TIENet® Barrier

Installation Guide

TELEDYNE ISCO
Everywhereyoulook™

Part #60-4803-079

Rev. C, August 2023

Foreword - Water and Wastewater Products

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

Although Teledyne ISCO designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If a problem persists, call or e-mail Teledyne ISCO technical support for assistance. Simple difficulties can often be diagnosed over the phone. For faster service, please have your serial number ready.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by technical support, including the use of the Return Merchandise Authorization (RMA) specified. Be sure to include a note describing the malfunction. This will aid in the prompt repair and return of the equipment. **No item may be returned for service without a Return Merchandise Authorization (RMA) number issued by Teledyne.**

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

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

Contact Information

Customer Service

Phone:	(800) 228-4373	(USA, Canada, Mexico)
	(402) 464-0231	(Outside North America)
Fax:	(402) 465-3022	
Email:	isco.orders@teledyne.com	

Technical Support

Phone:	Toll Free (866) 298-6174 (Samplers and flowmeters)
Email:	iscowatersupport@Teledyne.com
Return equipment to:	4700 Superior Street, Lincoln, NE 68504-1398

Other Correspondence

Mail to:	P.O. Box 82531, Lincoln, NE 68501-2531

Warranty and Operation Manuals can be found on our website at:

www.teledyneisco.com

⚠ DANGER

The TIENet Barrier MUST be installed in accordance with control drawing 60-4362-096, in Figure 2-1 in this manual, and in accordance with the requirements of the authority that has jurisdiction for the installation of equipment in hazardous areas at your specific installation site.

The certified control drawing details the only approved method of installing the TIENet Barrier. Where specific ISCO part numbers appear, they represent the only approved equipment certified to be used with the TIENet Barrier. Any equipment substitutions or installations not specifically detailed on the control drawing will automatically void the intrinsically safe certification of the TIENet Barrier and could result in fire or explosion!

Hazard Symbols

This manual uses symbols to warn of hazards. The symbols are explained below.

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
Advertencias y Precauciones	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

⚠ CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

⚠ WARNING

Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

⚠ DANGER

Danger is limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.

General Warnings

Before installing, operating, or maintaining the TIENet Barrier, it is imperative that all hazards and preventive measures are understood. Be sure to read all safety information contained in this manual, in addition to the installation instructions in Section 2.

While specific hazards may vary according to location and application, take heed of the following general warnings:

⚠ WARNING

Avoid hazardous practices! If you use these instruments in any way not specified in this manual, the protection provided by the instruments may be impaired; this will increase your risk of injury.

⚠ AVERTISSEMENT

Eviter les manipulations hasardeuses! Si vous utilisez ces appareils de façon non conforme au mode d'emploi, vous risquez des blessuresgraves .

⚠ WARNING

The installation and use of this product may subject you to hazardous working conditions that can cause you serious or fatal injuries. Take any necessary precautions before entering a worksite. Install and operate this product in accordance with all applicable safety and health regulations, and local ordinances.

⚠ AVERTISSEMENT

L'installation de ces instruments peut vous entrainer à travailler dans des conditions précaires et risquées pouvant entrainer de graves blessures.Veuillez respecter toutes les conditions requises de sécurité avant de pénétrer dans un regard ou sur le site concerné. Installer et manipuler l'instrument selon les règles ou la législation en vigueur concernant la sécurité et la protection des individus.

TIENet® Barrier

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TIENet® Barrier

Section 1 Introduction

1.1 Product Description

The TIENet Barrier provides intrinsically safe power to, and intrinsically safe communications with, TIENet devices in Class I, Div. 1, Zone 0, IIB hazardous classified locations. It is designed for permanent installation in a safe area and is intended to be powered by a UL Listed, Class 2, limited energy power source.

The concept of intrinsic safety is to limit the energy available to a given circuit or device to a level where electrical discharge (sparking) cannot ignite the hazardous (flammable or explosive) atmosphere. With no spark ignition possible, safe operation of the equipment in areas with hazardous atmospheres is possible.

1.2 Technical Specifications

Table 1-1 TIENet Barrier Specifications

Size (HxWxD)	3.82 × 3.46 × 0.73 inches (9.7 × 8.8 × 18.5 cm)
Weight	0.7 lbs (0.32 kg)
Housing	Glass-filled Polycarbonate
Terminals	Chromated Steel
Power	8-18 VDC, 250 mA nominal (U_m = 20 V, UL60950 certified[a])
Serial Communications	19,200 baud, 8 bits, even parity, 1 stop bit
Operating Temperature	-40° to 140°F (-40° to 60°C)
Storage Temperature	-40° to 140° F (-40° to 60° C)

a. Class 2, limited energy power supply.

TIENet® Barrier

Section 2 Preparation and Installation

2.1 Unpacking Instructions

When the TIENet Barrier arrives, inspect the outside packing for any damage. Then carefully inspect the contents for damage. If there is damage, contact the delivery company and Teledyne ISCO (or its agent) immediately.

⚠ WARNING

If there is any evidence that any items may have been damaged in shipping, do not attempt to install the unit. Please contact Teledyne ISCO (or its agent) for advice.

When you unpack the system, check the items against the packing list. If any parts are missing, contact the delivery company and Teledyne ISCO's Customer Service Department. When you report missing part(s), please indicate them by part number. In addition to the main packing list, there may be other packing lists for various sub-components.

It is recommended that you retain the shipping cartons as they can be reused to ship the unit in the event that it is necessary to.

Please complete the registration card and return it to Teledyne ISCO.

