



## **PCS-302 and PCS-304 Measuring Chains Installation Manual**

**(P/N: 9438-09IGA-101)**

**This manual divides into the following sections:**

Section 1: Overview of the PCS-302 and PCS-304 Measuring Chains

Section 2: Installation of the PCS-302 / PCS-304 Universal Proximity Probe

Section 3: Installation of the extension cable for the PCS-302 / PCS-304 Universal Proximity Probe

Section 4: Signal verification





## TABLE OF CONTENTS

<b>1. PCS-302 AND PCS-304 MEASURING CHAINS OVERVIEW</b>	
1.1 Typical PCS-302/304 measuring chain installation .....	5
1.2 Safety information .....	6
<b>2. INSTALLATION OF PCS-302 &amp; PCS-304 MEASURING CHAINS</b>	
2.1 Preliminary considerations .....	9
2.1.1 Supplies needed .....	9
2.1.2 Tools needed.....	9
2.2 Installation of the PCS-302/PCS-304 probe .....	10
2.2.1 Choosing the probe location.....	10
2.2.2 Fabrication of a mounting bracket.....	11
2.2.3 Probe installation .....	12
2.3 General specifications of the PCS-302 and PCS-304 Universal Proximity Probes .....	13
<b>3. EXTENSION CABLE FOR PCS-302 AND PCS-304</b>	
3.1 Preliminary considerations .....	15
3.1.1 Supplies needed.....	16
3.1.2 Tools needed.....	16
3.2 Preparing an extension cable with a M12 connector .....	16
3.3 Extension cable installation .....	19
<b>4. PCS-302/PCS-304 SIGNAL</b>	
4.1 Signal verification.....	21



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## 1. PCS-302 AND PCS-304 MEASURING CHAINS OVERVIEW

