

ATEX and IECEx Certified Sensors

Installation of Intrinsically Safe Sensors Manual



Applicable to Rheonics Sensor Types: SRV, SRD, SRV-FPC, SRD-FPC
Certified ATEX and IECEx Viscometers and Density Meters

Product: SR Sensors - ATEX and IECEx certified
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English version of this manual is the only approved version from Rheonics. Installers should refer to it to confirm the correctness of information. In case of any questions contact your local partner or Rheonics support.

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Introduction

The operational conditions cited in this manual are essential to and pertain only to the maintenance of intrinsic safety of the device. Operational conditions required for achieving the specified measurement accuracy and operational factors not relevant to operation in explosive atmospheres are given in the configuration data sheet supplied with the sensor. Please refer to the sensor configuration data sheet before installing and operating the sensor.

This is a certified ATEX document. Changes must be approved by the Rheonics EX Authorized Personnel.



ATTENTION: Installation in hazardous environment locations shall be made in accordance with IECEx 60079-14 and other applicable codes and standards.

1. Purpose of this manual

This manual contains information to enable the safe installation and operation of Rheonics SRV, SRV-FPC, SRD and SRD-FPC sensors in areas that potentially contain explosive atmospheres. The manual is an adjunct to the operation and configuration manual provided with the particular sensor to be installed. It applies only to Rheonics SRV, SRV-FPC, SRD and SRD-FPC sensors labelled with the hexagonal ATEX mark:



All other versions of Rheonics SRV/SRD sensors should NOT be considered safe to use in areas with potential presence of explosive atmospheres.

2. Description of the sensors and general installation considerations

Rheonics SRV sensors are used to measure and control the viscosity of fluids, mainly under process conditions. Rheonics SRD sensors measure, in addition, fluid density as well as true dynamic and kinematic viscosity. Each sensor has a symmetric torsional resonator as its sensitive element. The effect of the fluid in which it is immersed on its resonant response – its resonant frequency and damping – is measured and interpreted by the electronics unit with which it is supplied.

Both of these devices, hereafter referred to collectively as “SR” sensors, are delivered in a version that is intrinsically safe. That means that as long as the sensors are installed and operated as specified in this manual, they are incapable of igniting explosive atmospheres in which they operate, provided they are operated within the envelope of parameters described in this manual.

Each Rheonics SR sensor is delivered paired with an electronics unit that both operates the sensor and transmits its measurement values over one of a variety of interfaces. The electronics unit is not itself intrinsically safe. When operating Rheonics SR sensors in a hazardous area, one or more Zener diode barriers must be installed between the Rheonics SR sensor and its electronics unit. This barrier serves to limit the amount of current and voltage available to the sensor in case of a fault in its electronics unit and/or within the sensor itself. The specifications for the required barriers are given in section [5.2](#) below.


Rheonics SR sensors are specified to maintain IP54 ingress protection under all operating conditions. They are hermetically sealed in fully welded AISI 316L housings. Electrical connections are made through a M12 connector whose contacts are hermetically sealed into a glass insulating disk.

The Zener diode barriers themselves must be situated either outside of any hazardous zone, or in the zone specified by the manufacturers as safe for the barriers. The Rheonics SR sensor's electronics unit must be situated outside the hazardous zone.

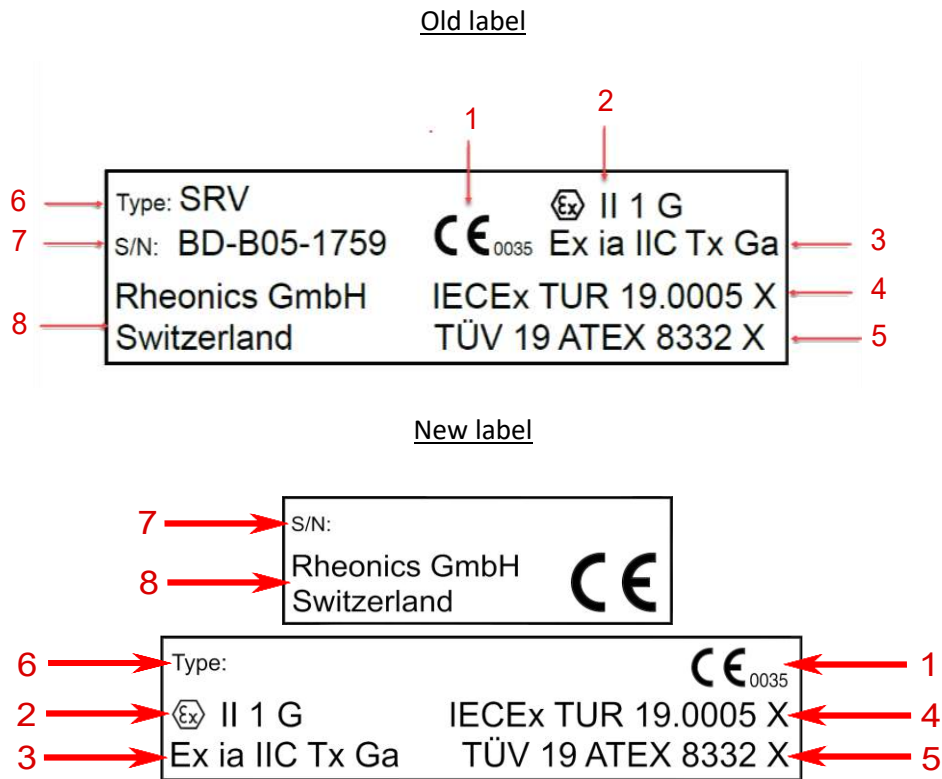
Suitable cabling to safely connect the Rheonics SR sensor to its associated Zener barrier(s) is to be provided by the installer. The minimum specification for the cabling to ensure intrinsic safety is given in section [5.1](#).

Installation of Rheonics SR sensors must be performed by a qualified installer who is familiar with safe installation practices for intrinsically safe equipment. In addition, the installer must be familiar with the contents of this installation manual, to ensure that all conditions relevant to maintaining intrinsic safety of the Rheonics SR sensors are met.

The following topics are covered in the next sections:

- Description of the  label as it defines the safe operating parameters of the sensor
- Discussion of limits on specific operating parameters of the Rheonics SR sensors not explicitly listed on the label, but as indicated by the symbol "X" following the ATEX and IECEx certificate numbers.
- Specification of the Zener diode barrier(s) to ensure safe operation of the Rheonics SR sensors, as well as specific recommendations for commercially available barriers for use with the Rheonics SR sensors.

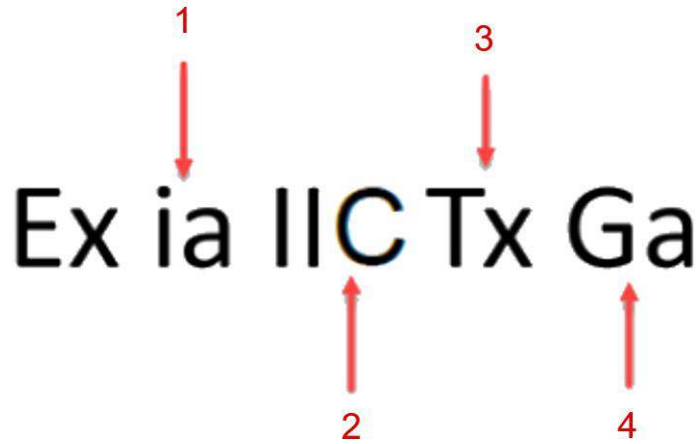
3. EX label description:



1	CE mark Notified body: TÜV Rheinland
2	ATEX Marking
3	Explosion classification
4	IECEx certificate number with appended "X"
5	ATEX certificate number with appended "X"
6	Sensor
7	Identification Number
8	Sensor Manufacturer