Teledyne ISCO
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone:(800) 228-4373
Outside USA & Canada call:
(402) 464-0231

FAX: (402) 465-3022

E-mail:
iscowatersupport@teledyne.com

2.2 Preparing for Installation

This equipment is intended to be installed on a DIN rail in an unclassified area with output going to a Class I, Div. 1; or Class I, Zone 0, IIB hazardous location. The equipment MUST be installed according to the installation control drawing P/N 60-4362-096, shown in Figure 2-1, and the requirements of the authority having jurisdiction at the installation site.

⚠ WARNING

Avoid hazardous practices! If you use these instruments in any way not specified in this manual, the protection provided by the instruments may be impaired; this will increase your risk of injury.

⚠ WARNING

The installation and use of this product may subject you to hazardous working conditions that can cause you serious or fatal injuries. Take any necessary precautions before entering a worksite. Install and operate this product in accordance with all applicable safety and health regulations, and local ordinances.

2.3 Installing the TIENet Barrier

The following general steps may be used as a guide to install a Signature Flowmeter System, which includes a Signature Flow meter, a TIENet Barrier, and a LaserFlow Ex. (Your installation may include other Teledyne ISCO flow meters and/or various TIENet sensors.)

1. Install the LaserFlow Ex sensor above the flow stream.
2. Feed the sensor cable through the conduit to the equipment box.
3. Make the necessary wire and network connections to the TIENet Barrier. All screws should be tightened to a torque of 0.8 Nm. Mount the barrier on the DIN rail.
4. Power the system.
5. Program the Signature or 2160 to collect data from the LaserFlow Ex and store that data at your desired rate.

