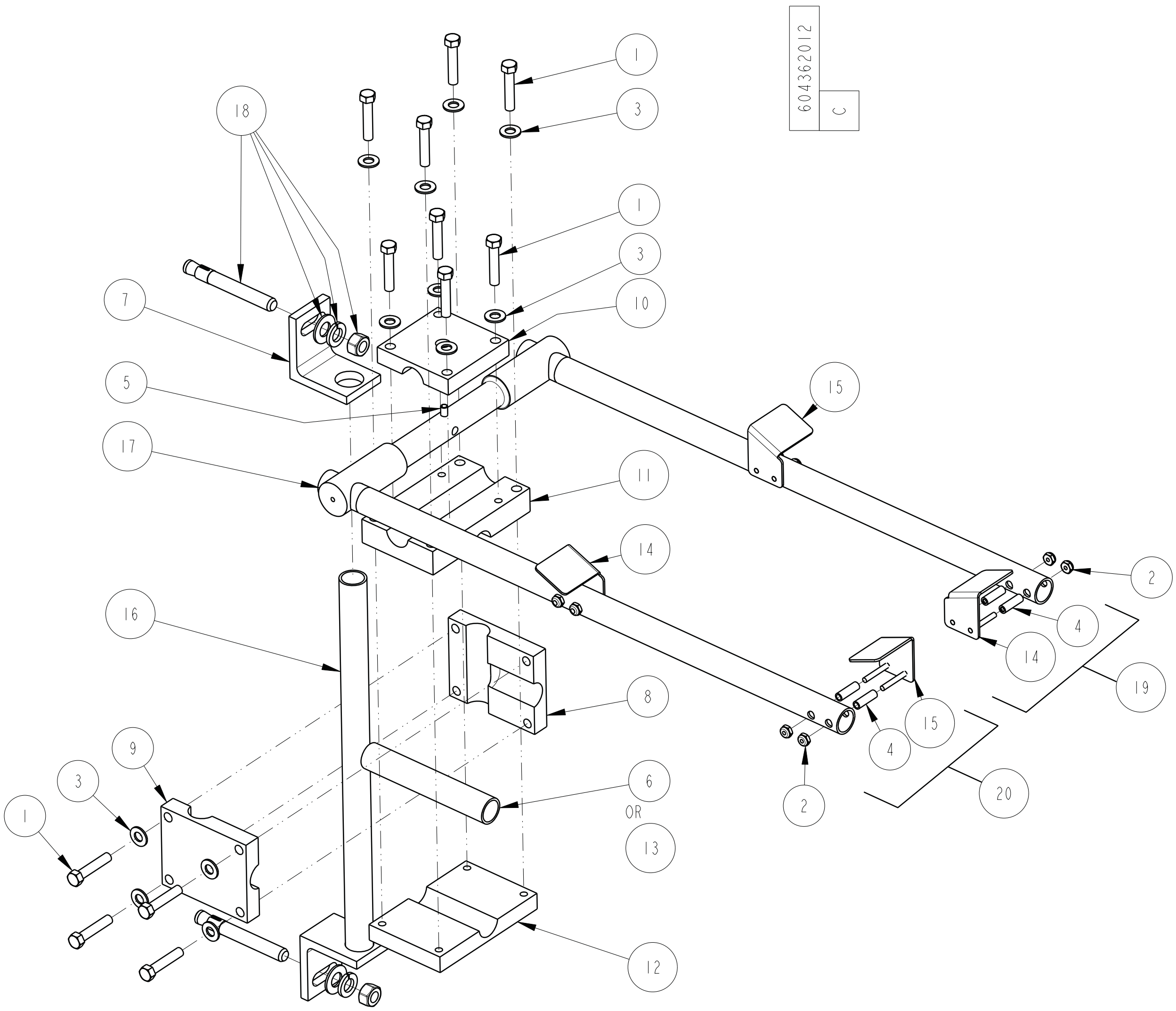
TELEDYNE ISCO

REV: B

ITEM NO.	PART NUMBER	DESCRIPTION
2	202100669	O-RING .669ID .079 CROSS SECTION
9	231310140	SCREW, SELF-TAPPING #4X3/8
16	602003076	PLUG, FEMALE PROBE

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.

A.3 Wall Mounting Hardware



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REPLACEMENT PARTS LIST

SHEET: 2 OF 2

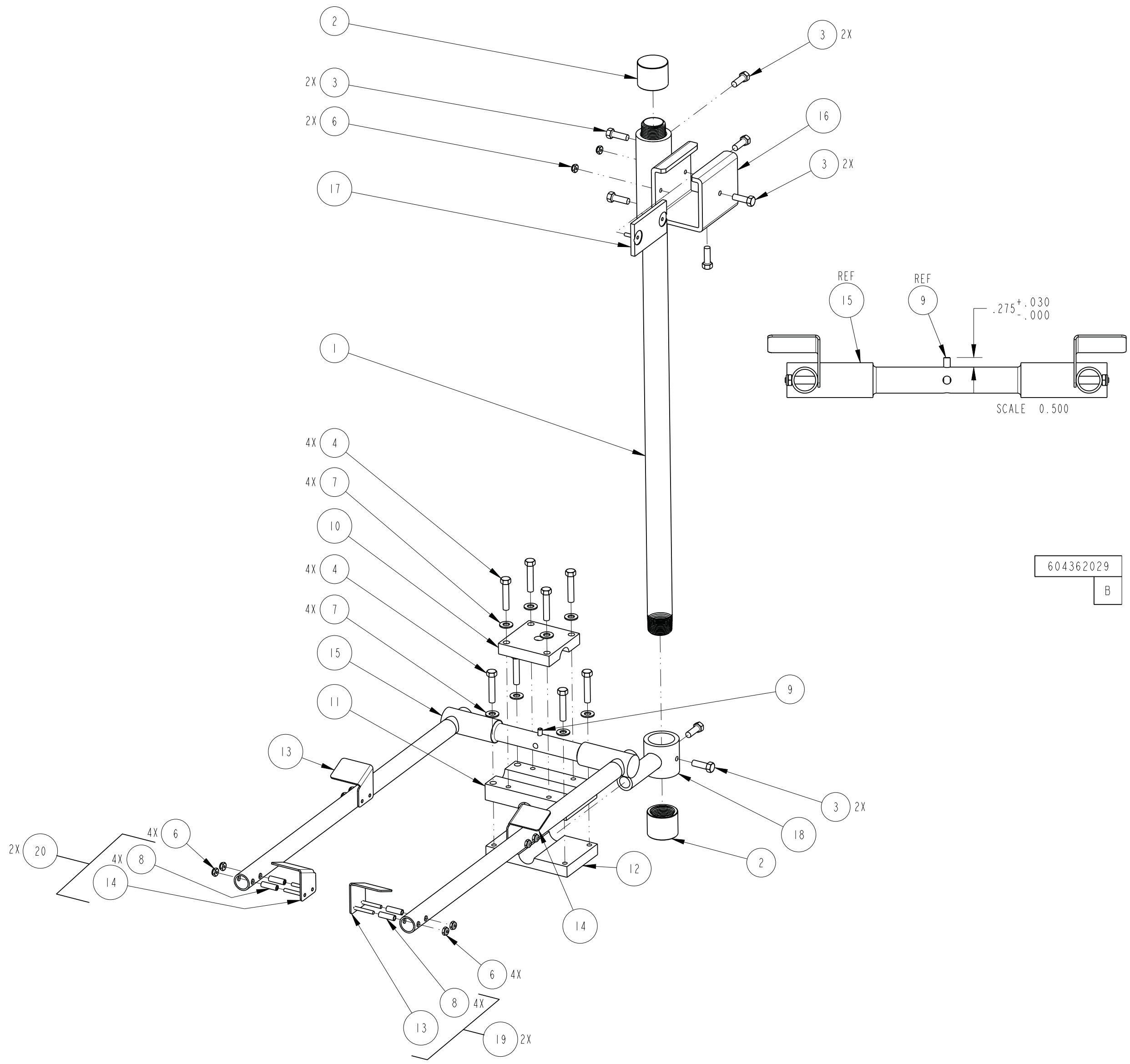
TELEDYNE ISCO

REV: C

ITEM NO.	PART NUMBER	DESCRIPTION
1	231115921	SCREW HEX 1/4-20X1-1/4
2	232914000	LOCK NUT 6-32 NYLON INSERT SST
3	233112800	WASHER SPRING LOCK, 1/4 SST
4	604363058	THREADED STANDOFF, 6-32
5	236411214	ROLL PIN, SPRING, 3/16 X 7/8
6	604363026	TUBE, COUPLING
7	604363027	BRACKET, WALL MOUNT
8	604363029	CLAMP, VERTICAL COUPLING TUBE, R
9	604363030	CLAMP, VERTICAL COUPLING TUBE, L
10	604363031	CLAMP, CARRIER
11	604363032	CLAMP, COUPLING TUBE, TOP
12	604363033	CLAMP, COUPLING TUBE, BOT
13	604363036	COUPLING TUBE, EXTENDED
14	604368007	ALIGNMENT TAB, R
15	604368008	ALIGNMENT TAB, L
16	604368009	VERTICAL WALL MOUNT W/ BRACKET
17	604368010	HORIZONTAL CARRIER TUBE
18	604364037	ANCHOR STUD W/LOCK WSHR 3/8-16X3 SST
19	604364040	ALIGNMENT TAB WITH STANDOFF, RIGHT
20	604364041	ALIGNMENT TAB WITH STANDOFF, LEFT

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

A.4 Temporary Mounting Hardware



604362029

REPLACEMENT PARTS LIST

SHEET: 2 OF 2

TELEDYNE ISCO

REV: B

ITEM NO.	PART NUMBER	DESCRIPTION
1	209016710	PIPE 3/4NPT X 24" 304 SST
2	209016711	CAP 3/4NPT 304 SST
3	231015910	HEX SCREW 1/4-20X3/4
4	231115921	HEX SCREW 1/4-20X1.25
6	232914000	LOCK NUT 6-32 NYLON INSERT SST
7	233112800	SPRING LOCK WASHER 1/4 SST
8	604363058	THREADED STANDOFF, 6-32
9	236411214	SPRING ROLL PIN 3/16 X 7/8 SST
10	604363031	CARRIER CLAMP
11	604363032	COUPLING TUBE TOP CLAMP
12	604363033	COUPLING TUBE BOTTOM CLAMP
13	604368007	RIGHT ALIGNMENT TAB
14	604368008	LEFT ALIGNMENT TAB
15	604368010	HORIZONTAL CARRIER UTUBE
16	604368013	COUPLER WELDED ASSEMBLY
17	604368014	STUD SPACER PLATE
18	604368015	KNUCKLE WELDED ASSEMBLY
19	604364040	ALIGNMENT TAB WITH STANDOFF, RIGHT
20	604364041	ALIGNMENT TAB WITH STANDOFF, LEFT

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

A.5 Replacement Sensors

TIENet™ 360 LaserFlow™ Sensor with Built-in Ultrasonic

LaserFlow Sensor, 10m Cable w/ TIENet™ Plug .... Call Factory
LaserFlow Sensor, 23m Cable w/ TIENet™ Plug .... Call Factory
LaserFlow Sensor, 10m Cable w/ TIENet™ Plug, 350 Surcharge Kit.......... Call Factory
LaserFlow Sensor, 23m Cable w/ TIENet™ Plug, 350 Surcharge Kit.......... Call Factory
LaserFlow Sensor, 10m Unterminated Cable .... Call Factory
LaserFlow Sensor, 23m Unterminated Cable .... Call Factory
LaserFlow Sensor, 10m Unterminated Cable, 350 Surcharge Kit .... Call Factory
LaserFlow Sensor, 23m Unterminated Cable, 350 Surcharge Kit .... Call Factory

Includes TIENet™ 310 Ultrasonic Level Sensor

LaserFlow Sensor with Remote 310 Ultrasonic, 10m Cable w/ TIENet™ Plug .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 23m Cable w/ TIENet™ Plug .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 10m Cable w/ TIENet™ Plug, 350 Surcharge Kit .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 23m Cable w/ TIENet™ Plug, 350 Surcharge Kit .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 10m Unterminated Cable .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 23m Unterminated Cable .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 10m Unterminated Cable, 350 Surcharge Kit .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 23m Unterminated Cable, 350 Surcharge Kit .... Call Factory

Excludes TIENet™ 310 Ultrasonic Level Sensor

LaserFlow Sensor with Remote 310 Ultrasonic, 10m Cable w/ TIENet™ Plug .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 23m Cable w/ TIENet™ Plug .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 10m Cable w/ TIENet™ Plug, 350 Surcharge Kit .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 23m Cable w/ TIENet™ Plug, 350 Surcharge Kit .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 10m Unterminated Cable .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 23m Unterminated Cable .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 10m Unterminated Cable, 350 Surcharge Kit .... Call Factory
LaserFlow Sensor with Remote 310 Ultrasonic, 23m Unterminated Cable, 350 Surcharge Kit .... Call Factory

A.6 Sensor Accessories

LaserFlow Sunshade 60-4364-080

TIENet™ 360 LaserFlow™ Velocity Sensor

Appendix B Installation Checklist

B.1 Introduction

This special appendix is to assist you in ensuring that you have all equipment, supplies, and site information readily available prior to going to site for installation.

Print these pages and fill out all relevant information.

Once you have established that all of the items listed here are on hand, take this printout to the site to assist in installation and setup.

B.2 Equipment and Recommended Tools

- ☐ Laptop computer
- ☐ LaserFlow Sensor
- ☐ 2160 Module or Signature Flow Meter
- ☐ Flowlink 5.1 Software and Communication Cable
- ☐ Power source
- ☐ Tape Measure
- ☐ Level
- ☐ Wall Mount Kit, if mounting on wall
  - ☐ 7/16" Open or Socket Wrench
  - ☐ 9/16" Open or Socket Wrench
  - ☐ Hammer Drill
  - ☐ 3/8" Masonry Bit
  - ☐ Hammer
- ☐ Temporary Mount Kit, if application is temporary
  - ☐ 7/16" Open or Socket Wrench
- ☐ Optional Sensor Retrieval Tool

B.3 Site Information

1. Site Name: ____

2. Meter:

- ☐ 2160 Module (Serial Number: ________________________)
- ☐ Signature Flow Meter (Serial Number: ________________)
- ☐ LaserFlow Sensor (Serial Number: ___________________)
- ☐ ____

3. Meter Location: ____

4. Channel Shape:

- ☐ Round
- ☐ U-Shaped
- ☐ Rectangular
- ☐ Trapezoidal
- ☐ Elliptical

5. Channel Dimensions:

6. Number of Velocity Points: ______________________________

7. Expected Level (m or ft)
   Minimum: __________
   Maximum: __________
   Average: ___________

8. Expected Velocity (m/s or ft/s)
   Minimum: __________
   Maximum: __________
   Average: ___________

9. Distance between bottom of sensor &
   Maximum Level (m or ft) _________

10. Distance between bottom of
    sensor & channel bottom (m or ft): _________

11. Direction sensor is facing:
    - ☐ Upstream
    - ☐ Downstream

12. Site IP Address: ____

13. Call-In Window
    Start: __________
    Stop: ___________

14. Server Push Address: ___________________________________

15. Software Revisions
    Flowlink: _______*(Help > About Flowlink)*
    LaserFlow: ________*(TIENet/Configure)*
    2160: __________*(Device Tab)*
    Signature: __________*(Menu > Admin > Display Signature Information)*

16. Data Storage Rate: ____________________________________

B.4 Recommended Essential Parameters

The following basic parameters are used in almost every measurement site.

In the 2160, parameters are activated in the Jump to Measurements tab.

In the Signature, parameters are activated by going to Hardware Setup > Configure Measurements.

360 Distance	360 Level
360 Velocity	360 X-Axis
360 Y-Axis	360 Ultrasonic Signal
360 Doppler Power	360 Case Temperature
360 Air Temperature	Flow Rate

After programming, Retrieve Data to download initial diagnostic data, to verify that this data will be available if/when needed.

B.5 Site Conditions

LaserFlow with Built-in Sensor: When using the LaserFlow module with the built-in sensor, never install the LaserFlow in a free-flowing outfall or in a drop manhole (see Figure B-1).

Figure B-1 Do not install LaserFlow with built-in sensor in a free-flowing outfall or in a drop manhole.

LaserFlow with Remote Ultrasonic Sensor: When using the LaserFlow module with the remote ultrasonic sensor, the LaserFlow sensor can be installed in a free-flowing outfall or in a drop manhole.

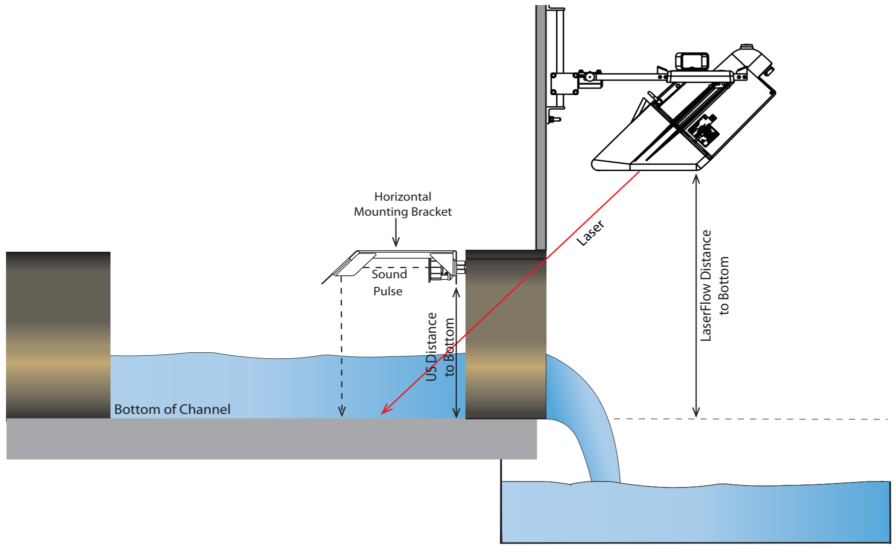
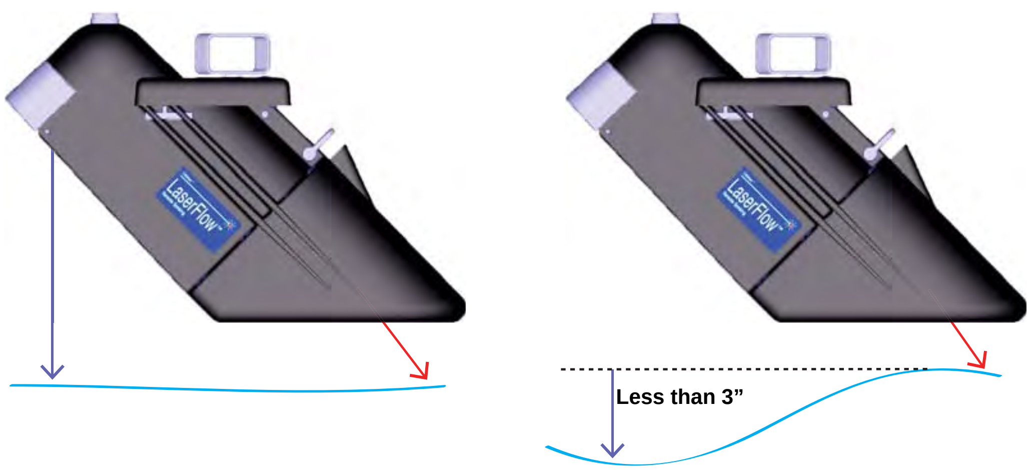


Figure B-2 Correct setup when using the LaserFlow module with remote ultrasonic sensor and horizontal mount bracket

Stream Level – The stream level should be the same at both the laser and ultrasonic measuring points.



Correct placement with built-in sensor

Correct placement with built-in sensor
(Ensure “Adaptive Focus” option is active)

Figure B-3 Placement of LaserFlow with built-in sensor

☑ Note

If the stream level is less than 3” (7.62 cm) when using the LaserFlow with built-in sensor, ensure the Adaptive Focus option is active. Refer to Section X.X for details.

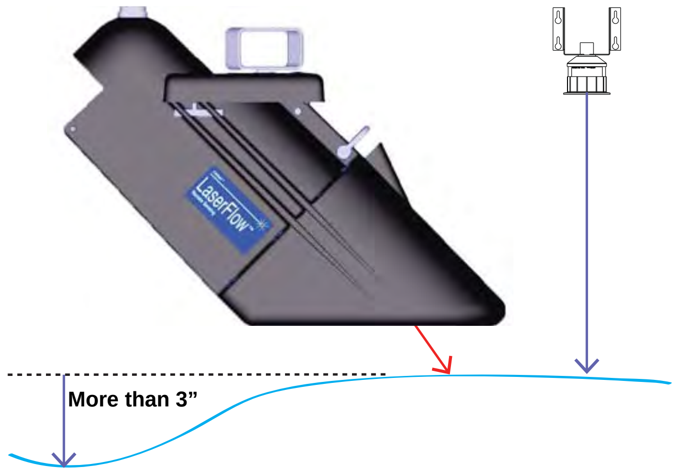


Figure B-4 Placement of LaserFlow with remote ultrasonic sensor

☑ Note

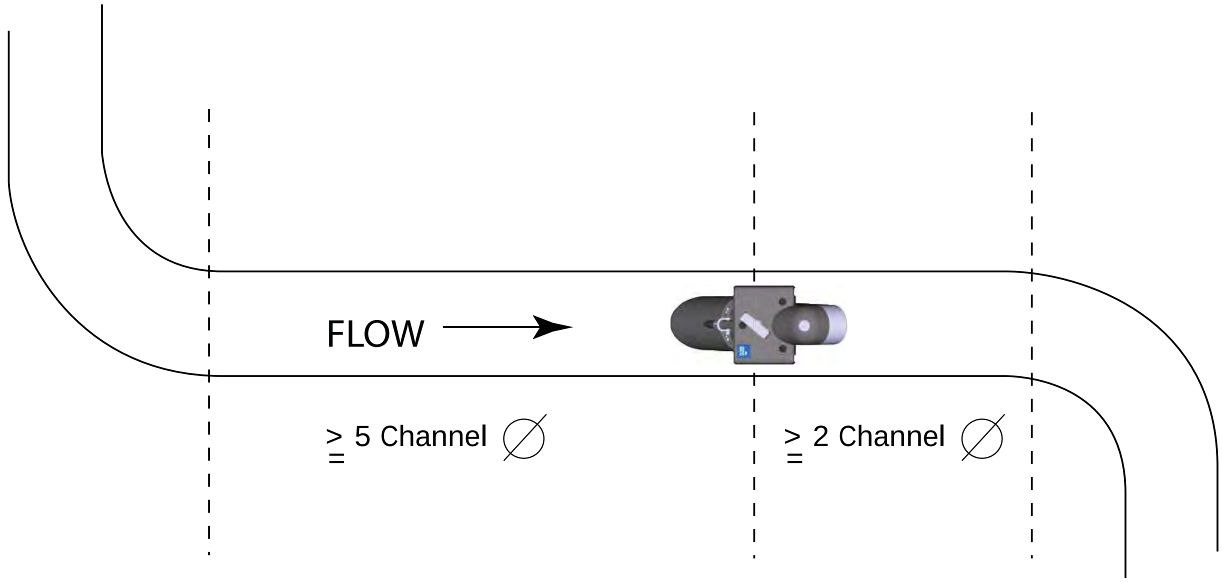
If the laser and ultrasonic measuring points differ at the stream level by more than 3” (7.62 cm), the remote ultrasonic sensor must be used. Refer to Section X.X for details.

Foam or Steam – Never install the LaserFlow over foam or steam.

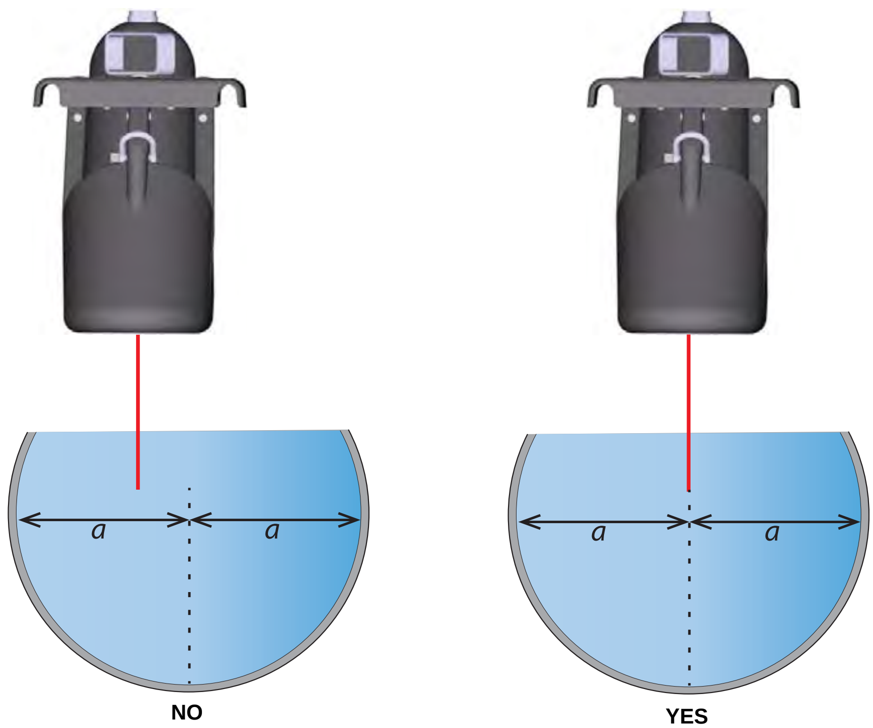
B.6 Sensor Positioning

For complete installation requirements, refer to *Sensor Positioning*, page B-8.

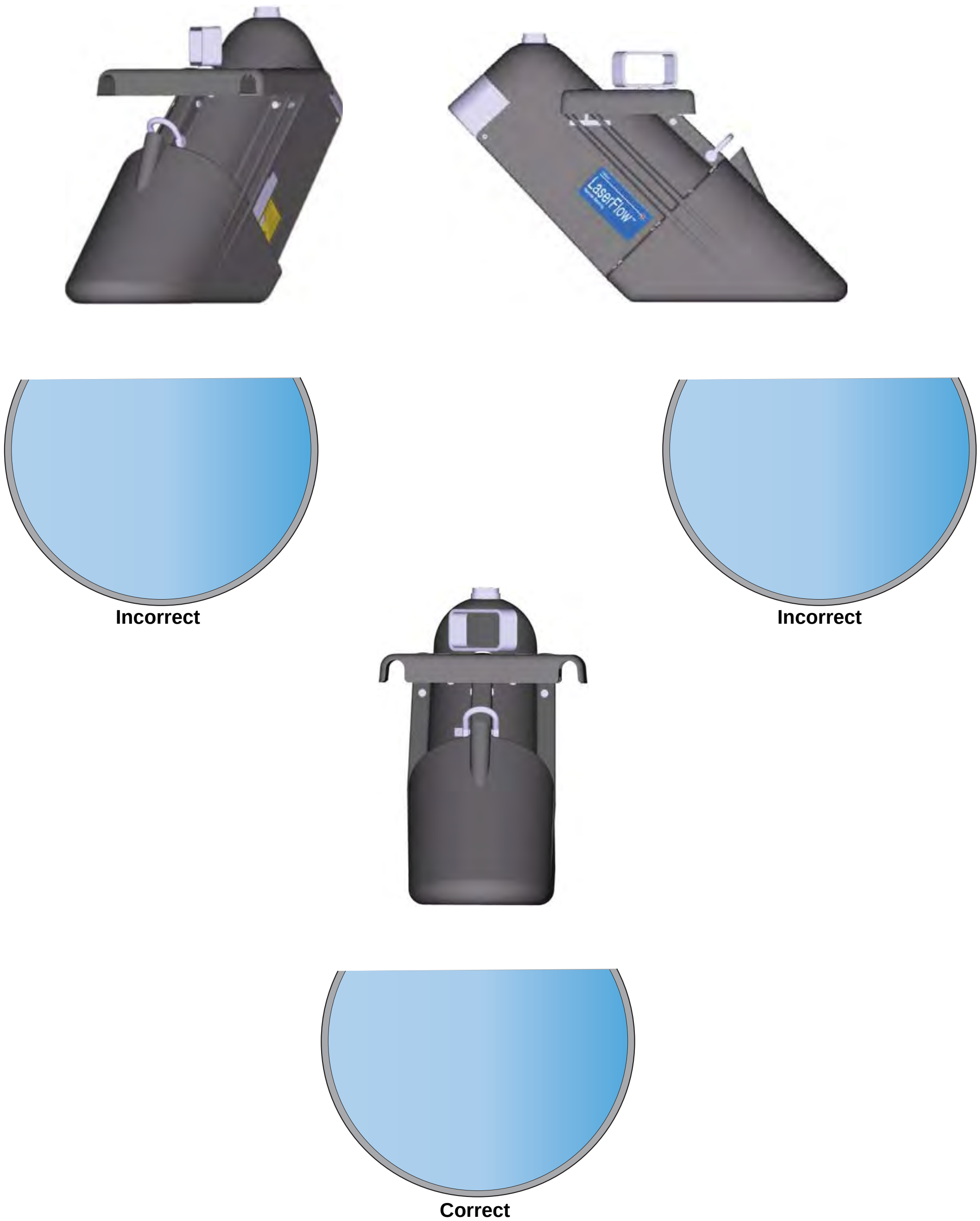
Straight Runs – For best performance, place the sensor in the straightest possible run, at a minimum of 5 channel diameters downstream from a bend and 2 channel diameters upstream from a bend.



Center of Pipe – Center the LaserFlow (and middle laser beam) relative to the pipe walls.



Parallel w/ Flow – Install the LaserFlow parallel with the flow. Never install it at an angle, or perpendicular, to the flow.


LaserFlow
Incorrect
Incorrect
Correct

TIENet™ 360 LaserFlow™ Velocity Sensor

Appendix C Velocity Error Codes

C.1 Introduction

Erroneous flow data can result from a number of factors. The LaserFlow system provides numbered error codes associated with the 360 Velocity data to assist in troubleshooting.

If using the 2160 LaserFlow module, error codes are viewable using Teledyne Isco Flowlink® software. If using the Signature flow meter, error codes are viewable in the bottom panel of the display. Definitions of the error codes are provided in Table C-1. For further assistance, contact the factory.

C.2 Importing Data Dump (.ddp) Files (Signature Only)

Flow data can be downloaded from the Signature Flow Meter onto a USB flash drive in the form of a .ddp (Data Dump) file.

To download the data:

1. Connect a flash drive to the USB port on the front panel of the Signature flow meter. From the USB Options menu, select Retrieve Data.
2. Select “All data” or specify a start date or date range, and press NEXT. The data will be stored on the connected flash drive in the “ISCO” folder.
3. Connect the flash drive to a computer with Flowlink installed.
4. Launch the Flowlink application.
5. Copy the file using one of the methods below:
   a. Select File > Import. When the import window appears, browse to the folder containing the desired .ddp file. Select the file and click Open.
   b. Select “Signature Data Transfer” from the File menu and then browse to the appropriate folder.

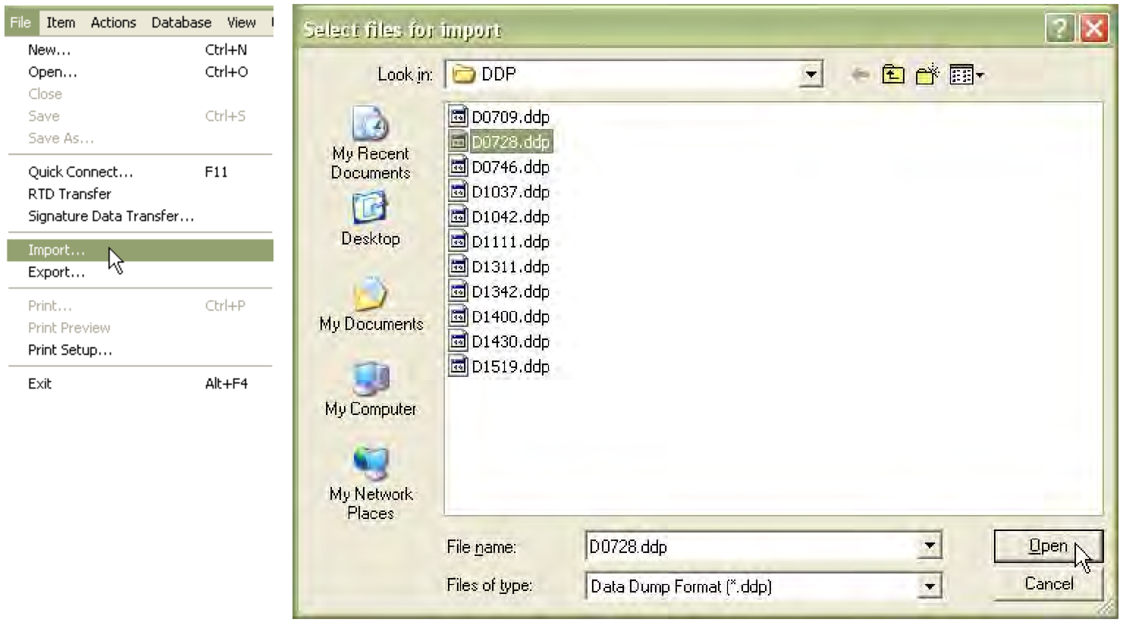


Figure C-1 Signature flow data: Selecting the .ddp file(s)

A progress window will appear, displaying the filename, site name, device type, number of data types in the site file, and progress of the download.

6. When the two progress bars have completed, click Done to close the window.

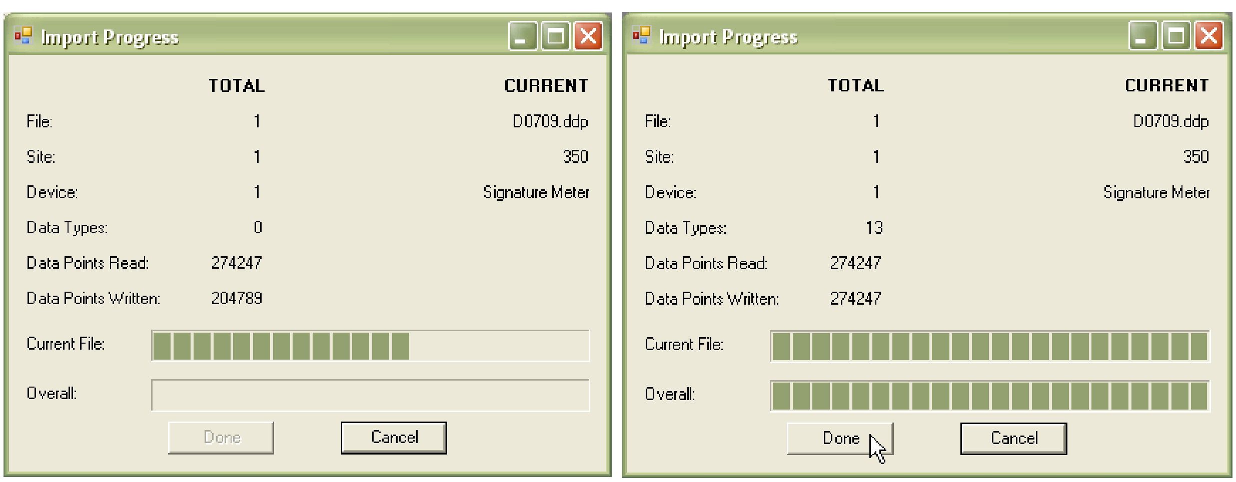
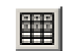


Figure C-2 Signature flow data: Importing the .ddp file

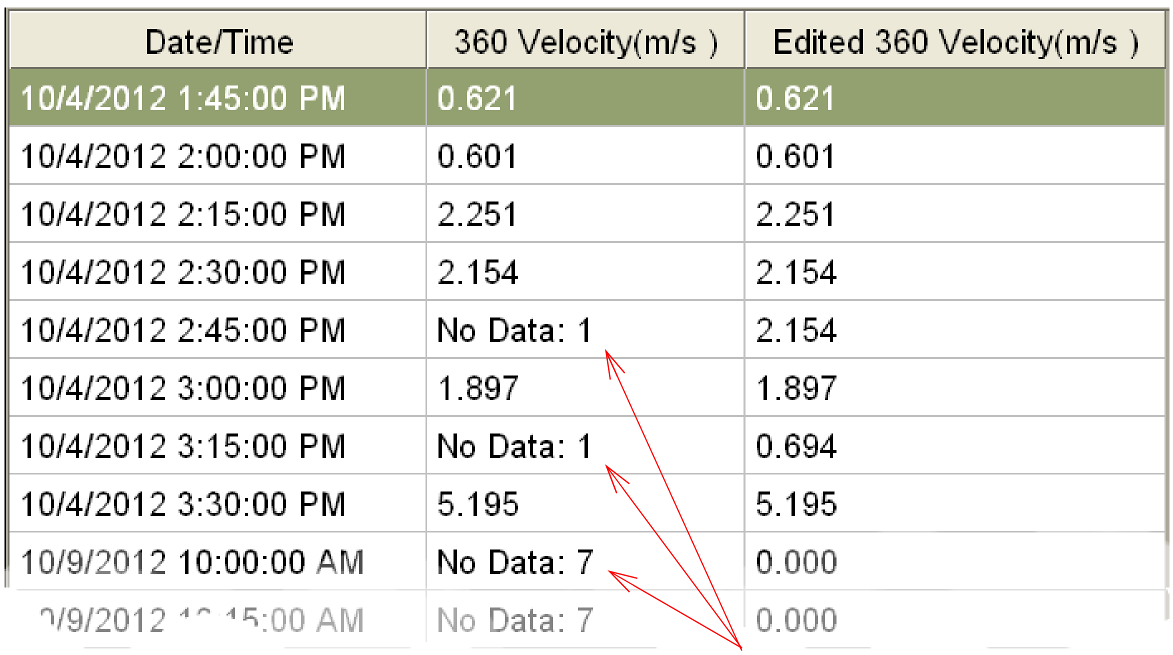
Upon completion, a new site file will appear in the Flowlink workspace.

C.3 Viewing Velocity Error Codes in Flowlink

In order to view error codes for velocity readings:

1. In the Flowlink workspace, double-click the 360 Velocity data set. When the graph appears, click the Table View button. 
2. When the table appears, click the Edit/View button. 

Any error codes will appear in the 360 Velocity column following the words “No Data.” Definitions of the error codes are provided in Table C-1.



Date/Time	360 Velocity(m/s)	Edited 360 Velocity(m/s)
10/4/2012 1:45:00 PM	0.621	0.621
10/4/2012 2:00:00 PM	0.601	0.601
10/4/2012 2:15:00 PM	2.251	2.251
10/4/2012 2:30:00 PM	2.154	2.154
10/4/2012 2:45:00 PM	No Data: 1	2.154
10/4/2012 3:00:00 PM	1.897	1.897
10/4/2012 3:15:00 PM	No Data: 1	0.694
10/4/2012 3:30:00 PM	5.195	5.195
10/9/2012 10:00:00 AM	No Data: 7	0.000
[illegible]/9/2012 [illegible]:15:00 AM	No Data: 7	0.000

Figure C-3 Identifying error codes in the 360 Velocity data set

Table C-1 Definitions of 360 Error Codes

Error Code	Meaning	Possible Solutions
1: Low Signal Power Error	No laser Doppler signal peak or sufficient strength is found. Minimum is 1000.	Ensure the protective window cap is removed. Refer to Section 1.7.1 Protective Window Cap. Ensure the location of the laser is correct. Verify the distance is 0 to 10 ft from the bottom of the sensor. Ensure the input voltage is 10V (minimum). Ensure the Y-axis (pitch) is accurate (greater or equal to 45º).
2: Flow Direction Error	An error occurred while determining flow direction. This error displays only if the “Positive Velocity” option is set to “true” in the Flowlink application.	Call factory.

Table C-1 Definitions of 360 Error Codes

Error Code	Meaning	Possible Solutions
3: Ultrasonic Read Error	An error occurred during an ultrasonic reading. This includes communication errors with the ultrasonic sensor.	Ensure the blanking distance is correct. Refer to Section 3.2 Measurement Setup. Ensure the placement of the sensor is accurate. Refer to Section 2.5.3 Sensor Positioning and Requirements. Verify there is no foam or extreme turbulence.
4: Analog-to-Digital Converter (ADC) Error	An error occurred during an ADC reading.	Contact factory.
5: Focus Error	An error occurred while focusing the laser.	Ensure the input voltage is 10V (minimum).
6: Digital Signal Processor (DSP) Communication Error	An error occurred during communication with the DSP.	Contact factory.
7: Sensor not seen	Communication failed between flow meter and sensor. This could be due to the sensor being disconnected, losing power, etc.	Ensure the sensor is connected to the flow meter. Ensure the input voltage is 10V (minimum). Verify the battery is connected or charged.

Table C-2 Definitions of 350 Error Codes

Error Code	Meaning	Possible Solutions
1: Measurement Error	Unable to generate valid velocity data set.	Contact factory.
3: Velocity Filter Error	An error occurred while setting the filter clock.	Ensure there are uniform flow conditions at sensor location.
5: Velocity Gain Error	Unable to set gain after maximum attempts.	Ensure there is no debris on the sensor.
6: Level to Low error	The absolute level is too low to attempt velocity measurement.	Place sensor in flow with at least 1” deep. Set storage of velocity to be secondary based on depth of 1”.
7: Timeout/Quality Error	Measurement timed out or did not meet measurement quality requirements.	Contact factory.

TIENet™ 360 LaserFlow™ Velocity Sensor

Appendix D Material Safety Data Sheets

This appendix provides Material Safety Data Sheets for the desiccant used by the TIENet 360 LaserFlow Sensor.

Teledyne Isco cannot guarantee the accuracy of the data. Specific questions regarding the use and handling of the products should be directed to the manufacturer listed on the MSDS.

SORB-IT® is a registered trademark of N. T. Gates Company.

101 Christine Drive
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 861-2355

SÜD-CHEMIE
Performance Packaging
ISO 9002

MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION I -- PRODUCT IDENTIFICATION

Trade Name and Synonyms:	Silica Gel, Synthetic Amorphous Silica, Silicon, Dioxide
Chemical Family:	Synthetic Amorphous Silica
Formula:	$SiO_2.x H_2O$

SECTION II -- HAZARDOUS INGREDIENTS

Components in the Solid Mixture

COMPONENT	CAS No	%	ACGIH/TLV (PPM)	OSHA-(PEL)
Amorphous Silica	63231-67-4	>99	PEL - 20 (RESPIRABLE), TLV – 5	LIMIT – NONE, HAZARD - IRRITANT ″

Synthetic amorphous silica is not to be confused with crystalline silica such as quartz, cristobalite or tridymite or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms.

This product is in granular form and packed in bags for use as a desiccant. Therefore, no exposure to the product is anticipated under normal use of this product. Avoid inhaling desiccant dust.

SECTION III -- PHYSICAL DATA

Appearance and Odor:	White granules; odorless.
Melting Point:	>1600 Deg C; >2900 Deg F
Solubility in Water:	Insoluble.
Bulk Density:	>40 lbs./cu. ft.
Percent Volatile by Weight @ 1750 Deg F:	<10%.

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SORB-IT®
Packaged Desiccant

SECTION IV -- FIRE EXPLOSION DATA

Fire and Explosion Hazard - Negligible fire and explosion hazard when exposed to heat or flame by reaction with incompatible substances.

Flash Point - Nonflammable.

Firefighting Media - Dry chemical, water spray, or foam. For larger fires, use water spray fog or foam.

Firefighting - Nonflammable solids, liquids, or gases: Cool containers that are exposed to flames with water from the side until well after fire is out. For massive fire in enclosed area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of the tank due to fire.

SECTION V -- HEALTH HAZARD DATA

Health hazards may arise from inhalation, ingestion, and/or contact with the skin and/or eyes. Ingestion may result in damage to throat and esophagus and/or gastrointestinal disorders. Inhalation may cause burning to the upper respiratory tract and/or temporary or permanent lung damage. Prolonged or repeated contact with the skin, in absence of proper hygiene, may cause dryness, irritation, and/or dermatitis. Contact with eye tissue may result in irritation, burns, or conjunctivitis.

First Aid (Inhalation) - Remove to fresh air immediately. If breathing has stopped, give artificial respiration. Keep affected person warm and at rest. Get medical attention immediately.

First Aid (Ingestion) - If large amounts have been ingested, give emetics to cause vomiting. Stomach siphon may be applied as well. Milk and fatty acids should be avoided. Get medical attention immediately.

First Aid (Eyes) - Wash eyes immediately and carefully for 30 minutes with running water.

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SORB-IT®
Packaged Desiccant

NOTE TO PHYSICIAN: This product is a desiccant and generates heat as it adsorbs water. The used product can contain material of hazardous nature. Identify that material and treat accordingly.

SECTION VI -- REACTIVITY DATA

Reactivity - Silica gel is stable under normal temperatures and pressures in sealed containers. Moisture can cause a rise in temperature which may result in a burn.

SECTION VII --SPILL OR LEAK PROCEDURES

Notify safety personnel of spills or leaks. Clean-up personnel need protection against inhalation of dusts or fumes. Eye protection is required. Vacuuming and/or wet methods of cleanup are preferred. Place in appropriate containers for disposal, keeping airborne particulates at a minimum.

SECTION VIII -- SPECIAL PROTECTION INFORMATION

Respiratory Protection - Provide a NIOSH/MSHA jointly approved respirator in the absence of proper environmental control. Contact your safety equipment supplier for proper mask type.

Ventilation - Provide general and/or local exhaust ventilation to keep exposures below the TLV. Ventilation used must be designed to prevent spots of dust accumulation or recycling of dusts.

Protective Clothing - Wear protective clothing, including long sleeves and gloves, to prevent repeated or prolonged skin contact.

Eye Protection - Chemical splash goggles designed in compliance with OSHA regulations are recommended. Consult your safety equipment supplier.

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MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION IX -- SPECIAL PRECAUTIONS

Avoid breathing dust and prolonged contact with skin. Silica gel dust causes eye irritation and breathing dust may be harmful.

* No Information Available

HMIS (Hazardous Materials Identification System) for this product is as follows:

Health Hazard	0
Flammability	0
Reactivity	0
Personal Protection	HMIS assigns choice of personal protective equipment to the customer, as the raw material supplier is unfamiliar with the condition of use.

TIENet™ 360 LaserFlow™ Velocity Sensor

Index

DECLARATION OF CONFORMITY

ISM1-A

Application of Council Directive:	2004/108/EC -The EMC Directive 2012/19/EC– The WEEE Directive 2006/95/EC – The Low Voltage Directive
Manufacturer's Name:	Teledyne Isco
Manufacturer's Address:	4700 Superior, Lincoln, Nebraska 68504 USA Mailing Address: P.O. Box 82531, Lincoln, NE 68501 Phone: +1 (402) 464-0231 FAX: +1 (402) 465-3799
Equipment Type/Environment:	Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No:	360 Laser Flow Sensor with 2160 Laser Flow Area Velocity Module and 2191 Battery Module
Year of Issue:	2012
Standards to which Conformity is Declared:	EN 61326:2006 EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN 61010-1 2nd edition Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN60529 Special Protection offered by the Signature's Enclosure: IP-66

Standard	Description	Severity Applied	Performance Criteria
EN61000-4-2:2008	Electrostatic Discharge	Level 2 - 4kV contact discharge Level 3 - 8kV air discharge	A
EN61000-4-3:2006 /A1:2007 /A2:2010	Radiated RF Immunity	80 mHz to 2.7gHz 80% AM at 1 kHz Level 2 - 3V/m	A
EN61000-4-4:2004 /A1:2010	Electrical Fast Transient (EFT) on Mains and I/O	Level 2 - 1kV on AC lines	A
EN61000-4-5:2005	Surge on AC Lines	Level 2 - 1kV Line Common Mode Level 2 - 0.5kV Differential Mode	A
EN61000-4-6:2008	Conducted RF Immunity on Mains and I/O	150 kHz to 80 mHz Level 1 – 1V rms, 80% Modulated	A
EN61000-4-11:2004	Voltage Dips	0% during1 cycle and full cycle 70% at 25 cycles	A
CISPR11/ EN 55011:2009 /A1:1020	RF Emissions Radiated, below 1GHz and Conducted, AC Mains	Group 1, Class A Industrial, Scientific, and Medical Equipment	PASS
EN61000-3-2:2005 /A1:2008 /A2:2009 EN61000-3-3:2008	AC Harmonics, Flicker		PASS

We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of September 21. 2012.

USA Representative

-

Vikas Padhye

____

Vikas V. Padhye Ph, D
Vice President and General Manager
4700 Superior Street
Lincoln, Nebraska 68504
Phone: 402-464-0231
Fax: 402-464-0318

TELEDYNE ISCO
Everywhereyoulook™

60-4362-017
Rev. A

产品中有毒有害物质或元素的名称及含量
Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	X
接线 Wiring	O	O	O	O	O	X
内部电缆 Internal Cables	O	O	O	O	O	X
主电源线 Line Cord	O	O	O	O	O	X
直流电机 DC Motor	X	O	O	O	O	X
接头 Connectors	O	O	X	O	O	O
电池 Battery	X	X	X	O	O	O

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component's any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打"X" 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component's at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the "X"marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January; "B" is February and so on.

Teledyne Isco One Year Limited Factory Service Warranty*

This warranty exclusively covers Teledyne Isco instruments, providing a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period due to faulty parts or workmanship will be repaired at the factory at no charge to the customer. Teledyne Isco's exclusive liability is limited to repair or replacement of defective instruments. Teledyne Isco is not liable for consequential damages.

Teledyne Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Teledyne Isco, and Teledyne Isco will pay surface transportation to return the repaired instrument to the customer. Teledyne Isco will not pay air freight or customer's packing and crating charges. This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

The warranty for any instrument is the one in effect on date of shipment. The warranty period begins on the shipping date, unless Teledyne Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as pH sensors, charts, ribbon, lamps, tubing, and glassware; fittings and wetted parts of valves; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover products not sold under the Teledyne Isco trademark or for which any other warranty is specifically stated.

No item may be returned for warranty service without a return authorization number issued by Teledyne Isco.

This warranty is expressly in lieu of all other warranties and obligations and Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

The warrantor is Teledyne Isco, 4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to the USA and countries where Teledyne Isco does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.**

Before returning any instrument for repair, please call, fax, or e-mail the Teledyne Isco Service Department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE PROBLEM.**

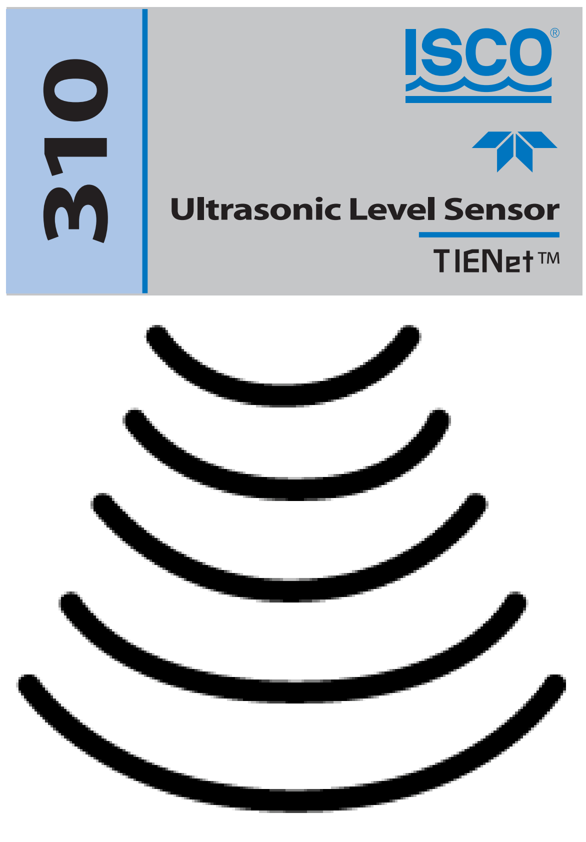
Shipping Address:	Teledyne Isco - Attention Repair Service 4700 Superior Street Lincoln, NE 68504 USA	
Mailing Address:	Teledyne Isco PO Box 82531 Lincoln, NE 68501 USA	
Phone:	Repair service:	(800) 775-2965 (lab instruments) (866) 298-6174 (samplers & flow meters)
	Sales & General Information: (800) 228-4373 (USA & Canada)	
Fax:	(402) 465-3001	
Email:	IscoService@teledyne.com	

October 11, 2013 P/N 60-1002-040 Rev H

TELEDYNE ISCO
Everywhereyoulook™

TIENet® 310 Ultrasonic Level Sensor

Installation and Operation Guide



TELEDYNE ISCO
Everywhereyoulook™

Manual Body #69-4313-010

Revision C, May 2015

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If a problem persists, call or e-mail Teledyne Isco technical support for assistance. Simple difficulties can often be diagnosed over the phone. For faster service, please have your serial number ready.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by technical support, including the use of the **Return Merchandise Authorization (RMA)** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

Contact Information

Customer Service

Phone: (800) 228-4373 (USA, Canada, Mexico)

(402) 464-0231 (Outside North America)

Fax: (402) 465-3022

Email: IscoCSR@teledyne.com

Technical Support

Phone: Toll Free (866) 298-6174 (Samplers, Flow Meters and Multi-parameter Probes)

Toll Free (800) 775-2965 (Syringe Pumps and Liquid Chromatography)

Email: IscoService@teledyne.com

Return equipment to: 4700 Superior Street, Lincoln, NE 68504-1398

Other Correspondence

Mail to: P.O. Box 82531, Lincoln, NE 68501-2531

Email: IscoInfo@teledyne.com

General Warnings

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed of the following general warnings:

⚠ WARNING

Avoid hazardous practices! If you use this instrument in any way not specified in this manual, the protection provided by the instrument may be impaired.

⚠ AVERTISSEMENT

Éviter les usages périlleux! Si vous utilisez cet instrument d’une manière autre que celles qui sont specifiées dans ce manuel, la protection fournie de l’instrument peut être affaiblie; cela augmentera votre risque de blessure.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

⚠ CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

⚠ WARNING

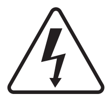
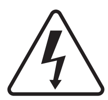
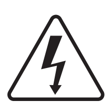
Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

⚠ DANGER

DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.

Hazard Symbols

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
Advertencias y Precauciones	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.
	Esta señal alerta sobre la presencia de alto voltaje en el interior del producto.

TIENet™ Model 310 Ultrasonic Level Sensor

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Section 1 Introduction

Section 2 Installation and Setup for Signature

List of Figures

TIENet® Model 310 Ultrasonic Level Sensor

Section 1 Introduction

The Signature® Flow Meter uses the TIENet 310 Device to provide non-contact liquid level measurement. The flow meter has built-in level-to-flow conversions that cover the majority of open channel flow measurement situations.

1.1 Description

The ultrasonic sensor is mounted over the flow stream. The flow meter measures the time interval between transmission of a sound pulse from the sensor, and receiving its echo off the surface of the liquid, to determine the level of the stream.

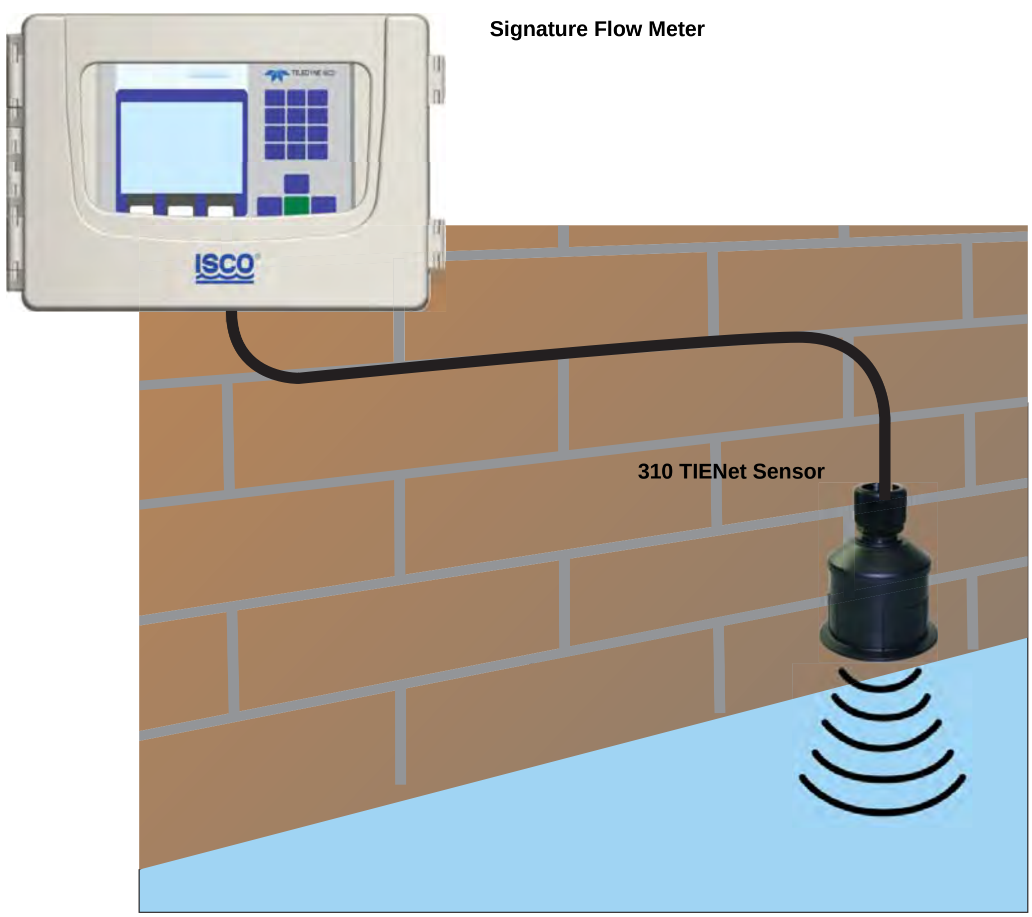


Figure 1-1 Basic Signature monitoring system with 310 (mounting hardware not shown)

This non-contact measurement method reduces the frequency of maintenance, and is ideal for applications where the flow may contain chemicals, grease, silt, or suspended solids.

1.2 310 Sensor Design

The ultrasonic level sensor consists of a housing with a single transducer that is both pulse transmitter and echo receiver. A temperature sensor within the housing measures the ambient temperature, and a microprocessor automatically compensates for speed-of-sound changes due to any changes in air temperature.

The 310 is available with a 10m, 23m, and special order to 150m or less cable lengths with or without connectors. For greater distances, external connection via conduit, and connection of additional TIENet devices, the TIENet Expansion Box is available. Bulk TIENet cable may also be used for greater distances.

Figure 1-2 310 Ultrasonic TIENet Sensor with unterminated leads (l) or TIENet plug (r)

1.3 Operation

The sensor emits multiple ultrasonic pulses per second. Between pulses, the transducer switches from transmitter to receiver. When the transducer receives the echo from the water's surface, the sound energy is converted into an electrical signal. The signal is then amplified and processed by the Signature flow meter into an "echo-received" signal. The time between the transmitted pulse and the echo-received signal is proportional to the distance between the transducer and the liquid surface. This distance in turn determines the liquid level used to calculate flow.

1.4 Technical Specifications

Table 1-1 310 TIENet Device Specifications[a]

Sensor Dimensions	3.63" ∅ x 4" tall	(9.1cm ∅ x 10.2cm tall)
Cable Length	10 or 23 meters standard	(32.8 or 75.5ft) standard
Mounting Attachment	3/4" NPT Pipe thread nipple w/ Conduit lock nut	
Weight	4 lbs	(1.8 kg)
Body Material	PVDF	
Enclosure	IP68 when connected and properly sealed with cord-grip fitting.	
Temperature Range Operating (compensated) Storage Hazardous Locations	 -22 to 140°F -40 to 158°F -40 to 140°F	 (-30 to 60°C) (-40 to 70°C) (-40 to 60°C)
Measurement Range	Minimum: 1 ft (0.3m) from sensor to liquid surface Maximum: 11 ft (3.3m) from sensor to liquid at minimum level	
Measurement Accuracy at 72 °F (22 °C)	±0.02ft (0.006m) at 1ft level change or less; ±0.03ft (0.009m) at greater than 1ft level change	
Temperature Coefficient within compensated range	± 0.0002 x D (m) per degree C ± 0.00011 x D (ft) per degree F (Where D is the distance from the transducer to the liquid surface)	
Beam Angle	10°	5° From center line
Ultrasonic Signal	50KHz	
Certifications	Group II, Category 1G (zone 0), T4 Class I, Division 1 (and Zone 0), T4	

a. All specifications are subject to change without notice.

1.5 Accessories

Accessories used in sensor installation are briefly described below. Refer to the next section for ordering information.

☑ Note

Only the Wall Mount Bracket is approved for use in classified hazardous locations. Other accessories must undergo a hazardous location evaluation in order to fulfill safe installation requirements.

Spreader Bar – The Spreader Bar is an expandable pipe for suspending equipment inside a manhole. Outward spring pressure secures it against the manhole walls, like a shower curtain rod. Depending on your application, you can then suspend the 310 TIENet Device, or the Signature Flow Meter itself, from the bar.

Cable Straightener – The cable straightener is designed for use in installations where the transducer is suspended by its cable only, such as from the Spreader Bar. The straightener helps hold the transducer vertically plumb, thereby stabilizing alignment.

Cable Clamp – The cable clamp is used with the Spreader Bar to secure the mounting of the sensor.

Wall Mount Bracket – This device lets you install the ultrasonic level sensor on a convenient nearby wall over a flow stream, such as the side of a bridge, or other structure.

Floor Mount – The Ultrasonic Floor Mount is a collapsible metal stand attached to the floor, for extending the sensor out over a flow stream.

Ultrasonic Calibration Target – This option is designed to make calibration of the level sensor more accurate during the installation process by letting you calibrate the level sensor from outside the manhole.

Sunshade – The ultrasonic sunshade is a white plastic cap that fits over the top of the ultrasonic transducer. Its purpose is to keep sunlight from heating the body of the level transducer and introducing temperature errors to the internal temperature compensation.

1.5.1 Ordering Information

Options and accessories can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA
Phone: 800 228-4373
402 464-0231
FAX: 402 465-3022
E-mail: IscoInfo@teledyne.com

1.5.2 TIENet 310 Ultrasonic Level Sensor

310 Ultrasonic Level Sensor with Signature connection ending in unterminated leads. For use with Signature 6 position plug-in (green) terminal strip.

Includes cord grip and sensor with cable. (See cable lengths below).

310 Ultrasonic sensor w/ 10m cable	60-4314-005
310 Ultrasonic sensor w/ 23m cable	60-4314-006
310 Ultrasonic sensor Cut-to-length	60-4314-014
Cut to length cable up to 999 ft*	60-4304-050

*Cable lengths can go up to 150 m with an expansion box.

310 Ultrasonic Level Sensor with Signature connection ending in TIENet plug. For use with portable Signature TIENet receptacle.

Includes cord grip and sensor with cable. (See cable lengths below).

310 Ultrasonic sensor w/ connector and 10m cable	60-4314-009
310 Ultrasonic sensor w/ connector and 23m cable	60-4314-011
310 Ultrasonic sensor w/ connector Cut-to-length*	60-4314-013
Cable Assembly with TIENet Y w/ connector	60-4304-066

*Cable lengths can go up to 150 m with an expansion box.

Sunshade for ultrasonic sensor	60-3004-142
Spreader bar for suspension of sensor or flow meter in manhole shaft	60-3004-110
Cable clamp	60-3004-129
Sensor Mounting Bracket U/S	60-2003-615
Floor mount for horizontal surfaces	60-2004-611
Cable straightener for suspension over stream	60-4313-009
Ultrasonic calibration target	60-3004-143
TIENet Expansion Box	60-4307-023
Kit includes 10ft TIENet cable	
Cord grip fitting, $^3/_4$" NPT, for TIENet cable	209-0073-12
Barrier for Signature (SPA 2060)	60-5324-060

☑ **Note**

Teledyne Isco uses FreeRTOS version 5.4.2 in its TIENet devices. In accordance with the FreeRTOS license, FreeRTOS source code is available on request. For more information, visit www.FreeRTOS.org.

TIENet® Model 310 Ultrasonic Level Sensor

Section 2 Installation and Setup for Signature

The Signature Flow Meter does not have to be mounted near the flow stream. You can install the flow meter itself at a convenient, protected location and route the sensor cable to the measurement point. Proper installation of the 310 sensor is critical for accurate measurement.

2.1 Sensor Installation Considerations

Measurement accuracy can be affected by a number of site factors that should be taken into consideration when selecting the location for the sensor. If the sensor cannot obtain a valid reading, an asterisk (*) will appear next to the displayed level, indicating there is an error.

2.1.1 Beam Angle

The 310 sensor has a 10° beam angle, forming a cone whose apex is the ultrasonic transducer. The sensor can only detect surfaces within this cone. Narrow channels can result in false echoes and incorrect level readings off the walls and sides of the channel. For preventive measures, see Section 2.5.2 *Measurement Setup*, and the programming steps in Figure 2-14.

The beam becomes narrower at shorter distances, which can increase difficulty in detecting the return echo. If the beam is too wide, the sensor may pick up signals from unwanted surfaces, such as the walls of the channel.

Sensor elevation is highly specific to the particular site.

2.1.2 Humidity

Conditions of extremely high or low humidity can cause detection to occur either earlier or later than under normal conditions. A drop in water level, normally compensated for by the sensor's interval-based amplifier, may produce errors in echo detection.

Additionally, water droplet condensation on the bottom surface of the sensor can cause measurement errors.

2.1.3 Surface

Solids, foam, oil, and turbulence can all absorb or weaken the ultrasonic pulses, causing errors in detection. Foam or oil on the surface of the stream can produce false level readings.

2.1.4 Temperature

Changes in ambient temperature significantly affect the velocity of sound. If ambient temperature changes rapidly, there may be a delay before the 310's temperature sensor can activate temperature compensation.

If the sensor will be installed outdoors in direct sunlight, use a sunshade to prevent heating of the sensor housing.

2.1.5 Waves

Waves on the surface of the flow stream can deflect the ultrasonic signal, causing erroneous readings or total loss of signal. The Signature Flow Meter software is able to reject occasional readings that deviate substantially from normal.

2.1.6 Wind

Strong winds can significantly reduce the strength of the return echo. Narrow beams can result in the sound being blown away; likewise, greater distances to the flow stream surface are more subject to distortion in strong winds.

2.1.7 Hazardous Locations

Installation in classified hazardous locations must meet specific conditions in order to fulfill safety requirements. Installation must be performed only by trained, qualified personnel. Refer to Section 2.4 *Installation in Hazardous Locations* for complete information.

2.2 Connecting the Cable

External TIENet devices such as the 310 are all connected to the Signature flow meter in the same manner. These connections usually use conduit or cord-grip cable fittings for permanent mounted meter or with TIENet receptacle for portable meters. Multiple external TIENet devices can be connected simultaneously.

Refer to your Signature flow meter manual for instructions on accessing the instrument's interior components.

☑ **Note**

The steps that follow include instructions for installing cord-grip fittings. Some applications will require cables to be routed through user-supplied conduit. Conduit with a minimum $^3/_4$" ID is suggested for unterminated sensor cables and conduit with minimum 1-$^1/_2$" ID is suggested for straight runs for sensor cables with connectors.

2.2.1 Permanent Meters

☑ **Note**

Before proceeding, ensure that the flow meter has been disconnected from mains power.

1. Remove one of the 6-position plug-in terminal strip connectors from the case board.

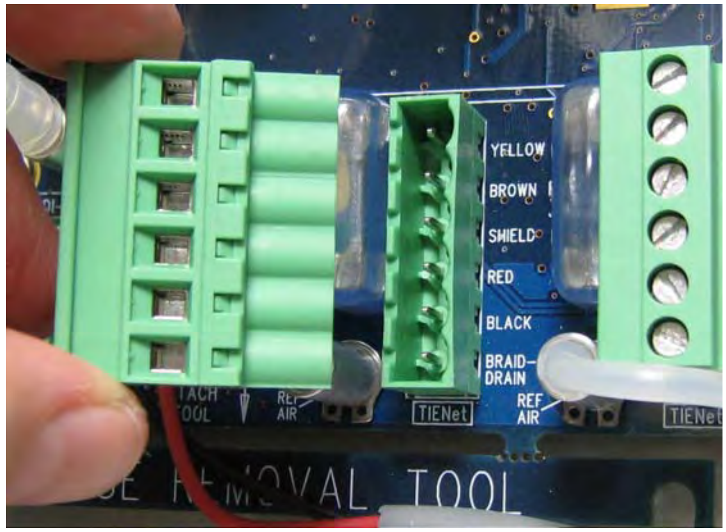


Figure 2-1   TIENet Device terminal strips

2. If using a cord-grip fitting, install the cable nut in the appropriate opening on the bottom of the Signature enclosure, securing it to the wall with the lock nut (concave side facing wall).
3. Feed the TIENet device cable end through the sealing nut and seal, and through the cable nut. Lightly tighten the sealing nut, just enough to hold the cable in place while installing the connector.

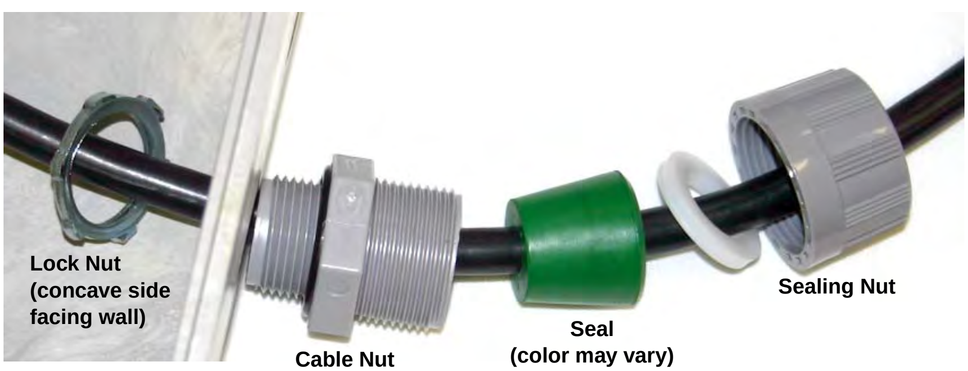


Figure 2-2   Installing cable with a cord-grip fitting

4. Attach the wire ends to the terminal strip as shown in Figure 2-3, then press the terminal strip back down into its socket on the case board, as shown in Figure 2-4, taking care not to strain any wire connections. Gently tug each wire when finished, to verify secure connection to the screw terminals.

☑ Note

The SHIELD wire is the bare drain emerging from the foil shield around the YELLOW and BROWN wires. The BRAID-DRAIN wire is the bare drain emerging from the surrounding braided shield inside the cable jacket. It is not necessary to prevent the two braids from coming into contact with each other.The drain wires need to be kept very short.

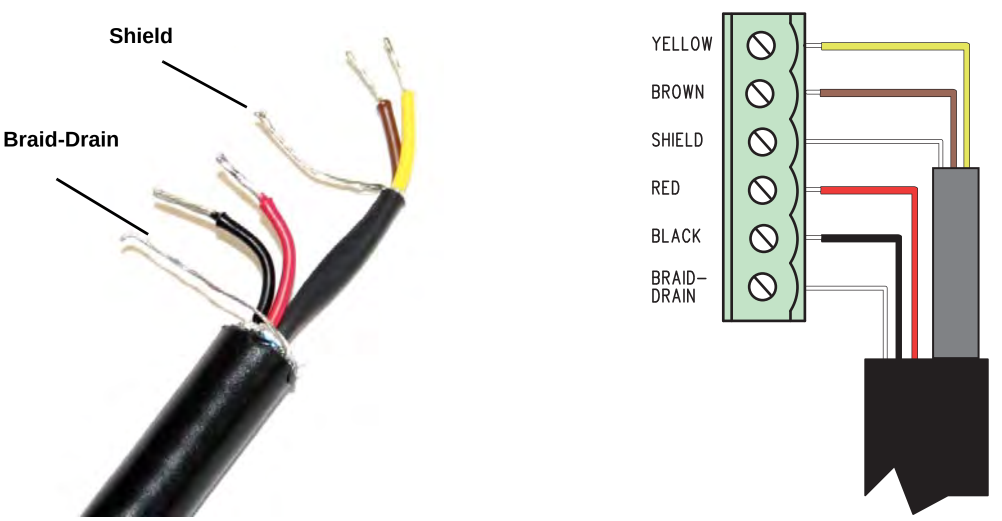


Figure 2-3   TIENet Device terminal connections

5. Press the terminal strip back down into its socket on the case board, as shown in Figure 2-5, taking care not to strain any wire connections. The 310 sensor cable does not include a reference air connection (Figure 2-4).

