UniMag and ChemMag Flow Tubes

Instruction Manual

Part #69-4403-002 of Assembly 60-4404-002

Revision B, March 2003

ISCO®

IMPORTANT - PLEASE READ

⚠ DANGER

The installation and operation of this product may put you at risk of serious injury or even death. Take whatever precautions are necessary to ensure your safety before making an installation or working on one. Never work alone or unsupervised. Install and operate this product in accordance with all applicable safety and health regulations, as well as any appropriate local ordinances.

This product may be installed in confined spaces. Examples of confined spaces are manholes, pipelines, digesters, and storage tanks. These places can be dangerous or fatal if you are not suitably prepared. The primary hazards of confined spaces are the possibility of poisoned air, and the lack of proper ventilation. Work in such places is governed by OSHA 1910.146, and may require a permit before entering. The other major hazard particular to this product is its extreme weight, which makes it dangerous to handle and creates the risk of being crushed or struck by the unit during installation.

This manual may also contain Material Safety Data Sheets (MSDS) for chemical agents supplied or recommended for use with this product. If needed, these sheets will be in the MSDS Appendix. These sheets provide information about possible hazards from the chemicals. Additional MSDS, covering various proprietary agents (name-branded or trademarked mixtures) that can also be used with this product, are available from the manufacturers of those agents.

This manual uses the following notations to set apart hazard warnings and notes:

⚠ DANGER

DANGER describes situations that will result in loss of life or serious personal injury, unless avoided. The emphasis is on clear and immediate threats to your life or safety.

⚠ WARNING

WARNING describes situations that could result in loss of life or serious personal injury, unless avoided. The emphasis here is on the potential for a serious accident.

⚠ CAUTION

CAUTION describes situations that may result in moderate personal injuries, property damage, or damage to the equipment, unless avoided.

☑ Note

NOTES draw your attention to particular features, practices, tips, or other information useful in setting up or operating the product.

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Isco recommends that you read this manual completely before placing the equipment in service.

Although 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 the problem persists, call or email the Isco Customer Service Department for assistance. Contact information is provided below. 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.

Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

Contact Information

Phone:	(800) 228-4373	(USA, Canada, Mexico)
	(402) 464-0231	(Outside North America)
Repair Service:	(800) 775-2965	(Analytical and Process Monitoring Instruments)
	(800) 228-4373	(Samplers and Flow Meters)
Fax:	(402) 465-3022	
Email address:	info@isco.com	
Website:	www.isco.com	

Return equipment to: 4700 Superior Street, Lincoln, NE 68504-1398

Other correspondence: P.O. Box 82531, Lincoln, NE 68501-2531

Revised February 12, 2003

UniMag and ChemMag

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UniMag and ChemMag

Section 1 Introduction

1.1 Scope

The UniMag and ChemMag flow tubes are suitable for full pipes and are normally calibrated for volumetric flow traceable to the USA National Institute of Standards and Technology, and complete with a certificate. The flow tubes are powered by transmitters, which may be integrally mounted on the sensor flow tube (metal UniMags only), or more commonly, remote from it. The flow meter and transmitter make up a complete magnetic flow meter system. The transmitter has separate instructions.

The flow meter system operates in accordance with *Faraday's Law of Induction*, which states that electrical energy will be induced across a conductor as it passes through a magnetic field. The amount of electrical energy created across the conductor is directly proportional to the velocity of the conductor.

The conductor is the media being measured (liquid inside the pipe). The magnetic field is generated by coils in the flow tube and the induced voltage is normally measured across two insulated electrodes. When the flow tubes are supplied with the UniPulse pulsed AC transmitter, they are equipped with additional reference coils. The reference coils compensate for variation in media temperature and for any magnetic field inherent in the media.

Figure 1-1 UniMag Flow Tube

1.2 Safety

The following warnings are provided for your safety. Please read them and keep them in mind when working with the flow tubes.

⚠ DANGER

Crush hazard. The flow tubes may be very heavy (from 12 pounds to two tons). You could be crushed to death instantly, or very seriously injured, if the flow tube slips during installation and strikes you or falls on you. Keep your hands away from flanges when positioning the flow tube for installation. Make sure that the hoisting apparatus can safely lift the weight of the flow tube.

⚠ WARNING

Before installation, make sure that the operating environments of the flow tube and transmitter are consistent with appropriate national approvals, such as USA UL, Canadian CSA, Entela. The installation of the flow tube must be carried out by qualified personnel only. Read the entire manual before attempting to install or operate the equipment. This includes the separate instructions for the transmitter.

☑ Note

The flow meter requires AC commercial power for the transmitter only. The flow meter produces no electromagnetic fields that are harmful to the environment or operating personnel.

Figure 1-2 ChemMag Flow Tube

UniMag and ChemMag

Section 2 Installation

2.1 Media Considerations

The flow meters are suitable for such media as drinking water, raw sewage, slurries, pulps, pastes and some acids. The minimum conductivity is 0.5 micromhos/cm (micro Siemens/cm), for operation with Isco UniPulse transmitters. Most water based media has a conductivity of 100-800 micromhos/cm.

Check the compatibility of the media with the wetted parts. With some media the percent consistency and operational temperature range can affect this compatibility.

Make sure the operational temperature and pressure of the media does not exceed that specified for the flow tubes (See Sections 5.1.2 and 5.2.2).

2.2 Location

The flow meters have high insensitivity to environmental electrical noise, including radio frequency interference. However, it is good practice to locate the sensors and transmitter away from the immediate area of such noisy environments.

Make sure the flow tube is located consistent with its environmental protection rating. See the code on the flow tube nameplate and check against the appropriate specification.

For integrally mounted transmitters, the transmitter must not be mounted where it is under direct sunlight or subject to driving rain, where it cannot be reasonably read or serviced. Place at least a simple canopy over the transmitter and avoid environments where moisture can accumulate in it (see separate transmitter instructions).

2.3 Cautions and Important Notes

⚠ CAUTION

Do not use transmitters in manholes or similar locations subject to flooding. In all cases it is essential that the cable terminals be dry at all times.

The UniMag and ChemMag are supplied submersible to NEMA 6 and IP68 (see Section 2.8). However, when any further cable junction boxes are located in an area where flooding can occur, that junction box must be first dried out with a portable hair dryer, direct sunlight or other method.

☑ *Note*

When the junction box is absolutely dry, fill it with potting compound (see important note in Section 2.8.5) so that air is not trapped in it when the lid is finally assembled.

Do not use silicone rubber (RTV) for potting; acetic acid released during curing can corrode terminals.

☑ Note

a) The cable shielding should not be cut more than 1" (25 mm) from the terminals.

b) The UniMag and ChemMag flow tubes are approved by Entela to CSA and UL standards for use in a Class 1, Division 2 explosive atmosphere, with the transmitter located in a safe area. It is a requirement of approval that rigid conduit or Teck metal clad cable is used for the connection of the transmitter to the UniMag or ChemMag flow tube assembly. Metal $^1/_2$" conduit connectors type UNYSONR-A are supplied in the flow tube junction box and transmitter.

c) It is also a requirement of Class 1, Division 2 approval that the UniMag and ChemMag are completely potted with 3M "High Gel" type 4442 re-enterable compound. Details of this are given in Section 2.8.5.

For UniMags with polyurethane sensors the differential temperature between the media and ambient should not exceed 140°F (60°C). This may be prevented by thermal insulation on the outside of the flow tube.

2.4 Serial Numbers

Make sure the serial number of the flow tube, shown on the nameplate of the flow tube, agrees with the serial number on the transmitter when they have been supplied together. When they have been supplied separately, the transmitter range factor and pulse frequency has to be adjusted to the sensor and flow tube calibration requirements (see instructions for the transmitter).

2.5 Mounting Recommendations

The UniMag or ChemMag may be mounted into a pipeline in any attitude, taking note of the flow direction arrow on the flow tube flow tube. However, the recommendations in this section should be observed.

☑ Note

To obtain accurate measurement with a magmeter, the pipe must be totally full (unless using a UniMag designed to measure flow in non-full pipes) and air must not be entrained in the flow. If the pipe is not full, or if air is entrained in the flow (for example, due to pump cavitation) a magmeter will indicate a flow rate higher than the actual flow rate.

2.5.1 Straight Pipe Lengths

The piping downstream from a UniMag is much less critical than that upstream. Essentially, all that is required of the downstream piping is that sufficient back pressure is provided to ensure that the flow tube remains full.

A full pipe UniMag requires a minimum of 5 pipe diameters of straight length of pipe upstream from the flow tube and a minimum of 2 diameters downstream, after which 90° bends can then be located upstream and downstream (see Figure 2-1).