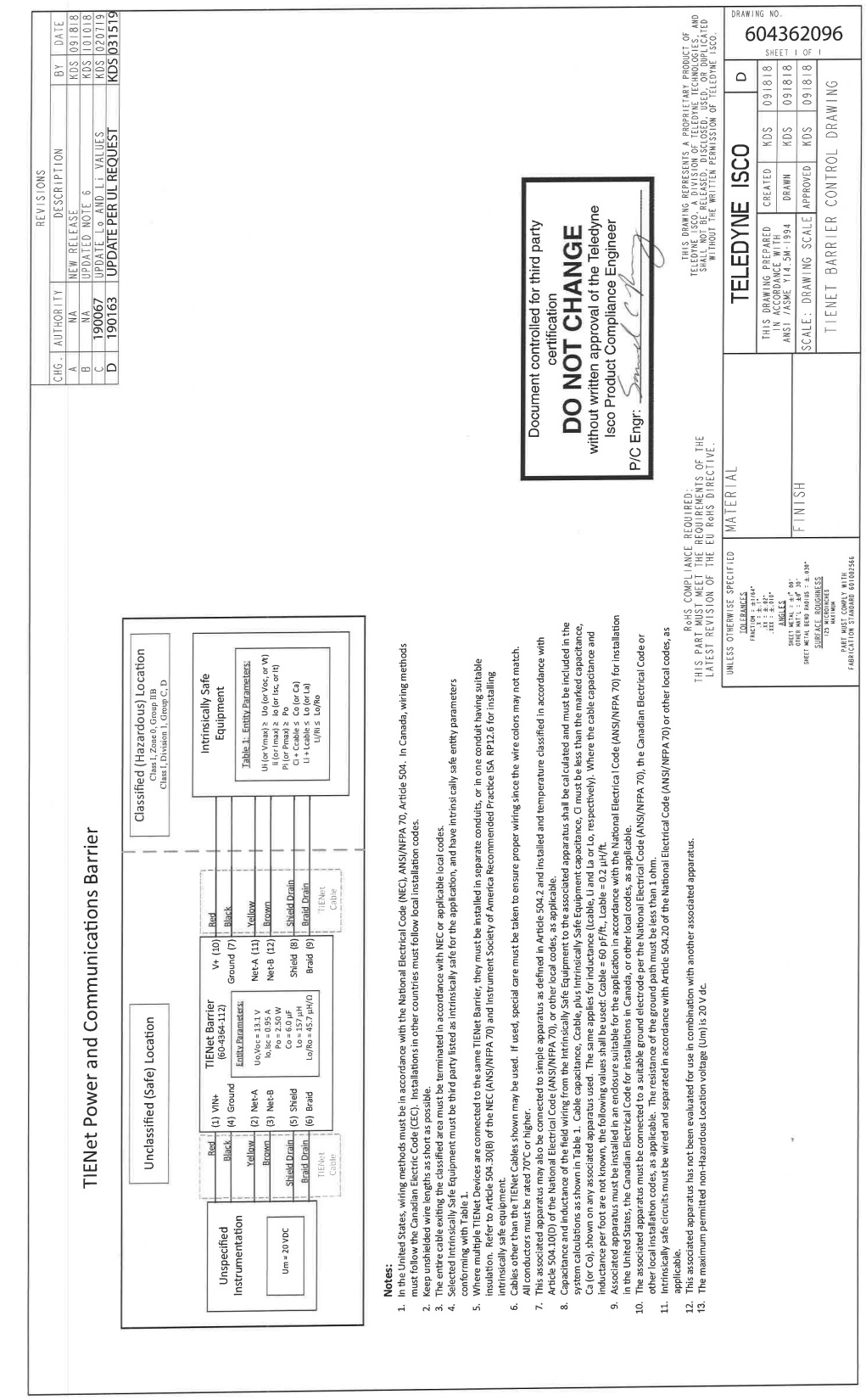


Figure 2-1 TIENet Power and Communications Barrier

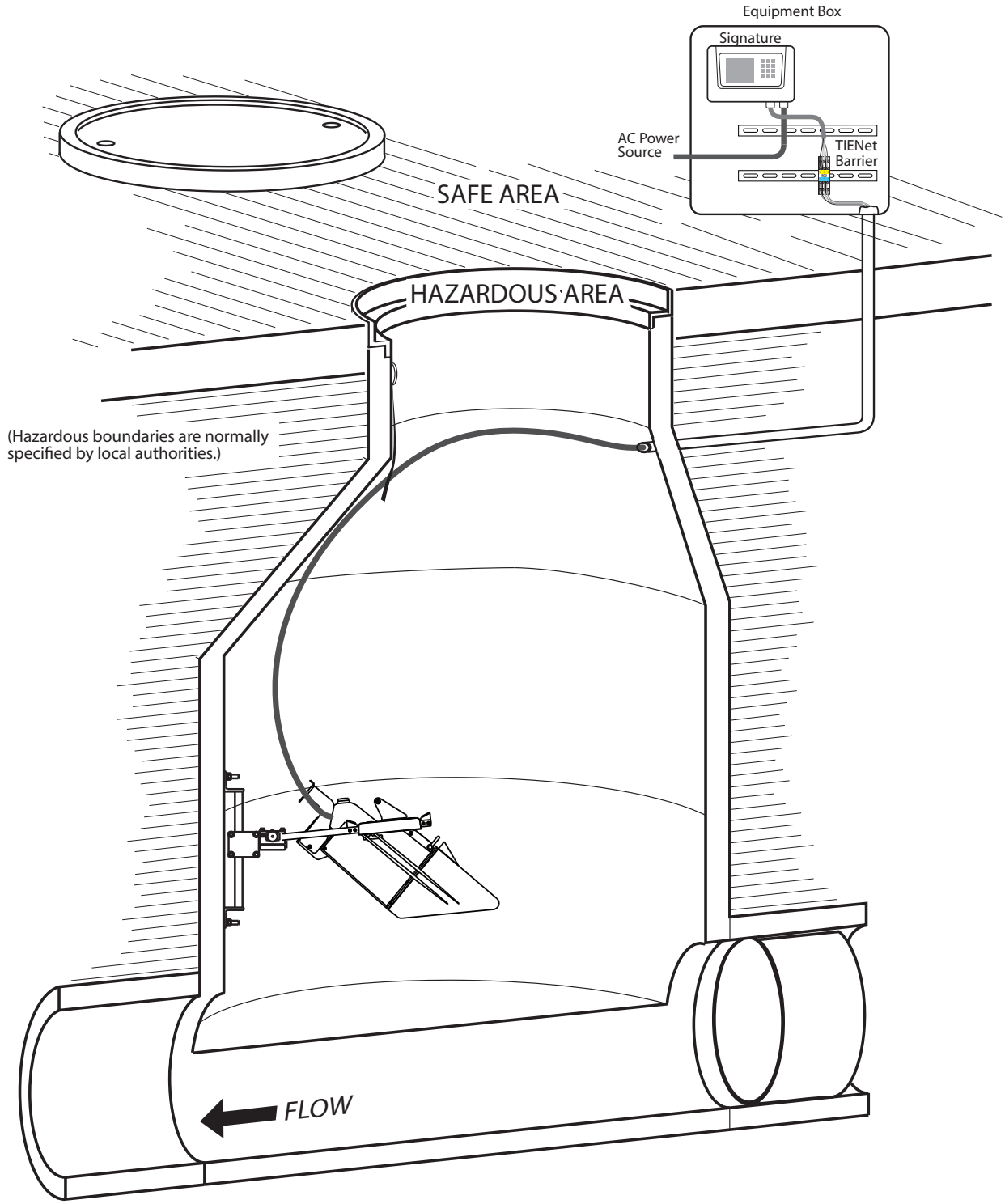
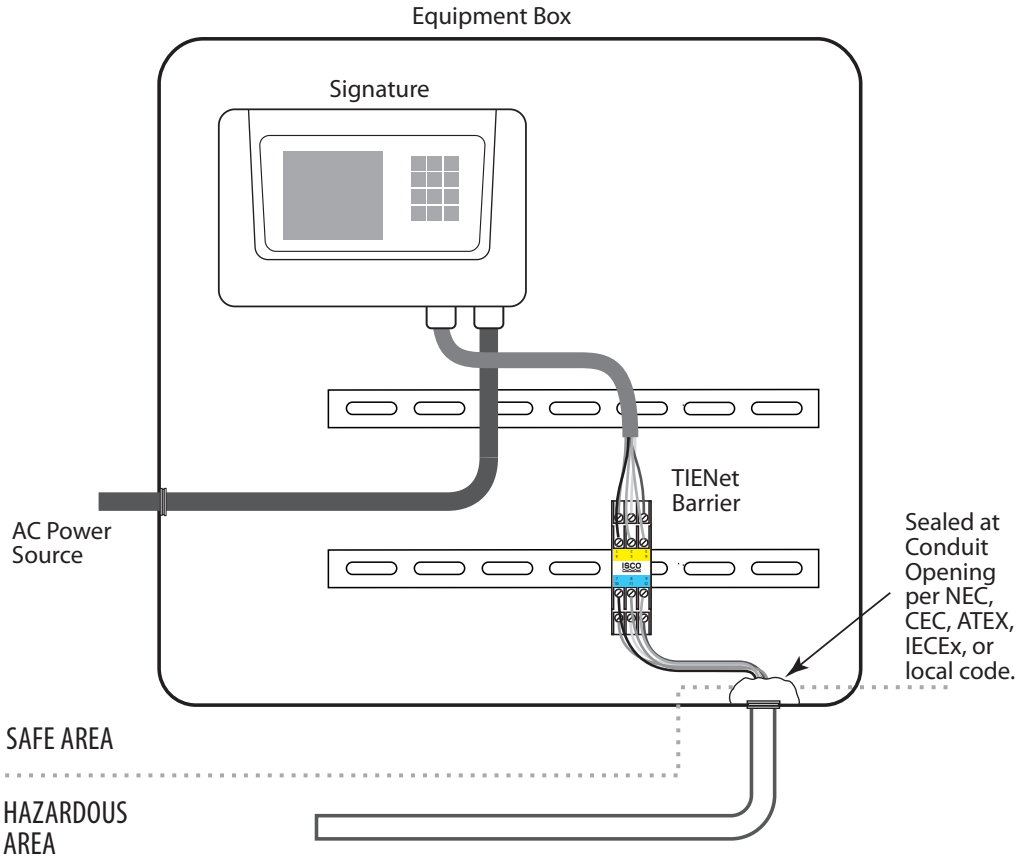
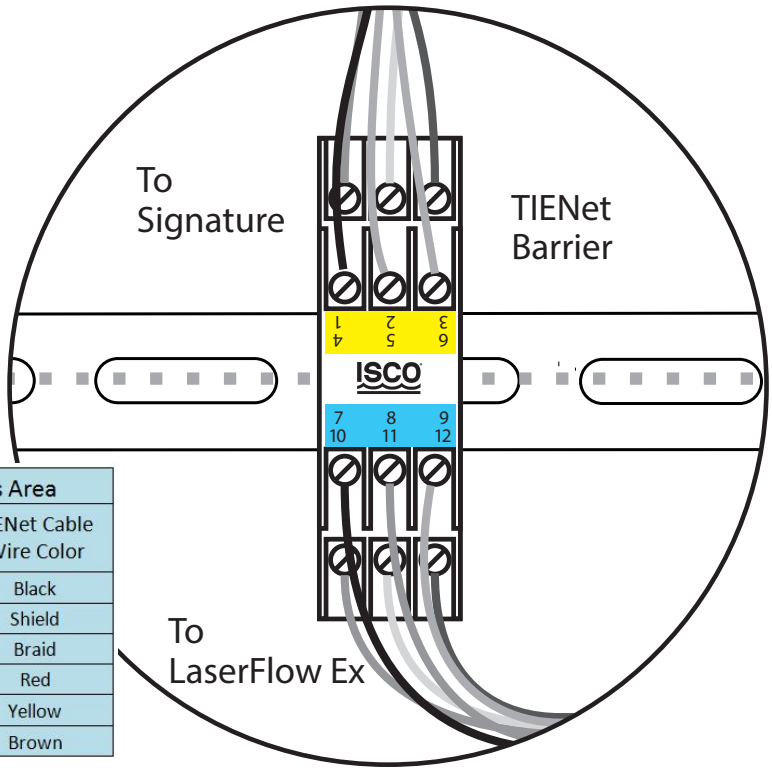