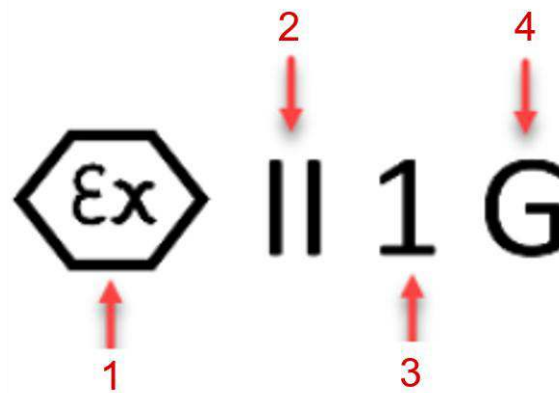
*** See below for "Tx" and "X" conditions for explosion classification and certificates**

Figure 1: Example of sensor labels identifying the markings



1	Intrinsically safe
2	Safe for gas groups IIA, IIB and IIC
3	Ignition temperature classes that define ambient/fluid temperature range, as given in table below
4	Equipment protection level = very high

Figure 2: IECEx Explosion classification description



1	ATEX Mark
2	Non-mining equipment
3	Category 1 (Zone 0)
4	For gases

Figure 3: ATEX marking description

3.1. General note on Category of protection and operating zone

Although the sensors are specified for Category 1 (hazardous Zone 0), they may also be used for Categories 2 and 3 (Zones 1 and 2). However, if the sensor has been used in a Category 3 (Zone 2) installation, it is no longer safe to use in categories 1 and 2 (Zones 0 and 1), because of the risk that the sensor has been damaged. It is the responsibility of the installer and the end user to ensure that any Rheonics SRV or SRD sensor that has been used in a Category 3 installation is not re-used for Category 1 or 2 installations.

3.2. Description of “X” conditions: operating conditions not described on the label, but that are necessary in order to maintain intrinsic safety

Certain operating conditions must be met in order to ensure that the sensors and their associated Zener diode barriers meet intrinsic safety criteria. These include:

- Electrical parameter
- Operating temperature ranges
- Safe hydrostatic pressure limits
- Maintenance of ingress protection
- Protection against mechanical impact
- Protection against solid materials transported by fluid being monitored

3.2.1. Area classification & Gas Grouping

Area classification

Zone 1	Area in which an explosive gas atmosphere is likely to occur in normal operation occasionally
Zone 2	Area in which an explosive gas atmosphere is not likely to occur in normal operation and if it does occur, is likely to do so only infrequently and will exist for a short period only
Zone 21	Place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally
Zone 22	Place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does, will persist for a short period only

Gas Grouping

Group IIA	Propane
Group IIB	Ethylene
Group IIC	Hydrogen and Acetylene

3.2.2. Electrical parameters relevant to intrinsic safety

Table 1: EX-relevant electrical specification for SRV/SRD sensors

Parameter	RTD (Pt1000) circuit	Transducer coil circuit
U_i	N/A	7.5 V
I_i	N/A	750 mA
P_i	100 mW	1.4 W
C_i	negligible	negligible
L_i	negligible	<99.5 μ H

The two circuits are considered independent because they are electrically isolated from one another.

3.2.3. Temperature rating of the sensors according to T class

The following temperature class table shows the range of ignition temperature classes for which the sensors are specified, together with the ambient operational temperature for each class, where T_a is the lesser of the process fluid temperature and the ambient temperature surrounding the portion of the sensor outside of the process fluid. In typical applications, the fluid temperature will be equal to or greater than the ambient temperature, so it will determine the temperature class. The symbol “Tx” refers to the corresponding symbol on the sensor EX label. It refers to the temperature classes listed on the following Table 2. However, the user must be aware that these temperatures only show the limits for safe operation of the sensor in different explosive atmospheres. The actual temperature range over which the sensor will function accurately and without functional damage is shown on the individual configuration data sheet provided with each sensor.

Table 2: Temperatures for gas ignition classes

Tx (T class)	T_a
T6	-40°C....+70°C
T5	-40°C....+85°C
T4	-40°C....+120°C
T3	-40°C....+185°C

3.2.4. Pressure rating of the sensors

The SR sensors are provided in two variants that have different pressure ratings. All variants except for the “FPC” or fixed process connection SRV and SRD sensors are rated for a maximum hydrostatic pressure of the process fluid of 700 bar (10,000 PSI) in order to retain IP54 ingress protection as relevant for the sensor’s intrinsic safety. The SRV/SRD “FPC” sensors have a maximum fluid pressure rating of 70 bar (1,000 PSI).

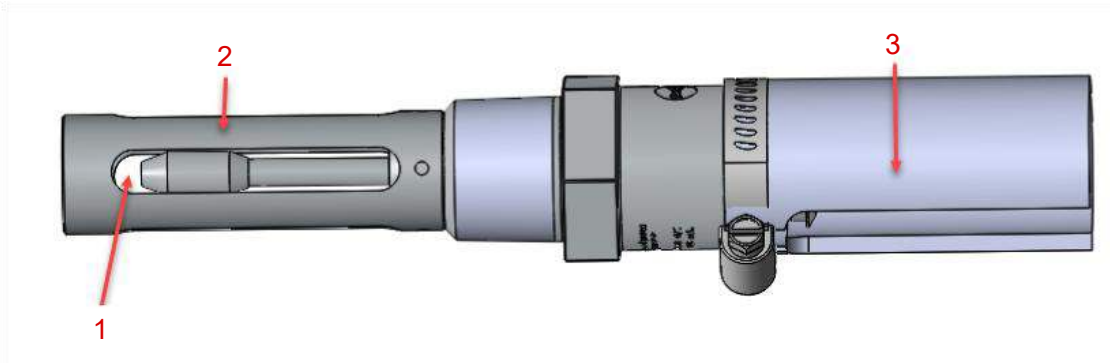
These pressure ratings pertain only to maintenance of intrinsic safety of the sensors. Please consult the configuration data sheet delivered with the particular sensor for pressure limits for maintenance of accuracy and operational safety.

3.2.5. Damage protection

Rheonics SRV/SRD sensors are provided with an impact shield to protect the back end of the sensor from mechanical damage that could compromise IP54 ingress protection. The impact shield must be installed whenever the surrounding equipment permits it. If there is insufficient space to install the impact shield, the sensor must be protected from mechanical impact (as from falling objects) by the surrounding equipment. In all cases, it is the responsibility of the installer to ensure that the sensor cannot be impacted by falling objects or other sources of mechanical impact. The shield is installed by sliding the end of the shield over the back end of the sensor, up to at least the weld line on the sensor body. It must extend far enough toward the back so that it completely covers the M12 connector that connects the sensor cable to the sensor. The worm-drive screw is then tightened so that the shield securely grips the back end of the sensor housing.

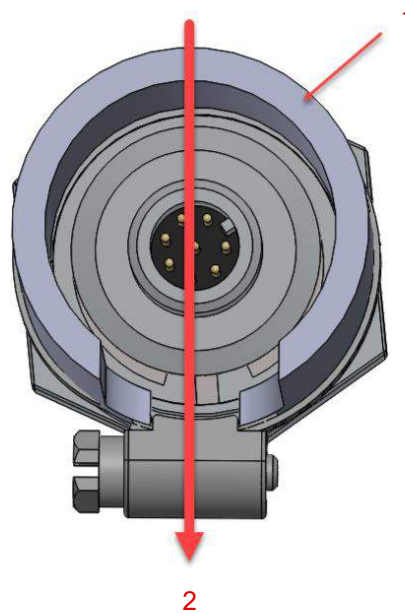
Rheonics SRV/SRD sensors are also provided with a protective sleeve that shields the immersed end of the sensor from impact by large objects in the fluid flowing over it that could damage the sensor and lead to fluid penetration. Although the sensor is very robust, the sleeve must be installed whenever there are solid objects in the fluid larger than 8mm in their smallest dimension. The protective sleeve is attached by sliding it over the neck of the sensor as far as it will go, and then tightening the set screws around its periphery.

The following Figures 4 and 5 show the correct method for installing both the impact shield and the protective sleeve:



1	Slots in protective sleeve exclude any fluid-borne particles larger than 8 mm diameter
2	Protective shield
3	Impact shield

Figure 4: SRV sensor with protective sleeve and impact shield mounted



1	Impact shield
2	Impact shield must be installed so that slot in shield is facing down

Figure 5: End view of SRV showing orientation of slot in impact shield



ATTENTION: These parameters and conditions must be adhered to. If not, injury may be caused to person or property.