### 1.1 Typical PCS-302/304 measuring chain installation

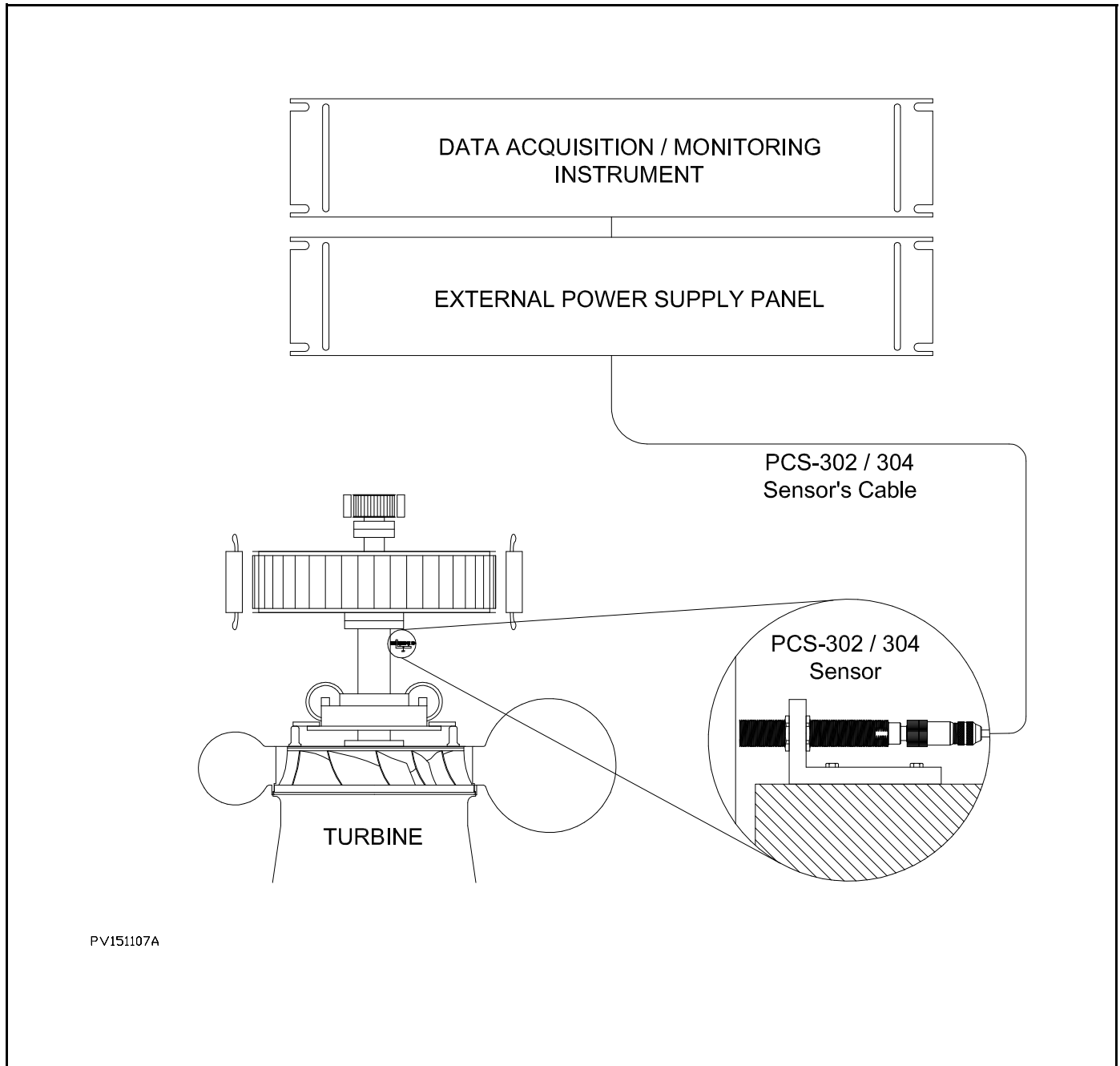


Figure 1 : Typical view of a PCS-30x sensor connected to a ZPU Acquisition Unit and/or PCU-100 Monitoring Unit via an XPSP External Power Supply Panel

Each measuring chain includes at least:


Qty	Description
1	PCS-302/304 Universal Proximity Probe
1	M12 connector for connection to power input and signal output cable (included with sensor)

The power input and signal output extension cable can be ordered as either a spool of unterminated cable or pre-assembled M12 cordset. Available options are:

Option	Description
A)	spool of 2-pair twisted and shielded copper cable
B)	Pre-assembled M12 cordset, straight or right angle connector, various lengths available

## 1.2 Safety information

This manual contains information and warnings that must be observed to keep the instruments in a safe condition and ensure safe operation.

 **Warning - Danger** messages identify conditions or practices that could cause bodily harm, and result in damage to the measuring chain and other equipment to which it is connected.

 **Caution** messages identify conditions or practices that could result in permanent loss of data.

### **Warning - Danger**    **Caution**

- To use the described measuring chains correctly and safely, read and follow all the safety instructions or warnings given throughout this manual.
- To avoid electric shock, personal injury, or death, carefully read the information under “Safety Information” before attempting to install, use, or service the measuring chains.
- In addition, follow all generally accepted safety practices and procedures required when working with and around electricity.
- For safe operation and to ensure that your system functions at its optimum capability, the installation and adjustment process should be handled only by VibroSystM trained service specialists.

- Although most instruments and accessories are normally used at non-hazardous level voltages, hazardous conditions may be present in some situations.
- This product is intended for use by qualified operators and maintenance personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product.
- Install and use the measuring chains only as specified in this manual, or the protection provided by the measuring chain might be impaired.
- Do not use this instrument in wet environments.



- Whenever it is likely that safety protection has been impaired, make this instrument inoperative and secure it against any unintended operation.
- Have this instrument serviced only by qualified service personnel.
- To avoid shock hazard, connect the power supply to a properly grounded line power source. If a two-conductor power cord must be used, a protective grounding wire must be connected between the ground terminal and earth ground before connecting the power cord or operating the instrument.
- Use caution when working with voltages above 30 V<sub>AC</sub> rms, 42 V<sub>AC</sub> peak, or 42 V<sub>DC</sub>, as these voltages pose a shock hazard.
- Safety and electrical symbols that appear in this manual and on the material:



**Warning - Danger** - identify conditions or practices that could cause bodily harm, and result in damage to the measuring chain and other equipment to which it is connected. Conditions include a risk of electric shock (voltage > 30 V<sub>DC</sub> or V<sub>AC</sub> peak might be present).



**Caution** - identify conditions or practices that could result in permanent loss of data.



Important information.





## 2. INSTALLATION OF PCS-302 & PCS-304 MEASURING CHAINS

### 2.1 Preliminary considerations



Figure 2 : PCS-302 proximity probe with jam nuts and connector

- The PCS-302 and PCS-304 high-precision capacitive technology proximity probes are primarily designed to measure relative shaft vibration.
- These probes can also be used to analyze the vibrating motion of any structure made of a conducting or semi-conducting material such as a metal plate.