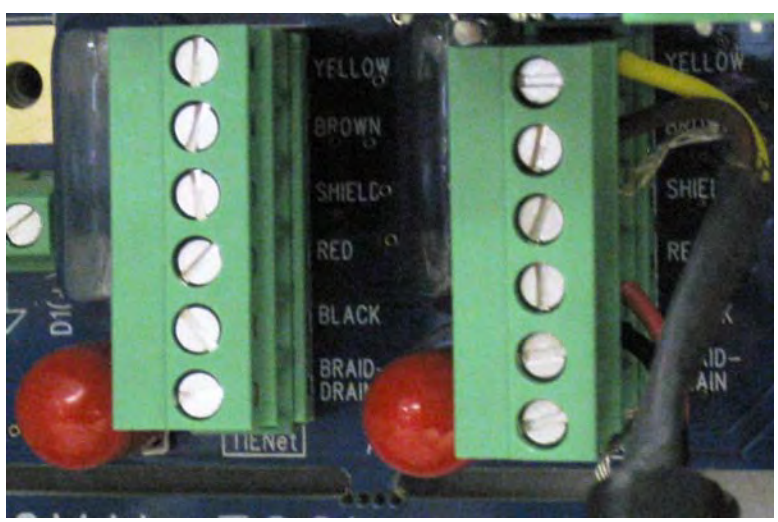


Figure 2-4   Attach wired terminal strip to case board socket

6. Gently tug the cable downward, to remove any slack within the enclosure, taking care not to put any stress on the connection.
7. Tighten the cord grip sealing nut.

⚠ CAUTION

If you are using conduit instead of the cord-grip fitting, the conduit must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

8. Close the front panel and fasten it shut with the two Phillips screws.

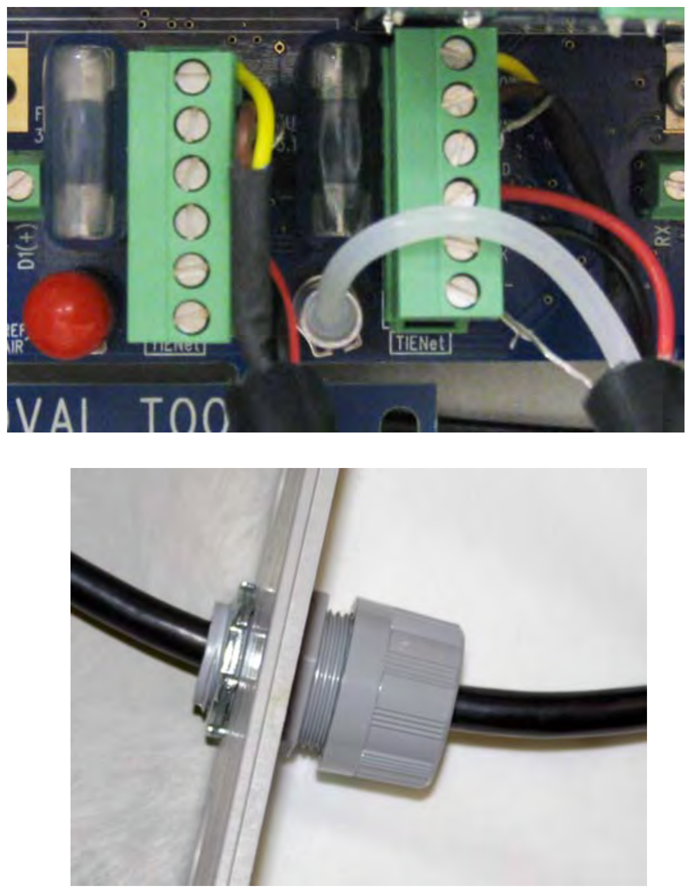


Figure 2-5 Position and secure the cable

2.2.2 Connecting to Signature Portable via a TIENet Receptacle

The optional external TIENet devices compatible with the Signature Portable (and Signature) all scan into the hardware in the same manner. A scan is required anytime a new TIENet device is added.

Multiple TIENet devices can be connected simultaneously to the same Signature Portable Flow Meter. The following TIENet devices will attach to the TIENet receptacle:

- Ultrasonic Level Sensor

- Area Velocity Sensor
- 301 pH Interface
- LaserFlow
- 306 Sampler Interface

Connecting a TIENet plug to the Signature Portable

To connect the TIENet plug from the sensor to the TIENet Receptacle:

1. Align the connectors and push together (Figure 2-6).
2. After the physical connection is made, a scan must be performed for the device to be recognized.

For additional TIENet connections, use the TIENet Y-cable or alternately an Expansion Box.

O-Ring and Lubrication for the TIENet receptacle

1. Coat the O-ring's sealing surface with a silicone lubricant.

⚠ CAUTION

Do not use petroleum-based lubricants. Petroleum-based lubricants will cause the O-ring to swell and eventually deteriorate. Aerosol silicone lubricant sprays often use petroleum-based propellents. If you are using an aerosol spray, allow a few minutes for the propellent to evaporate before proceeding.

2. Align and insert the connector. The sensor release will "click" when the sensor connector is fully seated.
3. Connect the two caps together.

Figure 2-6 How to connect a TIENet plug to the Signature Portable

2.3 Sensor Installation

The mounting location of the ultrasonic level sensor depends on the type of primary measuring device (such as a weir or flume), and on the method of level-to-flow conversion used. Refer to the *Isco Open Channel Flow Measurement Handbook* included with your Signature flow meter, or to instructions provided by the manufacturer of the primary device, for detailed information about locating the measuring point.

If you intend to measure flow by some other means, such as a gravity flow equation (Manning) or by calibrating a section of the flow channel, you must locate the measuring point based on the hydraulic characteristics of the channel, as well as the level-to-flow conversion method.

In most open channel installations where the level may exceed one-half of full pipe, mount the sensor as near as possible to the midpoint between the entrance and exit to measure over the least turbulent flow.

2.3.1 Dead Band

Mount the sensor as close as possible to **one foot** (0.3 m) above maximum expected level. The sensor cannot measure within the foot of space directly below it, called the *dead band*.

2.3.2 Submersion and Fouling

Fouling by grease or solids can cause the sensor to malfunction. The sensor is sealed, so unless it was exposed to corrosive substances, temporary accidental submersion should not harm it. Upon retrieval, ensure that the sensor's surface is clean. Clean the bottom surface very gently with running water and a soft cloth.

2.3.3 Mounting Options

The 310 sensor can be mounted over the flow stream in various ways, depending on which method best fits the application.

Optional equipment is available from Teledyne Isco for wall, floor, suspension, and horizontal mounting (see Section 1.5 *Accessories*). The sensor has a 3/4" NPT male pipe thread with a conduit lock nut to connect it to a mounting bracket or cable stiffener. The sensor cable can be routed through user-provided conduit back to the Signature Flow Meter.

Regardless of the mounting method you select, always place the sensor over the center of the stream, and always use a circular bubble level for vertical alignment.

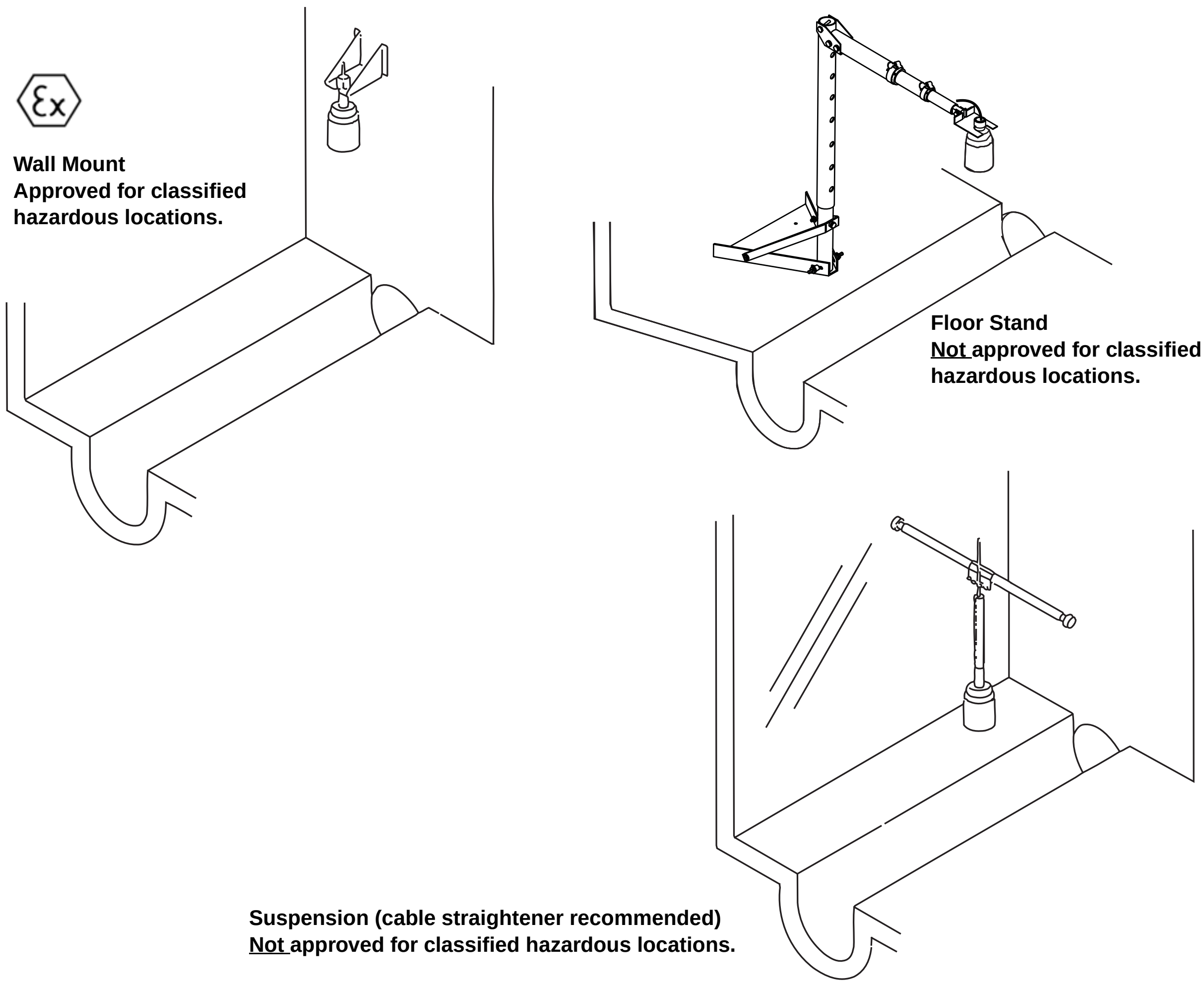


Figure 2-7   Sensor mounting options

2.4 Installation in Hazardous Locations

Read all labels carefully before installing the equipment!

The TIENet Model 310 device is ATEX-approved for use in potentially explosive atmospheres when specific conditions are met, as described in this section in reference to "X" Marking.

The 310 is Group II, Category 1G equipment for use in gas hazard zones 0, 1, and 2 (European standards), or Class I Division 1 (North American standards).

The braid-drain lead depicted in Figure 2-8 *Sensor labeling regarding hazloc installations* is normally bonded to earth through the Signature connector case terminals or conduit; it is also electrically connected to the anti-static conductive housing of the 310 sensor.

Installation must be performed only by trained, qualified personnel.

Barriers or isolators required for certifiable safe installation are the responsibility of the user. Refer to the control drawings provided in Figures 2-9 and 2-10.

Note

There is TIENet barrier (a weatherproof box with terminals and power supply) available for hazardous locations (PN# 60-5324-060). Contact Teledyne Isco's SPA department for more details.

Note

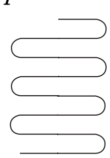
Only the Wall Mount Bracket is approved for use in classified hazardous locations. Non-Isco hardware must undergo a hazardous location evaluation in order to fulfill safe installation requirements.

⚠ WARNING

The mounting bracket is a potential isolated charge carrier. For classified hazardous locations, your installation MUST satisfy earthing requirements. Refer to IEC 60079-14 section 12.2.4 and IEC 60079-11.

⚠ WARNING

Serpentine loop



Do not coil the sensor cable; this will form an inductor and create a hazard. The cable should be kept as short as is practical. If necessary, use a serpentine loop (see figure at left) instead.

2.4.1 Important Information Regarding "X" Marking

The ATEX labeling on the serial tag of the 310 device includes a number ending in "X." The X marking indicates that there are specific conditions that must be met in order for the equipment to comply with intrinsic safety requirements. Refer to Figure 2-8 on the following page.

These specific conditions are as follows:

- The integral cable must be terminated in a manner suitable for the zone of installation.
- No additional cable must be added to the sensor during the installation and the sensor integral cable must be connected directly to the terminals of the associated apparatus.
- The Li and Ci of the associated apparatus must be negligible.
- The physical spacing between the exposed ends of each insulated wire lead, and earth ground and other IS

circuits, must be such that the equipment is isolated up to 500V, and to 1500V for non-IS circuitry.

- The physical spacing between the end of the wire jacketing and the terminal to which a lead is connected must be such that solid foreign objects of 12.5mm ∅ and greater shall not be able to fully penetrate.

2.4.2 Electrical Requirements

Always refer to the electrical values listed at the bottom of the 310 serial tag when connecting associated apparatus (i.e., power supply, network interface, etc.).

This labeling indicates the maximum input voltage (Ui), maximum input current (Ii), and maximum power (Pi) that can be present at the specified terminals without invalidating intrinsic safety.

The power supply parameter allowances *must exceed* maximum internal capacitance (Ci) and either the maximum internal inductance (Li), or the maximum internal inductance-to-resistance ratio (Li/Ri) of the 310 device and integral cable. These parameters are established on the third party certification report and are available by contacting Teledyne Isco.

2.4.3 Ambient Environment

Installation in designated hazardous areas must fall within the temperature range of -40 to +60°C, as specified on the serial tag labeling.

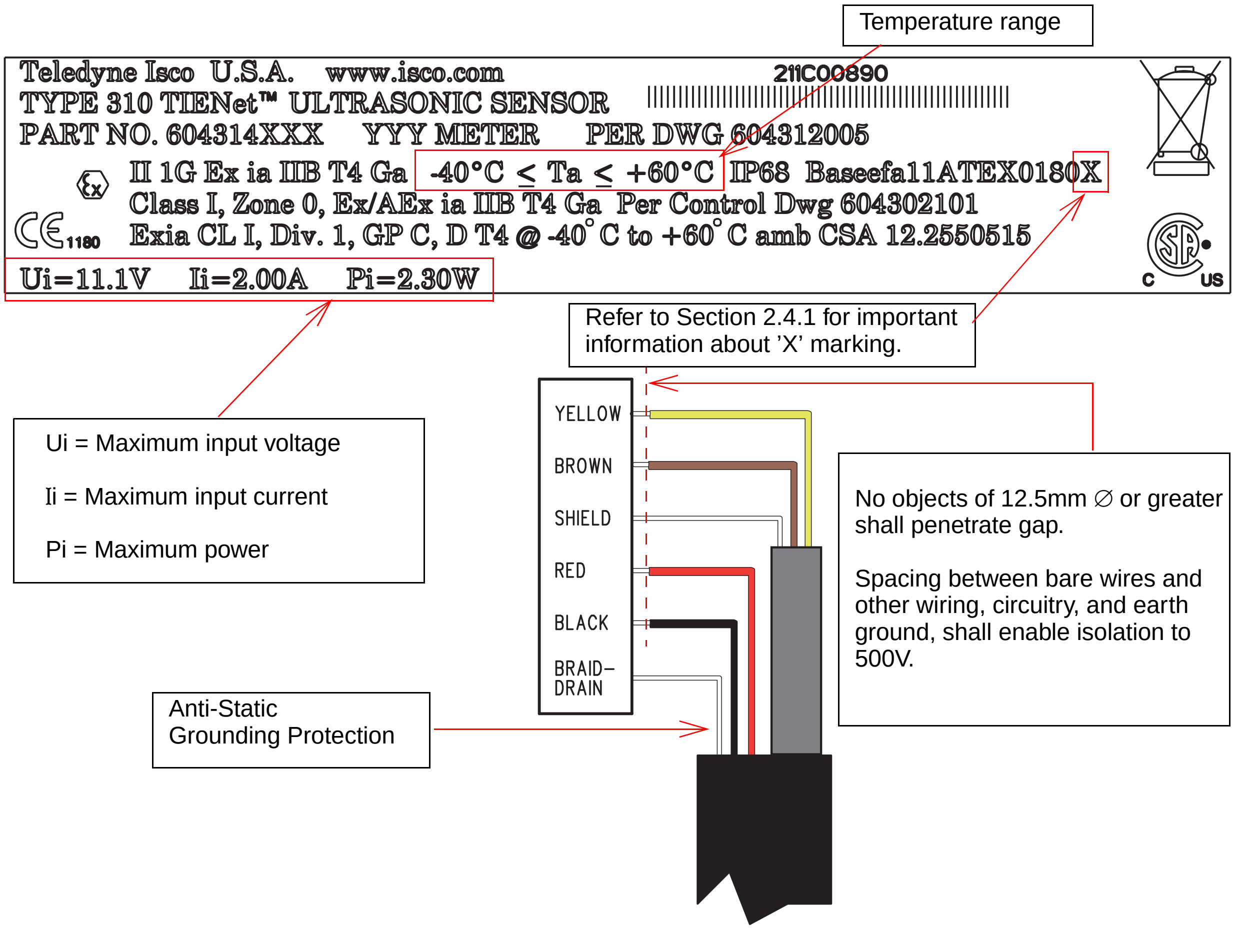


Figure 2-8 Sensor labeling regarding hazloc installations

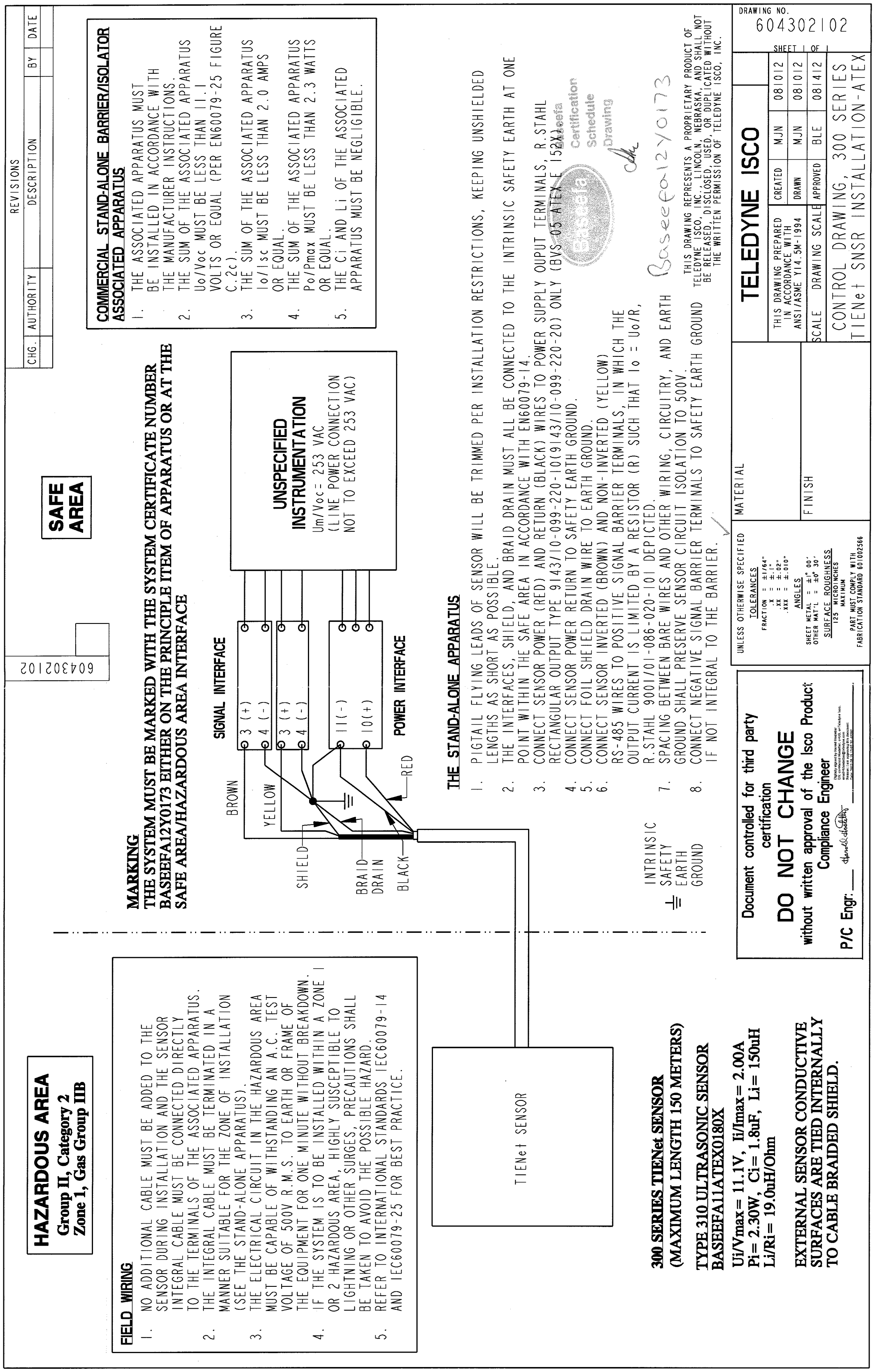


Figure 2-9 Hazardous Location Installation Control Drawing-Atex

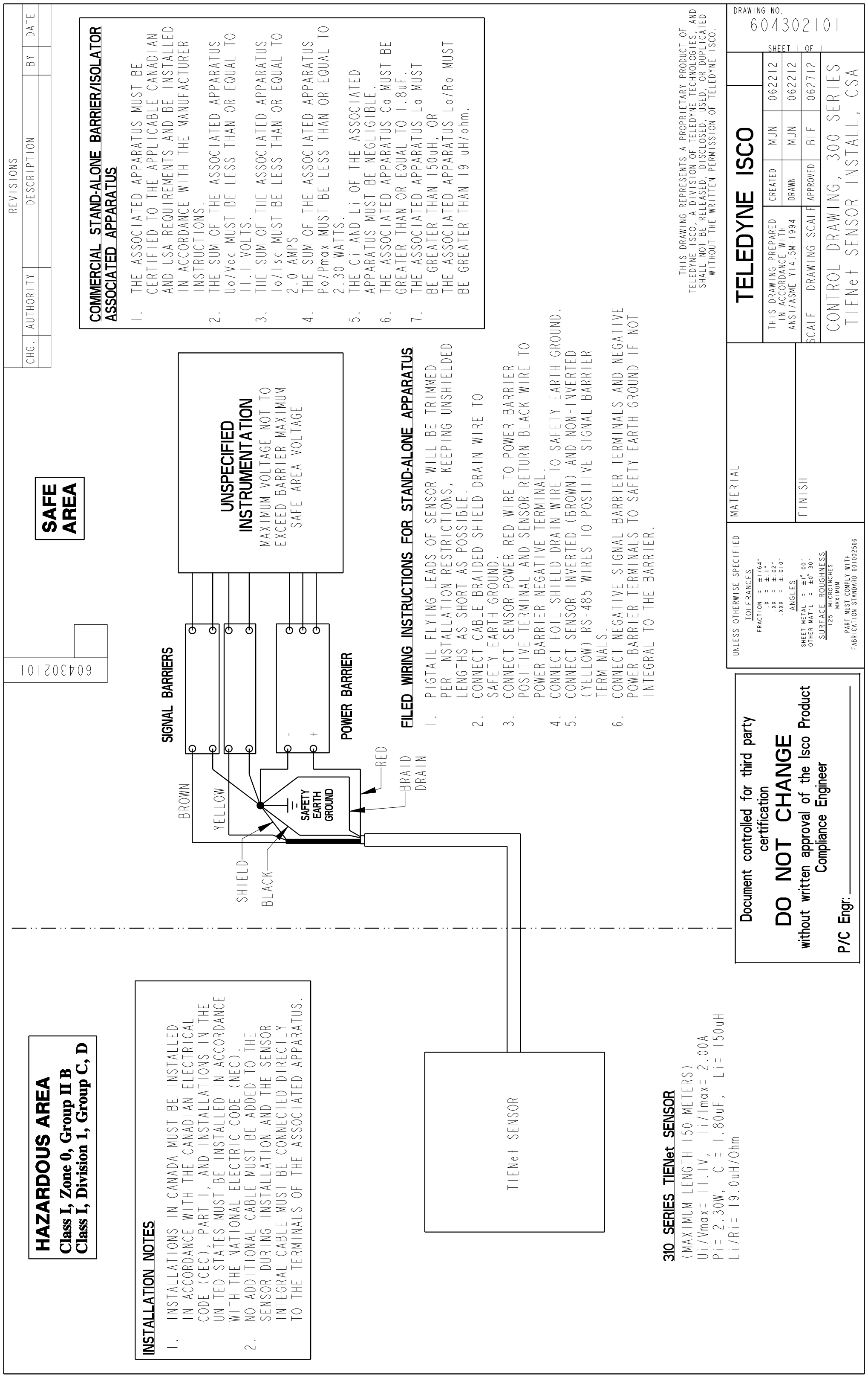


Figure 2-10 Hazardous Location Installation Control Drawing-CSA

2.5 Configuring the System

To configure the Signature flow meter for operation with the TIENet 310 device, press MENU (B) to access the top menu, and select Hardware Setup. For all TIENet devices including the 310, select Smart Sensor Setup (TIENet).

2.5.1 Updating the Device List

When the 310 is physically added to the system, select Perform Scan so that the flow meter detects it. When the scan is complete, the 310 appears in the list of connected devices, ready to be configured with the steps shown in Figure 2-12 on the following page.

> **Note**
> From the Hardware Setup menu, “Configure” refers to defining and selecting the parameters for each connected device.

The four parameters that will appear for the 310 device are:

310 Distance – Distance between the bottom of the sensor and the surface of the flow stream.

310 Air Temperature – Temperature of surrounding (ambient) air

310 Level – Level of the flow stream surface

310 Signal – Strength of the return echo

The name of any parameter can be customized by highlighting it and pressing Enter ( ) to display the character grid. Navigate the grid using the arrow keys. Select characters with Enter and clear characters with Delete ( ).

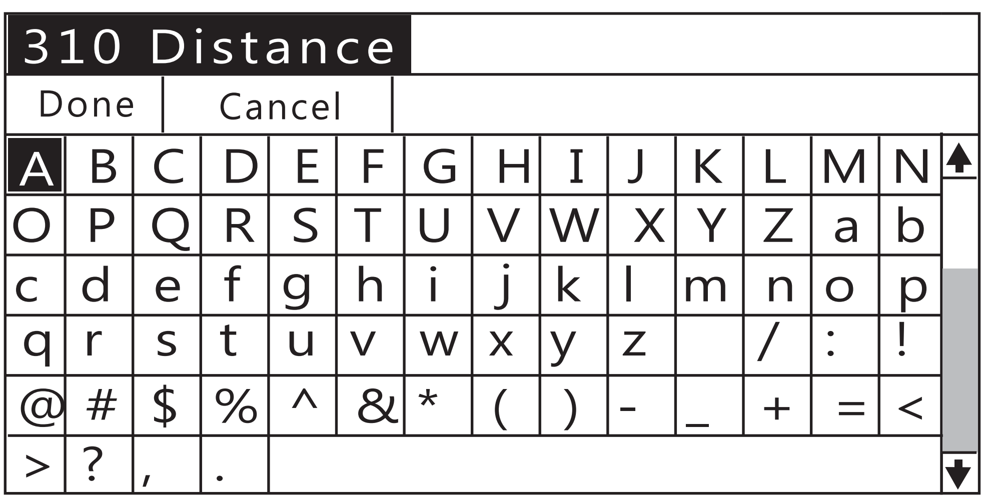


Figure 2-11 Character grid

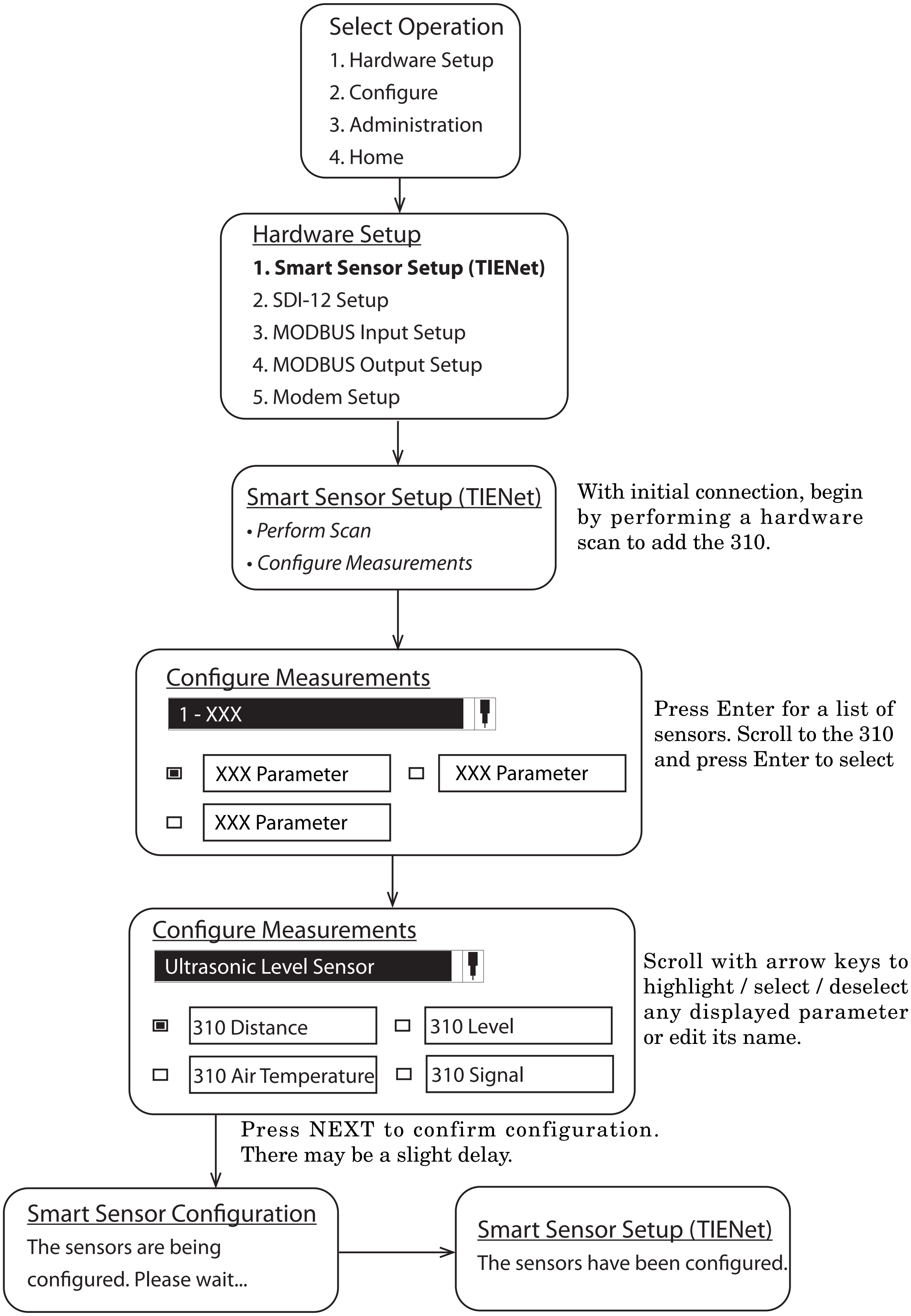


Figure 2-12 Menu Tree: 310 Configuration

2.5.2 Measurement Setup

From Measurement Setup (Figure 2-13 below), select Level Input Setup to define the measurement range.

The **Minimum Blanking Distance** is the shortest distance from the sensor face (highest expected liquid level). Because of the dead band, this value can never be less than one foot. Depending on the elevation of your sensor, this value may be increased to help ensure that echoes read by the flow meter come only from the surface of the flow stream, and not off the walls or sides of the channel.

The **Maximum Blanking Distance** is the distance between the sensor face and the bottom of the channel, or zero level. You can enter a slightly larger value than calculated, if you prefer.

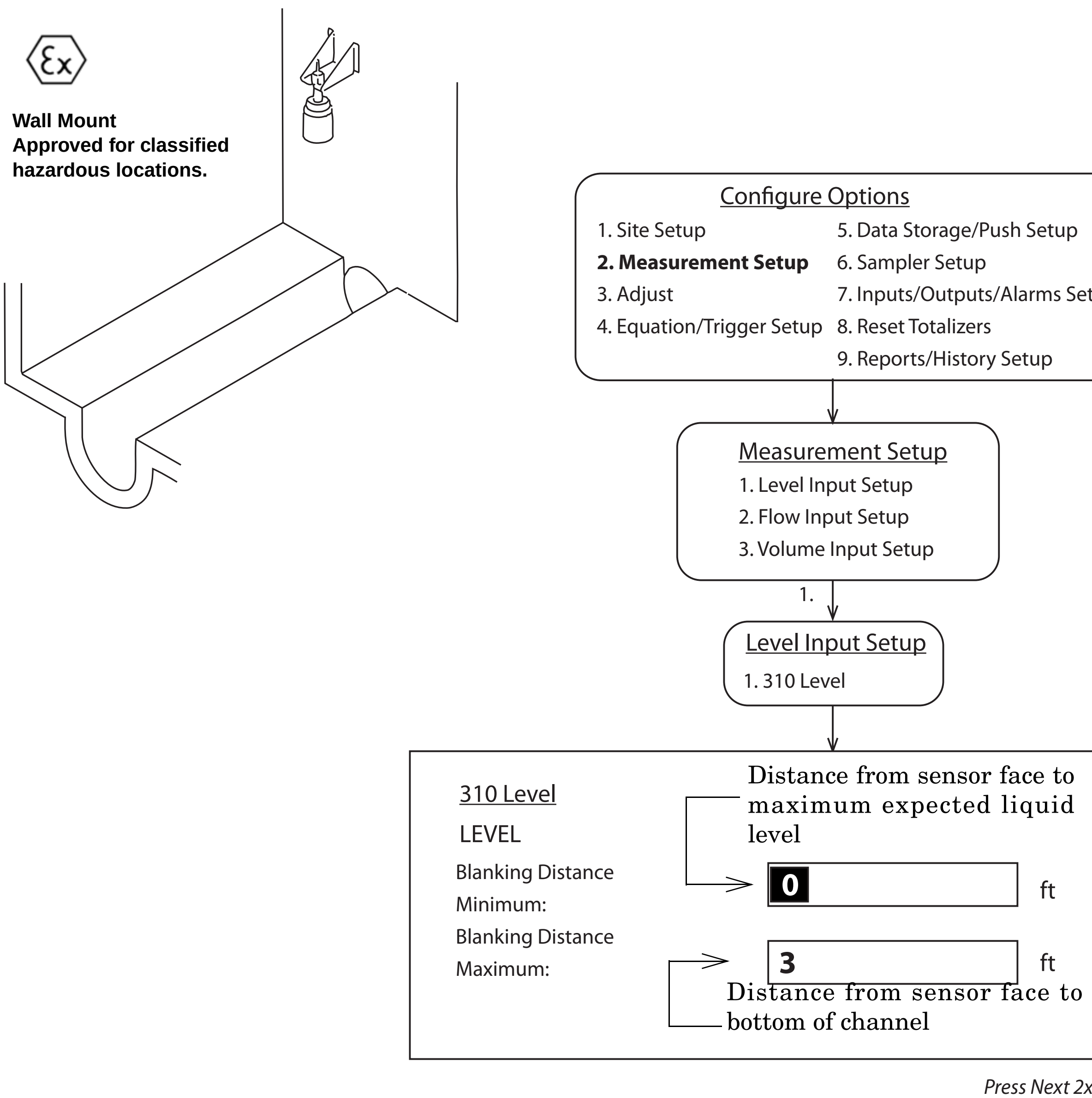
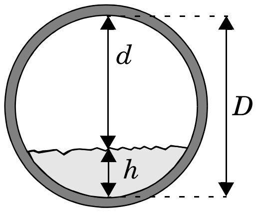


Figure 2-13 Configuring ultrasonic level measurement

2.6 Level Calibration

$D - d = h$ (level)



Although all other programming steps can be performed off-site, level must be set at the measurement site following installation, at ambient temperature.

Once the sensor is installed over the flow stream, measure the present liquid level (see figure at left) and enter this value for Level, under Adjust Options. Then highlight “Adjust” and press Enter to confirm.

From this screen, you can also update the display to show the current level of the stream.

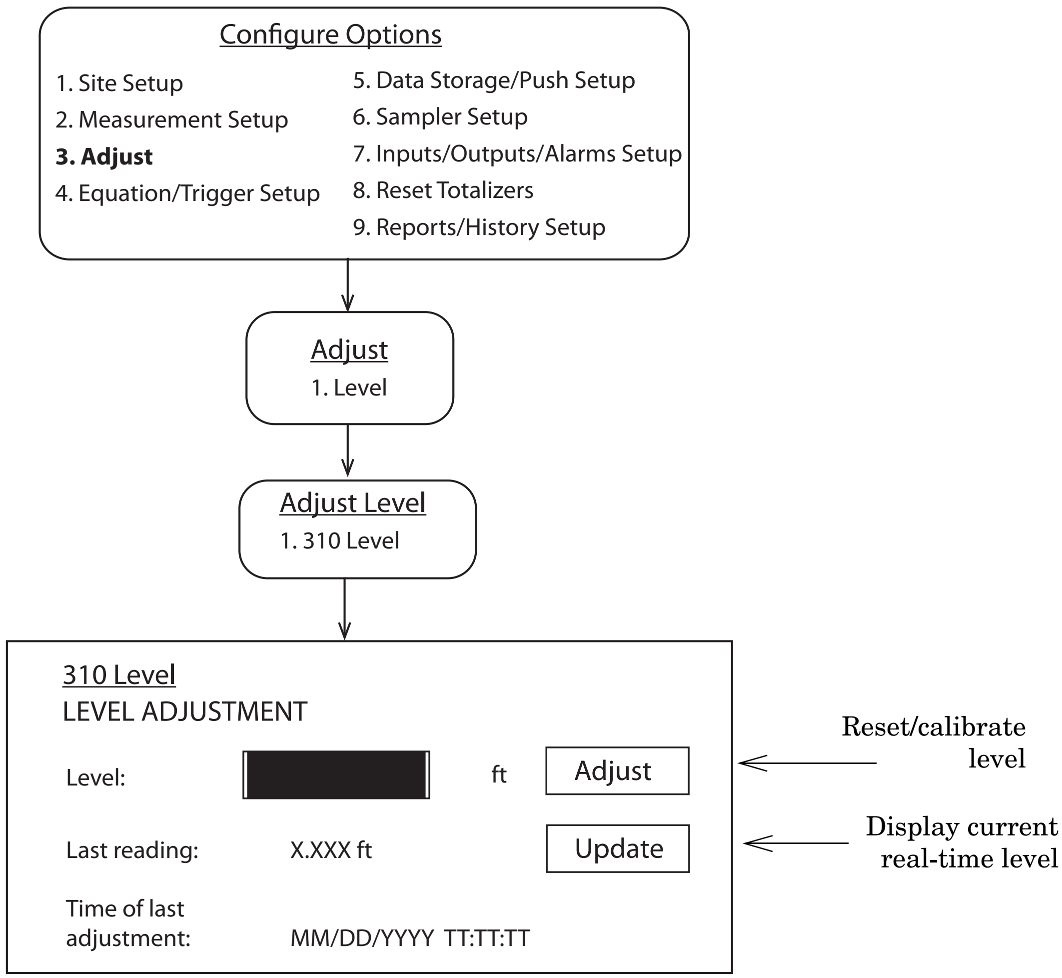


Figure 2-14 Ultrasonic level adjustment and calibration

2.7 Firmware Updates

The TIENet device's firmware is updated via the USB port on the front panel of the Signature Flow Meter. Step-by-step instructions for updating the firmware can be found in Section 2 of the Signature user manual.

2.8 Troubleshooting TIENet 310 USLS

Table 2-1 Troubleshooting: TIENet 310 Ultrasonic Level Sensor

Symptom	Cause	Action
Invalid level, display has asterisk (*) by level reading	Not scanned	Perform a smart sensor scan
	Not able to achieve signal lock (misalignment, loose mounting, turbulence, foam, or debris in the water)	Adjust mounting or place over a solid surface.
	Level outside of the Blanking distances	Adjust min/max blanking distances
	Not wired correctly	Check/repair wiring
	Open fuse	Replace fuse FU-T 3.15A and rescan. Part #411-0212-70. Refer to Figure 3-2 Item K.
	Failed sensor	Replace with known good sensor
No level reading on the display	Parameter not selected to be displayed on Home Display	Add the parameter to the Home Display. Refer to Section 2.7.1 *Site Setup*.
Incorrect level reading	Level not adjusted properly	Readjust level
	Sensor misaligned	Realign sensor
	Objects in the path of the signal	Adjust min/max blanking distances and/or reposition sensor.
	Sensor exposed to direct sunlight	Install sunshade. Refer to Appendix Appendix B *Options and Accessories*.

2.9 Contact Teledyne Isco

If you have further questions about the installation, operation, and maintenance of your TIENet device, please contact our service department at:

Teledyne Isco
4700 Superior St.
Lincoln, NE 68504

Phone: 866 298-6174 or 402 464-0231
Fax: 402 465-3022
E-mail: IscoService@teledyne.com

TIENet® Model 310 Ultrasonic Level Sensor

Appendix A Replacement Parts

A.1 Replacement Parts

Replacement parts are called out in the following illustrations. Refer to the call-out in the adjacent table to determine the part number for the item.

Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Department
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX:(402) 465-3022

E-mail:IscoInfo@teledyne.com

A.1.1 TIENet 310 Ultrasonic Level Sensor Replacement Parts

Split mounting Nut	60-4313-007
Cap Sensor Connector	60-4314-011
310 Ultrasonic sensor Cut-to-length	60-4314-014
O-Ring Sensor Connector	20-2100-669
Screw Connector Cap #4-40 X1/4	23-1014-304

产品中有毒有害物质或元素的名称及含量
Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	O
显示 Display	X	O	O	O	O	O
接线 Wiring	O	O	O	O	O	X
内部电缆 Internal Cables	O	O	O	O	O	X
直流电机 DC Motor	X	O	O	O	O	X
接头 Connectors	O	O	X	O	O	O
电池 Battery	X	X	X	O	O	O
电磁阀 Solenoid valve	X	O	O	O	O	X

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component’s any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打“X” 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component’s at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the “X”marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January, "B" is February and so on.

DECLARATION OF CONFORMITY

ISM1-A

Application of Council Directive:	2004/108/EC-The EMC Directive 2006/95/EC- The Low Voltage Directive 94/9/EC - The ATEX Directive
Manufacturer's Name:	Teledyne Isco
Manufacturer's Address:	4700 Superior, Lincoln, Nebraska 68504 USA Mailing Address: P.O. Box 82531, Lincoln, NE 68501
Equipment Type/Environment:	Equipment for Light Industrial/Commercial Environments: The device is an ultrasonic transmitter/receiver using reflected impulses from water surfaces to calculate its depth. It is cable connected to flow monitoring instruments and consists of several circuit board assemblies inside a plastic enclosure. The device is intended for safe operation in an ambient temperature range of -40 to +60 C.
Trade Name/Model No:	**310 Ultrasonic Sensor**
Year of Issue:	2011
Provisions of the Directive fulfilled by the Equipment:	II 1G Ex ia IIB T4 Ga (-40C $\leq$ Ta $\leq$ +60C) IP68 (self-certified; submerged 9 meters for 72 hours)
Notified Body for EC-Type Examination:	Baseefa 1180 Buxton UK
EC-type Examination Certificate:	Model Type 310 Ultra Sonic Sensor: Baseffa11ATEX0180X Issued December 8, 2011
Notified Body for Production:	Baseefa 1180 Buxton UK
Harmonized Safety Standards:	EN60079-0:2009, EN60079-11:2007
Other Harmonized Standards and Specifications used:	EN 61326-1998 - EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN60529:1992 - Degrees of Protection Provided by Enclosure; IP-68

I, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of December 20, 2011.

USA Representative:

Vikas Padhye

Vikas V. Padhye Ph.D.
Vice President and General Manager
Teledyne Isco Inc.
4700 Superior Street
Lincoln, Nebraska 68504
Phone: (402)-464-0231
FAX: (402)-464-0318

TELEDYNE ISCO
A Teledyne Technologies Company

60-4312-011

Teledyne Isco One Year Limited Factory Service Warranty*

This warranty exclusively covers Teledyne Isco instruments, providing a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period due to faulty parts or workmanship will be repaired at the factory at no charge to the customer. Teledyne Isco's exclusive liability is limited to repair or replacement of defective instruments. Teledyne Isco is not liable for consequential damages.

Teledyne Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Teledyne Isco, and Teledyne Isco will pay surface transportation to return the repaired instrument to the customer. Teledyne Isco will not pay air freight or customer's packing and crating charges. This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

The warranty for any instrument is the one in effect on date of shipment. The warranty period begins on the shipping date, unless Teledyne Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as pH sensors, charts, ribbon, lamps, tubing, and glassware; fittings and wetted parts of valves; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover products not sold under the Teledyne Isco trademark or for which any other warranty is specifically stated.

No item may be returned for warranty service without a return authorization number issued by Teledyne Isco.

This warranty is expressly in lieu of all other warranties and obligations and Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

The warrantor is Teledyne Isco, 4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to the USA and countries where Teledyne Isco does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.**

Before returning any instrument for repair, please call, fax, or e-mail the Teledyne Isco Service Department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE PROBLEM.**

Shipping Address:	Teledyne Isco - Attention Repair Service 4700 Superior Street Lincoln, NE 68504 USA	
Mailing Address:	Teledyne Isco PO Box 82531 Lincoln, NE 68501 USA	
Phone:	Repair service:	(800) 775-2965 (lab instruments) (866) 298-6174 (samplers & flow meters)
	Sales & General Information: (800) 228-4373 (USA & Canada)	
Fax:	(402) 465-3001	
Email:	IscoService@teledyne.com	

October 11, 2013 P/N 60-1002-040 Rev H

TELEDYNE ISCO
Everywhereyoulook™

Installation and Operation Guide

TELEDYNE ISCO
Everywhereyoulook™

Manual #69-4303-070 of Assembly #60-4304-036

Revision G, February 2015

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If a problem persists, call or e-mail Teledyne Isco technical support for assistance. Simple difficulties can often be diagnosed over the phone. For faster service, please have your serial number ready.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by technical support, including the use of the **Return Merchandise Authorization (RMA)** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

Contact Information

Customer Service

Phone:	(800) 228-4373	(USA, Canada, Mexico)
	(402) 464-0231	(Outside North America)
Fax:	(402) 465-3022	
Email:	IscoCSR@teledyne.com	

Technical Support

Phone:	Toll Free (866) 298-6174	(Samplers, Flow Meters and Multi-parameter Probes)
	Toll Free (800) 775-2965	(Syringe Pumps and Liquid Chromatography)
Email:	IscoService@teledyne.com	
Return equipment to:	4700 Superior Street, Lincoln, NE 68504-1398	

Other Correspondence

Mail to:	P.O. Box 82531, Lincoln, NE 68501-2531
Email:	IscoInfo@teledyne.com

Revised April 2014

General Warnings

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed of the following general warnings:

⚠ WARNING

Avoid hazardous practices! If you use this instrument in any way not specified in this manual, the protection provided by the instrument may be impaired.

⚠ AVERTISSEMENT

Éviter les usages périlleux! Si vous utilisez cet instrument d'une manière autre que celles qui sont specifiées dans ce manuel, la protection fournie de l'instrument peut être affaiblie; cela augmentera votre risque de blessure.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

⚠ CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

⚠ WARNING

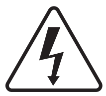
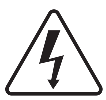
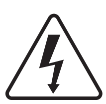
Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

⚠ DANGER

DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.

Hazard Symbols

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
Advertencias y Precauciones	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.
	Esta señal alerta sobre la presencia de alto voltaje en el interior del producto.

Signature™ Flow Meter

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Section 1 Introduction

Section 2 Setup and Programming

Section 3 Standard Installation

Section 4 Portable Installation

Section 5 Equipment Options

Section 6 Maintenance and Servicing

Appendix A Replacement Parts

Appendix B Options and Accessories

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Appendix D Material Safety Data Sheets

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Signature® Flow Meter

Section 1 Introduction

The Signature Flow Meter is designed for open channel flow monitoring applications using any combination of flow and parameter measurement technologies and sampling, depending on what is required at the monitoring site.

The Signature has built-in standard level-to-flow conversions that cover the majority of open channel flow measurement situations. Flow measurement is usually a calculation based on a known relationship between liquid level and flow rate. Additionally, the Signature can calculate flow using standard open channel level-to-flow and area-velocity conversions, as well as equations, or data points, depending upon the measurement device(s) attached to the meter and the program specified by the user.

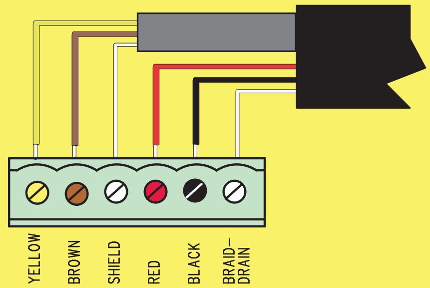
☑ **Note**

Recent enhancements have been made to the Signature Flow Meter. Many of these features are standard for all new Signature units which are identifiable by the serial label mounted on the bottom of the unit (PN 60-4304-065).

Figure 1-1 Signature Flow Meter

1.1 Quick Start

Signature®



TIENet™

Numerical: 0 , 1 , 2 . . .

• Enter values • Type characters

Arrows: ◀ , ▲ . . .

• Navigate up, down, left, right

Soft Keys: A B C

• Current displayed function

• Back = Return to last menu

• Next = Confirm & advance to next step

Home:

• Return to Home Screen from anywhere

Enter:

• Open list • Confirm selection • Activate field

• = Pull down list available

• = Character grid available

Delete / Exit:

•Clear last entry • Exit list • Close window

Decimal: .

• Navigate up one screen at a time

Plus-Minus: ±

• Navigate down one screen at a time
• Adjust screen contrast, when used with the up or down arrow keys.

Hardware Setup	Configure Options	Administration
TIENet Devices	**Site:** Clock, Name, Display, Units	**Language**
SDI-12 Setup	**Measurement Setup:** Level, Velocity, Flow, Volume	**Set New Passcode**
Modbus In	**Adjust:** Level, pH, Velocity	**Update Firmware**
Modbus Out	**Equation / Trigger**	**Sensor Diagnostics**
Modem	**Data Storage Rate / Data Push**	**System Information**
	Sampler Interface Setup	**License Information**
	Outputs: Alarm, Analog	**Gather Fault Data**
	Reset Totalizers	**Restore Defaults**
	Reports / History	

1.2 Data Integrity

What makes the Signature Flow Meter unique is its ability to verify data integrity. This is accomplished by logging four special event data types that cannot be altered, and are designed to alert the user to any trends or anomalies, and to assess compliance. This data can be downloaded from the flow meter and observed in tabular or graphical format alongside regular site data, using Flowlink software (see Section 2.10 *Signature Data in Flowlink*).

The data can also be downloaded onto a flash drive via the micro-USB assembly on the front panel of the flow meter, then imported into a spreadsheet or other viewing application (refer to Section 2.9 *USB Options* for more information).

The four event data types are:

Program Report – Tracks changes to the Signature Flow Meter configuration

Summary Report – Documents summaries of data measurements (e.g., Min/Max/Avg)

Diagnostic Report – Tracks results from diagnostic tests

History Report – Tracks user and meter events (e.g., level adjustments, data push, etc.)

1.3 Security

The Signature Flow Meter can be secured shut with a padlock with the hasp on the right side of the housing (refer to Figure 1-3). The program settings and recorded data can be protected by a user-selected passcode (refer to Section 2.8.2 *Set New Passcode*.

1.4 Compatible Equipment

The Signature Flow Meter can interface with a variety of measurement devices and other system components, depending on site requirements.

Measurement devices for flow and water quality can be connected to the same Signature Flow Meter and run simultaneously with TIENet® connectivity (up to nine TIENet devices). The flow meter can also communicate with an optional Teledyne Isco wastewater sampler and rain gauges.

For descriptions of interfacing and parameter sensing TIENet devices, refer to Section 5 *Equipment Options*. Each external TIENet device comes with its own user manual.

The Signature is capable of receiving data from devices using Modbus ASCII or Modbus RTU protocol.

A variety of application-specific accessories are available from Teledyne Isco. Refer to Appendix B *Options and Accessories* for a complete list with ordering information.

A basic Signature system has one or more TIENet devices for flow and/or parameter measurement connected to the Signature Flow Meter (up to nine TIENet devices at once). Other configurations may include an enclosure and additional internal or external devices, including analog output cards, analog input cards, contact output cards, a modem, up to two SDI-12 inputs, and Modbus devices.

When connected remotely via modem, the web interface of the Signature Flow Meter provides remote control and data access.

Figure 1-2 Multiple options can be used in any combination

1.5 Identifying Signature Components

The following are key components of the Signature Flow Meter:

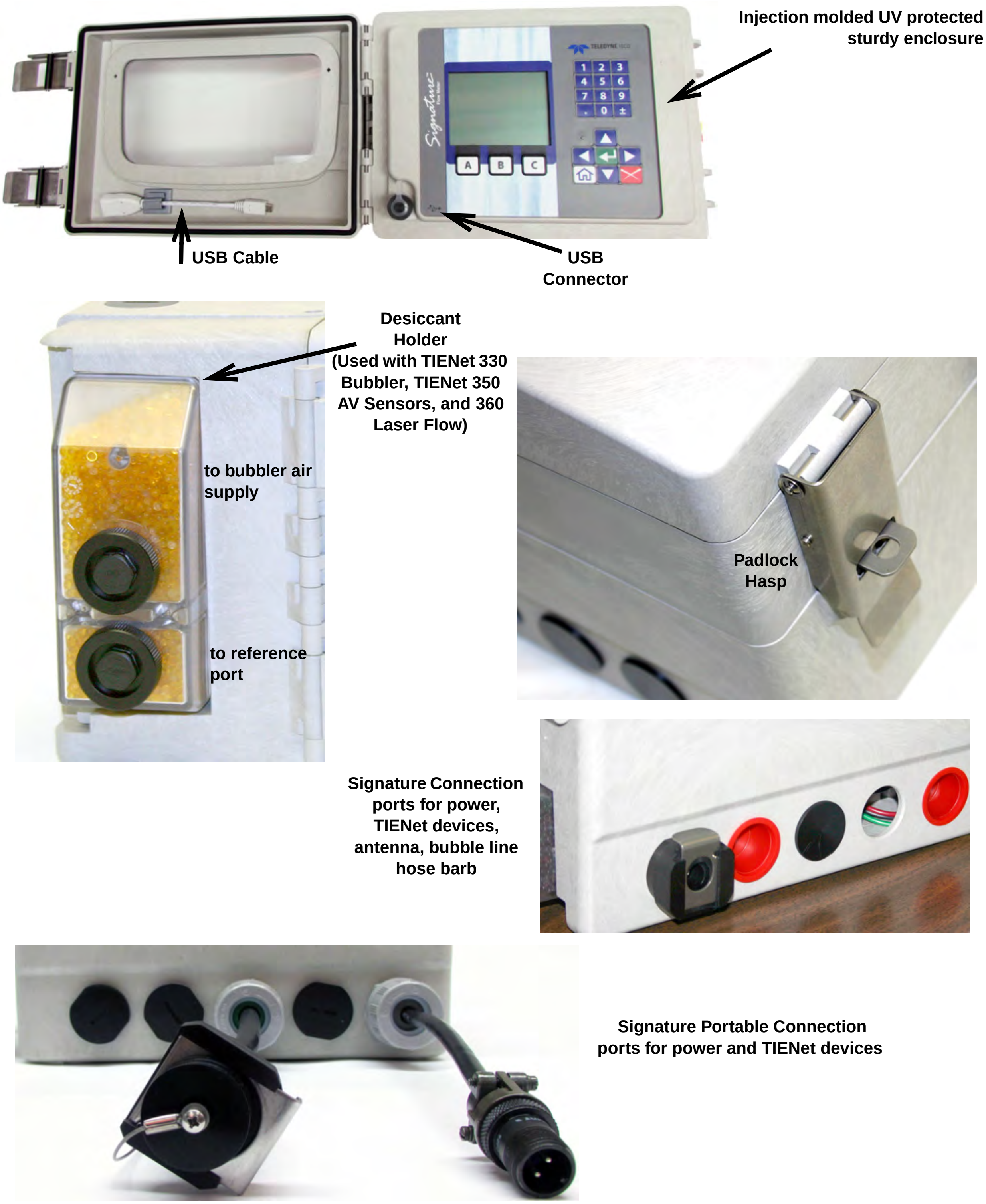


Figure 1-3 Front and exterior component identification

1.6 Controls and Indicators

Before programming and operating the Signature Flow Meter, become familiar with the keypad and standard screens.

1.6.1 Keypad

Keys are identified in Figure 1-4; keypad functions are detailed in Section 2.1.1.

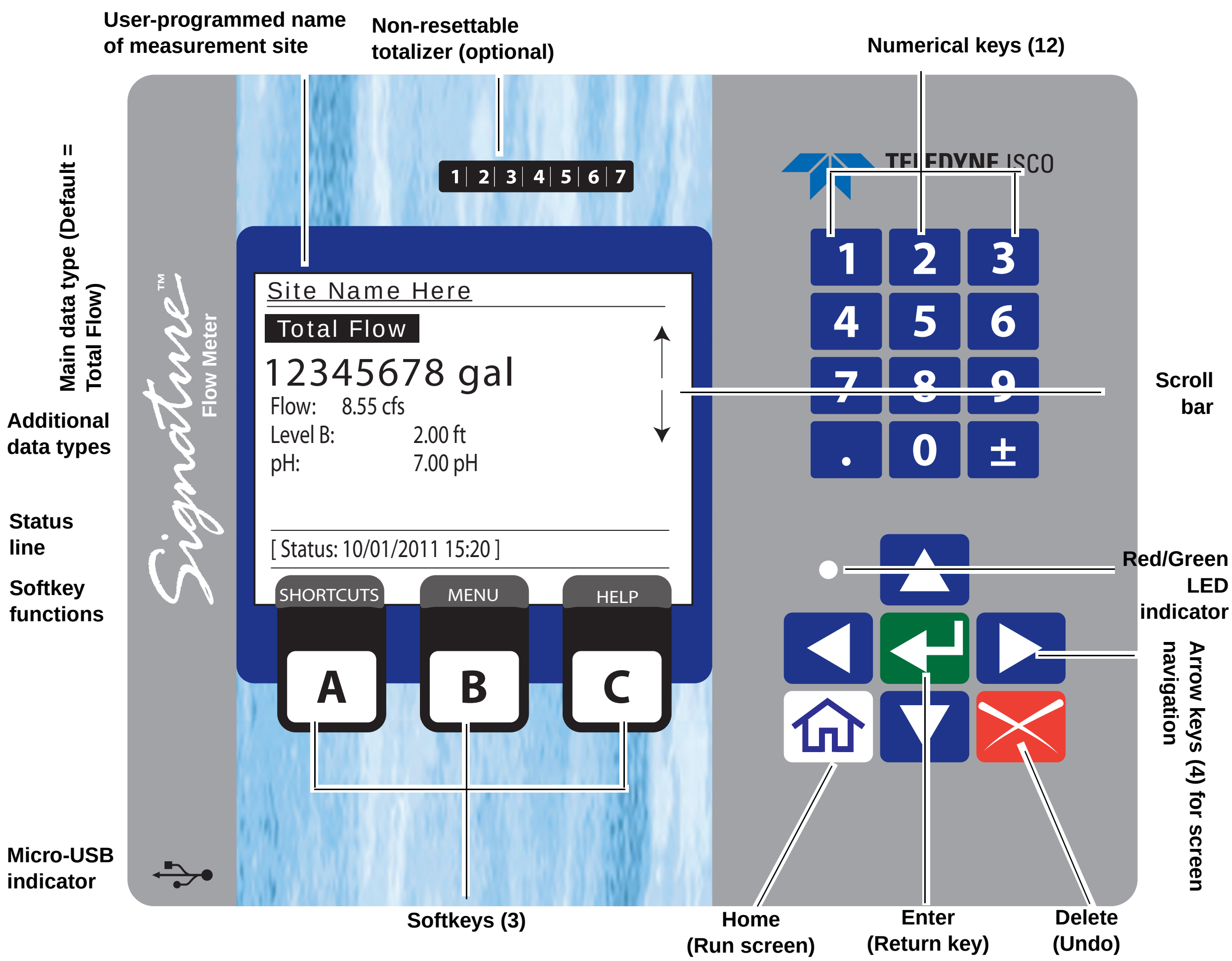


Figure 1-4 Home screen and basic keypad functions

Below the display are three software configured function keys (softkeys) that are used to make selections and navigate through menus. Their specific functions are dependent upon what operation you are performing, and will appear in the display window.

1.6.2 Display and LED

The LED on the front panel is aligned next to the Status line on the display screen.

- A green light indicates that new information is available for viewing in the Status line.
- A flashing green light indicates low power mode when the screen is off and data traffic on some channels.
- A red light indicates a warning or a user-defined alarm condition, with further details viewable by pressing the Alarm softkey (C).

Figure 1-4 shows the standard home screen, or run screen.

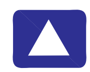
Displayed menus and programming steps are explained in Section 2 *Setup and Programming*.

1.6.3 Backlight and Screen

There is an option to turn off the backlight and screen.

1.6.4 Display Contrast

The contrast of the LCD screen can be adjusted using the keypad.

To adjust the contrast, hold down the ± key  and repeatedly press the down arrow  (softer) or the up arrow  (sharper) to achieve the desired appearance.

1.7 Technical Specifications

Table 1-1 provides technical specifications for the Signature Flow Meter.

Table 1-1 Signature Flow Meter Technical Specifications[a]

Size (HxWxD)	22.6 x 31.0 x 20.9 cm (8.9 x 12.2 x 8.2 in) with mounting bracket & external desiccator
Size with Portable Stand (HxWxD)	42.5 x 34.5 x 26.6 cm (16.74 x 13.58 x 10.48 in)
Weight	
Flow Meter, No Bubbler	Signature w/o options: 4.5 kg (10 lbs) Signature w/ all interior options: 4.9 kg (10.7 lbs) Signature w/ all int. options + mounted battery backup: 7.8 kg (17.3 lbs)
Bubbler Flow Meter	Signature w/o options: 5.9 kg (13 lbs) Signature w/ all interior options: 6.1 kg (13.5 lbs) Signature w/ all int. options + mounted battery backup: 9.1 kg (20 lbs)
Weight (Portable Signature)	Base Portable Signature w/ stand, TIENet Receptacle, DC Power Cable, Desiccator: 8.0 Kg (17.5 Lbs.) Optioned Portable Signature w/ Bubbler, stand, TIENet Receptacle, DC Power Cable, Desiccator, CDMA Modem, 3 option card, rain gauge: 10.1 Kg (22.3 lbs.) Includes antenna. Stand only: 3.9 Kg (8.7 lbs.)
Materials	
Housing	PPO Plastic (Noryl)
Window	Polycarbonate
Hardware	Stainless Steel

Table 1-1 Signature Flow Meter Technical Specifications[a] (Continued)	
Enclosure	NEMA4X/IP66
Power	100 to 240 VAC, 50/60Hz, 1.3A; Disconnect Device = Line Cord 12VDC (optional battery backup)[b] 12VDC 4.0A battery standalone power
Connections to Signature Flow Meter	
External TIENet devices	Bottom Cable entry, 1 to 4 position (3/4" NPT user-supplied conduit or optional cord grips); Pluggable screw terminals, 6-position;
Power supply	Screw terminal, Wire 14-22 AWG
Parameter inputs	Fixed terminals, 3-pin, Wire 14-30 AWG
Analog Input	Pluggable screw terminal, 3-position, Wire 14-30 AWG
Analog Output	Pluggable screw terminal, 3-position, Wire 14-30 AWG
Contact Output	Pluggable screw terminal, 3-position, Wire 14-30 AWG
Cellular Modems	Antenna Custom SMB connector
Ethernet	RJ-45 connector
330 Bubbler module	Internal, factory-installed
Flow Measurement Technologies	Ultrasonic (TIENet 310) Bubbler (TIENet 330) Laser Doppler Velocity (TIENet 360 LaserFlow) Continuous Wave Doppler Velocity (TIENet 350)
Flow Conversions	Weir, Flume, British Flume, Metering Insert, Manning Formula, Equation, LTF or LTA Data Points (up to 50 pairs), Area Velocity
Data Storage	Non-volatile flash; retains stored data during program updates. Interval: 15 or 30 seconds; 1,2, 5,15, or 30 minutes; or 1, 2, 4, 12, or 24 hrs Capacity: 8M (180 days with 5 parameters logged at 1 minute intervals, reports at 24-hour intervals)
Setup and Data Retrieval	Serial connection to PC via USB; Cellular or Ethernet modem
Ambient Temperature Range (Operation and Storage)	-20 to 60 °C (-4 to 140 °F)[c] NOTE — The operating ambient temperature range of the optional mechanical totalizer (see Section 5.3) is -10 to 60 °C (14 to 140 °F).
Optional Teledyne Isco Sampler Interfacing	TIENet 306 device Output: Flow pacing, Enabling on trigger Input: Event and bottle information
Optional 304 TIENet Contact Output:	
Switching modes	Normally open, Normally closed
Max Load	30 volts 1 amp
Isolation	Galvanic Isolation
Outputs per card	2
Optional 307 TIENet Analog Input:	Configurable either active (signature supplying loop power) or passive (relying on loop power, signature is not powering the loop).
Output voltage (in active mode)	17 VDC minimum
Range	4 to 20 mA
Isolation	Galvanic Isolation
Maximum Load	400Ω maximum (in passive mode at 20 mA)
Outputs per card	2

Table 1-1 Signature Flow Meter Technical Specifications[a] (Continued)

Optional 308 TIENet Analog Output: Range Isolation Maximum Load Outputs per card	 4 to 20 mA Monolithic Isolation 900Ω 2
Industry Standard Inputs	Two SDI-12, RS485 Modbus ASCII & RTU, 4-20 mA Analog
Industry Standard Outputs	4-20 mA Analog, Modbus ASCII & RTU
Rain Gauge Connection[d]	Fixed terminals, 3-pin, Wire 14-30 AWG
Communication Options	Direct USB Serial Connection, CDMA (1XRTT), GSM (GPRS), and Ethernet

a. All specifications are subject to change without notice.

b. Optional external power loss alarm available. Refer to Signature Power Loss Alarm Box in Appendix B, Section B.2 - Signature Flow Meter Accessories.

c. Older model 69-4303-024 Connector Case circuit boards limit Ethernet ambient range to +40 °C (104 °F)

d. Optional industry standard rain gauge connector 60-4304-055.