4. Safe use of ATEX approved equipment

4.1. Notes on Safe Use of the ATEX Approved Equipment

Approved usage of the sensor is restricted to fluids compatible with the wetted materials of the sensor and within the restrictions on temperature and pressure as defined in the product manual.

4.2. Mounting, Commissioning, and Operation

The device has been designed to operate safely in accordance with the current technical and safety regulations of the EU. If installed incorrectly or used for applications for which it is not intended, it is possible that application related changes may arise. For this reason, the instrument must be installed, connected, operated, and maintained according to the instructions in this and the specific product operating manual.

Persons handling/installing or commissioning this equipment must be authorized and suitably qualified. The manual must be read, understood, and the instructions must be followed.

Modifications and repairs to the device are only permissible when they are expressly approved in this manual.

5. Electrical Installation



ATTENTION: Substitution of components may impair intrinsic safety.

Installation of the sensors must be carried out according to the instructions and diagrams in this section. Sensors installed in this manner will become part of an intrinsically safe system that will be incapable of igniting explosive gas atmospheres as specified on the sensor label and additional specifications in the preceding section [3](#) above.

There are four basic considerations that govern the electrical installation of the sensor. They are:

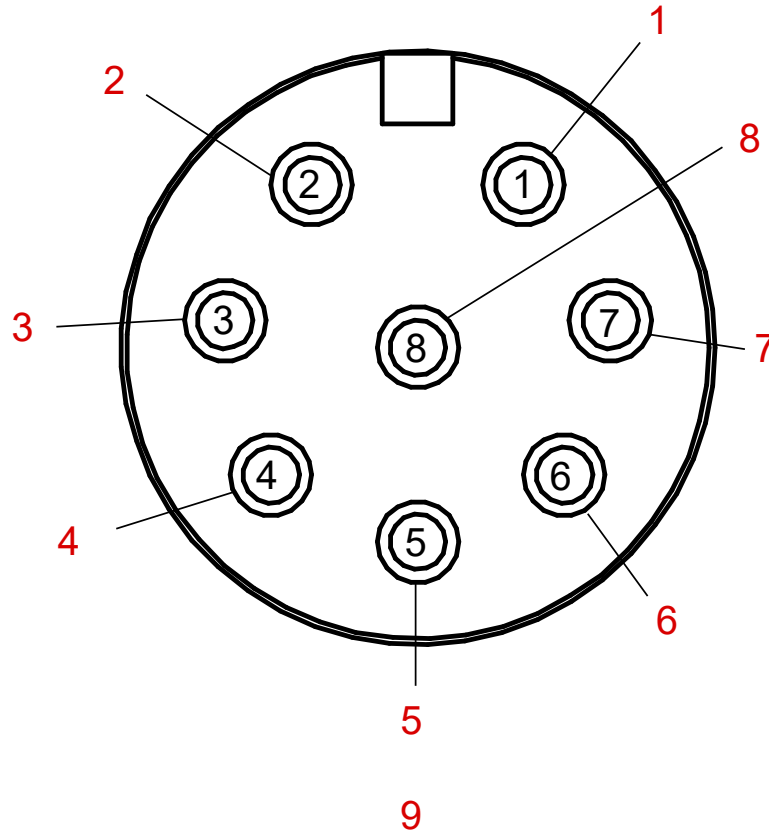
- Cabling
 - Selection of a suitable cable
 - Wiring of the cable to a suitable sensor-side connector
 - Wiring of the cable to the Zener diode barrier(s) associated with the system.
- Selection / identification of wiring scheme depending on intended Pt1000 temperature sensor connection

- Sensor with 4-wire Pt1000 connection
 - 3 Zener diode barriers required
 - Highest accuracy
 - Uses standard sensor
- Sensor with 3-wire Pt1000 connection
 - 2 Zener diode barriers required
 - Lower accuracy than 4-wire Pt1000 connection
 - Uses standard sensor
 - May require temperature calibration for best accuracy
- Sensor with no Pt1000 sensor
 - 1 Zener diode barrier required
 - Uses special sensor with no Pt1000 installed
 - Temperature may be measured with external temperature sensor
 - Possibility of temperature estimation without external sensor. Please consult Rheonics for more information regarding accuracy.
- Zener diode barrier selection
 - Using Zener diode barriers recommended in this manual
 - Using alternative Zener diode barriers that meet the specifications given in this manual.
- Equipotential bonding method selection
 - Using cable shield for equipotential bonding
 - Using separate bonding conductor
 - Different schemes possible depending on requirements of system layout

5.1. Cabling

The SRV/SRD sensor is connected to its associated Zener diode barriers by means of a cable that has an 8 pole M12 connector on the sensor end. The end that connects to the Zener diode barrier must be provided with crimped conductor-end sleeves, which are held by screw clamps on the Zener diode barriers.

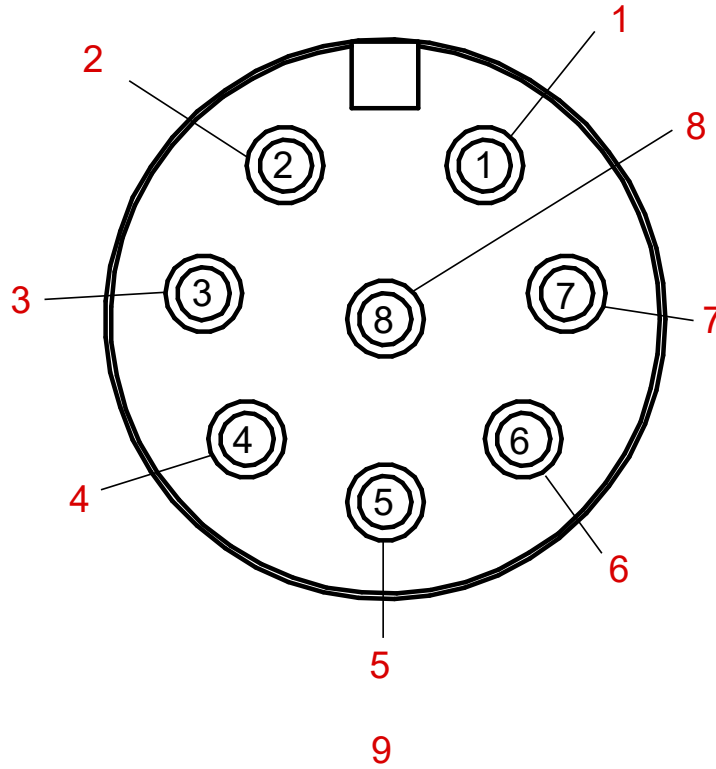
Electrical connections to the M12 connector depend on the presence or absence of the Pt1000, and in its presence, whether a 3-wire or a 4-wire connection has been selected. For a connection with no Pt1000, the pins are assigned as in Fig. 6:



1	1: Transducer coil +
2	2: Transducer coil -
3	3: No connect
4	4: No connect
5	5: No connect
6	6: No connect
7	7: No connect
8	8: No connect
9	Signal assignment version without Pt1000 M12 connector front view