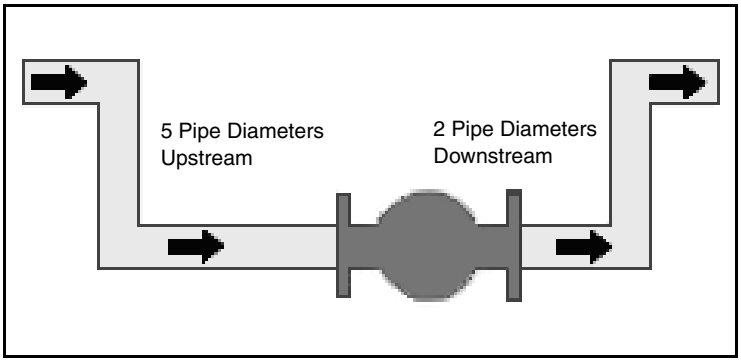


Figure 2-1 Piping Configuration

Straight pipe lengths for ChemMags > 1" (25 cm) Ø and all UniMags are presented in the table below.

Table 2-1 Minimum Straight Lengths of Pipe

Condition	2 Sensor UniMags
90° bend or tee	5D up 2D down
90° bends in 2 planes	10D up 5D down
Upstream pump	20D up
Downstream pump	5D down
For 1 sensor UniMags, the above lengths should be doubled.	
D = Pipe Internal Diameter	

☑ *Note*

For upstream straight pipe lengths less than 10D, the UniMag sensors should be in plane with the last upstream bend or tee.

2.5.2 Increasing Velocity

For particularly poor velocity profiles caused, for example, by upstream bends in two or more planes or partially open valves, a full pipe UniMag requires a minimum of 10 pipe diameters of straight length of pipe upstream from the flow tube, and a minimum of 5 diameters downstream. In addition, flow straighteners should be located upstream of the UniMag.

Flow straighteners are typically used in pipes from 6" to 20" (150 to 500 mm) in diameter. Flow straighteners are bundles of small tubes 1½ pipe diameters in length, located inside the pipe 10 pipe diameters upstream of the UniMag flow tube. In pipes 4" (100 mm) and less in diameter, a flow straightener would restrict the flow considerably and is not recommended. In addition, flow straighteners should not be used in pipes containing sludge due to the potential for blockage.

Extremely large measurement errors may occur in installations with both low velocities less than 1 ft/s (0.3 m/s), and poor velocity profiles due to insufficient lengths of straight pipe upstream and downstream from the UniMag flow tube.

In some applications it is necessary to install a UniMag flow tube smaller in diameter than the adjacent piping, in order to increase the velocity through the UniMag to maintain accuracy. In such installations, the angle on the reduction and expansion must be less than 10, in which case no additional straight lengths of pipe are required between the UniMag flow tube and the reduction and expansion (see Figure 2-2).

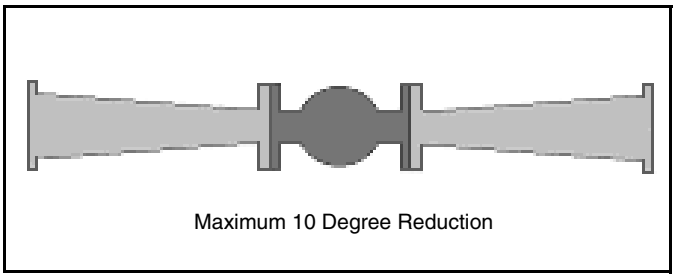


Figure 2-2 Angle on the Reduction and Expansion

2.5.3 Vertically Orientated Pipes

One way to prevent non-full pipes and cavitation of the media is to install the UniMag in a vertical pipe with upward flow (see Figure 2-3).

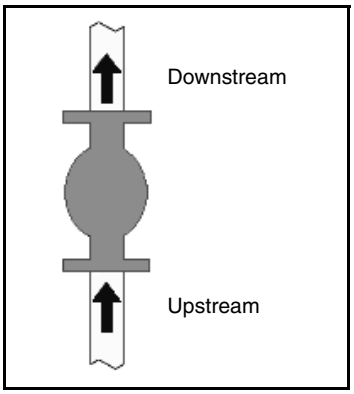


Figure 2-3 Installation in Vertically Orientated pipes

2.5.4 Horizontally Orientated Pipes

Horizontally-orientated pipes should always be installed with a downstream head of media above the flow tube to prevent non-full pipes, as shown in Figure 2-4.

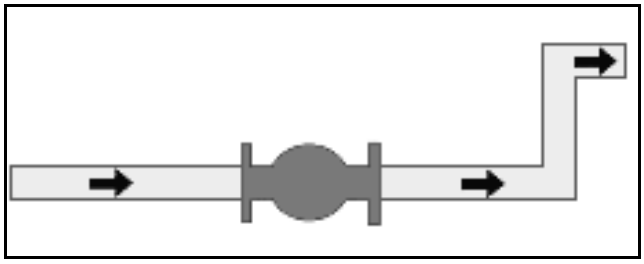


Figure 2-4 Installation in Horizontally Orientated Pipes

> **Note**
>
> Avoid installing the flow tube at the highest part of the pipe work (Figure 2-5). If the UniMag is installed at the highest location in the piping, a full pipe condition cannot be guaranteed.

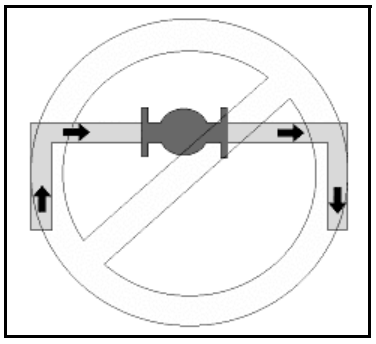


Figure 2-5 Avoid Installing at Highest Horizontal Location

Horizontally-mounted pipes should be supported so that there are no undue stresses on them or the flow tubes. There must not be any misalignment between the pipes either side of the flow tube. Make sure there are no gaskets protruding into the pipes either side of the flow tube, nor immediately before or after the upstream and downstream straight lengths of pipe respectively.

2.5.5 Sensor Electrodes

In horizontal pipes the diameter across the center point of opposite pairs of UniMag sensor electrodes should be mounted horizontally. This avoids possible buildup of solids on the bottom electrode pair and gas build-up on the upper pair, as shown in Figure 2-6. With UniMags, the electrodes should be horizontal.

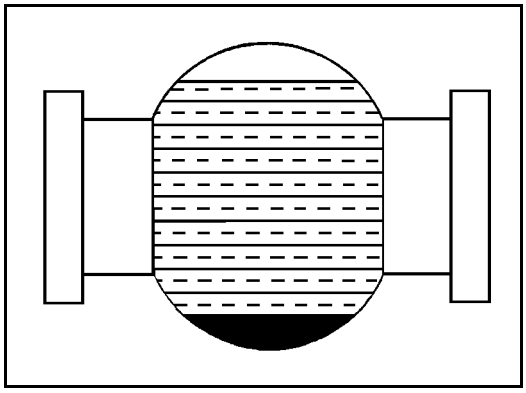


Figure 2-6 Solids and Gas Buildups

2.5.6 Non-Full Pipe Detection

For non-full pipe detection in horizontally-mounted pipes the electrodes detect when the media has fallen below their level (Figure 2-7).

At that time the non-full pipe contact is actuated in the transmitter. The signal normally goes to 4mA, a N/O or N/C contact is actuated and an LED on the transmitter front panel is lit (except on the 4412, which does not have an LED).

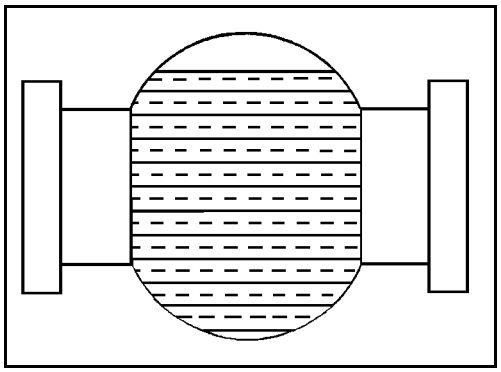


Figure 2-7 Non-Full Pipe Condition

2.5.7 Non-homogenous Media

For particularly non-homogenous slurries, pulps, or pastes, the flow tube should be mounted in a vertical pipe to obtain the most even distribution of solids and fibers. There must be a minimum of 20 pipe diameters between any media mixing point and the UniMag flow tube (Figure 2-8). The 20 pipe diameters can include a bend if the bend is located a minimum of 10 pipe diameters upstream of a double sensor UniMag (a minimum of 20 pipe diameters with single sensor UniMag).