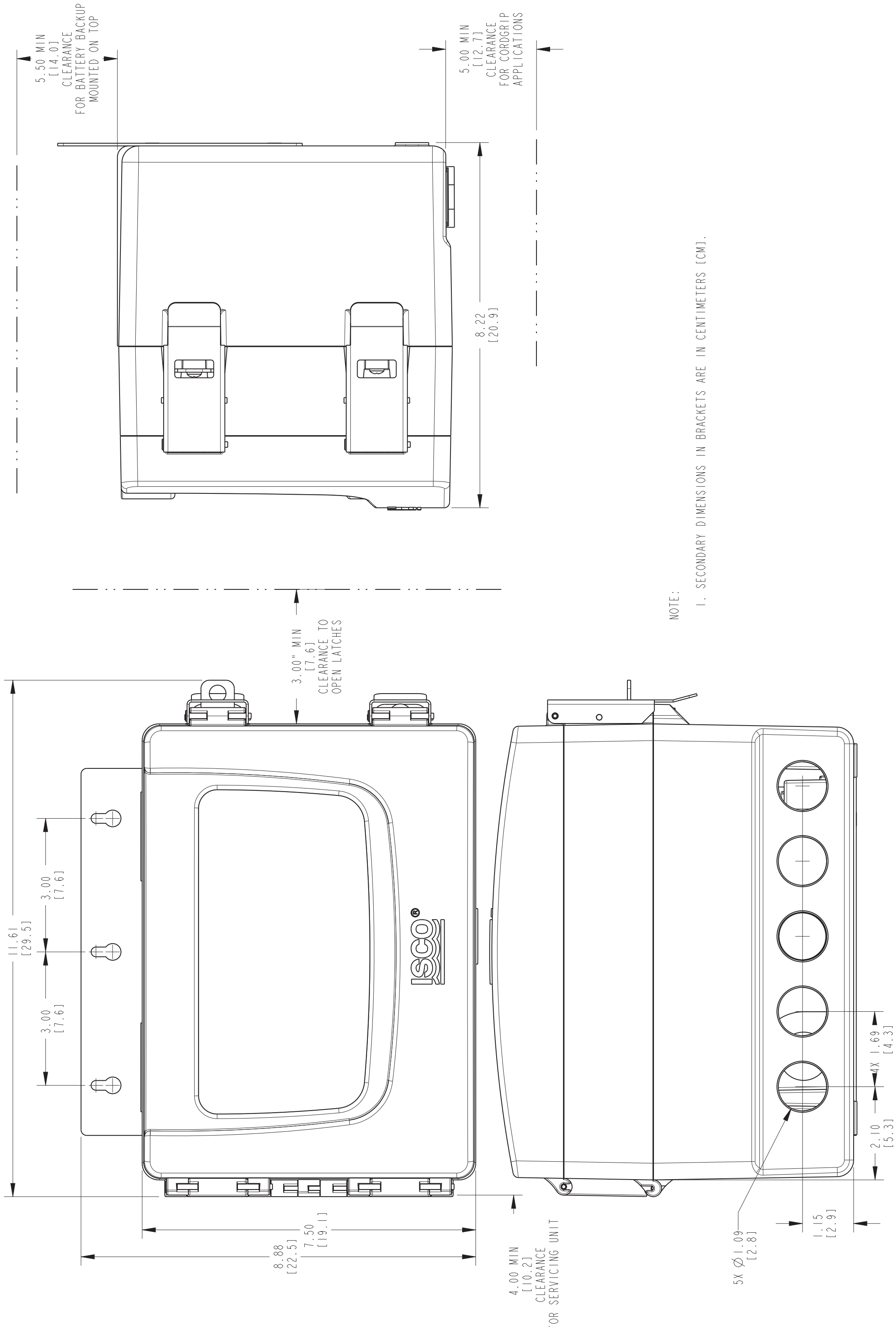


Figure 1-5 Specification drawing: Signature Flow Meter, 1 of 2

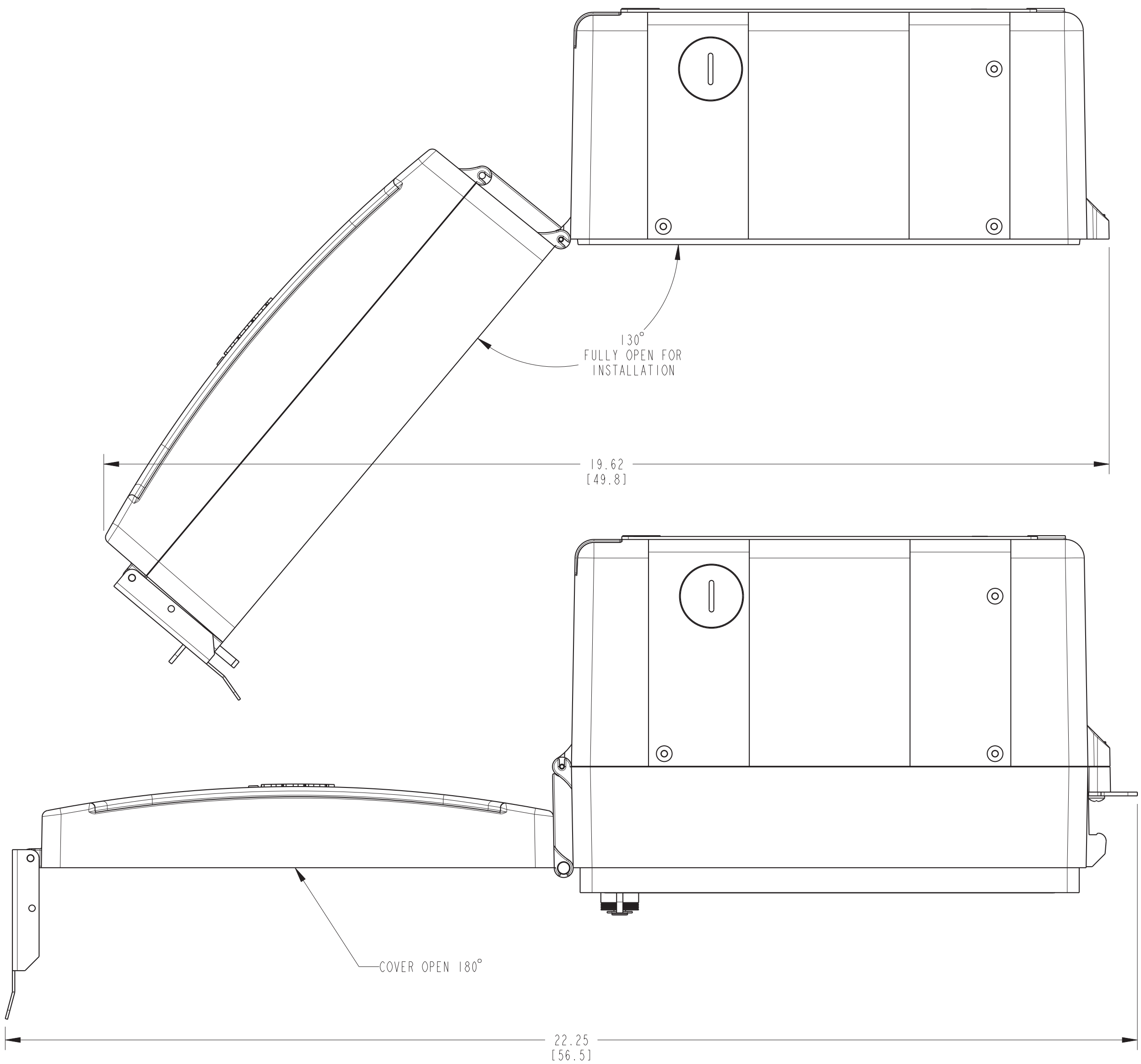
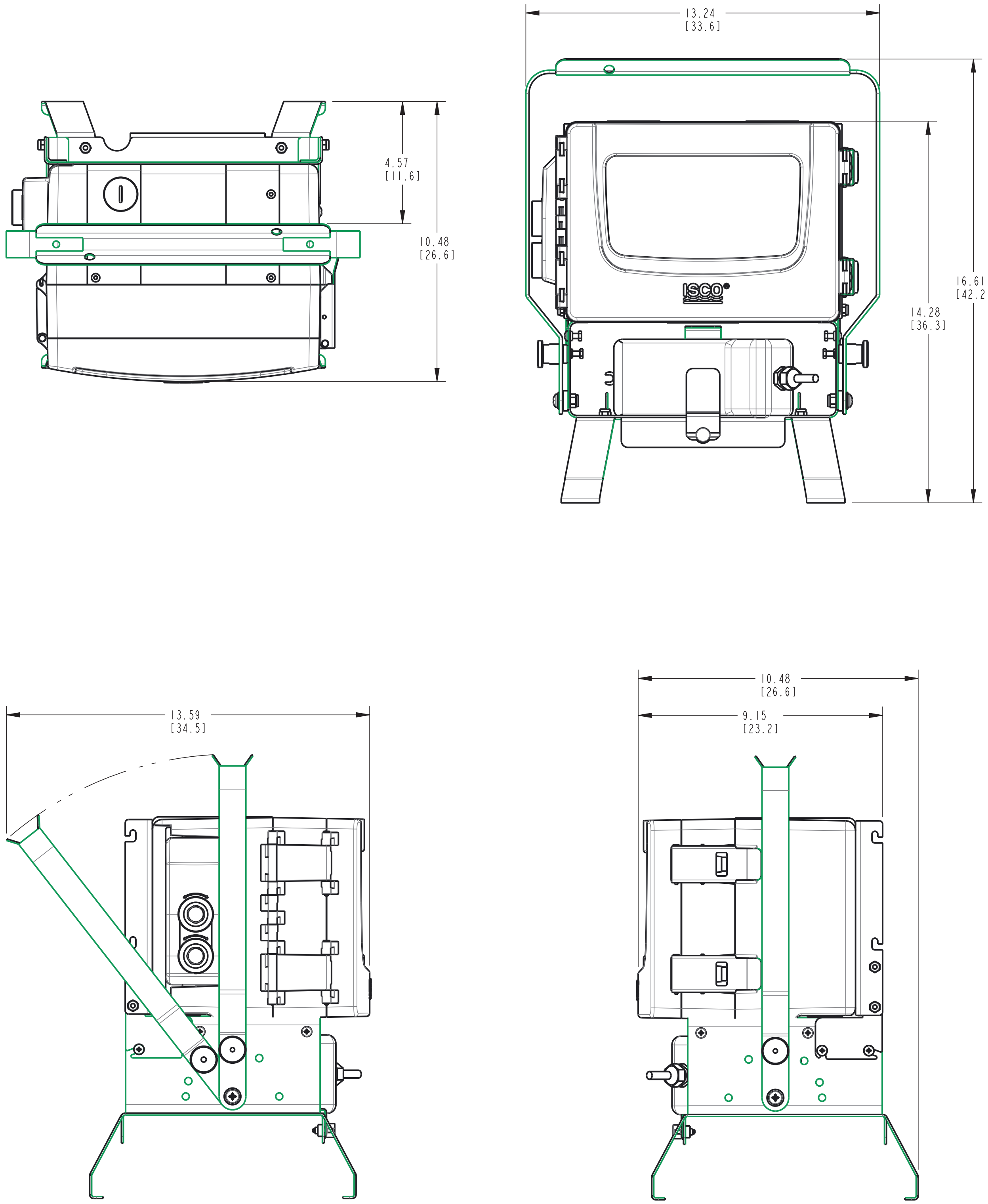


Figure 1-6 Specification drawing: Signature Flow Meter, 2 of 2


13.24
[33.6]
4.57
[11.6]
10.48
[26.6]
16.61
[42.2]
14.28
[36.3]
ISCO
13.59
[34.5]
10.48
[26.6]
9.15
[23.2]

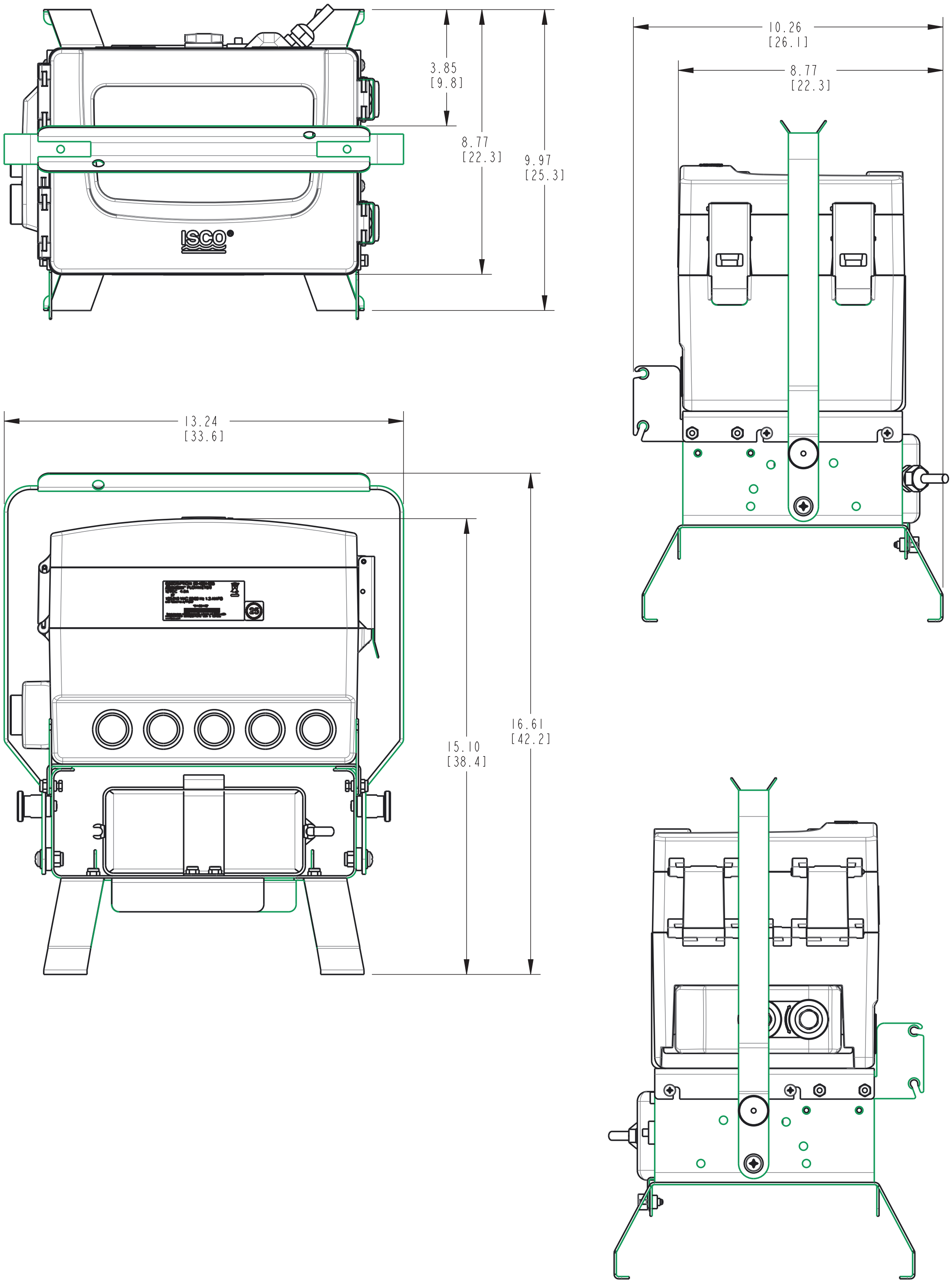

3.85
[9.8]
8.77
[22.3]
9.97
[25.3]
10.26
[26.1]
8.77
[22.3]
13.24
[33.6]
15.10
[38.4]
16.61
[42.2]
ISCO

Figure 1-7

Signature® Flow Meter

Section 2 Setup and Programming

The Signature Flow Meter is shipped from the factory with a default program already configured. The Signature Portable is shipped with different defaults than the Signature. Your particular installation will normally require different program settings, specific to your monitoring site and application.

This section of the manual explains the Signature's operating modes, and provides instructions for site setup and programming. Programming may be performed before transportation to the installation site.

2.1 User Interface

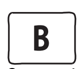
The Signature Flow Meter can be set up, programmed, and interrogated directly through the keypad and display screen, or remotely using a computer equipped with Teledyne Isco's Flowlink® software, with either a USB cable or optional modem.

The Signature Flow Meter has its own browser, accessed via Flowlink, that mirrors the physical keypad and display.

2.1.1 Keypad Functions

The following briefly explains the basic function of each key.


The numerical keys are for entering values during setup/programming.


The large softkeys (A, B, and C) perform whatever function is currently displayed above them. Note that pressing the BACK softkey (A) will discard any changes you have made without saving.


The arrow keys are for navigating to different areas on- and off-screen. The up/down arrows navigate a single line at a time.


From the home screen, the Enter key is used to adjust or configure the currently highlighted parameter.

From programming screens, the Enter key confirms selections and entries you have made, opens the setup/programming screen for a highlighted parameter, displays the character grid for alphanumeric entry, displays a calendar for date selection, or displays the pull down menu for a highlighted field.

☑ *Note*

Enter is for selection only. The NEXT softkey is for selection *and* advancement to a subsequent step.

 The home key returns the flow meter to the home screen from any other screen.

 The delete key clears the last character entry, exits a pull down list, or closes an open window.

 In addition to typing the decimal/period, this key can be used to navigate up one screen at a time.

 The ± key can be used to navigate down one screen at a time, and also to adjust screen contrast, when used with the up/down arrow keys.

2.1.2 Connecting to the Signature with Flowlink

With Flowlink software version 5.15.XX or later, you can set up, program, and download data from the flow meter through its browser. Connection between the flow meter can be direct, through the micro-USB assembly on the front panel, or remote, with an internal cellular or ethernet modem.

USB Driver for Signature

In order for your computer to connect to the Signature flow meter through the micro-USB assembly, you must have the correct driver installed. USB drivers for both 32-bit and 64-bit operating systems are included with your flowlink program.

To install the driver:

After installing Flowlink, navigate to its program directory, and then to the USB Driver folder, typically at C:\Program Files\Flowlink 5.1\USB Driver.

Here you will find two drivers:

4300Driver_x64.msi for 64-bit operating systems and 4300Driver_x86.msi for 32-bit operating systems.

Without the Signature connected to your computer, begin running the appropriate file for your operating system. When prompted, connect the Signature to your computer's micro-USB assembly. You should see a message in the lower right corner stating that new hardware has been found at the appropriate com port number.

Ensure that the Signature flow meter is connected to the computer before launching Flowlink.

Connect window

You can connect with the Connect window, or if you have connected with this site before, highlight the Signature site file in the workspace (left column in Flowlink) and select Item > Connect.

In the Connect window, select the Type of connection.

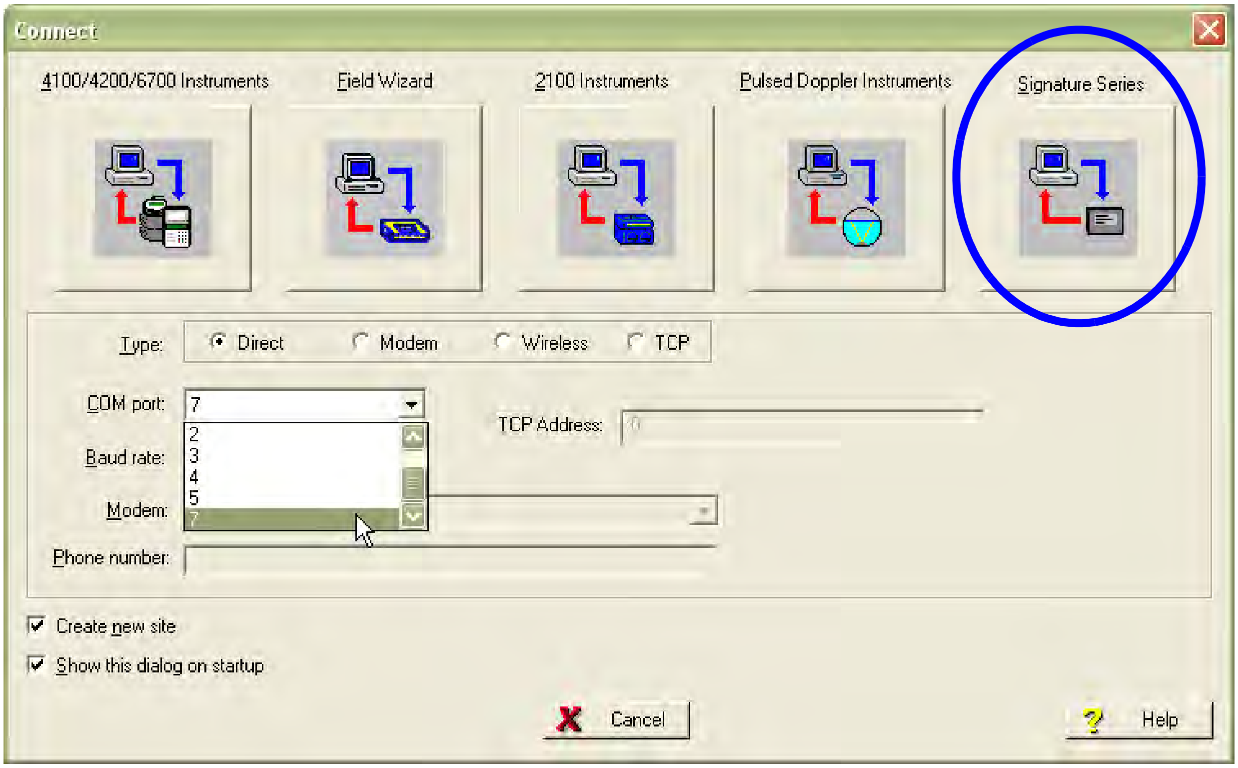
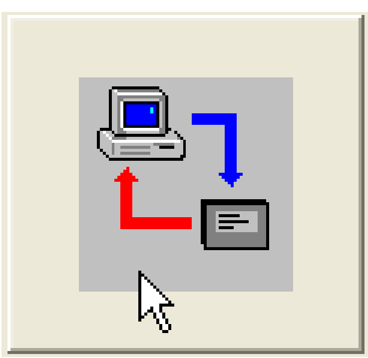


Figure 2-1 Flowlink Connect screen

Direct connection is made through the micro-USB assembly. From the COM Port pull down list, select the port associated with the Signature.

TCP connection is made from the computer to the Signature flow meter's optional CDMA, GSM, or Ethernet modem. Enter the correct static IP and port number, separated by a colon, the correct public domain address.



If you do not want the flow meter matched with an existing site in the database, select the Create new site check box. (If this is the first time the flow meter is connected to Flowlink, a new site will be created automatically.)

Then click the large button under the heading Signature Series.

Site Screen

The Signature site screen has three tabs:

Site Info contains information specific to this site. Enter all relevant information into the Site Info fields, including the desired Site Name, and save the information by clicking Apply.

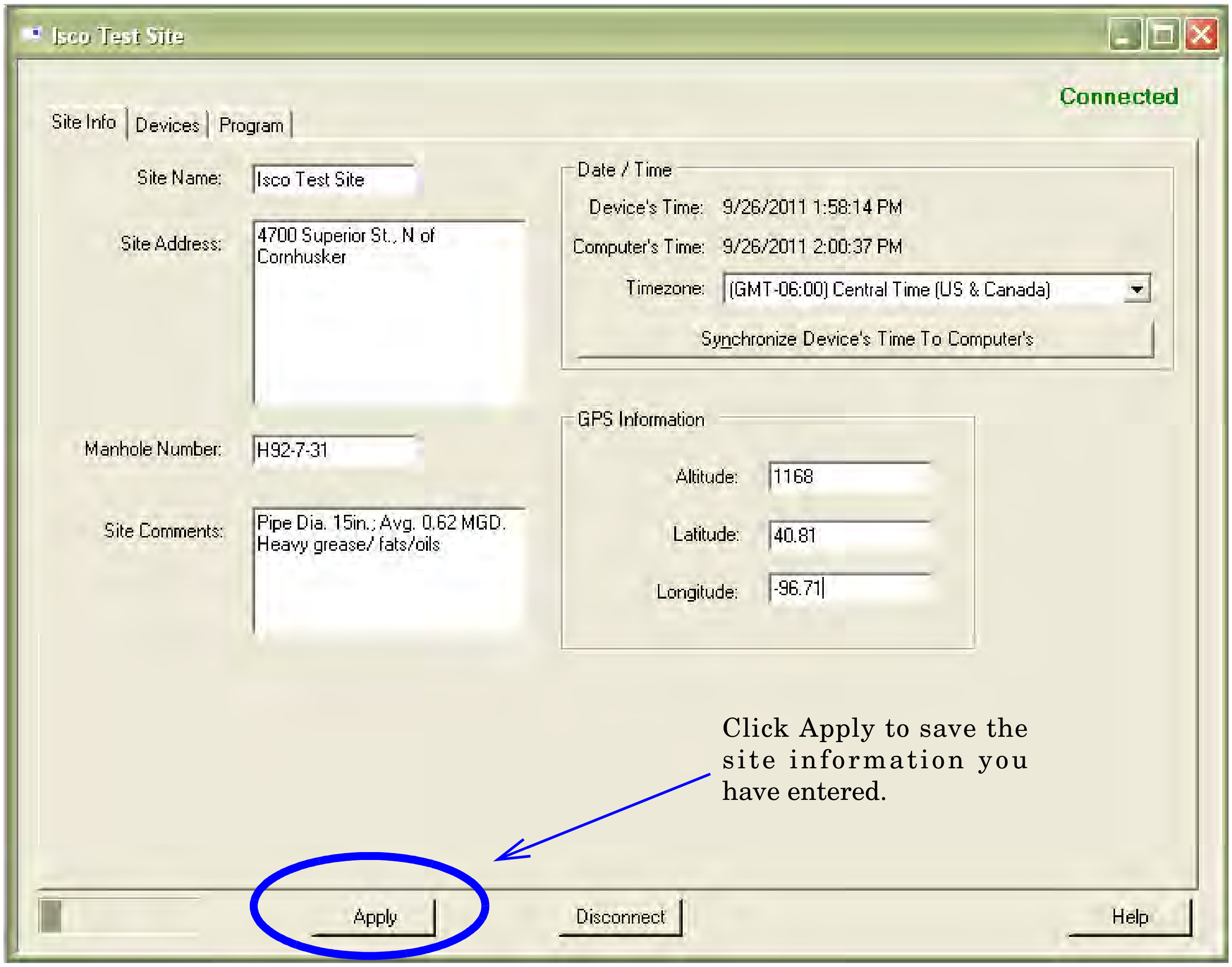


Figure 2-2 Site Info tab

Devices lists the name, software version, and hardware version of the flow meter for offline viewing of the site file.

This information, along with that of any connected TIENet devices, can be viewed from the specific flow meter's firmware (refer to *Sensor Diagnostics*, on page 2-31).

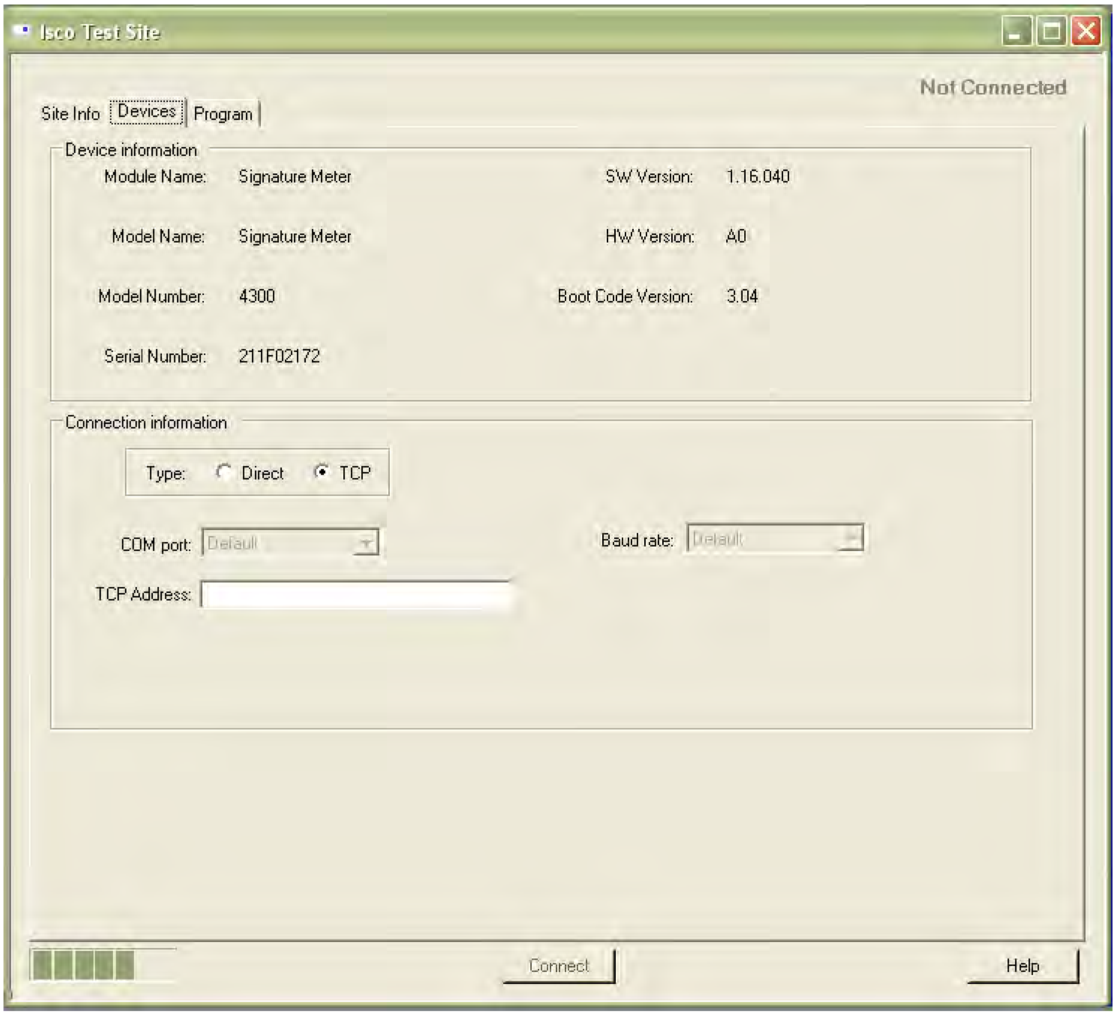
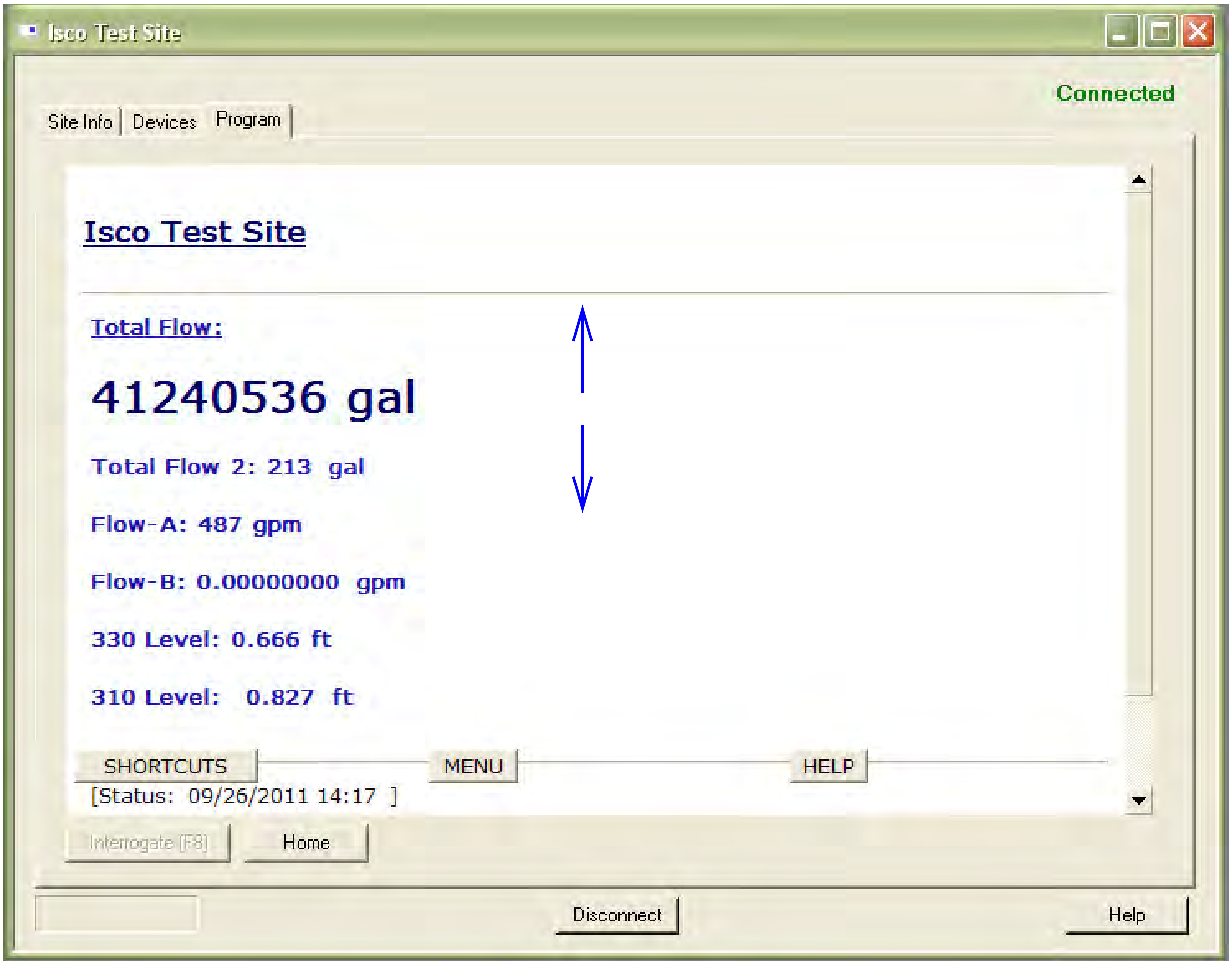
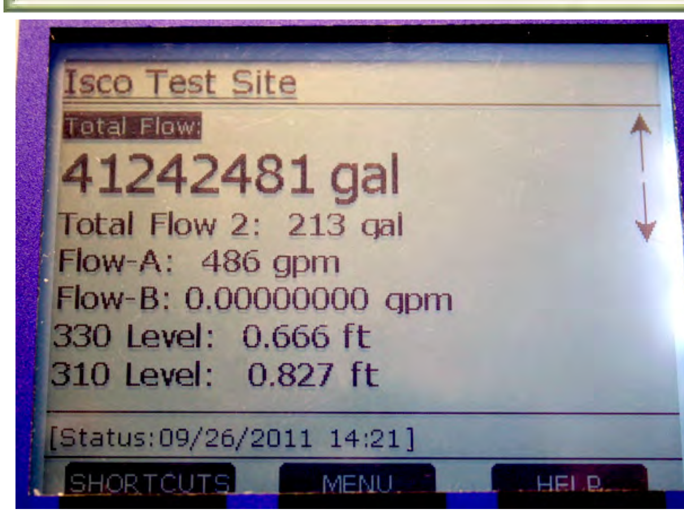


Figure 2-3 Devices tab

Program is the portal through which you access the Signature browser. The programming functions and displayed data in the browser are functions of the flow meter firmware, not Flowlink.





The Browser Window view (above) mirrors the Control Panel display (at left)

Figure 2-4   Program tab: Accessing the browser

2.2 The Home Screen

The home screen, or run screen, is displayed when the flow meter is in normal operating mode. This screen shows the current parameter readings and system status or alarm conditions.

A scroll bar on the right of the screen indicates there are more parameters off-screen that can be viewed by scrolling up or down.

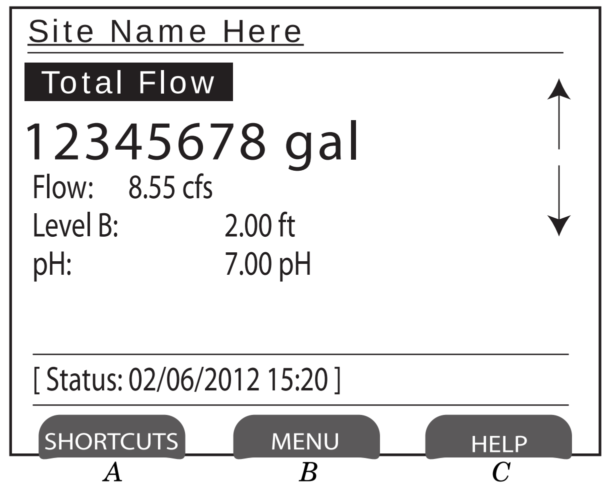


Figure 2-5   Home screen (normal operating mode)

2.3 Shortcuts

The Shortcuts menu provides quicker access to most commonly used commands, such as level adjustment or viewing data recorded over a period of time. Not all menu items described in this section will necessarily appear in your Shortcuts menu. The selections available in the Shortcuts menu are determined by what connected devices have been detected by the Signature flow meter. To access your shortcuts, press SHORTCUTS (A).

2.3.1 Adjust Level

To set a new level, enter the value in the field next to Level, and select Adjust. To update the current reading, select Update.

2.3.2 Adjust Velocity

This selection will open the velocity grid with current readings and laser controls for the TIENet LaserFlow velocity sensor. For complete information about this device, refer to the TIENet 360 LaserFlow user manual.

2.3.3 Purge

The Signature Bubbler flow meter allows you to manually purge the bubble line if an obstruction is suspected.

2.3.4 Histograph

The histograph displays the measurements taken of up to three selected parameters in graphical format, beginning at your selected date/time, and spanning one to 48 hours. Enter a value in the Threshold field for a reference line. The measurements available for graphing are determined by what measurements are set up for data storage.

2.3.5 Real-Time Measurement

The Real-Time Measurement will display the sensor/card options that are available. Once one is selected, a table will be displayed showing the different types of measurements the sensor/card is collecting.

2.3.6 Report View

Reporting is set up from the Configure Options menu. **Summary** displays summaries of data measurements (i.e., Min/Max/Avg). **History** tracks user and meter events. **Program** tracks changes made to the flow meter's program configuration.

2.4 Programming

To access the setup/program menus, press MENU (B).

When you press MENU, the four top menu options appear:

> *Hardware Setup* detects all devices connected to the flow meter, establishes proper communication with them, and allows configuration of each device.
>
> *Configure Options* sets up the measurement site and program parameters.
>
> *Administration* dictates operating preferences and perform general housekeeping tasks.
>
> *Home* returns to the home screen.
>
> Additionally,
>
> *USB Options* appears when a flash drive is connected to the micro-USB assembly in the lower left corner of the control panel.

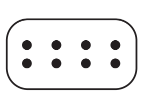
The program menus consist of steps and substeps. During programming, available subordinate menu content and steps will be determined by what you have previously entered, and what optional equipment is connected to the Signature flow meter.

2.4.1 Off-Screen Content

▲ ▼ ▲▼

An arrow in the lower right corner of the flow meter's screen (see symbols at left) indicates that there is additional content on this screen in the direction the arrow is pointing. Use the arrow keys to access this content.

2.4.2 Character Grid



A small grid icon in the lower right corner of the flow meter's screen (see symbol at left) indicates that the character grid is available.

Whenever you need to enter characters, such as letters, numbers, or punctuation, press Enter to display the character grid (Figure 2-6).

Use the arrow keys to navigate to the desired character and press Enter to select. When you are finished editing, select DONE and press Enter.

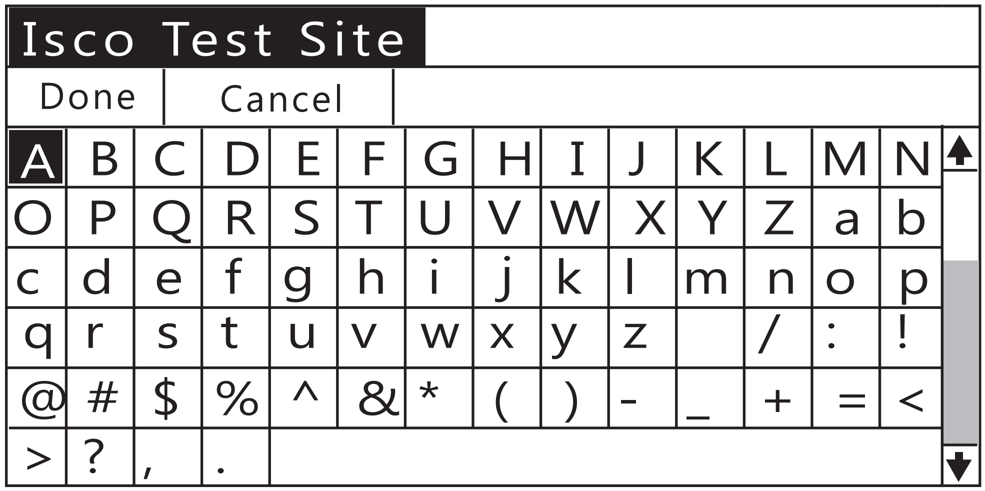
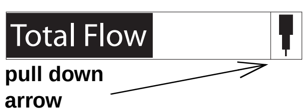


Figure 2-6 Character grid

2.4.3 Pull Down Menus



Fields with a pull down arrow next to them (see example at left) indicate a pull down list. Use the arrow keys to navigate between fields on the screen; when you highlight a pull down field, press Enter to display the items on the list. Then use the arrow keys and Enter to select from the list.

2.5 Program Steps (Menu Trees)

The program steps in Figures 2-7 through 2-22 show the overall menu sequencing.

An explanation of each program step, and information specific to connected devices, is provided in Sections 2.6 *Hardware Setup*, 2.7 *Configure Options*, 2.8 *Administration*, and 2.9 *USB Options*. This information can also be viewed by pressing the Help softkey on your Signature flow meter or its browser screen.

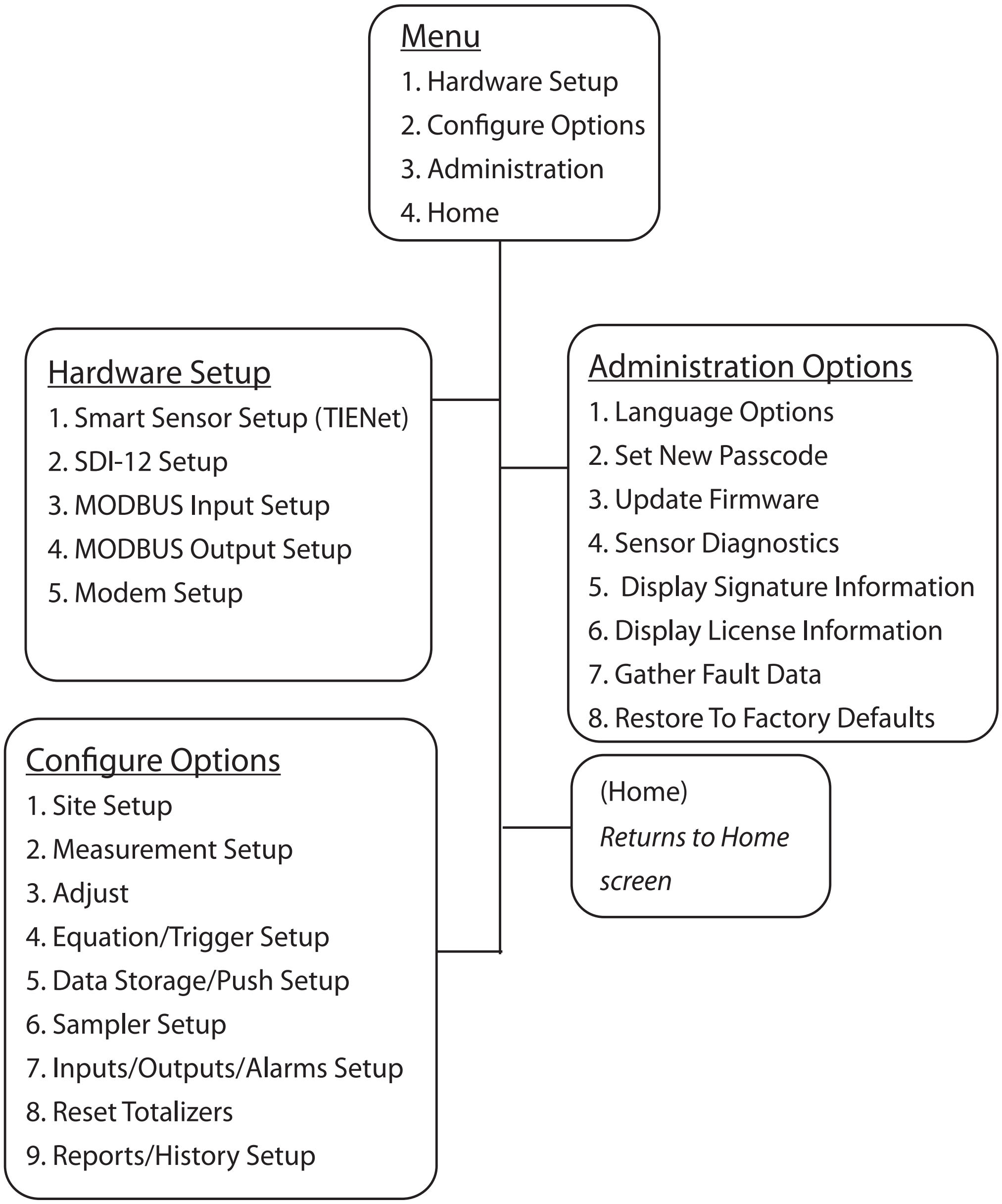


Figure 2-7   Menu Tree: Top menu

2.6 Hardware Setup

From the Hardware Setup menus, the flow meter detects and configures all connected devices.

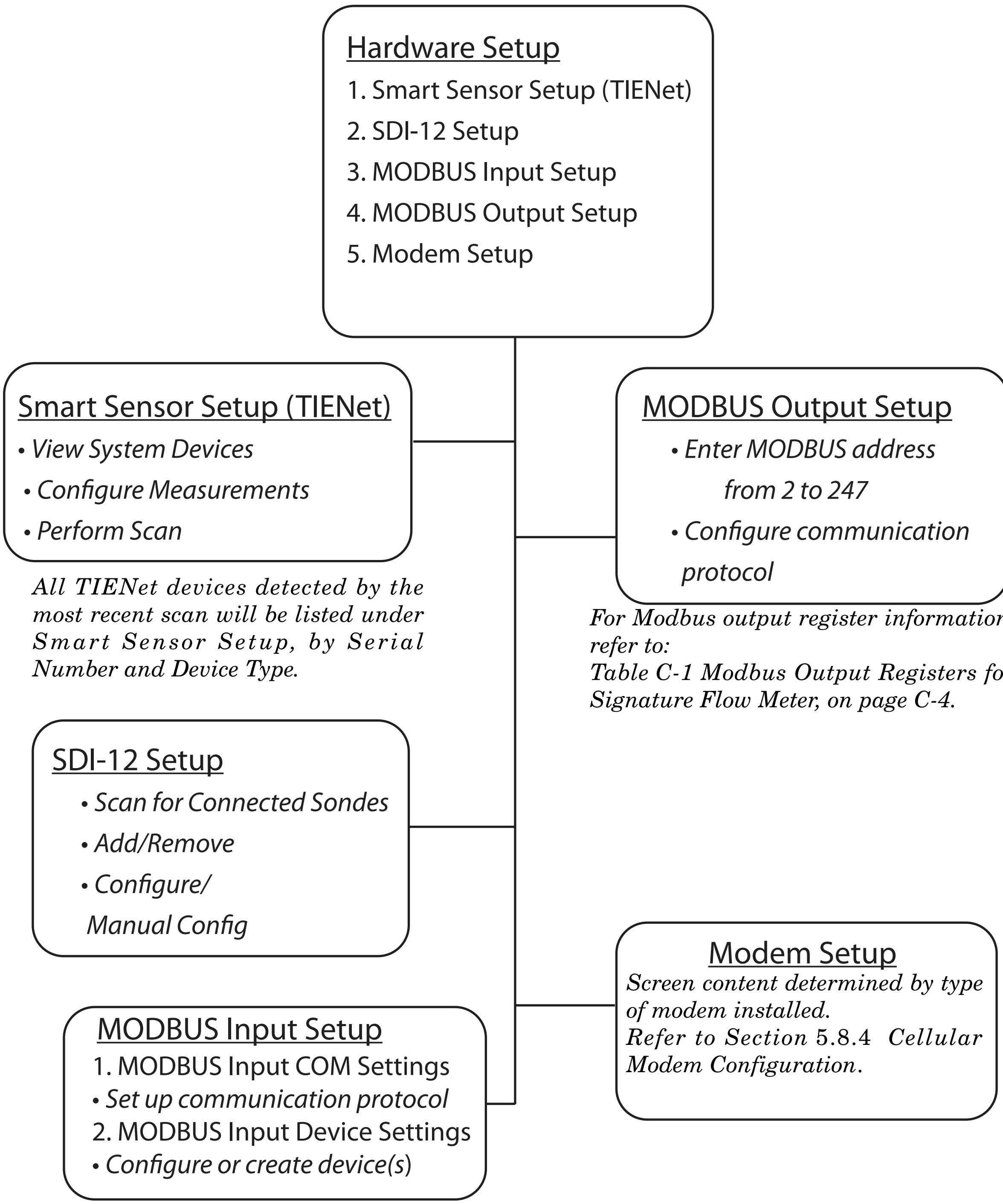


Figure 2-8 Menu Tree: Hardware Setup

2.6.1 Smart Sensor Setup (TIENet)

This selection will display the most recently detected TIENet devices connected to the Signature flow meter.

Perform Scan

If TIENet devices have been added or removed from the system, highlight Perform Scan and press Enter to detect the current system configuration.

Sensor Differences

If there are any differences in the device configuration since the last scan, a list of Sensor Differences will appear.

Missing Sensors – The Missing Sensors list will indicate any previously connected devices that are no longer detected. Select **Retain** to keep the identification information for a previous device; select **Remove** to delete it.

Replaced Sensors – The Replaced Sensors list displays any newly added sensors that have replaced Missing Sensors that have been Retained.

Additional Sensors – Displays any newly detected devices.

Following a scan, selecting NEXT from Sensor Differences will navigate to Configure Measurements.

Configure Measurements

Navigate to Configure Measurements to begin setting up measurement parameters for each TIENet device detected.

To activate a measurement, highlight the radio button next to it and press Enter. To change the name of the measurement, highlight the name and press Enter.

Regardless of what you name them, the measurement parameters for each device remain the same. For your reference, Figure 2-9 on the following page shows the position of each measurement for each type of TIENet device.

300 Case Board:

- Input Voltage
- Sense Voltage
- Charge Voltage
- Charge Current
- Case Humidity
- Reference Humidity
- AC Power
- Rainfall
- Case Temperature

301 pH / Temperature Device:

- pH
- Temperature

304 Contact Output:

- 304 Digital Output
- 304 Digital Output-

306 Sampler Interface:

- Sample Event / Bottle #
- Input Voltage

307 Analog Input Card(s):

- Analog Input
- Analog Input-A

308 Analog Output Card(s):

- Ch1 Current (Amps)
- Ch1 Percent of Scale (%)
- Ch2 Current (Amps)
- Ch2 Percent of Scale (%)

310 Ultrasonic Level Sensor:

- Distance
- Ultrasonic Level
- Air Temperature
- Signal Strength

330 Bubbler Level Sensor:

- Bubbler Level
- Bubble Air Humidity

350 Area Velocity Sensor:

- Level
- Sense Voltage
- Vel Spectrum Ratio
- Velocity
- Temperature
- Velocity Spectrum
- Velocity Signal

360 LaserFlow Sensor:

- Distance
- Ultrasonic Signal
- Case Temperature
- Air Temperature
- Velocity
- Sense Voltage
- X-Axis
- Laser Temperature
- Doppler Power
- Laser Diode Current
- Y-Axis
- Level
- Window Temperature

Figure 2-9 Measurement parameters for each TIENet device

2.6.2 SDI-12 Setup

Sondes detected since the last scan are displayed, with the activated sondes in the top box. If SDI-12 devices have been added or removed from the system, select Scan to detect the current system configuration. Following the scan, add/remove sondes from the Active list by selecting the sonde and clicking Add or Remove. To begin using an Isco-Ready sonde with its configured parameters, select Configure.

2.6.3 Modbus Input Setup

Connect the external Modbus input device at one of the three TIENet terminal connectors on the Signature case board as described below:

Modbus In
D1 = Yellow (+)
D0 = Brown (–)
Gnd = Black

Table 2-1 on the following page provides an example of Modbus settings for a connected DGH analog converter. The letters in the left column correspond to the entry fields shown in Figures 2-10 and 2-11.

The **multiplier** and **offset** are used to scale the raw number coming from the Modbus register(s) to represent the data in the units of measure you specify, as expressed in the following equation:

H in units of measure = (register value * **J**) + **K**.

In this example, the current input represents a flow rate where:

4mA = 0cfs, and 20mA = 10,000cfs

The D1252M documentation states that it produces a register value of 0 at 0mA, and 65535 at 25mA. This means that at 4mA the register will report 10485, and at 20mA it will report 52428.

The multiplier (J) is calculated as follows:

10,000/(52428 – 10485) = -2500

Before setting up the Modbus input function, it is recommended that you print Table 2-1 and use the empty columns provided on the right to fill in your own Modbus information.

	Examples:		**Table 2-1 Modbus Setup Worksheet**			
	Manufacturer	DGH	Manufacturer		Manufacturer	
	Model	D1252M	Model		Model	
A	Protocol (ASCII/RTU)	ASCII	Protocol (ASCII/RTU)		Protocol (ASCII/RTU)	
B	Baud Rate	9600	Baud Rate		Baud Rate	
C	Data Bits	8	Data Bits		Data Bits	
D	Parity	None	Parity		Parity	
E	Stop Bits	1	Stop Bits		Stop Bits	
F	Device Name	D1252M	Device Name		Device Name	
G	Address	11	Address		Address	
H	Parameter	Flow Rate X	Parameter		Parameter	
I	Address[a] (Register)	30001	Address (Register)		Address (Register)	
J	Multiplier[b]	.238422	Multiplier		Multiplier	
K	Offset[b]	-2500	Offset		Offset	
L	Byte Order[c] (Endian)	Little	Byte Order (Endian)		Byte Order (Endian)	
M	Data Size (Format)	Unsigned Word	Data Size (Format)		Data Size (Format)	
N	Data Type	Flow Rate	Data Type		Data Type	
O	Units	m^3/s	Units		Units	

a. For 2100 update interval in seconds must be written to register 26.
b. For assistance in calculating a multiplier and offset, contact Teledyne Isco.
c. Big Endian = Most significant register first; Little Endian = Least significant register first.

To begin configuring Modbus communication protocol and devices, select MODBUS Input COM Settings and use the pull down menus.

Add/Edit Device

Select Modbus Input Device Settings. Enter the device name, and the device address. For Request Timeout, enter a connection retry interval in milliseconds, and the number of attempts before a connection failure is determined.

Configure Modbus communication protocol using the pull down menus. To add/edit parameter(s) for the device, select Edit Parameters.

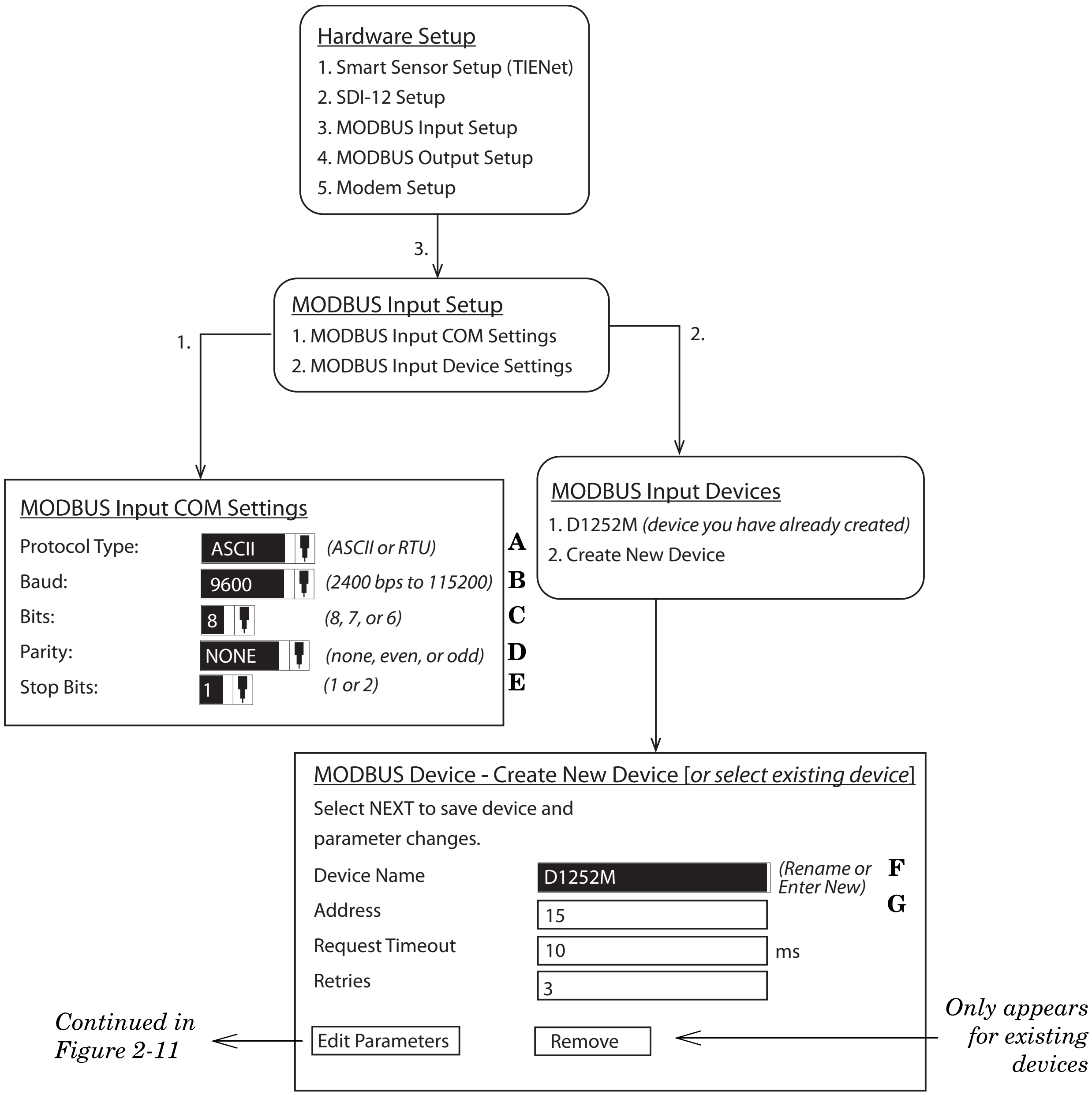


Figure 2-10 Modbus Input Setup

> **☑ Note**
> External Modbus RTU devices cannot use addresses 1 through 10.

Add/Edit Parameters

Select an existing parameter to edit, or select Add to add a new parameter for the device. Enter a name (such as a data type), and the register address. Use the pull down menus to select other parameters.

Select Little if a multiple register parameter has the low-order data in the first register; select Big if high-order. Select data size. The available Units of Measure are determined by the data type you select.

If necessary, enter a Multiplier and Offset so the register reports a value in the units specified.

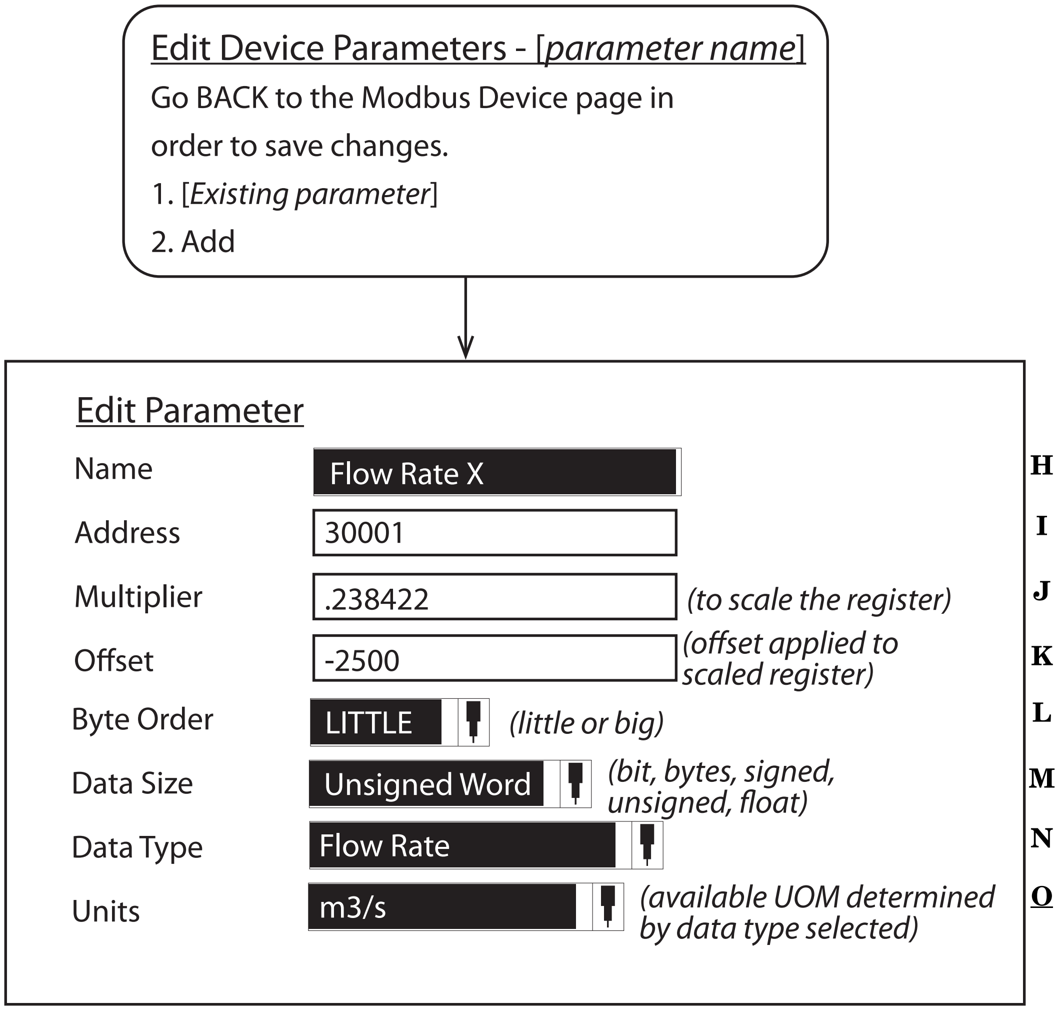


Figure 2-11 Editing Modbus device parameters

2.6.4 Modbus Output Setup

The Modbus RS-485 output function enables a SCADA system to retrieve site data from the flow meter. Connection to the flow meter is made via the RS-485 terminal on the Signature case board (shown in Figure 2-12 below).

In the **Device ID** field, enter the Signature's address (from 2 to 247) and configure the communication protocol.

⚠ CAUTION

Be careful not to assign the same address to more than one flow meter.

For Modbus data register numbers and definitions, as well as a general explanation of Modbus output protocol, refer to Table C-1, in Appendix C *Modbus Output Protocol*.

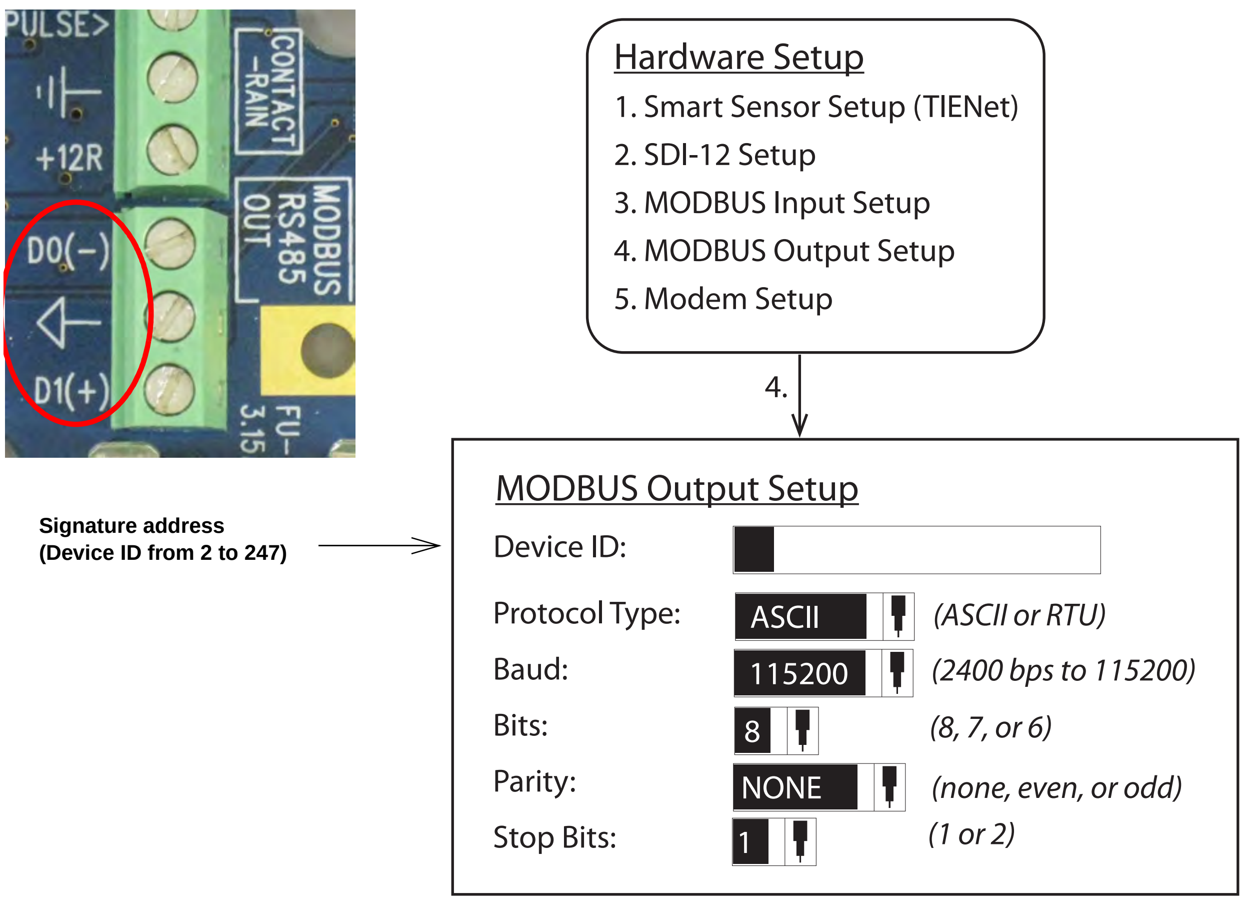


Figure 2-12 Modbus Output Setup

2.6.5 Modem Setup

The menu choices displayed for modem setup depend on which modem option is installed in the flow meter. For detailed information about installation and operation of Ethernet, GSM, and CDMA modems, refer to Sections 5.7 *Ethernet Modem* and 5.8 *Cellular Modems*.

2.7 Configure Options

The Configure Options menu is used for setting up the measurement site and setting the program parameters.

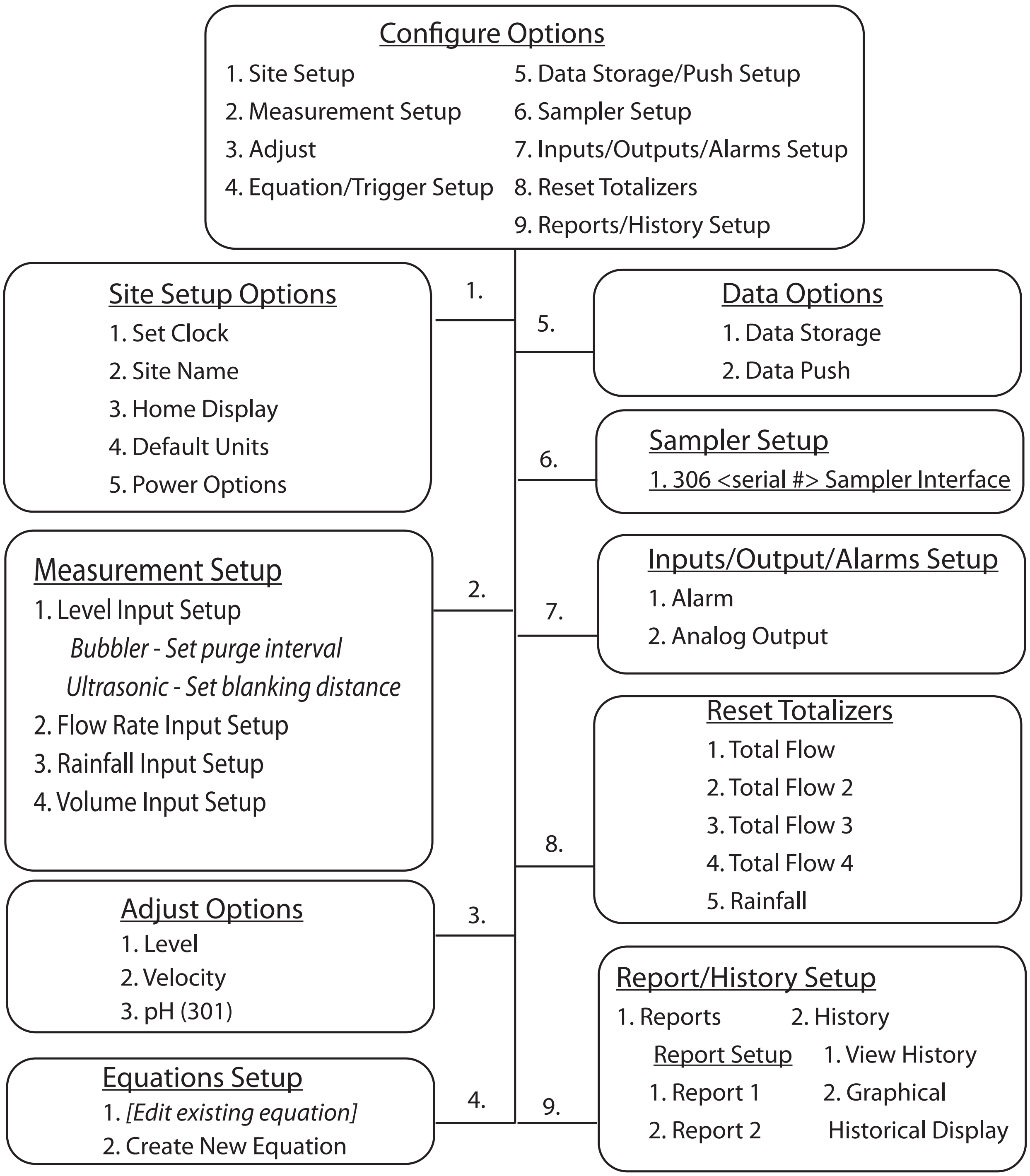


Figure 2-13 Menu Tree: Configure

2.7.1 Site Setup

The Site Setup menu sets some basic operating characteristics specific to the site.

Set Clock – Enter Year, Month, Day, Hour, Minute.

Site Name – Press Enter to display the character grid. Select one character at a time to create the desired site name.

Home Display – The Home Display determines how current measurement data is displayed on the Home screen.

From the Measurements Setup screen, select all measurement parameters to be displayed. The parameters available in the pull down menus will be determined by what devices are connected to the Signature meter.

Default Units – To set units of measure for each parameter, first select the parameter from the menu list.

The available units of measure that appear will be determined by the parameter you have selected. Under Units, highlight the units of measure and press NEXT. When finished, press NEXT again to save and exit.

Power Options – There are two power options:

- Display: will allow you to shut off the backlight and the screen.
- Low Battery Cutoff: will allow you to adjust the low battery cutoff. Refer to Section 4-4 for more power information.

2.7.2 Measurement Setup

This menu is for setting up the level measurement (Level Input Setup), flow conversion (Flow Input Setup), and flow volume totalizer(s) (Volume Input Setup). Menu items that appear are dependent on what equipment is connected to the Signature flow meter.

Level Input Setup – Under Level Setup, select the level input. Usually there will only be one listed, unless your system is using more than one level measurement device.For the TIENet 310 ultrasonic sensor, the minimum blanking distance refers to the maximum water level, and the maximum blanking distance refers to zero water level in the channel. For detailed instructions about 310 setup, refer to the TIENet 310 Installation and Operation Guide.

Flow Rate Input Setup – Measurement settings and flow conversion are programmed for the flow rate(s) from this menu (refer to Figure 2-14 on the following page). If more than one flow rate data set is being calculated, these settings are programmed separately for each one.

1. Select the flow rate to configure or select "Add Flow Rate" when two or more flow rates are present. Adding a flow rate enables calculation of flow rates dependent on condition. The flow rate also allows for configuring standard flow conversions from level inputs (e.g. level from Analog Input).
2. For level-to-flow conversions, from Measurement Settings, select the Level Input to be used in the flow calculation and the Measurement Rate (interval). Enter the name for this flow rate.

3. Select the flow conversion type to be used (Weir, Flume, Metering Inserts, Manning Formula, Area Velocity, Equation, or Data Points); then set up the conversion.

Note

Additional information about flow conversions can be found in the *Isco Flow Measurement Handbook* included with the Signature Flow Meter.

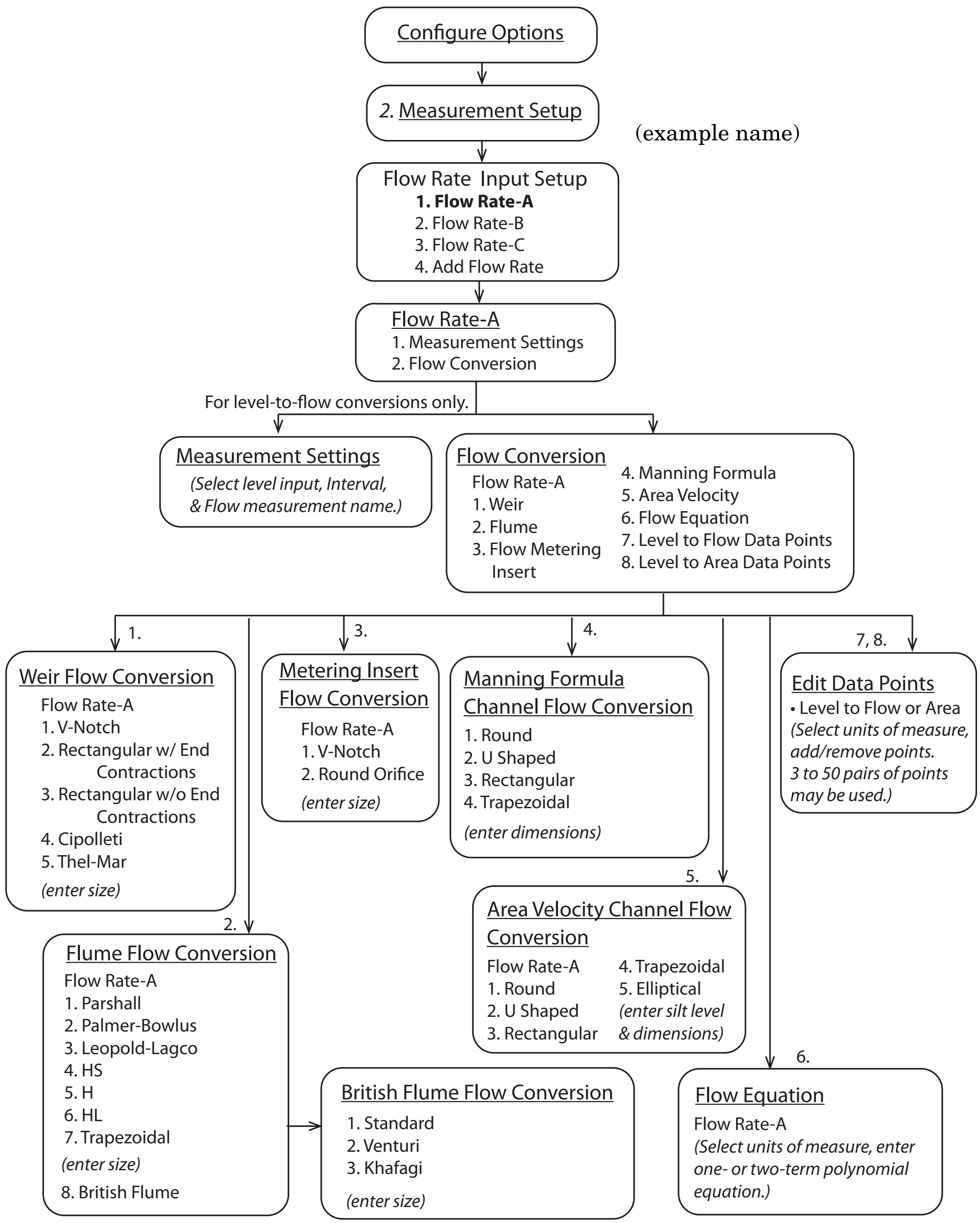


Figure 2-14 Menu Tree: Flow rate input setup

Volume Input Setup – You can set up one to four Total Flow measurements. Select the flow rate(s) used for total volume, the totalizing method (Net, Positive, or Negative), and the interval at which the total flow will be updated (between 30 seconds and 24 hours).

From the Resolution pull down menu, select the degree of resolution required for your total flow (lower = fewer digits to right of decimal; higher = more digits to right of decimal).

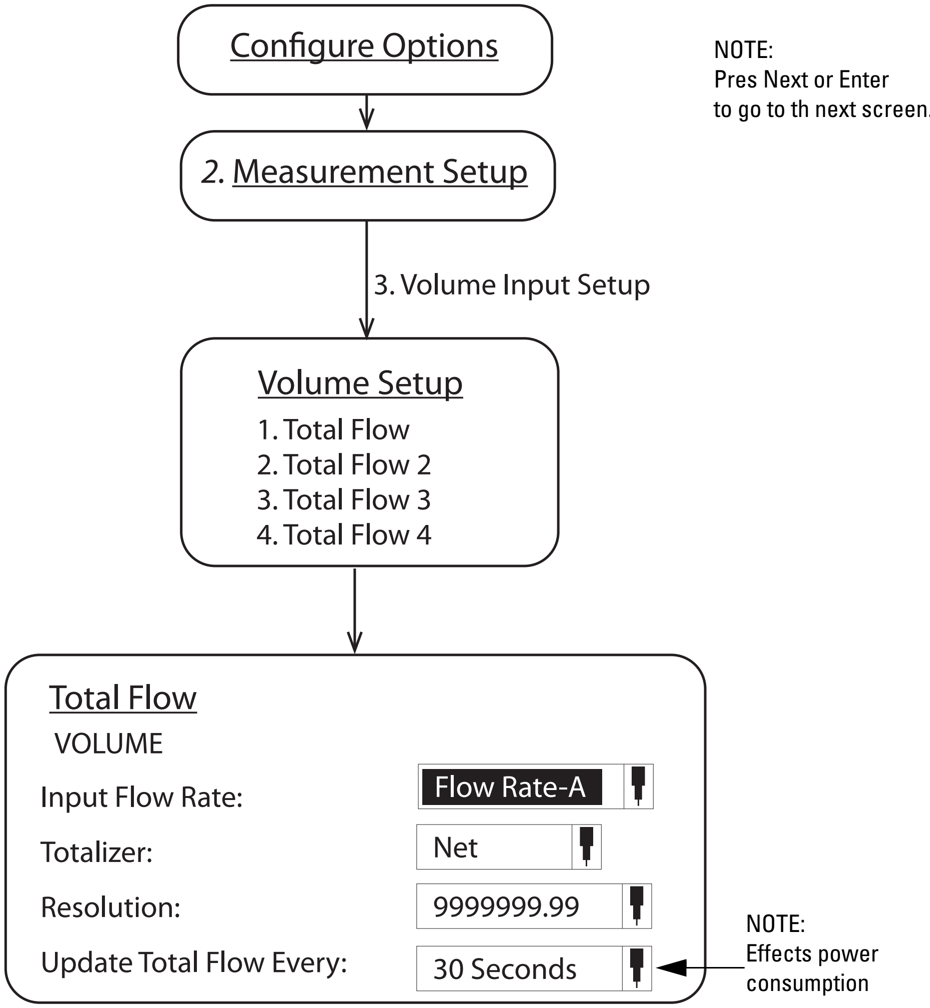


Figure 2-15 Menu Tree: Volume Input Setup (total flow)

Rainfall Input Setup – This option allows you to setup the per tip options for the rain gauge. The Automatic roll-over can be set to the time of day the rollover occurs. Once this number is reached, the roll-over will go back to zero.

