Appendix K: Manual

Please see the following pages.

MARSH McBIRNEY
A Hach Company Brand

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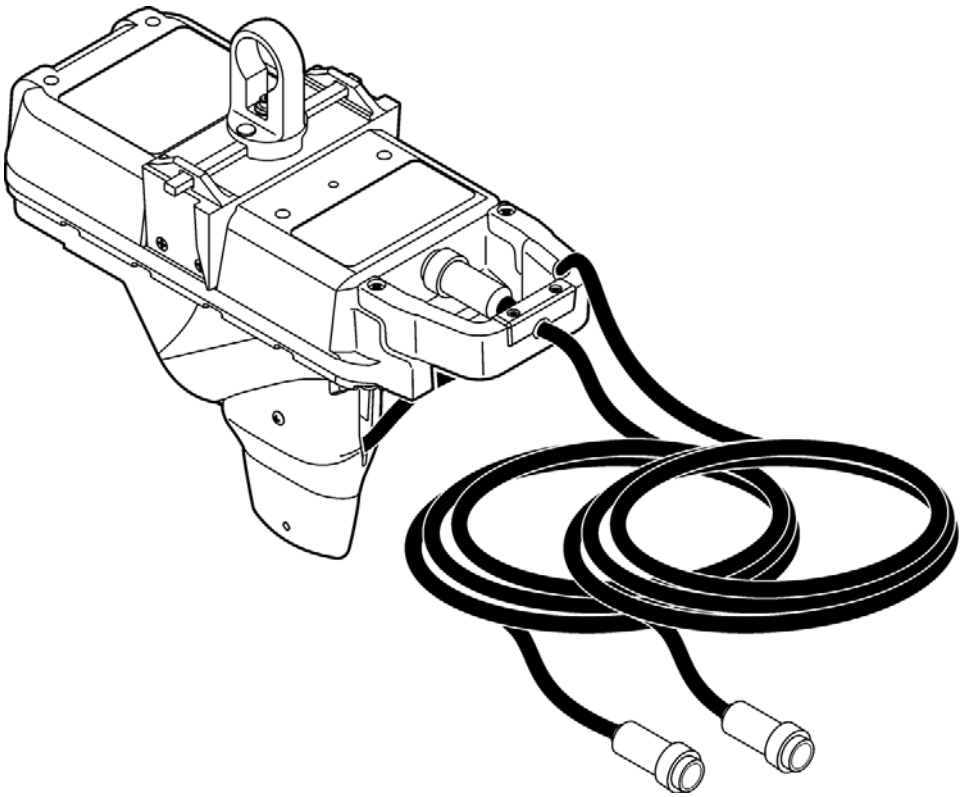
FLO-DAR™

Open Channel Non-Contact Radar Sensor
with Optional Surcharge Velocity Sensor

USER MANUAL

August 2009, Edition2



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Section 1 Specifications

Specifications are subject to change without notice.

Flo-Dar sensor	
Dimensions (without SVS)	17.5 cm W x 42.3 cm L x 29.7 cm D (6.9 in. x 16.65 in. x 11.7 in.)
Weight	4.8 kg (10.5 lb)
Enclosure	IP68 waterproof rating, polystyrene
Operating temperature	–10 to 50 °C (14 to 122 °F)
Storage temperature	–40 to 60 °C (–40 to 140 °F)
Power requirements	8–12 VDC
Connectors	Waterproof (IP67) connector for quick disconnect from the interconnecting cable below waterproof line.
Interconnecting cable	Polyurethane, 0.400 (±0.015) in. diameter
	IP 68
	Operating temperature: –4 to 221 °F (–20 to 105 °C)
Depth measurement	Method: Ultrasonic
	Standard operating range from sensor to liquid: 0.635 to 152.4 cm (0.25 to 60 in.)
	Optional extended operating range: 0 to 5.7 m (0 to 224 in.) (with 40.64 cm (16 in.) deadband), temperature compensated
	Accuracy: ±1% ±0.25 cm (±0.1 in.)
Surcharge depth measurement	Method: Piezo resistive pressure transducer
	Maximum range: 3.5 m (138 in.)
Temperature error	Stability: <0.02% per °C from 0 to 50 °C; long-term stability: 0.5 mV typical
	Zero measurement: <0.025 mV per °C from 0 to 50 °C
Overpressure	2.5 x full scale
Velocity measurement	Method: Radar
	Range: 0.23 m/s to 6.10 m/s (0.75 to 20 ft/s)
	Frequency Range: 24.075 to 24.175 G-Hz, 15.2mW (max.)
	Accuracy: ±0.5%; ±0.03 m/s (±0.1 ft/s)
Certification	RF device certified to FCC Part 15C, Subpart 245: FCC ID number: VIC-FLODAR24 and Industry Canada Spec RSS 210, IC number: 6149A FLODAR24 (User licensing not required)
Flow measurement	
Method	Based on continuity equation
Accuracy	± 5% of reading typical where flow is in a channel with uniform flow conditions and is not surcharged, ± 1% full scale max.
Surcharge velocity sensor (SVS) (optional)	
Power requirements	8–12 VDC
Velocity measurement	Method: Electro-magnetic
	Range: –1.5 to +6.1 m/s (–5 to +20 ft/s)

Section 2 General information

2.1 Safety information

Please read this entire manual before unpacking, setting up, or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

2.1.1 Use of hazard information

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury.

Important Note: *Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.*

Note: *Information that supplements points in the main text.*

2.1.2 Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

	This is the safety alert symbol. Obey all safety messages that follow this symbol to avoid potential injury. If on the instrument, refer to the instruction manual for operation or safety information.
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user. ***Note:*** *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.*
	This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists.
	This symbol, when noted on the product, identifies the location of the connection for Protective Earth (ground).
	This symbol, when noted on the product, identifies the location of a fuse or current limiting device.
	This symbol, when noted on the product, indicated the presence of devices sensitive to Electro-static Discharge (ESD) and indicated that care must be taken to prevent damage with the equipment.

2.1.3 Confined space precautions

DANGER
Explosion hazard. Training in pre-entry testing, ventilation, entry procedures, evacuation/rescue procedures and safety work practices is necessary before entering confined spaces.

Important Note: *The following information is provided to guide users of Flo-Dar and SVS Sensors on the dangers and risks associated with entry into confined spaces.*

On April 15, 1993, OSHA's final ruling on CFR 1910.146, Permit Required Confined Spaces, became law. This new standard directly affects more than 250,000 industrial sites in the U.S.A., and was created to protect the health and safety of workers in confined spaces.

Definition of a confined space:
A confined space is any location or enclosure that presents or has the immediate potential to present one or more of the following conditions:

- An atmosphere with less than 19.5% or greater than 23.5% oxygen and/or more than 10 ppm Hydrogen Sulfide (H2S).
- An atmosphere that may be flammable or explosive due to gases, vapors, mists, dusts or fibers.
- Toxic materials which upon contact or inhalation, could result in injury, impairment of health or death.

Confined spaces are not designed for human occupancy. They have restricted entry and contain known or potential hazards. Examples of confined spaces include manholes, stacks, pipes, vats, switch vaults, and other similar locations.

Standard safety procedures must always be followed prior to entry into confined spaces and/or locations where hazardous gases, vapors, mists, dusts or fibers may be present. Before entering any confined space check with your employer for procedures related to confined space entry.

2.1.4 FCC Regulations

This device complies with Part 15C, Subpart 245 of the FCC Rules and Industry Canada RSS210. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that causes undesired operation. No additional user license is required. Any changes or modifications not expressly approved by Marsh-McBirney. could void the users authority to operate the equipment.

2.2 Product overview

The Flo-Dar Sensor measures the flow velocity and liquid depth in open channels using radar and ultrasonic technology. The unit is designed to withstand submersion during surcharge conditions. The optional surcharge velocity sensor provides velocity measurements during surcharge conditions.

Figure 1 shows the configuration of a Flo-Dar system in a non-hazardous location.

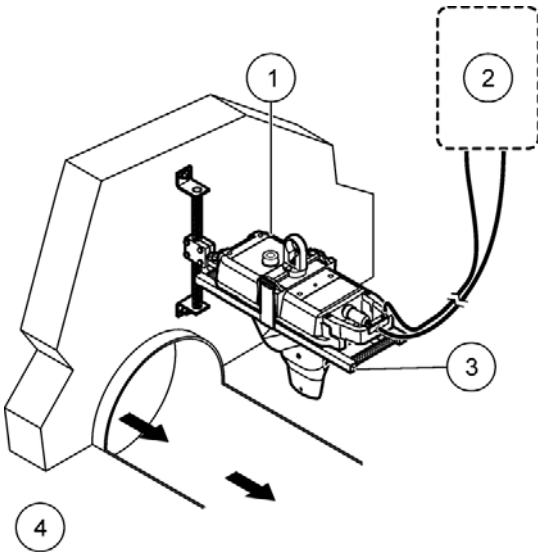

Figure 1 System overview

1	Flo-Dar sensor with optional surcharge velocity sensor	**3**	Mounting frame
2	Logger or controller	**4**	Non-hazardous environment

2.2.1 Theory of operation

The Flo-Dar Sensor is mounted above an open channel of water and measures the surface velocity and depth from above the surface of the water. The two measurements are used to calculate the flow rate.

During surcharge (submerged) conditions, a pressure transducer measures depth. The optional surcharge velocity sensor (SVS) can be used to measure velocity during surcharge conditions.

Surface velocity measurement
The surface velocity of the water is measured using radar technology. A radar beam is transmitted from the sensor to the water surface at the center of the channel. A portion of the signal is reflected back at a slightly different frequency. The difference in frequency, known as the Doppler frequency, is directly proportional to the speed of the flow. Proprietary algorithms are then used to calculate the average speed of the flow stream.

Note: *The radar velocity sensor does not operate under surcharge conditions.*

Velocity measurements during surcharge
The optional surcharge velocity sensor (SVS) is activated when the flow level rises to within four inches of the depth sensor and remains active until the flow falls to four inches below the sensor.

The SVS measures velocity using an electromagnetic sensor that generates a magnetic field. When the water passes through the magnetic field, a voltage is generated that is directly proportional to the speed of the water passing the sensor.

Depth measurement

The water depth is measured using an ultrasonic pulse echo sensor. An electronic pulse is sent to the water surface and a portion of the signal is returned to the sensor. The transit time to the surface and back is used to calculate the distance from the water surface to the sensor. The pipe diameter is used to convert the distance to water depth.

The depth sensor on the Flo-Dar unit can measure distances up to 1.5 m (5 ft). For larger channels, an extended range sensor is available to measure up to 5.7 m (18.7 ft).

During surcharge conditions, a pressure transducer in the Flo-Dar unit is used to measure depth.

Flow calculations

The velocity and depth measurements are used with the pipe diameter to determine the flow rate. The flow rate is calculated from the continuity equation (1):

(1) $\text{Flow rate} = \text{Average velocity} \times \text{Area}$

where

Flow rate = volume of liquid that passes the sensor per unit time (e.g. 200 gallons per minute)

Average velocity = average velocity of the liquid, calculated using surface velocity measurements and algorithms

Area = cross-sectional area of the liquid in the channel, calculated using the channel dimensions and depth measurement.

Section 3 Installation

DANGER: Potential Explosion Hazard
Only qualified personnel can do the tasks given in this section of the manual. The Flo-Dar Sensor can only be installed in non-hazardous environments.