- The maximum length of the extension cable is 300 m (984 ft.).
- There is no physical contact between the probe and the conductive surface which acts as its target.
- The probe must be electrically grounded.
- The mounting bracket must be stiff.
- If the sensor is installed on an insulated bearing, special care must be taken to preserve the insulation of the bearing.
- The surface for which a vibration measurement is required (the target facing the PCS-302 or PCS-302) must consist of a conductive or semi-conductive material.
- The gap between the target and the surface of the probe should always remain within the following range:
  - between 300 and 2300  $\mu\text{m}$  [12 to 92 mils] for the PCS-302 probe
  - between 500 and 4500  $\mu\text{m}$  [20 to 177 mils] for the PCS-304 probe

#### 2.1.1 Supplies needed

- probe with:
  - (1) M12 mating connector
  - (2) M20 nuts
- Liquid thread locking compound (Loctite)
- Mounting bracket (not included)

#### 2.1.2 Tools needed

- filler gauge:
  - 1.3 mm [52 mils] for PCS-302
  - 2.5 mm [99 mils] for PCS-304
- 24 mm open-end wrench
- small flat screwdriver
- multimeter

## 2.2 Installation of the PCS-302/PCS-304 probe

Installation of a PCS-302/PCS-304 probe involves the following steps:

- identifying clearly the location where the vibrations of interest occur;
- designing a mounting bracket;
- installing the probe and the mounting bracket;
- connecting the probe;
- verifying the signal.

### 2.2.1 Choosing the probe location

The location where the measurements must be taken has to be determined with respect to the following:

1. The surface for which a vibration measurement is required (the target facing the PCS-302/PCS-304) must be a conductive or semi-conductive material.
2. The gap between the target and the surface of the probe should always fall between the following values:

PCS-302 : 300 and 2300  $\mu\text{m}$  [12 to 92 mils]  
 PCS-304 : 500 and 4500  $\mu\text{m}$  [20 to 177 mils]

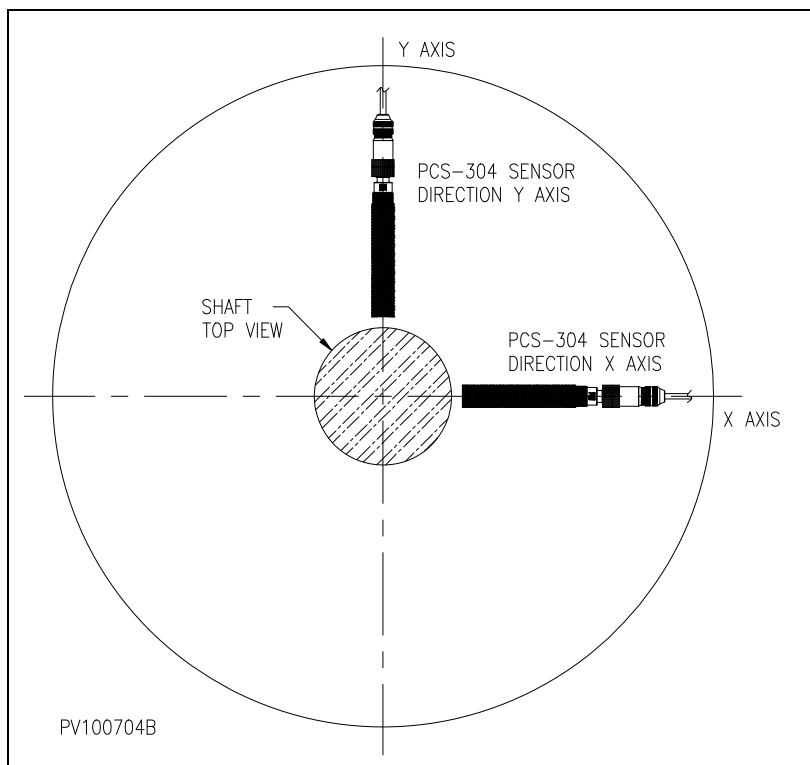


Figure 3 : Typical installation to measure relative shaft vibration

## 2.2.2 Fabrication of a mounting bracket

The capacitive principle of the probe requires that the probe housing be electrically grounded. An efficient ground will usually be achieved by following certain basic precautions during installation, including:

- avoiding the use of paint or any other sealant in and around the mounting holes of the bracket to ensure permanent electrical contact between probe shell, mounting bracket and machine;
- in cases where direct electrical ground through the mounting bracket can not be achieved (mounted on a concrete surface, for example) run an AWG 16 copper wire, as short as possible, between the mounting bracket and stator wall.

 **Caution**

If the sensor is installed on an insulated bearing, special care must be taken to preserve the insulation of the bearing.

The most widely recommended mounting method consists in placing a 1.6 mm [0.063"] thick mica sheet or other insulating material (such as FR4) between mounting bracket and bearing cover, using non-metallic screws.