Figure 6: Pinout of M12 connector with no Pt1000 installed

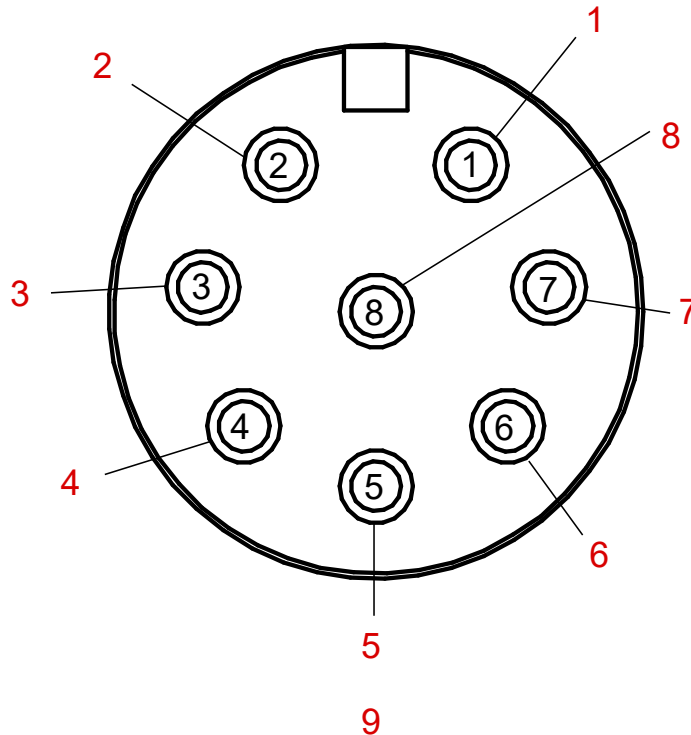
For a connection with 4 wires, the pinout is shown in Fig. 7 below:



1	1: Transducer coil +
2	2: Transducer coil -
3	3: No connect
4	4: No connect
5	5: Pt1000 Sens +
6	6: Pt1000 Sens -
7	7: Pt1000 I +
8	8: Pt1000 I -
9	Signal assignment Pt1000 4-wire version M12 connector front view

Figure 7: Pinout of M12 connector with 4-wire Pt1000 connection

For a connection with 3 wires, the pinout in Fig. 8 is used:



1	1: Transducer coil +
2	2: Transducer coil -
3	3: No connect
4	4: No connect
5	5: Pt1000 Sens +
6	6: Pt1000 Gnd
7	7: Pt1000 I +
8	8: No connect
9	Signal assignment Pt1000 3-wire version M12 connector front view

Figure 8: Pinout of M12 connector with 3-wire Pt1000 connection

In addition, the M12 connector must be rated at IP54 or higher.

Detailed pinout and connection diagrams are given in section [5.3](#) below.

The cable and connector selected must be rated for at least the highest ambient temperature at which the sensor will be used. They must meet the following specifications:

Table 3: Sensor cable specifications

Parameter	Value
Minimum ingress protection (cable + connector)	IP54
Connector	M12 8 pole, A-coded, female, IP54
Twisted pair cable with a shield	4x2, shielded cable with 4 twisted pairs
Maximum length	500 m.
Minimum required conductor cross section	0.25 mm ²
Maximum practical cross section	0.5 mm ²
Maximum inductance	1.5 mH/km, per conductor
Maximum capacitance, conductor-to-conductor	220nF/km
Maximum capacitance, wire to shield	300nF/km

A commercial cable that satisfies the preceding specification is Helu Kabel type OB-BL-PAAR-CY 4x2x0.5mm².

5.2. Zener diode barriers

Each SRV/SRD must be connected to its electronics unit through Zener diode barriers as appropriate to the installation. There are several different connection options, depending on whether or not the SRV/SRD has a built-in Pt1000, and if so, how the Pt1000 is connected (4 or 3 wire connection). The diagrams in section below show these options.

In addition to the proper connection, the Zener diode barriers need to fulfill the electrical specifications shown in the following tables.

The Zener diode barrier connected to the transducer coil circuit must meet the following specifications:

Table 4: Transducer coil circuit Zener diode barrier specifications

Max. output voltage	U_o	≤ 7.5	V
Min. series resistance	R_o	≥ 9.8	Ohm
Max. output current	I_o	≤ 750	mA
Max. output power	P_o	≤ 1.4	W
Fuse rating		≤ 200	mA

This Zener diode barrier must have two channels, one for each conductor of the transducer coil circuit.

If the Pt1000 is present in the sensor, it must be connected to one or two Zener diode barriers with the following specification, each with two channels:

Table 5: Pt1000 circuit(s) Zener diode barrier specifications

Max. output power	P_o	≤ 100	mW
Fuse rating		N/A	mA

For a 3-wire connection, a single barrier may be used, with the third (grounding) lead of the Pt1000 circuit connected to ground through the cable shield.

For a 4-wire connection, two Zener diode barriers must be used, with two wires connected to each of the two channels of the Zener diode barriers.

The Zener diode barriers must be located outside of the hazardous zone, or in a zone allowed by the manufacturer's specification. They must be properly grounded.

Commercial Zener diode barriers that fulfill these specifications are:

For transducer coil circuit:

Pepperl + Fuchs Z757

Table 6: Specification of commercial Zener diode barrier suitable for transducer coil circuit

Series resistance	9.8 ohms, min.
Fuse rating	200 mA
Maximum safe voltage	250 V
Output voltage, U_o	7.14 V
Output current, I_o	729 mA
Output power, P_o	1.3 W

Contact **Rheonics Technical Support** for information on other recommended barriers.

For Pt1000 circuits (1 or 2 units depending on whether 3 or 4 wire connections are used):

Pepperl + Fuchs Z041

Table 7: Specification of commercial Zener diode barrier suitable for Pt1000 circuit(s)

Series resistance	1957 ohms, min.
Fuse rating	80 mA
Maximum safe voltage	250 V
Output voltage, U_o	8.61 V
Output current, I_o	4 mA
Output power, P_o	9.4 mW

Contact **Rheonics Technical Support** for information on other recommended barriers.

5.3. Installation diagrams

The following diagrams show how the sensors, their cables and the associated Zener diode barriers must be connected in order to ensure intrinsic safety of the entire system.

The selected connection method depends on the configuration of the sensor, as well as the choice of temperature measurement connection.

For all variants, the following rules must be followed:

The cable shield must be connected to one of the sensor-side grounding terminals of the Zener diode barrier associated with the transducer coil circuit. In the following circuit examples, this is the Pepperl + Fuchs Z757 Zener diode barrier. The cable shield should be connected to either terminal 2 or 3 of the Zener diode barrier.

The Zener diode barrier(s) must be grounded to a known-reliable earth ground. It is the responsibility of the installer to ensure the quality and reliability of the selected ground point. Zener diode barriers are delivered with installation instructions that include information about grounding methods. Zener diode barriers that are mounted on DIN rails generally have grounding mechanisms that engage with the rails, which themselves must then be tied to a known-reliable grounding point. It is the responsibility of the installer to ensure that the Zener diode barriers are properly and reliably grounded according to the manufacturer's specifications.

In the event that more than one sensor is used in a system, the decision of how to bond the sensors to a grounding point depends on the layout of the system. One of the configurations shown in section 5.4.3 below may be used, depending on which is the most convenient. In the given examples, a system with three sensors is shown, although larger printing applications may have 10 or more sensors installed on a single machine.

First, we consider different wiring configurations for alternative Pt1000 temperature sensor connections.

Variant 1: Standard sensor with Pt1000 temperature element installed in the sensor tip. 4-wire connection of the Pt1000 circuit to the electronics unit. 2 Zener diode barriers with 2 channels each are required for the Pt1000 circuit. A single 2-channel Zener diode barrier is required for the sensor coil circuit. This configuration provides the highest temperature accuracy, but requires two Zener diode barriers for connection.

Variant 2: Special sensor with no Pt1000 temperature element installed. No Zener diode barriers are required for the Pt1000 circuit. A single 2-channel Zener diode barrier is required for the coil circuit.

Variant 3: Standard sensor with Pt1000 installed, with 3-wire connection to the electronics unit. A single 2-channel Zener diode barrier is required for the Pt1000 circuit. A single 2-channel Zener diode barrier is required for the coil circuit. The advantage of this circuit is that one less Zener diode barrier is required for the installation. Although the electronics unit will function

with this circuit, the accuracy of the temperature measurement must be verified and possibly re-calibrated by the end user.

In all cases, the sensor-side diagram shows a ground connection to the sensor labeled “Ground tab (optional)”. This refers to the installation of an equipotential bonding connection to the sensor. The options for bonding to the sensor body are given in section [5.4.2](#), following the installation diagrams.