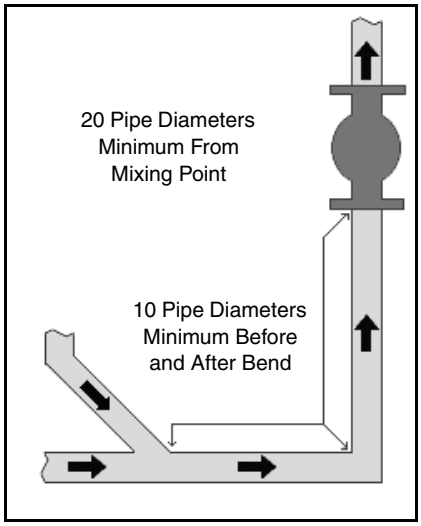


Figure 2-8 Non-homogenous Media

2.5.8 Partially Closed Valve

If the piping is horizontal and includes a partially closed valve, the valve should always be installed downstream of the UniMag, as shown in Figure 2-9. This will allow the head pressure in the system to be adjusted, preventing air entrainment in the flow.

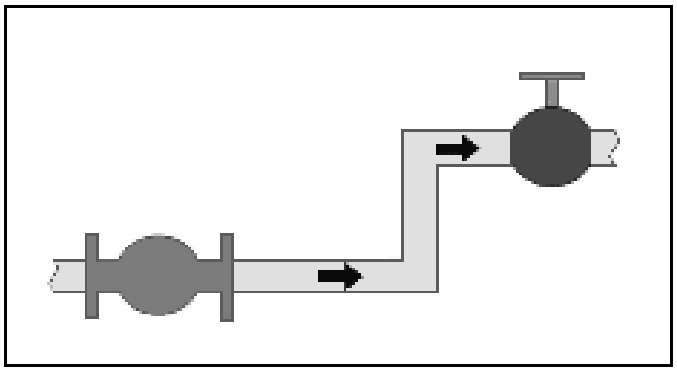


Figure 2-9 Partially Closed Valve Downstream

2.5.9 Vacuum Conditions

For vacuum conditions (for example, due to a pump downstream from the UniMag flow tube), use epoxy enamel, powder coated polyethylene or fusion bonded Teflon liners with the UniMag, or no liner at all.

A minimum of 3 pipe diameters of straight length of pipe are required downstream from the UniMag flow tube to the pump (Figure 2-10).

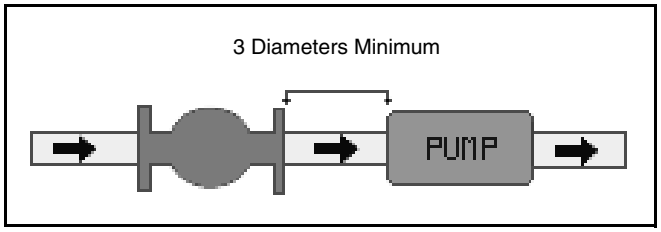


Figure 2-10 Avoiding a Vacuum Condition, Example One

For other liners, a vacuum condition can be averted by installing the flow tube on the positive pressure side of a pump (downstream from the pump). The pump should be a minimum of 20 pipe diameters upstream (Figure 2-11).

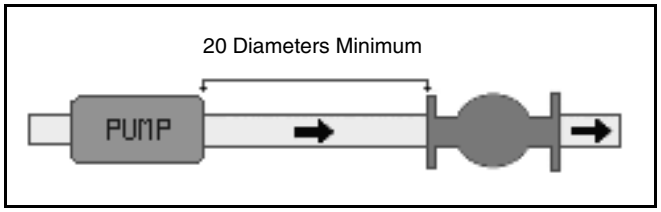


Figure 2-11 Avoiding a Vacuum Condition, Example Two

A vacuum condition can also be avoided by limiting vertical falling pipes downstream of the flow tube to a maximum of 16 feet (5 m) water column of vacuum (Figure 2-12). If this is unavoidable, a vacuum relief valve is then recommended downstream from the flow tube.

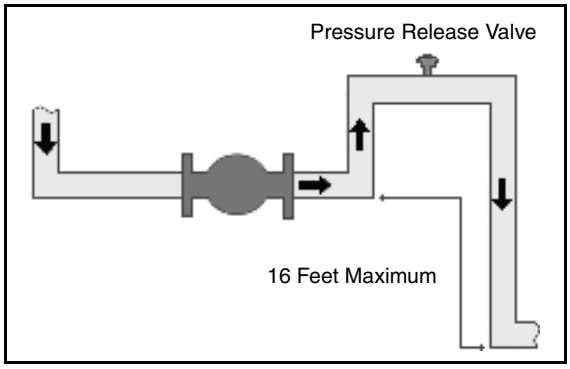


Figure 2-12 Avoiding a Vacuum Condition, Example Three

2.5.10 ChemMag Installation

The ChemMag flow tubes installed in all pipe configurations require 5 pipe diameters of straight pipe upstream and 2 downstream. However, an upstream pump requires 20 pipe diameters upstream of the ChemMag. A downstream pump requires 5 diameters.

Care must be taken to insure there is no entrained gas in the media, particularly on these smaller sizes. If this is unavoidable a positive error will result, which can possibly be compensated by the alteration of the “R-Factor” in the transmitter (see separate instructions).

The ChemMag may be mounted in any attitude.

2.6 Grounding

UniMags and ChemMags are equipped with grounding electrodes. As such they may be installed in adjacent pipes that are lined with electrically insulating material or made from plastic or similar materials, normally without any further grounding requirements.

However, in the rare event that unequal potentials occur between the pipeline and the flow tube cable shielding, and the transmission distance between the flow tube and the transmitter is greater than 100 feet (30 m), it may be necessary to install grounding rings between the flow tube and the adjacent pipe flanges (Figure 2-13), particularly if the flow tube has all plastic flow tubes and end connectors. The grounding rings should have a thickness of not less than 0.1" (2.5 mm), with a connection tab wired to a bolt on the underside of the UniMag junction box, or to terminal 26 of the transmitter in the case of ChemMags.

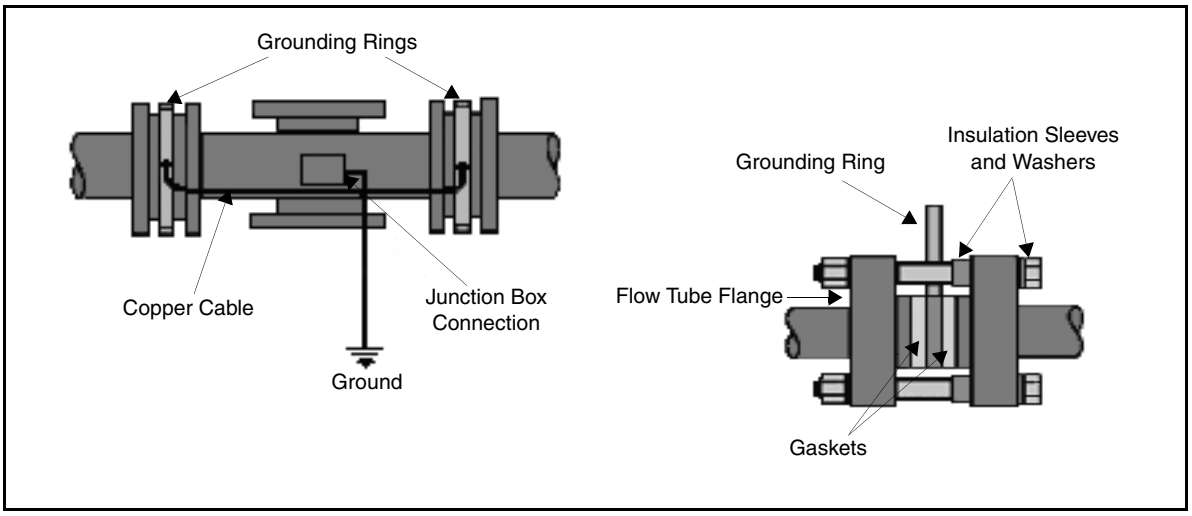


Figure 2-13 Grounding Rings

2.6.1 Cathodic-Protected Pipes

Cathodic-protected pipes are normally insulated on the outside and inside, so that the media inside the pipe is not grounded. When the flow tube is installed in cathodic-protected pipe it is necessary to install it with insulated grounding rings immediately upstream and downstream of the flow tube. The flange bolts must be insulated and the cathodic protection current must bypass the flow tube (Figure 2-14).

The grounding rings are connected to one of the bolts on the underside of the junction box of the UniMag, or to terminal 26 of the transmitter in the case of ChemMag.

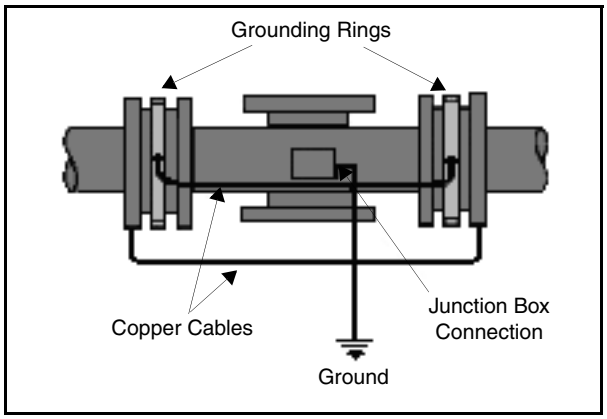


Figure 2-14 Grounding Rings for Cathodic-Protected Pipes

☑ Note

The flow tube cable shield and the media must be at the same potential.