CAUTION: Radar RF Exposure Hazard
Although the Flo-Dar microwave power level is very small (~15mW) and is well below government stated exposure limits for uncontrolled environments, users of this product should follow proper safety protocols for the handling of devices with radar frequency transmitters. Avoid placing the head and other vital organ areas within the microwave beam (within 1 meter of the microwave aperture).

3.1 Component list

Important Note: *Delicate Instrumentation. Handle with care to prevent damage to the microwave transmitter. Damaged transmitters can result in higher signal power levels, which can interfere with essential terrestrial microwave links.*

Make sure that the instrument components shown in Figure 2 have been received.

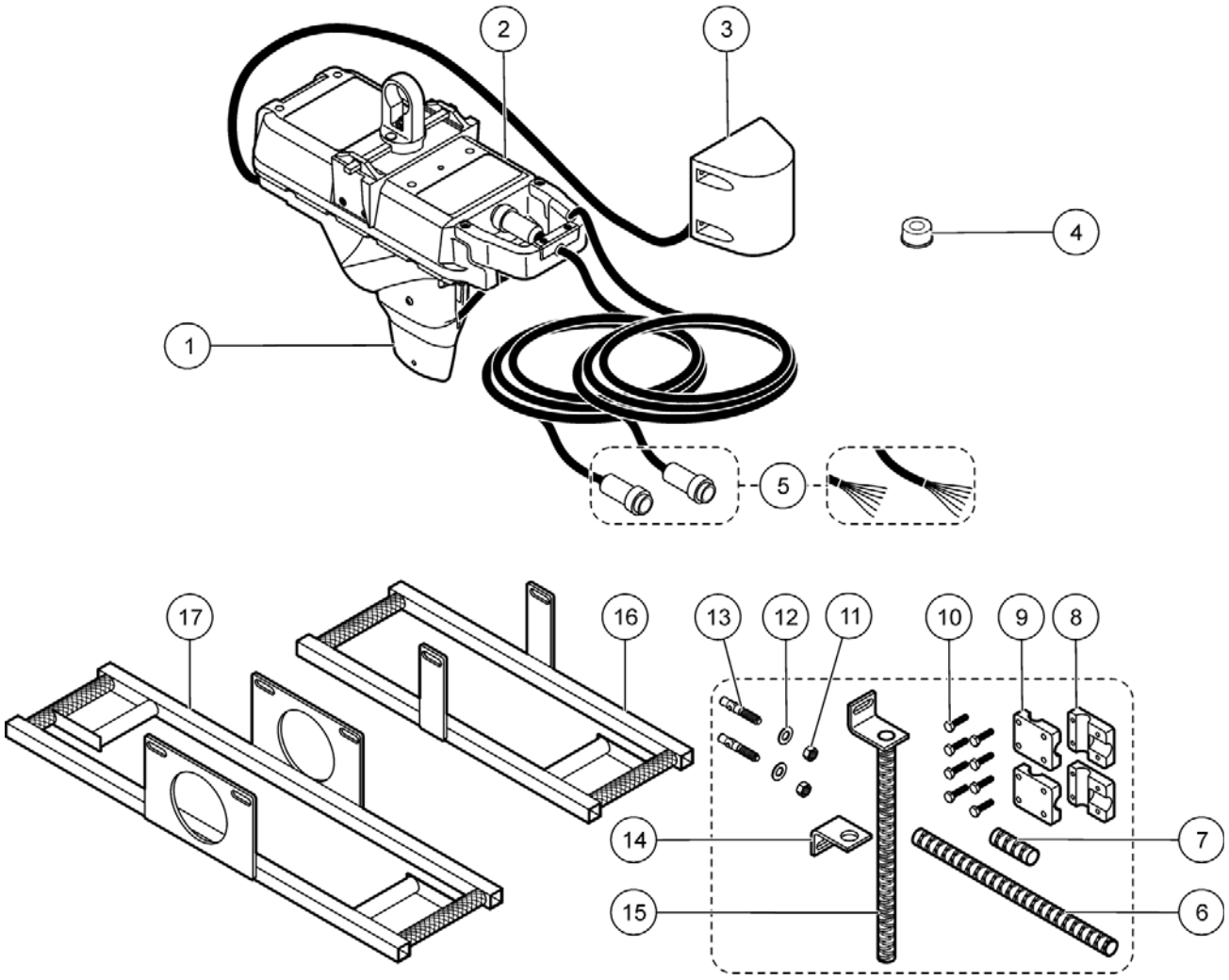

Figure 2 Instrument components

1	Surcharge velocity sensor (SVS) (optional)	**10**	Clamp bolt, ¼–20 x 1 in. (8x)
2	Flo-Dar sensor	**11**	Anchor nut, 3/8–16 (2x)
3	Optional extended depth sensor	**12**	Anchor washer (2x)
4	Bubble level	**13**	Anchor, 3/8 x 2¼ in. (2x)
5	Cable connector or unterminated wires	**14**	Adjustable wall bracket
6	Spacer, 12-inch	**15**	Wall mount bracket
7	Spacer, 2¼-inch	**16**	Standard frame
8	Clamp half, threaded (2x)	**17**	Frame for extended depth sensor (optional)
9	Clamp half, not threaded (2x)		

3.2 Mechanical installation

3.2.1 Site location guidelines

For best accuracy, install the sensor where the flow is not turbulent. An ideal location is in a long, straight channel or pipe. Outfalls, vertical drops, baffles, curves or junctions cause the velocity profile to become distorted.

Where there are outfalls, vertical drops, baffles, curves or junctions, install the sensor upstream or downstream as shown in Figure 3 and Figure 4. For upstream locations, install the sensor at a distance that is at least five times the pipe diameter or maximum fluid level. For downstream locations, install the sensor at a distance that is at least ten times the pipe diameter or maximum fluid level.

If the location contains a junction and the flow in one pipe is much higher, install the sensor on the wall near the lower flow pipe.

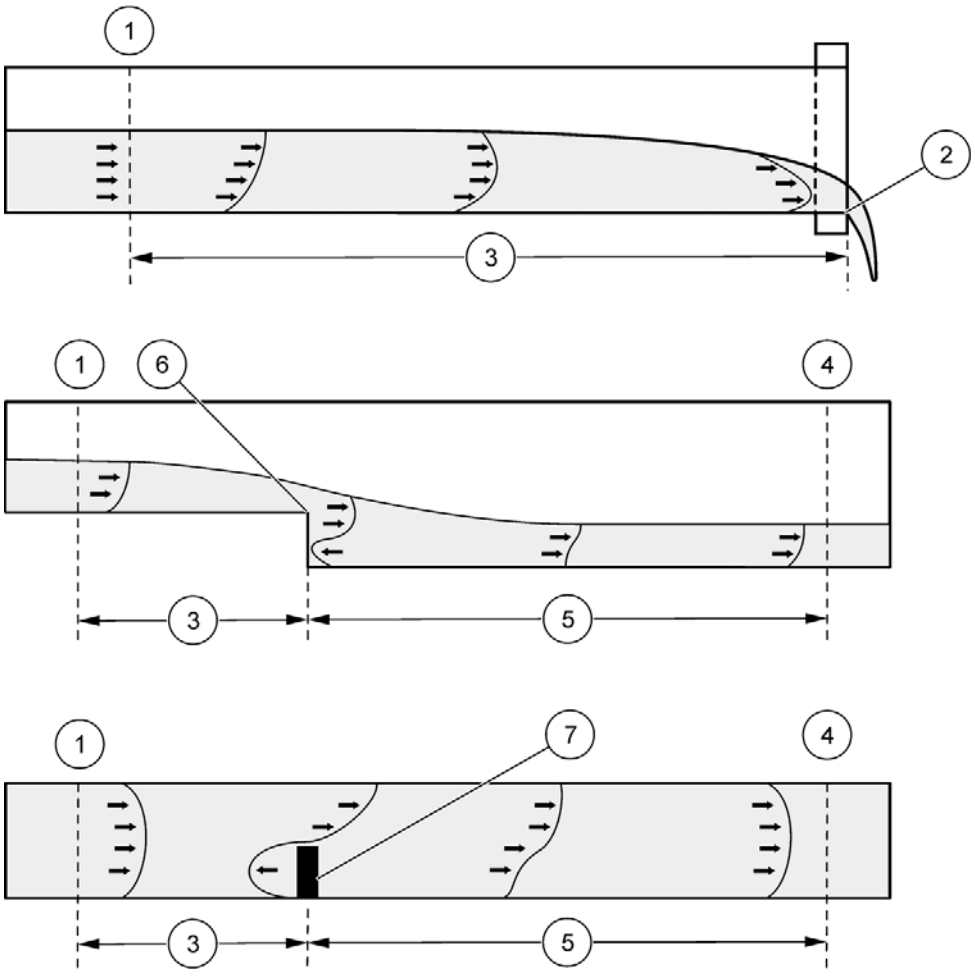

Figure 3 Sensor location near an outfall, vertical drop or baffle

1	Acceptable upstream sensor location	**5**	Distance downstream: 10 x pipe diameter
2	Outfall	**6**	Vertical drop
3	Distance upstream: 5 x pipe diameter	**7**	Baffle
4	Acceptable downstream sensor location		

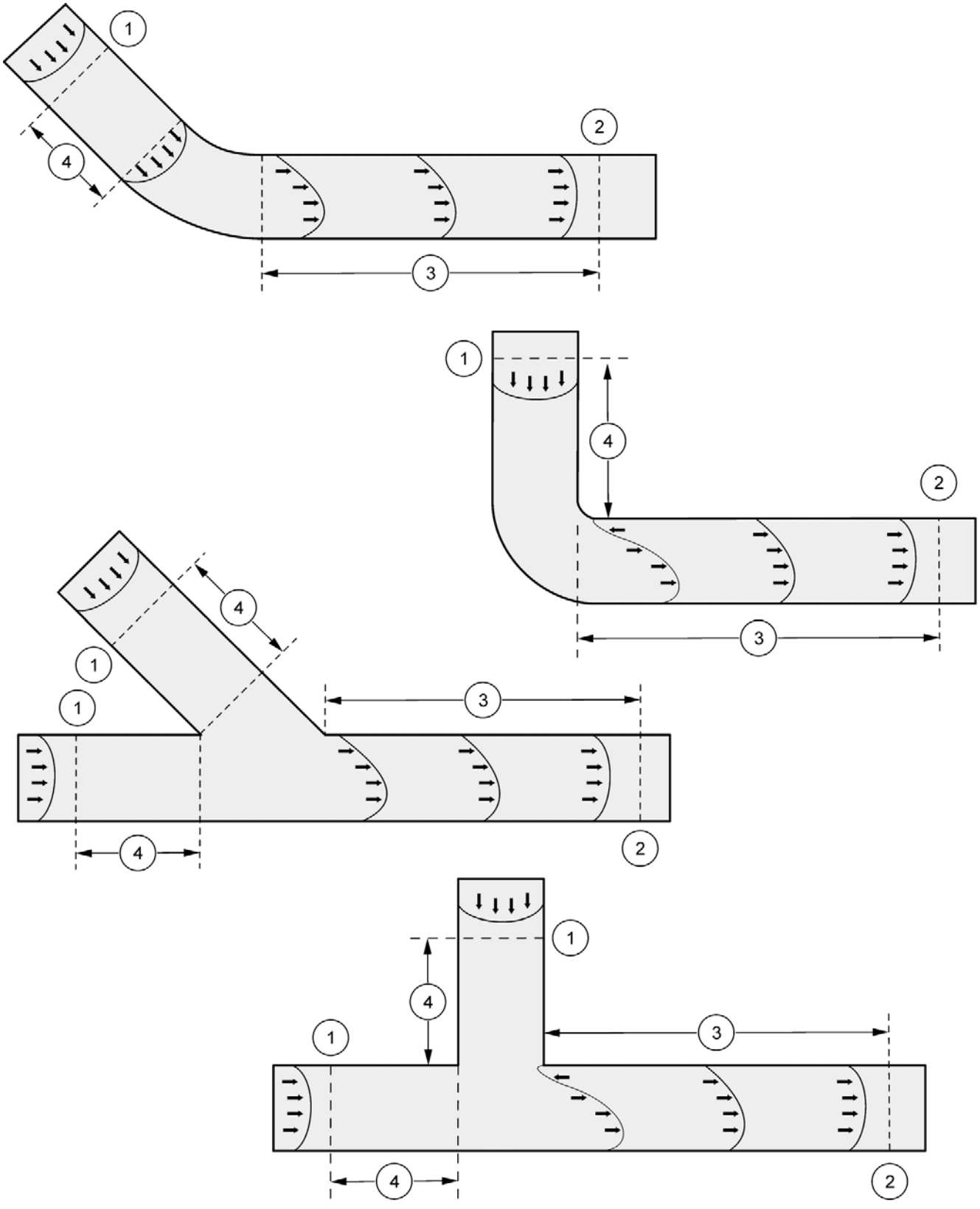

Figure 4 Sensor location near a curve, elbow or junction

1	Acceptable upstream sensor location	**3**	Distance downstream: 10 x pipe diameter
2	Acceptable downstream sensor location	**4**	Distance upstream: 5 x pipe diameter

3.2.2 Sensor installation

Mount the Flo-Dar sensor above the open channel on the wall of the manhole. A pole is available for retrieval of the Flo-Dar sensor without entry into the manhole.