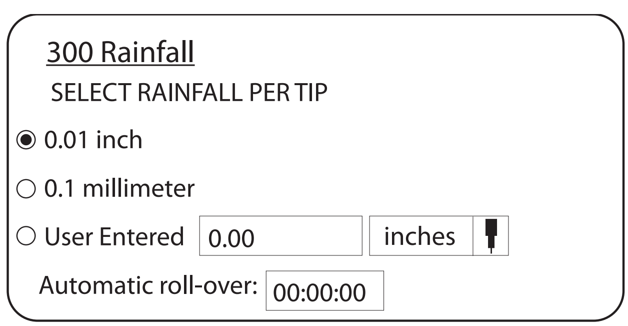


Figure 2-16 Menu for Rainfall Input Setup

Load Calculation Setup – This option allows you to setup the .....

Figure 2-17 Menu for Load Calculation Setup

2.7.3 Adjust

Adjust levels and/or velocity measurement, and/or calibrate measurement values for other connected TIENet devices. Level adjustment instructions can be found in Section *Setting the Level*, on page 3-14.

> **☑ Note**
>
> For detailed instructions on calibration of a connected TIENet 301 pH device through this menu selection, refer to the 301 user manual.

> **☑ Note**
>
> For detailed instructions on laser velocity measurement setup through this menu selection, refer to the LaserFlow (360) user manual.

2.7.4 Equation/Trigger Setup

Conditions are sets of site-specific, user-defined parameters. Refer to Figure 2-18 on the following page.

Equations are created from various site conditions that can be used to generate alarms, log or push data at secondary rates, trigger a connected sampler, or conserve power by turning on equipment only when needed.

Types of conditions

There are five types of conditions provided:

Range – TRUE when a measured parameter value is inside or outside specified upper and lower limits.

Rate of Change – TRUE when a measured parameter changes by a specified amount over a specified time duration.

Sensor Error – TRUE when a sensor error is present for a specified time duration.

Threshold – TRUE when a measured parameter reaches or exceeds a user-defined setpoint.

Time Table – TRUE when the flow meter's internal clock is within a defined time duration. This may be a weekly, daily, or specific one-time stop/start time.

Rain Event – TRUE when threshold is met over a period of time. Meeting threshold during the dry period will reset the Dry Period timer.

Defining conditions

To define a condition:

1. Highlight the desired condition in the lower left corner of the screen (Conditions A-F).
2. Highlight Edit Condition and press Enter.
3. Scroll down and press Enter to select the type of condition (listed above). Press NEXT to go to the configuration screen for that condition type. Press NEXT when complete.

The condition in the left-hand corner of the screen will now show the condition type.

Building equations

Build or modify the equation by navigating to the desired conditions and operators. Highlight Select Condition and press Enter again to add it to the equation. Press Enter to add a highlighted operator.

Press NEXT when complete.

Measurement Interval

When the screen is off and measurement interval is less than the data storage rate, the readings will be averaged and the battery life will slightly decrease.

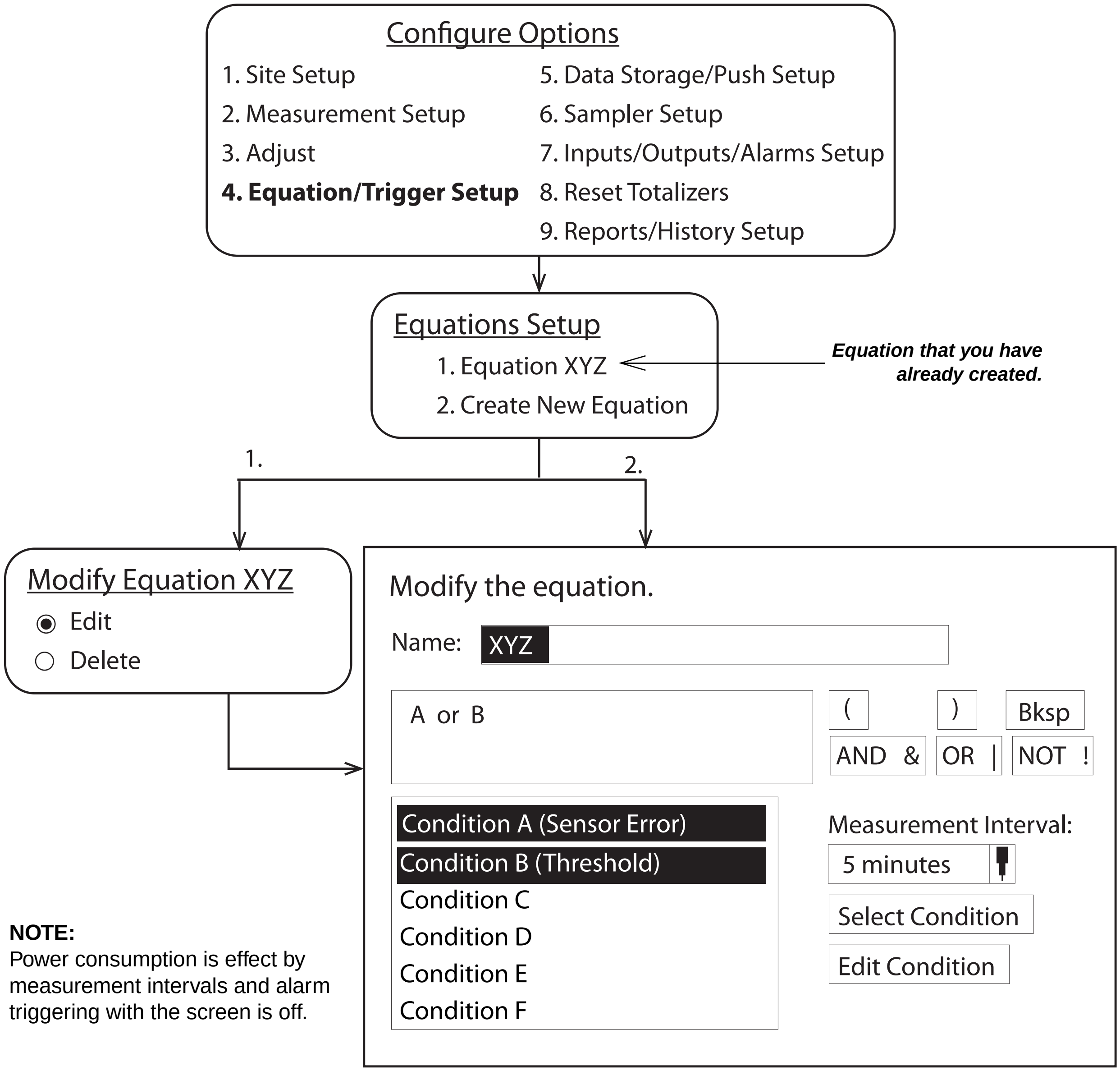


Figure 2-18 Example of defining conditions & building equations.

2.7.5 Data Storage/Push Setup

Data Storage – Set up data storage rates for a group of measurements, or separately for individual measurements. Scroll to the bottom of the screen to set up the primary storage rate, and a secondary one, if needed, with its trigger equation.

The display can be turned OFF and ON in the configure options, site setup, and power options menu. Turning the display OFF effects the way the data is recorded by the Signature meter.

- When the display is ON the Signature takes an average of the measurements over the data storage interval and records it.
- When the display is OFF the Signature takes a reading at the reading interval set in the data storage screen (no average is taken) unless alarms, triggers, or secondary measurements are active.
- When the display is OFF and if alarms, triggers, or secondary measurements are set up and the intervals are shorter than the data storage rate, the readings recorded by the meter will be an average of readings taken when the alarms, triggers, or secondary measurements were taken.

Data Push – Set up the flow meter to push data to a server running Isco Flowlink Professional software (internal modem required).

2.7.6 Sampler Setup

Program the flow meter to trigger and pace a sampler, and receive sampling information from the sampler.

> **☑ Note**
>
> For detailed instructions on configuring a connected TIENet 306 Sampler Interface through this menu selection, refer to the 306 user manual.

2.7.7 Inputs/Outputs/Alarms Setup

Alarm – Configure Local, SMS text, or Server alarms based on user-defined site conditions. Under Alarm, select an alarm from the list or set up a new alarm.

Next, select an Alarm Trigger from the pull down list.

> **☑ Note**
>
> The trigger(s) listed in the Alarm Trigger pull down list consist of equations you have already created based on your defined site conditions (refer to Section 2.7.4 *Equation/Trigger Setup*).

Alarms: Local

Local alarms are viewed on the Signature Flow Meter itself. When a programmed alarm condition becomes true, the LED on the front panel glows red.

To view the alarm message, press the Alarm softkey (C).

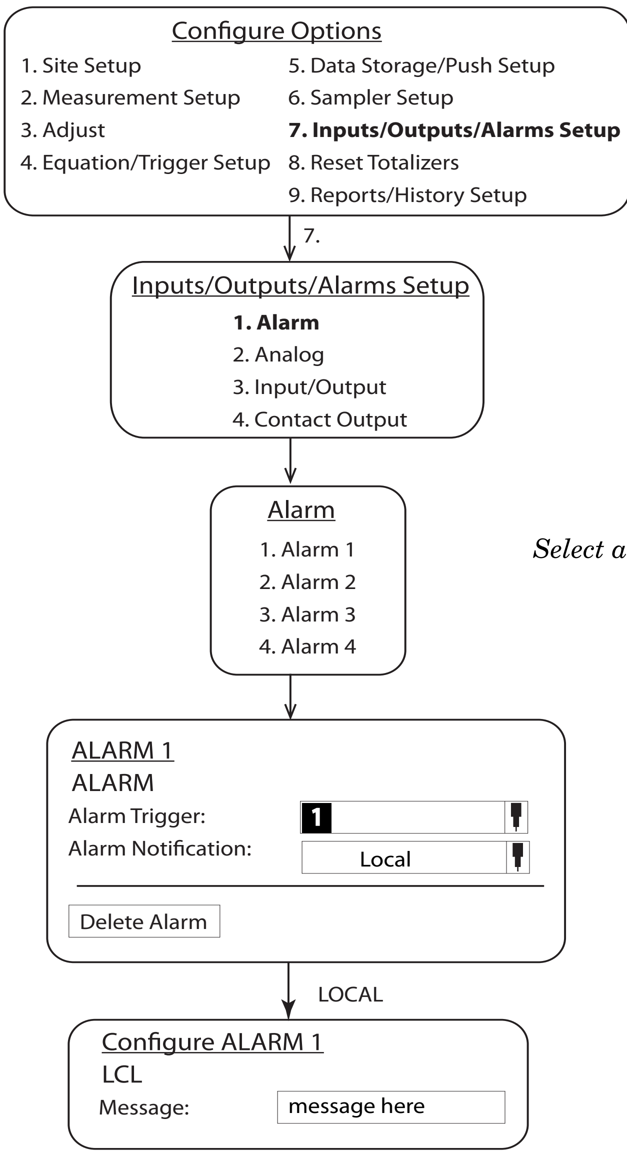
For local alarm setup, refer to Figure 2-19 on the following page.

Alarms: SMS / Server

SMS and Server alarms require an optional internal modem. To configure your modem for communication, refer to Section 5.7 *Ethernet Modem* or Section 5.8 *Cellular Modems*.

> **☑ Note**
> Server alarms notify a specified list of contacts in the event that a server running Flowlink Pro fails to receive pushed data from a site within a specified duration.

For SMS and Server alarm setup, refer to Figure 2-20.



Select an alarm from the list or set up a new alarm.

Select a trigger (equation) from the list. You must have at least one equation saved in order to trigger an alarm.

Your message will appear on the screen if the alarm is triggered and you press the Alarm softkey (C).

Figure 2-19 Local alarm setup

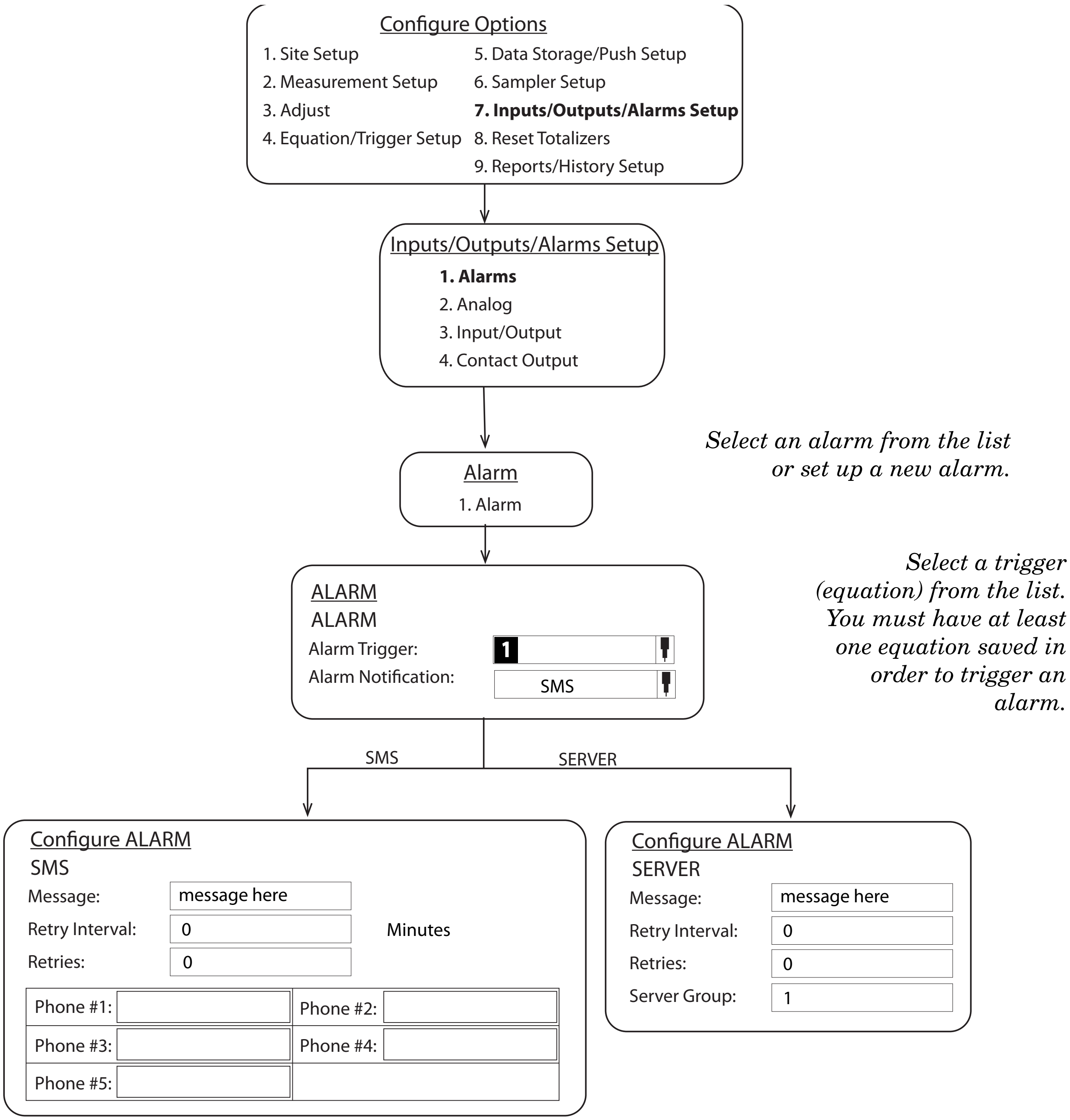


Figure 2-20 SMS and Server alarm setup (modem required)

Analog Output – Select the output to configure, then select and configure the measurement the output will represent. TIENet 308 option card required (see Section 5.5.10).

Analog Input – Select the input to configure, then select and configure the measurement the input will represent. TIENet 307 option card required (see Section 5.5.9).

Contact Output – Select the output to configure, then select and configure the measurement the output will represent. TIENet 304 option card required (see Section 5.5.8).

2.7.8 Reset Totalizers

Select the flow volume totalizer(s) to be reset. Selection resets the totalizer to zero.

2.7.9 Reports/History Setup

Reports – Set up report interval and measurements to include for one or two reports. To include all user and meter events in the report, select the option Include history log.

History – Display user and meter events (i.e., log-ins, adjustments, data push, etc.), and/or set up the graphical display for selected measurements over a period of time.

2.8 Administration

Administrative settings (see following page) dictate operating preferences and perform general housekeeping tasks.

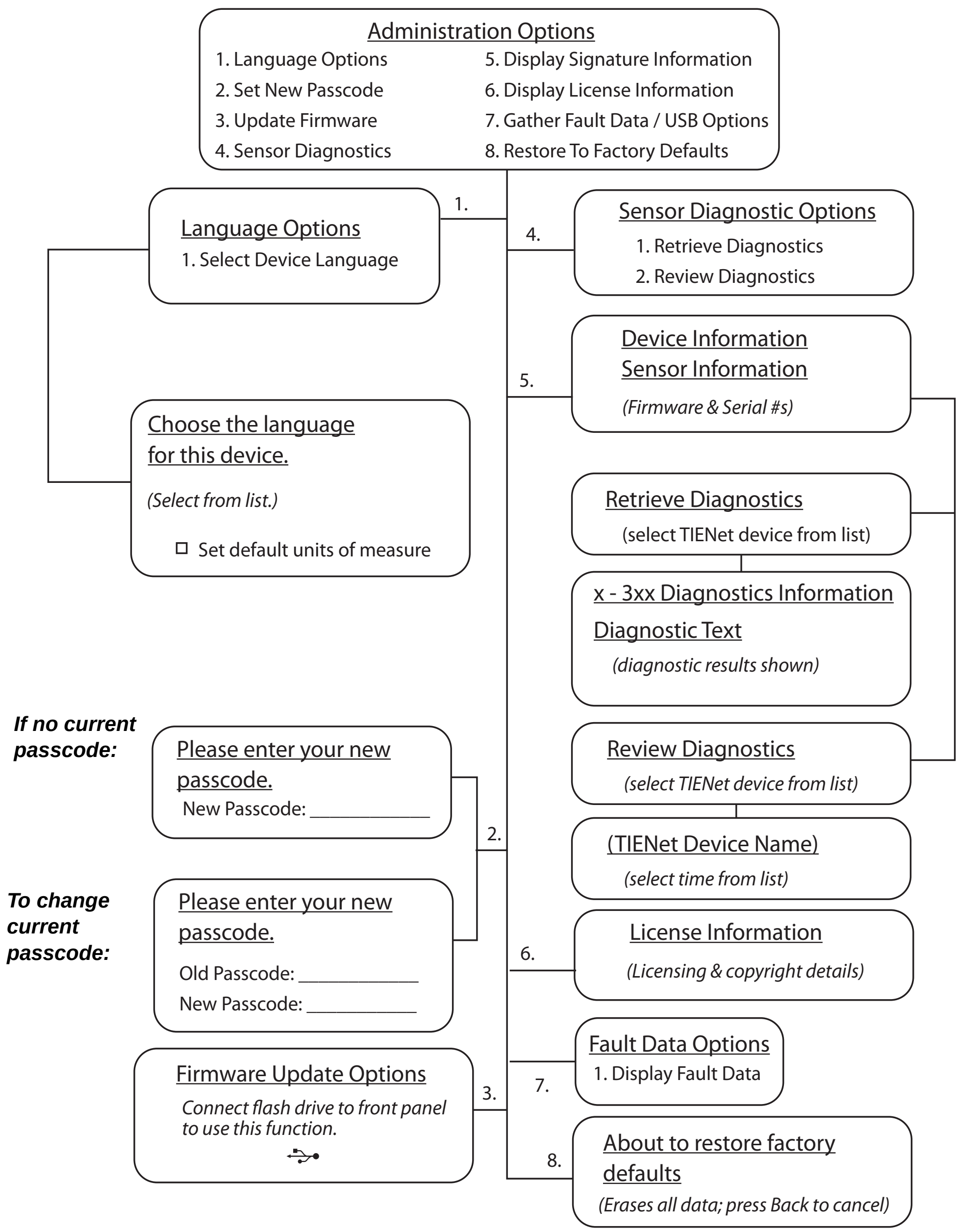


Figure 2-21 Menu Tree: Administration

2.8.1 Language Options

Select Device Language – From the list, select the default language to be displayed by the Signature flow meter. Available languages include:

English (USA)	Dansk	Português (Brasil)	Deutsch
English (International)	Nederlands	Español (México)	
Français	Türk	Svenskt	

From this screen, you can also set general default Units Of Measure to USA or International. You can still select units of measure for individual measurements through Configure Options > Site Setup.

2.8.2 Set New Passcode

A numerical passcode can be set to protect access to programming and data. By default, the flow meter is not passcode-protected. To change an existing passcode, enter the current passcode, and then the new passcode. To remove the passcode requirement, enter a new passcode of 0 (zero).

2.8.3 Update Firmware

To use this function, first connect a flash drive loaded with the correct firmware update file(s) to the micro-USB assembly. Refer to Section 2.9 *USB Options* for complete instructions.

2.8.4 Sensor Diagnostics

The Signature provides operating data for each connected TIENet device upon request, for site evaluation or troubleshooting purposes.

To generate a new diagnostic report, select **Retrieve Diagnostics**. The available devices can then be selected from a list. When the diagnostic data is available, press Enter to view it.

To view past diagnostic reports, select **Review Diagnostics** and select from the list of devices. Each past diagnostic report will be listed by date and time.

Diagnostic reports can also be downloaded to a connected USB flash drive in the form of a text file. Refer to *Retrieve Text Reports*, on page 2-33 for complete information.

☑ Note

If you are running diagnostics on a 360 LaserFlow velocity sensor, the Distance in the text report and graph are relative to the face of the integral ultrasonic transducer, which is located 11.7" above the bottom of the sensor. Subtract 11.7" from the Distance shown to obtain the actual value.

For more information about the LaserFlow sensor, refer to Section 5.5.3 *Laser Doppler Velocity Sensor* and the LaserFlow user manual.

2.8.5 Display Signature Information

Select this option to view the serial number, model number, software revision, and hardware revision of the Signature flow meter and any connected TIENet devices.

2.8.6 Display License Information

This selection displays open-source licensing and copyright information for the Signature firmware.

2.8.7 Gather Fault Data

Fault data is a term describing the capture of any user and/or flow meter activity prior to and during a system error or failure. This data can be displayed to assist in troubleshooting. To download the data to a flash drive, connect a flash drive to the micro-USB assembly on the front panel of the Signature and select Gather Fault Data from the USB Options menu that appears (refer to Section 2.9 *USB Options*).

2.8.8 Restore to Factory Defaults

This function returns the Signature Flow Meter to the program that was installed the factory. This is an example program that can be used for reference when designing your own program.

If the restore to portable defaults check box is selected, the power savings options will be automatically turned on.

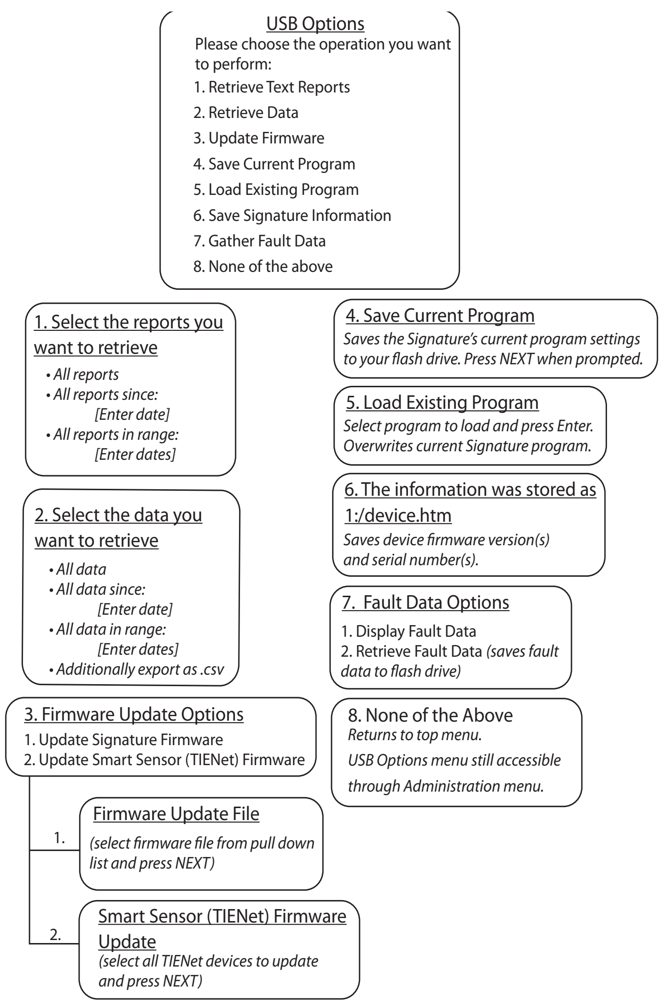
Be sure to record your own program settings and save all data before restoring the factory defaults.

2.8.9 Home

HOME returns to the home screen.

2.9 USB Options

The USB Options menu will only appear when you connect a flash drive to the micro-USB assembly on the front panel of the Signature.



Note:
To view all Administration menu selections, refer to igure 2-19.

Figure 2-22 Menu Tree: USB Options

2.9.1 Retrieve Text Reports

Select this function to download the Signature data text reports for sensor diagnostics and verification of data integrity.

Select “All reports,” or specify a start date or date range, and press NEXT. The reports will be stored on the connected flash drive in a folder called "ISCO."

This folder contains a sub-folder for each site, named with the first eight characters of the site name. The site folder contains one or more sub-folders, named by retrieval date (YYYYMMDD).

Each report file name has a prefix of one or two letters, followed by four digits representing the time of day, e.g., PH0935.TXT is a program report generated at 9:45 a.m.

Each report is contained in a text file, with a .TXT extension, or in a Smart Sensor Diagnostic file, with a .SSD extension. Each report file has a corresponding authentication file, with a .ath extension, for verification purposes. For more information about report verification, refer to *Verifying Exported Reports*, on page 2-35.

The four validation report types are:

Program Report (PH) – Tracks changes to the Signature Meter’s configuration

Summary Report (R1 / R2) – Documents summaries of data measurements (e.g. Min/Max/Avg)

Diagnostic Report – Tracks the occurrence of, and results from, diagnostic tests

History Report (H) – Tracks user and meter events (e.g. level adjustments, calibration, data push, etc.)

2.9.2 Retrieve Data

The program settings and flow data can be downloaded onto your flash drive in .ddp (data dump) format.

Select “All data,” or specify a start date or date range, and press NEXT. The data will be stored on the connected flash drive in a folder called “ISCO.”

This file can then be imported into Flowlink, where it can be viewed in regular site file format, with the recorded data and report/graphing capability.

There is a check box that, when checked, will export the .cvs file onto a USB flash drive.

2.9.3 Update Firmware

With a USB flash drive connected to the Signature’s front panel, the Update Firmware option becomes active on both the Administration menu and the USP Options menu.

For step-by-step instructions for updating the firmware for either the Signature flow meter or connected TIENet devices, refer to *Firmware Updates*, on page 6-2.

2.9.4 Save Current Program

Select this option to save a copy of the Signature's current program to your USB flash drive. You can also use this information to program other meters with the same configuration.

2.9.5 Load Existing Program

Select this option to load a saved program from your flash drive. Note that selecting this option will cause the current program to be overwritten with the one from the flash drive.

In order for the Signature to load the correct program, the name of the site must match that of the site program that was saved.

2.9.6 Save Signature Information

This option saves a snapshot of the firmware version(s) and serial number(s) of the Signature and any connected TIENet devices.

2.9.7 Gather Fault Data

Fault data is a term describing the capture of any user and/or flow meter activity prior to and during a system error or failure. This data can be viewed and/or downloaded as a file to your flash drive to assist in troubleshooting.

2.9.8 None of the above

This item returns the screen to the top menu.

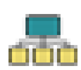
However, as long as the flash drive remains connected, the USB Options menu will still be active, and can be reopened from the Administration menu.

2.10 Signature Data in Flowlink

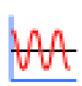
To download flow and event data from the Signature Flow Meter into the database with Flowlink, connect to the flow meter and select Interrogate (F8), or Import ddp (data dump).

2.10.1 Event Viewer

By default, Flowlink's Event Viewer displays the four event data types in tabular format, with a time stamp and short description of the event for each entry (refer to Figure 2-23). Each event type is represented by a graphical symbol, located in the first column:

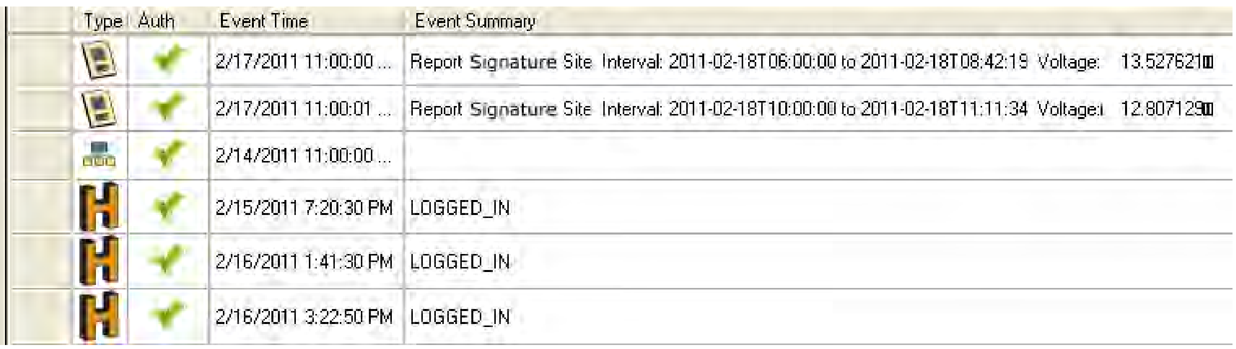
Program 

Summary Reports 1 & 2 

Diagnostic 

History (User / Meter Actions)  Meter Actions include Data Push - start/fail/complete, and Power Up/Down; all other events are user events (i.e., calibration, changes to the program, totalizer reset, etc.).

If the data for that event is unaltered, a green check mark  appears next to it. If the data cannot be verified as authentic, a red slash  appears next to it.



Type	Auth	Event Time	Event Summary
		2/17/2011 11:00:00 ...	Report Signature Site Interval: 2011-02-18T06:00:00 to 2011-02-18T08:42:19 Voltage: 13.5276210
		2/17/2011 11:00:01 ...	Report Signature Site Interval: 2011-02-18T10:00:00 to 2011-02-18T11:11:34 Voltage: 12.8071290
		2/14/2011 11:00:00 ...	
		2/15/2011 7:20:30 PM	LOGGED_IN
		2/16/2011 1:41:30 PM	LOGGED_IN
		2/16/2011 3:22:50 PM	LOGGED_IN

Figure 2-23 Event Viewer in Flowlink

Printing reports

Select one or more rows in the viewer to be printed and then select the Print button.

Exporting reports

To save event data as a text report for future verification, highlight the desired row(s) in the Event Viewer table and click Export (or right-click and select Export).

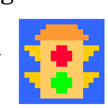
The default destination is your My Documents folder; however, you can change this to another preferred destination, including a USB drive, if preferred. A message window will notify you when the export is complete.

The files you exported are saved using the following hierarchy:

SITENAME \ MODULENAME \ DATE.

2.11 Verifying Exported Reports

Flowlink will only export already verified reports; they can also be verified after being retrieved from the Signature, either via Flowlink export or USB flash drive download.

Verification of exported data reports is done using the **Report Verification tool**, a small application installed separately when Flowlink was installed. This tool is located in the Flowlink program folder, normally at C:\Program Files\Flowlink 5.1, and is identified with a traffic light icon .

Note that this tool can also be used to verify data exported directly to a USB drive using the USB Options menu (refer to Section 2.9).

Use the top Browse... button to navigate to the desired report (*.txt or *.SSD) file. Use the bottom Browse... button to navigate to its corresponding authentication (*.ath) file. Click Verify. The application will quickly return a message showing the verification result.

Data is authentic.

Data has been altered.

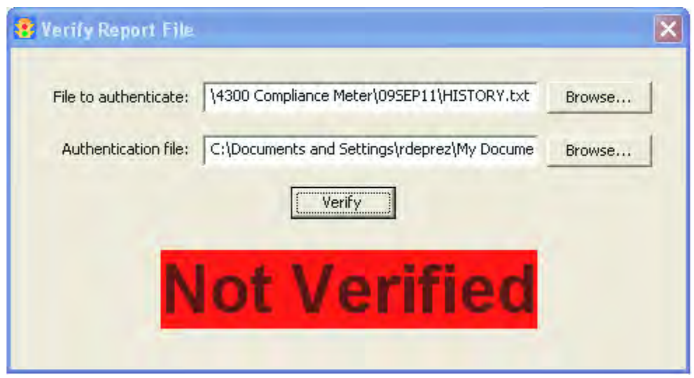


Figure 2-24 Report file verifier

Signature® Flow Meter

Section 3 Standard Installation

This section contains physical preparation procedures and permanent mounting methods for the Signature Flow Meter and associated Teledyne Isco equipment. Section 4 will contain the installation information for the Signature Portable Flow Meter.

⚠ WARNING

The installation and use of this product may expose you to hazardous working conditions that can cause serious or fatal injury. Take all necessary precautions before entering a worksite. Install and operate this product in accordance with all applicable safety and health regulations and local ordinances.

3.1 Introduction

The Signature Flow Meter is used for permanent installations.

3.2 Connecting External Devices

External device cables and mains line cord are passed, usually via conduit or cord-grip fittings, through the port holes in the bottom of the case and wired directly to the connector case. Cable fittings are also available for Rain, Ethernet and option card circuits as a 3 hold cord grip.

Trimming unterminated wires prior to installation is recommended.

Tools Required:

Small flat screwdriver (3.5mm)

#2 Phillips screwdriver

Channel locks

Soldering iron (for tinning wires)

⚠ DANGER

Before opening the case, first ensure that mains power is disconnected from the unit.

⚠ CAUTION

Before opening the case, disconnect the optional battery or battery backup power, if used.

☑ Note

Before restoring mains power, ensure that the flow meter's USB connector does not have a cable attached.

Open the door to access the two large screws holding the front panel on the connector case. Remove the two screws, then reinsert them in the front panel and latch the lid so they will not be misplaced.

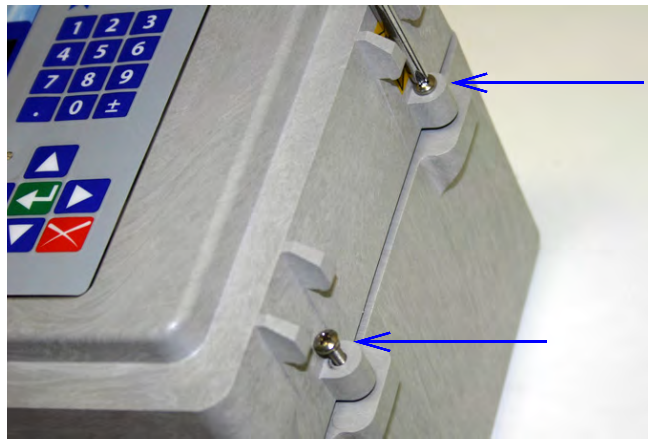
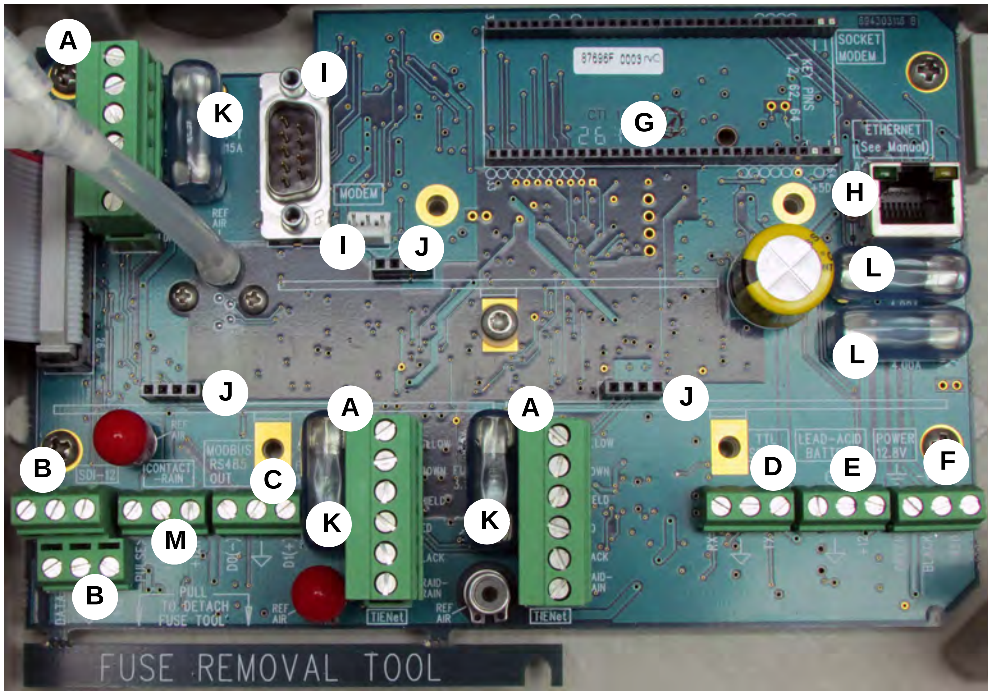


Figure 3-1   Open door and front panel to access interior

Open the front panel to access the connector case. Connectors on the board are identified in Figure 3-2.



A	External TIENet Devices/ Modbus RS485 In D1 = Yellow (+) D0 = Brown (–) Gnd = Black
B	SDI-12 Input
C	Modbus RS485 Out
D	TTL Serial
E	Battery Backup/ Battery for Portable
F	12.8 VDC
G	Ethernet Modem
H	Ethernet Port
I	Cellular Modem (power & serial)
J	4-20mA Input/Output Card and Contact Output Card
K	Fuse "T" 3.15A
L	Fuse "T" 4.00A
M	Rain Gauge

Note: No power supply for Signature Portable Flow Meter

Figure 3-2 Connector case, connectors, and fuses

Note

The two TIENet connections satisfy most applications. If additional TIENet connections are needed, consider the two TIENet Expansion Box versions for standard installations or TIENet 'Y' cables for Portable Signature applications. See Appendix B for ordering information.

3.3 Case Bottom Cable Entries

The connections made through the cable entries depend on the application, but their most common uses, in accordance with the connector case layout, are depicted on the following page.

All optional cable entries must use appropriate ID conduit connections or cord-grip fittings to retain the IP66 rating. If you are using non-TIENet or non-Signature cables, you must supply the appropriate ID conduit connections or cord-grip fittings.

⚠ CAUTION

If you are using conduit instead of the cord-grip fitting, the conduit and wires must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

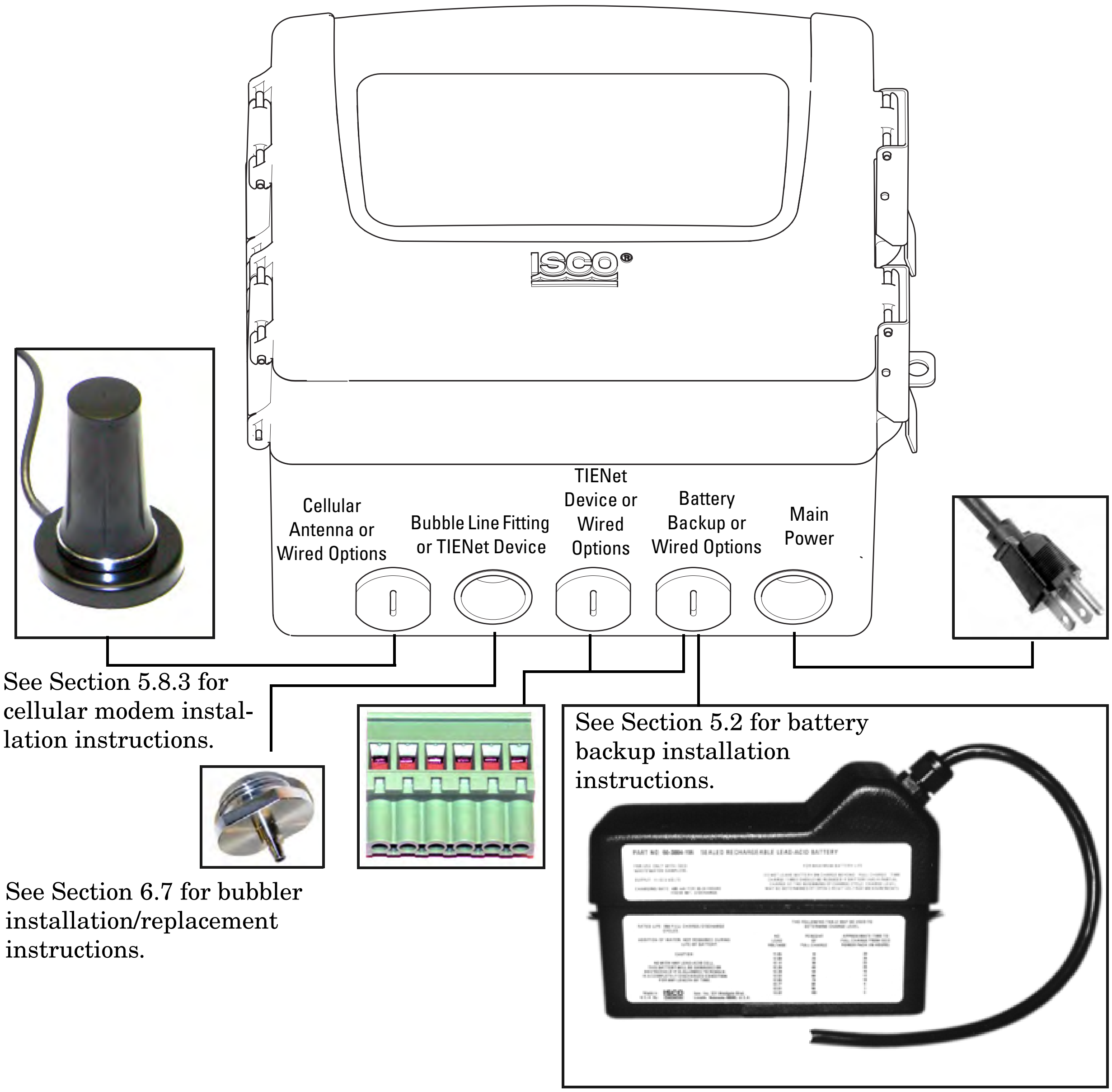


Figure 3-3 Connector Case cable entries for power and external devices

3.3.1 Cable Fittings

Cord-grip fittings for TIENet devices, line cord, and battery backup option are available from Teledyne Isco (see Appendix B for ordering information). Cable fittings are also available for rain, ethernet, and optional card circuits as a 3-hole cord grip.

The fitting for the line cord is a special strain-relief fitting, as shown in Figure 3-5.

Figure 3-4 Strain relief $^3/_4$ NPT Cord-grip fitting for TIENet devices

Figure 3-5 Cord-grip fittings installed

Any unused cable entry holes should be sealed with plugs. Do not overtighten the plugs. When a plug is flush against the outside of the case and held in place by the metal nut inside, the hole is sealed.

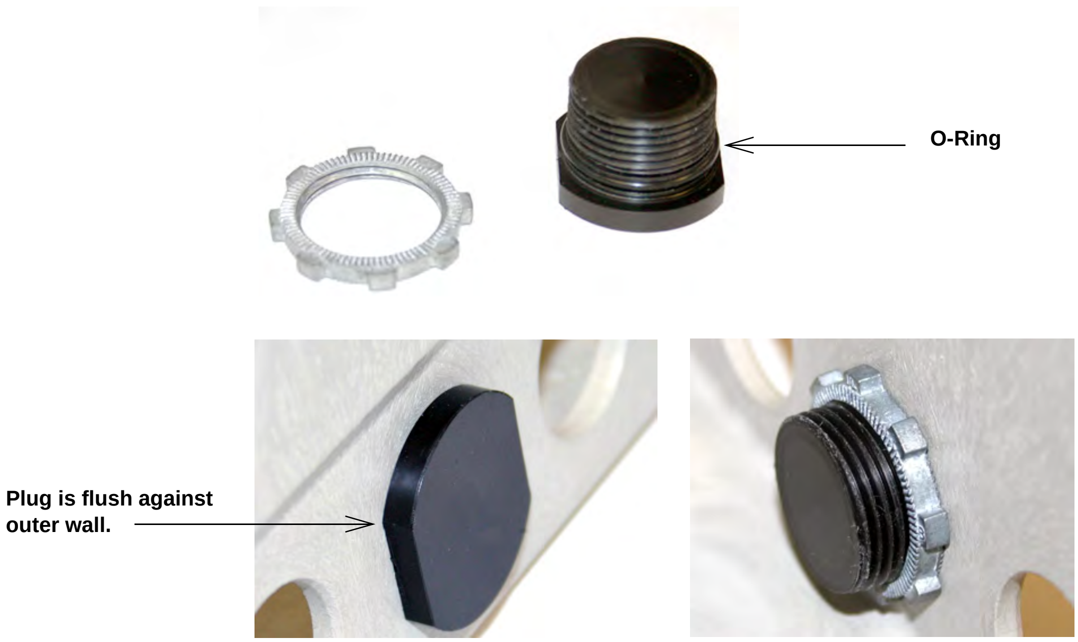


Figure 3-6   Diameter-seal plugs for unused ports

3.3.2 Connecting TIENet Devices

The optional external TIENet devices compatible with the Signature flow meter all connect in the same manner. Multiple TIENet devices can be connected simultaneously to the same Signature Flow Meter.

> ☑ **Note**
>
> The steps that follow include instructions for installing cord-grip fittings. Some applications will use user-supplied $^3/_4$" ID conduit for cable routing.

1. Remove one of the 6-position plug-in terminal strip connectors from the connector case.

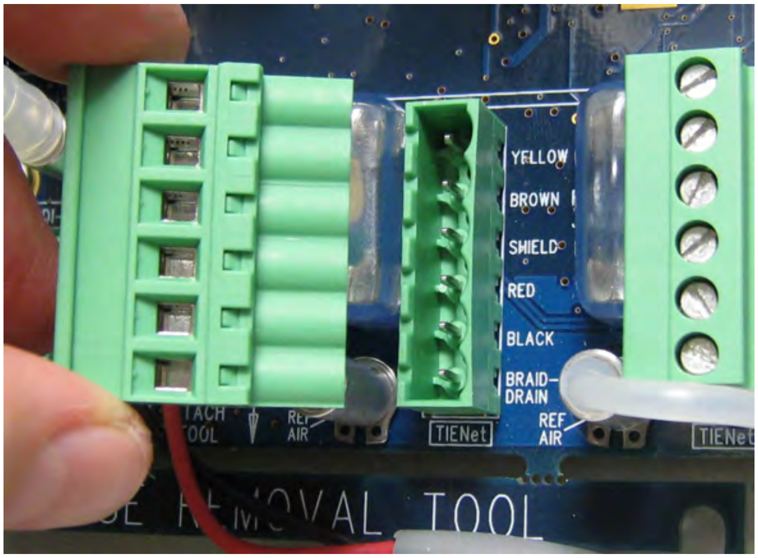


Figure 3-7 TIENet Device terminal strips

2. If using a cord-grip fitting, install the cable nut in the appropriate opening on the bottom of the Signature enclosure, securing it to the wall with the lock nut (concave side facing wall).
3. Feed the TIENet device cable end through the sealing nut and seal, and through the cable nut. Lightly tighten the sealing nut, just enough to hold the cable in place while installing the connector.

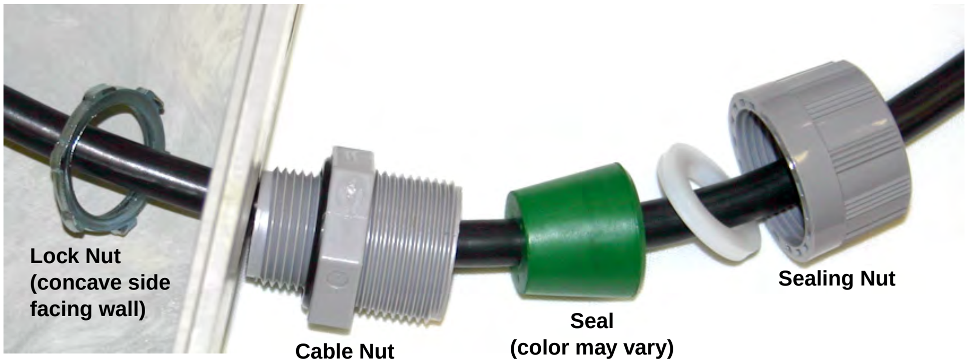
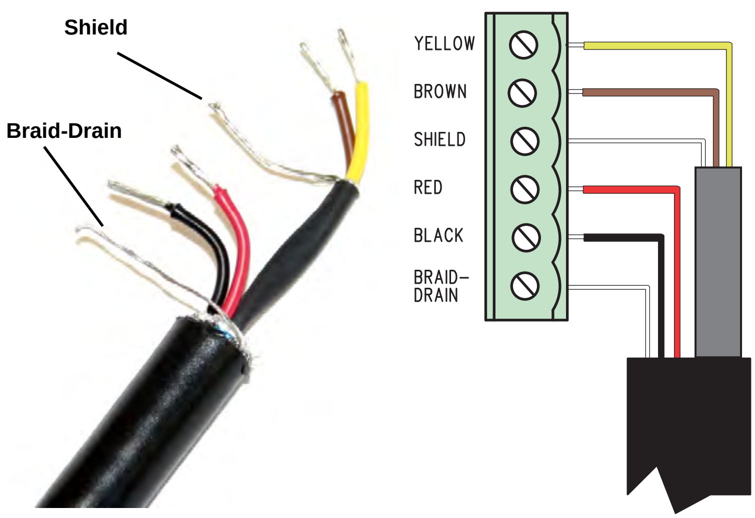


Figure 3-8 Installing TIENet cable with a cord-grip fitting

4. Attach the wire ends to the terminal strip as shown in Figure 3-9, then press the terminal strip back down into its socket on the case board, as shown in Figure 3-10, taking care not to strain any wire connections. Gently tug each wire when finished, to verify secure connection to the screw terminals.

Note

The SHIELD wire is the bare drain emerging from the foil shield around the YELLOW and BROWN wires. The BRAID-DRAIN wire is the bare drain emerging from the surrounding braided shield inside the cable jacket. It is not necessary to prevent the two braids from coming into contact with each other.



D1	YELLOW
D0	BROWN
Shield	SHIELD
VP	RED
Common	BLACK
Chassis	BRAID DRAIN

All optional cable entries must use appropriate ID conduit connections or cord-grip fittings to retain the IP66 rating. If you are using non-TIENet or non-Signature cables, you must supply the appropriate ID conduit connections or cord-grip fittings.

Figure 3-9 TIENet Device terminal connections

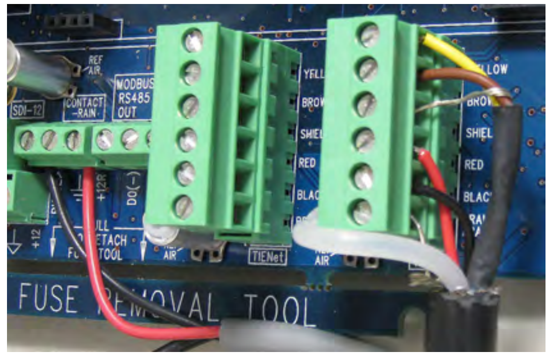


Figure 3-10 Attach wired terminal strip to connector case socket

a. **Systems using the LaserFlow or Area Velocity 350 Sensor:**
Insert the reference tubing into the REF AIR port on the case board, pushing it down inside the silicon tubing. Be **careful not to kink the reference tubing.**

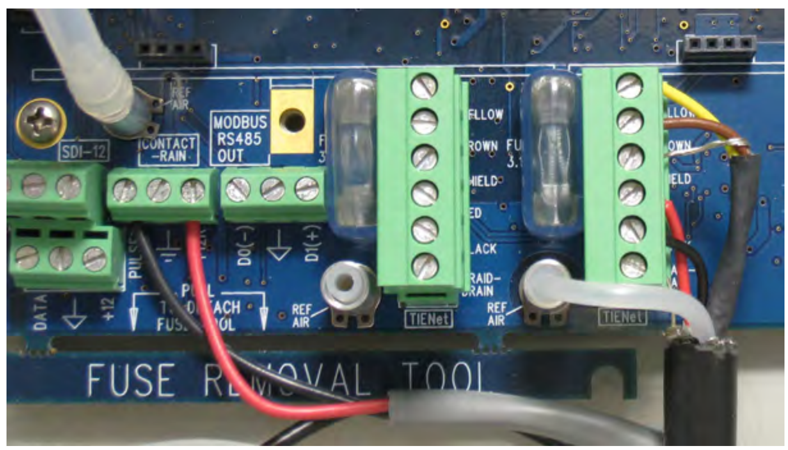


Figure 3-11 Insert the cable reference tubing into the case board reference port

5. Tighten the cord grip sealing nut.

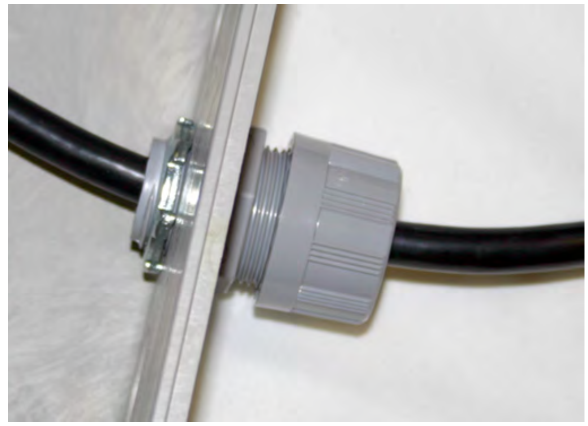


Figure 3-12 Position and secure the cable

6. Close the front panel and fasten it shut with the two Phillips screws.

⚠ CAUTION

If you are using conduit instead of the cord-grip fitting, the conduit must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

3.4 Power

The Signature is in compliance with North American and International safety standards while the input voltage remains within 100-240 VAC (50/60 Hz).

For external current protection, a 2 A slow-blow or time-lag fuse between mains power and the Signature is recommended to accommodate up to 40 A inrush current at power up in applications up to 230 VAC.

The flow meter comes with the internal power supply wired to the connector case, and held in place by a screw (see Figure 3-13 on the following page). Mains power is wired into the Signature's internal power supply, normally via a standard three-wire line cord or hard-wiring through user-supplied conduit.

3.4.1 Hard Wiring

Cable entries for hard wiring must use appropriate ID conduit connections.

⚠ CAUTION

If you are using conduit instead of the cord-grip fitting, the conduit and wires must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

If the instrument has been hard-wired for power, ensure that a switch or mains circuit breaker is installed near the instrument for easy access to remove power in the event of an emergency.

3.4.2 Line Cord

If the instrument has been fitted with a line cord, ensure that its installation is near a mains outlet for easy access to remove power in the event of an emergency.

3.4.3 Power Connections

Teledyne Isco offers an AC line cord kit that is installed at the factory when ordered with the Signature. It is also sold separately, and is easily installed by the user.

For installation instructions, refer to Section 5.1 *AC Power Cord Kit /AC Wiring (Applies to Permanent Installation Only)*. **Note that these instructions can also be used as guidance for user-supplied line cord, hard wiring, or replacement power supply.**

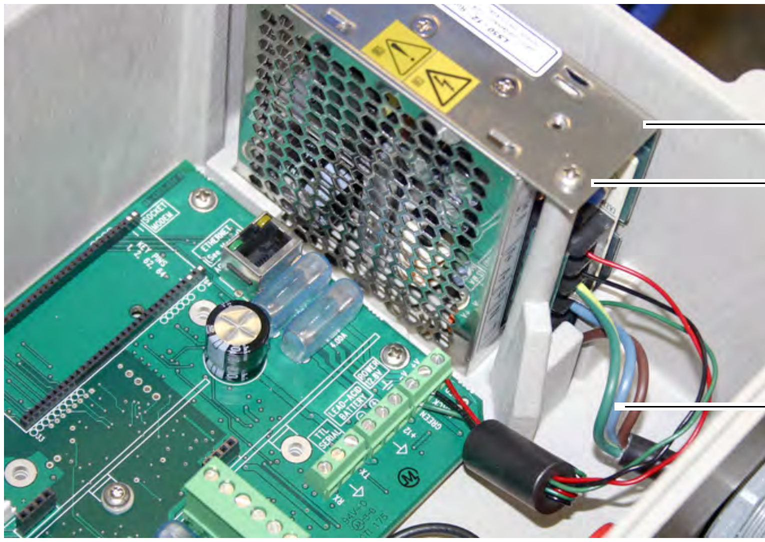


Figure 3-13 Location of power supply

3.5 Mounting the Signature

The Signature can lie flat on a horizontal surface, or be attached to a wall using the stainless steel bracket on the back of the case.

It can also be installed inside a console enclosure with other system components. If a console enclosure is used, ensure that it provided proper sealing to protect the flow meter and other equipment from harsh environments and/or moisture.

The mounting location should allow for easy removal and reinstallation in the event that cleaning, testing, or replacement is required. Refer to the dimensional drawings on the following pages for physical installation specifications.

Figure 3-14 Signature Flow Meter mounted on wall

3.6 Outdoor Recommendations

Where the Signature Flow Meter is mounted outdoors, a weather shield for protection from direct sunlight and rain is recommended. The shield should accommodate the flow meter's 18 inch dimensions with the cover opened, as shown below.

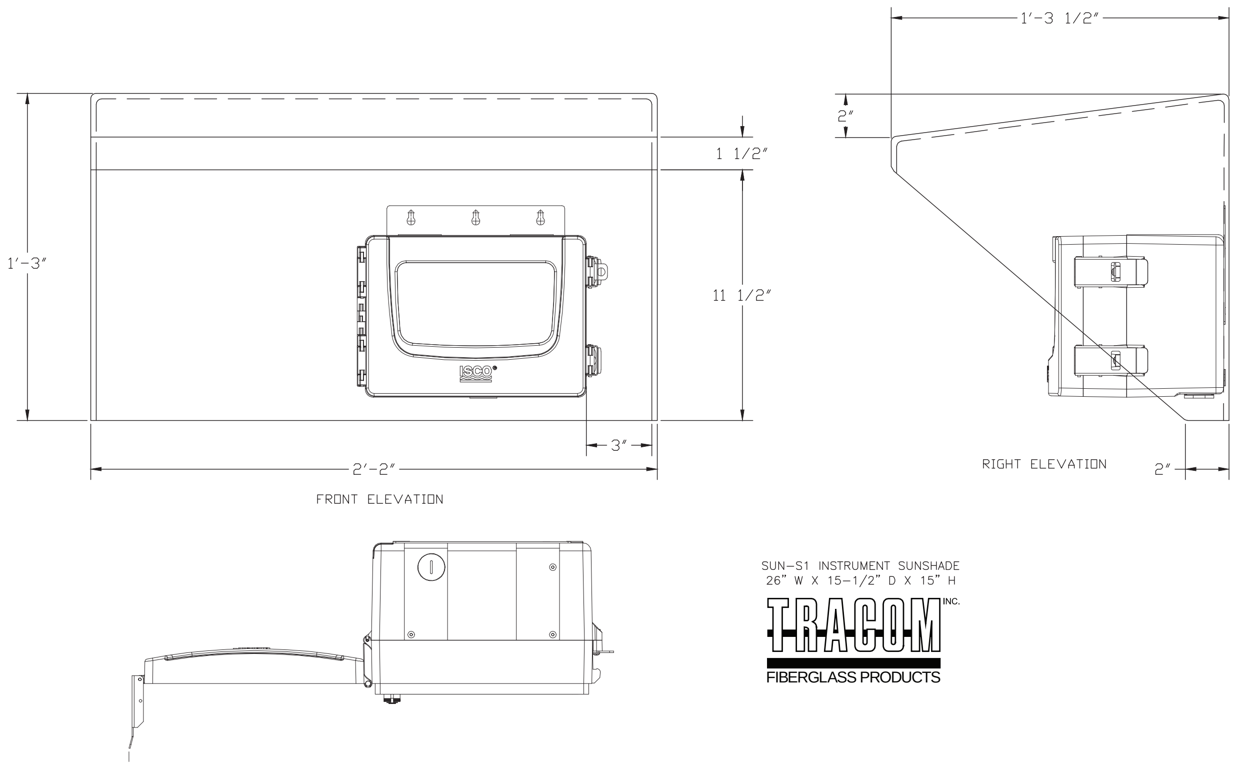


Figure 3-15 Weather shield - recommended for outdoor installations (Drawing & Photo courtesy of TRACOM, Inc.)

3.7 Setting the Level

Although all other programming steps can be performed off-site, the liquid level must be set at the measurement site following installation.

Once the 330 bubble line is installed in the flow stream, or the 310 sensor is installed over the flow stream, measure the present liquid level and enter this value for Level, under Configure > Adjust Options. Highlight “Adjust” and press Enter to confirm.

From this screen, you can also update the display to show the current level of the stream.

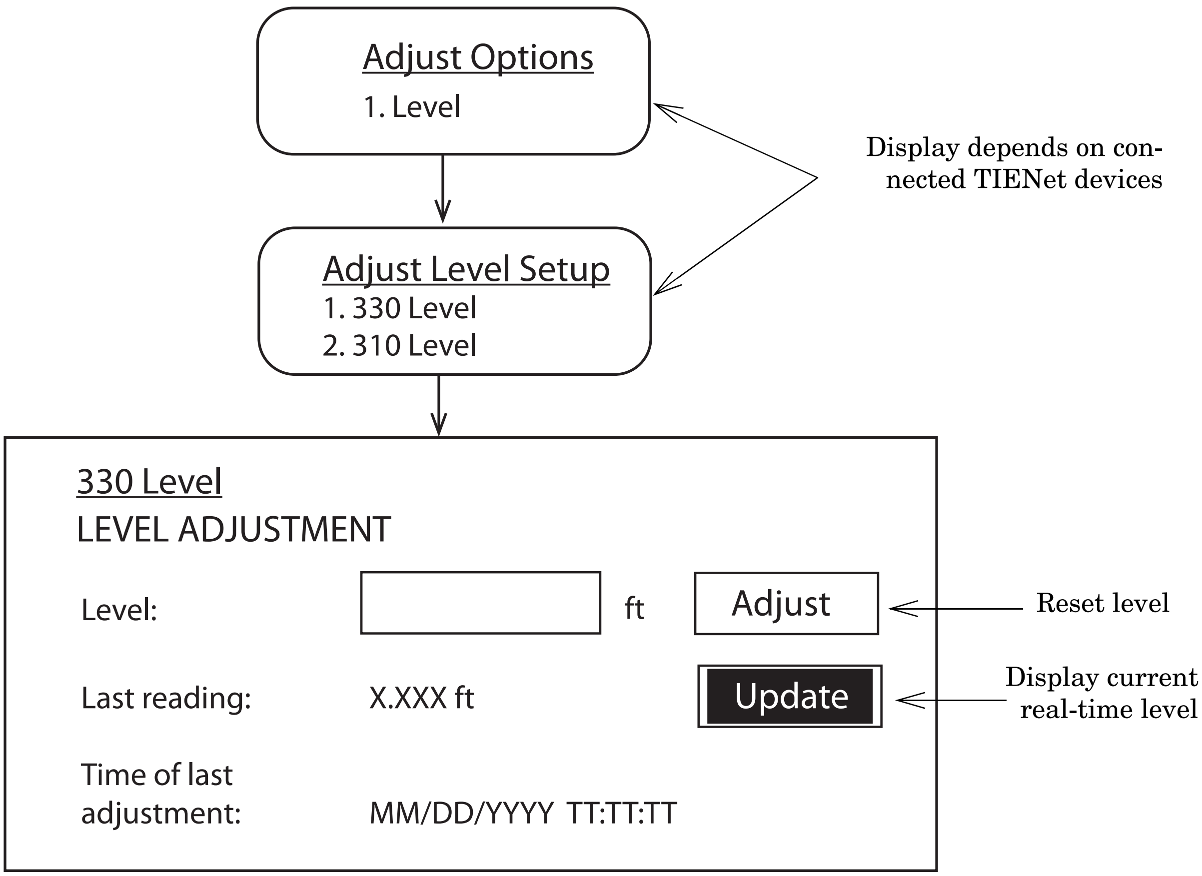


Figure 3-16 Level adjustment

3.8 TIENet Sensor Installation in a Hazardous Location

In applications where the TIENet sensor will operate within a hazardous area, the installation must be performed by trained and qualified personnel, according to the installation control drawing provided in Figure 3-17, and in accordance with local requirements.

Information about hazloc installation specific to the TIENet 310 Ultrasonic Level Sensor is provided in the sensor’s user manual.

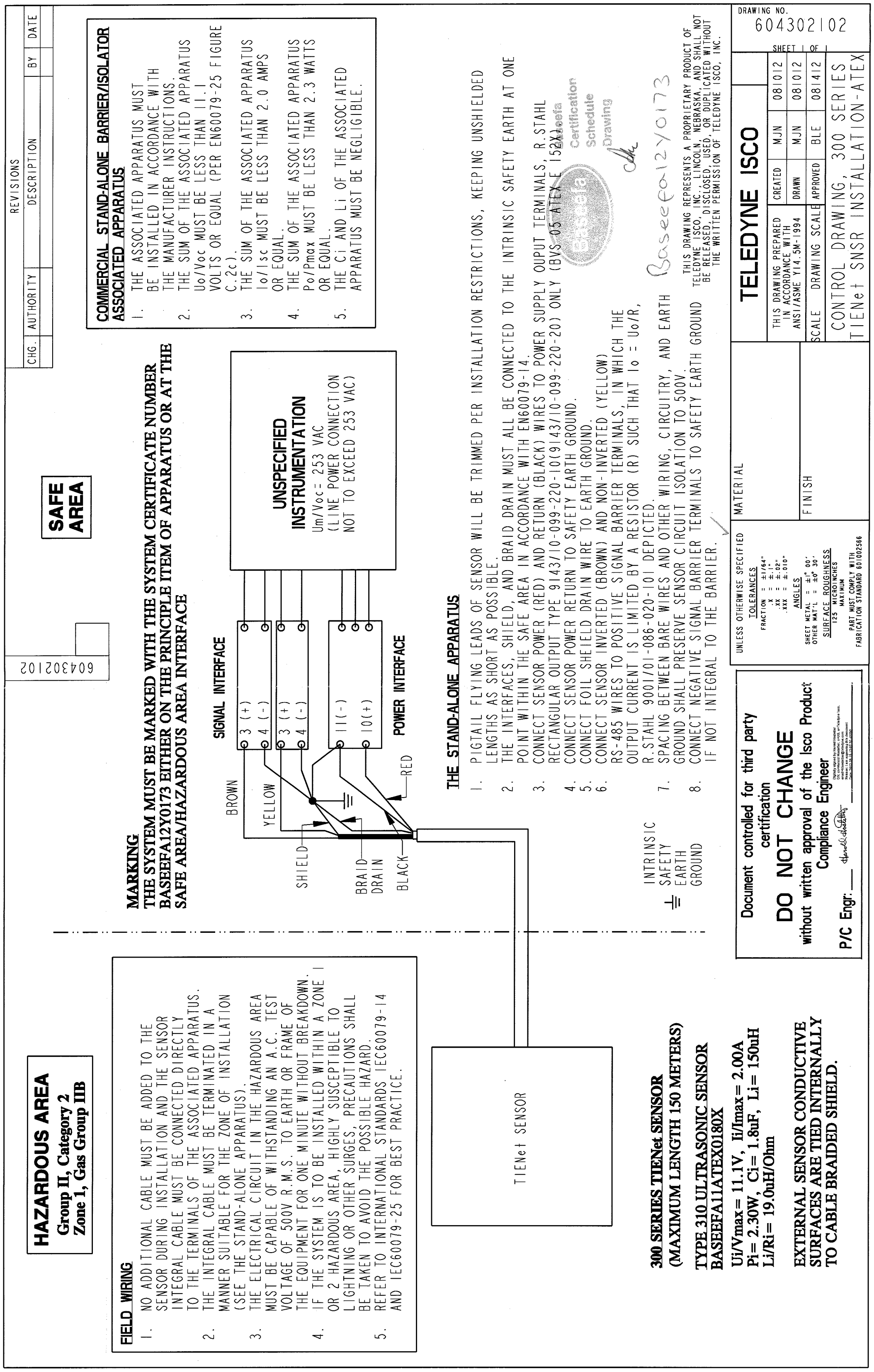


Figure 3-17 Hazardous Location Installation Control Drawing-ATEX

Signature® Flow Meter

Section 4 Portable Installation

This section contains physical preparation procedures and portable mounting methods for the Signature Flow Meter and associated Teledyne Isco equipment. Section 3 will contain the permanent installation information for the Signature Flow Meter.

4.1 Introduction

The Signature Portable is equipped with one TIENet® receptacle. In the event a connection must be made directly to the board refer to the permanent Signature installation connection to external devices in Section 3.2.

Where additional TIENet devices are deployed with a Signature Portable, there is an optional TIENet 'Y' connection cable available to expand the number of connections as needed. See Appendix B for ordering information.

4.2 Portable Stand

The portable stand allows the user to move the Signature to various locations and without a permanent installation. This Signature has multiple power options and can be in either in an upward facing or side facing position (Figure 4-1). The Signature Portable is shipped from the factory in a side facing position.

Figure 4-1 Signature on portable stand side facing (left) and upward facing (right)

Tools #2 Phillips screw driver

4.2.1 Adjust Signature to Upward Position

To adjust the Signature to be in the upward facing position:

1. Move the handle into the down position by pulling out the handle latch pins on each side of the stand (Figure 4-2)

Figure 4-2 Pull out the handle latch pins on each side of the stand

2. Loosen all of the screws in the top of the stand (2 panhead and 2 flathead per side) with a #2 Phillips screw driver. (Figure 4-3). These screws are captivated, so loosen until they stop turing.

Figure 4-3 One of the eight screws loosened.

3. Once the four flathead screws are loosened, rotate the meter toward the back and lift straight up to remove it from the stand (Figure 4-4).

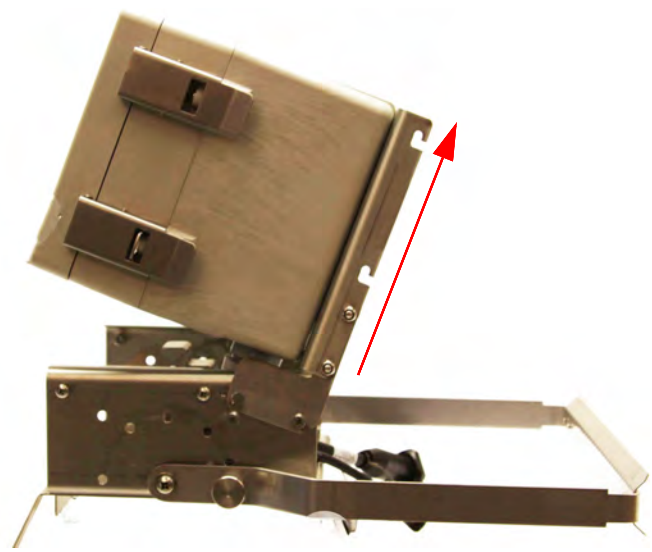


Figure 4-4 Signature tilted up in preparation of removal

4. Align the notches in the Signature mount with the pan-head screws on the stand.
5. Engage the slots and push the meter toward the back until it stops.
6. Tighten all 8 screws (4 on each side) (Figure 4-5).

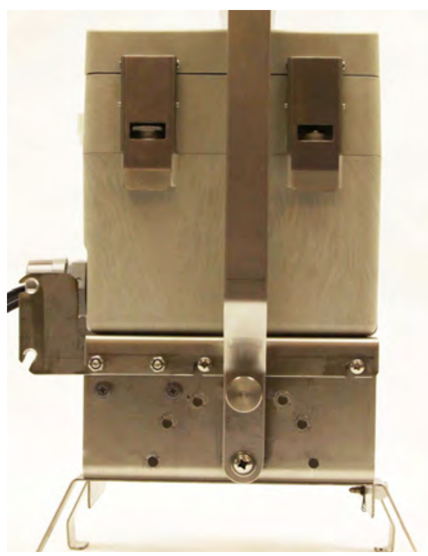


Figure 4-5 Signature in upward facing position

4.3 Power

The Signature Portable is designed to be used with 12 VDC lead acid batteries.

4.3.1 Power Connections

The standard battery connection on a Signature Portable accepts Teledyne Isco model 948 or 946 lead acid batteries.

Adapting cables can be purchased to connect to a customer supplied deep cycle marine battery.

⚠ WARNING

Do not set the portable stand directly on the terminals of a battery. Serious injury or permanent damage may occur.

4.3.2 Outdoor Recommendations

The Signature Portable can be mounted to the portable stand in a side facing or upward facing position (Figure 4-1).

When the Signature Portable is used in an unprotected environment it is recommended the screen is in the side facing position so it does not collect water.