Standard UniMag orders do not include grounding rings. Grounding rings must be ordered separately.

2.7 Cable Types

The flow tube is connected to the transmitter using two-wire shielded cables. There are 3 cables (optional 4) Beldon #8760 or 2 × 0.75mm^2, as shown in Table 2-2.

Note that the cables may be supplied as 1×4 core cable for the reference coils and exciter coils and 1×4 for the pre-amp and electrodes. The cable free ends are fitted with a shrink fitted shroud, not to be cut until immediately prior to installation.

☑ Note

FOR UNIMAGS AND CHEMMAGS IN EXPLOSIVE ATMOSPHERES USED WITH A 4412 IN A SAFE AREA: For Entela approval conforming to CENELEC Zone 2, EExnAX it is required that the reference coil and exciter coil cable are 4-core IEC approved cable through a single gland. This is normally supplied by Isco.

The cables are marked “coils,” “electrodes,” “pre-amp,” and “reference.” The cable colors are connected to the transmitter terminals as outlined in Table 2-2.

Table 2-2 Cable Connections

Exciter Coils	Electrodes	UniMag Pre-Amp	Reference
black to 4	black to 24	shield to 19	black to 31
white to 5	white to 25	black to 20	white to 32
shield to 6	shield to 26	white to 21	shield to 19
Note: IEC Hazardous Location cables may have other colors, but they will be labelled.			

The coils and electrodes of multiple sensors are connected in parallel in the junction box of the flow tube.

The pre-amp is an option for media conductivity < 0.5 µS/cm with UniMag flow tubes and are wired as described in the above table.

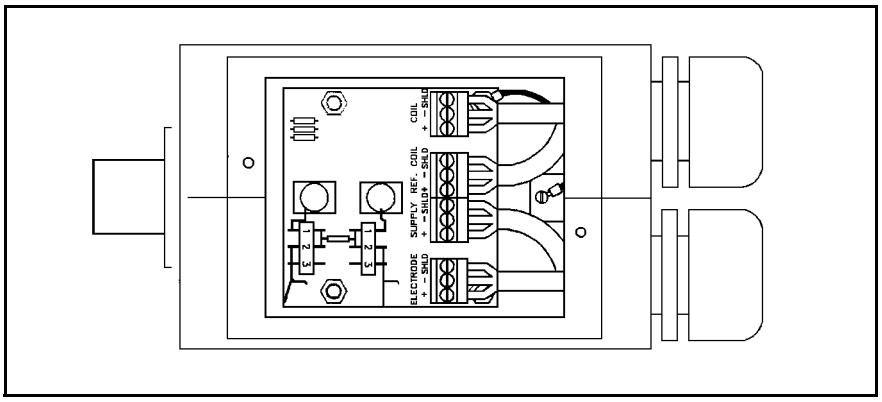


Figure 2-15 Cable Connections

When making cable connections, observe the following:

1. When the UniMag is used with a 4411 transmitter, the reference cables are omitted.
2. The cable shielding should not be cut more than 1" (25 mm) from the terminals.
3. The UniMag and ChemMag flow tubes are approved by Entela to CSA and UL standards for use in a Class 1, Division 2 explosive atmosphere, with the transmitter located in a safe area. It is a requirement of approval that rigid metal conduit or teck metal clad cable is used for the connection of the transmitter to the UniMag or ChemMag flow tube assembly. Conduit connectors Appleton type UNY50NR-A are supplied.
4. The UniMag and ChemMag must be completely potted with 3M re-enterable gel type 4442, when used in hazardous locations. See Section 2.8.5.

2.8 Cable Runs

⚠ CAUTION

NEMA 6 and IE68 submersible protected versions have their cables as pigtail leads already potted in the junction box (see note in Section 2.8.5). Any wiring in additional junction boxes for extended cable lengths must have the coil terminals separated from the electrode terminals or each individual cable must be braid-shielded. An aluminum or other metal shield must be placed between the coil and electrode terminals within the junction box.

2.8.1 Long Runs

Cables running greater than 30 feet (10 m) must have the electrode pair separated from the coil pair by at least 2 feet (0.5 m).

2.8.2 Multiple Runs

For cable runs from multiple flow tube sensors to the transmitter, multi-electrode cables may all run together in the same conduit, but separate from all other cables. Multi-coil cables may all run together in the same conduit, even with other power cables.

The maximum recommended distance for separate multiple runs is 150 feet (50 m) or ten times the media conductivity in feet, whichever is less. The multiple flow tubes and cable runs must be at least two feet (0.5 m) from each other (Figure 2-16).

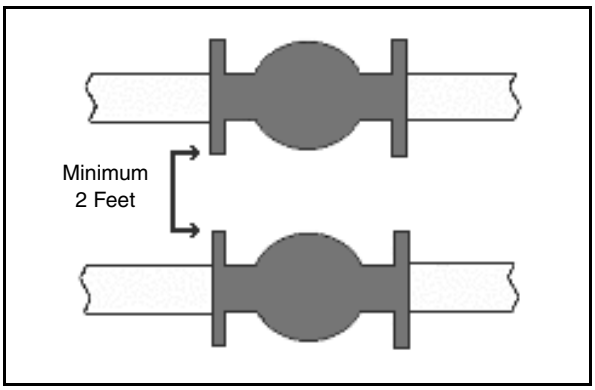


Figure 2-16 Multiple Runs

2.8.3 Media Conductivity

The maximum distance between single flow tube sensors and the transmitter depends on the media conductivity for the given recommended cable in Section 2.7.

For media conductivities that are greater than 3 micromhos/cm (microSiemens/cm), use the following distance:

- 300 feet or ten times the media conductivity (micromhos/cm) in feet, whichever is less.
- 90m or three times the media conductivity (micromhos/cm), whichever is less.

For conductivities < 3 micromhos/cm the maximum distance is 30 feet (9 m).

Most water-based media has a conductivity of 100-800 micromhos/cm. (Micromhos/cm = microSiemens/cm.)

2.8.4 NEMA 6 or IP68 Specifications

The cables from the flow tube junction box specified to NEMA 6 or IP68 have shrink-fit sleeves at their free ends. These are to prevent permeating the cables, which can cause a signal zero offset and instability.

⚠ CAUTION

It is important not to cut these sleeves off the cables during storage of the flow tube. Do not cut until immediately before wiring to the transmitter terminals or other cable extension joins for operation.

2.8.5 Junction Box Terminals and Wiring Identification

Should the junction box on the flow tube be installed to NEMA 4 specifications (non-standard) it must be wired as shown in Figure 2-17. NEMA 6 versions are readily wired and potted normally with a submersible removable gel.

⚠ CAUTION

Each individual cable must be braid-shielded. The cables must not be coiled within the junction box. The cables must run straight to the terminals and split not more than 1" (25 mm) from the terminal entries and exits.

☑ *Note*

The UniMag and ChemMag flow tubes are approved by Entela to CSA and UL standards for use in a Class 1, Division 2 explosive atmosphere, with the transmitter located in a safe area. It is a requirement of approval to CSA and UL standards that rigid conduit or Teck metal clad cable is used for the connection of the transmitter to the UniMag or ChemMag flow tube assembly. Metal ½” conduit connectors type UNY50NR-A are supplied in the flow tube junction box and UniPulse transmitters.

☑ *Note*

It is also a requirement of Class 1, Division 2 and CENELEC Zone 2 approval that the UniMag and ChemMag are completely potted with 3M “High Gel” type 4442 re-enterable compound, mixed 50% / 50%. The typical drying time is 2-3 hours, but it never solidifies hard. This gel must completely fill the space between the outside of the sensors and outer cover, the connection conduits from the sensor outer covers to the junction box and the junction box itself.

A wiring diagram for the UniMag junction box is shown in Figure 2-17 for your reference. Normally, the junction box is wired, potted, and sealed at the factory.