For temporary installation, an optional Jack-bar is available (see Accessories on page 33). Instructions are included with the Jack-bar.

The Flo-Dar sensor dimensions are shown in Figure 5 and Figure 6.

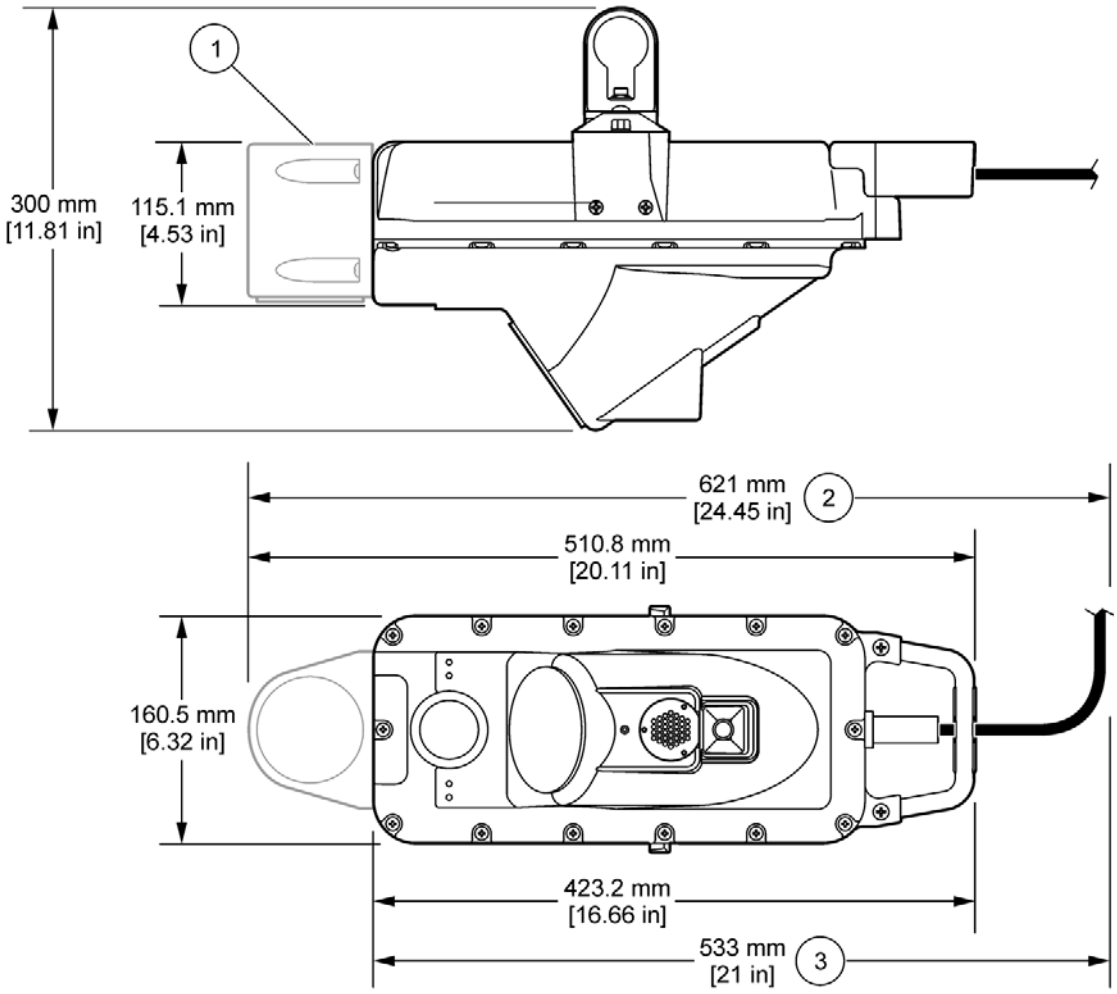

Figure 5 Flo-Dar sensor dimensions

1	Optional extended depth sensor	**3**	Minimum clearance for cable
2	Minimum clearance for cable with extended depth sensor		

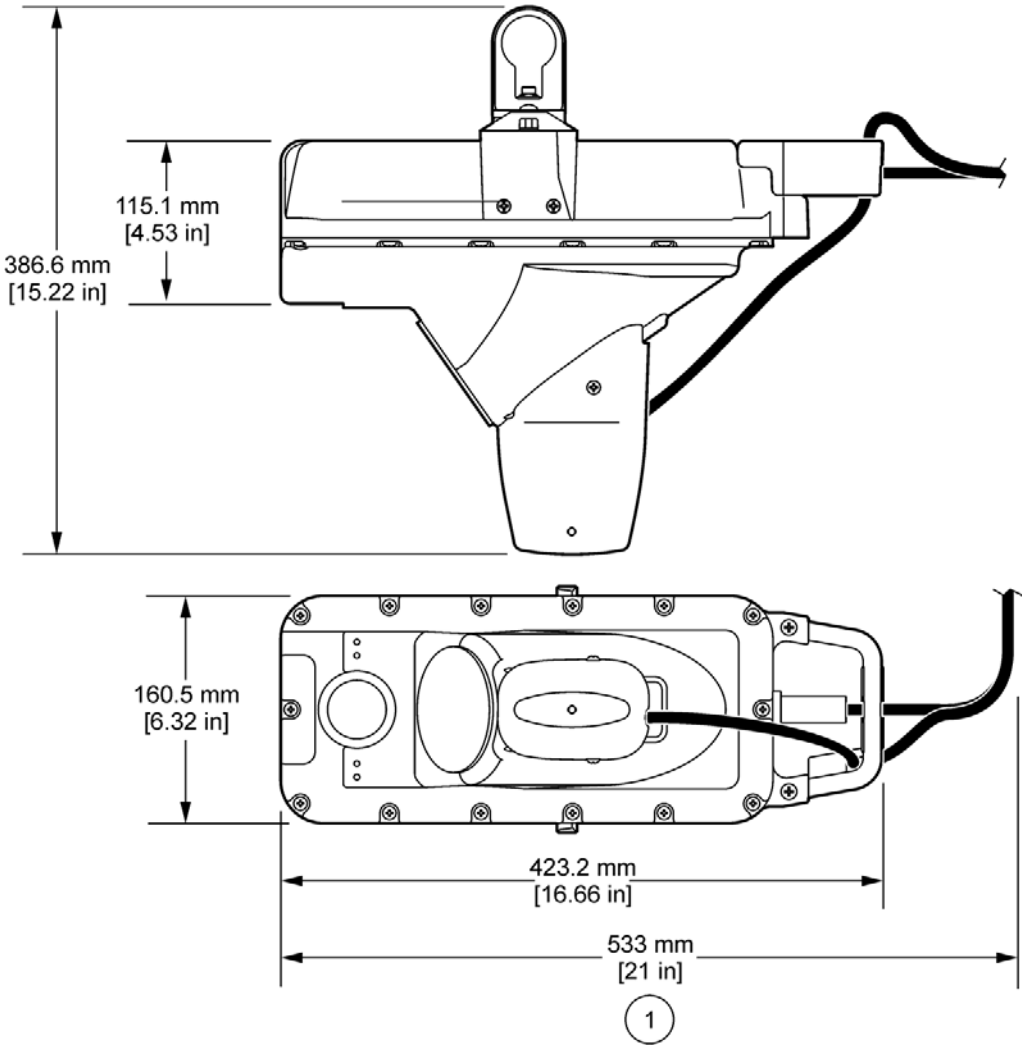

Figure 6 Flo-Dar sensor with SVS dimensions

1	Minimum clearance for cable

The dimensions of the standard frame for wall installation are shown in Figure 7.