Cable conductor colors are given for convenience only. They reflect cables whose conductors are color coded according to the DIN 47100 norm. It is the installer’s responsibility to verify that the correct M12 cable connector pins are routed to the proper Zener diode barrier terminals, regardless of the actual conductor colors.

In the following wiring diagrams (Figs. 9-11), there are three types of ground connections, labeled “G1”, “G2” and “G3”. For the Zener diode barriers, G2 is the default grounding connection, usually provided by the manufacturer as a grounding clamp that grips the DIN rail on which the Zener diode barrier is mounted. It is the installer’s responsibility to make sure that the DIN rails are securely grounded to a known reliable grounding point.

In the case that secure grounding of the DIN rails cannot be assured, most Zener diode barriers are provided with a screw-clamp grounding terminal labeled G1. In that case, the installer must ground each Zener diode barrier to a known reliable grounding point with a suitable conductor.

The sensor grounding tab ground connections are labeled “G3” and refer to the sensor’s connection to an equipotential bonding conductor. As described in section [5.4.3](#) below, there are several options available for equipotential bonding of the sensor. The appropriate method for bonding the sensor should be selected from among these options.

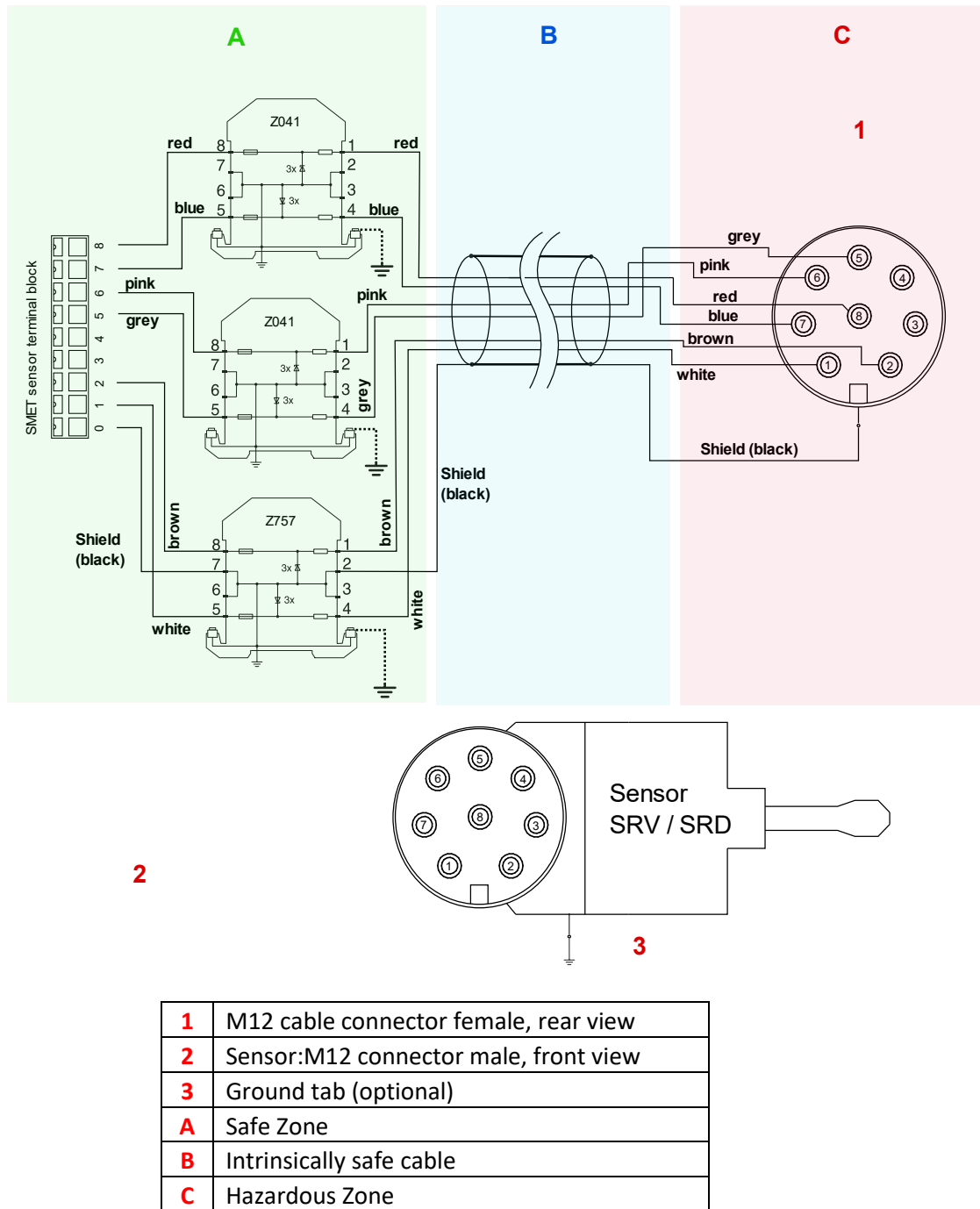


Figure 9: Variant 1 - Wiring diagram with Pt1000 installed, 4-wire Pt1000 connection