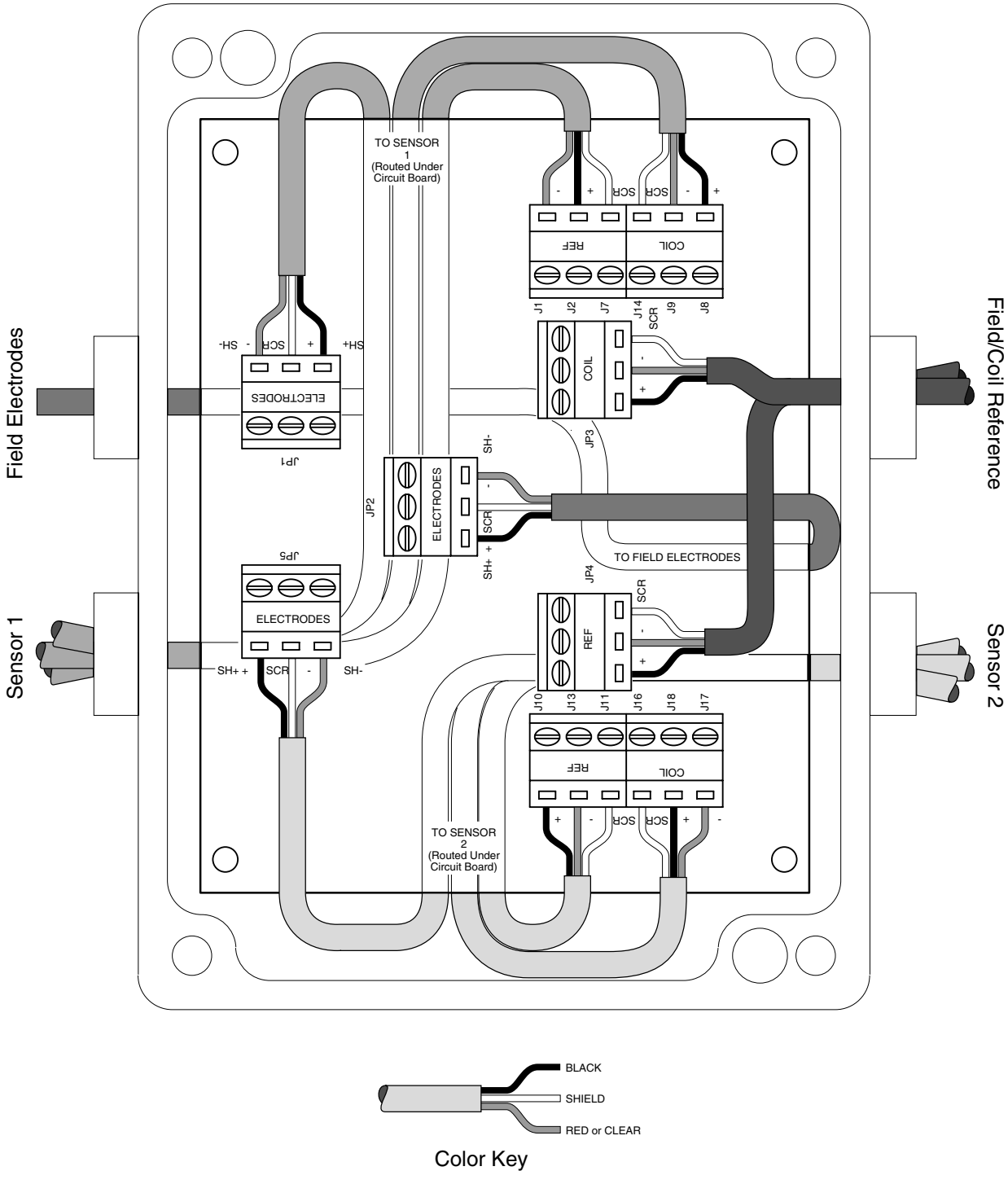


Figure 2-17 UniMag Junction Box Wiring Connections

UniMag and ChemMag

Section 3 Calibration Data

3.1 Calibration Factors

A calibration factor C appears on the flow tube nameplate. It is equated to a range factor R in the flow meter transmitter as follows:

$$R = \frac{100C}{\text{Range}}$$

where the range is full-scale in gallons per minute

$$R = \frac{22.73C}{\text{Range}}$$

where the range is full-scale in m^3/hr

The range factor R is determined to four figures and set digitally in the transmitter. Should a range change be required, then:

$$R_{new} = R_{old} \times \frac{\text{Range old}}{\text{Range New}}$$

If relevant, the pulse frequency output and totalizer scaling in the transmitter input must be changed accordingly (see appropriate transmitter instructions).

3.2 ChemMag and UniMag Simulation

For use with pulsed DC 4401/4404 transmitters, the flow tubes may be simulated for bench testing using a coil resistance 8-10 Ohms, 15-250 mH. A resistor instead of a coil is not acceptable.

For use with UniPulse transmitters no flow meter simulation input is necessary. However, for checking for correct wiring, the sensor coils have the following resistances:

- 2" and 3" (50 and 80 mm) are approximately 20 Ohms per pair of coils (40 Ohms per sensor).
- 6" (150 mm) sensors are approximately 5 Ohms/pair (10 Ohms per sensor).
- 8" (200 mm) sensors are approximately 2.5 Ohms/pair (5 Ohms per sensor).
- 12" (300 mm) sensors are approximately 4 Ohms/pair (8 Ohms per sensor).
- The ChemMag coil is approximately 100 Ohms.
- Single sensor UniMag reference coils are 10 K Ohms and multiple sensor reference coils are 6.6 K Ohms.
- Make sure the cables are not damaged or moisture laden.

☑ Note

Multiple sensors are normally wired in parallel. However, 4 sensors are wired with 2 sensors in series, wired in parallel with the other 2 sensors in series.

☑ Note

Since zero, span and calibration diagnostics are available in the transmitters, an extra “calibration box” is not necessary.

UniMag and ChemMag

Section 4 Maintenance

4.1 Removal and Replacement of UniMag Sensors

When the sensors are placed in the standpipes of the flow tube, a vee notch in the sensor flange is mounted coincident with a center punch found on the standpipe flange. The point of the vee notch indicates the direction of flow and the vee is situated on the upstream side of the flow tube standpipe. This applies to both sensors, when diametrically opposite on the flow tube. The electrode's axis is then at 90 degrees to the flow stream.

The new sensor is then retained with the existing outer retaining flange using a 1/16" thick gasket under the sensor flange and 1/8" thick gasket above the sensor flange. The sensor is then wired to the junction box.

Before installing the covers on the junction box and outer sensor retaining flange, the exposed cables must be potted for submersible duty using an epoxy (not silicone rubber), or preferably a "re-enterable" encapsulant. The "re-enterable" encapsulant is removable. We recommend 3M's "High Gel" Type 4442 re-enterable compound in a 6 kg size, mixed 50/50%, with a typical drying time of 2-3 hours.

> ☑ ***Note***
>
> For use in explosive atmospheres see the important note in Section 2.8.5.

The sensor retainer flanges should be tightened in diagonal sequence to a torque of 40 foot-lbs (5.5 m.kg or 55 N.m) for metal flanges.

For PVC flanges, the torque is as follows:

Table 4-1 Torque Specifications

Flange Size	Torque		
2" - 4" (50-100 mm)	25 ft.lb	3.5 m Kg	35 N.m
6" - 8" (150-200 mm)	40 ft.lb	5.5 m Kg	55 N.m
10" (250 mm)	60 ft.lb	8.5 m Kg	85 N.m
12" (300 mm)	80 ft.lb	11 m Kg	10 N.m

4.2 UniMag Components

The illustration below identifies the different components of the UniMag.

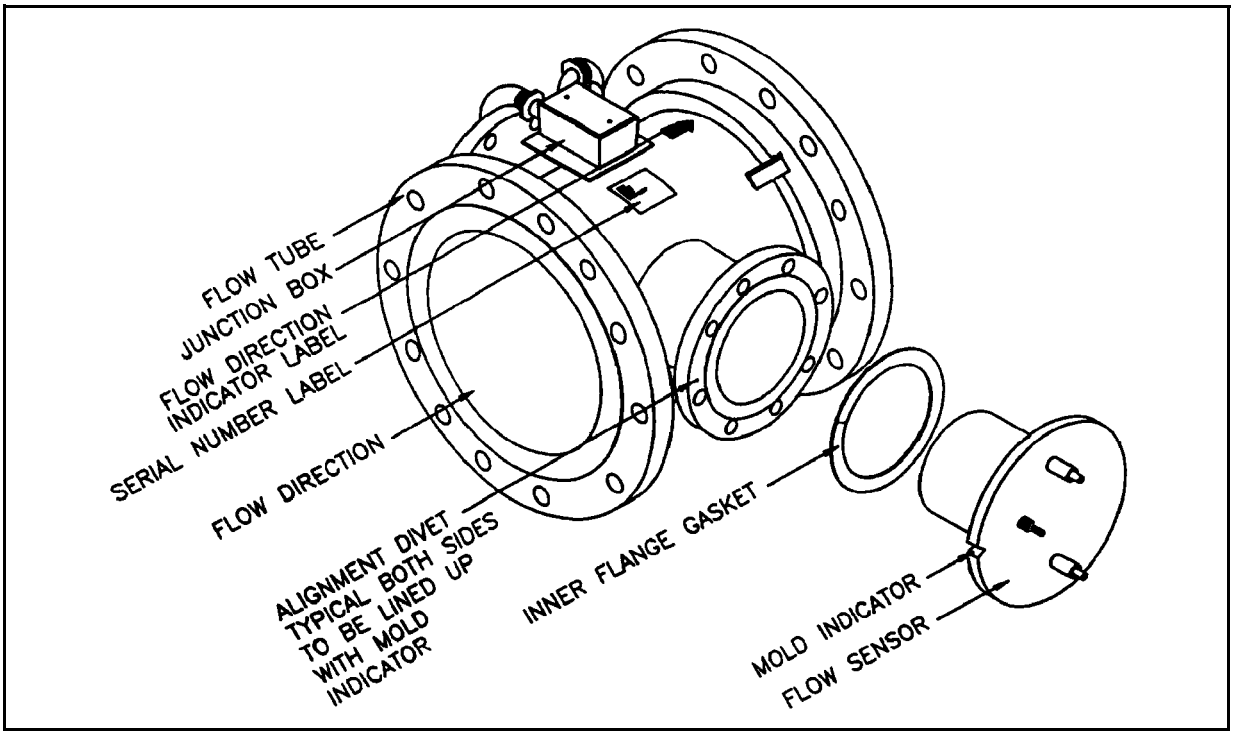


Figure 4-1 UniMag Components

> **☑ Note**
>
> For Entela approval to UL and CSA standards for location in Class 1. Division 2 and CENELEC Zone 2 explosive atmosphere, see notes in Section 2.8.5.