4.3.3 Battery Installation

Common battery options for the Signature Portable:

- 946 lead-acid battery
- 948 lead-acid battery
- Lead-acid battery with solar panel

948 lead-acid battery

When using the 948 lead-acid battery the portable stand will sit directly on top of the battery case, where the battery is enclosed. There is a notch in the back of the portable stand that will fit over the power cable from the Signature to the battery. (Figure 4-6).

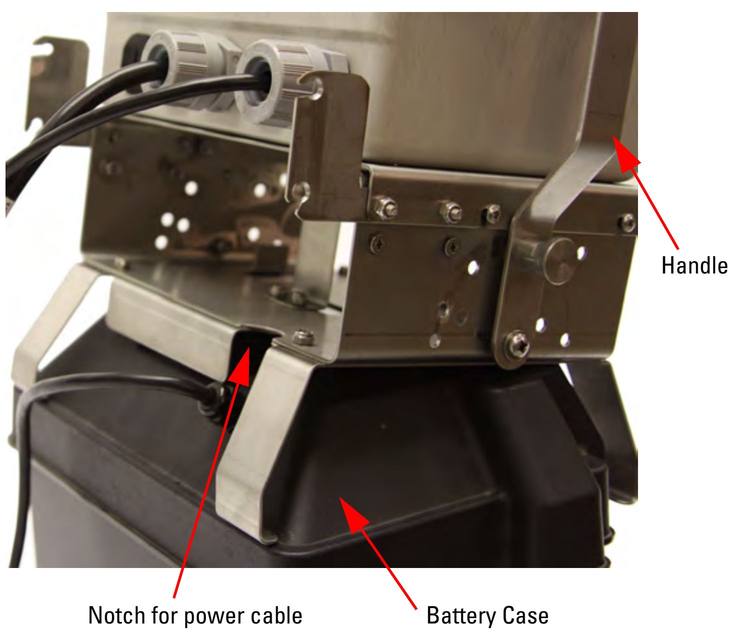


Figure 4-6 Notch in stand for the power cable

When using the 946 lead-acid battery, this battery will fit directly under the Signature inside of the portable stand (Figure 4-7).

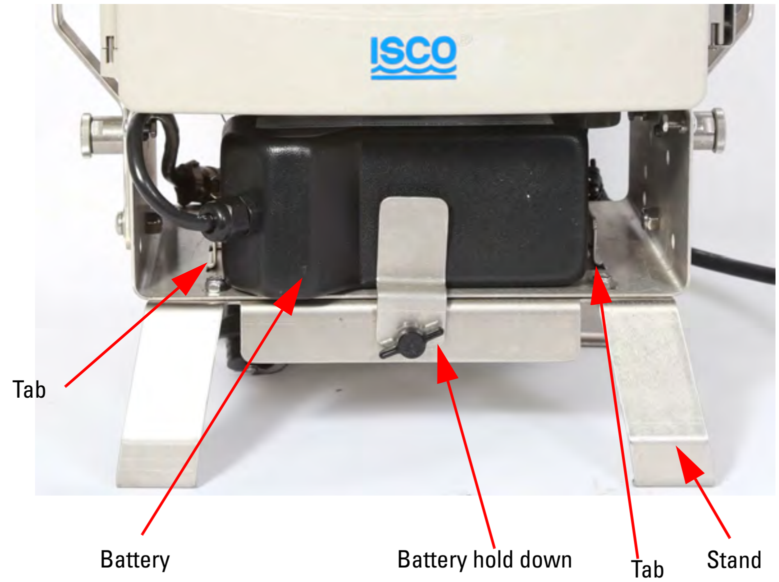


Figure 4-7 946 lead-acid battery installed under the Signature Portable

946 lead acid battery

To install the 946 lead-acid battery:

1. Remove the battery hold down of the portable stand by loosening the thumb screw.
2. Thread the power cable through to the left side of the portable stand and slide the battery in, between the metal tabs, after it. The battery will fit snugly.
3. Replace the battery hold down and tighten the thumb screw.
4. Plug the cable into the Signatures power connector.

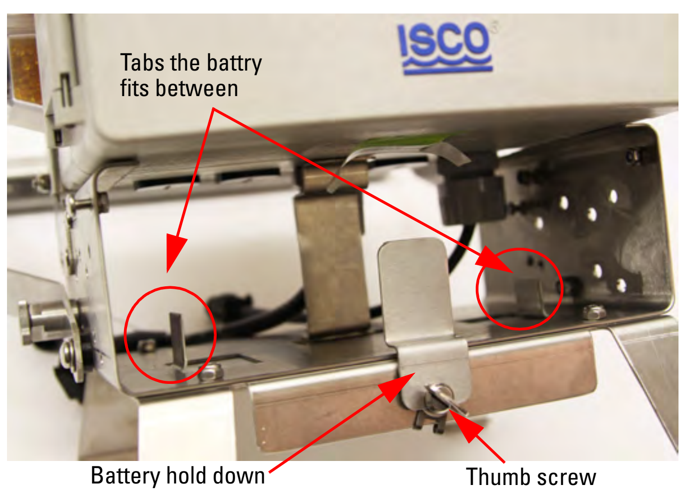


Figure 4-8 Battery hold down and thumb screw

4.4 Battery Life Expectancy

This section will cover the average battery life as related to the most common applications. For more information about battery life please consult the factory.

⚠ CAUTION

The following section on battery life is for information purposes only and does not constitute a guarantee of service or warranty of any kind.

4.4.1 Major Standard Equipment Settings Effecting Battery Life

Display backlight and power

When the front screen is powered off the Signature is no longer taking near continuous readings. The reading interval will be based on the data storage rate and any actively used equations.

Data storage rate

Many options effect the storage rate as related to battery life, see. See 2.7.5 Data storage for a complete explanation.

Equations

Equations used by alarms, triggers, or secondary measurements can effect the battery life of the equipment. The minimum measurement setup in the equation should be the data storage interval used for battery calculations.

For example, the data storage rate is set to 15 minutes, an equation is set with a measurement interval of 5 minutes. For battery life calculations it would be more accurate to use the battery life expectancy of 5 minutes.

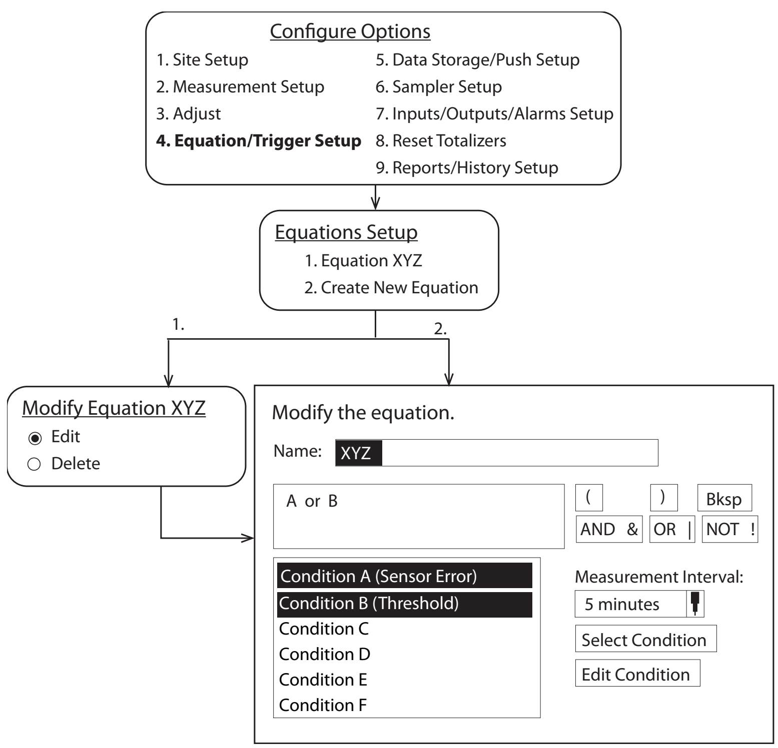


Figure 4-9 Example of defining conditions and building equations

4.4.2 Major Optional Equipment Settings Effecting battery Life

Cell Modem

The longer the call window is open the more it will drain battery.

LaserFlow

The LaserFlow has additional battery life considerations. Please see the Laser 360 manual for more information

Analog Output Card

The analog output card is not a typical component on a battery operated device. The current draw over time is great and hard to predict.

Ethernet Card

With a very high average current, the ethernet card is not recommended for most applications using batteries.

Bubbler

Bubbler purges draw a large amount of current. Lengthen the Purge Interval for improved battery life.

4.4.3 Additional Considerations for Battery Life

Bubbler Tubing

The longer the bubbler and sensor line the more current draw the meter will have. In most cases the difference in current draw will not be a factor, but exceptionally long lengths will be a factor.

Reading Retries

If the sensor is in a location where reading errors occur, the unit will attempt to retry until a good reading is taken.

Battery Capacity

If the battery is damaged (decreased battery capacity) the Signature will not run as long as the charts and calculations in this section suggest. Batteries loose capacity:

- as they age
- as temperatures decreases
- when stored
- discharged below default or recommended levels

Table 4-1 Battery Life Expectancy (default measurement rate of 15 minutes)

	Ultra Sonic	LaserFlow	A/V	Bubbler
Average current draw in ma	65	68	68	67
Model 946 lead-acid battery, 12 vCD, 6.5 amp-hours	100 hours	96 hours	96 hours	97 hours
Model 948 lead-acid battery, rechargeable, 12 vCD, 45 amp-hours	692 hours	662 hours	662 hours	672 hours

Table 4-2 Battery Life Expectancy (measurement rate of 5 minutes, all other parameters use default)				
	Ultra Sonic	LaserFlow	A/V	Bubbler
Average current draw in ma	65	70	69	67
Model 946 lead-acid battery, 12 vCD, 6.5 amp-hours	100 hours	93 hours	94 hours	97 hours
Model 948 lead-acid battery, rechargeable, 12 vCD, 45 amp-hours	692 hours	643 hours	652 hours	672 hours

Table 4-3 Default Method for Portable Signature	
Setting	**Duration/Setting**
Laser (if present)	Single point measurement
Optical clarity (if laser used)	enabled (but not active)
Bubbler purge (if bubbler is present)	4 hours
Measurement Rate	15 minutes (for all flow technologies)
Backlight	Key press time-out (30 second timeout enabled)
Display shutoff	Key press time-out (5 minute timeout enabled)
Cellular Modem call Window (if modem is present)	Open daily for 1hr
Equations used by alarms, triggers. Secondary Data storage rate	None set
If present during a TIENet scan the Signature will configure flow technologies, modem and laser as shown in the chart above. If none are present the options will not be configured and will not affect power settings.	

Table 4-4 Additional Average Current Draw	
Purge interval 15min (if bubbler is present)	7
Backlight always on, display always on	48
301 PH sensor (15min data storage interval)	27
306 Sampler interface assuming	No significant increase
307 Analog input card (active)	45
307 Analog input card (passive)	No significant increase
304 Contact Output	10
Totalizer 1000 count per hour	No significant increase
Ethernet communication module	88

4.4.4 Calculating Average Current Draw

If the conditions listed in the average battery life tables and default method do not match your application, you can use the following procedure to calculate the current draw.

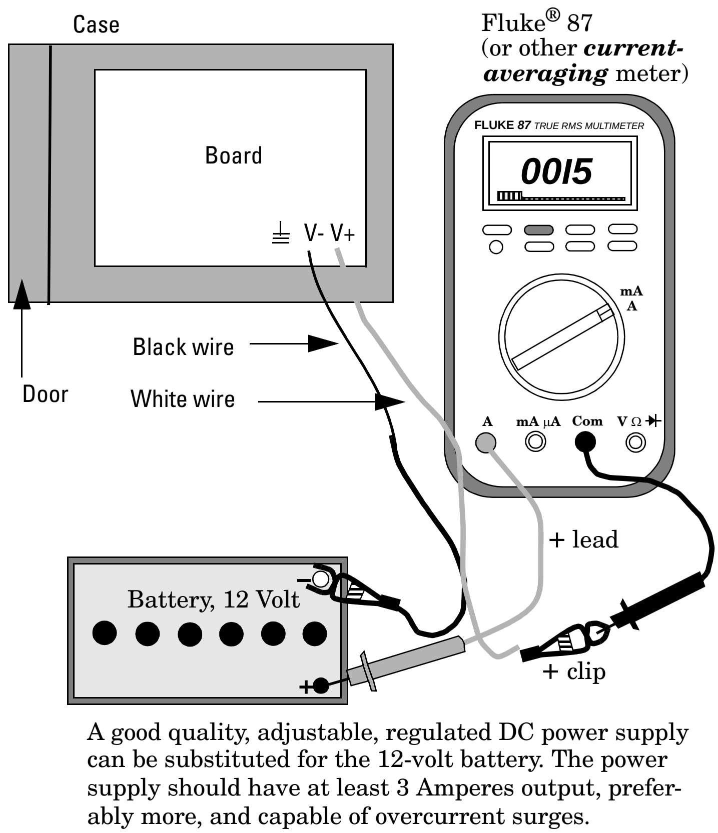


Figure 4-10 Measuring flow meter current

> ☑ **Note**
>
> Do not attempt this procedure unless you have the proper equipment available and know how to make electrical measurements.

Many of the power using functions in the Signature vary over time. To measure current for a varying load requires a more-sophisticated type of multimeter, one that is capable of averaging high and low readings over a period of time. The Fluke® 87 Multimeter is one example of this type of meter.

You should set the meter on MIN/MAX and let it run with your program for several hours or more. Other manufacturers' meters are also acceptable, but only if they are capable of averaging current draw. The current test should be run long enough to capture all periodic usage. The longer you run the test, the more accurate the average will be.

4.4.5 Battery Life Calculations

To calculate battery life expectancy for an installation, you must know two things:

- The capacity of the battery you are using
- The average current draw of the flow meter or (other device) powered

Battery capacity is expressed in ampere-hours. The battery manufacturer provides this information for each battery. This value is the product of a load current times an arbitrary time period, twenty hours for lead-acid types. Isco 946 batteries lead acid batteries are rated for 6.5 ampere-hours.

To determine battery life for a Signature running on a 946 lead acid battery, convert the battery capacity into milliamperes/hours and then divide the ma/hrs by the avg current draw. This will give you a number in hours. Divide that figure by 24, and you will have the number of days.

☑ Note

The published ampere-hour figures do not mean that you can expect to draw 6.5 amperes from the lead-acid battery for one hour.

To convert ampere-hours to milliamperes, multiply by 1,000.

Examples

6.5 ampere-hours × 1,000 = 6,500 mAh

If you divide this figure by the average current of the flow meter, say 65 mA, you will have:

6,500 ÷ 65 = 100 hours

Divide this number by twenty-four to get days:

100 hours ÷ 24 = 4.1 days

For considerations of safety, we suggest you subtract 10% from this number (100% – 5% for 95% capacity and 5% for a reserve at the end of discharge).

4.1 – .4 = 3.7 days

The 3.7 days is the battery expectancy for a lead-acid battery with a 65 mA continuous average drain, with a 10% derating factor. Remember if the battery fails there will be a period of time during which no measurements will be taken and no data stored (if you are also using Flowlink® software).

☑ Note

Always operate these batteries with a reserve factor.

4.4.6 Low Battery Cut Off and Battery Care

Batteries are considered fully discharged well before the terminal voltage drops to zero volts. Operating lead acid batteries below the fully discharged point decreases their capacity and damages the battery. Lead acid batteries, under a constant rate of discharge, are considered fully discharged at 10.5 volts, however; the Signature does not discharge the batteries at a constant rate.

To get the maximum amount of life and readings out of the battery without damaging it, a duration was added. Adding a time durations also prevents a short term power dip from causing a premature shutdown. By default the Signature will turn itself off when the battery voltage is at 11.5v for 2 min. To prevent the unit from cycling off and on the unit will not recover (turn back on) until the battery voltage is 13.0 for 2 minutes.

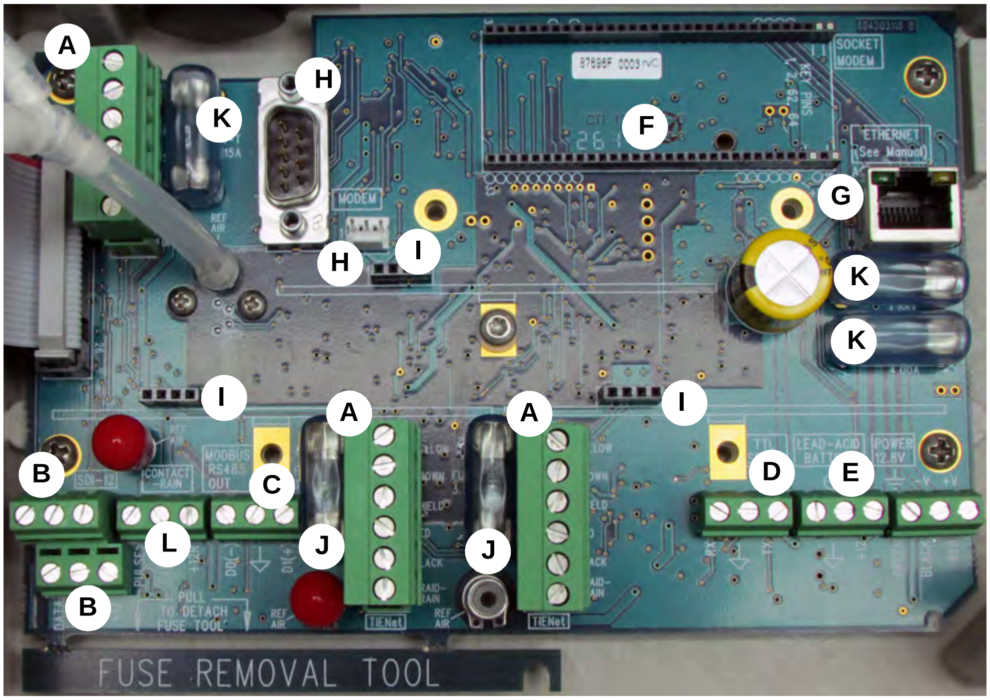
⚠ WARNING

Adjusting the low battery cutoff improperly will damage the batteries. Teledyne Isco assumes no liability for damage done to Teledyne Isco or third party vendors batteries. Adjust the low battery cut off at your own risk. User assumes all liability for damage done to batteries by altering the low battery cut off.

To allow for greater flexibility and possible usage, with disposable batteries, the low battery cutoff point can be adjusted by the user. The duration the battery must remain at this voltage for shutdown to occur is fixed at 5 min. If the low battery cut off is altered it must remain at the adjusted level for 5 min before the unit will shut down. Altering the low battery cutoff does not alter the recovery settings. No matter what the low battery cutoff is set to the unit will not recover or turn back on until the battery voltage is at 13.0 for 2min.

4.5 Connect to External Devices

Connection to TIENet socket.



Note: No 12.8VDC power supply for Signature Portable

A	External TIENet Devices/ Modbus RS485 In D1 = Yellow (+) D0 = Brown (–) Gnd = Black
B	SDI-12 Input
C	Modbus RS485 Out
D	TTL Serial
E	Battery Backup/ Battery for Portable
F	Ethernet Modem
G	Ethernet Port
H	Cellular Modem (power & serial)
I	4-20mA Input/Output Card and Contact Output Card
J	Fuse "T" 3.15A
K	Fuse "T" 4.00A
L	Rain Gauge

Figure 4-11 Connector case, connectors, and fuses for Signature Portable Flow Meter

4.5.1 Connecting Devices to the TIENet Receptacle

The optional external TIENet devices compatible with the Signature Portable all scan in the hardware in the same manner. Multiple TIENet devices can be connected simultaneously to the same Signature Flow Meter. The following TIENet smart sensors/cables will attach to the TIENet receptacle:

- Ultrasonic Level Sensor
- Area Velocity Sensor
- Bubbler
- pH/Temperature
- LaserFlow
- Sampler

Connecting a TIENet receptacle to the Signature Portable

To connect the TIENet plug from the sensor to the TIENet Receptacle:

1. Align the connectors and push together (Figure 4-12).
2. After the physical connection is made, a scan must be performed (see section 2.6.1) for the device to be recognized.

For additional TIENet connections, use the TIENet Y-cable or alternately an expansion box.

O-Ring and Lubrication for the TIENet receptacle

1. Coat the O-ring's sealing surface with a silicone lubricant.

⚠ CAUTION

Do not use petroleum-based lubricants. Petroleum-based lubricants will cause the O-ring to swell and eventually deteriorate. Aerosol silicone lubricant sprays often use petroleum-based propellents. If you are using an aerosol spray, allow a few minutes for the propellent to evaporate before proceeding.

2. Align and insert the connector. The sensor release will "click" when the sensor connector is fully seated.
3. Connect the two caps together.

Figure 4-12 How to connect a TIENet receptacle to the Signature Portable

Three-Hole Cord Grip

The following device wires/cables are normally connected thru the 3-hole cord grip:

- Rain Gauge
- SDI-12
- Modbus output

The wire/cable diameter can be .200 in to .230 in.

Installing a Cable Through a Three-Hole Cord Grip

1. Remove plug to open hole for an additional cable.

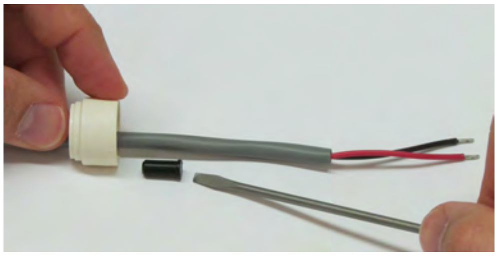
☑ Note

Gland nut must be loose to remove this plug.

Figure 4-13 Removing the plug

☑ Note

When replacing the plug, the rounded side needs to be pushed into the hole, with the flange facing out (see figure below).



2. Thread the cable through the open hole and various connectors.

3. Connect the three-hole cord grip to the Signature.

4. Attach the three-hole cord grip to the Signature port and attach the wires to the appropriate screw terminals.

⚠ CAUTION

Drilling holes in the Signature cases is not recommended and may result in water damage. The material of the Signature case is constructed of Noryl and does not lend itself to post molding alterations.

Connecting the Rain Gauge

The following shows how to connect the rain gauge to the Signature Portable and how the cables should look when properly connected (Figure 4-14).

1. Remove the rain gauge cap and connect it to the TIENet receptacle.

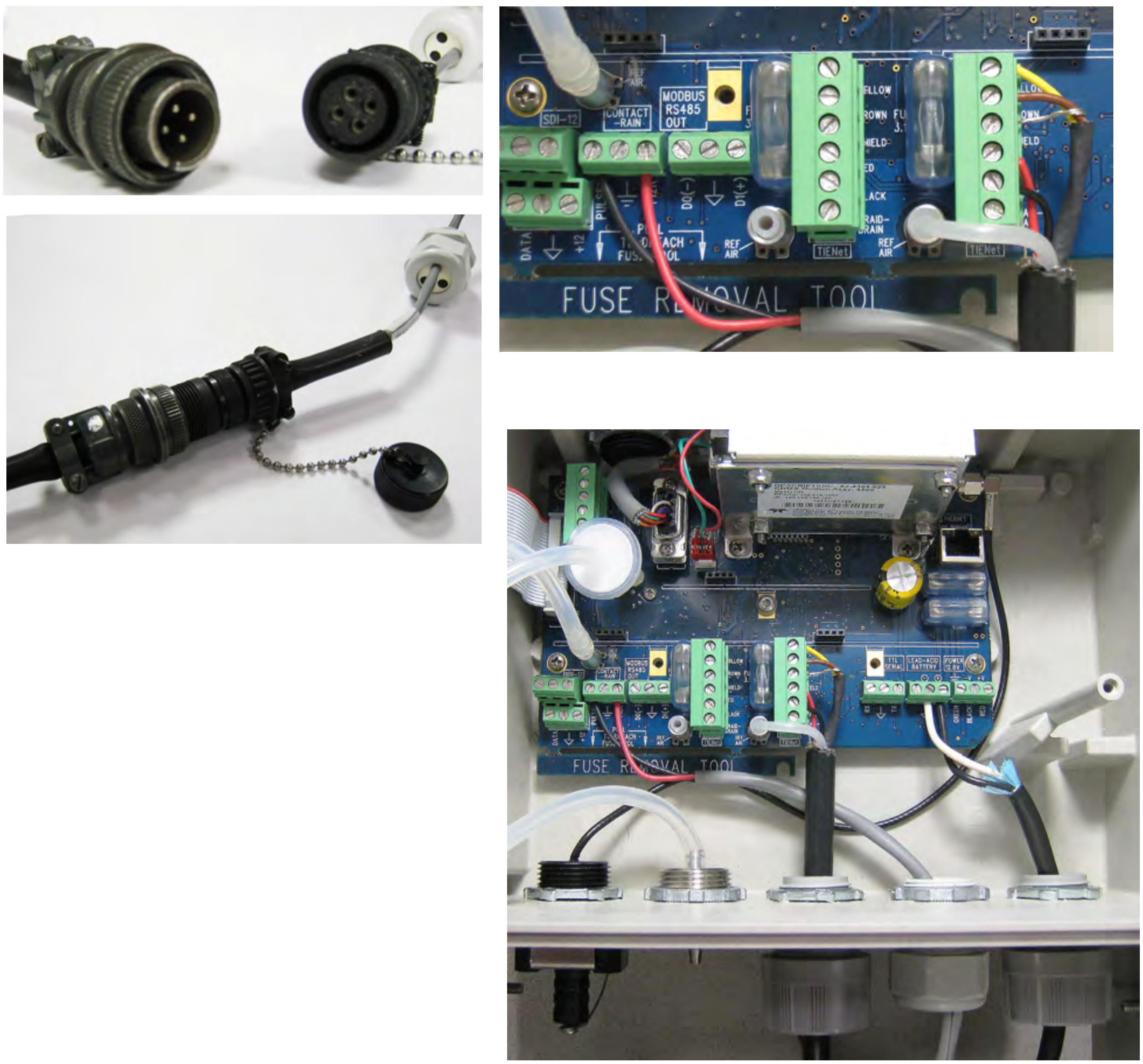


Figure 4-14 Connecting a rain gauge to the Signature receptacle (L) and then to the Signature connector board (R)

Signature® Flow Meter

Section 5 Equipment Options

Optional equipment is designed to be user-installable. Internal options, when ordered at time of purchase, are installed in the Signature meter at the factory. This section describes each option and provides instructions for its installation and operation.

All optional cable entries must use appropriate ID conduit connections or cord-grip fittings to retain the IP66 rating. If you are using non-TIENet or non-Signature cables, you must supply the appropriate ID conduit connections or cord-grip fittings.

☑ Note

Installation and operation of exterior TIENet devices is covered in detail in the user manual for that technology.

Many options require interior access for installation. For connector case interior access and TIENet device wiring instructions, refer to *Connecting External Devices*, on page 3-1 and *Connecting TIENet Devices*, on page 3-7.

⚠ DANGER

Before opening the case, first ensure that mains power is disconnected from the unit and any battery power is disconnected.

Part numbers for ordering accessories are provided in Appendix B *Options and Accessories*. Optional equipment from Teledyne Isco includes:

5.1 AC Power Cord Kit /AC Wiring (Applies to Permanent Installation Only)

The AC power cord kit includes a line cord with a strain relief cord-grip fitting. If ordered with the Signature Flow Meter, it will be shipped from the factory already installed.

Instructions for user installation are provided in this section. **Note that these instructions can also be used as guidance for user-supplied or replacement line cord, hard wiring, or replacement power supply.**

Open the flow meter housing, following all warnings and instructions provided in *Connecting External Devices*, on page 3-1.

1. *If a cord-grip fitting is already installed*, loosen the sealing nut on the AC line cord. *If conduit is installed*, remove the sealing material around the AC line cord where it enters the housing. This is to free the cabling for movement or removal.

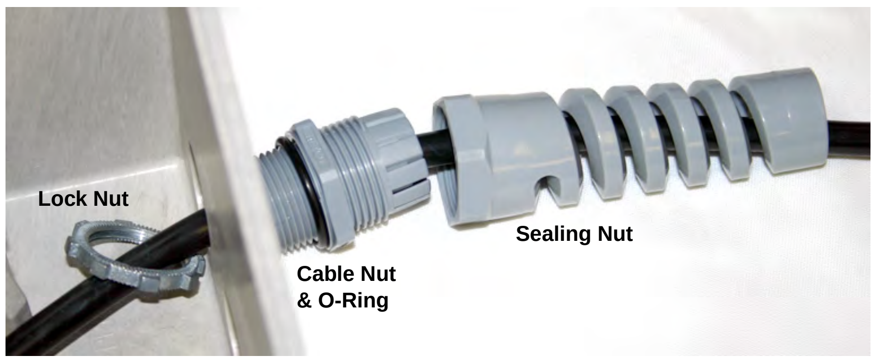


Figure 5-1   AC Line cord with a cord-grip fitting

2. Remove the mounting screw and lift the power supply out of its molded niche, taking care not to strain the wires going to the board.

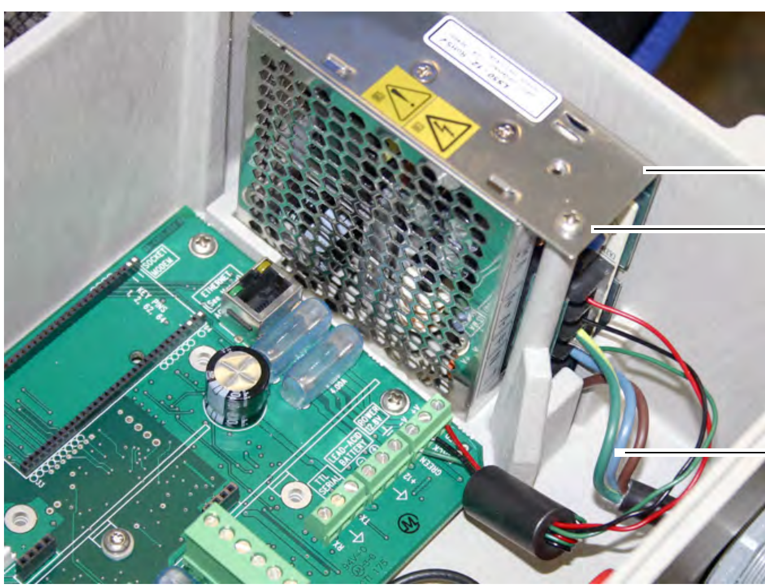


Figure 5-2   Power supply mounting screw

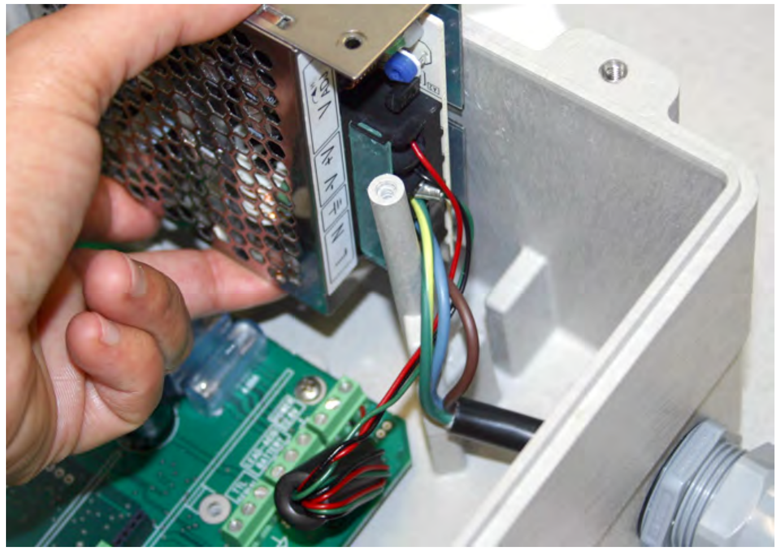


Figure 5-3 Power supply removal / replacement

3. Remove the clear plastic shield protecting the power supply terminals (Figure 5-4). Note that the Signature ground wire ends in a ring terminal so the line cord ground wire can easily be connected to the same terminal.
4. *If replacing the power supply*, label all wires according to their terminal connections (i.e., **L**, **N/L**, **Gnd**, **-V**, **+V**), and disconnect them.

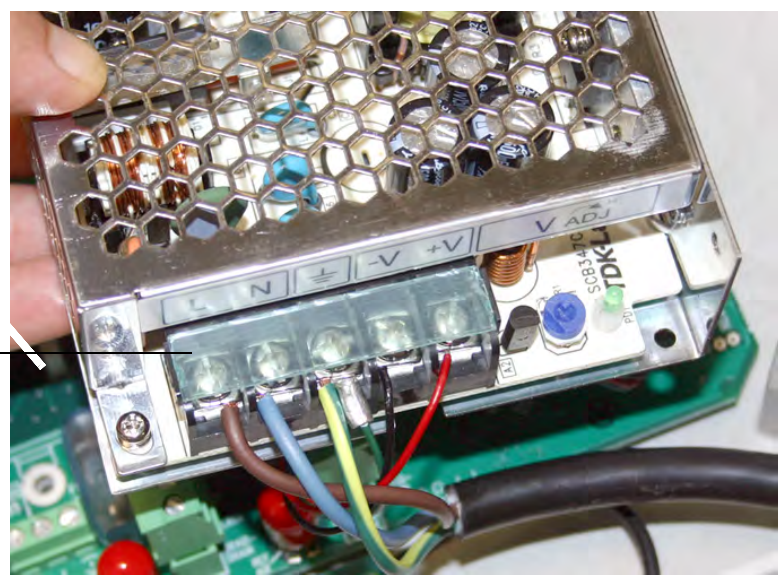


Figure 5-4 Power supply terminal strip: AC Input and DC Output

5. *If installing a cord-grip fitting (refer to Figure 5-1):*
   a. Remove the lock nut from the cable nut.
   b. Install the cable nut through the line cord cable entry (closest to power supply location) in the bottom of the connector case and secure it to the Signature case wall with the lock nut.
   c. Feed the line cord end through the sealing nut and then through the cable nut, into the case.
   d. Lightly tighten the sealing nut, just enough to hold the line cord in place while connecting it to the power supply.
6. Connect the line cord wires to the power supply, as shown in Figure 5-4, and then reinstall the plastic protective shield.

☑ **Note**

Double-check to ensure that the terminals labeled **Gnd**, **-V**, and **+V** on the Signature circuit board are wired to their corresponding terminals on the power supply.

7. Reinstall the plastic shield over the wiring connections.
8. When seating the power supply into its niche, guide the attached wires around in front of the mounting standoff and through the molded slot, so they are not strained or damaged (see Figure 5-3).
9. *If using a line cord*, gently tug the line cord to remove any slack within the enclosure, taking care not to stress the connection, and tighten the cord grip sealing nut.

⚠ **CAUTION**

If you are using conduit instead of the cord-grip fitting, the conduit and wires in the conduit **must be sealed** to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

10. Close the front panel and fasten it shut with the two Phillips screws.

5.2 Battery Backup (Applies to Permanent Installation Only)

The battery backup option consists of a Teledyne Isco Model 946 lead-acid battery pack and extension cable, with special hardware to mount it on the top of the Signature Flow Meter, or on a wall. The unterminated power cable normally enters the connector case through the second port from the right.

☑ **Note**

An optional external power loss alarm is available. Contact the factory for more information.

⚠ DANGER

Before opening the case, first ensure that mains power is disconnected from the unit.

⚠ CAUTION

Before opening the case, disconnect the optional battery backup power, if used.

⚠ CAUTION

Do not substitute another battery type for this option. Use only the Model 946 Lead-Acid battery.

Figure 5-5 Battery backup kit contents

⚠ CAUTION

If you are using conduit instead of the cord-grip fitting, the conduit and wires must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

Installation

1. Remove line power from the Signature Flow Meter and open the case as previously described in Section 3.2.

⚠ CAUTION

Do not connect the extension cable to the battery cable until all other steps are completed.

2. At the LEAD-ACID BATTERY terminal strip, connect the extension cable's black wire to the +12 terminal, and the white wire to the ground terminal.

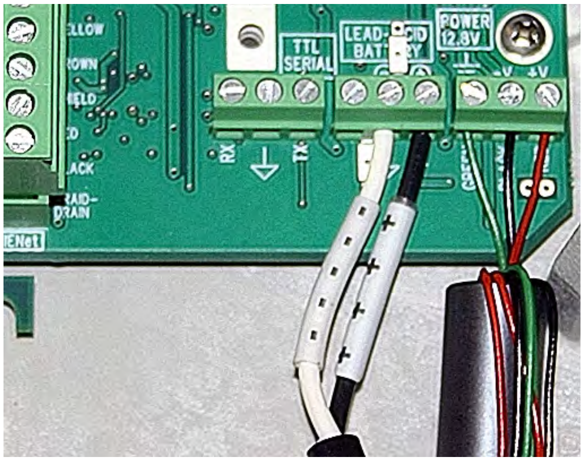


Figure 5-6   Attach extension cable to the connector case

3. Install the mounting plate, either on top of the flow meter case using the Torx screws provided, or on the wall nearby.

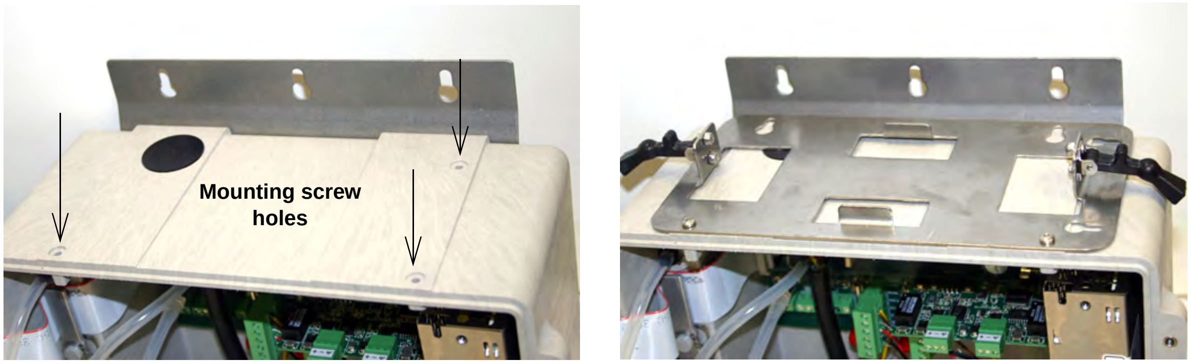


Figure 5-7   Installing the battery backup mounting plate

4. Place the 946 battery on the mounting plate and secure it in place using the two black rubber draw catches.
5. Connect the battery cable to the extension cable.

Figure 5-8 Backup battery, installed

> ☑ **Note**
> Be sure to unplug the battery when intentionally disconnecting from AC power.

5.3 Mechanical Totalizer

The mechanical totalizer is a seven-digit, non-resettable mechanical counter installed in the front panel. It increments according to programmed totalizer resolution and units of measure. The totalizer can be viewed once the metal shield or bubbler module is removed.

The volume represented by the mechanical totalizer is always the primary Total Flow programmed in Measurement Setup > Volume Input Setup (refer to *Configure Options*, on page 2-19).

The mechanical totalizer increments with the **third significant digit** of the selected resolution (see Figure 2-15 *Menu Tree: Volume Input Setup (total flow)*), e.g.:

Resolution 999999999 = Increment every 100 units;

Resolution 99999999.9 = Increment every 10 units;

Resolution 9999999.99 = Increment every 1 unit, etc.

The Signature permits a maximum 300 counts per minute; if totalized flow exceeds this rate, remaining volume will be buffered until it can be counted, although buffering over extended time periods is not recommended.

Installation

1. Remove line power from the Signature Flow Meter and open the case as previously described in Section 3.2.

2. Remove the four mounting screws holding the metal shield in place and set it aside.
3. Using a razor blade or utility knife, carefully cut the six tabs in the control panel label to detach the totalizer window cover.

☑ Note

Be sure to cut all six tabs. Pulling on the cover with some of the tabs still attached will damage the control panel label.

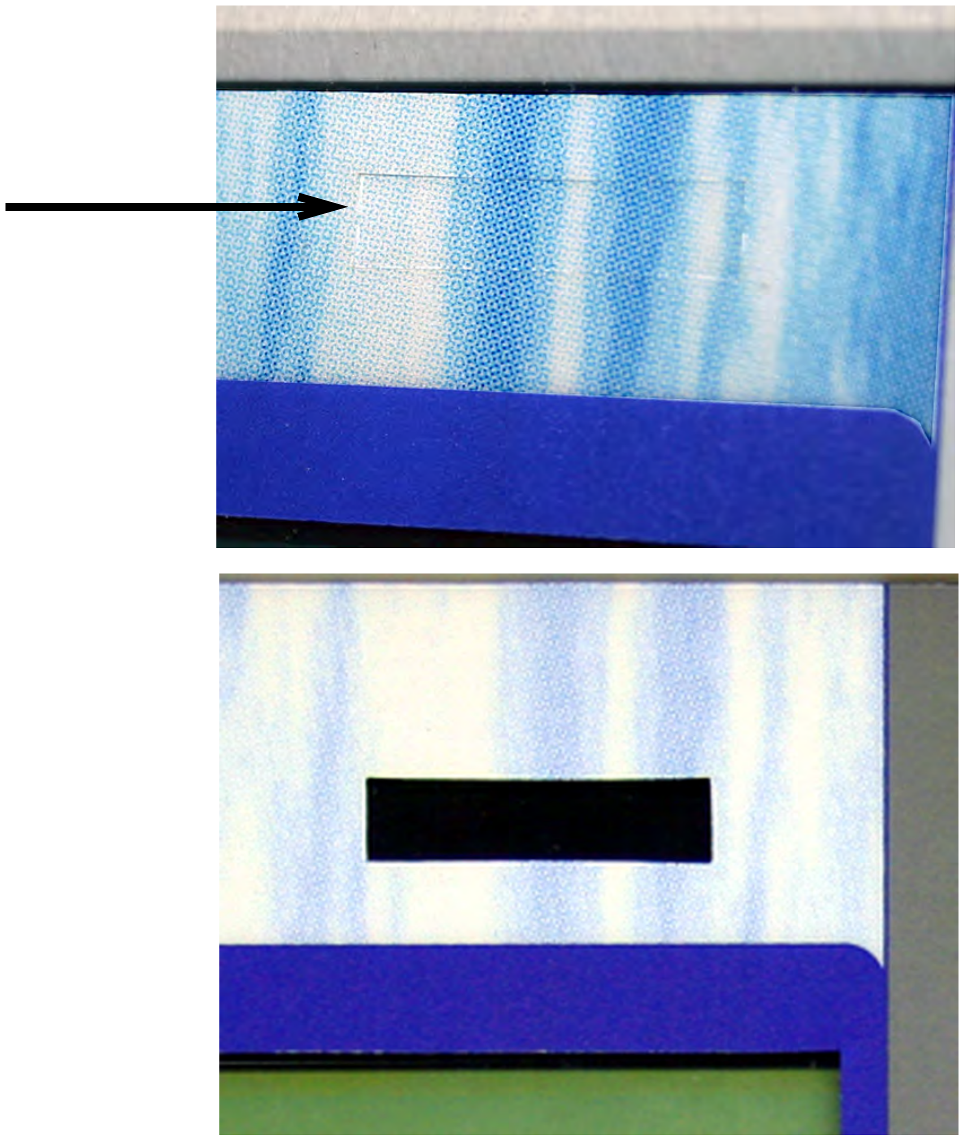
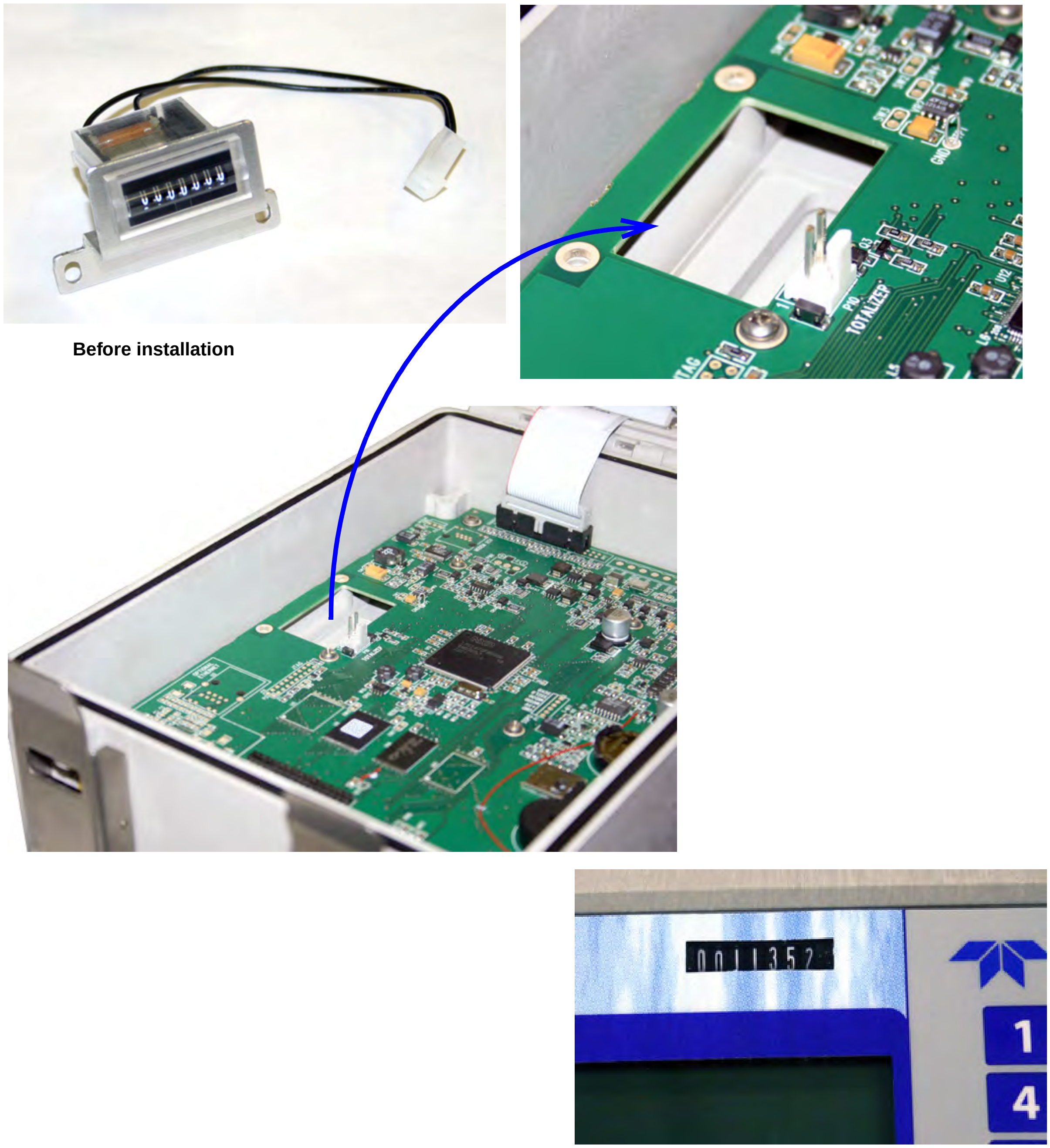


Figure 5-9   Remove totalizer window cover

Referring to Figure 5-10:

4. Remove the two screws above the totalizer cutout provided in the Main CBA. These screws will be used for mounting the totalizer.
5. Install the totalizer in the cutout, attaching the two mounting tabs with the two screws, so that the numbers appear in the window.
   View the totalizer through the window and adjust the position, if necessary, before tightening the screws.
6. Plug the totalizer connector into **P10** on the Main CBA. This two pin connector is keyed to prevent incorrect attachment.



Before installation

After installation

Figure 5-10 Optional non-resettable totalizer installation

5.4 External Desiccator

For Signature systems using the 330 or 360 Bubbler Module and/or the TIENet 350 Area Velocity Sensor, the desiccator vents the reference port for a pressure transducer, and the air intake port for the bubbler system air pump, keeping the interior of the flow meter case dry, as well as the sensor reference line.

☑ Note

The desiccant is standard on the portable version of the 330, 350, and 360 Bubbler module. It is not standard on the non-portable 310 Bubbler module.

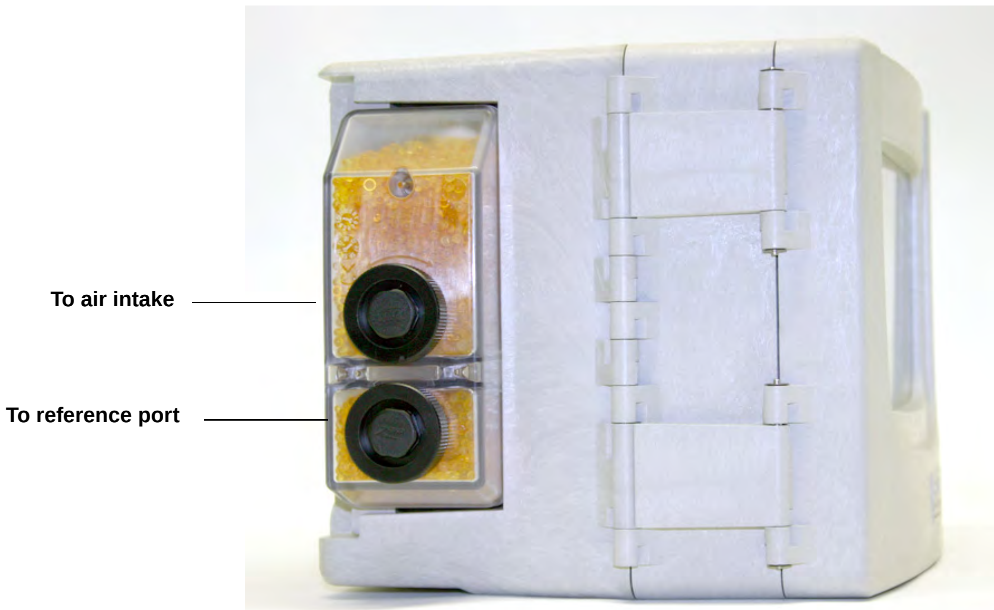


Figure 5-11 External desiccator, installed

Remove the two red protective end caps from the ports before installing a new cartridge.

Figure 5-12 Remove red caps before installing external desiccant cartridge

The desiccant cartridge is held in place by a spring tab on the side of the flow meter. Press against the front of the cartridge to disengage it from the unit.

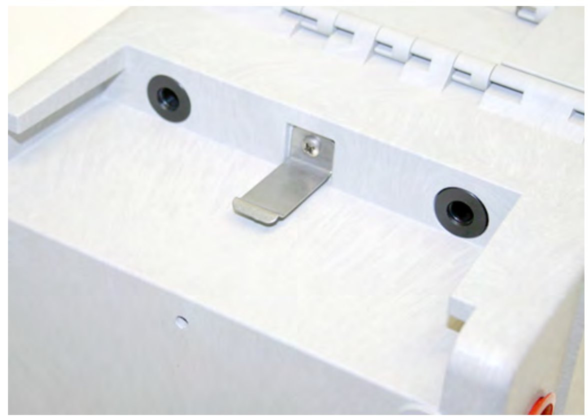


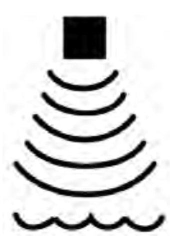
Figure 5-13 Removing the external desiccant cartridge

The desiccant cartridge requires periodic maintenance. Refer to Section 6.5.2 *External Desiccator* for instructions.

5.5 TIENet® Devices

Teledyne Isco's proprietary TIENet connectivity allows for the combination of multiple flow measurement technologies and other devices with the Signature flow meter.

5.5.1 Ultrasonic Level Sensor



The TIENet 310 Ultrasonic Level Sensor mounts directly over the flow stream. The sensor measures level by transmitting an ultrasonic pulse toward the liquid surface and then measuring the time it takes for the echo to return. The 310 is normally used with some type of primary device (typically a weir or flume) to measure flow in an open channel.

The 310 Sensor is ATEX-approved for use in potentially explosive atmospheres when specific conditions are met. Refer to the 310 user manual, as well as the control installation drawing in Section 3.8.

For complete installation and operation procedures, refer to the TIENet 310 sensor's user manual.

5.5.2 Bubbler Level Sensor

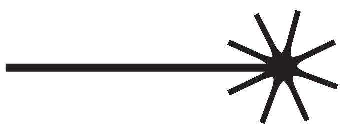
The factory-installed TIENet 330 Bubbler is normally used with some type of primary device (typically a weir or flume) to measure flow in an open channel.

The amount of pressure required to force bubbles from the end of a submerged bubble line is directly dependent on the hydrostatic pressure of the flow stream over the end of the bubble line. A pressure transducer inside the module senses this pressure and converts it into a level signal that the flow meter uses to calculate flow rate and total flow.

In order to operate with the 330 Bubbler, the Signature must have an external desiccator installed. For installation of the external desiccator, refer to Section 5.4.

Because the 330 Bubbler is a standard component in bubbler Signature meters, installation instructions are located in Section 6 *Maintenance and Servicing*, under *330 Bubbler Installation*.

5.5.3 Laser Doppler Velocity Sensor

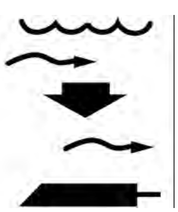


The TIENet 360 LaserFlow™ velocity sensor remotely measures flow in open channels with non-contact Laser Doppler Velocity technology and non-contact Ultrasonic Level technology. The sensor uses advanced technology to measure velocity with a laser beam at single or multiple points below the surface of the wastewater stream.

To operate with the LaserFlow, the Signature requires firmware version **1.18** or later. Firmware update instructions are provided in Section 6.3 *Firmware Updates*.

For complete installation and operation procedures, refer to the LaserFlow sensor's user manual.

5.5.4 Continuous Wave Doppler Velocity Sensor



The TIENet 350 Area Velocity Sensor measures flow stream average area velocity and liquid level. The Signature uses this information to calculate the flow rate and total flow of the stream. To operate with the 350 sensor, the Signature requires firmware version **1.18** or later. Firmware update instructions are provided in Section 6.3 *Firmware Updates*.

The sensor is mounted in the flow stream, normally at the bottom of the channel. It measures average velocity using continuous ultrasonic sound waves to produce a Doppler effect. The sensor measures liquid level using an internal differential pressure transducer.

In order to operate with the 350 AV sensor, the Signature must have an external desiccator installed (see Section 5.4 *External Desiccator*). Signature bubbler systems will already have a desiccator installed. If you are adding a 350 AV sensor to a non-bubbler system, you will also need to add an external desiccator.

For complete sensor installation and operation procedures, refer to the TIENet 350 sensor's user manual.

Optimal drying power

Some Signature flow meters have a single piece of tubing installed between the reference port and the humidity connector, and a cap plug on the intake port. While a Signature with this tubing configuration will operate satisfactorily with the 350 AV sensor in most situations, you can configure the tubing to utilize both chambers of the external desiccator to increase drying power and extend the desiccant service interval.

Items required:

- Plastic 'Y' Fitting (Part #209-0167-49)
- 0.25 x 0.125 silicone tubing (2 pcs, Part #029-1353-02)

Procedure:

1. Remove the cap plug.
2. Disconnect the tubing from the humidity connector and reroute it behind the ribbon cable.
3. Connect both the reference port tubing and the intake port tubing to the 'Y' connector.
4. Connect the 'Y' connector to the humidity connector (Figure 5-14).

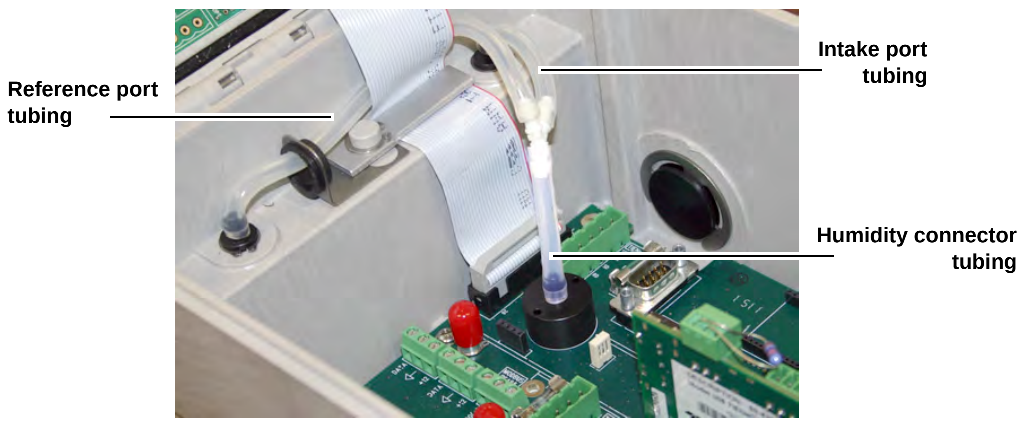


Figure 5-14 Tubing configuration for optimal drying power (Exterior desiccator required)

5.5.5 Sampler Interface

The TIENet 306 Sampler Interface connects the Signature Flow Meter to a Teledyne Isco wastewater sampler. Through this connection, the Signature can enable the sampler based on user-specified conditions, pace the sampling routine based on flow volume, and receive sample and bottle information from the sampler.

For complete installation and operation procedures, refer to the TIENet 306 device's user manual.

5.5.6 pH and Temperature Device

The TIENet 301 pH sensor measures the acidity or alkalinity of an aqueous solution by determining the relative quantity of dissociated hydrogen ions in the solution. The normal scale for pH runs from 0 to 14, with 0 being most acidic and 14 being the most alkaline.

For complete installation and operation procedures, refer to the TIENet 301 device's user manual.

5.5.7 TIENet Expansion Box

The water-tight expansion box connects to a TIENet terminal strip like other TIENet devices, and contains three additional strips inside, for connecting more devices. The expansion box can be daisy-chained with each box providing two additional cord grip ports. Additionally, the expansion box contains a TIENet connection for an option card (such as the 308 Analog Output option, Section 5.5.9). If an option card is used in an expansion box there is room for just one TIENet cable cord grip exiting the box.

☑ **Note**

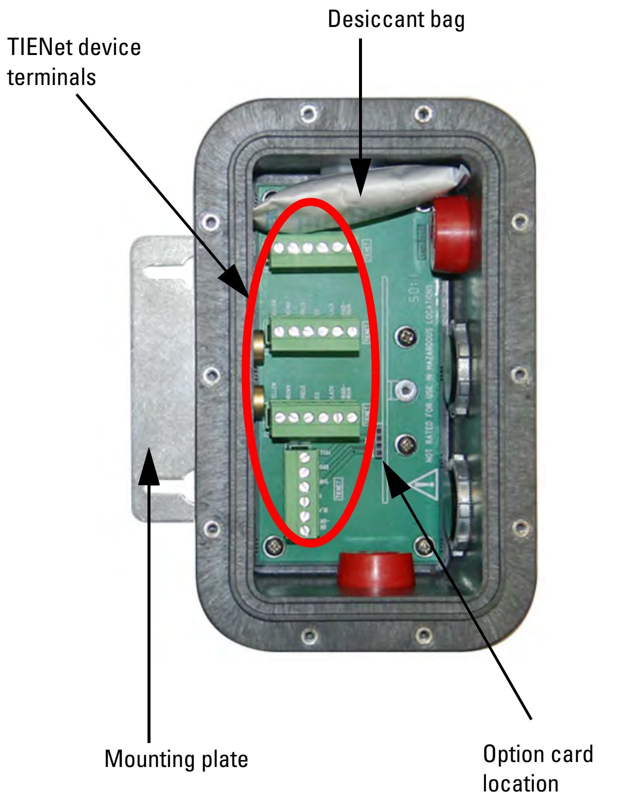
For applications requiring reference air moisture protection, please contact the factory.

☑ **Note**

The expansion box is not rated for use in hazardous locations.

Enclosure Rating:
IP67 (NEMA4X, 6)

All optional cable entries must use appropriate ID conduit connections or cord-grip fittings to retain the IP67 rating.
If you are using non-TIENet or non-Signature cables you must supply the appropriate ID conduit connections or cod-grip fittings.



(Cord-grip fittings are ordered separately)

Figure 5-15 TIENet Expansion Box

5.5.8 Contact Output Card (TIENet 304)

The contact output card provides a contact closure that can be enabled based off of conditions set in the equation builder.

The Signature accepts up to three internal, user-installed TIENet option cards. The 304 contact output card provides two contact outputs per card for connection between the Signature meter and non-Isco process control equipment that requires a contact output.

⚠ WARNING

The 304 contact output card is not recommended for voltages above 60vDC or 48vAC.

⚠ CAUTION

Use proper static dissipation when handling circuit boards.

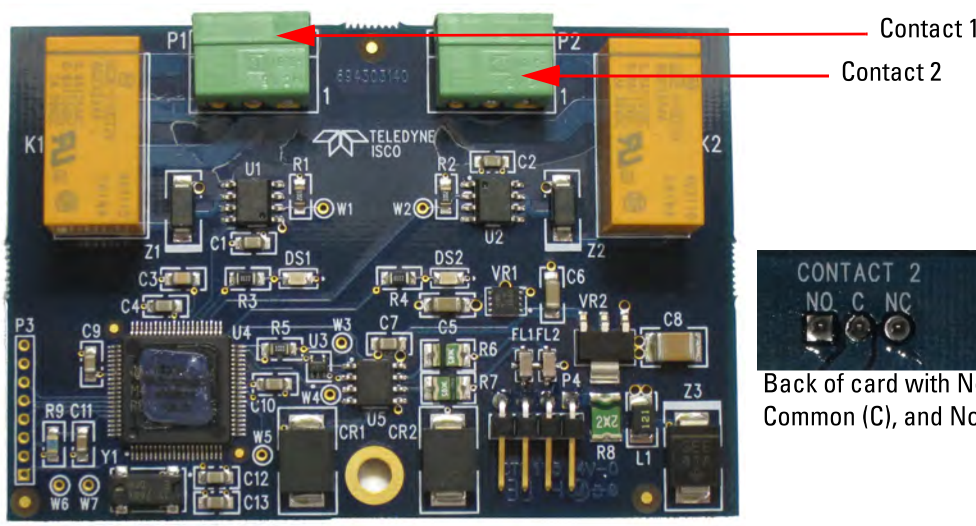
Programming menus and data display distinguish each output by serial number and channel number.

Tools required T-15 Torx driver

To install a card:

1. Remove power from the Signature flow meter and open the case, as previously described in *Connecting External Devices*, on page 3-1.
2. The option card includes a mounting screw. Remove the tubing retainer from the screw.
3. Remove the 3-pin header clip from its socket on the board.
4. Connect the receiving wires to the terminals according to their labeling (positive and ground).

   Note that Contact 1 and Contact 2 are identified on the back of the board.



Back of card with Normally Open (NO), Common (C), and Normally Closed (NC)

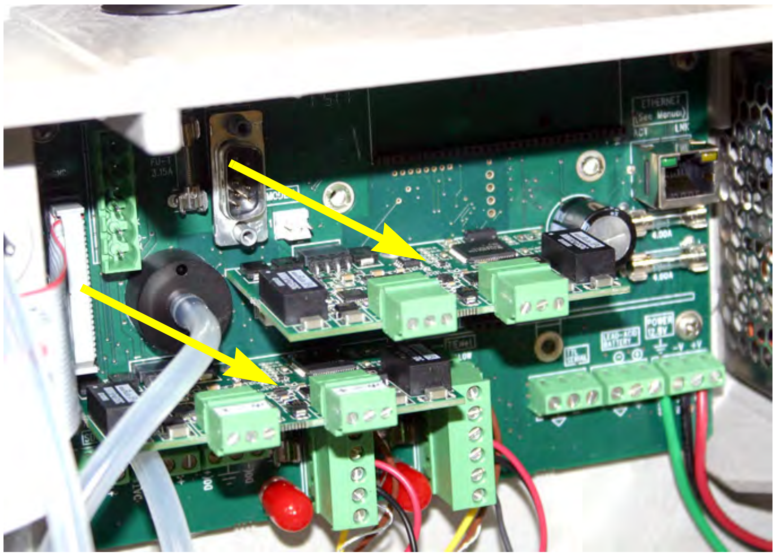
Figure 5-16 304 contact output card front and back view

☑ Note

• **Normally Open (NO)**: When the condition is met, the circuit will be closed.
• **Common (C)**: There is always be a connection to the common.
• **Normally Closed (NC)**: When the condition is met, the circuit will be closed.

5. Gently press the card down so that the 4-pin connector **P4** plugs into one of the three analog output jacks on the board (Item 'J' in Figure 3-2).

6. Secure the card in place by tightening its mounting screw with the T-15 Torx driver. Do not overtighten.



Two cards are shown here. The Signature accepts up to three cards at once, for a possible six simultaneous input/output channels.

Figure 5-17 View of two cards installed

7. Feed the clip with receiving wires through the appropriate port on the bottom of the meter, and press the clip down into its socket on top of the card.

☑ Note

Cabling is user-supplied. Shielded cable is recommended. For cord-grip fitting options, refer to Appendix B, Section B.2. If conduit is used, the conduit and wiring must be sealed to prevent entry of harmful gases and/or moisture.

Configuration

The 304 measurement configuration screen includes the 304 digital output option.

Home Display

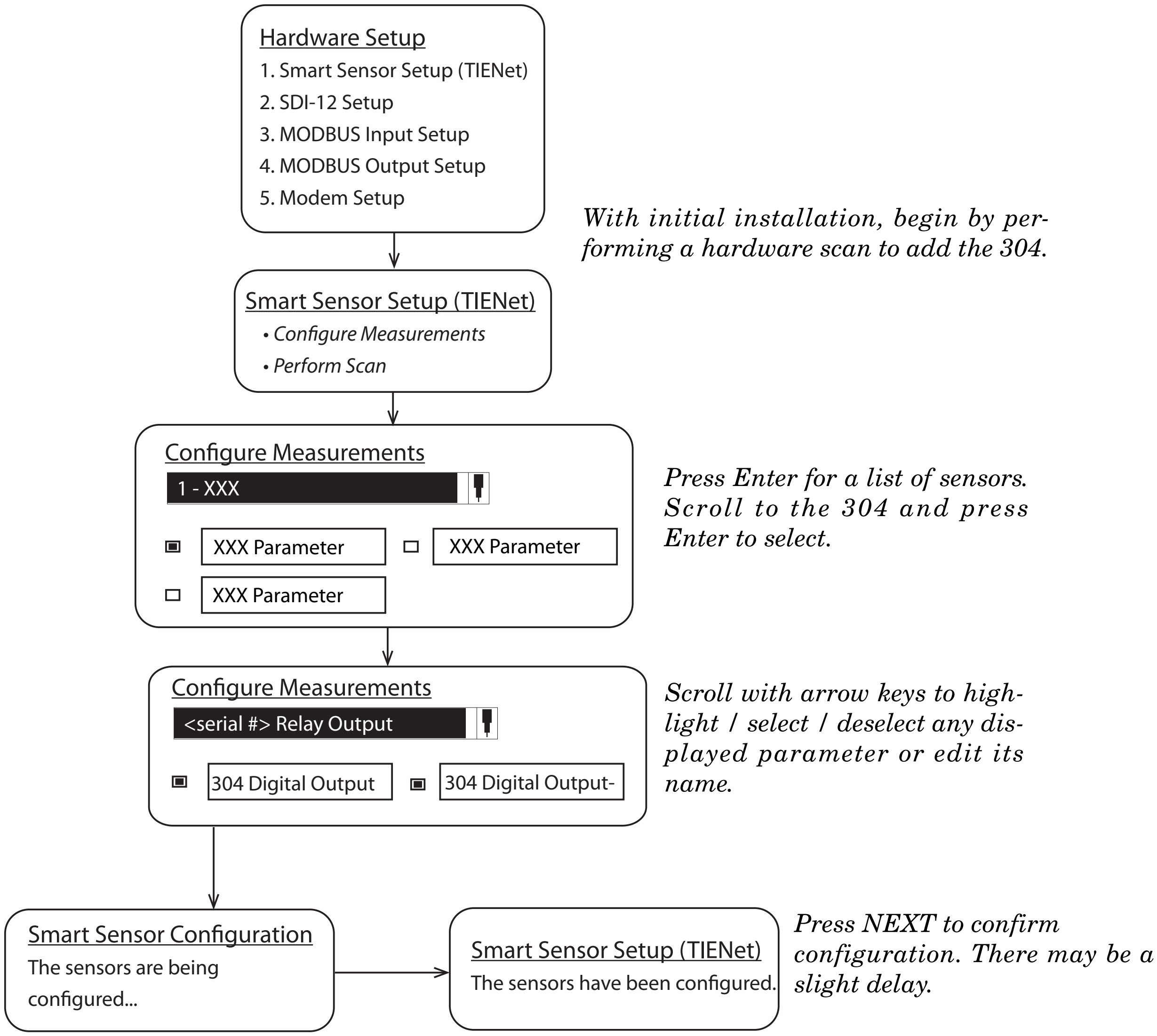


Figure 5-18 304 contact output device configuration

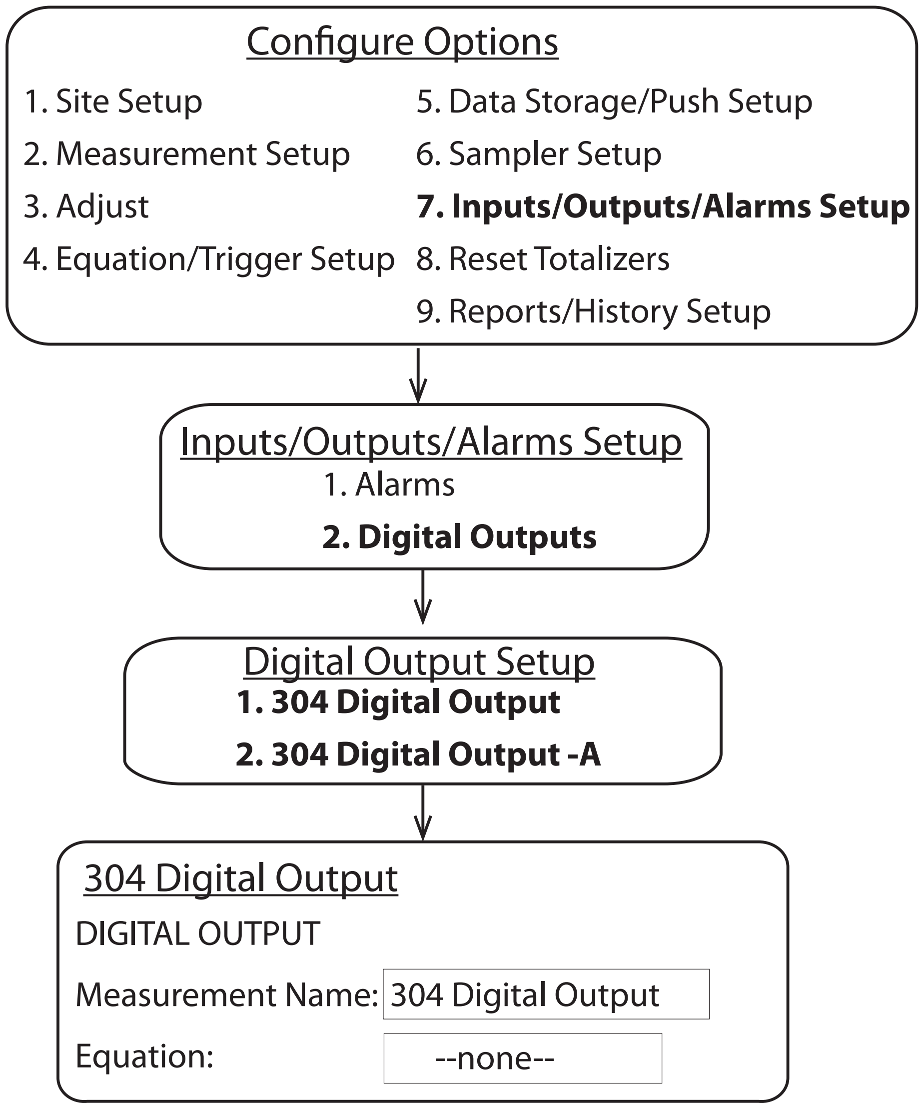


Figure 5-19 304 contact output setup

5.5.9 Analog Input Card (TIENet 307)

The 307 analog input card allows the Signature to record an analog signal as a number of data types from several different units.

The Signature accepts up to three internal, user-installed TIENet 307 option cards. The 307 analog input card provides two 4-20mA inputs a piece for connection between the Signature meter and non-Isco process control equipment or other equipment that outputs a 4-20mA current signal.

⚠ CAUTION

Use proper static dissipation when handling circuit boards.

Programming menus and data display distinguish each output by serial number and channel number.

Tools required

T-15 Torx driver

To install a card:

1. Remove power from the Signature flow meter and open the case, as previously described in *Connecting External Devices*, on page 3-1. If the LED is green, a current is flowing.
2. The option card includes a mounting screw. Remove the tubing retainer from the screw.
3. Remove the 3-pin header clip from its socket on the board.
4. Connect the receiving wires to the terminals according to their labeling (positive and ground).

   Note that Channel 1 and Channel 2 are identified on the back of the board.