Figure 2-2 Typical Round-pipe Installation Signature, TIENet Barrier, and LaserFlow Ex

⚠ WARNING

All installations in areas that are rated as hazardous locations must conform to control drawing 60-4362-096.





Safe Area			Hazardous Area	
Terminal Number	TIENet Cable Wire Color		Terminal Number	TIENet Cable Wire Color
1	Red		7	Black
2	Yellow		8	Shield
3	Brown		9	Braid
4	Black		10	Red
5	Shield		11	Yellow
6	Braid		12	Brown

Figure 2-3 TIENet Barrier connections

The example in Figure 2-3 portrays a Signature, TIENet Barrier, with a LaserFlow Ex Sensor, along with associated cables. Your specific configuration may vary; if you have any questions concerning your specific site, contact a Teledyne ISCO service representative.

All installations in hazardous locations **must** conform to all applicable control drawings in addition to the requirements of the authority having jurisdiction over the installation site.

When installing the measurement system, keep the following points in mind:

Intrinsically Safe Wiring

Note in Figure 2-3 that the area below the dotted line contains intrinsically safe wiring (wiring that enters the hazardous area), which is connected to the intrinsically safe terminals of the TIENet barrier.

The intrinsically safe terminals are usually identified with light blue, and in our examples, are shown on the bottom of the TIENet barrier.

Generally, intrinsically safe wiring must leave or enter the safe (non-hazardous) area by the shortest, most direct route. If possible, equipment in the safe area should be located as close as possible to the hazardous location. This will minimize the length of intrinsically safe conductors within the safe area. Local electrical codes may dictate how intrinsically safe wiring should be routed; we recommend checking applicable local codes before installation.

Non-intrinsically Safe Wiring

Non-intrinsically safe wiring (wiring that is in the safe area only) must be kept separate from the intrinsically safe wiring and is connected to the non-intrinsically safe terminals of the TIENet Barrier.

In our example, the non-intrinsically safe terminals are located on the upper half of the TIENet Barrier. Non-intrinsically safe wiring should NEVER be connected to the intrinsically safe terminations of any associated equipment!