4.3 Fault Finding

With the flow tube connected to the transmitter, check for zero and span in accordance with the appropriate transmitter instructions. This confirms whether an electrical fault or leak into the flow tube has occurred. If zero or span has significantly deviated, then determine whether the flow tube or transmitter is at fault. Note that bad grounding will not affect the zero and span electrical test.

4.3.1 Flow Tube Coil Check

Check the flow tube coils by removing the cables from the transmitter terminals. The resistance between the shield (terminal 6) and coil (terminal 4 or 5) should be a minimum of 10 Meg Ohms. If it is significantly less, the media has penetrated the flow tube internals.

The coil terminals should have a resistance as stated below. If these tests are unsatisfactory, the ChemMag or the sensor(s) of the UniMag must be replaced, unless they can be dried out.

Sensor coils have the following resistances:

- 2" and 3" (50 and 80 mm) are approximately 20 Ohms per pair of coils (40 Ohms per sensor).
- 6" (150 mm) sensors are approximately 5 Ohms/pair (10 Ohms per sensor).
- 8" (200 mm) sensors are approximately 2.5 Ohms/pair (5 Ohms per sensor).
- 12" (300 mm) sensors are approximately 4 Ohms/pair (8 Ohms per sensor).
- The ChemMag coil is approximately 100 Ohms.
- Single sensor UniMag reference coils are 10 K Ohms and multiple sensor reference coils are 6.6 K Ohms.

Electrode resistance readings should be:

Black - White > 100 K

White - Shield > 100 K

Black - Shield > 100 K

The reference coils should have the following readings:

Black - White 10-20 K Ohms

White - Shield > 100 K

Black - Shield > 100 K

Should the flow tube prove acceptable, but the zero and span test are still unacceptable, then the transmitter is at fault.

Should the zero and span test prove satisfactory, but in operation an erratic signal is obtained, the most common fault is a non-full pipe, where at least one electrode is uncovered. Check all terminal connections and wiring layout and make sure the flow tube is correctly grounded. If all is satisfactory, then check pipe work against the mounting recommendations in Section 2.5 and make sure the flow tube is full.

4.4 Other Fault Symptoms:

The following list describes other fault symptoms and instructions on how to resolve the problem. Additional troubleshooting guidance is provided in Table 4-2.

a. **Incorrect flow direction.** Change over electrode terminals 24 and 25 in the junction box or incoming at the transmitter terminals. Take note of the flow direction arrow on the flow tube.

b. **Indicated flow is half the expected flow.** One or more of the electrodes are being grounded or are open-circuited. If the electrodes are covered with media, check each electrode resistance to ground 6. Each should be between 100K- 5 Meg Ohms and approximately equal. If any electrode is significantly different, it has an open or broken electrode lead.

Similarly if the electrodes are not covered with media, each electrode resistance to ground must be greater than 10 Meg Ohms.

c. **Media conductivity too low.** This will result in erratic readings, particularly if media is of low conductivity and the distance between sensors and transmitter is too long.

d. **No flow indication.** Check piping condition, making sure any valves, actuators or positioners are correctly set. Check the flow direction.

e. **Signal or indication "swing."** If all of the symptoms above check satisfactorily then this will be due to pulsating flow. Dampen the signal in the transmitter. For extreme conditions requiring damping more than 60 seconds, consult Isco or nearest approved representative.

☑ *Note*

Should pulsating flow prevail and totals and/or 4-20mA control loop output be required, the UniPulse transmitter should be used as follows:

The UniPulse has separate damping on the rate indicator, so that the average rate is displayed. The pulse frequency output and totalizer, together with the isolated 4-20mA output should be un-dampened, or damped as little as possible, for best accuracy and to prevent "hunting" in the control loop. A proportional controller capable of fast time constant input from UniPulse should be selected.

f. **Erratic signal, especially with "walky talky" or variable frequency drive noise in the area of the flowmeter.** Normally UniMag and ChemMags are virtually immune to these effects. However, should the media be low conductivity and/or low velocity and/or distances > 50 feet (15m), particularly using plastic flow tubes in plastic piping and flow loops, the resultant erratic signal is likely due to unequal potentials in grounding. Normally the internal grounding electrodes are sufficient. But in extreme cases an extra grounding ring may be necessary, as described in Section 2.6.1.

g. **Signal/totals too high.** Possible non-full pipe. Check pipework configuration in Section. 2.5.

h. **Signal/totals too low.** Either 1) the long distance cables should be separated (see Section 2.7), or 2) the response time to slow - signal has not responded to relatively fast change flow rate conditions. Reduce damping to as fast as possible (see Note above).

Table 4-2 Troubleshooting Guide

Problem	Probable Cause
No Display or Totalizer	Check fuse F1, and battery on display.
Forward Span Test Goes to Zero	Check fuse F1. Check wire connections.
Fluctuating Flow Rate	Separate coil and electrode wires, isolate electrode from 4-20 ma cables. Ground coil and electrode shields are together. Check wire connections and wire location. Verify that the flow tube is full. Ground the flow tube.
Flow Rate is Incorrect	Check hydraulic zero, rate scale, range factor, or meter factor.
Low Flow Rate	Check the resistance between the shield and black/white wires.
Zero Flow Rate	Check the resistance of coil and electrode wires. Check meter factor and range factor. The coil fuse may be open. The coil wires may not be connected. Cycle the power. Check the flow direction.
No Flow Rate	Switch the black and white wires on the electrode.
No 40-200 mV Output at Test Point	Make sure either a wire or a 4-20 device is connected to the 4-20 ma output terminal strip.
Totalizer Counting Backwards	Press the reset button.

Notes

UniMag and ChemMag

Section 5 Specifications

5.1 Metal UniMag

The dimensions and weights for the metal UniMag are listed in the table below. Refer also to Figure 5-1.

For comprehensive specifications, see the appropriate separate product brochures.

Table 5-1 Metal UniMag Dimensions and Weights

Nominal Size		UniMag Sensor	Dimension L (Length)		Dimension W (Width)		Approximate Weight (Basic Type)	
Inches	mm	Type (Qty 2)	Inches	mm	Inches	mm	lb	kg
1 & 1½	25-40	UM2	12	305	13.10	332	48	22
2	50	UM2	10	254	13.05	332	43	20
2 ½	65	UM2	10	254	13.55	344	50	23
3	80	UM2	10	254	14.35	365	55	25
4	100	UM3	12	305	16.35	416	80	36
5	125	UM3	12	305	17.55	446	92	42
6	150	UM3	12	305	18.65	474	100	46
8	200	UM6	18	457	21.25	540	185	84
10	250	UM6	18	457	23.55	598	225	102
12	300	UM6	18	457	25.75	654	301	137
14	350	UM6	18	457	27.05	687	335	152
16	400	UM8	20	508	30.25	769	490	223
18	450	UM8	20	508	32.45	824	515	234
20	500	UM8	20	508	34.55	878	615	280
24	600	UM8	24	610	38.85	987	840	382
28	700	UM12	30	762	41.75	1061	980	445
30	760	UM12	30	762	43.85	1114	1280	580
32	800	UM12	30	762	46.05	1170	1310	595
36	900	UM12	30	762	50.25	1277	1625	740
42	1000	UM12	40	1016	56.45	1434	1980	900
48	1200	UM12	40	1016	62.55	1589	2210	1015
56	1400	UM12	48	1219	70.55	1792	2860	1300
60	1600	UM12	48	1219	78.65	1998	2930	1335
72	1800	UM12	48	1219	90.45	2218	3609	1633
80	2000	UM12	48	1219	98.45	2501	3898	1764

Notes: Plain ends without flanges suitable for pipe couplings may be supplied.
Lengths may be made to order.
For Non-Full Pipe Series, the above dimensions do not apply. See Non-Full Pipe Series Flow Meter Specifications.
Flow Meters 1" - 6" equipped with a sampling port have an L dimension of 15" (380 mm).