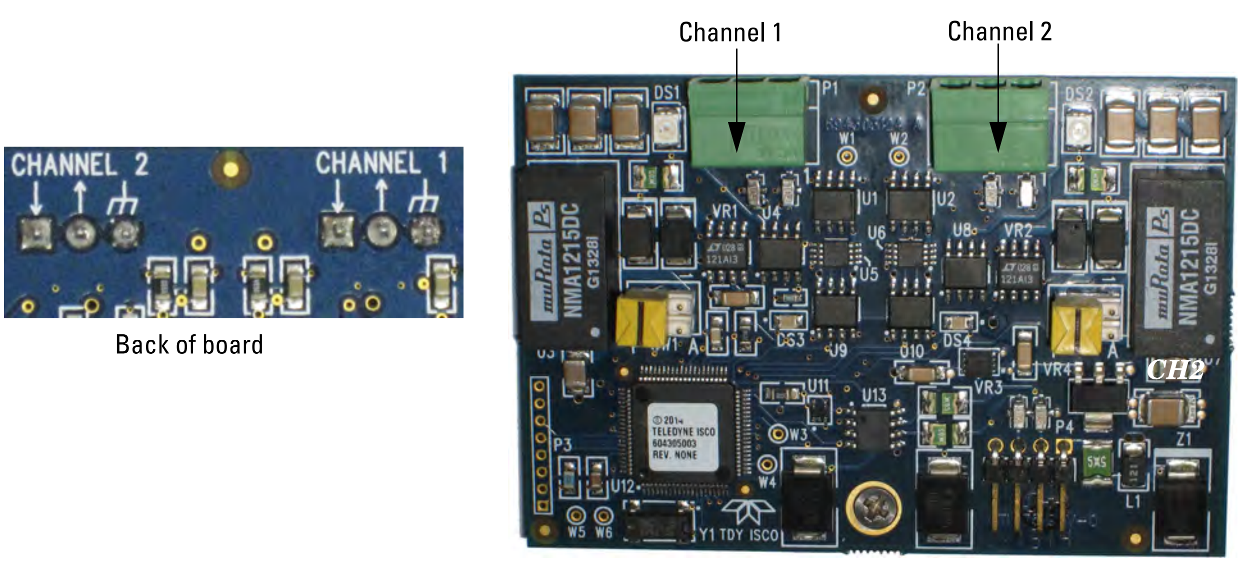


Figure 5-20 307 analog input channel identification and terminal connections

5. Gently press the card down so that the 4-pin connector **P4** plugs into one of the three analog output jacks on the board (Item 'J' in Figure 3-2).
6. Secure the card in place by tightening its mounting screw with the T-15 Torx driver. Do not overtighten.
7. Feed the clip with receiving wires through the appropriate port on the bottom of the meter, and press the clip down into its socket on top of the card.

Note

Cabling is user-supplied. Shielded cable is recommended. For cord-grip fitting options, refer to Appendix B, Section B.2. If conduit is used, the conduit and wiring must be sealed to prevent entry of harmful gases and/or moisture.

Channels

The orientation of the wires is dependent on the setting of the channel. If the channel is set to active, the positive wire is connected to the out arrow. The connection will be reversed for the passive mode.

Table 5-1 Direction of arrows and mode types

Switch	Out (arrow pointing away from the board)	In (arrow is pointing toward the board)
Switch is in the active mode (A)	Positive	Negative
Switch is in the passive mode (P)	Negative	Positive

Active Mode

Passive Mode

NOTE: Active mode supplies power to the loop. Passive relies on another device powering the loop.

Figure 5-21 Direction of switch in active and passive modes

Configuration

The 307 measurement configuration screen includes a reading at 0% (minimum or 4 ma) and a reading at 100% (maximum or 20ma) as well as a scaling option.

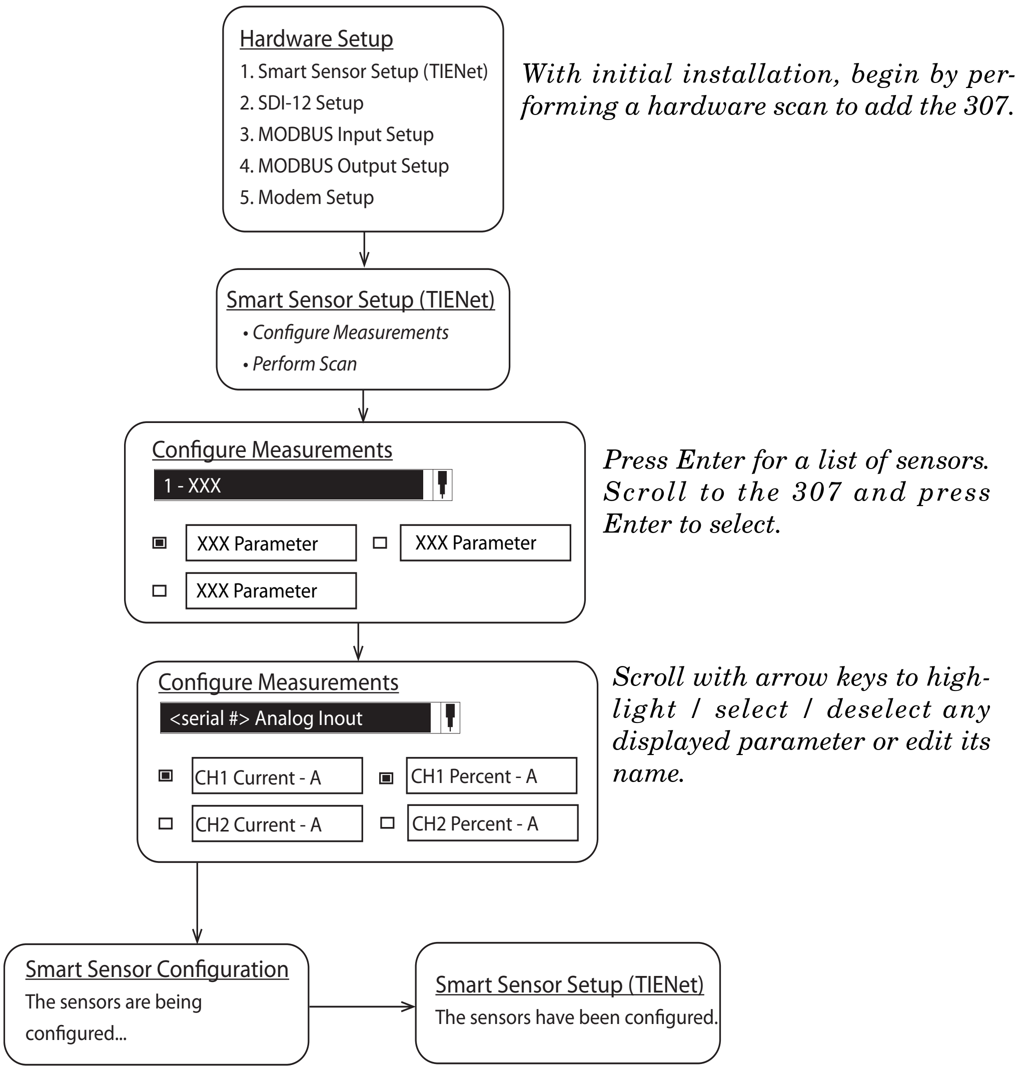
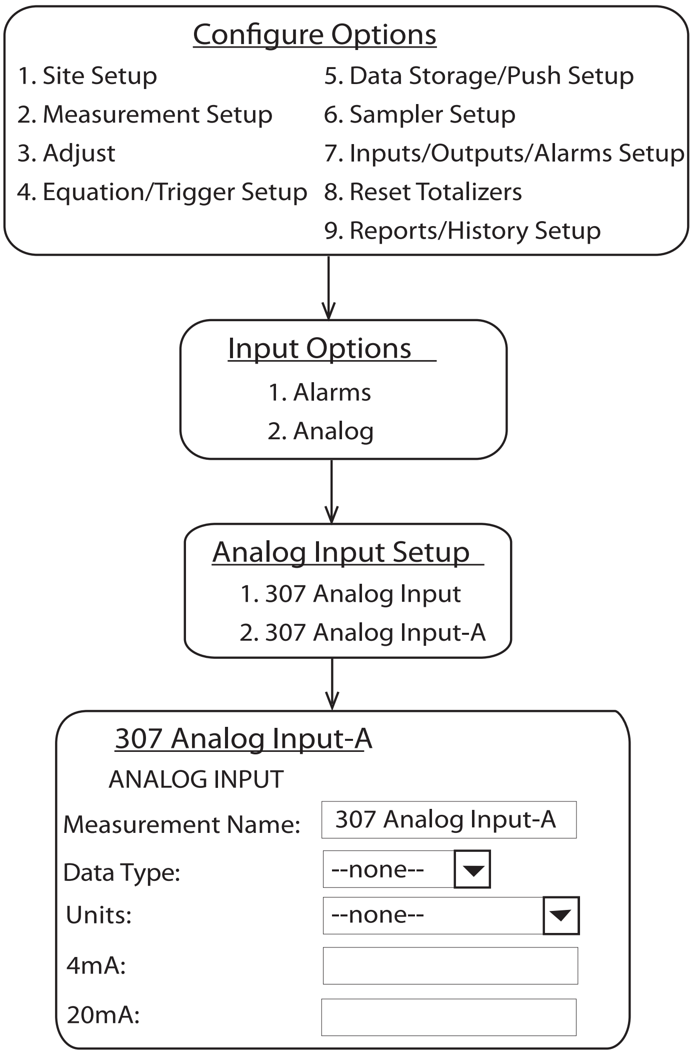


Figure 5-22 307 analog input device configuration



Press Enter for the list of parameters.

To edit units of measure, highlight and press Enter. Percent and humidity UOM are % only.

Figure 5-23 307 analog input setup

5.5.10 Analog Output Card (TIENet 308)

The 307 analog output cards convert digital information from the flowmeter to a variable analog output current ranging from 4 to 20 milliamperes. When a parameter measured by the flow meter is converted into an analog output, 4 mA becomes the 0%, or baseline, for the parameter, while 20 mA becomes the 100%, or full-scale, of the parameter. For basic programming steps, refer to Figures 5-18 and 5-19.

The Signature accepts up to three internal, user-installed TIENet option cards. The 308 analog output card provides two scalable 4-20mA outputs per card for connection between the Si nature meter and non-Isco process control equipment or other equipment that accepts a 4-20mA current signal.

⚠ CAUTION

Use proper static dissipation when handling circuit boards.

Programming menus and data display distinguish each output by serial number and channel number.

Tools required

T-15 Torx driver

To install a card:

1. Remove power from the Signature flow meter and open the case, as previously described in *Connecting External Devices*, on page 3-1.
2. The option card includes a mounting screw. Remove the tubing retainer from the screw.
3. Remove the 3-pin header clip from its socket on the board.
4. Connect the receiving wires to the terminals according to their labeling (positive and ground).

   Note that Channel 1 and Channel 2 are identified on the back of the board.

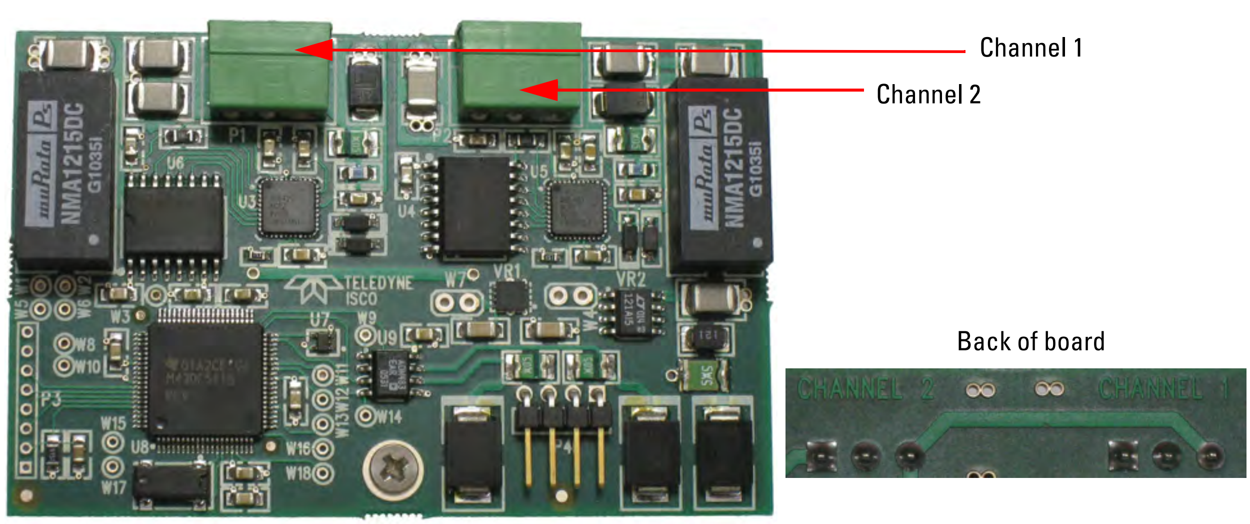


Figure 5-24 308 analog output channel identification and terminal connections

5. Gently press the card down so that the 4-pin connector **P4** plugs into one of the three analog output jacks on the board (Item ‘J’ in Figure 3-2).
6. Secure the card in place by tightening its mounting screw with the T-15 Torx driver. Do not overtighten.
7. Feed the clip with receiving wires through the appropriate port on the bottom of the meter, and press the clip down into its socket on top of the card.

☑ Note

Cabling is user-supplied. Shielded cable is recommended. For cord-grip fitting options, refer to Appendix B, Section B.2. If conduit is used, the conduit and wiring must be sealed to prevent entry of harmful gases and/or moisture.

Configuration

The 308 measurement configuration screen includes a minimum and maximum reading as well as a scaling option.

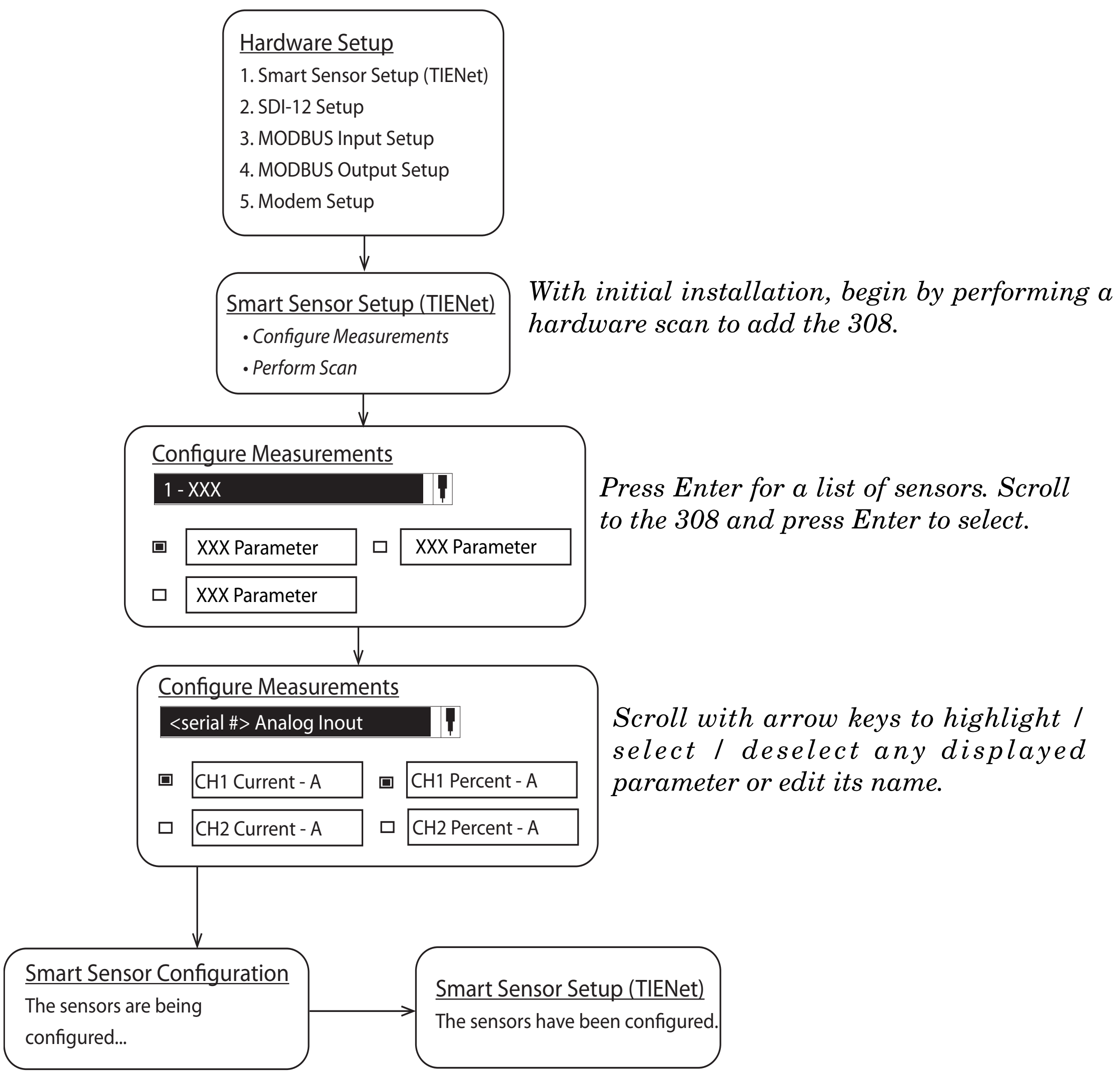


Figure 5-25 308 analog output device configuration

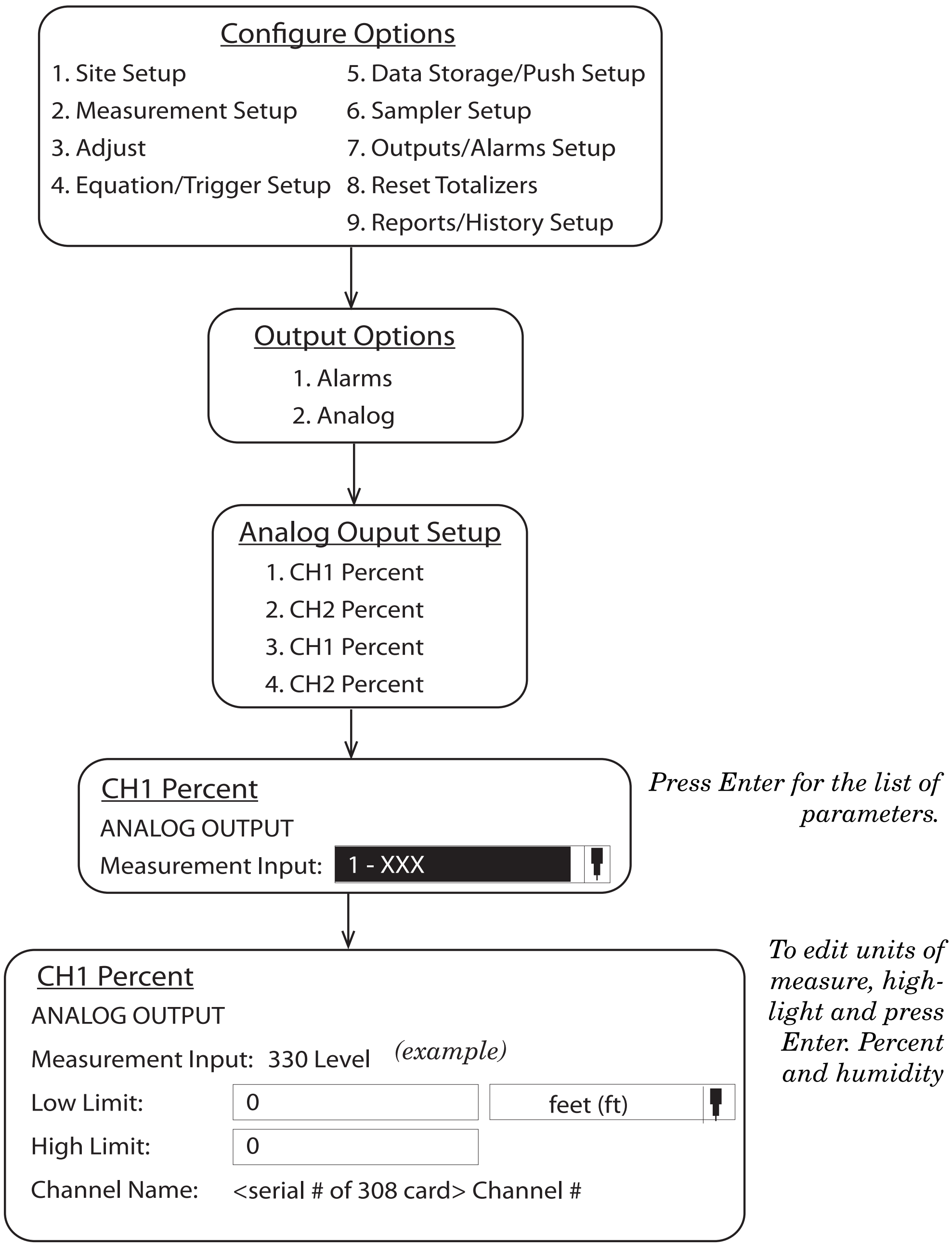


Figure 5-26 308 analog output setup

5.6 Isco Flowlink Software

Flowlink® is Teledyne Isco's proprietary software system for data acquisition, storage, retrieval, and analysis. Using the interface of Microsoft Windows, Flowlink can be used to remotely program the Signature Flow Meter, retrieve data from the flow monitoring system, present site data graphically, and generate statistical information from the site data.

Flowlink helps ensure data integrity by displaying the Signature's tracked configuration changes, data measurement summaries, diagnostic test results, and user events in the program. With these tools, Flowlink provides assurance that the data has not been altered.

USB drivers for computer direct connection to the Signature Flow Meter are included on the Flowlink CD, and must be loaded prior to direct connection between the computer and the Signature.

See Section *Connecting to the Signature with Flowlink*, on page 2-2 for instructions on how to connect to the Signature meter with Flowlink software.

From Flowlink, the event data can be exported and saved in the form of text reports on your computer, searchable by site name, module, and date. For complete information, refer to Section *Signature Data in Flowlink*, on page 2-34.

5.7 Ethernet Modem

Setup and data retrieval, as well as alarm output configuration, can be accomplished remotely via TCP/IP communication protocol with a static address, using Flowlink software and the ethernet modem to access the Signature's web browser. The ethernet modem is factory-installed on the connector case.

The ethernet modem can also be installed by the user. Remove line and/or optional battery power from the Signature Flow Meter and open the case as previously described in Section 3.2.

⚠ CAUTION

Always use proper static dissipation methods when handling circuit boards.

⚠ DANGER

Before opening the case, first ensure that mains power is disconnected from the unit.

⚠ CAUTION

Before opening the case, disconnect the optional battery backup power, if used.

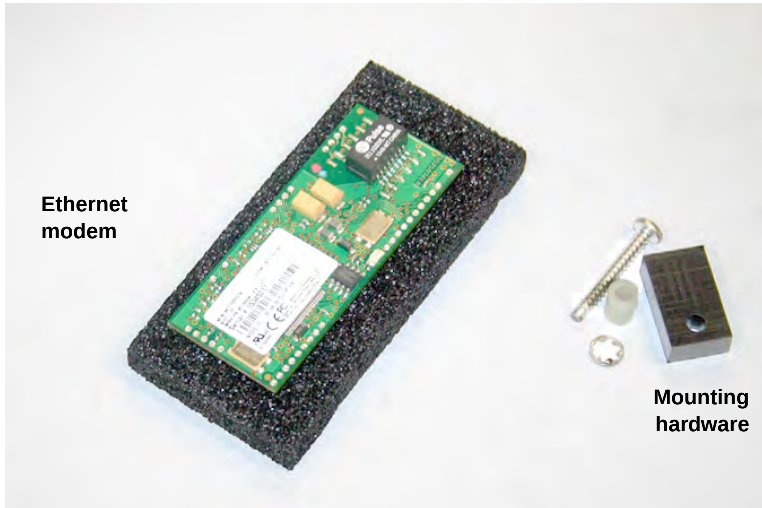
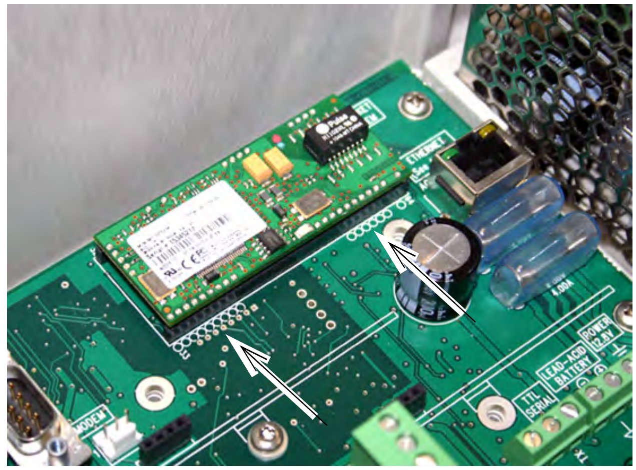
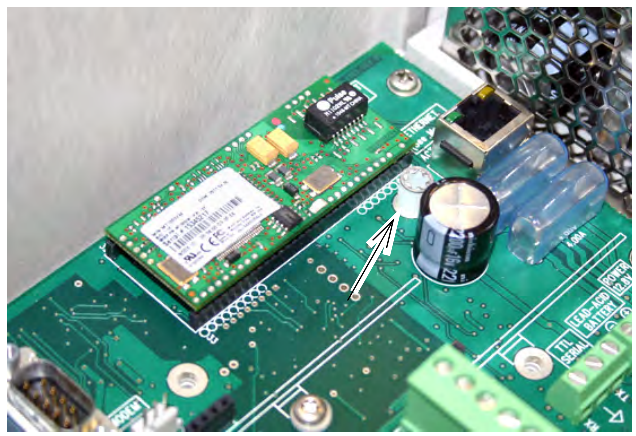


Figure 5-27 Ethernet modem kit contents

1. Press the modem assembly down into its socket on the connector case (item G in Figure 3-2 *Connector case, connectors, and fuses*), with the row of dots along the bottom left and right edges aligned with the row of circles on the board to ensure proper orientation.



2. Place the plastic spacer over the screw hole by the bottom right corner of the modem.
3. Place the lock washer on top of the spacer.



4. Place the rectangular retainer over the lockwasher, with the countersink facing up, and attach with the screw.

Figure 5-28 Ethernet modem installation

In order to communicate with the Signature Flow Meter using the ethernet modem, your network must have TCP/IP services installed. A static IP address must be reserved for the Signature, and client network computers must be allowed to access the static IP address.

5.7.1 Ethernet Modem Configuration

When installation is complete and power restored, wait one minute for the Signature to recognize the modem before programming.

> ☑ **Note**
>
> The Signature does not support Dynamic Host Configuration Protocol (DHCP). The network communication information (IP, gateway, and subnet mask) must come from your network administrator and be entered manually into the flow meter.

When you select Modem Setup from the Hardware Setup menu, the type of modem installed determines what screen is displayed.

To configure the Signature for ethernet communication, you must have the following information on hand prior to Hardware Setup:

IP Address – An Internet Protocol (IP) address is the unique numerical label assigned to each device (e.g., computer, printer, flow meter, etc.) on a computer network for interface identification and location addressing. The Signature's Ethernet modem requires a *Static* IP address for remote communication.

TCP Port – The default port setting is 1700. This is the communication port associated with the static IP address on your network.

Gateway Address – The gateway is the point of communication that joins two different networks with different base IPs.

Subnet Mask – This is the umbrella location that allows multiple nodes to communicate within the network.

It designates a subnetwork within the larger network. Traffic between subnetworks is exchanged or routed through the Gateway.

Special network access may be required to configure these settings. For further assistance, contact your network administrator.

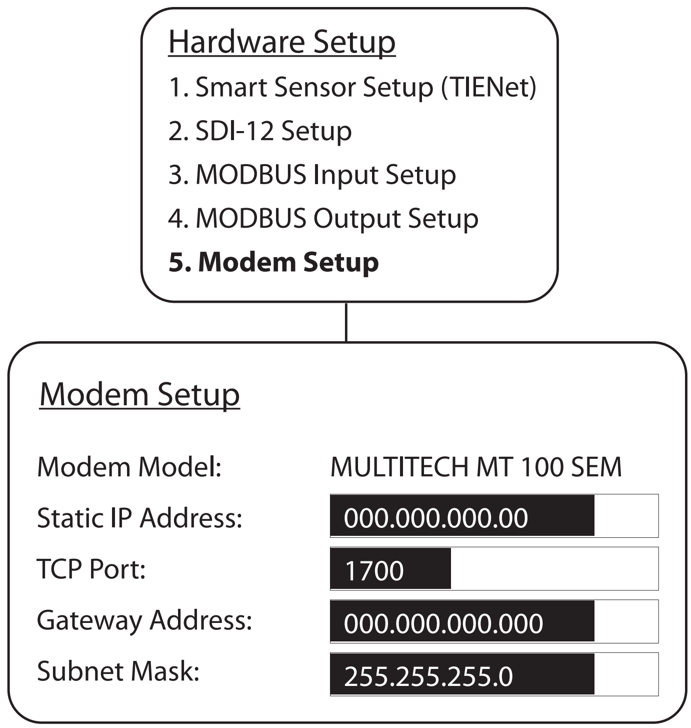


Figure 5-29 Ethernet modem setup: Communication settings (default settings shown)

5.7.2 Network Firewall Settings

In order for your network administrator to identify the Signature in the network firewall setup, it must have a node ID (also known as the MAC address). This is the NODE ID printed on the ethernet modem's serial tag (refer to Figure 5-30).

Figure 5-30 Locating the NODE ID (MAC address) on the ethernet modem

5.8 Cellular Modems

Setup and data retrieval through the Signature's web browser, as well as alarm outputs, can be accomplished remotely with one of the available cellular modems. The whip-style antenna has a magnetic mounting base.

Figure 5-31 Magnetic-mount cellular antenna

5.8.1 CDMA Modem

The Code Division Multiple Access (CDMA) modem can automatically push data to a secure server running Isco Flowlink Pro software, with 1xRTT data transmission.

Figure 5-32 CDMA Cellular modem

5.8.2 GSM Modem

The Global System Mobile (GSM) modem can automatically push data to a secure server running Isco Flowlink Pro software, with GPRS data transmission.

Your service parameters, or provider, can be changed by replacing the removable Subscriber Information Module (SIM) card in your modem.

> **Note**
> The modems shown do not necessary represent the modems installed.

Figure 5-33 GSM Cellular modem

5.8.3 Installing the Cellular Modem

The modem kit includes the modem, power cable, DB9 serial cable, and coaxial antenna plug cable.

> **Note**
> Before installing the modem, remove the top label (with the FCC ID on it) taped to the modem and adhere it to the outside of the Signature case on the bottom of the unit, on the left side, in the largest of the three sections (Figure 5-34). This is required by the FCC.

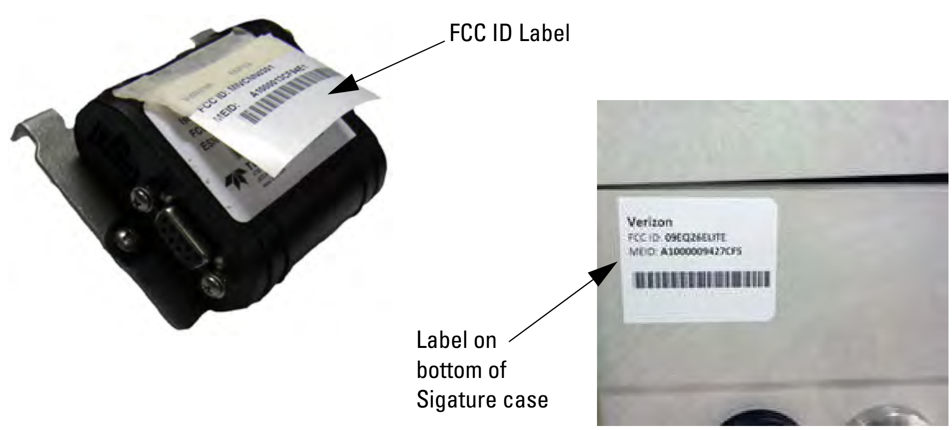


Figure 5-34 FCC ID label on modem and location of label on the bottom of Signature case

1. Remove line power from the Signature Flow Meter and open the case as previously described in Section 3.2.

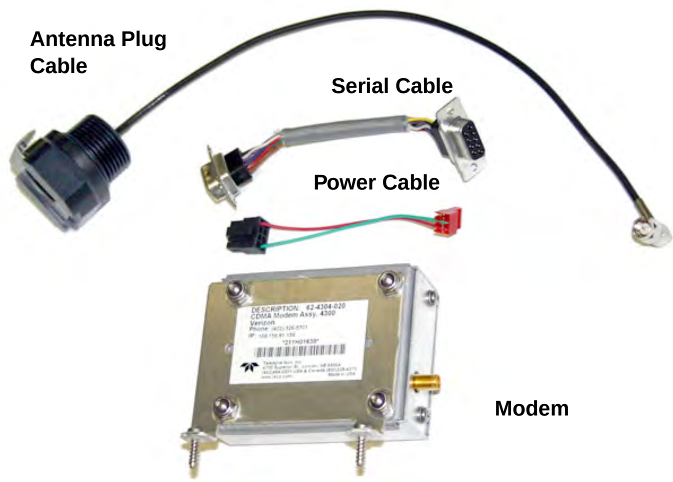


Figure 5-35 Cellular modem kit contents

2. Install the plug in the preferred port (far left most commonly used). Route the antenna plug cable under any other cabling, and install the plug in any open port.
3. Connect the three cables to the modem.
4. Remove the screw retainers and fasten the modem's mounting bracket against the connector case, as shown below, using the two mounting screws.
5. Plug the serial and power cables into their respective connectors on the board.

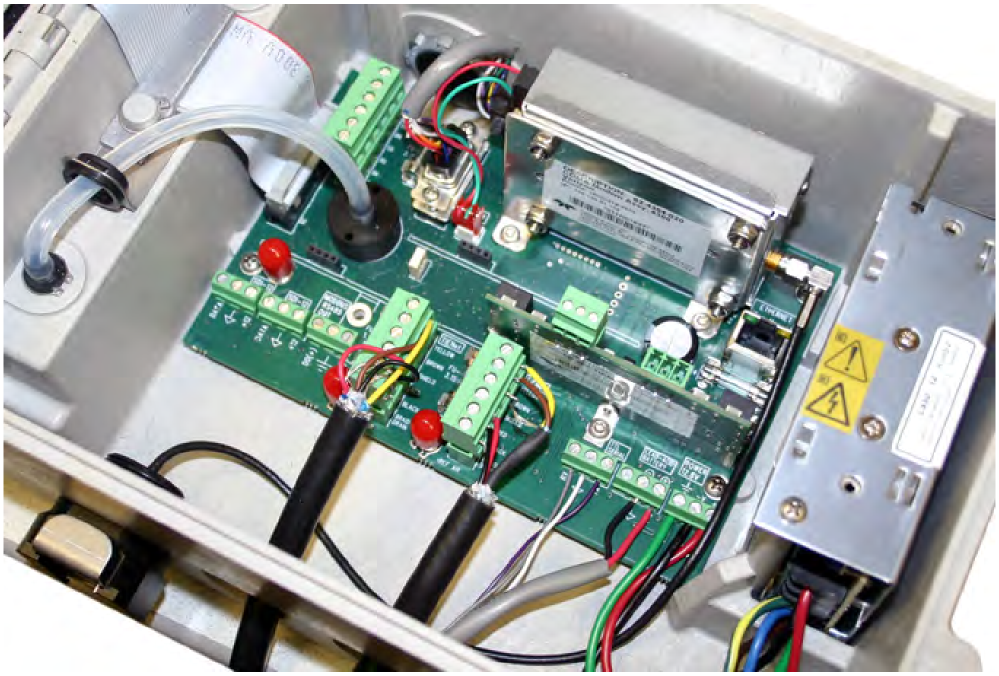


Figure 5-36 Cellular modem installation

5.8.4 Cellular Modem Configuration

When installation is complete and power restored, wait one minute for the Signature to recognize the modem before programming.

When you select Modem Setup from the Hardware Setup menu, the type of modem installed determines what screen is displayed.

To set up the Signature Flow Meter for cellular communication, select either internet (IP) or CSD for the connection.

For the GSM modem, if an Access Point Name (APN) is used, select SINGLE for the operating mode and enter the name.

For portable applications the modem can be set up with the call in the time window. To conserve power, the time window does not effect the push/outgoing connections. The time window restricts when the meter can be acceded via a modem connection.

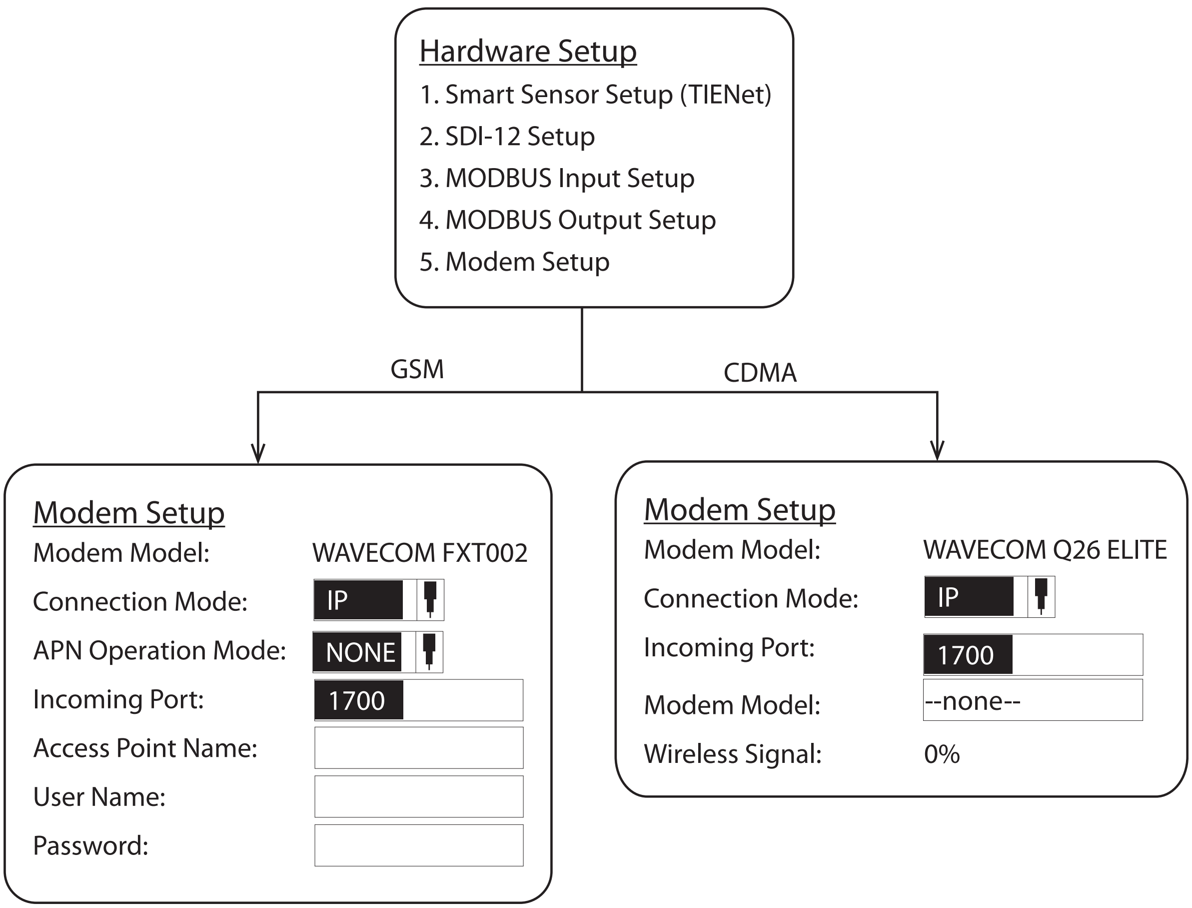


Figure 5-37 Cellular modem setup: Communication settings

Section 6 Maintenance and Servicing

6.1 Maintenance

The following tables are recommended maintenance checks to ensure proper operation. As site conditions may vary, increase the frequency of inspections as needed.

Table 6-1 Recommended Maintenance (Accessible Locations)

Action	Recommended Frequency	Location
Check desiccant for appropriate color[a]	Monthly or following humidity error	On-site
Check bubble line for plugs or obstructions	Monthly	On-site
Check bubble line for kinks	Monthly	On-site
Check pump run time during manual purge[b]	Monthly	On-site
Check for level measurement errors	Weekly	Via Flowlink application

a. When dry, the desiccant appears orange in color.
b. If the run time is >15 seconds, replace the intake gore filter.

Table 6-2 Recommended Maintenance (Difficult-to-Access Locations)

Action	Recommended Frequency	Location
Check desiccant for appropriate color[a]	Every 6 months or following humidity error	On-site
Check bubble line for plugs or obstructions	Every 6 months	On-site
Check bubble line for kinks	Every 6 months	On-site
Check pump run time during manual purge[b]	Every 6 months	On-site
Check for level measurement errors	Weekly	Via Flowlink application

a. When dry, the desiccant appears orange in color.l
b. If the run time is >15 seconds, replace the intake gore filter.

6.2 Cleaning

The Signature flow meter may be cleaned with water and a mild detergent. For hard to remove stains, isopropyl alcohol may be used. If the instrument is in an isolated area and the case is sealed closed, it may be cleaned using a water hose.

6.3 Firmware Updates

Signature and TIENet device firmware updates are provided in the form of .bin files, which will be available for download from the Teledyne Isco website. Note that firmware updates do not remove any program settings or delete data.

To install an update:

1. Create a folder in the top directory of a flash drive, and name it BINFILE.
2. Download the .bin file to be installed. To find your correct .bin file, go to www.isco.com and click on *Software/Firmware Updates* in the lower left corner. Select *Open Channel Flow Measurement*.

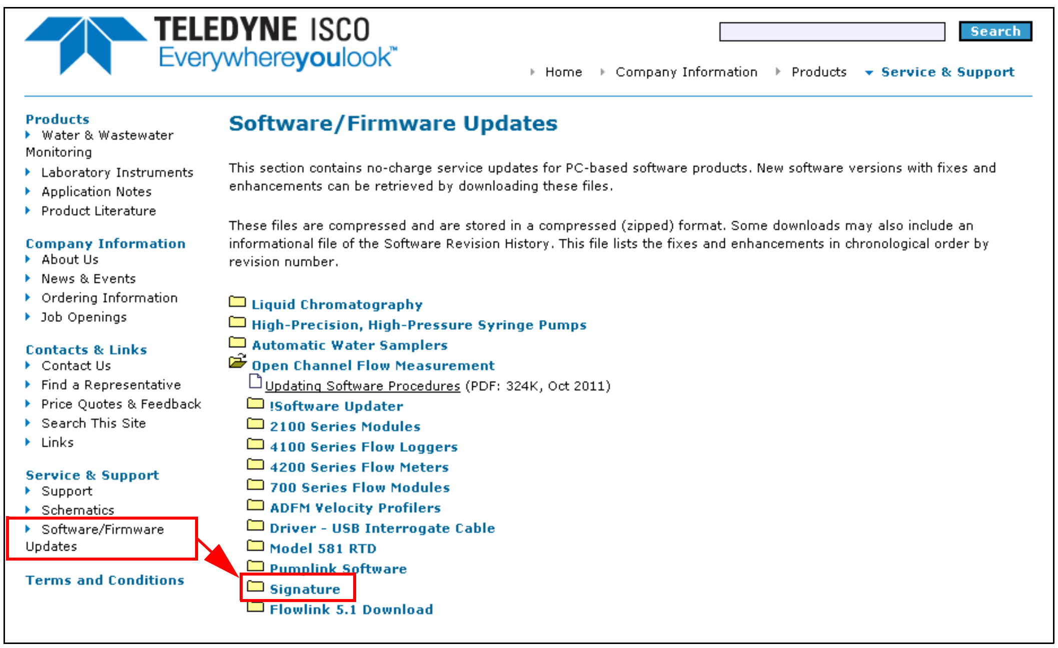


Figure 6-1 Locating firmware updates

3. Save the new .bin file(s) to the BINFILE folder you created on the flash drive.

4. Using the flash drive adaptor cable provided with the Signature, connect the flash drive to the micro-USB assembly on the flow meter's front panel.

Figure 6-2 USB Micro adaptor cable (flash drive not included)

5. The USB Options menu appears on the display. Select option #3, Update Firmware.
6. You will be prompted to select either Signature or TIENet firmware. Select the appropriate .bin file from the pull down menu and press NEXT.
   a. **Update Signature Firmware**
   The update will load for approximately three minutes. During this time, do not make any changes to the Signature. When the firmware load is complete, the Signature will prompt you to remove the USB drive. An automatic reboot then occurs over a period of approximately five minutes, during which the green LED signals that an internal operation is in progress. Do not unplug the flow meter or press any keys until the Home screen appears. In the event that the upload fails, contact Teledyne Isco.
   b. **Update TIENet (Smart Sensor) Firmware**
   Select the radio button next to each device to be updated and press NEXT. The progress of the sensor firmware update(s) will be displayed. A confirmation screen will appear when the update is complete.
   c. **Bootcode**
   This option is only used when the update(s) failed and the sensor is no longer responding. Select the "Bootcode" option, then select the appropriate file from the drop-down menu to be updated. All other updates are inactive when this option is selected.

6.4 Accessing the Interior

Some maintenance or servicing tasks require opening the Signature housing to access the interior. Always refer to this section prior to doing so.

⚠ DANGER

Before opening the case, first ensure that mains power is disconnected from the unit.

⚠ CAUTION

Before opening the case, disconnect the optional battery backup power, if used (refer to Figure 5-8 *Backup battery, installed*).

Note

Before restoring mains power, ensure that the flow meter's USB connector does not have a cable attached.

Open the door to access the two large screws holding the front panel on the connector case. Remove the two screws, then reinsert them in the front panel and latch the lid so they will not be misplaced.

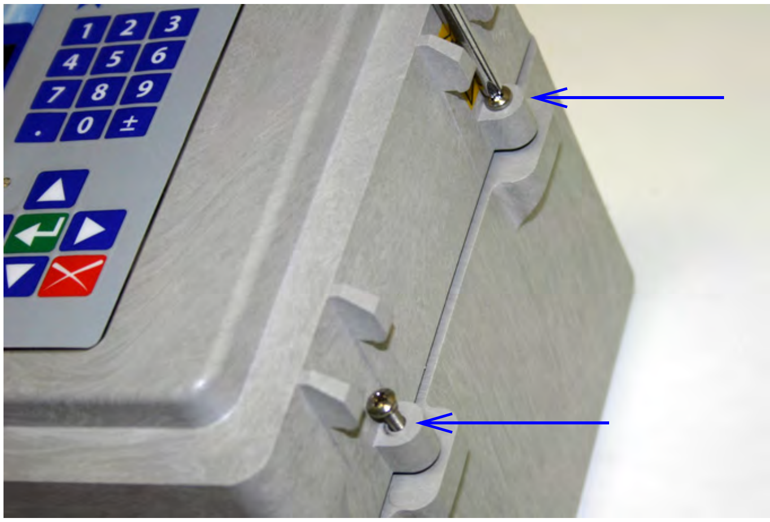


Figure 6-3 Open door and front panel to access interior

6.5 Desiccant

The inside of the flow meter housing must be kept dry at all times to prevent moisture damage to the internal components. All Signature flow meters have an internal desiccant bag to absorb moisture. Signature flow meters using a 330 bubbler also require an external desiccator.

If increased humidity is indicated by either the humidity reading of the flow meter or the color of the external desiccant, the desiccant must be renewed or replaced before damage occurs.

If this occurs more frequently than expected, inspect the seals of cord-grip fittings and conduit, if used.

Humidity alarm

The humidity of the case interior, reference (ambient) air, and bubble intake air (if a 330 bubbler is installed) are all parameters that can be selected as conditions to trigger an alarm, notifying you when it is time to renew or replace your desiccant.

The suggested alarm setting is a threshold condition of 40%. For detailed instructions about setting up conditions and alarms, refer to Sections *Equation / Trigger Setup*, on page 2-24, and *Inputs / Outputs / Alarms Setup*, on page 2-27.

6.5.1 Internal Desiccator

Saturated internal desiccant bags must be replaced; unlike the external desiccant, they are not renewable.

The desiccant bag is held in place by a metal bracket. Remove the two screws holding the bracket.

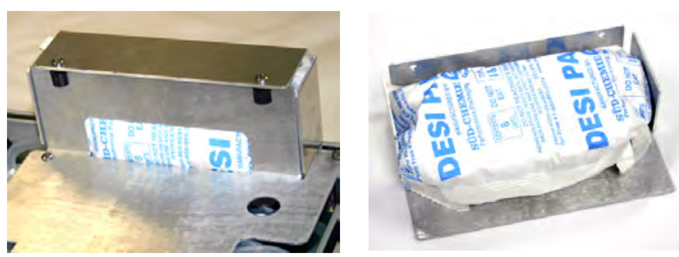


Figure 6-4   Removing the internal desiccant bag

6.5.2 External Desiccator

The desiccator vents the reference port for a pressure transducer, and the air intake port for the bubbler system air pump, keeping the interior of the flow meter case dry.

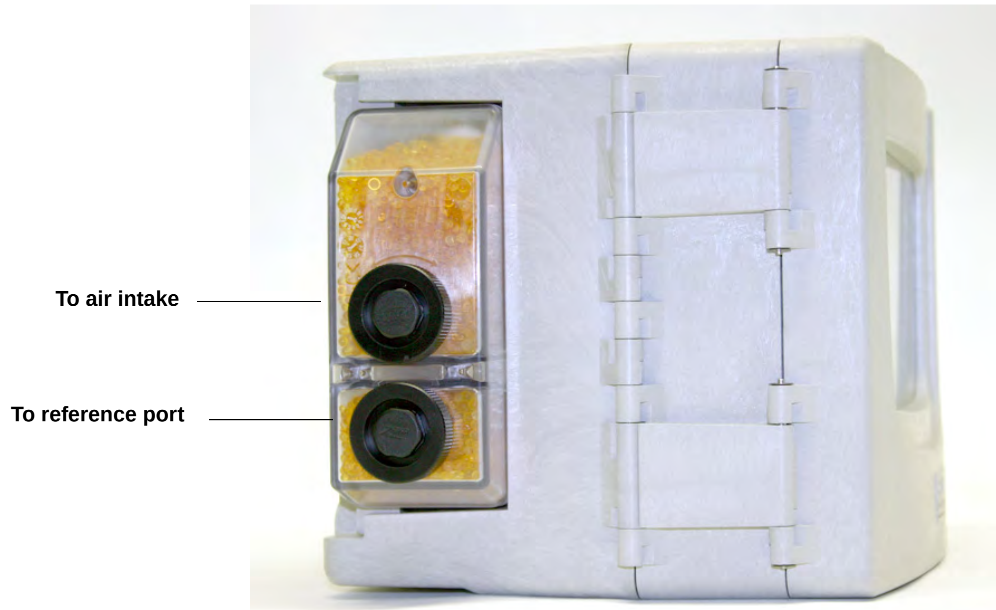


Figure 6-5 External desiccator, installed

When dry, the loose silica gel desiccant inside the chambers is orange or yellow. When the desiccant becomes saturated with moisture, it turns green or blue, indicating that the intake air and reference line are no longer protected from humidity.

> ☑ **Note**
> Teledyne Isco recommends checking the desiccant at least every 6 months, and changing/renewing the desiccant before the entire compartment has changed color.

Figure 6-6 Desiccant indicating saturation

The desiccant cartridge is held in place by a spring tab on the side of the flow meter. Press against the front of the cartridge to disengage it from the unit.

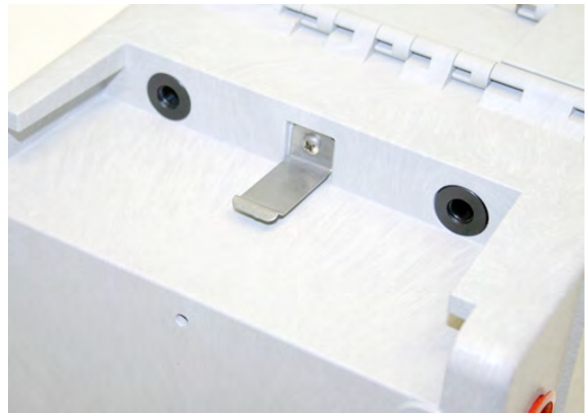


Figure 6-7   Removing the external desiccant cartridge

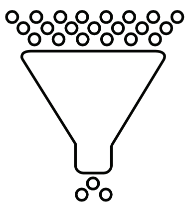
Unscrew the two black caps and carefully pour the desiccant out.

If removal is difficult, screw the caps back in and unscrew again.

Gently knock the caps and the cartridge against a hard surface to free any small particles in the threads, as these can hinder proper sealing and cause wear.

Using a funnel, fill both chambers with dry desiccant, replace the caps, ensuring that they are fully engaged. Press the cartridge back into place on the side of the flow meter.

Use a funnel to refill the desiccator.



☑ Note

If this is a new desiccant cartridge, remove the two red protective end caps from the ports before installing a new cartridge.

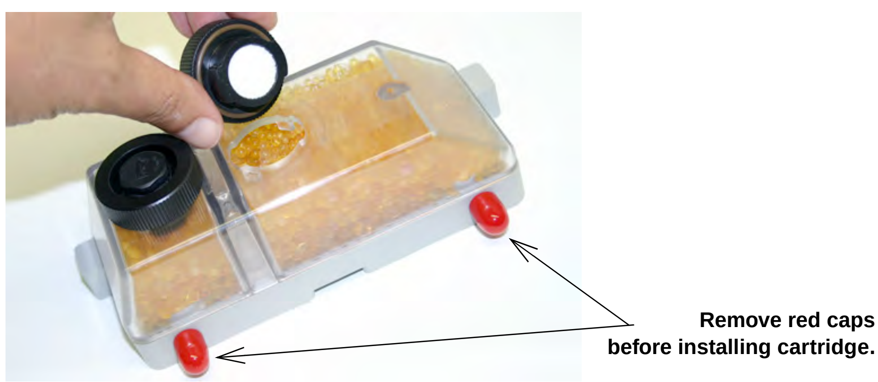


Figure 6-8   Opening the desiccant cartridge chambers

Renewing loose desiccant

To renew the desiccant, spread it in a single layer on a flat metal tray. Place in a vented, circulating forced air, conventional oven in a well ventilated room, and heat at 100 - 175°C (212 - 350°F) for about three hours, or until the color has returned to orange or yellow.

MSDS (Material Safety Data Sheets) for silica gel chemicals are provided in Appendix C.

6.6 Troubleshooting

The tables in the following section provide troubleshooting information to help in determining the causes of problems that may occur with the Signature flow meter or TIENet devices.

The troubleshooting tables cover the flow meter and each TIENet device separately. Note that the 300 TIENet device (Table 6-4) is the internal connector case.

> **Note**
>
> Any time a circuit board is replaced or a sensor disconnected, you MUST perform a hardware scan and SDI-12 scan (if connected) before resuming operation.

6.6.1 Signature Flow Meter

Table 6-3 Troubleshooting: Signature Flow Meter

Symptom	Cause	Action	Parts
Display repeatedly goes blank	Power setting is set to turn display off	If key is not pressed within 5 minutes, press any key to turn the display on.	
Blank Display but audible beep when a key is pressed	Contrast is out of adjustment	Adjust the display contrast by repeatedly pressing the up or down arrow while holding down the +/- key.	
	Faulty Display	Replace with known good display.	Display 130-0602-06

Table 6-3 Troubleshooting: Signature Flow Meter (Continued)

Symptom	Cause	Action	Parts
Blank display and no beep when a key is pressed	Open Fuse F3	Replace 4A/250V/5X20mm Slo Blo fuse (Figure 3-2 *Connector case, connectors, and fuses*, Item L). If the fuse opens again, check for devices that may be shorting the supply, such as an external connection, modem or option card.	4A Fuse 411-9901-84
	Dead Lead-Acid Battery	Replace or recharge the main battery connected to the internal “Lead-Acid” terminals.	60-3004-106 Model 946 Lead-Acid Battery
	DC power supply not supplying 12.8 VDC output.	Check for proper AC voltage. If proper AC voltage is present, replace DC power supply.	DC Power Supply 60-4304-037
		Service check: Disconnect the internal power supply wires (Red +/pos, Black –/neg) from the power terminals (Figure 3-2 *Connector case, connectors, and fuses*, Item F). Connect an Isco adaptor cable to the power terminals (Black +/pos, White –/neg). Then connect an Isco power supply (Model 913, 914, 923, or 924) to the adaptor cable. If the Signature then functions properly, replace the internal power supply.	Isco Adaptor Cable 69-4304-034
	Broken or loose wire from power supply module to the connector case.	Repair connections (Red +/pos, Black –/neg).	

Table 6-3 Troubleshooting: Signature Flow Meter (Continued)			
Symptom	**Cause**	**Action**	**Parts**
Blank display and no beep when a key is pressed (Con't.)	Ribbon cable loose or damaged	Check or cycle connections, then replace with known good cable.	Ribbon Cable 69-4304-032
	Defective keypad	Substitute a known working keypad.	Keypad 69-4303-009
	Faulty or missing SD card	Reinstall or replace SD card on Main CBA.	SD Card 250-3000-66
	Main CBA faulty	Substitute with known good Main CBA.	Main CBA 60-4304-042
Nonresettable totalizer does not advance	Programming error - Zero flow rate or aster-isk (*)	Check measurement configuration of level, flow rate, and volume input for the Total Flow parameter.	
	Broken wire connection	Check wire connections for the totalizer on the Main CBA.	
	Defective totalizer	Replace totalizer	Mechanical Totalizer 60-4304-015
USB device not recog-nized - No USB Options screen	Flash drive encrypted or defective	Try a different USB Flash drive	
	Adaptor cable defective	Replace cable	USB Adaptor Cable 480-2946-02
	Micro-USB Assembly damaged	Replace port	Micro-USB Assembly 60-4304-053
Cannot update soft-ware / Read flash drive	The necessary files are not on the flash drive.	Load the firmware from our website onto the flash drive, into a folder named BINFILE.	www.isco.com
	SD Card not functional or missing files.	Verify that the SD card includes a BINFILE folder with the appropriate bin file(s) inside.	Micro-USB Card 250-300-066
	Faulty Main CBA	Replace the Main CBA.	Main CBA 60-4304-042

6.6.2 TIENet 300 Connector Case

<table>
<tr><th colspan="4">Table 6-4 Troubleshooting: TIENet 300 Connector Case</th></tr>
<tr><th>Symptom</th><th>Cause</th><th>Action</th><th>Part</th></tr>
<tr><td rowspan="8">TIENet or SDI12 devices not appearing on display for configuration
Refer to Section 2.6.1& 2.6.2.</td><td>Device not configured for display on the Home Display.</td><td colspan="2">Add the parameters to the Home Display. Refer to Section 2.7.1 Site Setup.</td></tr>
<tr><td>Device has not been scanned.</td><td colspan="2">Perform a hardware scan from TIENet Setup or SDI-12 Setup. Refer to Sections 2.6.1 Smart Sensor Setup (TIENet) and 2.6.2 SDI-12 Setup.</td></tr>
<tr><td>Device is not wired correctly.</td><td colspan="2">Rewire connector following label on the case circuit board.</td></tr>
<tr><td>Open Fuse</td><td>Check fuse FU-T 3.15A (F1, F4, F5). Replace if open. Refer to Figure 3-2 Connector case, connectors, and fuses, Item K.</td><td>3.15A Fuse
411-0212-70</td></tr>
<tr><td>Defective TIENet or SDI12 device.</td><td colspan="2">Substitute a known working device and rescan. If it now works, replace the faulty device.</td></tr>
<tr><td>Case circuit board faulty.</td><td rowspan="2">Substitute with known working board.</td><td>300 Connector Case CBA
60-4304-041</td></tr>
<tr><td>Main CBA faulty.</td><td>Main CBA
60-4304-042</td></tr>
<tr><td>Ribbon cable damaged or loose.</td><td>Check or cycle connections, then substitute with known working cable.</td><td>Ribbon Cable
69-4304-032</td></tr>
</table>

6.6.3 TIENet 301 pH/Temp

<table>
<tr><th colspan="4">Table 6-5 Troubleshooting: TIENet 301 pH/Temperature Device</th></tr>
<tr><th>Symptom</th><th>Cause</th><th>Action</th><th>Part</th></tr>
<tr><td rowspan="5">pH Will not calibrate</td><td>No sensor connected to the 301</td><td colspan="2">Connect pH probe</td></tr>
<tr><td rowspan="2">301 module not recognized</td><td colspan="2">Rescan device in Hardware Setup</td></tr>
<tr><td colspan="2">Check TIENet wire connections. Follow wiring code silk-screened on circuit board.</td></tr>
<tr><td>TIENet connection fuse open</td><td>Replace if open</td><td>3.15A Fuse
411-0212-70</td></tr>
<tr><td>Probe defective</td><td>Replace probe</td><td>pH Probe
60-9004-126</td></tr>
</table>

<table>
<tr><th colspan="4">Table 6-5 Troubleshooting: TIENet 301 pH/Temperature Device (Continued)</th></tr>
<tr><th>Symptom</th><th>Cause</th><th>Action</th><th>Part</th></tr>
<tr><td rowspan="4">Incorrect pH readings / slow response</td><td>Buffers contaminated or wrong buffer used.</td><td colspan="2">Use new/correct pH buffer solution.</td></tr>
<tr><td>Temperature is not being read.</td><td>Replace probe</td><td rowspan="2">pH Probe
60-9004-126</td></tr>
<tr><td>Probe bulb is contaminated</td><td>Clean probe and recalibrate. If readings are still incorrect, replace probe.</td></tr>
<tr><td>Calibrated before reading stabilized.</td><td colspan="2">Recalibrate and allow the readings to stabilize before continuing with calibration.</td></tr>
</table>

6.6.4 TEINet 304 Contact Output Card

<table>
<tr><th colspan="3">Table 6-6 Troubleshooting: TIENet 304 Contact Output Card</th></tr>
<tr><th>Symptom</th><th>Cause</th><th>Action</th></tr>
<tr><td rowspan="2">The 304 card is not a selectable option in the software after the card is installed.</td><td>A TIENet scan must be preformed after the card is physically installed.</td><td>Preform a TIENet scan.</td></tr>
<tr><td>In the Hardware Setup | Smart Sensor Setup | Configure Measurements, no options are selected.</td><td>In the Hardware Setup | Smart Sensor Setup | Configure Measurements, select one or more of the options.</td></tr>
<tr><td>Contact closure is not being made (verified with an ohm meter)</td><td>The Contact Output card is not configured correctly in the software.</td><td>See section 2.7.7 to configure the 304 card properly.</td></tr>
</table>

6.6.5 TIENet 307 Analog Input Card

Table 6-7 Troubleshooting: TIENet 307 Analog Input Card

Symptom	Cause	Action
The 307 card is not a selectable option in the software after the card is installed.	A TIENet scan must be preformed after the card is physically installed.	Preform a TIENet scan.
	In the HARDWARE SETUP | SMART SENSOR SETUP | CONFIGURE MEASUREMENTS, no options are selected.	In the HARDWARE SETUP | SMART SENSOR SETUP | CONFIGURE MEASUREMENTS, select one or more of the options.
The 307 card is not reading 4-20	The analog input card is not configured correctly in the software.	See section 2.7.7 to configure the 307 card properly. Use the green and yellow LED lamps to verify the hardware using the set-up menus.
	The passive/active setting is incorrect or indeterminate.	Verify the setting your device requires and change the active or passive settings on the 307 card. Verify the setting from the set-up menus.
	Improper connection.	Verify the wires are attached to the correct channels and in the correct polarity. Use the labels and LED lamps to verity the hardware using the setup menus. The green LED lamp will light when proper current is flowing in the analog circuit.
	External device is faulty or incorrectly configured.	To verify, check the output with an ampmeter.
	Over-current protection device in the 307 has been tripped.	Disconnect power from the 307 card, the Signature, and the external analog loop. Wait 30 seconds.

6.6.6 TIENet 306 Sampler Interface

Table 6-8 Troubleshooting: TIENet 306 Sampler Interface

Symptom	Cause	Action
Incorrect pacing interval	Incorrect flow total selected for pacing	Assign the correct sensor to the correct flow rate to the correct total flow. Example: Needed to pace from the 330 bubbler, but programmed to pace from the 310 USLS.
No sampler pacing	Sampler's flow pulse input not working	Connect a different sampler, or test the existing sampler by shorting pins A and C on the sampler's Flow Meter port, while the program is running. The displayed pulse count should count down.

6.6.7 TIENet 308 Analog Output

Table 6-9 Troubleshooting: TIENet 308 4-20mA Analog Output

<table>
<tr><th>Symptom</th><th>Cause</th><th>Action</th></tr>
<tr><td rowspan="3">4-20 output is missing, or zero current output</td><td>Incorrect wiring</td><td>Rewire per connector diagram</td></tr>
<tr><td>Excessive load</td><td>Disconnect external equipment and test the output with VOM. If OK then reduce load resistance (maximum 900 Ω) or add <u>isolated</u> power to the current loop.</td></tr>
<tr><td>Analog circuit board failure</td><td>Use the other output channel on the 308 circuit board. If current is still 0 mA, replace circuit board. If the VOM reads 4mA or greater, reprogram to use that output or replace the circuit board. Part #60-4304-006</td></tr>
<tr><td rowspan="3">4-20 only reads 4mA</td><td>Wires on incorrect output (wired to output 2 instead of output 1)</td><td>Move connector to proper output and verify using the yellow LED lamp indications from the setup menu.</td></tr>
<tr><td>Analog percent is not selected in the TIENet HARDWARE SETUP | SMART SENSOR SETUP | CONFIGURE MEASUREMENTS</td><td>In the HARDWARE SETUP | SMART SENSOR SETUP | CONFIGURE MEASUREMENTS, select one or more of the options. See sections 2.6.1 Smart Sensor Setup (TIENet) and 2.7.7 Inputs/Outputs/Alarms Setup.</td></tr>
<tr><td>Improper parameter set for the output.</td><td>Verify/change the settings/range to the proper parameter.</td></tr>
</table>

Table 6-9 Troubleshooting: TIENet 308 4-20mA Analog Output (Continued)		
Symptom	**Cause**	**Action**
4-20 reading incorrectly	Excessive load	Disconnect external equipment and test the output with VOM. If OK then reduce load resistance (maximum 900 Ω) or add isolated power to the current loop.
	Improper module/parameter set for the output	Verify/change the settings/range to the correct module/parameter.
	Connected to incorrect output; e.g., wired to output 2 instead of output 1	Move connector to proper output and verify using the yellow LED lamp indications from the setup menu.
The 308 option card is not a selectable option in the software after the card is installed.	TIENet 308 is not properly configured	Verify the TIENet configuration contains analog percent readings
Measurement error for analog current	No load applied to the output circuit, or open circuit wiring.	The output must have a load resistance (maximum 900 Ω). For verification, this can be accomplished by connecting the current meter leads to the terminals of the 308 card.
External device not reading 4-20	Over-current protection device in the 307 has been tripped.	Disconnect power from the 307 card, the Signature, and the external analog loop. Wait 30 seconds.

6.6.8 TIENet 310 USLS

Table 6-10 Troubleshooting: TIENet 310 Ultrasonic Level Sensor		
Symptom	**Cause**	**Action**
Invalid level, display has asterisk (*) by level reading	Not scanned	Perform a smart sensor scan
	Not able to achieve signal lock (misalignment, loose mounting, turbulence, foam, or debris in the water)	Adjust mounting or place over a solid surface.
	Level outside of the Blanking distances	Adjust min/max blanking distances
	Not wired correctly	Check/repair wiring
	Open fuse	Replace fuse FU-T 3.15A and rescan. Part #411-0212-70. Refer to Figure 3-2 Item K.
	Failed sensor	Replace with known good sensor
No level reading on the display	Parameter not selected to be displayed on Home Display	Add the parameter to the Home Display. Refer to Section 2.7.1 *Site Setup*.

Table 6-10 Troubleshooting: TIENet 310 Ultrasonic Level Sensor (Continued)

Symptom	Cause	Action
Incorrect level reading	Level not adjusted properly	Readjust level
	Sensor misaligned	Realign sensor
	Objects in the path of the signal	Adjust min/max blanking distances and/or reposition sensor.
	Sensor exposed to direct sunlight	Install sunshade. Refer to Appendix B *Options and Accessories*.

6.7 330 Bubbler Installation

The TIENet 330 bubbler device is factory-installed for Signature bubbler flow meters. It can also be installed by the user to convert a Signature flow meter into a bubbler, or to replace an old 330 device.

Preparation steps are provided in Section 6.7.1 (converting a non-bubbler unit) and Section 6.7.2 (replacing an existing bubbler device). Instructions for installing the new bubbler are in Section 6.7.3.

⚠ DANGER

Before opening the case, first ensure that mains power is disconnected from the unit.

⚠ CAUTION

Before opening the case, disconnect the optional battery backup power, if used.

☑ *Note*

In order to work with the 330 Bubbler module, the Signature must have an external desiccator installed. Refer to *External Desiccator*, on page 5-11.

6.7.1 Preparation: Non-Bubbler

Open the case, as described in Section 3.2.

If no bubbler was previously installed, remove the cover shield over the main CBA. This will not be used again, since the 330 bubbler assembly includes its own cover shield.

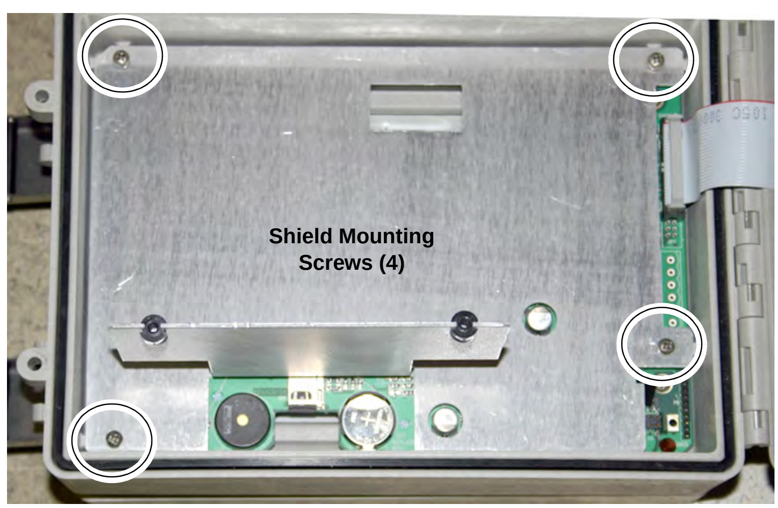


Figure 6-9 Remove non-bubbler shield

6.7.2 Preparation: Existing Bubbler

Open the case, as described in Section 3.2.

When replacing an existing 330 bubbler, to ensure that the bubble line tubing is reconnected correctly, **label the tubing ends**, then remove the four mounting screws holding the 330 bubbler module in place (see Figure 6-10).

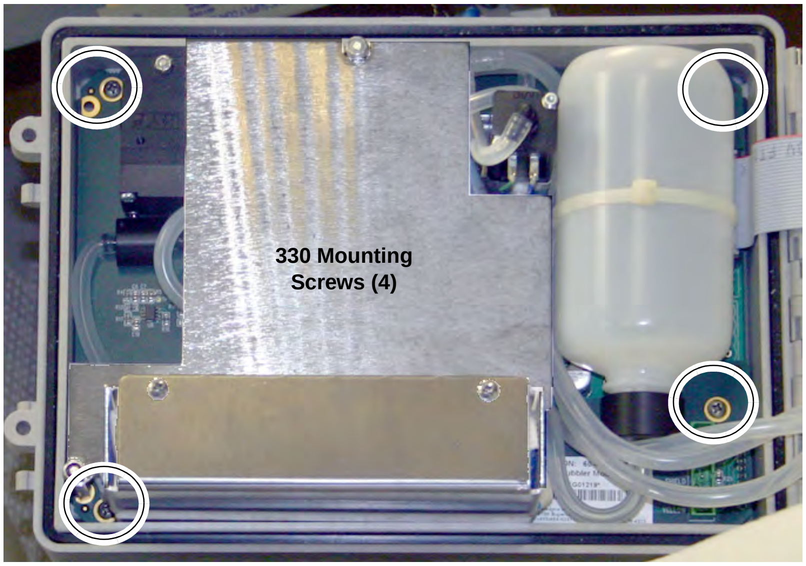


Figure 6-10 Remove bubbler module

6.7.3 Installation Procedure

Referring to Figures 6-11, and 6-13, perform the following steps.

1. Place the bubbler assembly on top of the main CBA, ensuring that the four screw holes line up in the case, and the 10-pin connector engages correctly in its socket.
2. Attach the bubbler board to the control panel using the four self-tapping screws previously (part #231-6149-07). Do not overtighten.