⚠ CAUTION

Intrinsically safe wiring MUST be separated from non-intrinsically safe wiring in order to prevent transfer of unsafe levels of energy to the hazardous area! Always follow National Electric Code (NEC) and Canadian Electric Code (CEC) guidelines, ATEX, and IECEx. See statement on DANGER warning on page-v.

Mounting Considerations

Because dust and moisture are conductive, equipment in the safe area should be mounted in an enclosure that is dust and moisture free. The panel layout should be constructed so that it allows adequate clearance between intrinsically safe and non-intrinsically safe wiring. As a safety measure, we

recommend a clearance distance of at least 2 inches (50 mm) between any intrinsically safe wiring and non-intrinsically safe wiring.

Raceways or plastic ties should be used to keep intrinsically safe and non-intrinsically safe wiring separated from each other. Identify intrinsically safe wiring with permanently attached labels that state the wiring is intrinsically safe.

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Appendix A Safety Information

A.1 Safety Considerations

In field installations of the TIENet Barrier and associated equipment, the safety of the personnel involved should be the foremost consideration. No project is so important or deadline so critical as to justify the risk of human life.

This section provides general safety procedures for working in and around manholes and sewers. Section A.2 offers general safety advice; Section A.3 deals with the special problem of poisonous gases found in sewers. For specific safety information concerning the installation of a TIENet Barrier, read Section 2 of this manual thoroughly!

A.2 Explosive Atmospheres

The TIENet Barrier has been designed to provide intrinsically safe power to, and allow for intrinsically safe communications with, devices in Class I, Div. 1, Zone 0 hazardous locations.

The concept of intrinsic safety is to limit the energy available to a given circuit or device to a level where electrical discharge (sparking) cannot ignite the hazardous (flammable or explosive) atmosphere. With no spark ignition possible, safe operation of the equipment in areas with hazardous atmospheres is possible.

⚠ CAUTION

The TIENet Barrier MUST be installed according to the TIENet Barrier installation control drawing (Teledyne ISCO P/N 60-4362-096) shown in Figures 2-1, and the instructions in Section 2 of this manual. You must also follow the requirements of the authority having jurisdiction for equipment installation in hazardous locations at your specific installation site.

Before any TIENet Barrier is installed, the proper safety precautions must be taken. The following discussions of safety procedures are only general guidelines that supplement the information found in Section 2 of this manual. Each situation in which you install a TIENet Barrier varies. You must take into account the individual circumstances you are in. Additional safety considerations, other than those discussed here, may be required.

A.3 General Safety Procedures

The following procedures are used by Black & Veatch, a respected consulting firm, and are published here with their permission:

1. **Hazards**. There are many hazards connected with entering manholes. Some of the most common hazards are:
   a. **Adverse Atmosphere**. The manhole may contain flammable or poisonous gases or the atmosphere may be deficient in oxygen. Forced ventilation may be necessary.
   b. **Deteriorated Rungs.** Manhole steps may be corroded and not strong enough to support a man. It may be difficult to inspect the rungs because of poor lighting.
   c. **Traffic.** Whenever manholes are located in the traveled way, barricades and warning devices are essential to direct traffic away from an open manhole.
   d. **Falling Object.** Items placed near the manhole opening may fall and injure a worker in the manhole.
   e. **Sharp Edges.** Sharp edges of items in or near a manhole may cause cuts and bruises.
   f. **Lifting Injuries.** Unless proper tools are used to remove manhole covers, back injuries or injuries to hands and feet may result.
2. **Planning.** Advance planning should include arrangements for test equipment, tools, ventilating equipment, protective clothing, traffic warning devices, ladders, safety harness, and adequate number of personnel. Hasty actions may result in serious injuries. Time spent in the manhole should be kept to a minimum.
3. **Adverse Atmosphere.** (Refer to the table on the following pages) before entering a manhole, tests should be made for explosive atmosphere, presence of hydrogen sulfide, and oxygen deficiency. Since combustible or toxic vapors may be heavier than air, the tests on the atmosphere must be run at least ¾ of the way down the manhole.

   Whenever adverse atmosphere is encountered, forced ventilation must be used to create safe conditions. After the ventilating equipment has been operated for a few minutes, the atmosphere in the manhole should be retested before anyone enters the manhole.

   When explosive conditions are encountered, the ventilating blower should be placed upwind to prevent igniting any gas that is emerging from the opening. When a gasoline engine blower is used, it must be located so that exhaust fumes cannot enter the manhole.

   If testing equipment is not available, the manhole should be assumed to contain an unsafe atmosphere and forced ventilation must be provided. It should never be assumed that a manhole is safe just because there is no odor or the manhole has been entered previously.
4. **Entering Manholes.** Since the top of the manhole is usually flush with the surrounding surface, there may not be

anything for the person who is entering the manhole to grab on to steady himself.

Persons who are entering manholes should not be permitted to carry anything in their hands as they enter the manhole, to ensure that their hands are free to hold on or grab if they slip. A good method for entering a manhole is to sit on the surface facing the manhole steps or ladder, with the feet in the hole and the arms straddling the opening for support. As the body slides forward and downward, the feet can engage a rung, and the back can rest against the opposite side of the opening. If there is any doubt about the soundness of the manhole steps, a portable ladder should be used.

A person should never enter a manhole unless he is wearing personal safety equipment, including a safety harness and hard hat. Two persons should be stationed at the surface continuously while anyone is working inside a manhole, to lift him out if he is overcome or injured. One man cannot lift an unconscious man out of a manhole.

The persons stationed at the surface should also function as guards to keep people and vehicles away from the manhole opening. To avoid a serious injury, a person should not be lifted out of a manhole by his arm unless it is a dire emergency.