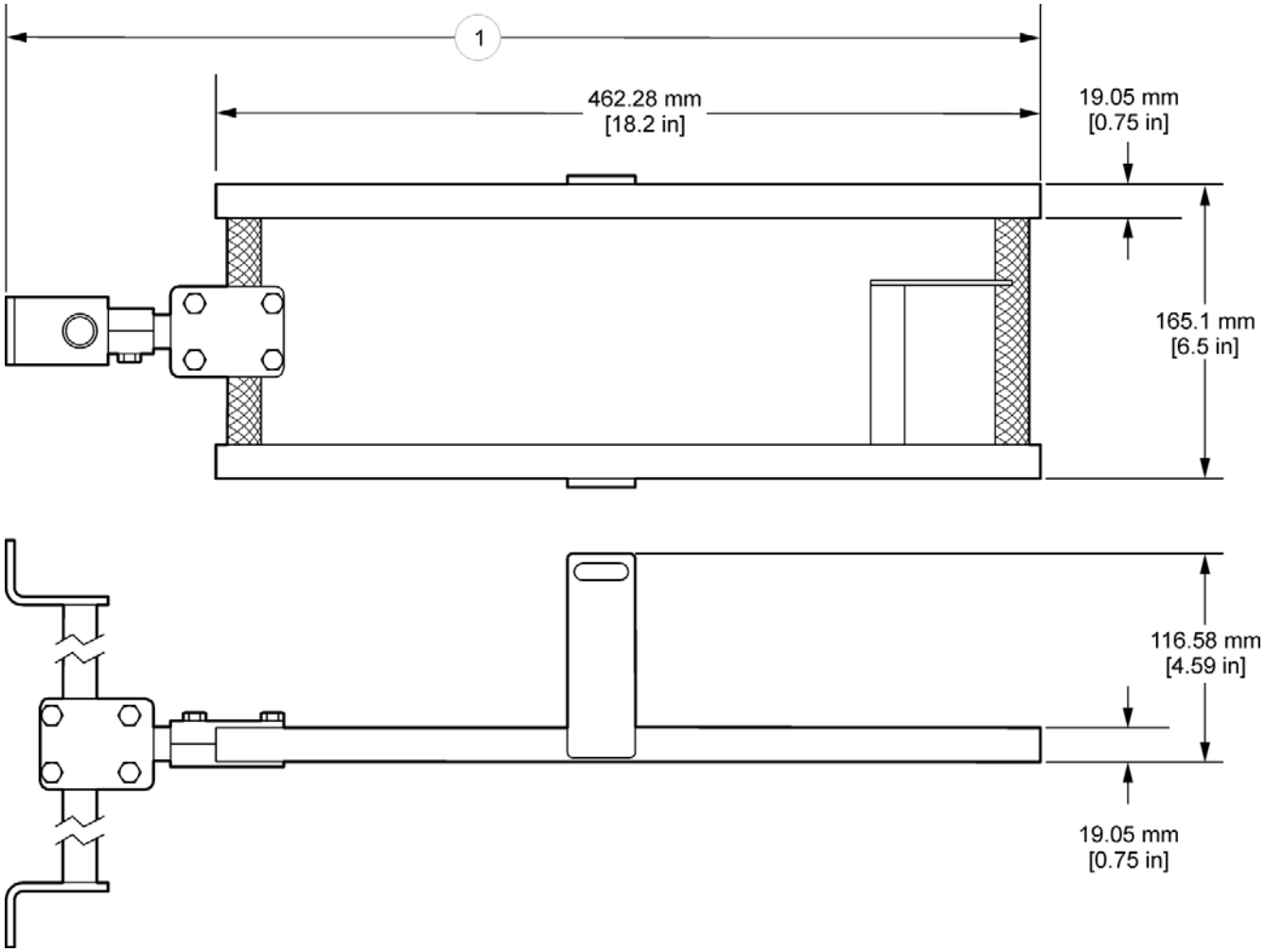

Figure 7 Standard frame dimensions

1	22.8 in. with 2¼ in. spacer; 32.6 in. with 12 in. spacer

3.2.2.1 Assemble the clamps on the frame and wall bracket

Install the clamps on the frame and wall mount bracket before installation on the wall.

Prerequisites

- Frame
- Wall mount bracket
- Clamps
- Hardware—wall bracket, spacer, nuts and bolts

Procedure

1. Position two clamp halves (one with threads and one without threads) around the wall mount bracket as shown in Figure 8.
2. Connect the clamp halves together with four bolts. Lightly tighten the bolts to temporarily hold the clamp in position.

3. Position the other two clamp halves around the front end of the frame as shown in Figure 8.

   Note: *In most cases the front of the frame will point toward the wall as shown in Figure 8 (see also Figure 12 on page 23). If flow conditions require the sensor to point away from the wall, use the 12 inch spacer and position the two clamp halves around the back end of the frame.*

4. Connect the clamp halves together with four bolts. Lightly tighten the bolts to temporarily hold the clamp in position.

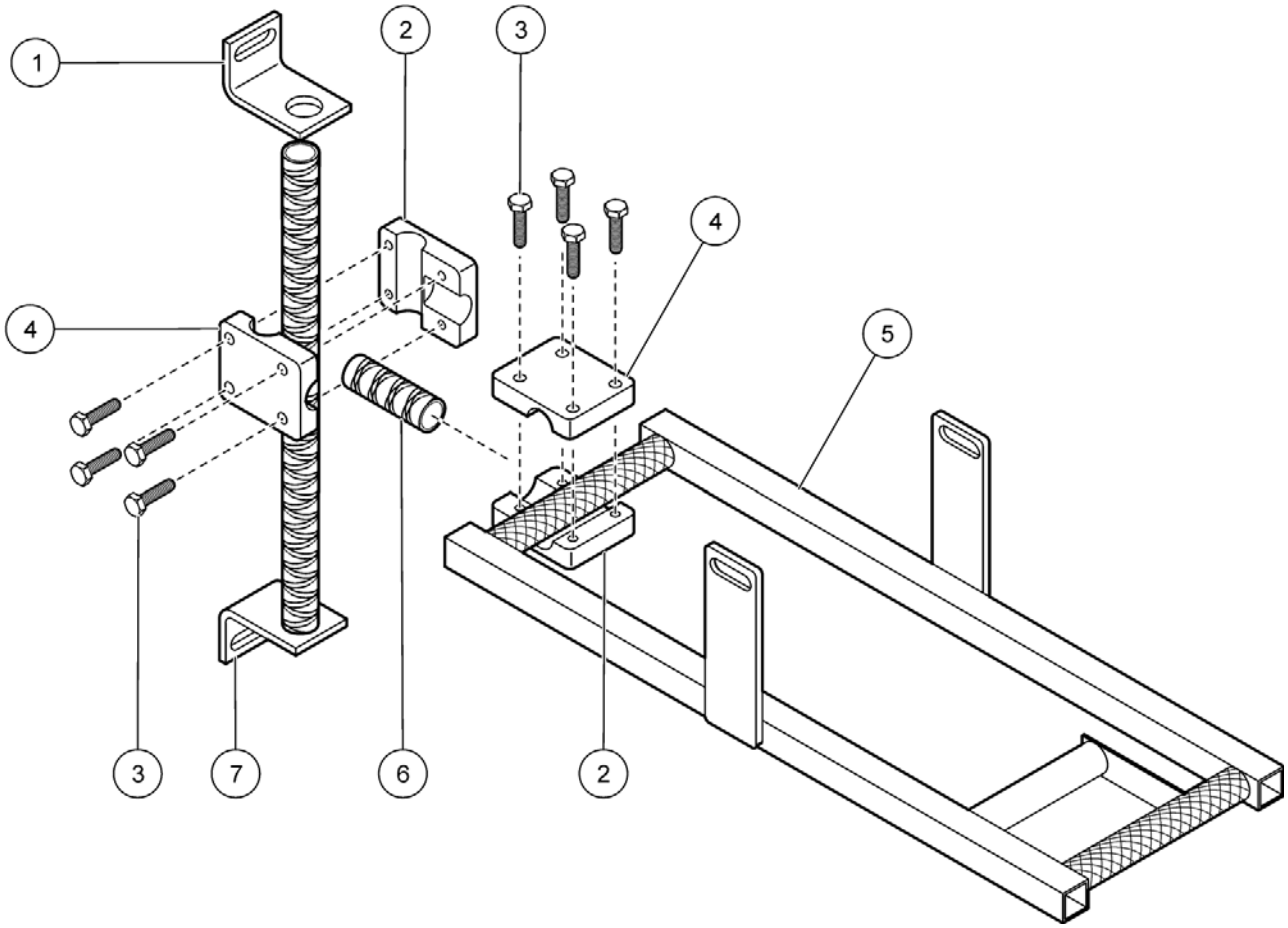

Figure 8 Clamps assembled on wall bracket and frame

1	Adjustable wall bracket	**5**	Frame
2	Clamp half, threaded	**6**	Spacer
3	Clamp bolt, ¼–20 x 1 in.	**7**	Wall mount bracket
4	Clamp half, not threaded		

3.2.2.2 Install the frame on the wall

DANGER
Explosion hazard. Review the safety information in section 2.1.3 on page 8 before entering a confined space.

Sensor location guidelines
Review the following guidelines to find the best location for the sensor.

- Examine the upstream and downstream flow characteristics. Use a mirror if necessary. Install the sensor above the water where the flow is steady. Do not install the sensor where there are standing waves, pools or objects or materials that can disrupt the flow profile.
- If the upstream flow characteristics are acceptable, install the sensor on the upstream wall of the manhole with the sensor pointing upstream. This location will make sure that the measured flow is the same as the flow in the pipe and that the sensor cable points away from the wall.
- Install the sensor away from the sides of the pipe and in the very center of the flow where the fluid is at the maximum depth.
- Install the sensor in a location that is accessible for maintenance.

Prerequisites

- Frame and wall mount bracket assembly (assembled in section 3.2.2.1)
- Anchors with nuts and washers
- Drill
- 3/8-inch concrete drill bit with tape to indicate a depth of 1½ inches
- Tools: mirror, ruler or tape measure, marker

Procedure
Complete the steps to install the frame on the wall of the manhole above the flow.

1. Make a mark on the wall that identifies the location of the top of the sensor frame (Figure 9). The wall brackets will be installed above and below this mark.
   - Flo-Dar without SVS—make sure that when the sensor is in the frame, the radar beam will not be blocked by the wall or channel (Figure 11).
   - Flo-Dar with SVS—the top of the sensor frame must be installed at an exact distance above the top of the channel. For pipe diameters greater than 24 inches, measure 5 inches from the top of the channel to the top of the frame. For pipe diameters less than 24 inches, measure 6 inches from the top of the channel to the top of the frame.
2. Position the wall mount brackets above and below this mark.
3. Make two marks to identify the position of the holes for each bracket.
4. Use a 3/8-inch drill bit to drill two holes at a depth of 1½ inches. Remove the debris from the holes.
5. Put the anchors in the holes and tap lightly with a hammer to seat the anchors.
6. Position the brackets over the holes and install the washers and nuts. Hold the brackets and tighten the nuts on the anchors. Do not over-torque.
7. Connect the frame to the wall bracket with a spacer as shown in Figure 9. The 12-inch spacer may be necessary to position the sensor farther from the wall when there is a large pipe lip.

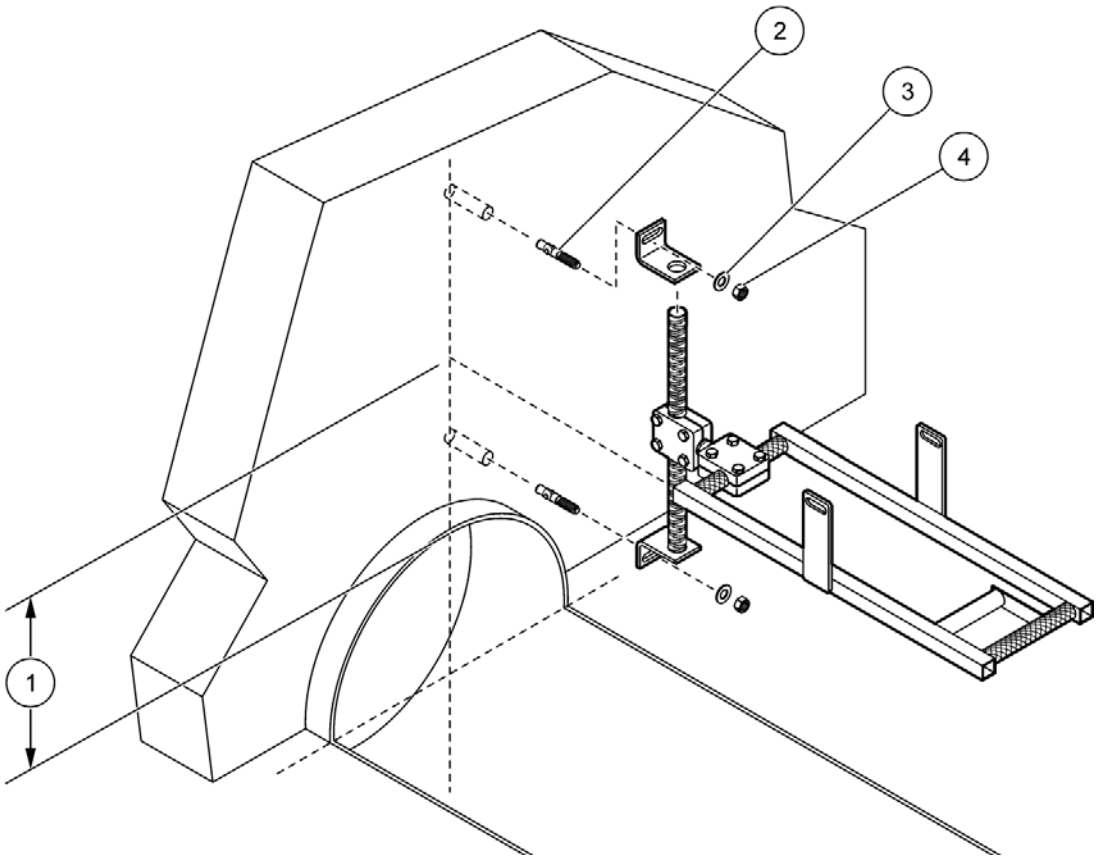

Figure 9 Wall installation

1	Distance from crown of pipe to top of frame	**3**	Washer
2	Anchor	**4**	Nut

3.2.2.3 Install the sensor on the frame

The sensor fits in the frame in only one direction and locks in position when the bail on the sensor is turned (Figure 10). The sensor can be removed from the frame and installed without entering the manhole when the optional retrieval pole is used (see Accessories on page 33).