Consider the following when designing the mounting support:

- Every effort must be put into installing the mounting bracket on a stable surface, free of any motion;
- The outer diameter of the probe is 20 mm [0.787"]. Drill a 21 mm [13/16"] diameter hole in the mounting plate to install the probe using two mounting nuts;
- The bracket must be stiff to avoid undesired vibration. Avoid thin bars. Furthermore, every effort must be put into installing the bracket on a stable surface, free of any motion. Use A36 steel, 10 to 13 mm thick [3/8" to 1/2"], is recommended. If need be, use lateral reinforcement to increase bracket stiffness.

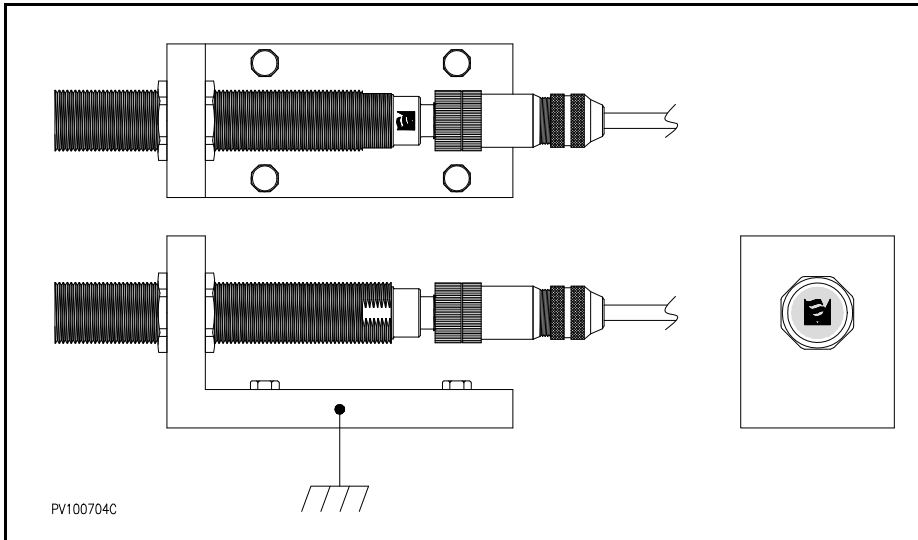


Figure 4 : Typical grounded mounting bracket

## Caution

The sensor face must be perfectly parallel to the target surface.

### 2.2.3 Probe installation

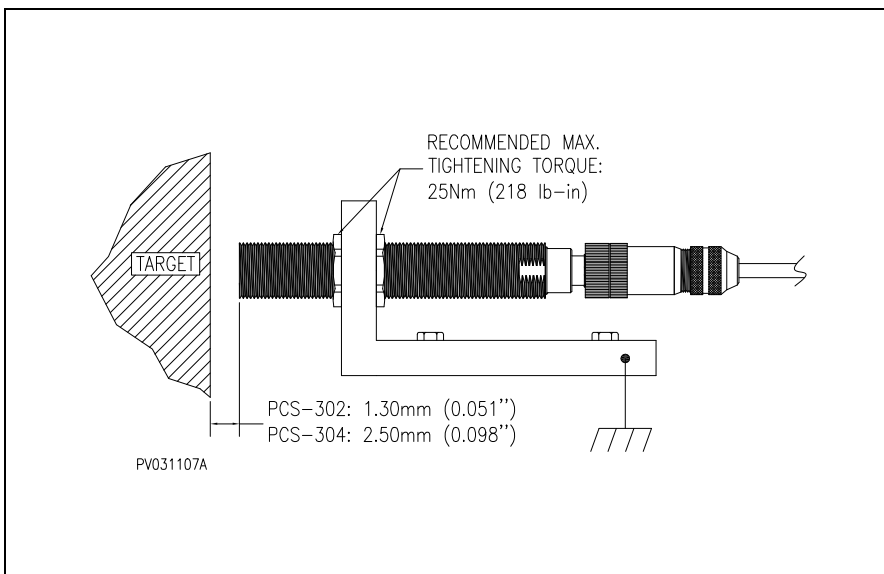


Figure 5 : Initial adjustment at installation for PCS-302 and PCS-304 probes

1. Firmly fasten the mounting bracket to the structure. Make sure it is precisely aligned.
2. Install the sensor away from the target using a filler gauge to measure the proper distance.  
PCS-302: 1.3 mm [51 mils]  
PCS-304: 2.5 mm [98 mils]
3. Secure with mounting nuts.



Once all eventual adjustments have been made and the signal has been validated (refer to the formula found in **Step 5) Verifying the Signal**), apply glue or liquid thread locking compound on the probe threads to prevent mounting nuts from loosening.