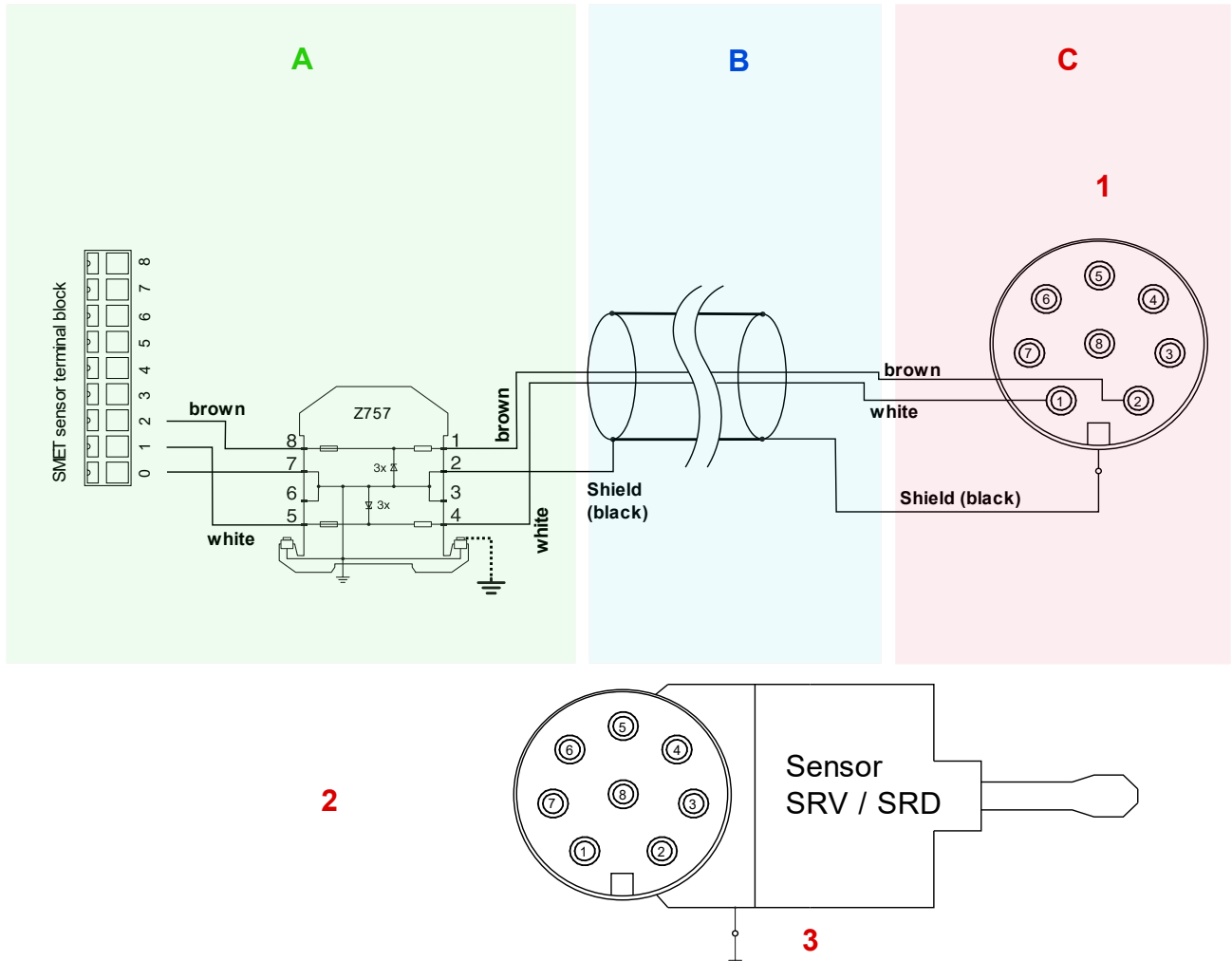
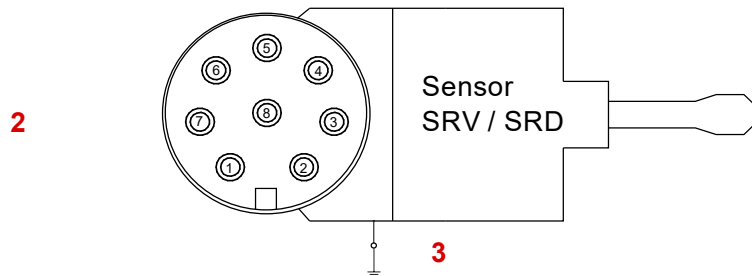
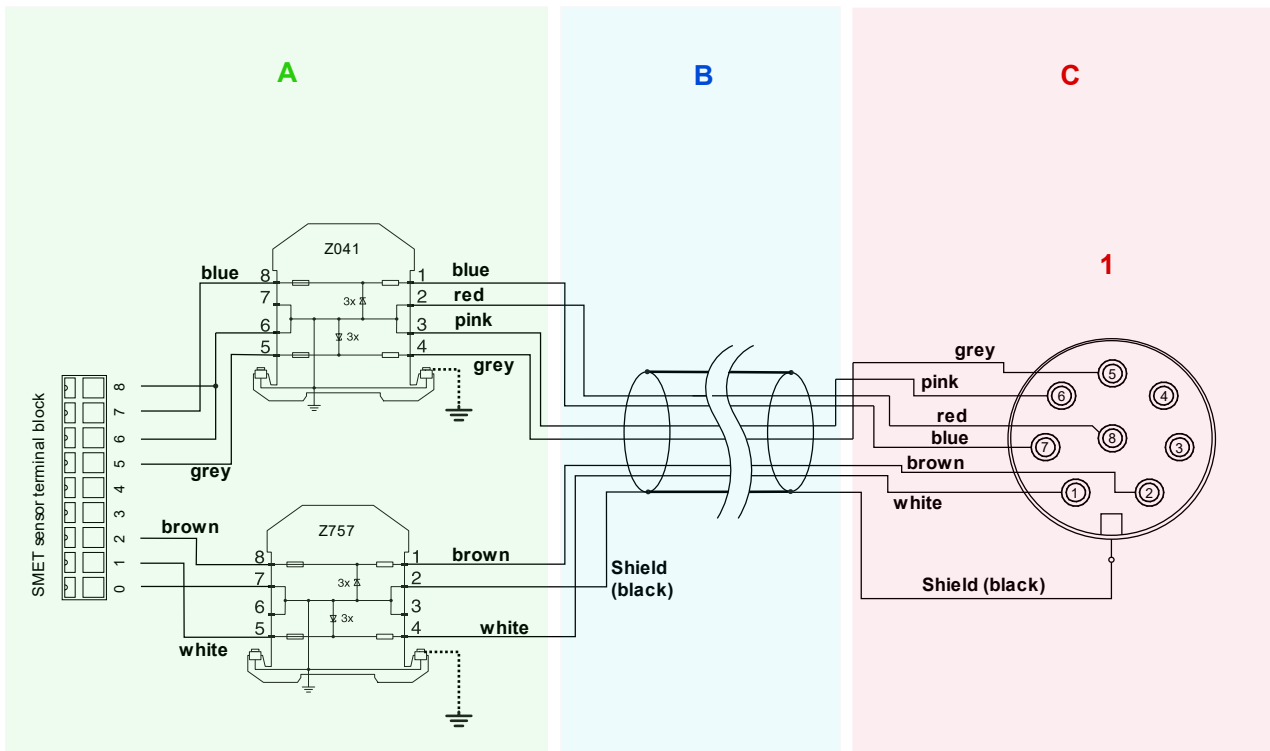


Figure 10: Variant 2 - Wiring diagram with no Pt1000 installed



1	M12 cable connector female, rear view
2	Sensor:M12 connector male, front view
3	Ground tab (optional)
A	Safe Zone
B	Intrinsically safe cable
C	Hazardous Zone

Figure 11: Variant 3 - Wiring diagram with Pt1000 installed, 3-wire Pt1000 connection

5.4. Equipotential bonding

5.4.1. Bonding/grounding conductor

In order to eliminate the risk of gas ignition by sparks and/or local heating caused by ground loops, the sensors and their associated Zener barriers must be connected by suitable conductors, as specified in the following sections.

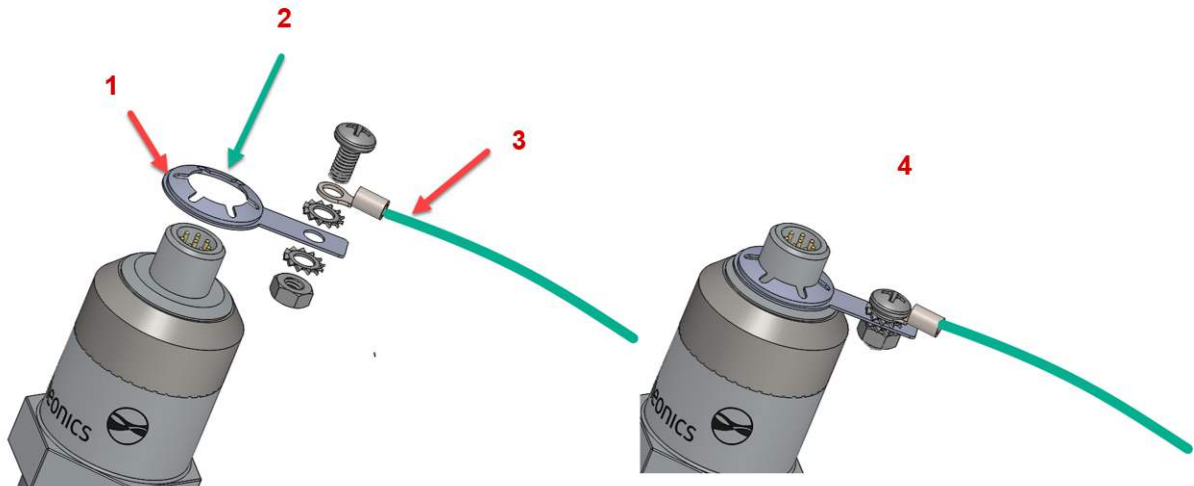
There are four different options for equipotential bonding. The first makes use of the cable shield braid to perform the potential equalization function, providing the shield meets certain basic requirements. The other three depend on independent bonding conductors that connect each sensor to the common ground potential.