When more than one person must enter a manhole, the first person should reach the bottom and step off the ladder before the second one starts down. When two men climb at the same time, the upper one can cause the lower one to fall by slipping or stepping on his fingers.

5. **Traffic Protection.** In addition to traffic cones, markers, warning signs, and barricades, a vehicle or heavy piece of equipment should be placed between the working area and oncoming traffic. Flashing warning signals should be used to alert drivers and pedestrians. Orange safety vests should be worn by personnel stationed at the surface when the manhole is located in a vehicular traffic area.
6. **Falling Object.** All loose items should be kept away from the manhole opening. This applies to hand tools as well as stones, gravel and other objects.
7. **Removing the Covers.** Manhole covers should be removed with a properly designed hook. Use of a pick ax, screwdriver, or small pry bar may result in injury. A suitable tool can be made from ¾ -inch round or hex stock. Two inches of one end should be bent at a right angle and the other end should be formed into a D-handle wide enough to accommodate both hands. Even with this tool, care must be exercised to prevent the cover from being dropped on the toes. The two inch projection should be inserted into one of the holes of the cover, the handle

grasped with both hands, and the cover lifted by straightening the legs, which have been slightly bent at the knees.

8. **Other Precautions.** Other precautions that should be taken when entering a manhole are:

- Wear a hard hat.
- Wear coveralls or removable outer garment which can readily be removed when the work is completed.
- Wear boots or nonsparking safety shoes.
- Wear rubberized or waterproof gloves.
- Wear a safety harness with a stout rope attached.
- Do not smoke.
- Avoid touching yourself above the collar until you have cleaned your hands.

9. **Emergencies.** Every member of the crew should be instructed on procedures to be followed in cases of an emergency. It is the duty of each crew chief to have a list of emergency phone numbers, including the nearest hospital and ambulance service, police precinct, fire station, and rescue or general emergency number.

10. **Field Equipment.** The following equipment will be available for use:

- Blowers
- Breathing Apparatus
- Coveralls
- Emergency Flashers
- First Aid Kits
- Flashlights
- Gas Detectors
- Gas Masks
- Gloves
- Hard Hats
- Harnesses
- Manhole Irons
- Mirrors
- Pick Axes
- Rain Slickers
- Ropes
- Safety Vests
- Traffic Cones
- Waders

A.4 Lethal Atmospheres in Sewers

The following is an article written by Dr. Richard D. Pomeroy, and published in the October 1980 issue of ***Deeds & Data*** of the WPCF. Dr. Pomeroy is particularly well known for his studies, over a period of nearly 50 years, in the field of the control of hydrogen sulfide and other odors in sewers and treatment plants.

He has personally worked in a great many functioning sewers. In the earlier years he did so, he admits, with little knowledge of the grave hazards to which he exposed himself.

"It is gratifying that the subject of hazards to people working in sewers is receiving much more attention than in past years, and good safety procedures are prescribed in various publications on this subject. It is essential that people know and use correct procedures.

It is less important to know just what the hazardous components of sewer atmospheres are, as safety precautions should in general be broadly applicable, but there should be a reasonable understanding of this subject. It is disturbing to see statements in print that do not reflect true conditions.

One of the most common errors is the assumption that people have died from a lack of oxygen. The human body is able to function very well with substantially reduced oxygen concentrations. No one worries about going to Santa Fe, New Mexico, (elev. 2100 m), where the partial pressure of oxygen is equal to 16.2 percent (a normal atmosphere is about 21 percent) oxygen. When first going there, a person may experience a little 'shortness of breath' following exercise. People in good health are not afraid to drive over the high passes in the Rocky Mountains. At Loveland Pass, oxygen pressure is 13.2 percent of a normal atmosphere. At the top of Mt. Whitney, oxygen is equal to 12.2 percent. Many hikers go there, and to higher peaks as well. After adequate acclimation, they may climb to the top of Mt. Everest, where oxygen is equal to only 6.7 percent.

The lowest oxygen concentrations that I have observed in a sewer atmosphere was 13 percent. It was in a sealed chamber, near sea level, upstream from an inverted siphon on a metropolitan trunk. A man would be foolish to enter the chamber. Without ventilation, he might die, but not from lack of oxygen.

It seems unlikely that anyone has ever died in a sewer from suffocation, that is, lack of oxygen. Deaths have often been attributed to 'asphyxiation.' This is a word which, according to the dictionary, is used to mean death from an atmosphere that does not support life. The word has sometimes been misinterpreted as meaning suffocation, which is only one kind of asphyxiation.

In nearly all cases of death in sewers, the real killer is hydrogen sulfide. It is important that this fact be recognized. Many cities diligently test for explosive gases, which is very important, and they may measure the oxygen concentration, which usually is unimportant, but they rarely measure H_2S. Death has occurred where it is unlikely that there was any measurable reduction in the oxygen concentration. Wastewater containing 2 mg/l of dissolved sulfide, and at a pH of 7.0, can produce in a chamber with high turbulence, a concentration of 300 ppm H_2S, in the air. This is considered to be a lethal concentration. Many people have died from H_2S, not only in sewers and industries, but also from swamps and from hot springs. In one resort area, at least five persons died from H_2S poisoning before the people were ready to

admit that H_2S is not a therapeutic agent. Hardly a year passes in the U.S. without a sewer fatality from H_2S as well as deaths elsewhere in the world.