## 2.3 General specifications of the PCS-302 and PCS-304 Universal Proximity Probes

### Operation

- Type of measurement Non-contact proximity, capacitive technology
- Measuring range
  - PCS-302: 2 mm / 0.3 to 2.3 mm [80 mils / 12 to 92 mils]
  - PCS-304: 4 mm / 0.5 to 4.5 mm [157 mils / 20 to 177 mils]
- Output signal 4 to 20 mA
  - PCS-302:  $(d_{(mm)} = (I_{out} - 4) / 8 + 0.3)$
  - PCS-304:  $(d_{(mm)} = (I_{out} - 4) / 4 + 0.5)$
- Accuracy
  - PCS-302: < 25  $\mu\text{m}$  @ 25°C [77°F]
  - PCS-304: <100  $\mu\text{m}$  @ 25°C [77°F]
- Repeatability <0.3 % of reading
- Sensitivity
  - PCS-302: 8  $\mu\text{A}/\mu\text{m}$
  - PCS-304: 5  $\mu\text{A}/\mu\text{m}$
- Resolution
  - PCS-302: 5  $\mu\text{m}$  at mid-range
  - PCS-304: 10  $\mu\text{m}$  at mid-range
- Frequency response 0 to 1 kHz (-3 dB)
- Temperature drift <500 ppm / °C

### Power requirements

- Type External
- Voltage +24 V<sub>DC</sub> ,  $\pm 15\%$ ,
- Consumption 60 mA including the 20 mA output signal
- Protection Overload and reverse polarity

### Connection

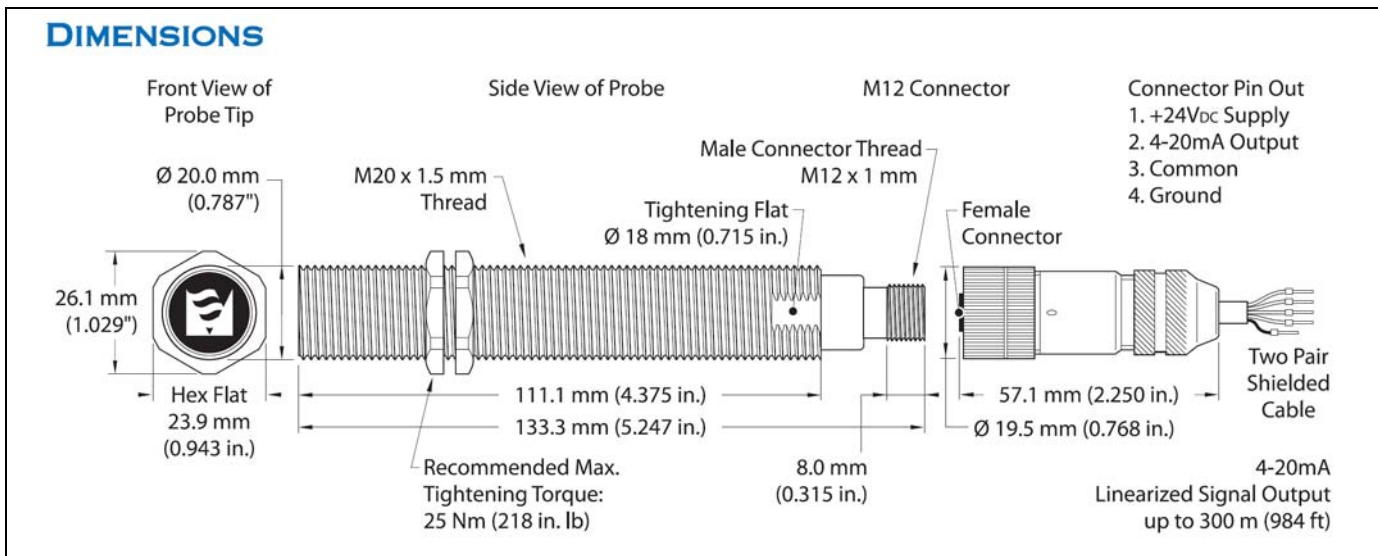
- Connector M12, 4-pin
- Cable
  - Type: 2-pair shielded
  - Length (max.): 300 m [984 ft.]

## Environmental

- Temperature Range:
  - operating -0° to 60°C [32° to 140°F]
  - storage: -25° to 85°C [-13° to 185°F]
- Humidity up to 95%, noncondensing

## Physical characteristics

- Probe body Chrome-plated brass
- Probe overall dimensions:
  - Diameter 20 mm [0.79 in.]
  - Length 133.3 mm [5.24 in.]
- Thread M20 x 1.5 mm
- Hex nut dimension
  - Hex flat 23.9 mm [0.94 in.]
  - Thickness 3.6 mm [0.12 in.]