Procedure

1. Make sure that the cable is tightly connected to the sensor.
2. Turn the bail to retract the locking bars on the sensor.
3. Position the sensor on the frame. The cable should point toward the center of the manhole.
4. Turn the bail to lock the sensor on the frame (Figure 10).

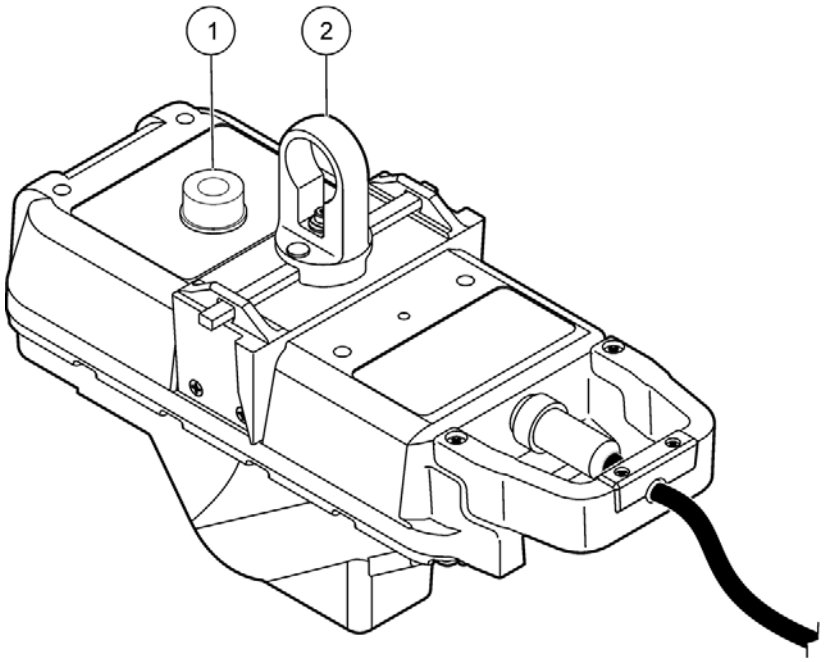

Figure 10 Horizontal alignment

1	Bubble level	**2**	Bail

3.2.2.4 Align the sensor vertically—Flo-Dar without SVS

The sensor must be aligned vertically to make sure that the sensor is above the flow and that the radar beam will not be blocked by the wall or pipe (Figure 11). Use the optional laser alignment tool for best accuracy (see Accessories on page 33).

Procedure

1. Make an estimate of where a line that extends from the top of the radar lens perpendicular to where the lens will point (Figure 11). Use the laser alignment tool for best accuracy.
2. Loosen the clamp on the wall mount bracket and position the frame so that the radar beam will point below the crown of the pipe by at least 1 inch (Figure 11). It may be necessary to install the 12 inch spacer to extend the frame farther from the wall.
3. Tighten the clamp and measure the frame position. Make sure that the radar beam is not blocked by the wall or pipe. If the beam is blocked, move the frame further away from the wall using the 12 inch spacer or lower the frame.

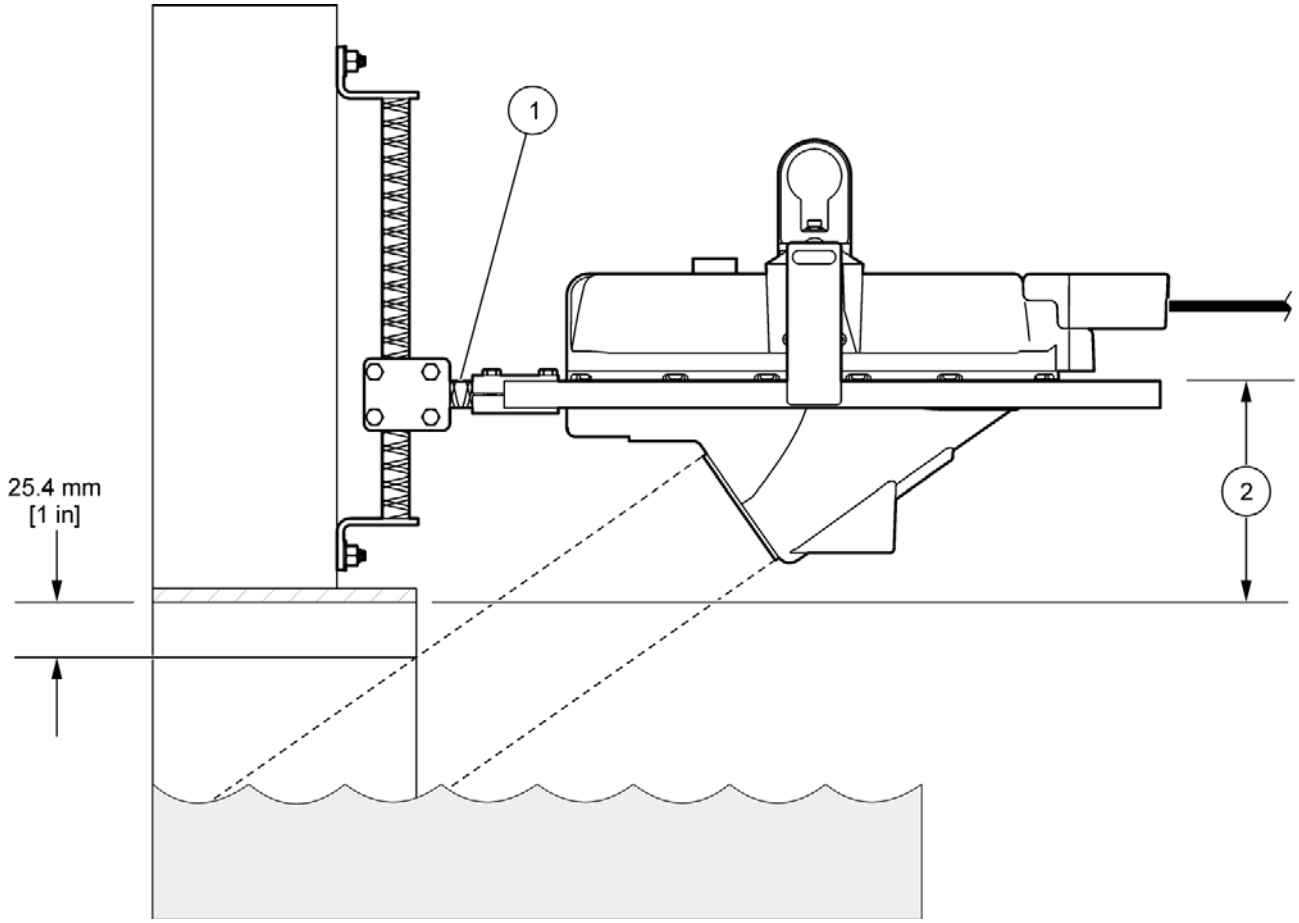

Figure 11 Vertical alignment of Flo-Dar sensor

1	Spacer	**2**	Distance from crown of pipe to top of frame

3.2.2.5 Align the sensor vertically—Flo-Dar with SVS

The sensor must be aligned vertically to make sure that the sensor is above the flow under normal full flow conditions and that the SVS is activated under surcharge conditions.

Prerequisites

- Ruler or tape measure

Procedure

1. Measure directly above the crown of the pipe to the top of the frame (Figure 9 on page 20).
2. If the pipe lip is longer than 5½ inches, install the 12 inch spacer between the wall mount bracket and the frame (Figure 12).
3. Loosen the clamp on the wall mount bracket and position the top of the frame above the crown of the pipe at the specified distance:
   - 6 inches for a pipe diameter that is less than 24 inches
   - 5 inches for a pipe diameter that is equal to or larger than 24 inches

4. Tighten the clamp and measure the frame position again to make sure it is at the correct position.

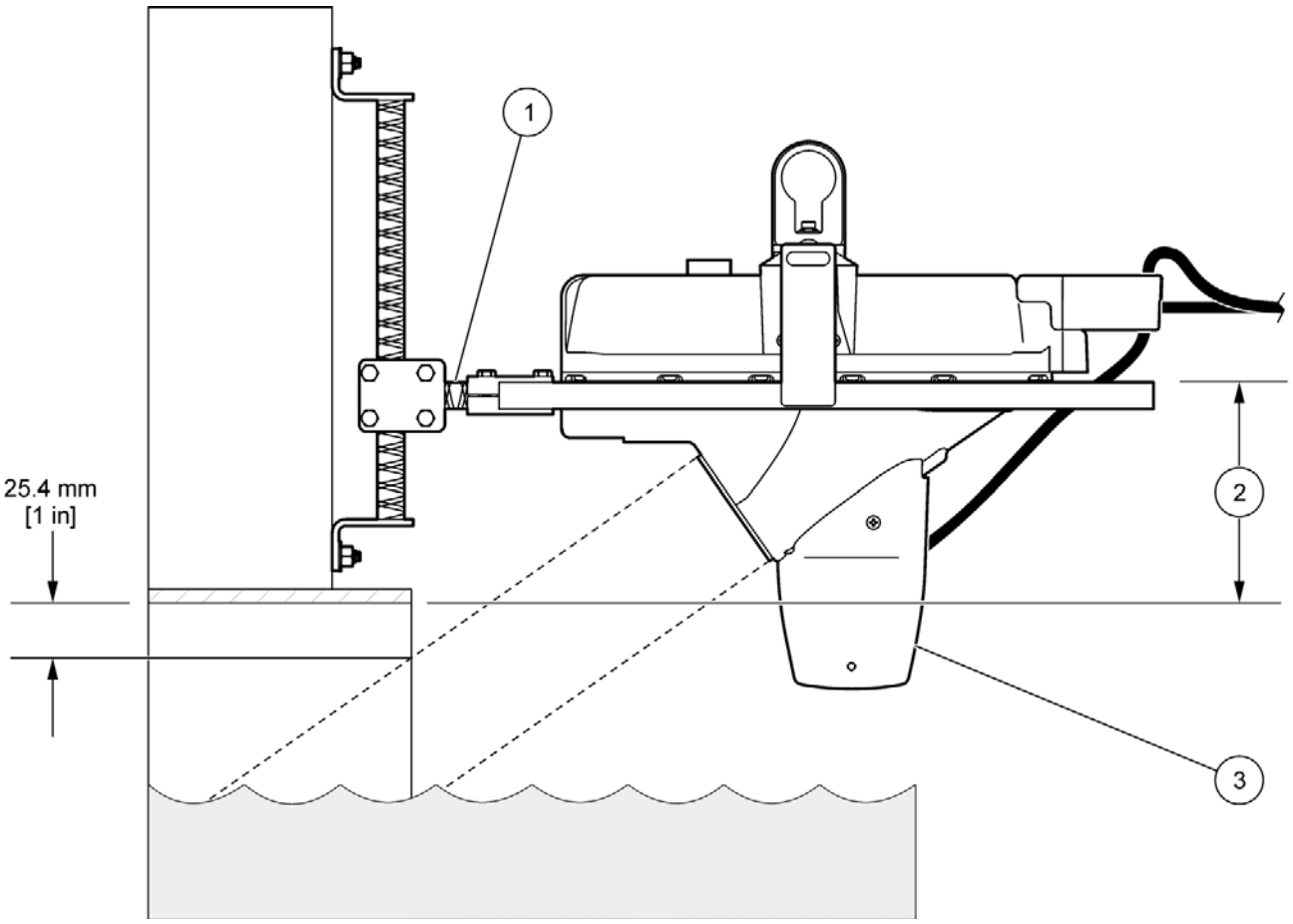

Figure 12 Vertical alignment of Flo-Dar sensor with SVS

1	Spacer	**3**	SVS sensor (optional)
2	Distance from crown of pipe to top of frame		

3.2.2.6 Align the sensor horizontally

The sensor must be aligned horizontally to make sure that the sensor is centered over the flow. If the pipe is not level and has a slope of 2 degrees or more, align the sensor to be parallel with the surface of the water.