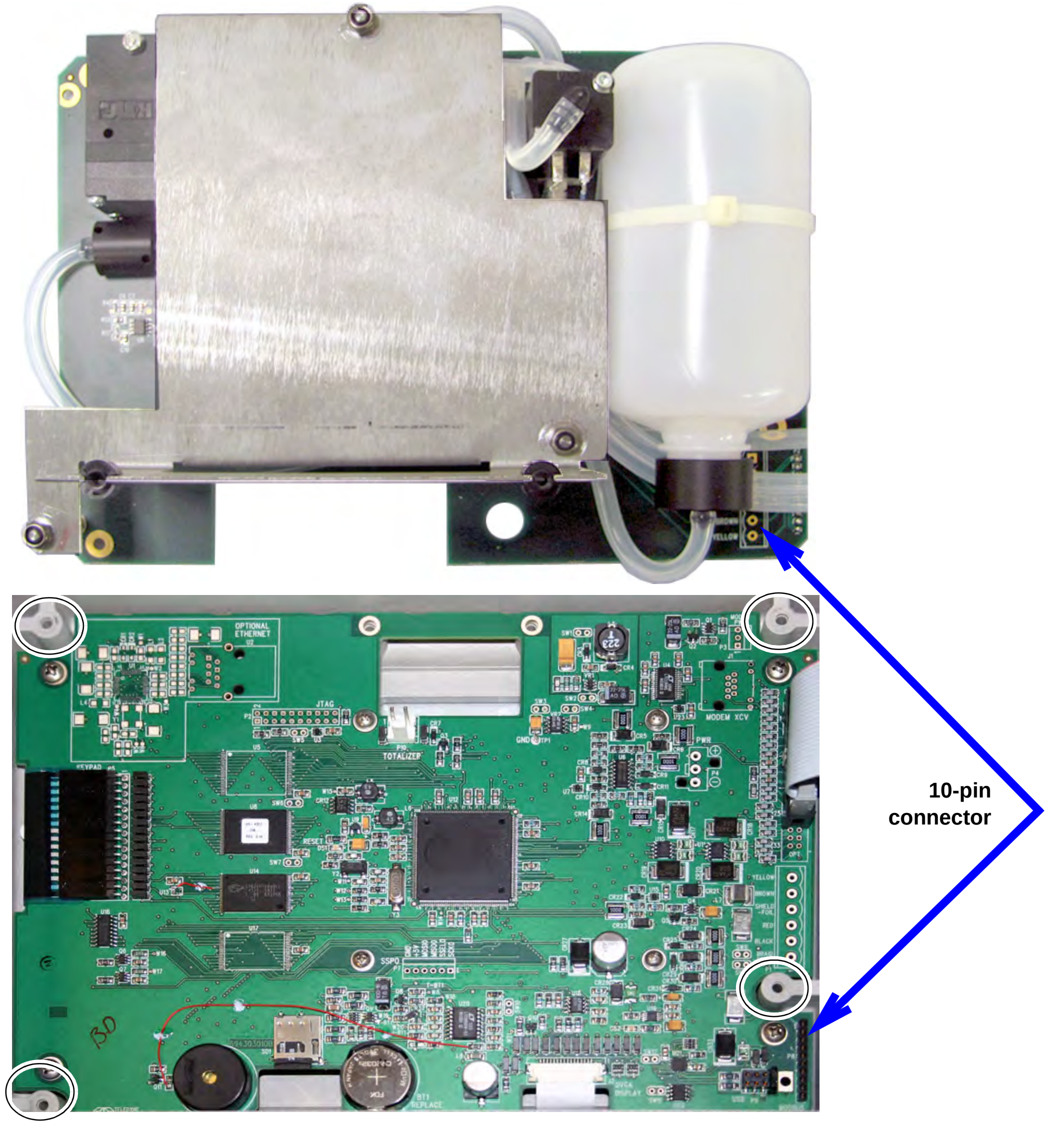


Figure 6-11 330 Bubbler assembly installation

Note

There are three pieces of tubing on the bubbler that must be correctly connected for operation.
If any tubing is damaged, please purchase 1 meter of part #029-1353-02 and cut to the length needed for replacement.
For additional information about tubing connections, refer to Section in Appendix A *Replacement Parts*.

3. Replace the port plug in the bottom of the case (usually second from the left) with the bubble line fitting.
4. Route the reference line tubing (with fitting on the end) through the bushing and press the fitting into the reference connector on the connector case.
5. Route the intake tubing (the shorter of the two open-ended tubes) through the bushing and behind the ribbon cable, and connect it to the intake port in the case wall.
6. Route the other end of the short tubing through the bushing and connect it to the humidity connector on the board.
7. Connect the bubble tubing (the longer of the two open-ended tubes) to the bubble line port in the bottom of the case.

Some Signature flow meters have a 'Y' fitting connecting both the reference and intake ports to the humidity connector.

When installing a 330 bubbler in a unit with this tubing configuration, remove the 'Y' fitting and two shorter pieces of tubing. Bring the reference port tubing out from behind the ribbon and reroute it directly to the humidity connector.

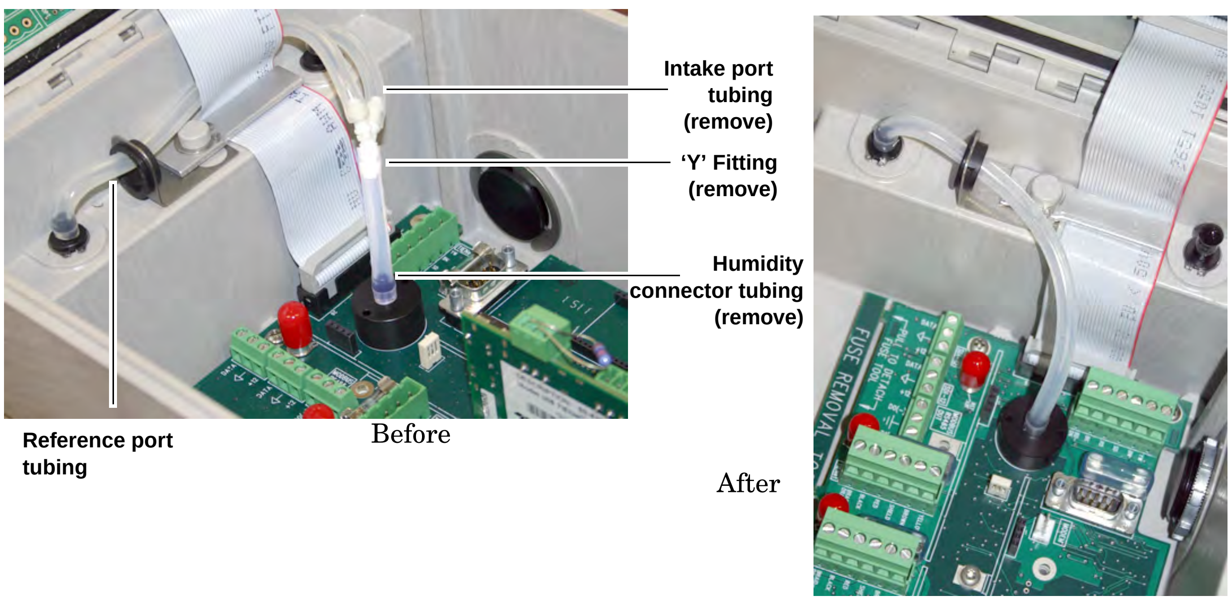


Figure 6-12 Remove extra tubing and fitting (if applicable)

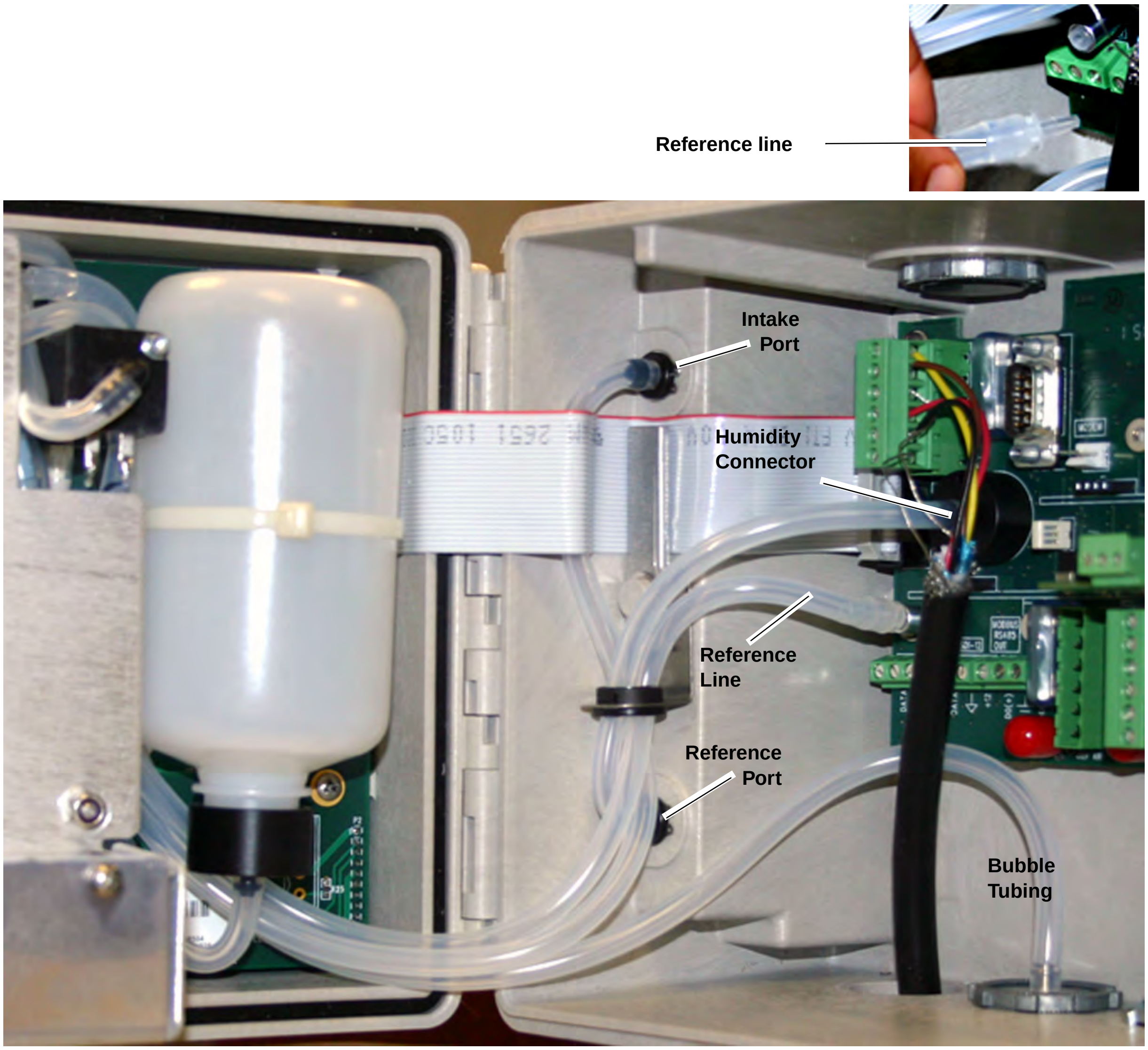


Figure 6-13 Routing and connections of 330 bubbler tubing

6.8 Front Cover Replacement

A replacement front cover (door) comes with latches attached, and two new hinge pins.

Align the hinges of the front cover front panel. Press the pins into the hinge barrels, with each flange facing inward (refer to Figure 6-14), until it is flush against the hinge surface.

Using a vice grip or other tool, spread and flatten the outward facing ends of the pins so they cannot be removed from the hinges.

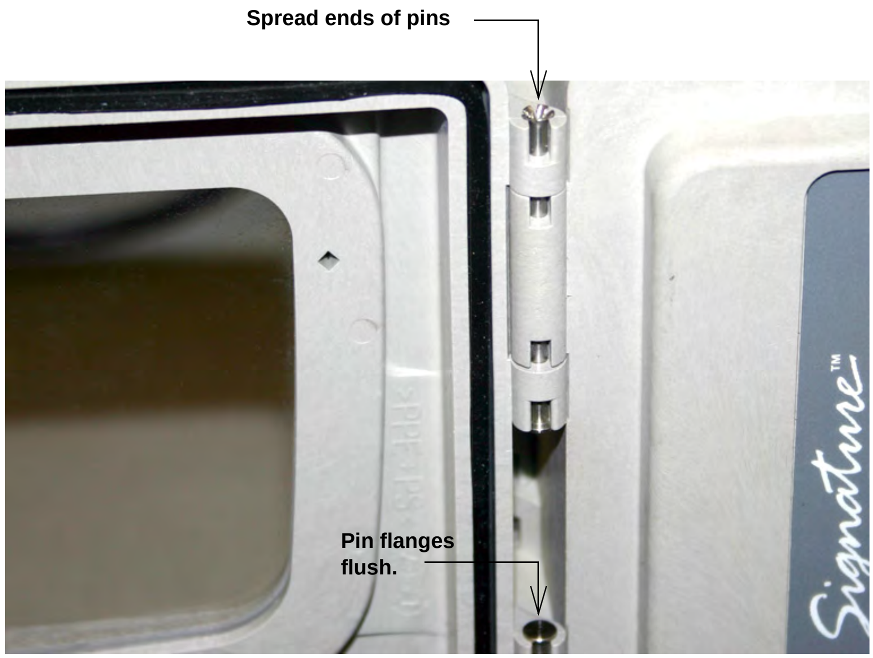


Figure 6-14 Front cover (door) replacement

6.9 System Reset

In the event that the Signature Flow Meter becomes unresponsive, operation may be restored by removing and then restoring line power.

If the problem persists, operation may be restored by performing a hard reset.

⚠ CAUTION

A hard reset erases site data and restores the program to factory default settings.

To perform a hard reset, first remove line power and any external battery power and wait 30 seconds. Then, while holding down both the Home key and the Delete key, restore line power.

6.10 Service and Repair

Service tasks described in this manual may be performed on site by properly trained personnel. Other service and repairs must be performed at the factory. If your Teledyne Isco equipment requires repair, contact Teledyne Isco technical support.

Teledyne Isco
Technical Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone:866 298-6174
402 464-0231
FAX:402 465-3085

E-mail:
IscoService@teledyne.com

Speaking with a Teledyne Isco Technical Service representative can often resolve the problem without the need to return the item. If the issue cannot be resolved by phone or email, you will receive a Return Authorization Number (RAN) and information on returning the equipment to the factory.

Signature® Flow Meter

Appendix A Replacement Parts

Replacement parts are called out in illustrations in this section. Reference the call-outs in the accompanying tables to determine the part number for the item.

A.1 How to Order

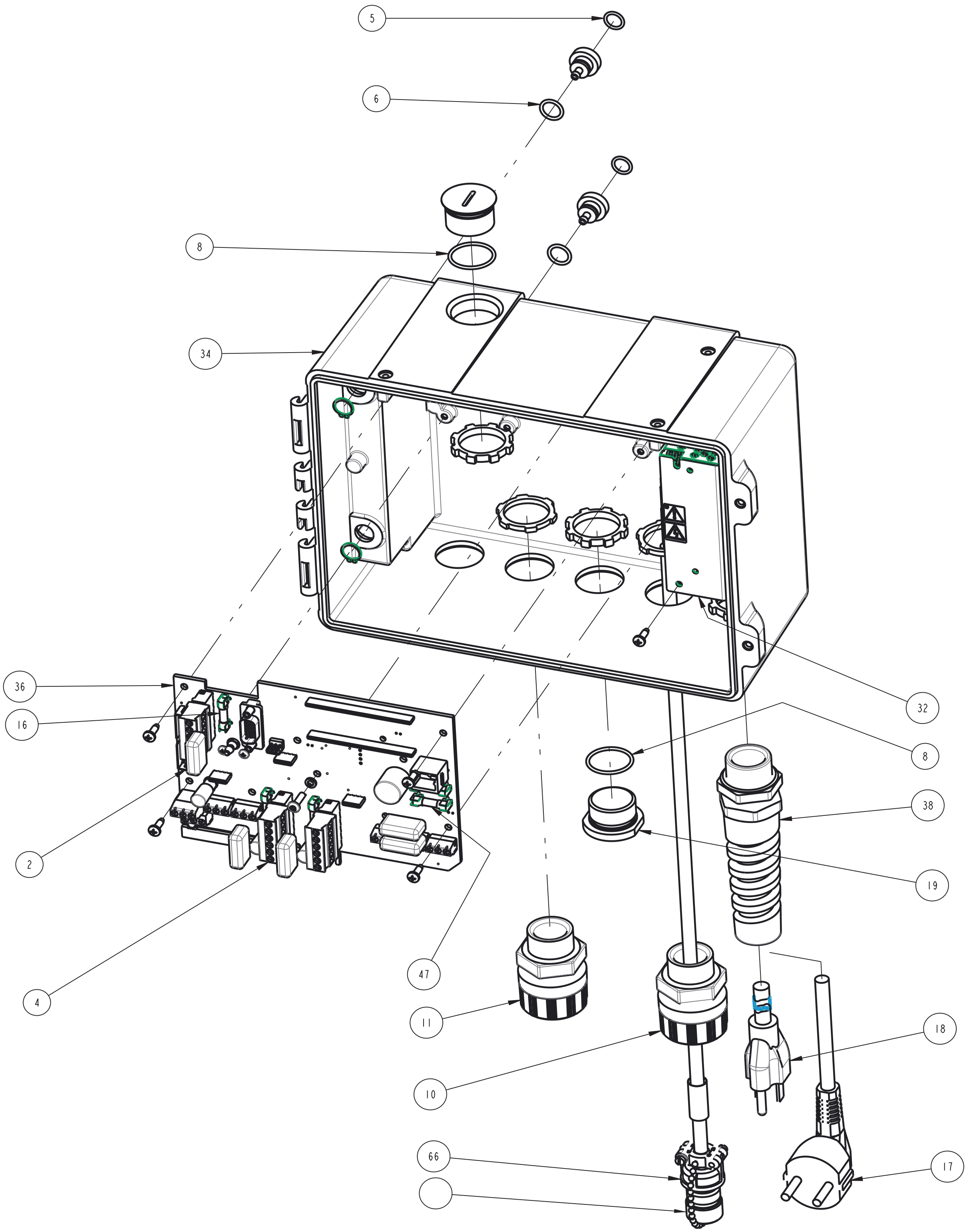
Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: 800 228-4373
402 464-0231
FAX: 402 465-3022

E-mail: IscoInfo@teledyne.com

A.2 Signature Flow Meter



604302038

SHEET: 2 OF 12

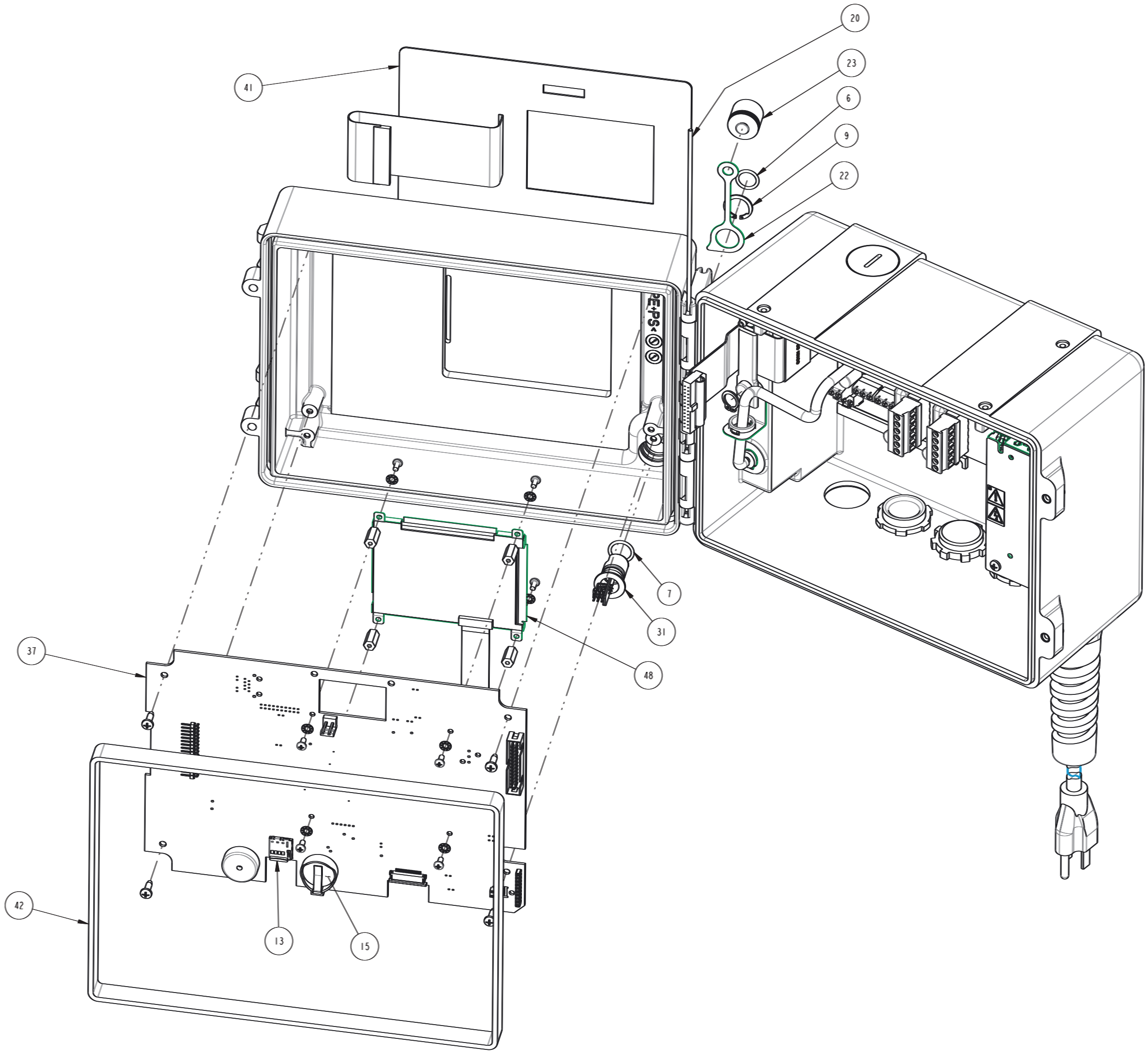
REPLACEMENT PARTS LIST

TELEDYNE ISCO

REV: D

ITEM NO.	PART NUMBER	DESCRIPTION
2	103000000	FUSE COVER 5MM PVC
4	694303102	6 PIN HEADER SOCKET W/ SCR CLAMPS
5	202100011	O RING .301ID .070
6	202100013	O RING .426ID .070
8	202100021	O RING .926ID .070
10	209007311	STRAIN RELIEF.250/.375
11	209007312	STRAIN RELIEF.375/.437
16	411021270	FUSE 3.15A 250 SB 5X20MM
17	480124101	LINE CORD 250V
18	601683216	LINE CORD UL OUTDOOR 120V
19	604303031	PLUG BOTTOM CONNECTOR
32	604304037	POWER SUPPLY ASSEMBLY
34	604304039	CASE ASSEMBLY
36	604304041	CONNECTOR CASE CBA ASSEMBLY
38	604307022	KIT CORD GRIP W/ FLEXIBL

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.


20
23
41
6
9
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7
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37
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42
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15

REPLACEMENT PARTS LIST

TELEDYNE ISCO

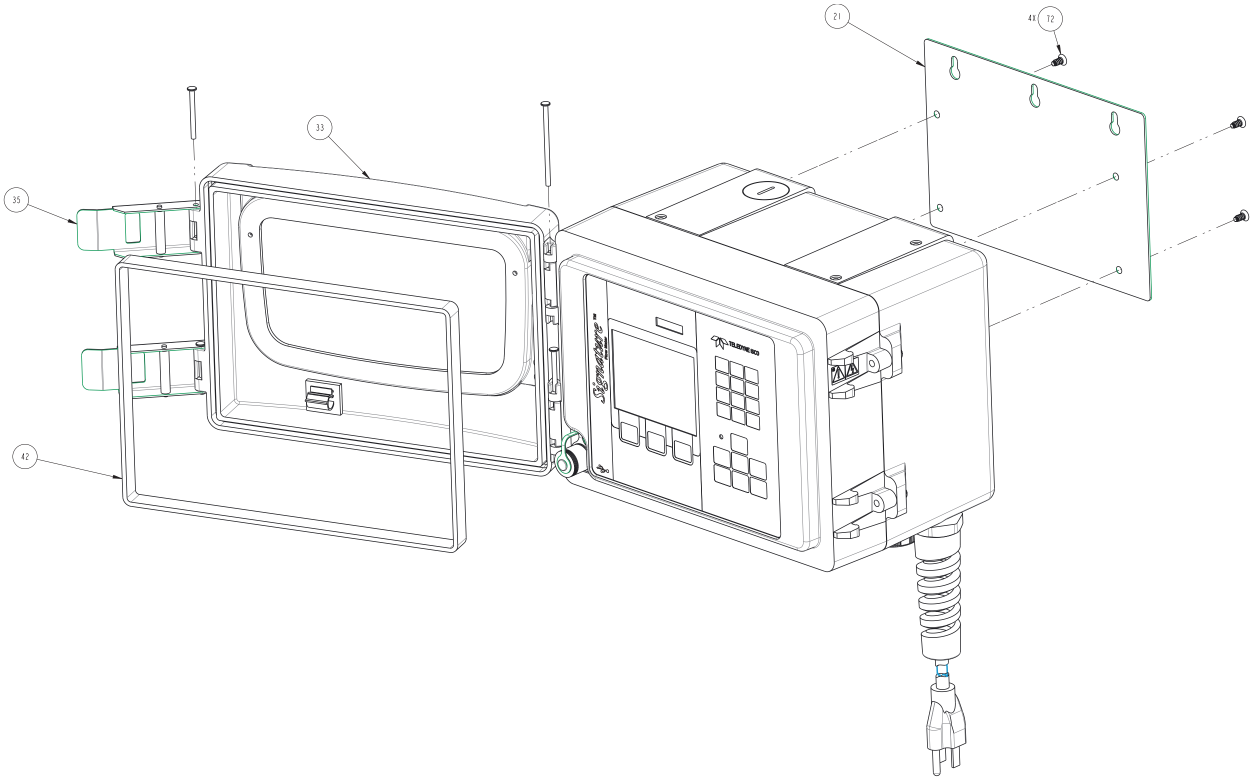
604302038

SHEET: 4 OF 12

REV: D

ITEM NO.	PART NUMBER	DESCRIPTION
6	202100013	O RING .426ID .070
7	202100014	O RING .489ID .070
9	209001056	RETAINING RING EXT .562
13	250300066	MICRO-SD MEM CARD
15	340503001	LITHIUM COIN CELL BATTERY
20	604303035	HINGE PIN
22	604303055	MICRO USB STRAP
23	604303056	PUSHON MICRO USB CAP
31	604304053	MICRO USB ASSEMBLY
37	604304042	MAIN CBA ASSEMBLY
41	694303009	FRONT PANEL LABEL
42	694303053	GASKET
48	130060206	LIQUID CRYSTAL DISPLAY 320X240

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.


21
4X 72
33
35
42

604302038

SHEET: 6 OF 12

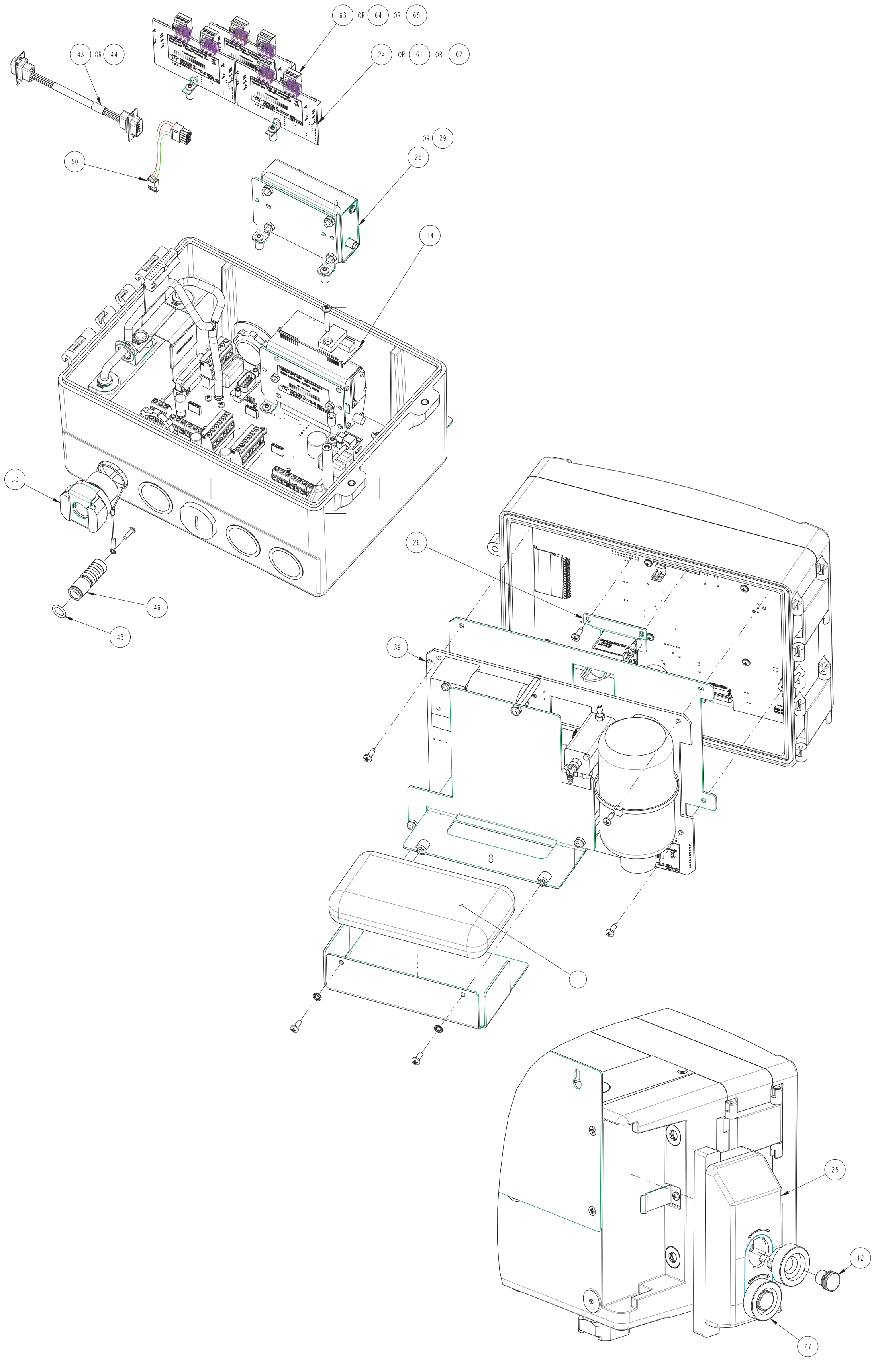
REPLACEMENT PARTS LIST

TELEDYNE ISCO

REV: D

ITEM NO.	PART NUMBER	DESCRIPTION
21	604303043	WALL MOUNT
33	604304038*	FRONT COVER ASSEMBLY
35	604304040**	LATCH ASSEMBLY
42	694303053	GASKET
72	231611906	SCREW, SELF TAPPING #8 FLAT HEAD
*	INCL. COVER HINGE PIN (604303061) & GASKET (694303053).	
**	INCLUDES LATCH PIN (604303060)	

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.


63 OR 64 OR 65
43 OR 44
24 OR 61 OR 62
50
OR 29
28
14
30
26
39
46
45
1
25
12
27

604302038

REPLACEMENT PARTS LIST

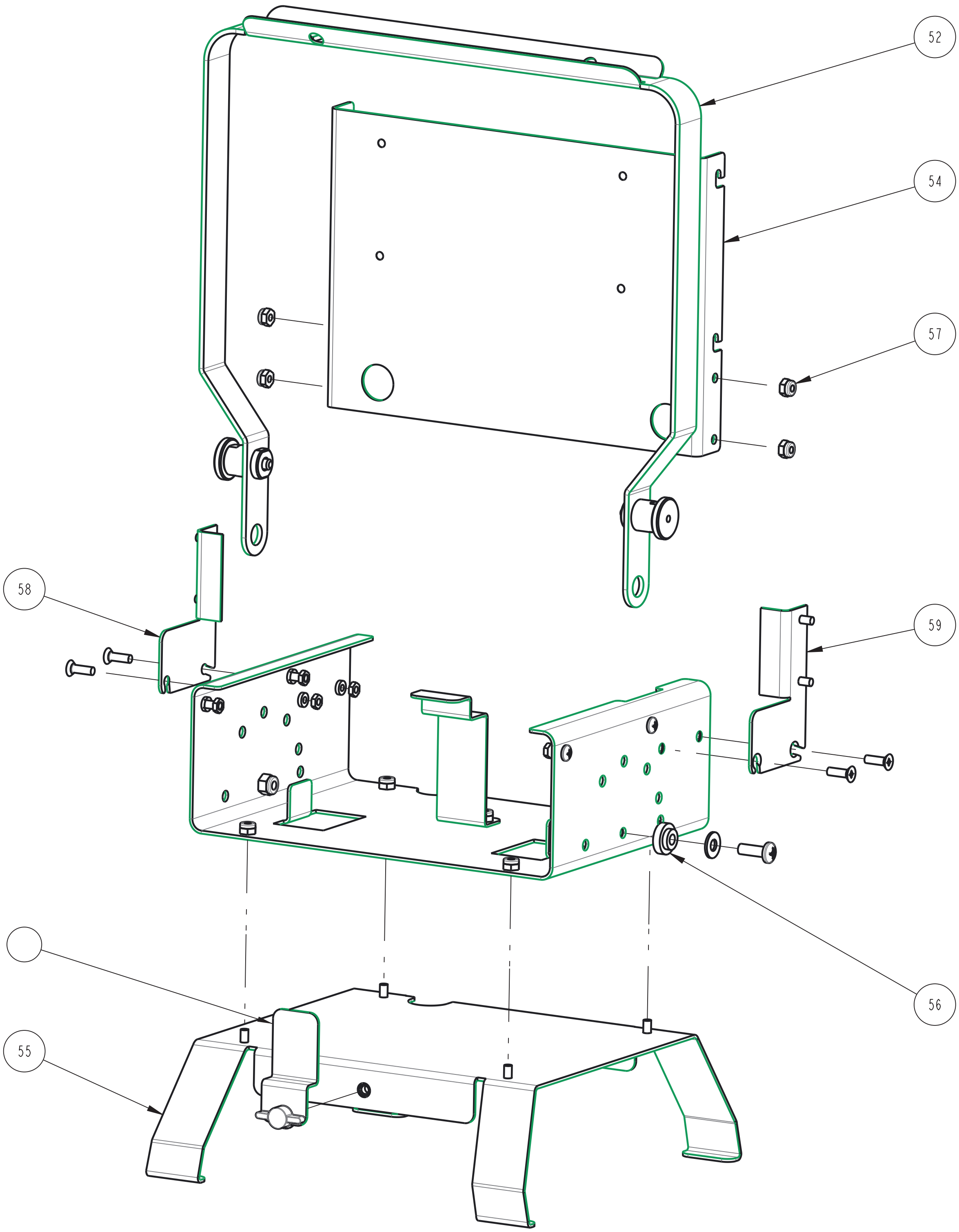
SHEET: 8 OF 12

TELEDYNE ISCO

REV: D

ITEM NO.	PART NUMBER	DESCRIPTION
1	099000200	DESICCANT 8OZ BAG
12	209009393	SCREW IN HYDROPHOBIC FILTER
14	250300067	10/100 BASE T ETHERNET MODEM
24	604304006	ANALOG OUTPUT CARD ASSEMBLY
25	604304013	DESICCANT ASSEMBLY
26	604304015	COUNTER ASSEMBLY
27	604304016	DESICCANT CAP ASSEMBLY
28	604304020	CDMA MODEM ASSEMBLY
29	604304021	GSM MODEM ASSEMBLY
30	604304027	COAX CABLE AND CLIP ASSEMBLY
39	604334003	BUBBLER MODULE ASSEMBLY
43	694304028	SERIAL CABLE ASSEMBLY (CDMA)
44	694304029	SERIAL CABLE ASSEMBLY (GSM)
45	202307012	O RING .364ID .070
46	602003568	PLUG FEMALE ANTENNA
50	602004530	8 PIN POWER CABLE ASSEMBLY
51*	602004233	SILICA GEL DESICCANT BOTTLE
52*	601703060	ADAPTER TUBE 1/16" BUBBLE LINE
53*	601873048	SUPPORT TUBE 1/16" BUBBLE LINE
61	604304069	CONTACT OUTPUT CARD ASSEMBLY
62	604304054	ANALOG INPUT CARD ASSEMBLY
63	604304083	3 PIN CONNECTOR ANALOG IN
64	604304084	3 PIN CONNECTOR CONTACT OUT
65	604304085	3 PIN CONNECTOR ANALOG OUT
*	NOT SHOWN	

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.


52
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59
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55

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REPLACEMENT PARTS LIST

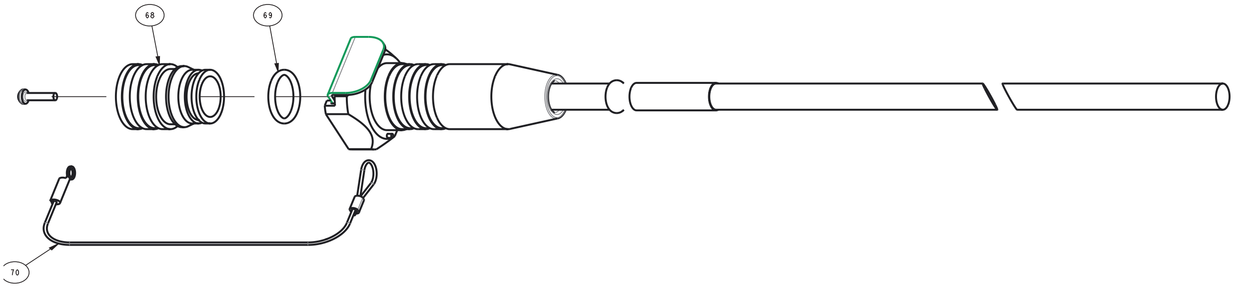
SHEET: 10 OF 12

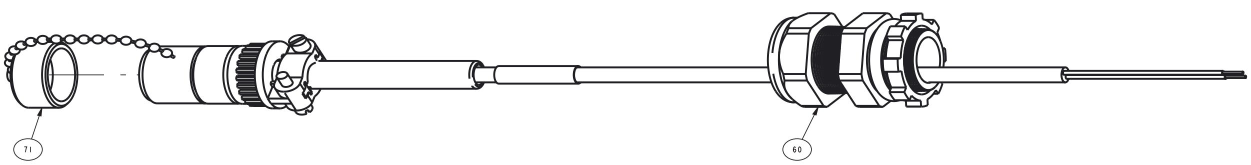
TELEDYNE ISCO

REV: D

ITEM NO.	PART NUMBER	DESCRIPTION
52	604304081	HANDLE ASSEMBLY WITH LOCKS
53	604304082	FRONT BATTERY RETAINER ASSEMBLY
54	604303110	SIGNATURE MOUNT
55	604308013	SIGNATURE MOUNT BASE
56	604303111	HANDLE BUSHING
57	232916101	LOCK NUT, 10-32, NYLON INSERT
58	604308010	SIGNATURE LEFT BRACKET
59	604308011	SIGNATURE RIGHT BRACKET

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.


68
69
70


71
60

604302038

REPLACEMENT PARTS LIST

SHEET: 12 OF 12

TELEDYNE ISCO

REV: D

ITEM NO.	PART NUMBER	DESCRIPTION
60	604304080	3-HOLE CORD GRIP W/PLUGS, ORING & LK NUT
68	602003076	PLUG
69	202100669	ORING, .669ID X .079 CROSS SECTION
70	692003174	CAP CABLE
71	149100100	DUST COVER #14

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.

Signature® Flow Meter

Appendix B Options and Accessories

B.1 Ordering Information

Options and accessories can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: 800 228-4373
402 464-0231
FAX: 402 465-3022

E-mail: IscoInfo@teledyne.com

☑ Note

For options and accessories exclusive to the external TIENet devices, refer to the appropriate TIENet user manuals (found at www.isco.com and listed in Section B.5 *Manuals*).

B.2 Signature Flow Meter Accessories

Cord grip fitting for TIENet cable *3/4" NPT .375/.437" OD*	209-0073-12
Cord grip fitting for Battery backup cable *3/4" NPT .250/.375" OD*	209-0073-11
Cord grip fitting with flexible strain protection	60-4307-022
Cord grip fitting for rain gauge and option card circuits, 3 hole	60-4304-080
Exterior desiccator - Required for use with 330 and 350 TIENet devices	60-4354-019
Silica gel desiccant, 1.5-lb container	099-0011-03
Model 674 rain gauge connect cable for Signature	60-4304-055
TIENet connection cable for Signature	60-4304-056
TIENet connection cable for Signature, cut to length	60-4304-068
TIENet 'Y' connection cable	60-4304-066
TIENet Header 6 screw clamp plug	69-4303-102
Analog Output 3 screw clamp header clip	60-4304-085
Analog Input 3 screw clamp header clip	60-4304-083
Contact Output 3 screw clamp header clip	60-4304-084
Power Supply Assembly with wiring harness	60-4304-037
TIENet Expansion Box w/ 10 ft cable	60-4307-023
TIENet Expansion Box w/ 10 ft cable and reference air support	60-4357-018
Bulk TIENet Cable, cut to Length	60-4304-050

Battery Backup: 946 Lead-acid battery pack, connect cable, and battery mounting hardware 60-4307-015

DC Power Cable with cord grip 60-4304-086

117V Power cord kit 60-4304-044

Includes strain relief cord-grip fitting

240V Power cord kit 60-4304-045

Includes strain relief cord-grip fitting

117V Power cord 60-1683-216

Signature Power Loss Alarm Box 60-5324-024

Contact the Teledyne Isco Special Product Applications department for ordering information

240V Power cord 48-0124-101

USB Flash drive, 2GB 250-3000-42

Adaptor cable, USB Micro to USB-A 480-2946-02

USB connect cable, Signature to PC 480-2946-01

ProHanger SST Suspension bracket for 18 - 24in. manhole shaft 69-2003-599

Spreader bar for suspension of sensor or flow meter in manhole shaft 60-3004-110
Suspension harness 60-1704-016
7-Digit, non-resettable mechanical totalizer 60-4304-015
Dri-Can Desiccant 099-0012-00
8oz. Desiccant bag 099-0002-00
Gore Filter 209-0093-93
External Desiccator Assembly 60-4304-013

B.3 330 Bubbler Options and Accessories

330 Bubbler internal sensor 60-4334-003
Bubble line, PTFE, 1/16" x 25ft 60-1873-051
Bubble line, vinyl, 1/8" x 50ft 60-1873-044
Bubble line, vinyl, 1/8" x 100ft 60-1700-003
SST Bubble tube, 4ft long - for PTFE, 1/16" Line 60-1704-018
SST Bubble tube, 4ft long - for PTFE, 1/8" Line 60-1873-043
Bubble line carrier - attach to Isco Mounting Ring 60-3204-007
Reference port tubing kit 60-4307-017
External Desiccator Assembly 60-4304-013

Note

Teledyne Isco uses FreeRTOS version 5.4.2 in its TIENet devices. In accordance with the FreeRTOS license, FreeRTOS source code is available on request. For more information, visit www.FreeRTOS.org.

B.4 Modems

CDMA Digital cellular modem
(Cellular service not included.) 60-4307-074
Magnetic mount antenna for CDMA 60-2004-550

GSM Digital cellular modem (Outside North America)
(Cellular service not included.) 60-4307-075
GSM Digital cellular modem (North America)
(Cellular service not included.) 60-4307-090
Magnetic mount antenna for GSM 60-2004-551
Ethernet modem 60-4307-016

B.5 Manuals

Signature Flow Meter 69-4303-070
Signature Bubbler Flow Meter 69-4333-004
TIENet 301 pH/Temperature Device 69-4303-071
TIENet 306 Sampler Interface 69-4303-072
TIENet 310 Ultrasonic Sensor 69-4313-010
TIENet 350 Area Velocity Sensor 69-4353-024
TIENet 360 LaserFlow Sensor 69-4363-043
Mounting Rings 60-3203-061
Flow Metering Insert 60-3234-064
Flowlink 5.1 Software 69-2543-213
Isco Open Channel Flow Measurement Handbook, 6th Ed. 60-3003-041

B.6 Sensor Mounting Rings

B.6.1 Spring Rings

Probe Mounting Ring for 6" pipe 68-3200-007
Probe Mounting Ring for 8" pipe 68-3200-008
Probe Mounting Ring for 10" pipe 68-3200-009
Probe Mounting Ring for 12" pipe 68-3200-010
Probe Mounting Ring for 15" pipe 68-3200-011

B.6.2 Scissor Rings

Base Section *(with tabs for mounting up to five probes)* 60-3004-169
Scissors Assembly 60-3004-170
Extension 1 (9.0") 60-3004-172
Extension 2 (21.5") 60-3004-173
Extension 3 (31.5") 60-3004-174
Extension 4 (41.5") 60-3004-175

Note that Scissor Mounting Ring Assemblies will require a base and scissors section for all sizes. Sizes from 16" to 80" will also require two or more extension sections.

Signature® Flow Meter

Appendix C Modbus Output Protocol

Sections C.1 through C.3 give an overview of the basic capabilities and operation of Modbus output protocol as it applies to the Isco Signature Flow Meter.

For a Glossary of Terms and Common Acronyms, see Section C.4.

C.1 Introduction

Modbus is a simple command/response mechanism to read from and write to specific memory locations called *registers*. A register is a holding place for a piece of digital information within the equipment. The Signature uses Modbus ASCII and Modbus RTU protocols, providing a standard protocol for real-time data retrieval. The data can be sent to a central computer for display, data collection, or process control. Modbus cannot be used to retrieve historical data from the Signature's memory.

This section describes the overall capabilities and operation of Modbus.

C.2 Operation

There are many standard, third party Modbus drivers and OPC servers that may be used to link a remote Modbus device, such as the Signature Flow Meter, to SCADA or process control software, such as Wonderware®[1] or Intellution®[2]. The OPC server communicates with the flow meter and accesses registers. The definition of what information is contained and where (the register number, or address) is set by Teledyne Isco.

The Signature register addresses, and what parameters are held where, are available in Table C-1.

By accessing these registers you can obtain the current value of whatever parameter you desire. The reading(s) can then be displayed or stored wherever you designate as a destination; for example, a process control computer.

Not all registers are limited to read-only data storage. You can also use two of the registers for control purposes. For example, writing a "1" value to register 25 ("TakeReadingFlag" register), tells the Signature to update its readings.

1. Wonderware® is a registered trademark of Wonderware Software Development Corporation.
2. Intellution® is a registered trademark of Intellution, Inc.

C.3 Configurations

A variety of configurations can be made with Modbus, either through direct connection or through a modem.

In the example shown in Figure C-1, you are direct-connecting a server PC to two individual Signature sites through Modbus, using the COM ports on the OPC Server, which are directly connected to the remote sites.

Connection to the flow meter is made via the RS-485 terminal on the Signature case board (refer to Figure 3-2 *Connector case, connectors, and fuses*).

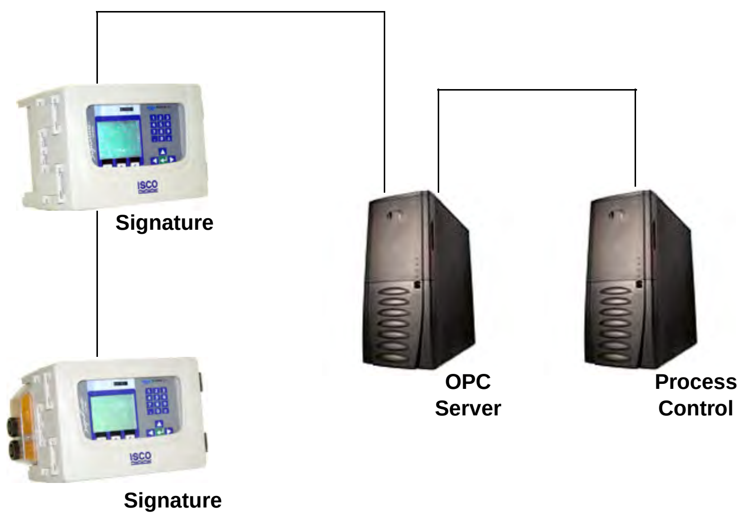


Figure C-1 Configuration example

The operation sequence for the example above can be summarized in the following steps:

1. Signatures take readings from sensors.
2. Signatures store readings (level, velocity, flow rate, etc.) in their specified registers.
3. The user requests data through Process Control.
4. Process Control asks the OPC server to gather information.
5. OPC connects to the specified Signature flow meter through the cable (direct connection), retrieves site data and populates the OPC server's holding index.
6. Process Control takes the data from the OPC server's holding index and gives the data to the user.

Note that Process Control can be either manual or automated in this example, and that the OPC server and Process Control may be located physically on the same computer.

C.4 Glossary of Terms

Address – An address is a digital location specified for a device (such as the Signature Flow Meter).

ASCII – Short for American Standard Code for Information Interchange, ASCII is a code that represents English characters with numbers. Most computers represent text with ASCII code, making it possible for one computer or device to share data with another.

DCS – Distributed Control Systems

Dedicated Line – A telecommunications path reserved for communication between two specified points and not shared among multiple points.

Modbus Protocol – Modbus Protocol is a messaging structure used to establish master-slave/client server communications between intelligent devices. Modbus is a simple command/response mechanism to read from and write to registers.

MTU – Master Terminal Unit

OPC – OPC (OLE for Process Control) means open connectivity via open (free for use) standards. It is a series of software standards specifications that fill a need in automation (like printer drivers did for Windows), acting as a translator for data transmission and process control.

The specification defines a standard set of objects, interfaces, and methods for use in process control and manufacturing automation applications to facilitate interoperability. There are hundreds of OPC Data Access servers and clients.

PLC – Programmable Logic Controller

Registers – A register is a location in memory for a specific data type. The definition of what data is contained and where (the registry number, or address) is set by the equipment manufacturer (in this case Teledyne Isco).

RTU – Short for Remote Terminal Unit (or Remote Telemetry Unit), RTU is a code that represents data using a compact binary format.

SCADA – SCADA (Supervisory Control And Data Acquisition) is a computer system for gathering and analyzing real-time data. SCADA systems are used to monitor and control plant operation, or equipment in industries.

The SCADA system transfers the information (for example, where a leak has occurred in a pipeline), back to a central site, alerting the home station of the leak, performing necessary analysis and control (such as determining if the leak is critical), and displaying the information in a logical and organized manner.

SCADA systems can be relatively simple, such as one that monitors the environmental conditions of a small office building, or very complex, such as a system that monitors all the activity in a nuclear power plant or a municipal water system.

TCP/IP – Transmission Control Protocol/Internet Protocol

C.5 Signature ASCII or RTU Address

The Signature's address (Device ID) is user-programmable between 2 and 247.

⚠ CAUTION

Be careful not to assign the same address to more than one flow meter.

C.6 Register Definitions

The register definitions for the Signature flow meter are provided in the following table.

Where no other Unit Of Measure exists for a parameter, percent (%) can be used in most situations.

C.6.1 Modbus Registers

Table C-1 Modbus Output Registers for Signature Flow Meter

Register Number	Name	Data Type	Units of Measure	Read/ Write	Description
40025	TakeReadingFlag	Word		R/W	Set to 1 to update readings, 2 for automatic update
40026	UpdateInterval	Word	Seconds	R/W	The reading update interval in seconds
40027	Activeflags	Word		R	The bit fields to indicate which sensors are active
40040 40041	Level	Float	Meters	R	Level
40042	Levelstatus	Word		R	The level status - non-zero is an error
40043 - 48	Leveltime	Word		R	The last level reading time, sec-min-hour-day-month-year
40055 40056	Level1	Float	Meters	R	Level 1
40057	Level1status	Word		R	The level 1 status - non-zero is an error
40058 - 63	Level1time	Word		R	The last level 1 reading time, sec-min-hour-day-month-year
40070 40071	Level2	Float	Meters	R	Level 2
40072	Level2status	Word		R	The level 2 status - non-zero is an error
40073 - 78	Level2time	Word		R	The last level 2 reading time, sec-min-hour-day-month-year
40085 40086	Level3	Float	Meters	R	Level 3
40087	Level3status	Word		R	The level 3 status - non-zero is an error
40088 - 93	Level3time	Word		R	The last level 3 reading time, sec-min-hour-day-month-year
40100 40101	Velocity	Float	Meters/Sec	R	Velocity

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
40102	Velocitystatus	Word		R	0 = Good, 1 = Failed to Measure, 4 = below min Depth
40103 - 08	Velocitytime	Word		R	The last velocity reading time, sec-min-hour-day-month-year
40115 40116	Velocity1	Float	Meters/Sec	R	Velocity 1
40117	Velocity1status	Word		R	0 = Good, 1 = Failed to Measure, 4 = below min Depth
40118 - 23	Velocity1time	Word		R	The last velocity 1 reading time, sec-min-hour-day-month-year
40130 40131	Velocity2	Float	Meters/Sec	R	Velocity 2
40132	Velocity2status	Word		R	0 = Good, 1 = Failed to Measure, 4 = below min Depth
40133 - 38	Velocity2time	Word		R	The last velocity 2 reading time, sec-min-hour-day-month-year
40145 40146	Velocity3	Float	Meters/Sec	R	Velocity 3
40147	Velocity3status	Word		R	0 = Good, 1 = Failed to Measure, 4 = below min Depth
40148 - 53	Velocity3time	Word		R	The last velocity 3 reading time, sec-min-hour-day-month-year
40160 40161	Flowrate	Float	Cubic Meters/Sec	R	Flow rate
40162	Flowratestatus	Word		R	The flow rate status - non-zero is an error
40163 - 68	Flowratetime	Word		R	The last flow rate reading time, sec-min-hour-day-month-year
40175 40176	Flowrate1	Float	Cubic Meters/Sec	R	Flow rate 1
40177	Flowrate1status	Word		R	The flow rate 1 status - non-zero is an error
40178 - 83	Flowrate1time	Word		R	The last flow rate1 reading time, sec-min-hour-day-month-year
40190 40191	Flowrate2	Float	Cubic Meters/Sec	R	Flow rate 2
40192	Flowrate2status	Word		R	The flow rate 2 status - non-zero is an error
40193 - 98	Flowrate2time	Word		R	The last flow rate 2 reading time, sec-min-hour-day-month-year
40205 40206	Flowrate3	Float	Cubic Meters/Sec	R	Flow rate 3
40207	Flowrate3status	Word		R	The flow rate 3 status - non-zero is an error
40208 - 13	Flowrate3time	Word		R	The last flow rate 3 reading time, sec-min-hour-day-month-year

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
40220 40221	Temperature	Float	Degrees Celsius	R	Temperature
40222	Temperaturestatus	Word		R	The temperature status - non-zero is an error
40223 - 28	Temperaturetime	Word		R	The last temperature reading time, sec-min-hour-day-month-year
40235 40236	Temperature1	Float	Degrees Celsius	R	Temperature 1
40237	Temperature1status	Word		R	The temperature 1 status - non-zero is an error
40238 - 43	Temperature1time	Word		R	The last temperature 1 reading time, sec-min-hour-day-month-year
40250 40251	Temperature2	Float	Degrees Celsius	R	Temperature 2
40252	Temperature2status	Word		R	The temperature 2 status - non-zero is an error
40253 - 58	Temperature2time	Word		R	The last temperature reading time, sec-min-hour-day-month-year
40265 40266	Temperature3	Float	Degrees Celsius	R	Temperature 3
40267	Temperature3status	Word		R	The temperature 3 status - non-zero is an error
40268 - 73	Temperature3time	Word		R	The last temperature 3 reading time, sec-min-hour-day-month-year
40280 40281	Volume	Float	Cubic Meters	R	Volume
40282	Volumestatus	Word		R	The volume status - non-zero is an error
40283 - 88	Volumetime	Word		R	The last volume reading time, sec-min-hour-day-month-year
40295 40296	Volume1	Float	Cubic Meters	R	Volume 1
40297	Volume1status	Word		R	The volume 1 status - non-zero is an error
40298 - 303	Volume1time	Word		R	The last volume 1 reading time, sec-min-hour-day-month-year
40310 40311	Volume2	Float	Cubic Meters	R	Volume 2
40312	Volume2status	Word		R	The volume 2 status - non-zero is an error
40313 - 18	Volume2time	Word		R	The last volume 2 reading time, sec-min-hour-day-month-year
40325 40326	Volume3	Float	Cubic Meters	R	Volume 3
40327	Volume3status	Word		R	The volume 3 status - non-zero is an error
40328 - 33	Volume3time	Word		R	The last volume 3 reading time, sec-min-hour-day-month-year
40340 40341	Voltage	Float	Volts	R	Voltage

Table C-1 Modbus Output Registers for Signature Flow Meter

Register Number	Name	Data Type	Units of Measure	Read/ Write	Description
40342	Voltagestatus	Word		R	The voltage status - non-zero is an error
40343 - 48	Voltagetime	Word		R	The last voltage reading time, sec-min-hour-day-month-year
40355 40356	Voltage1	Float	Volts	R	Voltage 1
40357	Voltage1status	Word		R	The voltage 1 status - non-zero is an error
40358 - 63	Voltage1time	Word		R	The last voltage 1 reading time, sec-min-hour-day-month-year
40370 40371	Voltage2	Float	Volts	R	Voltage 2
40372	Voltage2status	Word		R	The voltage 2 status - non-zero is an error
40373 - 78	Voltage2time	Word		R	The last voltage 2 reading time, sec-min-hour-day-month-year
40385 40386	Voltage3	Float	Volts	R	Voltage 3
40387	Voltage3status	Word		R	The voltage 3 status - non-zero is an error
40388 - 93	Voltage3time	Word		R	The last voltage 3 reading time, sec-min-hour-day-month-year
40400 40401	Analog/%	Float	4-20mA/ 0-100%	R	Analog output or percentage
40402	Analog/status	Word		R	The Analog output or percentage status - non-zero is an error
40403 - 08	Analog/time	Word		R	The last analog or percentage reading time, sec-min-hour-day-month-year
40415 40416	Analog/1	Float	4-20mA/ 0-100%	R	Analog 1 output or percentage
40417	Analog/1status	Word		R	The Analog 1 output or percentage status - non-zero is an error
40418 - 23	Analog/1time	Word		R	The last analog 1 or percentage reading time, sec-min-hour-day-month-year
40430 40431	Analog/2	Float	4-20mA/ 0-100%	R	Analog 2 output or percentage
40432	Analog/2status	Word		R	The Analog 2 output or percentage status - non-zero is an error
40433 - 38	Analog/2time	Word		R	The last analog 2 or percentage reading time, sec-min-hour-day-month-year
40445 40446	Analog/3	Float	4-20mA/ 0-100%	R	Analog 3 output or percentage
40447	Analog/3status	Word		R	The Analog 3 output or percentage status - non-zero is an error
40448 - 53	Analog/3time	Word		R	The last analog 3 or percentage reading time, sec-min-hour-day-month-year

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
40460 40461	Analog/4	Float	4-20mA/ 0-100%	R	Analog 4 output or percentage
40462	Analog/4status	Word		R	The Analog 4 output or percentage status - non-zero is an error
40463 - 68	Analog/4time	Word		R	The last analog 4 or percentage reading time, sec-min-hour-day-month-year
40475 40476	Analog/5	Float	4-20mA/ 0-100%	R	Analog 5 output or percentage
40477	Analog/5status	Word		R	The Analog 5 output or percentage status - non-zero is an error
40478 - 83	Analog/5time	Word		R	The last analog 5 or percentage reading time, sec-min-hour-day-month-year
40490 40491	Analog/6	Float	4-20mA/ 0-100%	R	Analog 6 output or percentage
40492	Analog/6status	Word		R	The Analog 6 output or percentage status - non-zero is an error
40493 - 98	Analog/6time	Word		R	The last analog 6 or percentage reading time, sec-min-hour-day-month-year
40505 40506	Analog/7	Float	4-20mA/ 0-100%	R	Analog 7 output or percentage
40507	Analog/7status	Word		R	The Analog 7 output or percentage status - non-zero is an error
40508 - 13	Analog/7time	Word		R	The last analog 7 or percentage reading time, sec-min-hour-day-month-year
40520 40521	Analog/8	Float	4-20mA/ 0-100%	R	Analog 8 output or percentage
40522	Analog/8status	Word		R	The Analog 8 output or percentage status - non-zero is an error
40523 - 28	Analog/8time	Word		R	The last analog 8 or percentage reading time, sec-min-hour-day-month-year
40535 40536	Analog/9	Float	4-20mA/ 0-100%	R	Analog 9 output or percentage
40537	Analog/9status	Word		R	The Analog 9 output or percentage status - non-zero is an error
40538 - 43	Analog/9time	Word		R	The last analog 9 or percentage reading time, sec-min-hour-day-month-year
40550 40551	Analog/10	Float	4-20mA/ 0-100%	R	Analog 10 output or percentage
40552	Analog/10status	Word		R	The Analog 10 output or percentage status - non-zero is an error
40553 - 58	Analog/10time	Word		R	The last analog 10 or percentage reading time, sec-min-hour-day-month-year
40565 40566	Analog/11	Float	4-20mA/ 0-100%	R	Analog 11 output or percentage

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
40567	Analog/11status	Word		R	The Analog 11 output or percentage status - non-zero is an error
40568 - 73	Analog/11time	Word		R	The last analog 11 or percentage reading time, sec-min-hour-day-month-year
40580 40581	Analog/12	Float	4-20mA/ 0-100%	R	Analog 12 output or percentage
40582	Analog/12status	Word		R	The Analog 12 output or percentage status - non-zero is an error
40583 - 88	Analog/12time	Word		R	The last analog 12 or percentage reading time, sec-min-hour-day-month-year
40595 40596	Analog/13	Float	4-20mA/ 0-100%	R	Analog 13 output or percentage
40597	Analog/13status	Word		R	The Analog 13 output or percentage status - non-zero is an error
40598 - 603	Analog/13time	Word		R	The last analog 13 or percentage reading time, sec-min-hour-day-month-year
40610 40611	Analog/14	Float	4-20mA/ 0-100%	R	Analog 14 output or percentage
40612	Analog/14status	Word		R	The Analog 14 output or percentage status - non-zero is an error
40613 - 18	Analog/14time	Word		R	The last analog 14 or percentage reading time, sec-min-hour-day-month-year
40625 40626	Analog/15	Float	4-20mA/ 0-100%	R	Analog 14 output or percentage
40627	Analog/15status	Word		R	The Analog 15 output or percentage status - non-zero is an error
40628 - 33	Analog/15time	Word		R	The last analog 15 or percentage reading time, sec-min-hour-day-month-year
40700 40701	Fluoresence	Float	%	R	
40702	Fluoresencestatus	Word		R	
40703	Fluoresencetime	Word		R	
40715 40716	Fluoresence1	Float	%	R	
40717	Fluoresence1status	Word		R	
40718 - 23	Fluoresence1time	Word		R	
40730 - 31	Fluoresence2	Float	%	R	
40732	Fluoresence2status	Word		R	
40733 - 38	Fluoresence2time	Word		R	
40745 - 46	Fluoresence3	Float	%	R	
40747	Fluoresence3status	Word		R	

Table C-1 Modbus Output Registers for Signature Flow Meter

Register Number	Name	Data Type	Units of Measure	Read/ Write	Description
40748 - 53	Fluoresence3time	Word		R	
40760 40761	Battery	Float	Volts	R	
40762	Batterystatus	Word		R	
40763 - 68	Batterytime	Word		R	
40775 40776	Battery1	Float	Volts	R	
40777	Battery1status	Word		R	
40778 - 83	Battery1time	Word		R	
40790 40791	Battery2	Float	Volts	R	
40792	Battery2status	Word		R	
40793 - 98	Battery2time	Word		R	
40805 40806	Battery3	Float	Volts	R	
40807	Battery3status	Word		R	
40808 - 13	Battery3time	Word		R	
40820 40821	Dissolved Gas	Float	mmHg	R	
40822	Dissolved Gasstatus	Word		R	
40823 - 28	Dissolved Gastime	Word		R	
40835 40836	Dissolved Gas1	Float	mmHg	R	
40837	Dissolved Gas1status	Word		R	
40838 - 43	Dissolved Gas1time	Word		R	
40850 40851	Dissolved Gas2	Float	mmHg	R	
40852	Dissolved Gas2status	Word		R	
40853 - 58	Dissolved Gas2time	Word		R	
40865 40866	Dissolved Gas3	Float	mmHg	R	
40867	Dissolved Gas3status	Word		R	
40868 - 73	Dissolved Gas3time	Word		R	
40940 40941	Photosyn Rad	Float	umol s1 m2	R	
40942	Photosyn Radstatus	Word		R	
40943 - 48	Photosyn Radtime	Word		R	
40955 40956	Photosyn Rad1	Float	umol s1 m2	R	

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
40957	Photosyn Rad1status	Word		R	
40958 - 63	Photosyn Rad1time	Word		R	
40970 40971	Photosyn Rad2	Float	umol s1 m2	R	
40972	Photosyn Rad2status	Word		R	
40973 - 78	Photosyn Rad2time	Word		R	
40985 40986	Photosyn Rad3	Float	umol s1 m2	R	
40987	Photosyn Rad3status	Word		R	
40988 - 93	Photosyn Rad3time	Word		R	
41000 41001	Transmissivity	Float	%	R	
41002	Transmissivitystatus	Word		R	
41003 - 08	Transmissivitytime	Word		R	
41015 41016	Transmissivity1	Float	%	R	
41017	Transmissivity1status	Word		R	
41018 - 23	Transmissivity1time	Word		R	
41030 41031	Transmissivity2	Float	%	R	
41032	Transmissivity2status	Word		R	
41033 - 38	Transmissivity2time	Word		R	
41045 41046	Transmissivity3	Float	%	R	
41047	Transmissivity3status	Word		R	
41048 - 53	Transmissivity3time	Word		R	
41060 41061	Conductivity	Float	uS/cm	R	
41062	Conductivitystatus	Word		R	
41063 - 68	Conductivitytime	Word		R	
41075 41076	Conductivity1	Float	uS/cm	R	
41077	Conductivity1status	Word		R	
41078 - 83	Conductivity1time	Word		R	
41090 41091	Conductivity2	Float	uS/cm	R	
41092	Conductivity2status	Word		R	
41093 - 98	Conductivity2time	Word		R	

Table C-1 Modbus Output Registers for Signature Flow Meter

Register Number	Name	Data Type	Units of Measure	Read/ Write	Description
41105 41106	Conductivity3	Float	uS/cm	R	
41107	Conductivity3status	Word		R	
41108 - 13	Conductivity3time	Word		R	
41120 41121	Specific Conductance	Float	uS/cm	R	
41122	Specific Conductan-cestatus	Word		R	
41123 - 28	Specific Conduc-tancetime	Word		R	
41135 41136	Specific Conductance1	Float	uS/cm	R	
41137	Specific Conductance1status	Word		R	
41138 - 43	Specific Conductance1time	Word		R	
41150 41151	Specific Conductance2	Float	uS/cm	R	
41152	Specific Conductance2status	Word		R	
41153 - 58	Specific Conductance2time	Word		R	
41165 41166	Specific Conductance3	Float	uS/cm	R	
41167	Specific Conductance3status	Word		R	
41168 - 73	Specific Conductance3time	Word		R	
41180 41181	Dissolved Solid	Float	mg/l	R	
41182	Dissolved Solidstatus	Word		R	
41183 - 88	Dissolved Solidtime	Word		R	
41195 41196	Dissolved Solid1	Float	mg/l	R	
41197	Dissolved Solid1status	Word		R	
41198 - 203	Dissolved Solid1time	Word		R	
41210 41211	Dissolved Solid2	Float	mg/l	R	
41212	Dissolved Solid2status	Word		R	
41213 - 18	Dissolved Solid2time	Word		R	

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
41225 41226	Dissolved Solid3	Float	mg/l	R	
41227	Dissolved Solid3status	Word		R	
41228 - 33	Dissolved Solid3time	Word		R	
41240 41241	Salinity	Float	mg/l	R	
41242	Salinitystatus	Word		R	
41243 - 48	Salinitytime	Word		R	
41255 41256	Salinity1	Float	mg/l	R	
41257	Salinity1status	Word		R	
41258 - 63	Salinity1time	Word		R	
41270 41271	Salinity2	Float	mg/l	R	
41272	Salinity2status	Word		R	
41273 - 78	Salinity2time	Word		R	
41285 41286	Salinity3	Float	mg/l	R	
41287	Salinity3status	Word		R	
41288 - 93	Salinity3time	Word		R	
41300 41301	Dissolved Oxygen	Float	mg/l	R	
41302	Dissolved Oxygensta-tus	Word		R	
41303 - 08	Dissolved Oxygen-time	Word		R	
41315 41316	Dissolved Oxygen1	Float	mg/l	R	
41317	Dissolved Oxygen1status	Word		R	
41318 - 23	Dissolved Oxygen1time	Word		R	
41330 401331	Dissolved Oxygen2	Float	mg/l	R	
41332	Dissolved Oxygen2status	Word		R	
41333 - 38	Dissolved Oxygen2time	Word		R	
41345 41346	Dissolved Oxygen3	Float	mg/l	R	

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
41347	Dissolved Oxygen3status	Word		R	
41348 - 53	Dissolved Oxygen3time	Word		R	
41360 41361	pH	Float	pH	R	
41362	pHstatus	Word		R	
41363 - 68	pHtime	Word		R	
41375 41376	pH1	Float	pH	R	
41377	pH1status	Word		R	
41378 - 83	pH1time	Word		R	
41390 41391	pH2	Float	pH	R	
41392	pH2status	Word		R	
41393 - 98	pH2time	Word		R	
41405 41406	pH3	Float	pH	R	
41407	pH3status	Word		R	
41408 - 13	pH3time	Word		R	
41420 41421	ORP	Float	Volts	R	
41422	ORPstatus	Word		R	
41423 - 28	ORPtime	Word		R	
41435 41436	ORP1	Float	Volts	R	
41437	ORP1status	Word		R	
41438 - 43	ORP1time	Word		R	
41450 41451	ORP2	Float	Volts	R	
41452	ORP2status	Word		R	
41453 - 58	ORP2time	Word		R	
41465 41466	ORP3	Float	Volts	R	
41467	ORP3status	Word		R	
41468 - 73	ORP3time	Word		R	
41480 41481	NH4 Nitrogen	Float	mg/l	R	
41482	NH4 Nitrogenstatus	Word		R	

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
41483 - 88	NH4 Nitrogentime	Word		R	
41495 41496	NH4 Nitrogen1	Float	mg/l	R	
41497	NH4 Nitrogen1status	Word		R	
41498 - 503	NH4 Nitrogen1time	Word		R	
41510 41511	NH4 Nitrogen2	Float	mg/l	R	
41512	NH4 Nitrogen2status	Word		R	
41513 - 18	NH4 Nitrogen2time	Word		R	
41525 41526	NH4 Nitrogen3	Float	mg/l	R	
41527	NH4 Nitrogen3status	Word		R	
41528 - 33	NH4 Nitrogen3time	Word		R	
41540 41541	NO3 Nitrogen	Float	mg/l	R	
41542	NO3 Nitrogenstatus	Word		R	
41543 - 48	NO3 Nitrogentime	Word		R	
41555 41556	NO3 Nitrogen1	Float	mg/l	R	
41557	NO3 Nitrogen1status	Word		R	
41558 - 63	NO3 Nitrogen1time	Word		R	
41570 41571	NO3 Nitrogen2	Float	mg/l	R	
41572	NO3 Nitrogen2status	Word		R	
41573 - 78	NO3 Nitrogen2time	Word		R	
41585 41586	NO3 Nitrogen3	Float	mg/l	R	
41587	NO3 Nitrogen3status	Word		R	
41588 - 93	NO3 Nitrogen3time	Word		R	
41600 41601	Turbidity	Float	NTU	R	
41602	Turbiditystatus	Word		R	
41603 41608	Turbiditytime	Word		R	
41615 41616	Turbidity1	Float	NTU	R	
41617	Turbidity1status	Word		R	
41618 - 23	Turbidity1time	Word		R	

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
41630 41631	Turbidity2	Float	NTU	R	
41632	Turbidity2status	Word		R	
41633 - 38	Turbidity2time	Word		R	
41645 41646	Turbidity3	Float	NTU	R	
41647	Turbidity3status	Word		R	
41648 41653	Turbidity3time	Word		R	
41660 41661	Chloride	Float	mg/l	R	
41662	Chloridestatus	Word		R	
41663 - 68	Chloridetime	Word		R	
41675 41676	Chloride1	Float	mg/l	R	
41677	Chloride1status	Word		R	
41678 - 83	Chloride1time	Word		R	
41690 41691	Chloride2	Float	mg/l	R	
41692	Chloride2status	Word		R	
41693 - 98	Chloride2time	Word		R	
41705 41706	Chloride3	Float	mg/l	R	
41707	Chloride3status	Word		R	
41708 - 13	Chloride3time	Word		R	
41720 41721	Resistivity	Float	Ohm-cm	R	
41722	Resistivitystatus	Word		R	
41723 41728	Resistivitytime	Word		R	
41735 41736	Resistivity1	Float	Ohm-cm	R	
41737	Resistivity1status	Word		R	
41738 - 43	Resistivity1time	Word		R	
41750 41751	Resistivity2	Float	Ohm-cm	R	
41752	Resistivity2status	Word		R	
41753 - 58	Resistivity2time	Word		R	
41765 41766	Resistivity3	Float	Ohm-cm	R	

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
41767	Resistivity3status	Word		R	
41768 - 73	Resistivity3time	Word		R	
41780 41781	Pressure	Float	mmHg	R	
41782	Pressurestatus	Word		R	
41783 - 88	Pressuretime	Word		R	
41795 41796	Pressure1	Float	mmHg	R	
41797	Pressure1status	Word		R	
41798 - 803	Pressure1time	Word		R	
41810 41811	Pressure2	Float	mmHg	R	
41812	Pressure2status	Word		R	
41813 - 18	Pressure2time	Word		R	
41825 41826	Pressure3	Float	mmHg	R	
41827	Pressure3status	Word		R	
41828 - 33	Pressure3time	Word		R	
41840 41841	Reserved	Float		R	
41842	Reservedstatus	Word		R	
41843 - 48	Reservedtime	Word		R	
41855 41856	Generic	Float		R	
41857	Genericstatus	Word		R	
401858 - 63	Generictime	Word		R	
401870 401871	Generic1	Float		R	
41872	Generic1status	Word		R	
41873 - 78	Generic1time	Word		R	
41885 41886	Generic2	Float		R	
41887	Generic2status	Word		R	
41888 - 93	Generic2time	Word		R	
41900 41901	Generic3	Float		R	
41902	Generic3status	Word		R	
41903 - 08	Generic3time	Word		R	

Table C-1 Modbus Output Registers for Signature Flow Meter					
Register Number	**Name**	**Data Type**	**Units of Measure**	**Read/ Write**	**Description**
41915 41916	Generic4	Float		R	
41917	Generic4status	Word		R	
41918 - 23	Generic4time	Word		R	
41930 41931	Generic5	Float		R	
41932	Generic5status	Word		R	
41933 - 38	Generic5time	Word		R	
41945 41946	Generic6	Float		R	
41947	Generic6status	Word		R	
41948 - 53	Generic6time	Word		R	
41960 41961	Generic7	Float		R	
41962	Generic7status	Word		R	
41963 - 68	Generic7time	Word		R	
41975 41976	Generic8	Float		R	
41977	Generic8status	Word		R	
41978 - 83	Generic8time	Word		R	
41990 41991	Wireless Power	Float		R	
41992	Wireless Powerstatus	Word		R	
41993 - 98	Wireless Powertime	Word		R	

Signature® Flow Meter

Appendix D Material Safety Data Sheets

This appendix provides Material Safety Data Sheets for the desiccant used by the Signature Flow Meter.