## 3. EXTENSION CABLE FOR PCS-302 AND PCS-304

### 3.1 Preliminary considerations



Figure 6 : Standard preassembled M12 cable

- Either a standard preassembled or custom fabricated M12 extension cable can be used to connect PCS-302 and PCS-304 probes. Installation of this cable usually follows that of the probe.
- The length of the standard preassembled M12 extension cable is 30m [100 ft.]. This cable can withstand heat up to 80° C (176° F). Since calibration is not a factor, the cable may be cut or extended as needed.



Figure 7 : Shielded twisted pair cable and M12 connector

- For longer distances (up to 300 m [984 ft]), a custom extension cable can be assembled, using shielded twisted-pair cable (typically Belden #9940) and an M12 connector.
- The extension cable should be mechanically protected by flexible or semi-rigid conduit along its whole length, up to the XPSP External Power Supply panel.

#### **Caution**

On some models of molded cables, the M12 connector is equipped with an internal ratchet element preventing unintentional loosening of the compression nut. M12 connectors with this feature produce a clicking sound when turning the compression nut.

When the ratchet mechanical device is present, make sure the coupling nut is well tightened, and the connector is correctly seated. A firm finger-tight connection suffice to prevent loosening.

### 3.1.1 Supplies needed

- M12 extension cable (standard preassembled, or field assembled)
- flexible or semi-rigid protection conduit (not included)
- conduit straps (not included)

### 3.1.2 Tools needed

- protection conduit cutting tool
- fish tape
- drill, assorted taps and drill bits
- cable cutting/stripping tool
- miniature flat screwdriver

## 3.2 Preparing an extension cable with a M12 connector

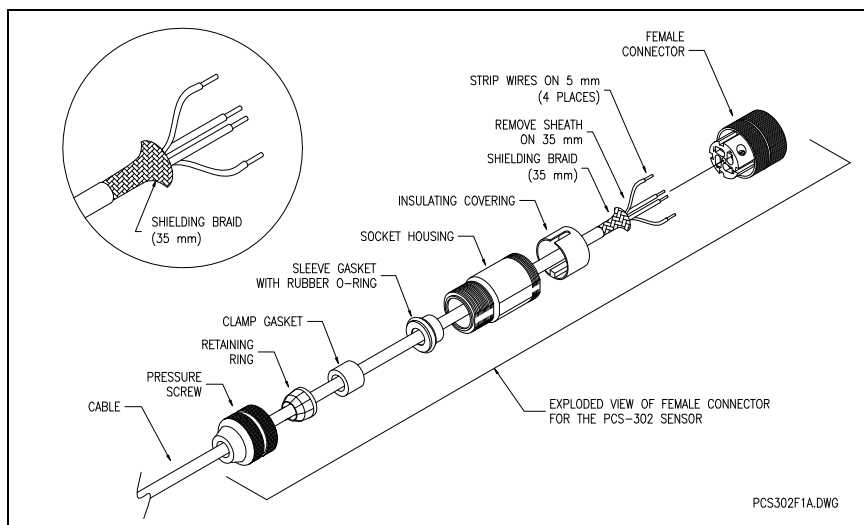


Figure 8 : M12 connector assembly

1. Slip the components on the cable as shown: pressure screw, retaining ring, clamp gasket, and sleeve gasket with o-ring.
2. Remove the external jacket of the cable on a length of 35 mm [1 3/8"]
3. Push shielding braid back.
4. Remove foil and nylon thread (under the shielding braid).
5. Strip 5 mm [1/4"] off the insulation of the wires.

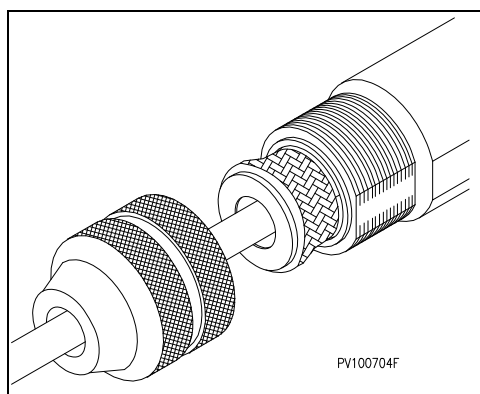


Figure 9 : Folded shielding braid

6. Stretch end of shielding braid and fold back on the sleeve gasket. Make sure that the shielding braid is correctly folded and covers the sleeve gasket all around. This step is very important to prevent EMI problems.
7. Slip the socket housing over the cable and push the sleeve gasket down into the socket housing, pressing the folded shielding braid inside the socket housing. Make sure that the shielding braid is not overlapping the o-ring on the sleeve gasket.