Prerequisites

- Bubble level

Procedure

1. Remove the paper backing from the bubble level and attach the level to the sensor (Figure 10 on page 21).
2. Loosen the clamps and tap the frame into position.
3. Tighten both clamps and measure the frame position to make sure it is at the correct position.

3.2.2.7 Make a final alignment check

The correct vertical and horizontal alignment of the sensor is necessary for accurate measurements.

1. Measure the vertical alignment (section 3.2.2.4 on page 21 or section 3.2.2.5 on page 22) and make adjustments if necessary.
2. Measure the horizontal alignment (section 3.2.2.6 on page 23) and make adjustments if necessary.
3. Repeat steps 1 and 2 until no further adjustments are necessary.

3.2.2.8 Optional extended depth sensor installation

The extended depth sensor (Figure 13) can be used when the pipe or channel depth exceeds the standard level specifications (see Specifications on page 5). Use the extended frame (Figure 14) in place of the standard frame, or mount the extended depth sensor on the wall. Unlike the standard frame, the extended frame is reversible with regard to mounting direction.

The extended depth sensor has a deadband zone below the sensor of 16 inches where the sensor is not active. Install the extended depth sensor at least 16 inches above the crown of the pipe for correct measurements.

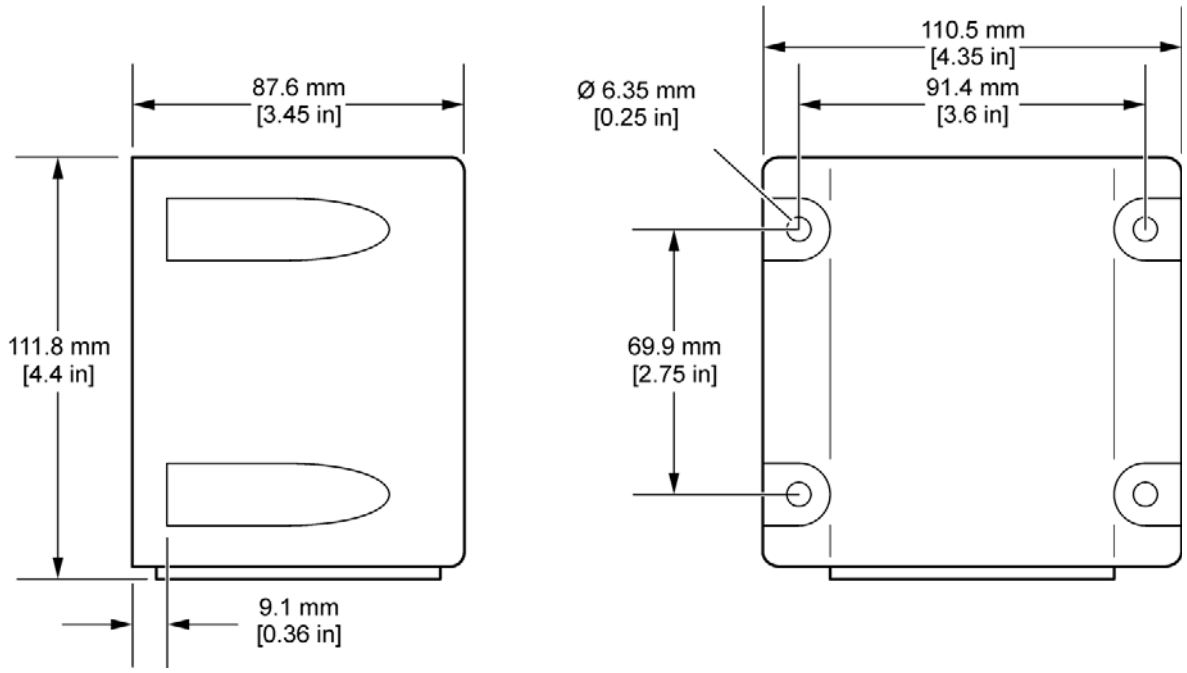

Figure 13 Extended sensor dimensions

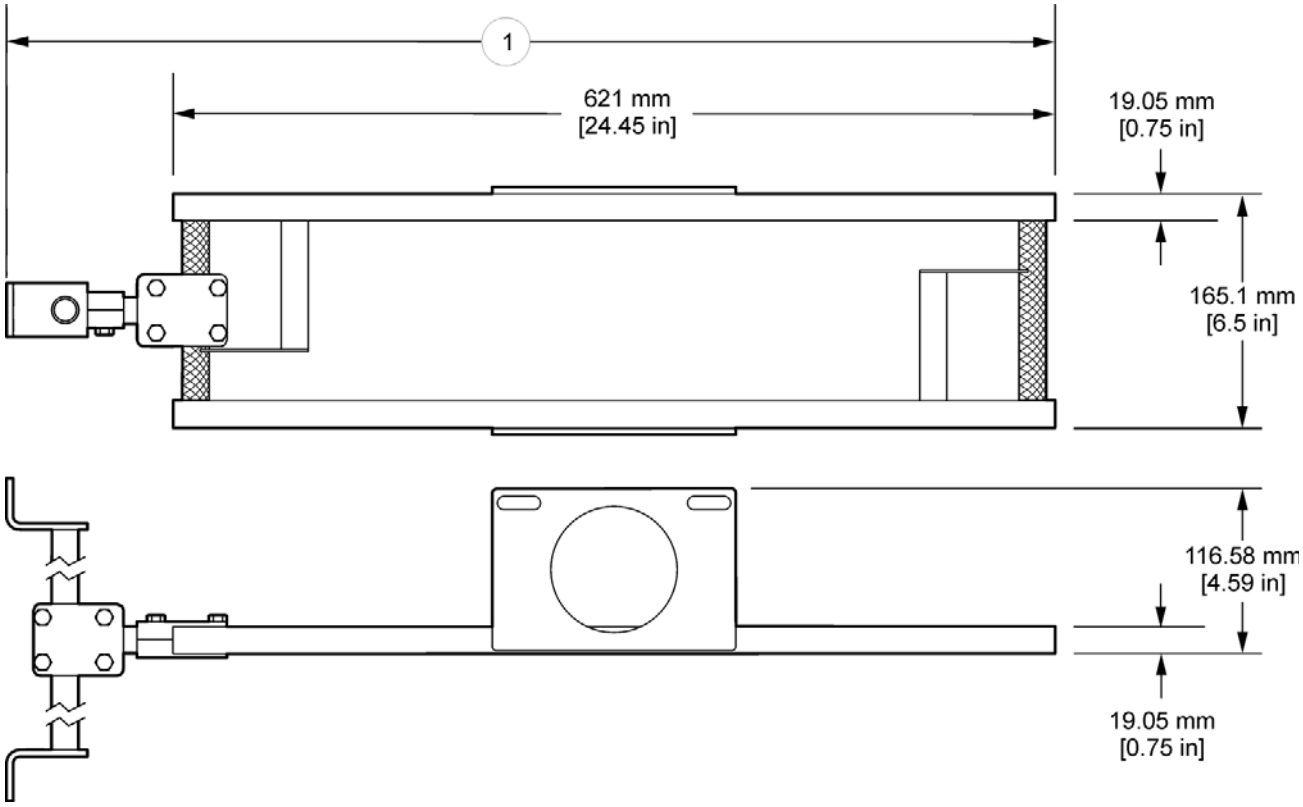

Figure 14 Extended frame dimensions

1	29.1 in. with 2¼ in. spacer; 38.8 in. with 12 in. spacer

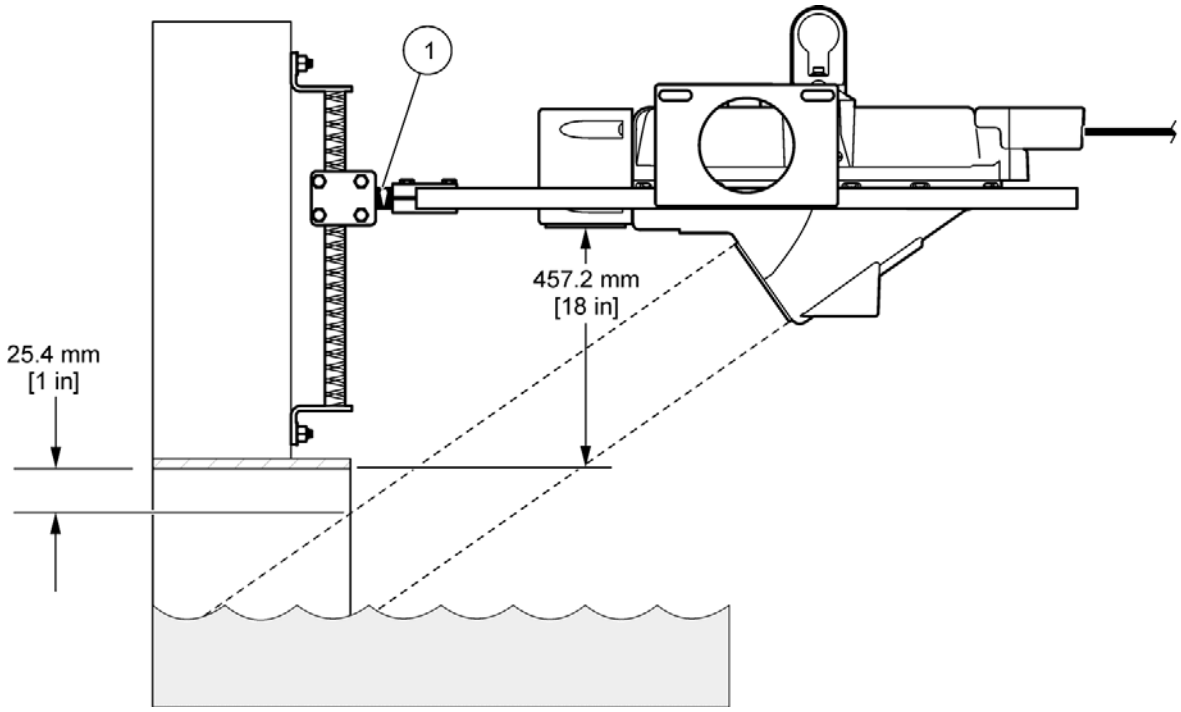

Figure 15 Vertical alignment with extended depth sensor

1	Spacer

3.2.3 Measure the sensor offset

The sensor offset is the distance from the top of the frame to the bottom of the pipe or channel. This distance will be entered into the software and is necessary for accurate flow calculations.