Dimensional drawings for the metal UniMag are shown below in Figure 5-1.

Note

For use in Class 1, Division 2 or Zone 2 explosive atmospheres, see Section 2.8.5.

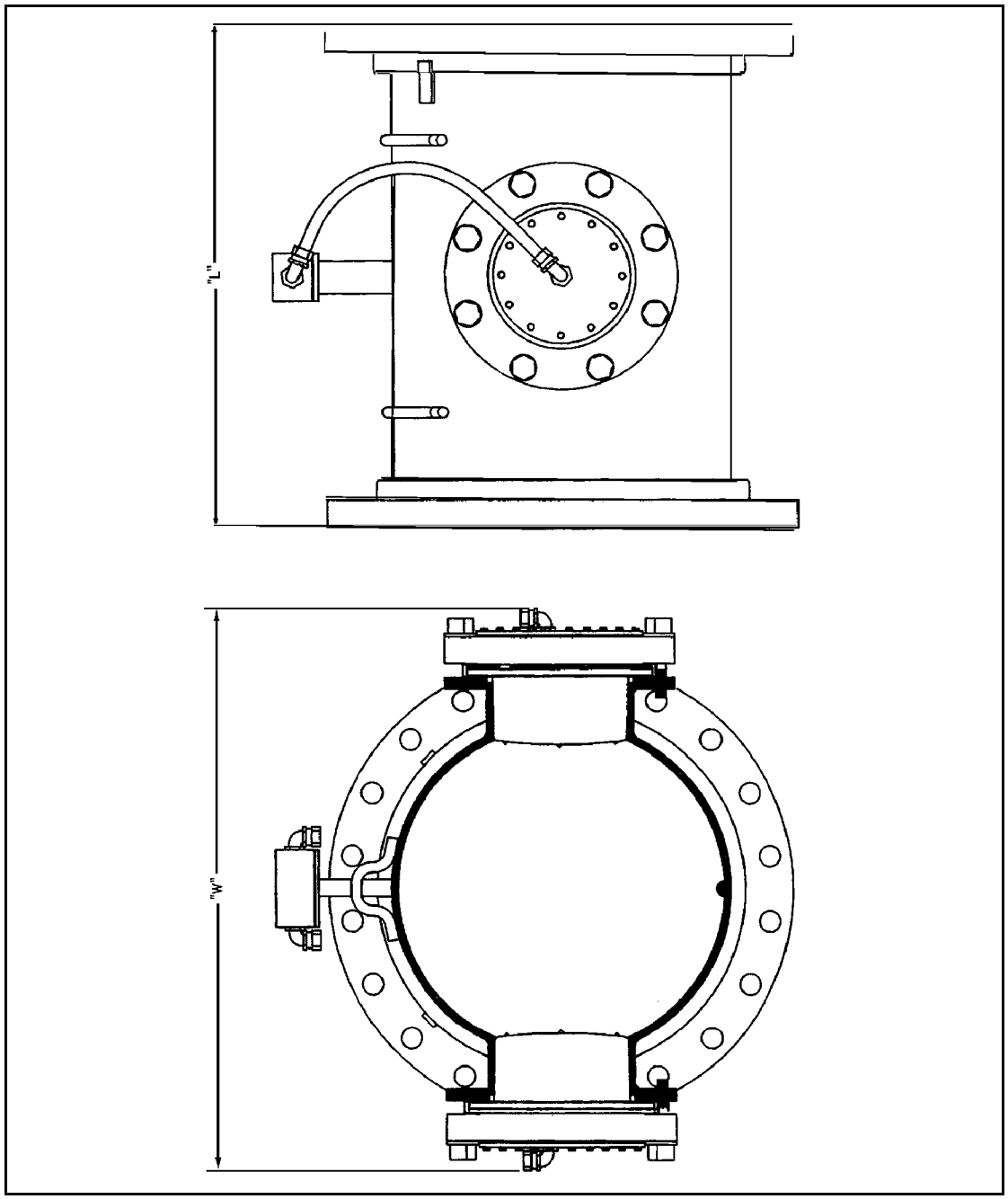


Figure 5-1 Dimensional Drawing for the Metal UniMag

5.1.1 Metal UniMag Ordering Code

See the ordering code in the separate data sheet.

5.1.2 Metal UniMag Maximum Pressure and Temperature

Refer to the table below for maximum pressure and temperature ratings for the metal UniMag.

Table 5-2 Metal UniMag Maximum Pressure and Temperature Ratings

Maximum Pressure	Polyurethane Sensors[1]	150 psig 10 bar g
	PVDF Sensors	356 psig 25 bar g
Maximum Temperature	Polyurethane[1]/Epoxy Enamel/Elastomer	175°F 80°C
	PVDF[3]/Tefzel[2]/No Liner	285°F 140°C
	Powder Coated Polyethylene	230°F 110°C
Protection	NEMA 4 and IP65 with unpotted 33 feet/10m cable pair	
	Submersible NEMA 6 and IP68 to 33 feet/10mwc with potted 33 feet/10m cable pair	

[1] For polyurethane sensors or liners, temperature differentials between inside and outside ambient of the flow tube is limited to 140°F (60°C). This maybe accomplished using thermal insulation on the outside of the flow tube.

[2] Do not use Tefzel with large abrasive solids. Use polyurethane or ceramic liners.

[3] PVDF at 285°F (140°C) is based on water. Various media may reduce this. Check manufacturer's recommendations.

⚠ WARNING

For use in hazardous locations, the maximum surface temperature must not exceed +275°F (+135°C), with a maximum ambient temperature of +104°F (+40°C).

5.2 UniMag PVC

The dimensions and weights for the UniMag PVC are listed in Table 5-3. Refer also to Figure 5-2.

For comprehensive specifications, see the appropriate separate product brochures.

⚠ WARNING

The UniMag PVC is not for use in explosive atmospheres.

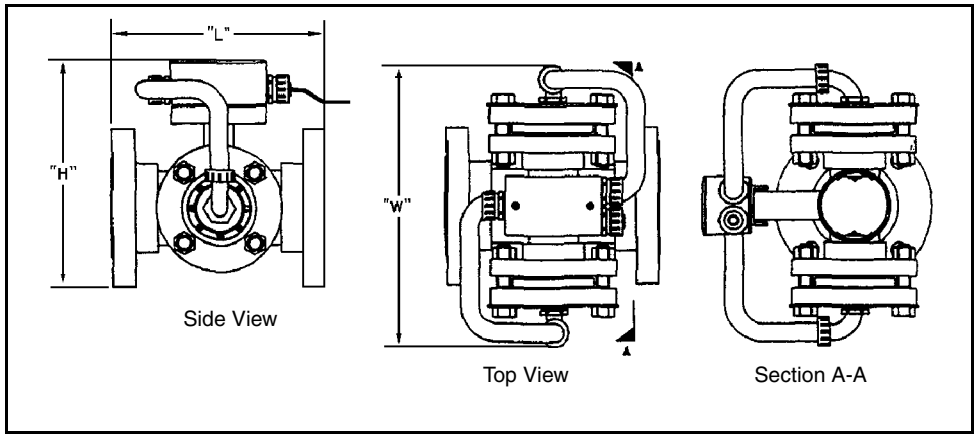


Figure 5-2 Dimensional Drawings for UniMag PVC

Table 5-3 UniMag PVC Dimensions and Weights

Nominal Size		Dimensions						Weight (flanged)		Weight (flanged)	
		Length (L)		Height (H)		Width (W)		Double Sensors		Single Sensors	
Inches	mm	Inches	mm	Inches	mm	Inches	mm	Pound	kg	Pound	kg
2	50	10	254	10	254	12	305	14	6.4	10	4.5
2	65	10	254	11	279	13	330	16	7.3	11	5.0
3	80	11	279	11	279	13.5	343	18	8.2	12	5.4
4	100	12	305	12	305	16	406	25	11.4	17	7.7
6	150	12	305	14	356	17	432	32	14.5	22	10.0
8	200	18	457	16	406	18	457	58	26.0	40	18.0
10	250	18	457	19	483	25	635	72	33.0	48	21.8
12	300	20	508	22	559	26	660	95	43.0	65	29.5

Note: For single sensor flow meters, the W dimension (width) is reduced by 2.5" (63 mm).

5.2.1 UniMag PVC Ordering Code

See the ordering code in the separate data sheet.

5.2.2 UniMag PVC Maximum Pressure and Temperature

Refer to the table below for maximum pressure and temperature ratings for the UniMag PVC .