Teledyne Isco cannot guarantee the accuracy of the data. Specific questions regarding the use and handling of the products should be directed to the manufacturer listed on the MSDS.

SORB-IT® is a registered trademark of N. T. Gates Company.

MATERIAL SAFETY DATA SHEET

INTERRA GLOBAL CORP

sSORB®

Health	1
Fire	0
Reactivity	0
Personal Protection	E

Section 1: CHEMICAL PRODUCT & COMPANY IDENTIFICATION

Product Name: sSORB®
Chemical Name: Yellow Indicating Silica Gel
Synonyms: Orange Indicating Silica Gel

Supplier: Interra Global Corporation
371 Edgemont Lane
Park Ridge, IL 60068
USA

Emergency Assistance

USA	+ 1.847.292.8600
Outside USA	+ 1.847.292.8600
Telephone:	+ 1.847.292.8600
Fax:	+ 1.847.292.8601

Section 2: COMPOSITION & INFORMATION ON INGREDIENTS

CAS Numbers: 1343-98-2, 77-09-8
Molecular Formula: $SiO_2 \cdot nH_2O + C_{20}H_{14}O_4$

Section 3: HAZARDS IDENTIFICATION

Potential Health Effects

Inhalation: May cause dryness and irritation to mucous membranes, nose and throat. Symptoms may include coughing, sore throat, and wheezing.
Ingestion: No adverse effects expected.
Skin Contact: May cause irritation with dryness and abrasion.
Eye Contact: May cause irritation, redness and pain.
Chronic Exposure: Repeated exposure may cause symptoms similar to those listed for acute effects. Synthetic amorphous silica does not produce silicosis.

Section 4: FIRST AID MEASURES

Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes wth plenty of water for at least 15 minutes. Get medical attention if irritation occurs.
Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.
Ingestion: Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Inhalation: If inhaled, remove to fresh air. If breathing is difficult, get medical attention.

Section 5: FIRE & EXPLOSION DATA

Fire: Not considered to be a fire hazard.
Explosion: Not considered to be an explosion hazard.
Fire Fighting Media and Instructions: Use any means suitable for extinguishing surronding fire.
Special Remarks: Use protective clothing and breathing equipment appropriate for surronding fire.

INTERRA Global Corporation msds sSORB p1

MATERIAL SAFETY DATA SHEET

Section 6: ACCIDENTAL RELEASE MEASURES

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container. Use respiratory protection and eye protection.

Large Spill: Use a shovel to put the material into a convenient waste disposal container. Vacuuming or wet sweeping may be used to avoid dust dispersal. Use respiratory protection and eye protection.

Section 7: HANDLING & STORAGE

Storage: Keep container tightly closed. Suitable for any general chemical storage area. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

Section 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls: Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Respirator (NIOSH Approved). Gloves.

Section 9: PHYSICAL & CHEMICAL PROPERTIES

Physical state:	Solid	**Boling Point:**	2230C (4046F)
Color:	Yellow/Orange-Dry:Green-Saturated	**Melting Point:**	1610C (2930F)
Odor:	Odorless	**Vapor Pressure:**	Not applicable.
Solubility:	Insoluble	**Vapor Density:**	Not applicable.
Specific Gravity:	2.1 (Water=1)	**Evaporation Rate:**	Not available.
pH :	3 - 8 (in 5% slurry)	**% Volatiles by volume @ 21C (70F):**	0

Section 10: STABILITY & REACTIVITY

Stability: The product is stable.

Hazardous Decomposition Products: Oxides of carbon and silicon may be formed when heated.

Hazardous Polymerization: Will not occur.

Incompatiblity with powerfull oxiders: Reacts with hydrogen flouoride, fluorine, oxygen difluoride, chlorine trifluoride, strong acids, strong bases, and oxidizers.

Conditions to Avoid: Moisture, extreme heat, and incompatibles.

Section 11: TOXICOLOGICAL INFORMATION

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available.

LC50: Not available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: This material is not expected to be toxic to aquatic life.

MATERIAL SAFETY DATA SHEET

Section 13: DISPOSAL CONSIDERATIONS
Waste Disposal: Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: TRANSPORT INFORMATION
DOT Classification: Not a DOT controlled material (United States).
Identification: Not applicable.

Section 15: OTHER REGULATORY INFORMATION	
HMIS (U.S.A.):	
Health Hazard:	1
Fire Hazard:	0
Reactivity:	0
Personal Protection:	E
National Fire Protection Association (U.S.A.):	
Health:	1
Flammability:	0
Reactivity:	0

Section 16: OTHER INFORMATION

References: Not available.
Other Special Considerations: Not available.

Created: 04/03/2009 11:20 AM
Last Updated: 03/25/2010 10:40 AM

The purpose of this Safety Data Sheet is to describe the products in terms of their safety requirements. The information above is believed to be accurat and represents the bet information currently available to us. However, we make no warrant of merchantability or any other warranty, express or implied, with respect ot such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the informtion for their particular purposes. In no event shal Interra Global Corporation be liable for an claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Interra Global Corporation has been advised of the possibiity of such damages.

03/21/2012 14:04 FAX 14137368257 002

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MATERIAL SAFETY DATA SHEET

SÜD-CHEMIE
Creating Performance Technology

Date Issued: 07/06/2004
MSDS No: 5008
Date-Revised: 11/28/2011
Revision No: 3

Desi Pak®

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Desi Pak®
GENERAL USE: Desiccant

MANUFACTURER
Süd-Chemie Performance Packaging
101 Christine Drive
Rio Grande Industrial Park
Belen, NM 87002
Customer Service: 505-864-6691

24 HR. EMERGENCY TELEPHONE NUMBERS
CHEMTREC : (800) 424 - 9300
Outside the U.S. Call Collect : 001 (703) 527-3887

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

PHYSICAL APPEARANCE: Performance packaging product, size and type vary.

IMMEDIATE CONCERNS: Poses little or no immediate hazard.

POTENTIAL HEALTH EFFECTS

EYES: Route of exposure unlikely. Dust may cause a mechanical irritation which can scratch the eye.

SKIN: No adverse effects expected.

INGESTION: Non-toxic by ingestion. Packets or canisters may pose a choking hazard. Keep away from children and pets.

INHALATION: Route of exposure unlikely. This material is normally packaged and contained in a pouch, bag or canister. If the container is opened, prolonged or repeated inhalation of high dust concentrations may cause lung damage.

3. COMPOSITION / INFORMATION ON INGREDIENTS

INGREDIENT(S)	CAS	Wt.%
Pouch, Bag, Canister, Stopper, or Cap		1 - 75
Clay	1302-78-9	25 - 99
Silica, quartz	14808-60-7	<0.5

See Section 8 for Exposure Limits

4. FIRST AID MEASURES

EYES: Do not rub eyes. Flush with lukewarm, gently flowing water for 5 minutes or until the particle/dust is removed, while holding the eyelid(s) open. Obtain medical attention.

SKIN: Wash with soap and water.

Desi Pak®

INGESTION: Normally not needed. If large quantities are ingested, call your local Poison Control Center (1-800-222-1222 in the U.S.).

INHALATION: Normally not needed. If exposed to excessive levels of dust or fumes, remove to fresh air and seek medical attention of cough or other symptoms develop or persist.

5. FIRE FIGHTING MEASURES

FLASHPOINT AND METHOD: Material is not flammable

EXTINGUISHING MEDIA: Use extinguishing agent applicable to surrounding fire.

FIRE FIGHTING PROCEDURES: As in any fire, wear self-contained breathing apparatus operated in pressure-demand mode, (NIOSH approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

SMALL SPILL: No special precautions required.

LARGE SPILL: With shovel or scoop, place material into appropriate container.

7. HANDLING AND STORAGE

HANDLING: Use of proper hygiene practices in the workplace is recommended.

STORAGE: Store in a dry area.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE GUIDELINES

HAZARDOUS COMPONENTS						
		EXPOSURE LIMITS				
		OSHA PEL		ACGIH TLV		
Chemical Name		ppm	mg/m³	ppm	mg/m³	
Clay	TWA	[1]	[1]	[1]	[1]	
Silica, quartz	TWA	[2]	[2]	[3]	0.025 [3]	

OSHA TABLE COMMENTS:
1. Exposure limits not established.
2. Total Dust = (30 mg/m3)/(%SiO2+2)
3. Respirable

ENGINEERING CONTROLS: If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Follow facility guidelines.

SKIN: Use of proper hygiene practices in the workplace is recommended.

RESPIRATORY: Use local exhaust if dusting occurs. Good general ventilation is adequate in the absence of dusts.

COMMENTS: All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is 5 mg/m3 for respirable fraction and 15 mg/m3 for total dust. ACGIH exposure guidelines of less than 3 mg/m3 (respirable) and 10 mg/m3 (inhalable) have been established for particles (insoluble/poorly soluble) not otherwise specified (PNOS).

Desi Pak®

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: Solid
ODOR: None
pH: Not Determined
PERCENT VOLATILE: None
VAPOR PRESSURE: Not Applicable
VAPOR DENSITY: Not applicable.
EVAPORATION RATE: Not Applicable
VISCOSITY: Not Applicable
OXIDIZING PROPERTIES: None

10. STABILITY AND REACTIVITY

STABLE: Yes
HAZARDOUS POLYMERIZATION: No

11. TOXICOLOGICAL INFORMATION

ACUTE

Chemical Name	ORAL LD_{50} (rat)	DERMAL LD_{50} (rabbit)	INHALATION LC_{50} (rat)
Clay	> 5000 gm/kg(b.w.)		> 200 mg/L/1H
Silica, quartz	500 gm/kg(b.w.)	No Data Available	No Data Available

CARCINOGENICITY

Chemical Name	NTP Status	IARC Status	OSHA Status
Clay	Not listed.	Not listed.	Not listed.
Silica, quartz	Known Carcinogen	Group I	Not listed.

SENSITIZATION: Not sensitizing
GENERAL COMMENTS: Crystalline silica present is contained within a pouch, canister or bag. No exposure to airborne particles of respirable size is expected under normal conditions of use.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL DATA: Low hazard for usual industrial or commercial handling.
CHEMICAL FATE INFORMATION: This material is of mineral origin. It is not biodegradable.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: This product, if discarded as sold, is not a Federal RCRA hazardous waste. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations.

14. TRANSPORT INFORMATION

DOT (DEPARTMENT OF TRANSPORTATION)
PROPER SHIPPING NAME: Not regulated
ROAD AND RAIL (ADR/RID)
PROPER SHIPPING NAME: Not regulated
AIR (ICAO/IATA)
SHIPPING NAME: Not regulated
VESSEL (IMO/IMDG)
SHIPPING NAME: Not regulated
CANADA TRANSPORT OF DANGEROUS GOODS
SHIPPING NAME: Not regulated

15. REGULATORY INFORMATION

UNITED STATES
SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)
FIRE: No **PRESSURE GENERATING:** No **REACTIVITY:** No **ACUTE:** No **CHRONIC:** Yes
313 REPORTABLE INGREDIENTS: Not listed.
CERCLA (COMPREHENSIVE RESPONSE, COMPENSATION, AND LIABILITY ACT)
CERCLA REGULATORY: Not listed.
TSCA (TOXIC SUBSTANCE CONTROL ACT)
TSCA STATUS: All components are listed on the TSCA Inventory or are excluded or exempt.
REGULATIONS
STATE REGULATIONS: California
CALIFORNIA PROPOSITION 65: This product does not contain chemical(s) known to the state of California to cause cancer, birth defects, or reproductive harm.

Crystalline silica present is contained within a pouch, canister or bag. There is no exposure to airborne particles of respirable size under normal conditions of use.

Chemical Name	Wt.%	Listed
Silica, quartz	<0.5	Cancer

RCRA STATUS: This product, if discarded as sold, is not a Federal RCRA hazardous waste. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations.

CANADA
WHMIS HAZARD SYMBOL AND CLASSIFICATION

Does not meet classification criteria pursuant to the Canadian Hazardous Products Act.

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM): This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

CANADA INGREDIENT DISCLOSURE LIST: Contains component(s) listed on the Canadian Hazardous Products Act Ingredient Disclosure List.

CANADIAN ENVIRONMENTAL PROTECTION ACT: All ingredients are listed on the Canadian Domestic Substances List inventory.

Desi Pak®

EUROPEAN COMMUNITY

EEC LABEL SYMBOL AND CLASSIFICATION

Not classified as dangerous

16. OTHER INFORMATION

APPROVED BY: Prepared and approved by SHE Dept. Sud-Chemie Inc.

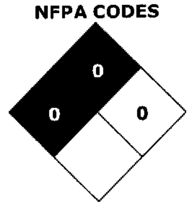
INFORMATION CONTACT: E-mail - MSDS_US@sud-chemie.com

REVISION SUMMARY: This MSDS replaces the 01/21/2009 MSDS. Revised: **Section 1:** INFORMATION CONTACT. **Section 16:** HMIS RATING (HEALTH, PHYSICAL HAZARD, HMIS RATINGS NOTES, CHRONIC).

HMIS RATING

HEALTH	*	1
[illegible]		0
PHYSICAL HAZARD		0
PERSONAL PROTECTION		

NFPA CODES



HMIS RATINGS NOTES: Personal Protection should be determined based on workplace conditions.

MANUFACTURER DISCLAIMER: The information presented herein is believed to be accurate but is not warranted. Recipients are advised to confirm in advance that the information is current, applicable and suitable to their circumstances.

Signature™ Flow Meter

Index

Numerics

A

B

C

D

产品中有毒有害物质或元素的名称及含量
Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	O
显示 Display	X	O	O	O	O	O
接线 Wiring	O	O	O	O	O	X
内部电缆 Internal Cables	O	O	O	O	O	X
直流电机 DC Motor	X	O	O	O	O	X
接头 Connectors	O	O	X	O	O	O
电池 Battery	X	X	X	O	O	O
电磁阀 Solenoid valve	X	O	O	O	O	X

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component’s any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打“X” 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component’s at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the “X”marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January, "B" is February and so on.

DECLARATION OF CONFORMITY

ISM1-A

Application of Council Directive:	2004/108/EC -The EMC Directive 2012/19/EC– The WEEE Directive 2006/95/EC – The Low Voltage Directive
Manufacturer's Name:	Teledyne Isco
Manufacturer's Address:	4700 Superior, Lincoln, Nebraska 68504 USA Mailing Address: P.O. Box 82531, Lincoln, NE 68501 Phone: +1 (402) 464-0231 FAX: +1 (402) 465-3799
Equipment Type/Environment:	Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No:	Signature Flow Meter (AC or DC power) with 350, 360, 301 sensors, 306 Sampler Interface, RS485 and Ethernet Modem options
Year of Issue:	2014
Standards to which Conformity is Declared:	EN 61326:2006 & IEC 61326-1:2012 EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN 61010-1 2nd edition Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN60529 Special Protection offered by the Signature's Enclosure: IP-66

Standard	Description	Severity Applied	Performance Criteria
EN61000-4-2:2008	Electrostatic Discharge (AC or DC power)	Level 2 - 4kV contact discharge Level 3 - 8kV air discharge	A
EN61000-4-3:2006 /A1:2007 /A2:2010	Radiated RF Immunity (AC or DC power)	10 V/m:80MHz-1GHz, 3 V/m:1.4GHz-2GHz, 1 V/m: 2GHz-2.7GHz, 80%, AM, 1KHz rate,1 sec dwell	A
EN61000-4-4:2004 /A1:2010	Electrical Fast Transient (EFT) on Mains and I/O	± 2 kV on AC lines, ±1 kV on (AC & DC) Signal Cables	A
EN61000-4-5:2005	Surge on AC Lines	±1 kV L-L /±2 kV L-PE	A
EN61000-4-6:2008	Conducted RF Immunity on Mains and I/O	3 Vrms on AC Mains & (AC & DC) Signal Cables	A
EN61000-4-11:2004	Voltage Dips	0.5,1,25 Cycle/0,0,70%	A
CISPR11/ EN 55011:2009 /A1:2010	RF Emissions Radiated, below 1GHz and Conducted, AC Mains	Group 1, Class A Industrial, Scientific, and Medical Equipment	PASS
EN61000-3-2:2006 /A1:2009 /A2:2009 IEC 61000-3-2:2014 EN61000-3-3:2008	AC Harmonics, Flicker		PASS

We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of August 18. 2014.

USA Representative

Vikas V. Padhye, Ph. D.
Executive Vice President of Sales and Marketing and Product Line General Management
4700 Superior Street
Lincoln, Nebraska 68504
Phone: 402-464-0231
Fax: 402-464-0318

TELEDYNE ISCO
Everywhereyoulook™

60-4302-021
Rev. C

Teledyne Isco One Year Limited Factory Service Warranty*

This warranty exclusively covers Teledyne Isco instruments, providing a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period due to faulty parts or workmanship will be repaired at the factory at no charge to the customer. Teledyne Isco's exclusive liability is limited to repair or replacement of defective instruments. Teledyne Isco is not liable for consequential damages.

Teledyne Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Teledyne Isco, and Teledyne Isco will pay surface transportation to return the repaired instrument to the customer. Teledyne Isco will not pay air freight or customer's packing and crating charges. This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

The warranty for any instrument is the one in effect on date of shipment. The warranty period begins on the shipping date, unless Teledyne Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as pH sensors, charts, ribbon, lamps, tubing, and glassware; fittings and wetted parts of valves; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover products not sold under the Teledyne Isco trademark or for which any other warranty is specifically stated.

No item may be returned for warranty service without a return authorization number issued by Teledyne Isco.

This warranty is expressly in lieu of all other warranties and obligations and Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

The warrantor is Teledyne Isco, 4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to the USA and countries where Teledyne Isco does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.**

Before returning any instrument for repair, please call, fax, or e-mail the Teledyne Isco Service Department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE PROBLEM.**

Shipping Address:	Teledyne Isco - Attention Repair Service 4700 Superior Street Lincoln, NE 68504 USA	
Mailing Address:	Teledyne Isco PO Box 82531 Lincoln, NE 68501 USA	
Phone:	Repair service:	(800) 775-2965 (lab instruments) (866) 298-6174 (samplers & flow meters)
	Sales & General Information: (800) 228-4373 (USA & Canada)	
Fax:	(402) 465-3001	
Email:	IscoService@teledyne.com	

October 11, 2013 P/N 60-1002-040 Rev H

TELEDYNE ISCO
Everywhereyoulook™

Harbor Brook CSO 018 Constructed Wetlands Pilot Treatment Facility
SCADA Alarms

Original Alarm Name	Alarm Name	Original Message	New Message	Description	Metro Board Action
E06I100	E06I100	UHB CSO - SANSEP System Normal Power Failure	HBW - Power Failure	Power failure at the grit and floatables facility	Notify On Call Flow Control Personnel for Harbor Brook and Adam Woodburn. Flow Control to proceed to site immediately and manually
E06I101	E06I101	UHB CSO - SANSEP Chamber 1 - Influent Level - Loss of Signal	HBW- SANSEP1 Inside Level - Loss of Signal	Level sensor signal loss	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to notify and discuss with CH2M HILL. System operation and
E06I102	E06I102	UHB CSO - SANSEP Chamber 1 - Effluent Level - Loss of Signal	HBW - SANSEP1 Outside Level - Loss of Signal	Level sensor signal loss	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to notify and discuss with CH2M HILL. System operation and
E06I103	E06I103	UHB CSO - SANSEP Chamber 2 - Influent Level - Loss of Signal	HBW - SANSEP2 Inside Level - Loss of Signal	Level sensor signal loss	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to notify and discuss with CH2M HILL. System operation and
E06I104	E06I104	UHB CSO - SANSEP Chamber 2 - Effluent Level - Loss of Signal	HBW - SANSEP2 Outside Level - Loss of Signal	Level sensor signal loss	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to notify and discuss with CH2M HILL. System operation and
E06I105	E06I105	UHB CSO - Man Hole 3C Level - Loss of Signal	HBW - MH-3C - Loss of Signal	Level sensor signal loss	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to notify and discuss with CH2M HILL. System operation and
E06I106	E06I106	UHB CSO - Box 2 Level - Loss of Signal	HBW - BOX 2 - Loss of Signal	Level sensor signal loss	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to notify and discuss with CH2M HILL. System operation and performance not affected.
E06I202	E06I202	UHB CSO - Man Hole 1A in Local Mode	HBW - BOX 1A Gate - Local Mode	Box 1A gate in manual mode, automatic operation of system will not occur	Notify On Call Flow Control Personnel and Adam Woodburn Flow Control to discuss internally and with CH2M HILL to determine when to put Box 1A gate back into remote mode.
E06I204	E06I204	UHB CSO - Man Hole 1A Malfunction Alarm	HBW - BOX 1A Gate - Malfunction Alarm	Box 1A gate malfunction	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to proceed to site to diagnose malfunction and discuss resolution with CH2M HILL.
E06I207	E06I207	UHB CSO - Man Hole 3C in Local Mode	HBW - MH-3C 3C Gate - Local Mode	MH-3C drain valve in manual mode; underflow from SanSeps will not be diverted to HBIS	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to discuss internally and with CH2M HILL to determine when to put MH-3C drain valve back into remote mode.
E06I209	E06I209	UHB CSO - Man Hole 3C Malfunction Alarm	HBW - MH-3C Gate - Malfunction Alarm	MH-3C drain valve malfunction	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to proceed to site to diagnose malfunction and discuss resolution with CH2M HILL.
E06_EVENT	E06_INF_ST	UHB CSO - SANSEP Event in Progress - Notify On Call ESF Personnel	UHB CSO - SANSEP Event in Progress - Notify On Call ESF Personnel	Box 1A gate valve closed, flow being diverted to the grit and floatables facility	Notify SUNY ESF sampling staff to mobilize and collect samples per sampling protocol.
-	E06_INF_END	-	HBW - BOX 1A - Gate Open, Influent End	Box 1A gate valve opened, influent diversion event end	None, provided to notify Metro Board that previous influent diversion has ended, in the event of a subsequent, new diversion.
E06_FLUSH_AL	E06_FLUSH_AL	UHB CSO - SANSEP Flush Cycle Failed to Complete	UHB CSO - SANSEP Flush Cycle Failed to Complete	SanSep washdown sprays failed to activate at the end of an event	Notify On Call Flow Control Personnel and Adam Woodburn. Flow Control to manually clean SanSep screens until washdown sprays return to automatic functioning.
E07_FT105	E07_EFF_ST	UHB Man Hole 19 Flow Alarm - Notify On Call ESF Personnel	HBW - MH-19 - Effluent Discharge Start	Flow is discharging out the CSO 018 outfall, an "Event" is occurring.	Notify SUNY ESF sampling staff to mobilize and collect samples per sampling protocol.
-	E07_EFF_END	-	HBW - MH-19 - Effluent Discharge End	Flow has stopped discharging out the effluent and the "Event" has ceased.	None, provided to notify Metro Board that Event has ended, in the event of a subsequent, new effluent Event.

MEMORANDUM

Shamrock Engineering P.C.
1 Thrush Terrace
East Greenbush, NY 12061
Ph: (518) 441-6148
Fax: (518) 286-2978

Date: May 2, 2013

To: **James Heist**
Process Wastewater Tech

Via: Mail

Re: **Review of the Harbor Brook CSO 18 Tank Installation and Collar Tie Design**

As requested, Shamrock Engineering P.C. has reviewed the proposed concrete collar design and the buoyancy calculations for the precast concrete tanks to be used for the above referenced project. The following is s brief summary of our review and conclusions.

Prior to commencing work we were provided data related to the proposed tanks to be used, buoyancy calculations as developed by PWT, foundation and pile cap information, and product information for manufactured items to be used. Based on the information provided, the system will employ six, precast, concrete tanks of varying sizes, shapes, and dimensions. The tanks will be founded on cast-in-place concrete pile caps that are supported by driven steel H-piles. The tanks will be interconnected by a series of large diameter pipes or conduits.

As part of our work, we reviewed the buoyancy calculations provided and assisted with the development of a "hold down" or anchorage system. For the calculations, the assumption is that the ground is fully saturated and the tanks are empty, that is, the buoyant forces are based on water being at ground level. Based on this assumption, a factor of safety was applied and the resultant forces were calculated, resulting in tank 1A, SS1 and 2, and MH3A having a net upward force. We are proposing that these upward forces will be resolved by anchoring the tanks to the pile caps. More specifically, we are specifying a minimum angle of 6"x6"x3/8"x12" long with two ½" diameter epoxy anchors per leg. Using these angles, tanks 1A and MH3A will required four anchors and SS! And SS2 will require six anchors each. The anchors must be equally spaced around the perimeter of the tank and the bolts must have a minimum embedment depth of four inches.

In addition to the buoyancy issue, we reviewed the concrete collar reinforcing and design. Based on our review, the concrete collars are adequately sized and reinforced as detailed in the attached drawing.

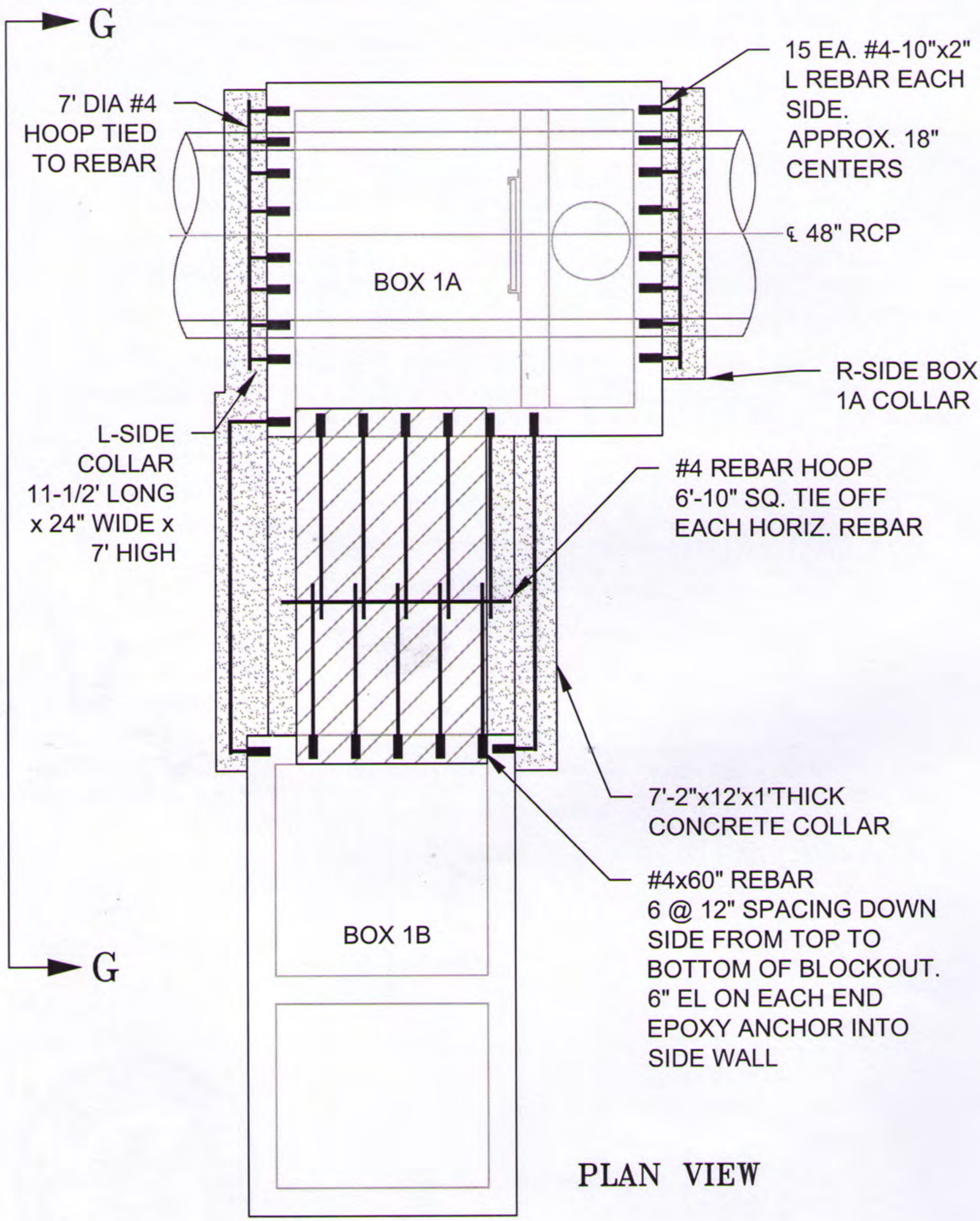
STATE OF NEW YORK
MICHAEL JOHN KENNEALLY
No. 069413
LICENSED PROFESSIONAL ENGINEER

e-mail: mkenneally@shamrockengpc.com

HARBOR BROOK WETLANDS PILOT PROJECT - FLOATABLES CONTROL PRETREATMENT
PRECAST BUOYANCY CALCULATIONS
14-Feb-13

structure		MT weight tons	volume cu ft	density #/cu ft	buoyant force (-) tons		net force on structure tons	#/ft periphery
1A	precast	30.81	1178.996	63.4	-37.3742			
	second pour	2.17525						
	total	32.98525					-4.39	
1B	precast	57.23	1715.516	63.4	-54.3819			
	sec pour	8.04375						
		65.27375					10.89189	
SS1&2	precast	56.99	2713.146	63.4	-86.0067			
	sec pour	0						
		56.99				x2 struc's	-29.0167	1561.507
MH3A	precast	55.57	1982.673	63.4	-62.8507			
	sec pour	0						
		55.57					-7.28074	556.4305
MH4A	precast	34	1360.813	63.4	-43.1378			
	base fill	19.05						
	total	53.05					9.91	
						overall	-48.90	

assumptions -
1. Buoyancy due to hydrostatic water pressure only - flooded to top of structure - net 63.4 #/cu ft.
2. Ignores collars as structural connection and friction forces that will help keep the structure from starting to move.
3. structure MH4A filled with rock and water to elev 400, and then capped with 1' of concrete to invert of 48" outlet pipe.

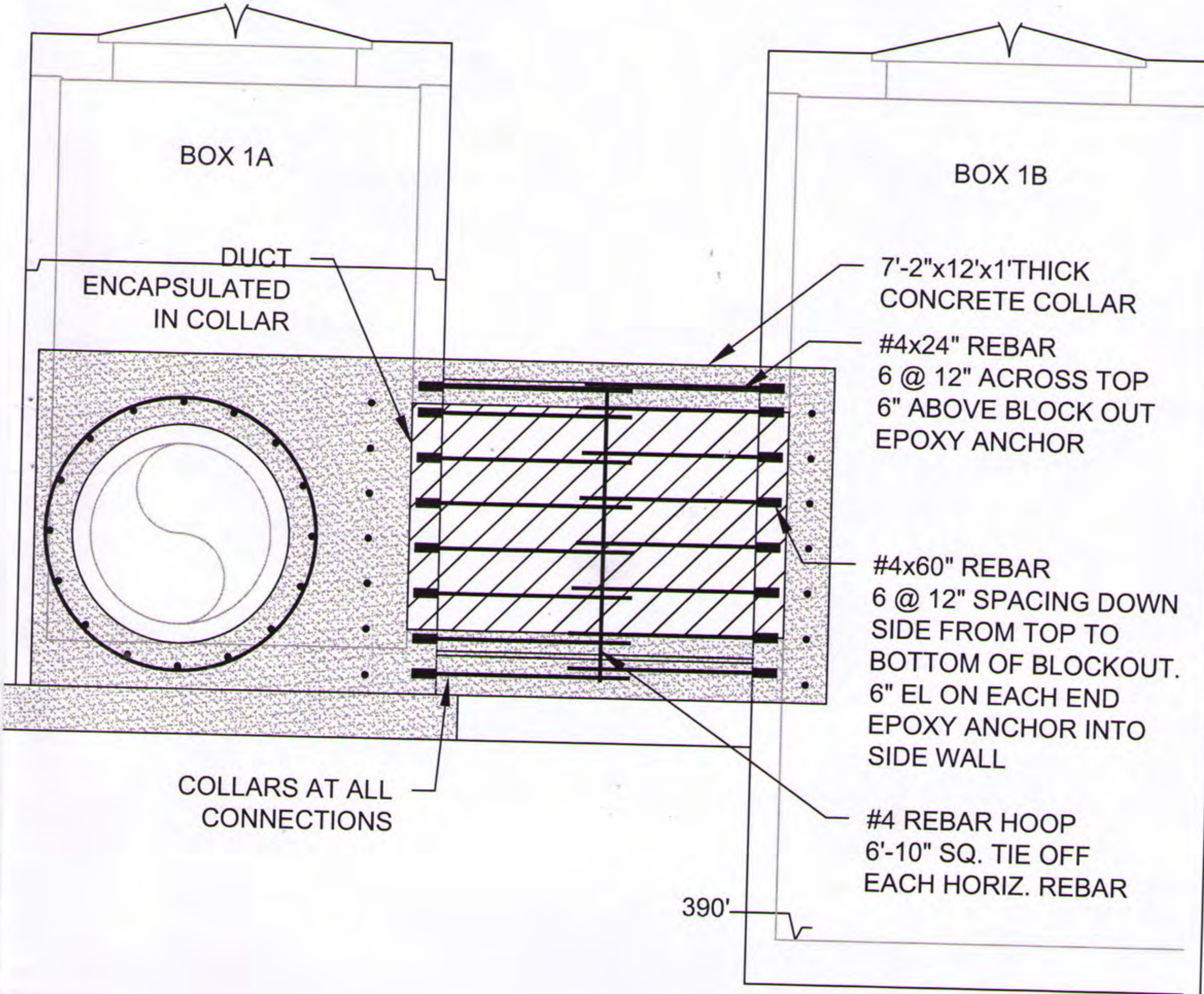


PLAN VIEW

PWTech
PROCESS WASTEWATER TECHNOLOGIES

Process Wastewater Technologies
105 Springbrook Place
Cary, North Carolina 27518
Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

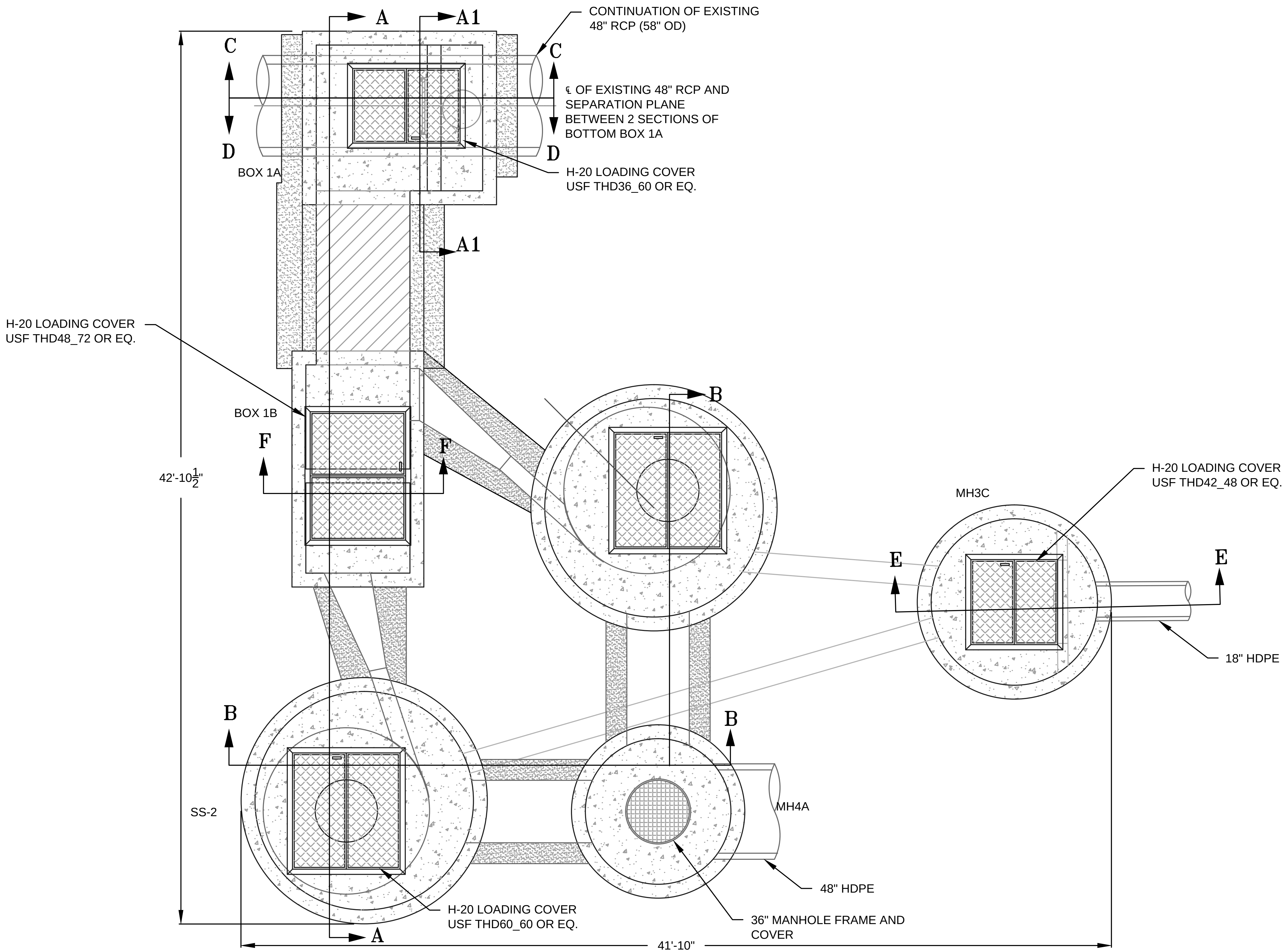
REFERENCE INFORMATION AND NOTES

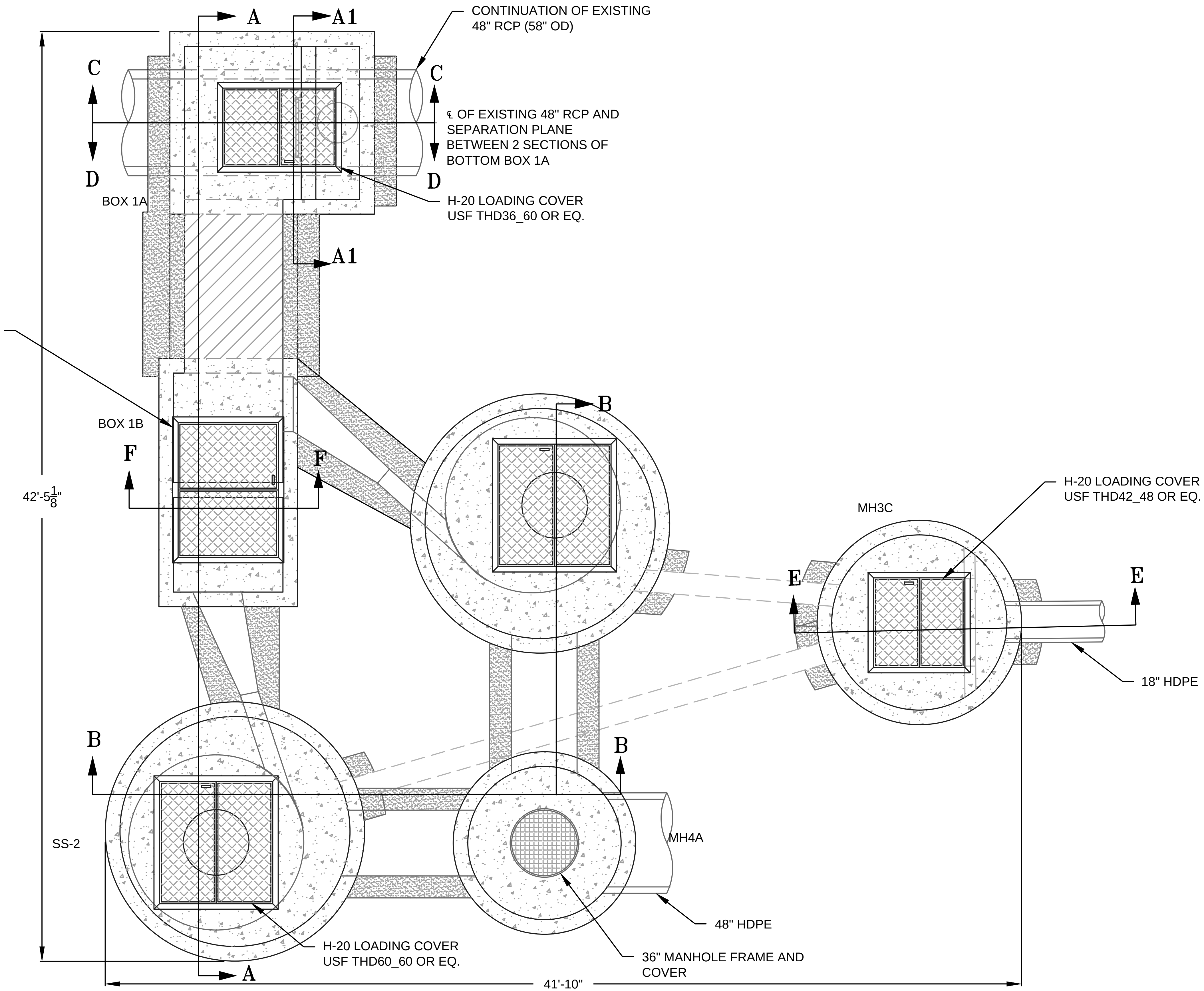


SECTION G–G

STATE OF NEW YORK
MICHAEL JOHN KENNEALLY
LICENSED PROFESSIONAL ENGINEER
No. 069413

PROJECT No. SSNY12002	TITLE		SCALE 1:40
DATE 5/24/2012		CONNECTION DETAILS	
DESIGNED JIM HEIST		HARBOR BROOK CSO 018	SHEET
DRAWN J. NOLAN		SYRACUSE, NEW YORK	9


CONTINUATION OF EXISTING
48" RCP (58" OD)
℄ OF EXISTING 48" RCP AND
SEPARATION PLANE
BETWEEN 2 SECTIONS OF
BOTTOM BOX 1A
H-20 LOADING COVER
USF THD36_60 OR EQ.
BOX 1A
H-20 LOADING COVER
USF THD48_72 OR EQ.
BOX 1B
42'-10½"
H-20 LOADING COVER
USF THD42_48 OR EQ.
MH3C
18" HDPE
SS-2
MH4A
48" HDPE
H-20 LOADING COVER
USF THD60_60 OR EQ.
36" MANHOLE FRAME AND
COVER
41'-10"
A
A1
C
D
B
E
F



Process Wastewater Technologies
105 Springbrook Place
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Tel. 919.858.8887
Fax 919.858.8983
www.PWTech.us

PWTech — PROCESS WASTEWATER TECHNOLOGIES

REFERENCE INFORMATION AND NOTES

PROJECT No.	SSNY12002
DATE	5/8/2013
DESIGNED	JIM HEIST
DRAWN	J. NOLAN

TITLE

PLAN VIEW
HARBOR BROOK CSO 018
SYRACUSE, NEW YORK

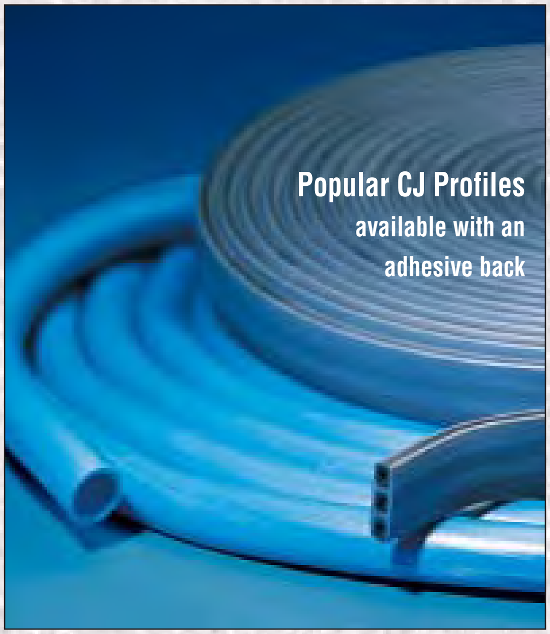
SCALE N.T.S.

SHEET 1

Hydrotite

hydrophilic water sealing materials

The Benchmark for Expandable Waterstops

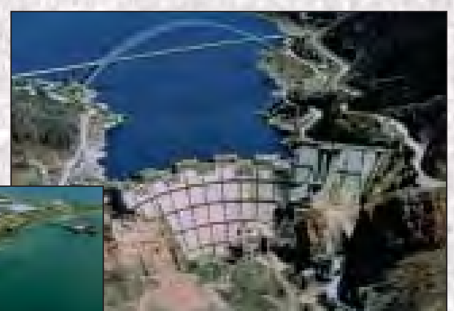


Hydrotite is a state-of-the-art hydrophilic waterstop with unmatched durability and watersealing capacity. Comprised of NON-BENTONITE, modified chloroprene rubber, **Hydrotite** expands up to EIGHT TIMES its original volume when exposed to water. This expansion creates an effective compression seal within joints of limited movement. Recognized worldwide, **Hydrotite** has a proven track record as a high quality and cost effective solution to your water containment needs.

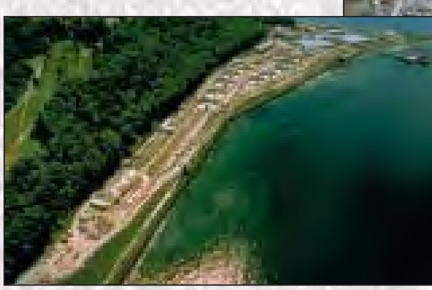
Since 1950, GREENSTREAK has maintained its position of industry leadership by responding to the unique needs of our customers. **Hydrotite** is one more example of our continued dedication to the construction market and to the advancement of joint sealing technologies.

TYPICAL STRUCTURES UTILIZING *HYDROTITE*:

- Water and waste water treatment facilities
- Primary and secondary containment structures
- Tunnels and culverts
- Dams, locks, canals, water reservoirs and aqueducts
- Pipe penetrations
- Swimming pools
- Storage tanks
- Retaining walls
- Foundations
- Slabs on grade



Hydroelectric and Flood Control Projects



Water and Waste Water Treatment Plants

Tunnels

GREENSTREAK®

3400 Tree Court Industrial Blvd., St. Louis, Missouri 63122
Phone: 800. **325-9504** or 636. **225-9400**
Fax: 800. **551-5145** or 636. **225-9854**
www.greenstreak.com

Flexible solutions. Concrete performance.

HYDROTITE: The Benchmark for Expandable Waterstops

Hydrotite® is a state-of-the-art hydrophilic waterstop now available from GREENSTREAK®. Comprised of a modified chloroprene rubber, **Hydrotite** has unmatched durability and water sealing capacity. **Hydrotite** expands up to EIGHT TIMES its volume when exposed to water. This remarkable hydrophilic property enables **Hydrotite** to reliably seal joints.

BEFORE EXPANSION AFTER EXPANSION

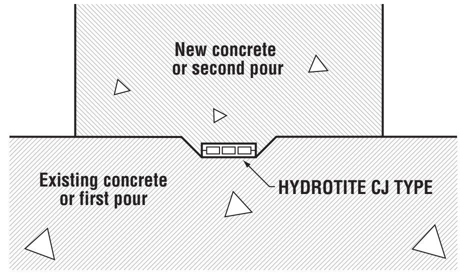
Note: *Hydrotite CJ-Type is not a sealing material for expansion joints and should not be used as such.*

Exceptional Qualities to Ensure Unparalleled Performance

- Swells up to EIGHT times its volume when exposed to water
- Comprised of NON-BENTONITE, modified chloroprene rubber
- Outstanding physical properties
- Available as a co-extruded profile to provide directional expansion (also available as a single extrusion)
- Special expansion delay coating to allow concrete cure prior to expansion
- Reliable and durable (lifespan up to 100 years)
- ISO 9002 certified
- CJ-0725-3K-ADH and CJ-1020-2K-ADH offered with an adhesive back
- Simple, low cost installation
- Available in a multitude of sizes and shapes for numerous applications
- Appropriate for retro-fit as well as new construction
- Can withstand high hydrostatic pressures (150' head minimum for most profiles)
- International acceptance
- 15 years of service

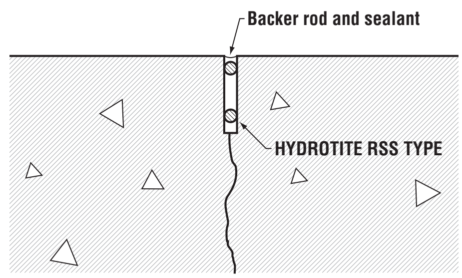
HYDROTITE CJ: A Superior Waterstop for Concrete Joint Gaps

As this innovative product absorbs water and expands, it conforms to gap variations along the joint. This action ensures complete sealing even under extraordinary hydrostatic pressures. Due to its slim profile, it won't project like conventional waterstops and trap air or become displaced by the second pour. The result is optimum concrete placement. **Hydrotite CJ**, is treated with a special expansion-delay coating to prevent it from reacting to the fresh, moist concrete and expanding before curing takes place.



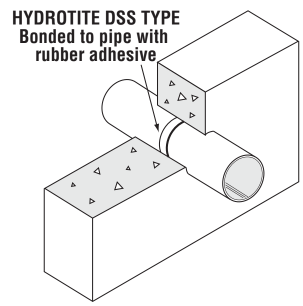
HYDROTITE RSS: Seal for Sawed Control Joints/Joint Repairs

Hydrotite RSS profiles create effective seals in sawed control joints and in the repair of failed joints. **Hydrotite** eliminates hydrostatic pressure below the sealant, thus extending the sealant's life. Select solid profiles with slightly larger diameters than the joint width for joints of consistent widths. Hollow profiles should be selected based on the maximum width of joints with varying widths. Compress both profiles slightly on initial insertion.



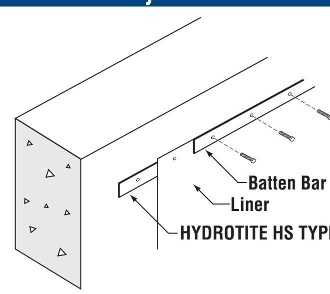
HYDROTITE DSS: Pipe Penetrations/Pipe Thimbles

The DSS profiles can be bonded to various piping materials, including concrete, steel and plastic. Bond **Hydrotite DSS** to the pipe prior to concrete placement. Installation in existing walls requires an oversize cutout be made and **Hydrotite** installed both on the pipe and the outside diameter of the cutout. Fill the annulus with a non-shrink grout. Embedded pipe thimbles can also be sealed with **Hydrotite DSS**.



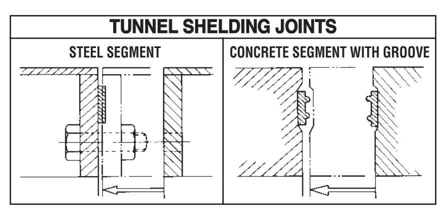
HYDROTITE HS: Termination for Liner Systems

Hydrotite HS-0540-30 is used to complete liner systems. Placed under a batten bar, between the liner and concrete wall, **Hydrotite HS** effectively terminates the liner. Dual composition prevents the profile from expanding out from under the batten bar. The HS profile can be supplied solid or with 3/8 inch diameter prepunched holes on 6 inch centers for ease of installing anchors.



HYDROTITE DS: Ideal In Shield Segment Tunnel Lining Systems

The outstanding hydrophilic performance of **Hydrotite DS** enables it to follow the expansion and contraction of joint gaps, creating an effective seal even under high water pressure. In contrast, conventional compressive seals tend to lose their elasticity and restoring force over time and, therefore, their water-sealing effectiveness. Furthermore, conventional seals must be thicker compared to **Hydrotite DS** to have the same gap-sealing ability.

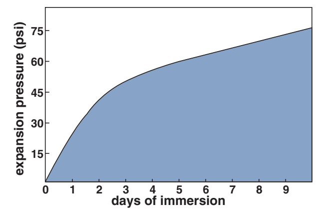


PROPERTIES OF *HYDROTITE*

Property	Test Method	Unit	Hydrophilic Rubber Minimum	Hydrophilic Rubber Typical	Chloroprene Rubber Minimum	Chloroprene Rubber Typical
Tensile Strength	ASTM D412	lb/in2	350	366	1300	1570
Elongation	ASTM D412	%	600	670	400	450
Hardness	ASTM D2240	Shore A	52+/-5	54	50+/-5	50
Tear Resistance	ASTM D624	lb/in	50	60.3	100	123
Specific Gravity	ASTM D792		1.32+/-0.1	1.32	1.38+/-0.1	1.38

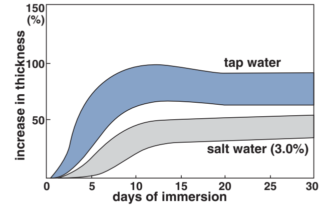
EXPANSION CHARACTERISTICS

Typical expansion pressures of **Hydrotite** are shown below.



SWELLING CHARACTERISTICS

Swelling characteristics of **Hydrotite** depend on the water quality as typical examples shown below.



INSTALLATION GUIDELINES

1. For best results, apply **Hydrotite** to smooth, even surfaces to ensure good bonding.
2. Provide 2" minimum concrete cover.
3. **Hydrotite** can be installed to the plain surface of concrete or in a formed keyway.

4. **Hydrotite** should be spliced by cutting ends square (or mitered) with a sharp knife or shears. Bond the prepared ends together with a cyanacrylate (super glue) adhesive. **Leakmaster** can be used to further protect the splice area.

5. Remove all dust, oil, etc. From concrete surface prior to adhering **Hydrotite**.
6. CJ-0725-3K-ADH and CJ-1020-2K-ADH are available with an adhesive back for adhering to the concrete surface. Bonding of other **Hydrotite** profiles can be accomplished using a contact adhesive compatible with chloroprene rubber. On rough concrete surfaces, **GREENSTREAK 7300 Epoxy** or **Leakmaster** should be used to smooth the surface and to adhere **Hydrotite**.
7. Concrete nails, in conjunction with adhesives, are recommended for vertical or overhead applications.

SHAPE AND APPLICATION

ITEM	NOMINAL SIZE mm (inches)			PACKAGING UNIT METERS/REEL x REELS (FT/BOX)
FOR CONSTRUCTION JOINTS				
	H	W		
CJ-0725-3K	7 (.28)	25 (.98)		10m x 4 (131)
CJ-0725-3K-ADH	Same as above with pressure sensitive adhesive backing			
CJ-1020-2K	10 (.39)	20 (.79)		10m x 5 (164)
CJ-1020-2K-ADH	Same as above with pressure sensitive adhesive backing			
CJ-1030-4M	10 (.39)	recommended by factory		
CJ-3030-M	30 (1.18)	30 (1.18)		10m x 1 (33)
FOR PIPE PENETRATIONS, CONCRETE CURBS, TUNNEL LINING SEGMENTS				
	H	W		h
SS-0215	2 (.08)	15 (.59)	–	25m x 4 (328)
SS-0220	2 (.08)	20 (.79)	–	25m x 4 (328)
SS-0320	3 (.12)	20 (.79)	–	25m x 4 (328)
SS-0520	5 (.20)	20 (.79)	–	20m x 4 (262)
RS-0520-3.5I	5 (.20)	20 (.79)	3.5 (.14)	20m x 5 (328)
RS-0723-3.5I	7 (.28)	23 (.91)	3.5 (.14)	15m x 4 (196)
DS-0415-2.5I	4 (.16)	15 (.59)	2.5 (.10)	20m x 5 (328)
DS-0420-2.5I	4 (.16)	20 (.79)	2.5 (.10)	20m x 5 (328)
DS-0520-3.5I	5 (.20)	20 (.79)	3.5 (.14)	20m x 5 (328)
DS-0615-4.5I	6 (.24)	15 (.59)	4.5 (.18)	15m x 5 (245)
DSS-0320	3 (.12)	20 (.79)	–	25m x 4 (328)
DSS-0420	4 (.16)	20 (.79)	–	25m x 5 (328)
HS-0540-30	5 (.20)	40 (1.57)	–	20m x 3 (196)
FOR JOINT REPAIR, CONTROL JOINTS, SPECIAL APPLICATIONS				
		D	B	
RSS-1006 D		10 (.39)	6 (.24)	20m x 3 (196)
RSS-1208 D		12 (.47)	8 (.31)	20m x 2 (131)
RSS-1409 D		14 (.55)	9 (.35)	10m x 2 (65)
RSS-1610 D		16 (.63)	10 (.39)	10m x 2 (65)
RSS-2014 D		20 (.79)	14 (.55)	10m x 2 (65)
RSS-2519 D		25 (.98)	19 (.75)	5m x 2 (32)
RSS-0806 C		8 (.31)	6 (.24)	20m x 5 (320)
RSS-1007 C		10 (.39)	7 (.28)	20m x 3 (196)
RSS-1209 C		12 (.47)	9 (.35)	20m x 2 (131)
RSS-1410 C		14 (.55)	10 (.39)	15m x 2 (98)
RSS-040 P		4 (.16)	–	20m x 10 (656)
RSS-050 P		5 (.20)	–	20m x 10 (656)
RSS-060 P		6 (.24)	–	20m x 10 (656)
RSS-080 P		8 (.31)	–	20m x 5 (320)
RSS-100 P		10 (.39)	–	20m x 3 (196)
RSS-120 P		12 (.47)	–	20m x 2 (131)
RSS-140 P		14 (.55)	–	15m x 2 (98)
RSS-160 P		16 (.63)	–	10m x 2 (65)

LEAKMASTER

SINGLE COMPONENT WATER-SWELLING SEALANT

LEAKMASTER

LEAKMASTER LV-1 is a single component water-swelling sealant with excellent and unique properties.

Its development was based on C.I. Kasei's technology and long experience in water-swelling sealants.

LEAKMASTER may be applied in locations where conventional solid sealants cannot be easily applied. This includes irregular shaped joints, rough surfaces, odd penetrations, etc.

After curing, LEAKMASTER has excellent physical properties. The rubber-like elasticity of the material and expansion characteristics create an effective watertight seal.

ADVANTAGES

EASY APPLICATION – As a moisture-cure single component water-swelling sealant, standard caulking guns can be used.

PHYSICAL PROPERTIES – After curing, LEAKMASTER has better physical properties than those of conventional sealants.

EXPANSION – LEAKMASTER expands approximately two times its original volume when exposed to water. It provides excellent water sealing properties while retaining its rubberlike elasticity.

ADHESION – Before swelling, LEAKMASTER adheres to various materials such as concrete, metal, glass, etc.

MAIN APPLICATION

- Water sealing at joints of in-situ cast concrete
- Water sealing around H-section steel joints and bars
- Caulking for water distribution systems
- Pipe penetrations
- Irregular joint surfaces
- Waterproofing work

CHARACTERISTICS

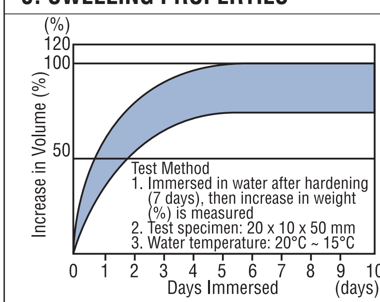
1. GENERAL PROPERTIES

Appearance	Putty-Like
Color	Grey
Specific Gravity	1.30
Extrudability	Within 20 seconds (at 23°C)
Slump	3mm max. (at 23°C)
Tack-Free Time	Within 8 hours (at 23°C, 60% R.H.)
	JIS-A-5758

2. PROPERTIES AFTER HARDENING

Hardness	35 Shore A
Tensile Strength	30 kgf/cm^2 (425 psi)
Elongation	1250%
Tear Strength	10 kgf/cm (56 lb/in)
	JIS-K-6301

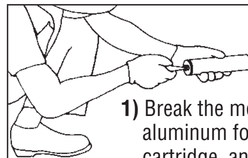
3. SWELLING PROPERTIES



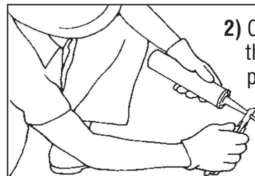
4. ADHESION PROPERTIES

	Steel	Aluminum	Mortar
50% Modulus (kgf/cm^2)	4.5 64 psi	6.5 92 psi	6.5 92 psi
Max. Tensile Strength (kgf/cm^2)	7.0 99 psi	12.2 173 psi	11.1 157 psi
Elongation at Break (%)	330	580	570
			JIS-A-5758

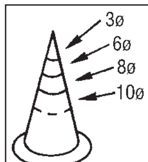
APPLICATION



1) Break the moisture-proofing aluminum foil at the top of the cartridge, and remove the metal back seamer from the bottom.

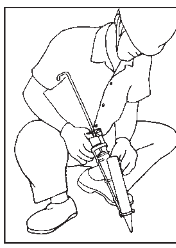


2) Cut the nozzle at the appropriate position diagonally.



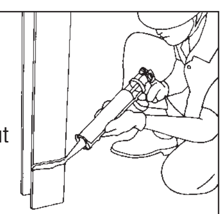
NOZZLE DIAMETER	LENGTH
3mm∅ (1/8 in)	35-40m (125 ft)
6mm∅ (1/4 in)	8-10m (30 ft)
8mm∅ (3/8 in)	4-5m (15 ft)
10mm∅ (1/2 in)	Approx. 3m (8 ft)

3) Average extrudable length vs. nozzle diameter.



4) Put the cartridge into caulking gun.

5) Apply Leakmaster continuously without a break to the place to be sealed.



PACKAGING

Item No.	LEAKMASTER LV-1
Cartridge	320 cc
Carton	24 cartridges

GREENSTREAK GROUP, INC
A Family of Construction Companies

3400 Tree Court Industrial Blvd., St. Louis, Missouri 63122
Phone: 800. **325-9504** or 636. **225-9400**
Fax: 800. **551-5145** or 636. **225-9854**
www.greenstreak.com

CRAFTED WITH PRIDE IN U.S.A.

Printed in U.S.A.
03/08

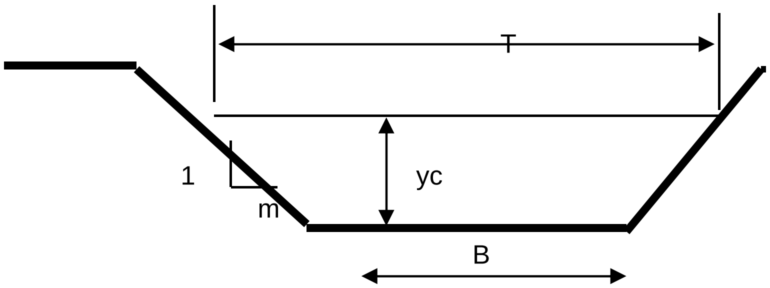
Critical Depth In Trapezoidal Sections

JAH 5/10/2012

1 $Q^2 / g = A_c^3 / T_c$

2 $A_c = B\, y_c + m\, y_c^2$

3 $T = B + 2\, m\, yc$



Substituting Ac and Tc in (1) And solving for yc by iteration:

4 $y_c = [(B + 2\, m\, y_c)\, Q2/g\ \ / (B + m\, y_c)^3]^{1/3}$

Q cfs	g ft/s^2	Q^2/g ft^5	B ft	m	yc_{ass} ft	yc_{cal} ft	A_c ft^2	T_c ft	A_c^3/T_c ft^5	V_c ft/s	$V_c^2/2g$ ft
25	32.2	19.41	1.00	1.00	1.65	1.65	4.37	4.30	19.40	5.72	0.51

Harbor Brook

Underflow Control Weir

check so:

$A_c^3/T_{c\,=}$	Q^2/g

2' WIDE 1:1 WEIR

Q, cfs	yc	V2/2g	Up-stream Ht over weir	Tc, ft	Tc, inches	elev over weir at 404.25
0.25	0.08	0.04	0.12	2.15	25.8	404.33
0.5	0.12	0.06	0.18	2.24	26.88	404.37
0.75	0.16	0.07	0.23	2.32	27.84	404.41
1	0.19	0.09	0.28	2.38	28.56	404.44
1.5	0.25	0.11	0.36	2.5	30	404.5
2	0.3	0.13	0.43	2.6	31.2	404.55
3	0.385	0.17	0.555	2.77	33.24	404.635
4	0.46	0.19	0.65	2.92	35.04	404.71
5	0.53	0.22	0.75	3.05	36.6	404.78
6	0.59	0.24	0.83	3.18	38.16	404.84
7.5	0.67	0.27	0.94	3.35	40.2	404.92
10	0.8	0.31	1.11	3.6	43.2	405.05
12.5	0.91	0.35	1.26	3.82	45.84	405.16

Thick box border - clean screen conditions at design flows

outlet box elev at 405.5, .25 ft loss through outlet, in-screen elev of 405.75

Set bottom of weir at 405.0 and get 1 cfs at 405.73 elev inside screen.

1.' WIDE 1:1 WEIR

Q, cfs	yc	V2/2g	Ht over weir	Tc, ft	Tc, inches	elev in MH3 at 404.25	
0.25	0.12	0.05	0.17	1.24	14.88	404.42	
0.5	0.19	0.08	0.27	1.37	16.44	404.52	
0.75	0.24	0.1	0.34	1.48	17.76	404.59	
1	0.28	0.12	0.4	1.57	18.84	404.65	
1.5	0.36	0.14	0.5	1.73	20.76	404.75	
2	0.43	0.17	0.6	1.86	22.32	404.85	
3	0.54	0.2	0.74	2.08	24.96	404.99	
4	0.64	0.23	0.87	2.27	27.24	405.12	
5	0.72	0.25	0.97	2.44	29.28	405.22	
6	0.79	0.28	1.07	2.59	31.08	405.32	limit ht of opening to .7
7.5	0.89	0.3	1.19	2.79	33.48	405.44	
10	1.04	0.34	1.38	3.09	37.08	405.63	
12.5	1.17	0.38	1.55	3.34	40.08	405.8	
15	1.28	0.41	1.69	3.56	42.72	405.94	
20	1.48	0.46	1.94	3.96	47.52	406.19	
25	1.65	0.51	2.16	4.30	51.60	406.41	

STANDARD LIMITED WARRANTY

Item 6 – PERFORMANCE GUARANTEE

6.1 PERFORMANCE. PWTech guarantees that the screen will exclude from the screened flows –

- All solids greater than 1 mm in two dimensions, regardless of type of material, or specific gravity.
- 99 wt-% of all particles greater than 100 microns (.1 mm) in size, regardless of specific gravity.
- 95 wt-% of all particles greater than 50 microns diameter and specific gravity 2.5 or greater.
- 95 wt-% of all fats, oils and greases, provided that these materials are cleaned out of the unit at appropriate times and not allowed to accumulate.
- Deliver of screened flows of 38 cfs with an inlet water elevation of 408 feet, and with an underflow not exceeding 6 cfs.

6.2 DETERMINATION OF PERFORMANCE. The contract documents did not specify the methods and procedures used to determine performance. PWTech offers this warranty with the understanding that methods must be jointly defined and agreed to by both parties. Further, performance evaluation based on partial sampling of influent flows are not agreeable to PWTech, and performance will be determined from measurements of effluent samples and a mass determination of materials removed and captured during an event.

6.3 COSTS OF PERFORMANCE EVALUATION
The Owner will be responsible for conducting and paying for all Performance Testing. PWTech may participate in the design and implementation of the Performance Tests at its own expense.

Onondaga County Harbor Brook Wetlands Pretreatment
PROCESS WASTEWATER TECHNOLOGIES LLC
STANDARD LIMITED WARRANTY

Item 1 - LIMITATION OF LIABILITY

The only warranty which Process Wastewater Technologies LLC ('PWT') makes is that warranty which is set forth in the sale Terms and Conditions and further detailed below:

THE GOODS SPECIFIED UNDER AGREMENT WITH PWT ARE PROVIDED 'AS IS' AND PWT DOES NOT MAKE ANY OTHER EXPRESS WARRANTIES OR ANY IMPLIED WARRANTIES WITH RESPECT TO THESE GOODS AND/OR RELATED SERVICES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR USE.

In addition, PWT does not assume and expressly disclaims any liability for (i) any SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES which anyone may suffer as a result of the sale, delivery, service, use or loss of use, of any goods and/or services provided by PWT, or (ii) any charges or expenses of any nature which are incurred without the express written consent of PWT. In particular, PWT does not warrant that any goods provided are free from any claim of any third person by way of infringement or the like, and PWT expressly disclaims any liability for any claim of infringement or the like that may result from the sale, delivery, service, use or loss of use of any goods and/or services provided by PWT.

PWT's obligations under this warranty are expressly limited to the repair or replacement of any part or parts that are proved to the satisfaction of PWT to have failed prematurely or because of a fault in workmanship or materials.

PWT's total liability under this warranty or in connection with any claim involving any goods or services is expressly limited to the purchase price of the goods and/or services in respect of which damages are claimed.

Item 2. DEFECTS WARRANTY

PWT warrants that the goods manufactured by PWT shall be free from defects in material and workmanship for the shorter period of: (i) eighteen (18) months from the date of delivery, or (ii) twelve (12) months from the date of substantial completion and putting the specified goods into service. PWT's liability under this warranty or in connection with any other claim relating to goods manufactured and delivered by PWT is limited to the repair, or at PWT's option, the replacement or refund of the purchase price, of any product or parts or components which are returned to PWT freight prepaid, and which PWT determines, in its discretion, are defective in material and workmanship. Products or parts or components thereof which are repaired or replaced by PWT will be retuned to the Buyer freight collect.

Item 3. PRODUCTS OF OTHER MANUFACTURERS

PWT makes no warranty with regard to any products not manufactured by PWT, including but not limited to electrical components or equipment and other prime movers.

Item 4 – TYPES OF DAMAGES AND CLAIMS FOR WHICH PWT IS NOT RESPONSIBLE.

The following non-exclusive list of items are specifically not covered by the PWT Standard Limited Warranty, and, in the event of their occurrence, will render the PWT Defects Warranty null and void:

- defects which are caused by improper installation, improper or abnormal use or operation, or improper storage or handling;
- defects caused by the failure of the Buyer or User to perform and log normal preventative maintenance;
- Defects caused by the use of replacement parts not approved in writing by PWT;
- Defects caused by repairs by persons not authorized in writing by PWT;
- Defects caused by modifications or alterations made by the Buyer or User;
- Any damage to the PWT product while it is in the possession of the Buyer or User.

Item 5 – EQUIPMENT SAFETY PARAMETERS

With respect to operation of the equipment, it is the responsibility of the Buyer to define and provide any safety device(s) or associated safety device(s) (other than that which is ordinarily furnished by PWT) which may be necessary and/or required, and to establish safety procedures and operational instructions to safeguard the operator(s) during normal operations, maintenance, cleaning, or any use of the equipment whatsoever, and to subsequently ensure that the equipment is operated in conformance with all applicable safety procedures, laws, regulations and instructions.

It is also the responsibility of the buyer to enforce all safety regulations and operational instructions and to maintain the equipment in a safe condition (e.g., guards in place, warning, caution and/or important labels affixed; electrical boxes secure; interlocks operational; etc.). In particular, all warning, caution, and/or important labels must be maintained in a readable condition, and if necessary, replaced with new labels.

Additionally, as the nature of the equipment does not always make it possible to fully prevent operator access to rotating components, maintenance or cleaning of any nature must not be performed on the equipment without first disconnecting all power.

Item 6 – OPERATOR SAFETY COMPLIANCE

Buyer warrants and agrees that because it has sole control over equipment, it shall be solely responsible for safety compliance. Operator access and use of equipment, and full compliance with all provisions of the Operator Safety section of PWT Instruction Manuals are essential and the user's responsibility; the provisions of that section being expressly incorporated herein.

PWTech
PROCESS WASTEWATER TECHNOLOGIES LLC

Process Wastewater Technologies LLC • 105 Springbrook Place • Cary, NC 27518 • Phone: 919-858-8887 • Fax: 919-858-8983 • www.PWTech.us

STANDARD LIMITED WARRANTY

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