If the extended depth sensor (section 3.2.2.8 on page 24) is installed on the wall without the extended frame, the sensor offset is the distance from the face of the extended depth sensor to the bottom of the pipe or channel.

Prerequisites

- Rod
- Tape measure

Procedure

1. Put the rod in the bottom of the pipe or channel and align it vertically with the frame (Figure 16).
2. Make a mark on the rod to identify where the top of the sensor frame is.
3. Measure the distance from the bottom of the rod to the mark. This is the sensor offset.

   Note: *If it is not practical to measure to the bottom of the pipe, measure the distance from the crown of the pipe to the top of the frame (Figure 16). Add this distance to the pipe diameter to get the sensor offset (sensor offset = pipe diameter + distance from crown of the pipe to top of frame).*

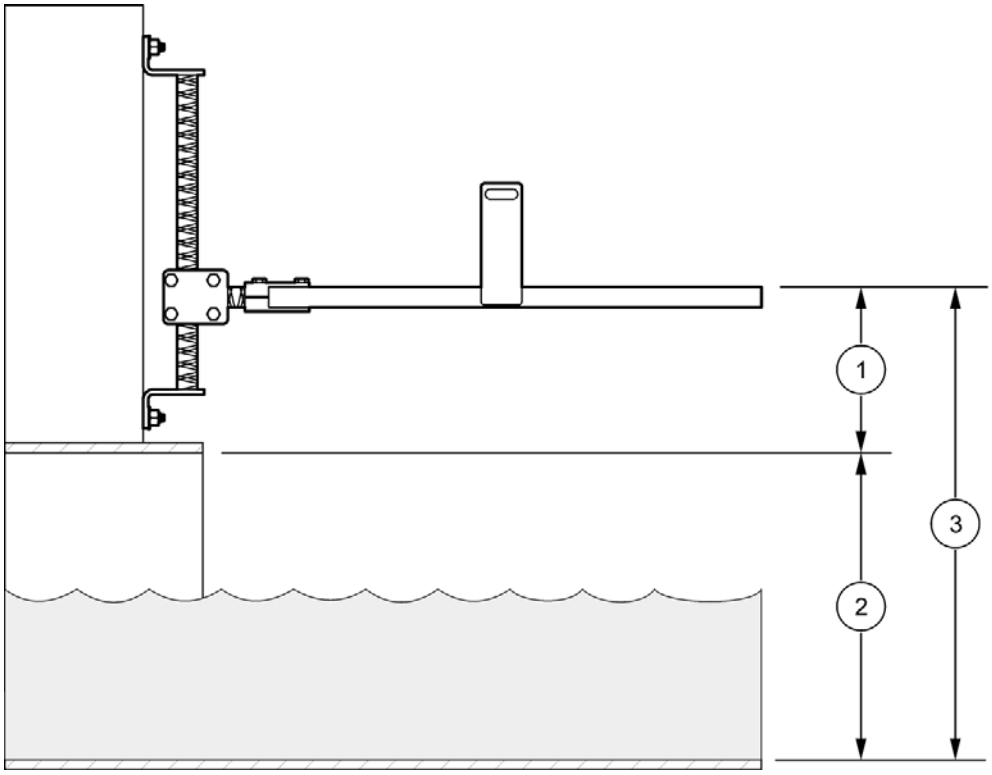

Figure 16 Sensor offset

1	Distance from crown of pipe to top of frame	**3**	Sensor offset
2	Pipe diameter		

3.2.4 Measure the pipe diameter

The correct diameter of the pipe or channel is necessary for accurate flow calculations.

1. Measure the inside pipe diameter (I.D.) at three locations (Figure 17). Be sure that the measurements are accurate.
2. Calculate the average of the three measurements. Record this number for use during the software setup for the site.

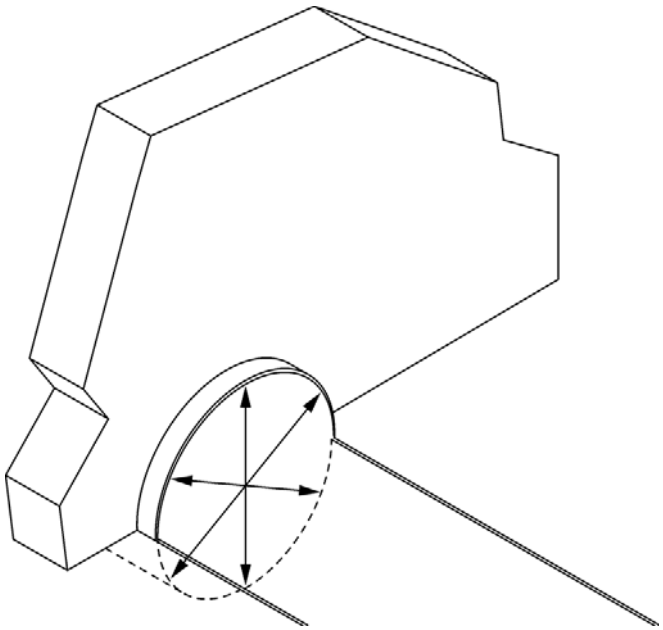

Figure 17 Pipe diameter measurement

3.3 Electrical installation

3.3.1 Wiring safety information

When making any wiring connections to the instrument, the following warnings and notes must be adhered to, as well as any warnings and notes found throughout the individual installation sections. For more safety information refer to section 2.1 on page 7.

CAUTION
Possible danger to sensor or logger. Always disconnect power to the instrument when making any electrical connections.

CAUTION: Radar RF Exposure Hazard
Although the Flo-Dar microwave power level is very small (~15mW) and is well below government stated exposure limits for uncontrolled environments, users of this product should follow proper safety protocols for the handling of devices with radar frequency transmitters. Avoid placing the head and other vital organ areas within the microwave beam (within 1 meter of the microwave aperture).

3.3.1.1  Electrostatic Discharge (ESD) considerations

Important Note: *To minimize hazards and ESD risks, maintenance procedures not requiring power to the instrument should be performed with power removed.*

Delicate internal electronic components can be damaged by static electricity, resulting in degraded instrument performance or eventual failure.

The manufacturer recommends taking the following steps to prevent ESD damage to your instrument:

- Before touching any instrument electronic components (such as printed circuit cards and the components on them) discharge static electricity from your body. This can be accomplished by touching an earth-grounded metal surface such as the chassis of an instrument, or a metal conduit or pipe.
- To reduce static build-up, avoid excessive movement. Transport static-sensitive components in anti-static containers or packaging.
- To discharge static electricity from your body and keep it discharged, wear a wrist strap connected by a wire to earth ground.
- Handle all static-sensitive components in a static-safe area. If possible, use anti-static floor pads and work bench pads.

3.3.2 Connection to the logger or controller

Connect the cable from the Flo-Dar sensor to the logger or the controller:

- Logger—connect the cable from the Flo-Dar sensor to the Flo-Dar connector on the logger. If the Flo-Dar sensor has the SVS component, connect the cable from the SVS component to the SVS connector on the logger.
- Controller—connect the cable from the Flo-Dar sensor to the correct terminal in the controller. If the Flo-Dar sensor has the SVS component, connect the cable from the SVS component to the correct terminal in the controller. Refer to the user manual for the controller for the correct terminal locations.

Section 4 Operation

A portable computer with Flo-Ware software must be connected to the controller or logger to set up and collect data from the Flo-Dar sensor.

4.1 Install the Flo-Ware software on the PC

Procedure

1. Put the Flo-Ware CD into the CD drive on the PC.
2. Save the floware4.exe file to the hard drive on the PC.
3. Open the file to start the installation wizard and follow the on-screen instructions to install the software.
4. Open and run the flodar.exe file. An installation wizard will start. Follow the on-screen instructions to install the software.

4.2 Set up the logger

Complete the steps to set up the Flo-Dar sensor for communication with the logger. Refer to the user manual for the logger for additional information.

Procedure

1. Connect the PC to the logger with the serial cable. A USB to serial adapter may be necessary for computers that do not have a serial port.
2. Double-click the Flo-Ware icon on the PC to open the software.
3. Select **Communicate with an instrument**>**Flo-Dar**>**communications**. The site setup screen will be shown (Figure 18).
4. Enter the site information.
5. Click **SAVE SITE** to save the information. Save the file to the hard drive.
6. Click **SEND SETUP** to download the site information to the logger.
7. Select both boxes for **Surcharge Level** and **Surcharge Velocity**.
8. Set the **Instrument Clock** to match the **Computer Clock** and click **OK**.
9. The message “Sending this setup will clear all logged data. Continue anyway?” will be shown. Select **OK**. The data will be sent to the logger. Select **OK** when the “Send setup complete” message is shown.

   The logger will start to collect data from the Flo-Dar sensor.
10. Select the **Real Time** tab on the Communications screen.
11. Select **SAMPLE** and wait for the data to be sent to the logger. The data will be shown in graphical format.
12. Make sure that the value in the **Level** field matches the actual water level (depth) in the pipe.
13. Make sure that the value in the **Velocity** field is reasonable for the flow conditions.
14. Close the Flo-Ware software and remove the communications cable from the logger.
15. Cover the communications port on the logger with the metal cap.