There are several options available for the equipotential bonding wiring:

1. Sensor cable shields for equipotential bonding
 - 1.1. The cable must have a braided shield with a total cross-sectional copper area of at least 2.5mm².
 - 1.2. If it is desired to use the cable shield for equipotential bonding, it is recommended to use Helu Kabel type OB-BL-PAAR-CY 4x2x0.5mm² for the sensor connection
 - 1.3. The cable shield must be firmly bonded to the shell of the M12 connector used for the sensor connection. Follow connector manufacturer's installation instructions.
 - 1.4. The cable shield must be securely connected to the grounding terminal of its associated Zener diode barrier.
2. If a cable other than the recommended type is used, the installer must ensure that its shield cross sectional area is at least 2.5mm². If this cannot be verified, then one of the following equipotential bonding methods must be used. *Each of the following methods requires using a sensor with an installed bonding tab. The optional bonding tab is included with each sensor delivered.* Proper installation of the bonding tab is shown in Fig. 12 below.
 - 2.1. In the case of multiple sensors installed in a specific location that are then connected to Zener barriers in a remote electrical system, a "star" topology can be used (Fig. 13 below)
 - 2.2. If it is more convenient because of the layout of an array of sensors in the system, a hybrid or "multi-drop" configuration can be used (Fig.14 below).
 - 2.3. Individual bonding wires between sensors and Zener diode barriers. This requires installing the bonding tab delivered with the sensor. Each sensor is connected to its respective barrier by means of a wire of at least 4mm² cross section. On the sensor side, the wire is connected to the bonding tab on the back of the sensor; on the Zener diode barrier side it is connected to the grounding terminal of the barrier (Fig. 15 below)

5.4.2. Bonding to the sensor

Two options are available for equipotential bonding to the sensor itself. The first makes use of a ground bonding tab that is affixed to the M12 connector shell on the back of the sensor:



1	Crown lock washer with bonding tab
2	Crown lock washer is forced down upon M-12 connector shell. Deformation of hardened teeth guarantees solid contact with threads of connector
3	Equipotential bonding wire
4	Fully assembled grounding tab is permanently installed; cannot be inadvertently dis-lodged

Figure 12: Installation of grounding tab on SRV/SRD sensor

The crown lock washer has an internal diameter that is slightly smaller than the outside diameter of the connector. When forced over the connector shell, the hardened spring fingers of the lock washer dig into the shell slightly, providing both a electrical bond and a solid mechanical connection. The bonding wire, which must have a minimum cross-sectional area of 4mm^2 , is then connected to the bonding tab by means of a screw, a nut and two toothed lock washers. The crown lock washer leaves sufficient space for normal installation of the M12 sensor connector.

A second option uses the cable shield for equipotential bonding. This can be done provided that the cross-sectional area of the shield conductor is 2.5mm^2 . The commercial cable, Helu Kabel type OB-BL-CY $4\times 0.5\text{mm}^2$, has a shield cross section sufficient to fulfill this requirement. It is then essential to use a suitable M12 cable connector that has a defined ground connection to which the cable shield can be attached. The other end of the cable, whose conductors are attached to the terminals of the Zener diode barriers, must also have a firm attachment of its shield to the grounding terminal of the Zener diode barrier. A recommended method is to free the conductors from the shield over a length of about 12 cm, and to cover the shield with a

length of heat-shrink tubing. The free end of the shield is then crimped into a ferrule, which can then be clamped under the appropriate ground terminal of the Zener diode barrier.

Even if a cable is used whose shield cross sectional area is less than the specified minimum, proper connection of the shield is essential to ensure proper functioning of the sensor. The shield must be connected both to the shell of the connector, as well as to the Zener diode barrier(s), although in that case, the function of preserving intrinsic safety will be performed by one of the following bonding configurations.

5.4.3. Bonding configurations

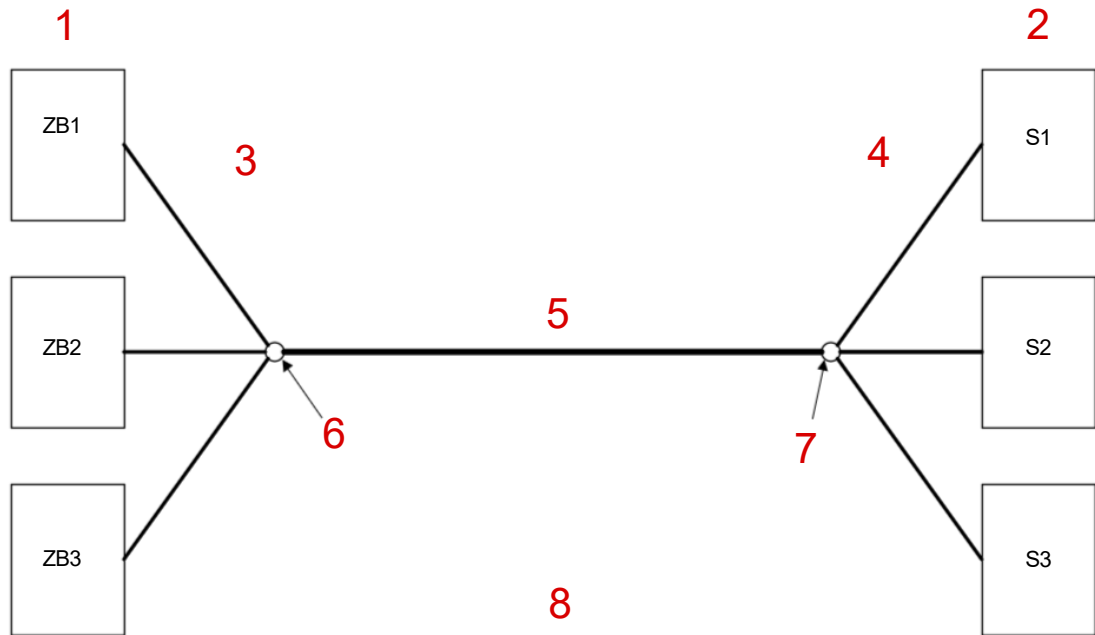
In the event that a cable with sufficient shield cross sectional area is used, then no additional configuration of the equipotential bonding must be performed.

If the shield cross sectional area is insufficient, or cannot be verified, then one of the following methods may be selected.

Three different scenarios are possible, each of which ensures adequate electrical bonding. The particular scheme that is used depends on the overall sensor setup as well as the preference of the installer.

5.4.3.1. Star topology

This is particularly useful where several sensors are installed in one area, and must be connected to their associated Zener diode barriers in an electrical cabinet somewhat remote from the installed sensors. In that case, all the sensors in a given area may be tied to a local grounding point, each with a wire of at least 4mm^2 cross section (ca. 11AWG), and that local grounding point connected to a second grounding point in the remote electrical cabinet by a wire of at least 6mm^2 cross section. Each Zener diode barrier in the electrical cabinet is then connected to the common grounding point by means of a wire of at least 4mm^2 cross section. This is shown schematically in the following figure:

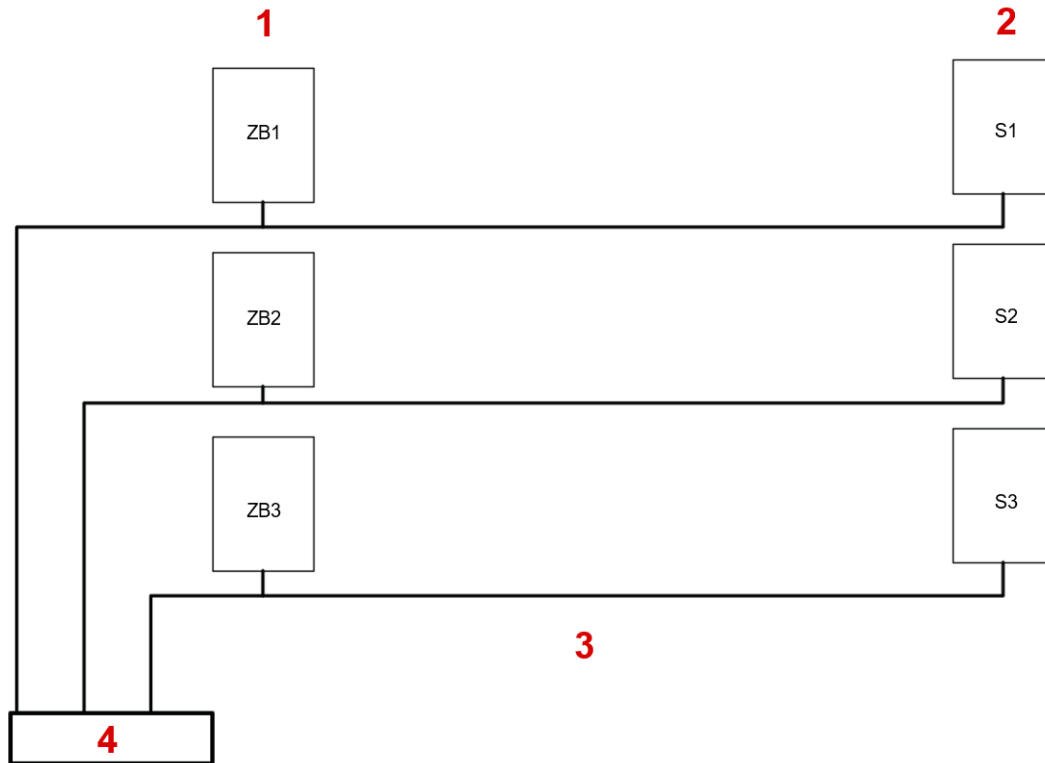


1	Zener Barriers, safe area
2	Sensors, Zone 0
3	4 mm ² bonding wires (1 per sensor)
4	4 mm ² bonding wires (1 per sensor)
5	6 mm ² wire connecting printing press ground point to barrier ground points
6	Common grounding points at printing press
7	Common grounding points at printing press
8	Star connected bonding