The presence of H_2S in a sewer atmosphere is easily determined. A bellows-and-ampoule type of tester is very satisfactory for the purpose, even though it is only crudely quantitative. When using a tester of this type, do not bring the air to the ampoule by way of a tube, as this may change the H_2S concentration. Hang the ampoule in the air to be tested, with a suction tube to the bulb or bellows.

Lead acetate paper is very useful as a qualitative indicator. It cannot be used to estimate the amount of sulfide, but it will quickly turn black in an atmosphere containing only a tenth of a lethal concentration.

Electrodes or other similar electrical indicating devices for H_2S in the air have been marketed. Some of them are known to be unreliable, and we know of none that have proved dependable. Do not use one unless you check it at frequent intervals against air containing known H_2S concentrations. A supposed safety device that is unreliable is worse than none at all.

Remember that the nose fails, too, when it comes to sensing dangerous concentrations of H_2S.

Various other toxic gases have been mentioned in some publications. It is unlikely that any person has been asphyxiated in a sewer by any of those other gases, except possibly chlorine.

The vapor of gasoline and other hydrocarbons is sometimes present in amounts that could cause discomfort and illness, but under that condition, the explosion hazard would be far more serious. The explosimeter tests, as well as the sense of smell, would warn of the danger. Pipelines in chemical plants might contain any number of harmful vapors. They, too, are sensed by smell and explosimeter tests if they get into the public sewer. Such occurrences are rare.

The attempt to instill a sense of urgency about real hazards is diluted if a man is told to give attention to a long list of things that in fact are irrelevant.

Be very careful to avoid high H_2S concentrations, flammable atmospheres, and hazards of physical injuries. Remember that much H_2S may be released by the stirring up of sludge in the bottom of a structure. Obey your senses in respect to irritating gases, such as chlorine (unconsciousness comes suddenly from breathing too much.) Be cautious about strange odors. Do not determine percent oxygen in the air. There is a danger that the result will influence a man's thinking about the seriousness of the real hazards. Most important, use ample ventilation, and do not enter a potentially hazardous structure except in a good safety harness with two men at the top who can lift you out."

Table A-1 Hazardous Gases

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air = 1	Physiological Effect*	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air.) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Ammonia	NH_3	Irritant and poisonous. Colorless with characteristic odor.	0.60	Causes throat and eye irritation at 0.05%, coughing at 0.17%. Short exposure at 0.5% to 1% fatal.	300 to 500	85	16 25	Near top. Concentrates in closed upper spaces	Sewers, chemical feed rooms.	Detectable odor at low concentrations
Benzene	C_6H_6	Irritant, colorless anesthetic	2.77	Slight symptoms after several hours exposure at 0.16% to 0.32%. 2% rapidly fatal.	3,000 to 5,000	25	1.3 7.1	At bottom.	Industrial wastes, varnish, solvents.	Combustable gas indicator
Carbon Bisulfide	CS_2	Nearly odorless when pure, colorless, anesthetic. Poisonous.	2.64	Very poisonous, irritating, vomiting, convulsions, psychic disturbance.	—	15	1.3 44.0	At bottom	An insecticide	Combustible gas indicator
Carbon Dioxide	CO_2	Asphyxiant, Colorless, odorless. When breathed in large quantities, may cause acid taste. Non-flamable. Not generally present in dangerous amounts unless an oxygen deficiency exists.	1.53	Cannot be endured at 10% more than a few minutes, even if subject is at rest and oxygen content is normal. Acts on respiratory nerves.	40,000 to 60,000	5,000	– –	At bottom; when heated may stratify at points above bottom.	Products of combustion, sewer gas, sludge. Also issues from carbonaceous strata.	Oxygen deficiency' indicator
Carbon Monoxide	CO	Chemical asphyxiant. Colorless, odorless, tasteless. Flammable. Poisonous.	0.97	Combines with hemoglobin of blood. Unconsciousness in 30 min at 0.2% to 0.25%. Fatal in 4 hours at 0.1%. Headache in few hours at 0.02%.	400	50	12.5 74.0	Near top, especially if present with illuminating gas	Manufactured gas, flue gas, products of combustion, motor exhausts. Fires of almost any kind.	CO ampoules.

Table A-1 Hazardous Gases

Carbon Tetra-Chloride	CCl_4	Heavy, ethereal odor.	5.3	Intestinal upset, loss of consciousness, possible renal damage, respiratory failure.	1,000 to 1,500	100	— —	At bottom.	Industrial wastes, solvent, cleaning	Detectable odor at low concentrations.
Chlorine	Cl_2	Irritant. Yellow-green color. Choking odor detectable in very low concentrations. Non-flammable.	2.49	Irritates respiratory tract. Kills most animals in a very short time at 0.1%.	4	1	—	At bottom.	Chlorine cylinder and feed line leaks.	Detectable odor at low concentrations.
Formaldehyde	CH_2O	Colorless, pungent suffocating odor.	1.07	Irritating to the nose.	—	10	7.0 73.0	Near bottom.	Incomplete combustion of organics. Common air pollutant, fungicide.	Detectable odor.
Gasoline	C_5H_{12} to C_9H_{20}	Volatile solvent. Colorless. Odor noticeable at 0.03%. Flammable.	3.0 to 4.0	Anesthetic effects when inhaled. Rapidly fatal at 2.4%. Dangerous for short exposure at 1.1 to 2.2%.	4,000 to 7,000	1,000	1.3 6.0	At bottom	Service stations, garages, storage tanks, houses.	Combustible gas indicator. Oxygen deficiency indicator.**
Hydrogen	H_2	Simple asphyxiant,. Colorless, odorless, tasteless. Flammable	0.07	Acts mechanically to deprive tissues of oxygen. Does not support life.	—	—	4.0 74.	At top.	Manufactured gas, sludge digestion tank gas, electrolysis of water. Rarely from rock strata.	Combustible gas indicator.
Hydrogen Cyanide	HCN	Faint odor of bitter almonds. Colorless gas	0.93	Slight symptoms appear upon exposure to 0.002% to 0.004%. 0.3% rapidly fatal.	—	10	6.0 40.0	Near top.	Insecticide and rodenticide.	Detector tube