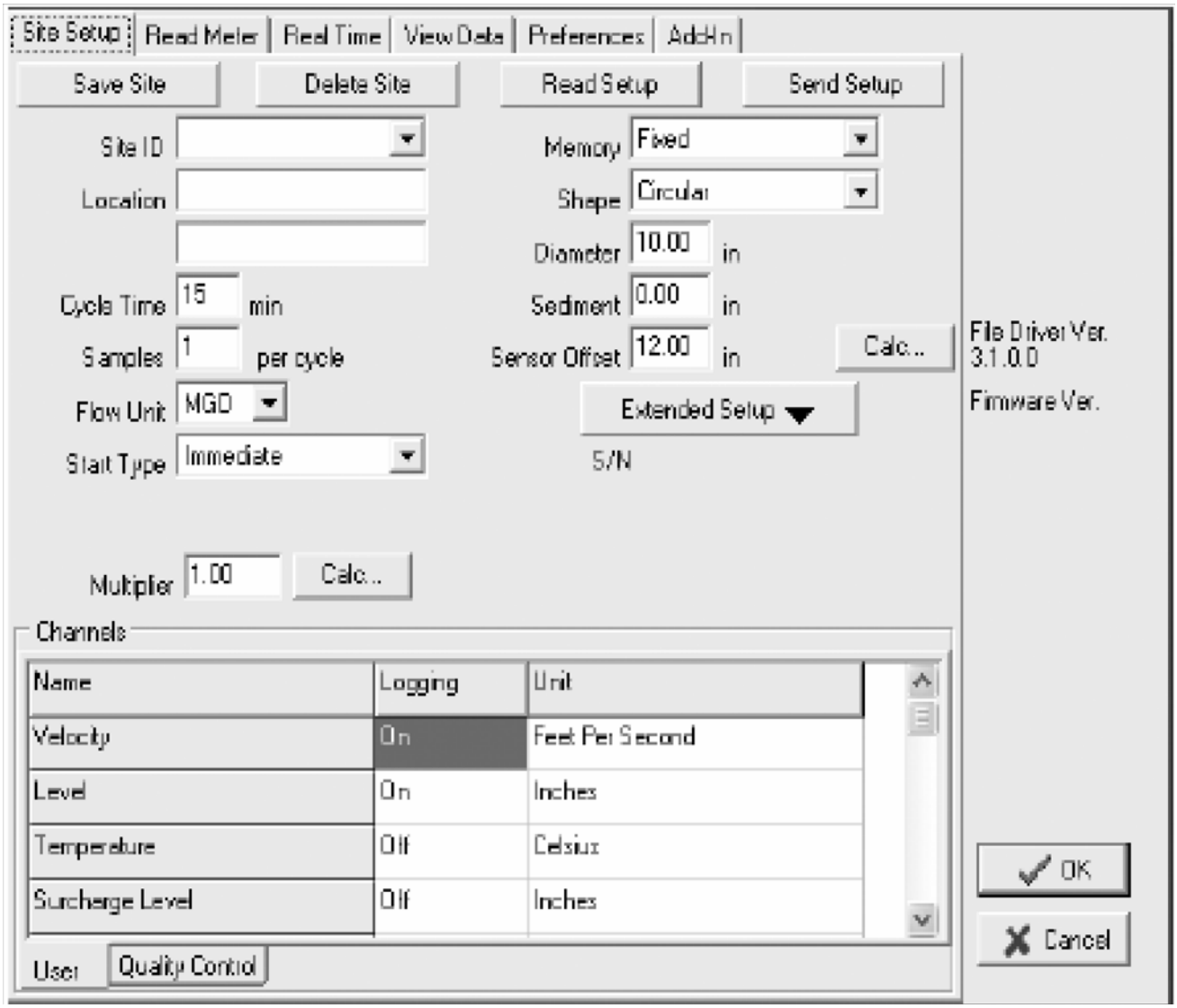

Figure 18 Site setup screen

Danger
Explosion hazard. When using the retrieval pole, make sure to connect the grounding strap to the ground lug of the barrier with the sensor cable (at least the shields) terminated to the barrier. This is to prevent ignition of explosive gases due to static discharge.

The safety of the transmitter may be impaired if any of the following conditions have occurred:

- ***visible damage***
- ***storage above 70ºC for prolonged periods***
- ***exposure to severe transport stresses***
- ***previous installation***
- ***failure to operate properly***

If any of these conditions have occurred, return the device to the manufacturer for recertification.

CAUTION: Radar RF Exposure Hazard
Although the Flo-Dar microwave power level is very small (~15mW) and is well below government stated exposure limits for uncontrolled environments, users of this product should follow proper safety protocols for the handling of devices with radar frequency transmitters. Avoid placing the head and other vital organ areas within the microwave beam (within 1 meter of the microwave aperture).

Important Note: *Delicate Instrumentation. Handle with care to prevent damage to the microwave transmitter. Damaged transmitters can result in higher signal power levels, which can interfere with essential terrestrial microwave links.*

5.1 Preventive maintenance

Examine the Flo-Dar sensor on an annual basis to look for corrosion or damage that can allow environmental gases into the interior. Make sure that no swelling, blistering, pitting or loss of material has occurred on the upper and lower portions of the main plastic enclosure, the depth module or the radome.

If the extended depth sensor is used, examine the enclosure and the four ¼-20 SS bolts. If the surcharge velocity sensor (SVS) is used, make sure the unit is not corroded and the labels are readable. Inspect the cable connectors for any damage or corrosion and tighten all connectors in the system.

The only parts of the Flo-Dar system that can be replaced by the user are the bail assembly, cable and desiccant. If the sensor becomes defective, it must be replaced as a complete unit.

Check the electrical connections
Examine the cable connectors on an annual basis for corrosion and tightness. If corrosion is found, clean and dry the connectors to make sure that no moisture is on the connector pins. If corrosion is severe, replace the cables.

5.2 Cleaning the instrument

Regular cleaning is not necessary because the sensor does not contact the flow unless a surcharge condition occurs. Examine the sensor after a surcharge to see if cleaning is necessary.

Prerequisites

- Retrieval pole with hook (optional, see Accessories on page 33)

Procedure:

1. Remove power to the sensor.
2. Put the hook on the retrieval pole for removal without manhole entry. Make sure the grounding strap is on the pole.
3. Hook the bail on the sensor and turn the pole counter-clockwise to unlock the sensor from the frame. Remove the sensor.
4. Remove any debris from the bottom of the sensor. Clean the external surface of the sensor with mild soap and rinse with water.

DANGER
Explosion hazard. Never attempt to wipe or clean the Flo-Dar or SVS sensor while in a hazardous location. Do not use abrasives or high-pressure hoses or washers to clean the sensors. Do not disturb the pressure port on the bottom of the sensor.

5. If the Surcharge Velocity Sensor (SVS) is used, use 600 grit sand paper to lightly sand the electrodes (small black dots). Use only light pressure when sanding or the electrodes will become damaged.
6. Lower and position the sensor on the frame. Make sure that the cable points toward the center of the manhole.
7. Turn the retrieval pole clockwise to engage the locking bars into the frame.
8. Apply power to the sensor.

5.3 Cable replacement

Replace the cable only when it is damaged.

Procedure

1. Remove power to the sensor.
2. Put the hook on the retrieval pole for removal without manhole entry. Make sure the grounding strap is on the pole.
3. Hook the bail on the sensor and turn the pole counter-clockwise to unlock the sensor from the frame. Remove the sensor.
4. Remove the cable clamp by removing the two Phillips screws on the sensor handle. Remove the cable.
5. Install the new cable. Make sure that the connector is aligned properly and that no debris or water gets into the connector.
6. Replace the cable clamp.
7. Lower and position the sensor on the frame. Make sure that the cable points toward the center of the manhole.
8. Turn the retrieval pole clockwise to engage the locking bars into the frame.
9. Apply power to the sensor.

Section 6 Replacement Parts and Accessories

6.1 Replacement Parts

Description	Catalog Number
Bail assembly	800014901
Cable assembly, 30 ft, connector on one end	570011801
Cable assembly, 60 ft, connector on one end	570011804
Cable assembly, 100 ft, connector on one end	570011802
Cable assembly, 30 ft, connectors on both ends	131012601
Cable assembly, 60 ft, connectors on both ends	131012611
Cable assembly, 100 ft, connectors on both ends	131012602
Flo-Dar sensor	890004901
SVS Surcharge Velocity Sensor, replacement only	890006001
Wall mount assembly, standard frame (includes frame and hardware)	800016701
Wall mount assembly, extended frame (includes frame and hardware)	800016201
Wall mount hardware	800015401

6.2 Accessories

Description	Catalog Number
Laser alignment tool	800012402
Hook for sensor retrieval pole	510012701
Sensor retrieval pole, 8–24 ft	245000501
Temporary mount assembly, standard frame, 34 in. to 52 in. manhole	800016401
Temporary mount assembly, standard frame, 52 in. to 70 in. manhole	800016402
Temporary mount assembly, standard frame, 70 in. to 88 in. manhole	800016403
Temporary mount assembly, standard frame, 89 in. to 107 in. manhole	800016404
Temporary mount assembly, extended frame, 34 in. to 52 in. manhole	800016301
Temporary mount assembly, extended frame, 52 in. to 70 in. manhole	800016302
Temporary mount assembly, extended frame, 70 in. to 88 in. manhole	800016303
Temporary mount assembly, extended frame, 89 in. to 107 in. manhole	800016304

United States

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4539 Metropolitan Court
Frederick, MD 21704-9452, U.S.A.
Tel (800) 368-2723
Fax 301-874-8459
hachflowsales@hach.com
www.hachflow.com

Information required
- Account number (if available)
- Name and phone number
- Purchase order number
- Brief description or model number
- Billing address
- Shipping address
- Part number
- Quantity

European Union

France
Polymetron/Dr. Lange
Division Lab
33 rue du ballon
F-93165 Noisy le Grand
Tel.: ++33/(0)1/ 48 15 68 70
Fax: ++33/(0)1/ 48 15 68 79
email: info@drlange.fr
www.drlange.fr

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Fax: ++44/(0)12 56/ 33 07 24
email: info@drlange.co.uk
www.drlange.co.uk

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Flow-Tronic
RUE J.H. COOL 19a
B-4840 Welkenraedt
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Tel: +-32-87-899797 or 899799
Fax: +-32-87-899790
email: sales@mmi-europe.com

Outside the U.S.A. and EU

Hach Company maintains a worldwide network of dealers and distributors. To find the representative for your location, send an email to hachflowsales@hach.com or visit www.hachflow.com.

Technical support

Technical and Customer Service Department personnel are eager to answer questions about our products and their use. In the U.S.A., call 800-368-2723. Outside the U.S.A., send an email to hachflowservice@hach.com or call 301-874-5599.

Section 8 Repair service

Under normal operating conditions the Flo-Dar System should not need to be returned for repair or calibration.

If the sensor or Flo-Logger/Flo-Station or both need to be returned to the factory for repair, do the following:

1. Identify the model number of the Flo-Dar sensor.
2. Identify the serial numbers of the sensor and the Flo-Logger or Flo-Station.
3. Record the reason for return.
4. Call the Customer Service Department (1-800-368-2723) and get a Return Materials Authorization (RMA) number.
5. Ship the equipment in the original packaging, if possible.

   Note: *Do not ship manuals, computer cables or other parts with the unit (unless required for repair).*
6. Make sure that the equipment is free from foreign debris and is clean and dry prior to shipping (instruments returned uncleaned will be charged a fee).
7. Write the RMA number on the shipping label.
8. Make sure that all return shipments are insured.
9. Address all shipments to:

   Marsh-McBirney - Hach Company

   5600 Lindbergh Drive - North Dock

   Loveland, CO 80538-0389, U.S.A.

   Attn: RMA# XXX

Section 9 Limited warranty

Manufacturer warrants all products of its manufacture to be free from defects in workmanship and material under normal use and service. This warranty extends for a period of twelve (12) months after date of shipment, unless altered by mutual agreement between the purchaser and manufacturer prior to the shipment of the product. If this product is believed to be defective, purchaser shall notify manufacturer and will return the product to the manufacturer, postage paid, within twelve (12) months after date of shipment by the manufacturer. If the purchaser believes the return of the product to be impractical, manufacturer shall have the option, but will not be required, to inspect the product wherever located. In any event, if the purchaser requests the manufacturer visit their location, the purchaser agrees to pay the non-warranty expenses of travel, lodging and subsistence for the field service response. If the product is found by the manufacturer's inspection to be defective in workmanship or material, the defective part or parts will either be repaired or replaced, at manufacturer's election, free of charge, and if necessary the product will be returned to purchaser, transportation prepaid to any point in the United States. If inspection by the manufacturer of such product does not disclose any defect of workmanship or material, manufacturer's regular service repair charges will apply. Computing devices sold but not manufactured by Marsh-McBirney are covered only by the original manufacturer's written warranty. Hence, this warranty statement does not apply.

The foregoing warranty is manufacturer's sole warranty, and all other warranties, express, implied or statutory, including any implied warranty of merchantability or fitness for a particular purpose, are negated and excluded. The foregoing warranty is in lieu of all other warranties, guarantees, representations, obligations or liabilities on the part of the manufacturer. Purchaser's sole remedy and manufacturer's sole obligation for alleged product failure, whether under warranty claim or otherwise, shall be the aforestated obligation of manufacturer to repair or replace products returned within twelve months after date of original shipment. The manufacturer shall not be liable for, and the purchaser assumes and agrees to indemnify and save harmless the manufacturer in respect to, any loss or damage that may arise through the use by the purchaser of any of the manufacturer's products.