Table 5-4 UniMag PVC Maximum Pressure and Temperature Ratings

	Temperature		Maximum Pressure	
	°F	°C	psig	bar gauge
Maximum Pressure and Temperature for PVC	85 105 140	30 40 60	80 60 15	5.5 4.0 1.0

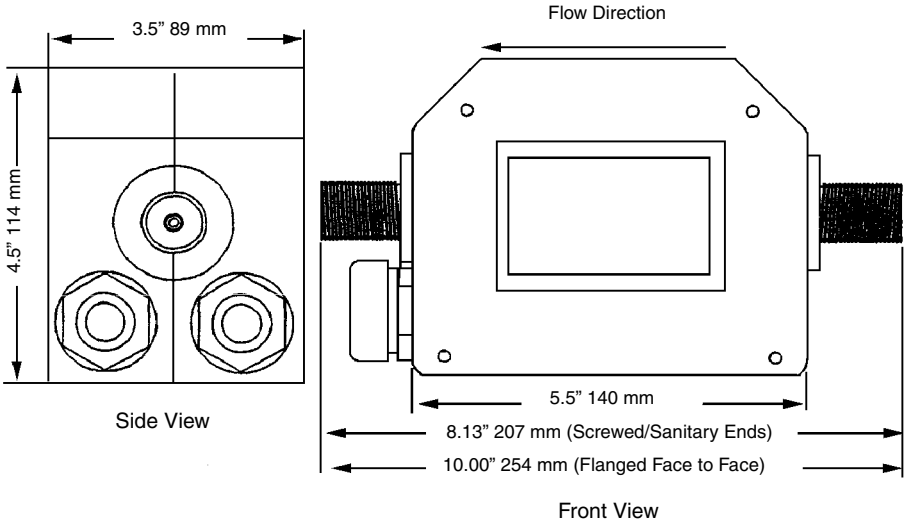
5.3 ChemMag

The dimensions and weights for the ChemMag are listed in Table 5-5. Refer also to Figures 5-3 and 5-4.

For comprehensive specifications, see the appropriate separate product brochures.

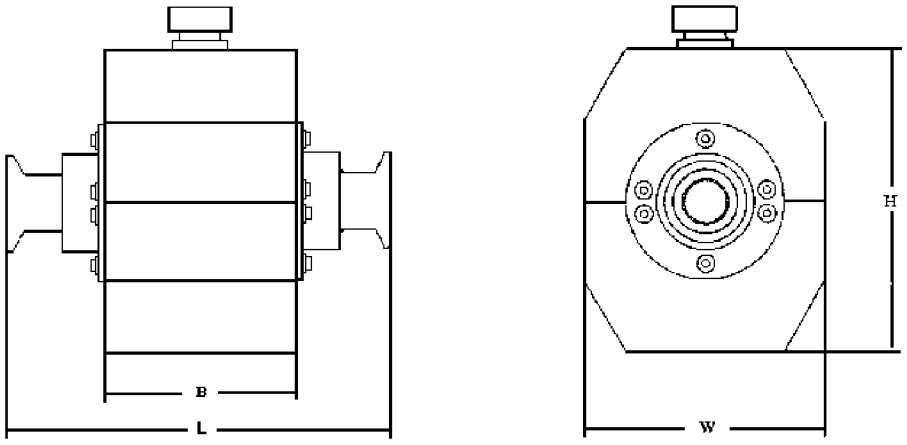
⚠ WARNING

For use in hazardous locations, see Section 2.8.5.



ChemMag 1/16” - 1/2” , 12 lb. (2 - 12 mm, 5.5 kg)

Figure 5-3 ChemMag Dimensions and Weight



ChemMag 3/4” - 11/2” , 12 lb. (20 - 40 mm, 5.5 kg

Part Number	Nominal Size	L	B	W	H	Weights (Flanged) lb	kg
UCA7	0.75’ (20mm)	7.87’ (200 mm)	3.92’ (100 mm)	5.00’ (125 mm)	6.30’ (160 mm)	13	6
UC01	1’ (25 mm)	7.87’ (200 mm)	3.92’ (100 mm)	5.00’ (125 mm)	6.30’ (160 mm)	18	8
UC15	1.5’ (40 mm)	7.87’ (200 mm)	3.92’ (100 mm)	5.50’ (138 mm)	7.00’ (175 mm)	26	12

Figure 5-4 ChemMag Dimensions and Weights

5.3.1 ChemMag Ordering Code

See the ordering code in the separate data sheet.

5.3.2 ChemMag Maximum Pressure and Temperature

Refer to the table below for maximum pressure and temperature ratings for the ChemMag.

Table 5-5 ChemMag Maximum Pressure and Temperature Ratings

Part	Maximum Temperature	Maximum Pressure
Ceramic Flow Tube	285°F (140°C)	150 psi (10 bar)
PVDF Parts *The PVDF ratings are based on water.*	250°F (120°C) at 40 psi (3 bar)	150 psi (10 bar) at 70°F (20°C)
316 Stainless Steel or Fusion Bonded Teflon (Tefzel) on 316 Stainless Steel Flow Tubes	300°F (150°C)	150 psi (10 bar)

Note: The pressure and temperature relationship is provided as a guide. We cannot guarantee that material strength is unaffected by media, mixtures, or excessive vibration. These and other factors may alter the material strength. Check manufacturers' recommendations.

⚠ WARNING

For use in hazardous locations, the maximum surface temperature must not exceed +275°F (+135°C), with a maximum ambient temperature of +104°F (+40°C).

UniMag and ChemMag

Section 6 Spare Parts and Accessories

6.1 UniMag Spares

The recommended spare parts for the UniMag sensor assembled in the flow tube in pairs are as follows:

A quantity of one (1) Calibrated UniMag sensor pair for up to 6 flow meters of each flow meter size (12 sensors over five years).

For single sensor flow meters only a single sensor is recommended as above.

> ☑ ***Note***
>
> Calibrated spare sensors are normally supplied at the time of original order in pairs for accuracy ±0.5% of rate >1.5 fps (0.45 m/s) or ±0.0075 fps (0.0025 m/s) for <1.5 fps. However, for a single new sensor used to replace one of a pair, the new calibration factor will be the exact average of the new and the existing sensors. (The range factor "'R" of a 4412 transmitter is calculated accordingly.) Re-calibration is not necessary. Accuracy of subsequently ordered spare sensors in an existing flow tube is typically better than ±1% of rate for > 2.0 fps (0.6 m/s) or ±0.02 fps (0.006 m/s) for < 2.0 fps.

6.2 ChemMag Spares

One spare ChemMag is recommended for up to six flow meters for each flow meter size.

6.3 Accessories

The following list includes parts that you may need while using a UniMag or ChemMag flow tube. Accessories can be purchased by contacting Isco's Customer Service Department.

Isco, Inc.
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3022

E-mail: info@isco.com

- Junction Box Refill Kit: P/N 500-000-013
- Isco sampler pacing uses the analog output with an Isco input interface (P/N 60-3704-075).

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Isco Limited Warranty *

For Isco Electromagnetic Flow Meters

Isco warrants its electromagnetic flow meters to be free from defects in material and workman-ship under normal use and service for the following periods from the date of purchase:

UniMag flow tubes only:	10 years
UniMag sensors:	5 years
ChemMags and WizMags:	1 year
4411 and 4412 transmitters:	2 years
4430 Flow Meter: (in non-full pipe system)	2 years

The customer must give notice of any defect to Isco within the warranty period, thoroughly sanitize the product, return the product intact, and prepay transportation charges. The obligation of Isco under this warranty is limited to repair at its factory or replacement. This warranty shall not apply to any product which is repaired or altered outside of the Isco factory without authorization by Isco, or which has been subject to misuse, negligence, accident, or incorrect wiring by others. This warranty applies only if the user has followed the application and installation recommendations set forth by Isco.

Note: (1) Isco may recommend materials that come in contact with the media; however, Isco does not guarantee their compatibility for any specific application. The customer, in the end, is responsible for compatibility of all solutions that will come in contact with the flow tubes and sensors. (2) For accuracy of calibrated spare UniMag sensors, see Recommended Spare Parts in the UniMag Instruction Manual, or consult Isco.

This warranty is expressly in lieu of all other warranties and obligations and Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose. Any changes in this warranty must be in writing and signed by a corporate officer.

The warrantor is Isco, Inc. 4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to USA customers. Customers in other countries should contact their Isco dealer for warranty service.**

In the event of problems with an Isco electromagnetic flow meter, the first step should be to contact the Isco Service Department at the toll-free Repair Service number (800) 228-4373. Many problems can be diagnosed and corrected over the phone, or by e-mail, more quickly than by an on-site service call. Before returning a product, contact Isco for a Return Authorization Number (RAN#) and shipping instructions.

Phone: Repair service: (800) 228-4373 (**samplers and flow meters**)
Sales & General Information (800) 228-4373 (USA and Canada)

E-mail: service@isco.com **Web site:** www.isco.com

Fax: (402) 465-3001

Shipping Address: Isco, Inc. - Attention Repair Service
4700 Superior Street
Lincoln NE 68504 USA

Mailing address: Isco, Inc.
PO Box 82531
Lincoln NE 68501 USA

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