Table A-1 Hazardous Gases

Hydrogen Sulfide	H_2S	Irritant and poisonous volatile compound. Rotten egg odor in small concentrations. Exposure for 2 to 15 min. at 0.01% impairs sense of smell. Odor not evident at high concentrations. Colorless Flammable.	1.19	Impairs sense of smell, rapidly as concentration increases. Death in few minutes at 0.2%. Exposure to 0.07 to 0.1% rapidly causes acute poisoning. Paralyzes respiratory center.	200 to 300	20	4.3 45.0	Near bottom, but may be Haz above bottom if air is heated and highly humid.	Coal gas, petroleum, sewer gas. Fumes from blasting under some conditions. Sludge gas.	1. H_2S Ampoule. 2. 5% by weight lead acetate solution
Methane	CH4	Simple asphyxiant. Colorless, odorless, tasteless, flammable.	0.55	Acts mechanically to deprive tissues of oxygen. Does not support life.	Probably no limit, provided oxygen percentage is sufficient for life.	—	5.0 15.0	At top, increasing to certain depth.	Natural gas, sludge gas, manufactured gas, sewer gas. Strata of sedimentary origin. In swamps or marshes.	Combustible gas indicator Oxygen deficiency indica- tor.
Nitrogen	N2	Simple asphyxiant. Colorless, tasteless. Non-flammable. Principal constituent of air. (about 79%).	0.97	Physiologically inert.	—	—	——	Near top, but may be found near bottom.	Sewer gas. sludge gas. Also issues from some rock strata.	Oxygen deficiency indicator.
Nitrogen Oxides	NO N_2O NO_2	Colorless Colorless, sweet odor Reddish-brown. irritating odor. deadly posion.	1.04 1.53 1.58	60 to 150 ppm cause irritation and coughing Asphyxiant 100 ppm dangerous. 200 ppm fatal.	50	10	——	Near bottom.	Industrial wastes. Common air pollutant.	NO2detector tube.

Table A-1 Hazardous Gases

Oxygen	O_2	Colorless, odorless, tasteless. Supports combustion.	1.11	Normal air contains 20.8% of O2. Man can tolerate down to 12%. Minimum safe 8 hour exposure, 14 to 16%. Below 10%, dangerous to life. Below 5 to 7% probably fatal.	—	—	——	Variable at different levels.	Oxygen depletion from poor ventilation and absorption, or chemical consumption of oxygen.	Oxygen deficiency indicator.
Ozone	O_3	Irritant and poison- ous. Strong electrical odor. Strong oxidizer. Colorless. At 1 ppm, strong sulfur-like odor.	1.66	Max. naturally occurring level is 0.04 ppm. 0.05 ppm causes irritation of eyes and nose. 1 to 10 ppm causes headache, nau- sea; can cause coma. Symptoms similar to radiation damage.	0.08	0.04	——	Near bottom.	Where ozone is used for disin- fection	Detectable odor at 0.015 ppm.
Sludge Gas	-- **	Mostly a simple asphyxiant. May be practically odorless, tasteless.	Variable	Will not support life.	No data. Would vary widely with composition.		5.3 19.3	Near top of structure	From digestion of sludge.	See components.
Sulfur Dioxide	SO_2	Colorless, pungent odor. Suffocating, corrosive, poisonous, non- flammable.	2.26	Inflammation of the eyes. 400 to 500 ppm immediately fatal.	50 to 100	10	——	At bottom, can combine with water to form sulfu- rous acid.	Industrial waste, combustion, common air pollutant.	Detectable taste and odor at low concen- tration.
Toluene	C_5H_{12} to C_9H_{20}	Colorless, benzene-like odor.	3.14	At 200-500 ppm, headache, nausea, bad taste, lassitude.	200	100	1.27 7.0	At bottom.	Solvent.	Combustible gas indicator.
Turpentine	$C_{10}H_{16}$	Colorless, Characteristic odor.	4.84	Eye irritation. Head- ache, dizziness, nau-sea, irritation of the kidneys.	—	100		At bottom.	Solvent, used in paint.	1. Detectable odor at low concentrations. 2.Combustible gas indicator.
Xylene	C_8H_{10}	Colorless, flammable	3.66	Narcotic in high con- centrations. less toxic than benzene.	—	100	1.1 7.0	At bottom.	Solvent	Combustible gas indicator.

A.5 Hazardous Substance or Elements

Table A-2 Hazmat 2100 Nodes

产品中有毒有害物质或元素的名称及含量

Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	O

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component's any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打"X" 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component's at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the "X"marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January, "B" is February and so on.

Table Hazmat 2100 Nodes 60-2003-550 Rev.

Table A-3 Hazmat Sensors

产品中有毒有害物质或元素的名称及含量

Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	O
外部电缆 External Cables	O	O	O	O	X	O

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component's any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打"X" 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component's at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the "X"marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January, "B" is February and so on.

Table Hazmat Sensors 60-2003-552 Rev.