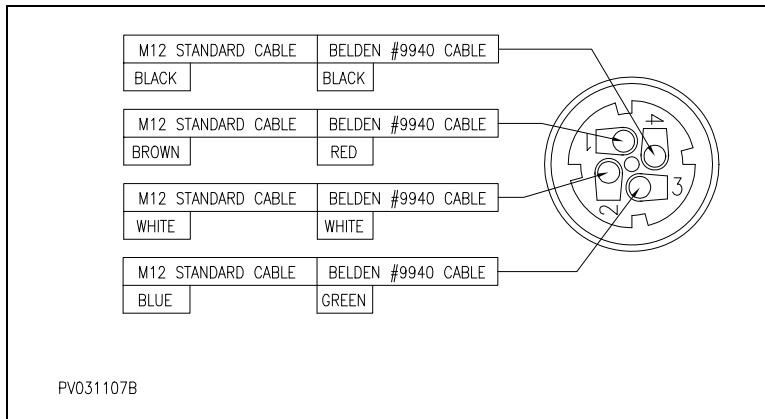
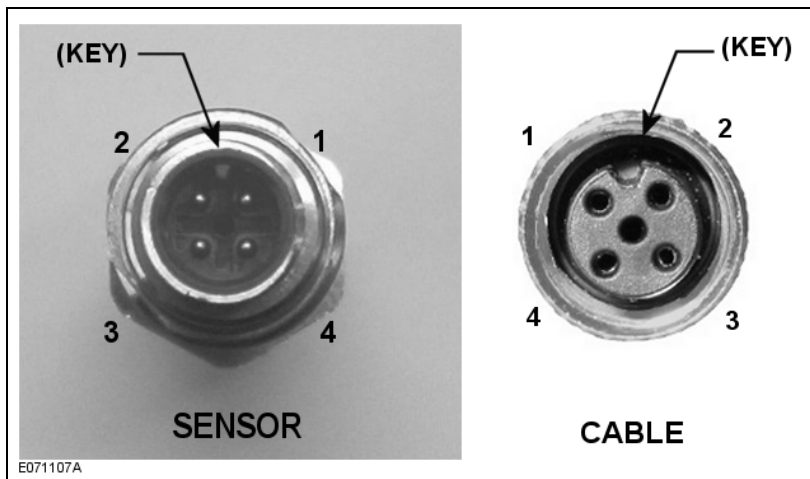


Figure 10 : Wiring the connector to the M12 female connector

8. Tighten the pressure screw on the back of the socket housing, making sure the cable is firmly secured.
9. Connect the four wires to female connector according to Figure 10 : "Wiring the connector to the M12 female connector".
10. Tighten the female connector firmly on the socket housing.



The M12 connector pinout is shown in Figure 10 : "Wiring the connector to the M12 female connector" and Table 1 : "Extension cable pinout".

Table 1: Extension cable pinout

Pin #	Standard pre-assembled 30 m (100 ft.) M12 extension cable	Belden cable #9940* for field assembly	Designation	Specifications
1	Brown	Red	+24V	+24 VDC approx. +/- 15%
2	White	White	lout	4-20 mA output signal
3	Blue	Green	lout-return	Signal common
4	Black	Black	GND	Common power supply and ground

Note\*: Belden cable #9940 can be replaced by any cable with similar characteristics.

**⚠ Caution**

Unless the sensor is installed on an insulated structure (such as an insulated bearing), the shield must not be connected on the monitoring / acquisition unit end.

To avoid ground loops, the extension cable shield must be grounded at one end only. On both field assembled and pre-assembled cables, the shielding braid is in contact with the connector outer shell, thus ensuring adequate grounding when the cable is connected to the sensor. Do not connect the other end of the cable shield (on the receiving instrument side).

**a) Installation with direct grounding**

The sensor's housing is grounded through the mounting bracket; the cable's shield must not be connected on the monitoring instrument's end.