Figure 13: Several sensors grounded to common grounding point (“Star” topology)

5.4.3.2. Individual bonding conductors

A second method, which may be more convenient in situations when the safe zone is close to the sensor installation area, is to use an individual bonding wire of at least 4mm² cross section connecting each sensor to its associated Zener diode barriers. This is analogous to the use of cable shields for bonding, except that the bonding conductors are now run parallel to the cables. This arrangement is shown schematically in the following figure:

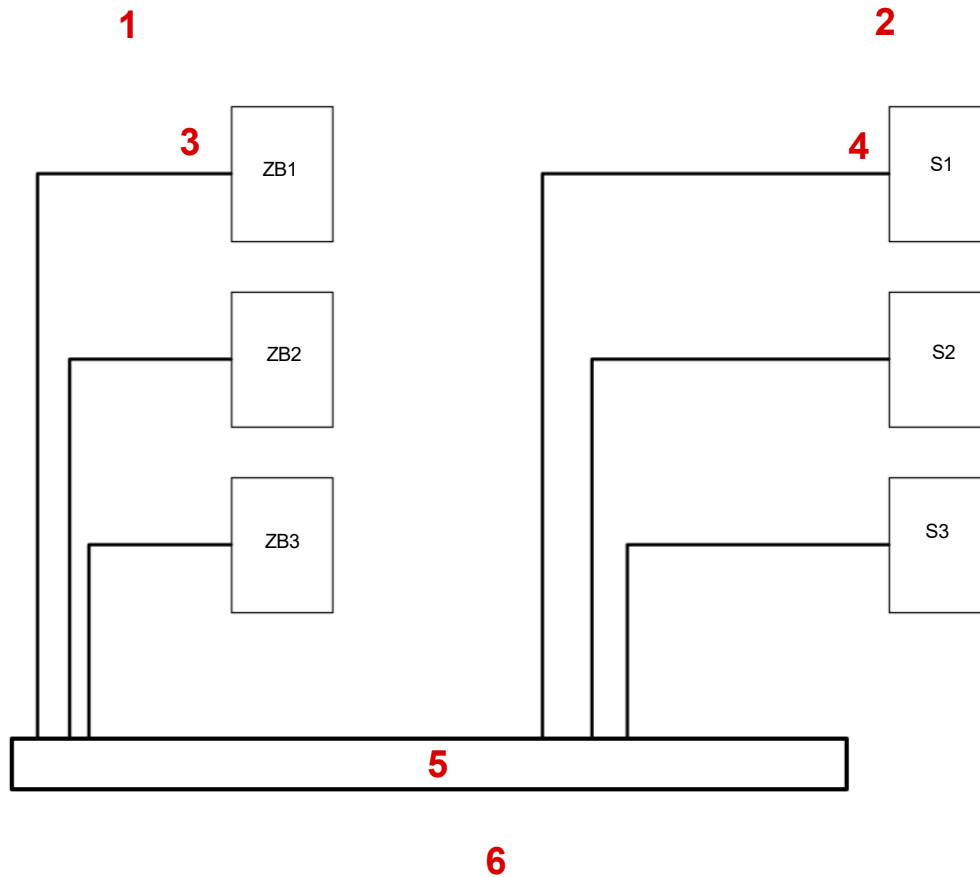


1	Zener Barriers, safe area
2	Sensors, Zone 0
3	4 mm ² individual bonding wires
4	Individual bonding

Figure 14: Individual bonding of sensors to their Zener diode barriers

5.4.3.3. Multi-drop bonding configuration

A third option, which is a hybrid of the preceding two variants, makes use of a mixture of local grounding rails for both the Zener diode barriers and the sensors, that connect sensor and electronics locales in large distributed apparatus, such as multi-station rotogravure presses. Each sensor and/or Zener diode barrier is connected to a common grounding rail that runs from the sensors to the Zener diode barriers. In this case, each sensor and/or Zener diode barrier must be bonded to the common rail with a conductor of at least 4mm² cross sectional area, while the common ground rail must have a cross sectional area of at least 6mm². This arrangement is shown schematically in the following diagram:



1	Zener Barriers, safe area
2	Sensors, Zone 0
3	4 mm ² individual bonding wires
4	4 mm ² individual bonding wires
5	Grounding rail (minimum 6mm ² cross section)
6	Multi-drop bonding

Figure 15: Hybrid, or multi-drop bonding

In any event, it is the sole responsibility of the installer to ensure proper equipotential bonding of all elements of the system, to avoid creation of a potentially unsafe system due to improper bonding.

6. Maintenance

6.1. External Maintenance

The Rheonics sensors can be externally cleaned and maintained by wiping with a dry clean cloth.

6.2. Sensor Maintenance

The sensor can be maintained by switching off the power, removing the probe from the process and cleaning the probe with a solvent compatible with 316SS. After cleaning the probe clean and dry the sensor with compressed air before inserting it back it the process. It is not recommended to use an ultrasonic bath for cleaning.

6.3. Internal Maintenance

Please make sure that the internals of the unit always stay dry and clean. There are no user maintainable components inside the electronic compartment.

7. Returning Equipment to the factory

Instructions for Returning Your Instrument for Service

The following information will help you return your instrument to Rheonics and will ensure that your order is processed promptly. To request details, contact your local Rheonics distributor or contact one of our offices directly.

Please follow these easy steps to return your instrument for factory service:

- 1) To obtain a Return Materials Authorization (RMA) number from Rheonics, submit a support ticket with subject "RMA Request for EX sensor" – <https://support.rheonics.com/support/tickets/new>
- 2) Rheonics Support Team will provide you with an RMA Number/Reference number to be used with the shipment.
- 3) Pack your instrument carefully. Use the original packaging and foam or bubble wrap and include the Reference Number/RMA number with the unit(s).

Ship the unit(s) to the address on the RMA. Include RMA/Reference Number (Your RMA Number – supplied by Rheonics) on the shipment.

8. Intrinsic safety certificates

[ATEX Certificate](#)

[IECEx Certificate](#)

For latest certificates of Rheonics products, solutions & electronics, visit:
<https://rheonics.com/resources/certificates/>

9. Revisions and approvals

Version	Nature of changes	Approvals	Date
1.0	Original version	S. Kumar, J. Goodbread	22.06.2020
2.0	<ol style="list-style-type: none"> 1. Minor edits in the existing sections. 2. Update of address and addition of revisions table. 3. Inclusion of the following sections: <ul style="list-style-type: none"> • Safe Use of ATEX approved equipment • Maintenance and procedures of return of equipment 	S. Kumar, J. Goodbread	29.10.2020
3.0	<ol style="list-style-type: none"> 1. Update of coil and PT1000 Ex relevant parameters (table 1). 2. Update of barrier specification (table 4, table 5). 	S. Kumar, J. Goodbread	30.09.2022
3.1	<ol style="list-style-type: none"> 1. Update of coil and PT1000 Ex relevant parameters (table 1). 	S. Kumar	23.02.2023