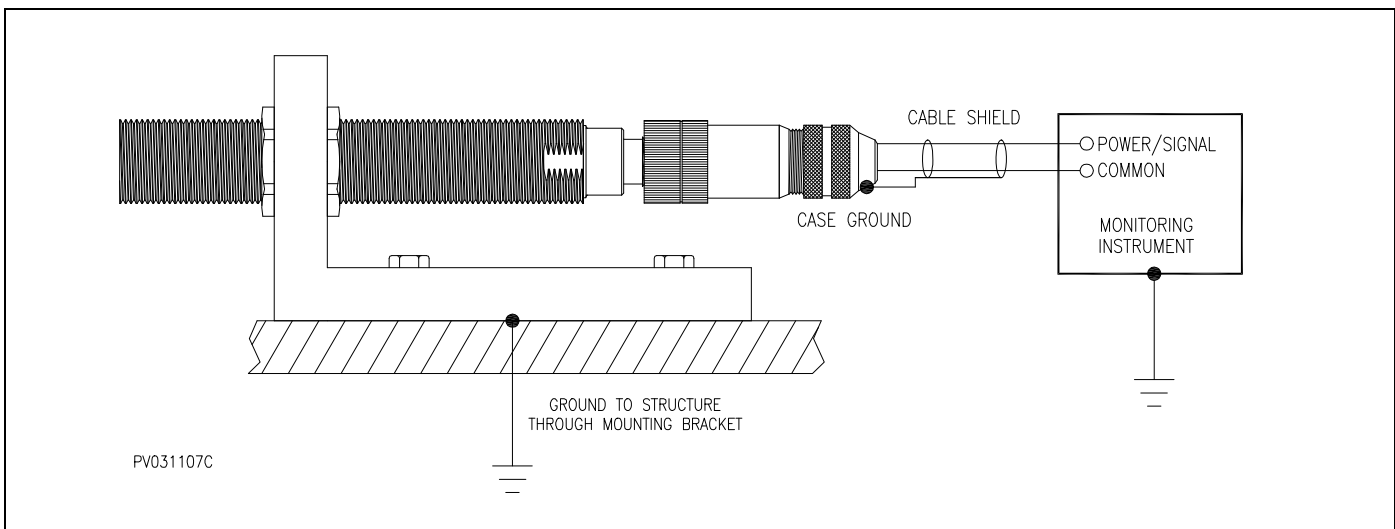


Figure 11 : Sensor grounded through bracket

**b) Installation on an insulated bearing**

The sensor's housing is insulated from ground: since the cable shield is not in contact with ground at the sensor's end, it must be connected to ground on the monitoring instrument's end.

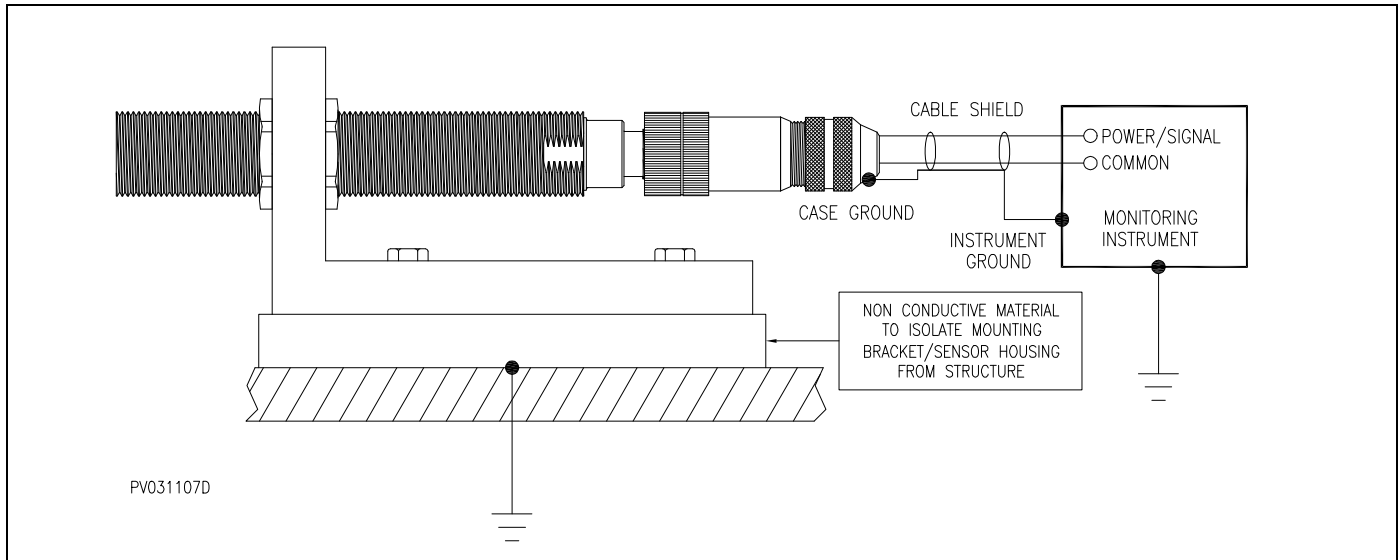


Figure 12 : Sensor installation on an insulated bearing

### 3.3 Extension cable installation

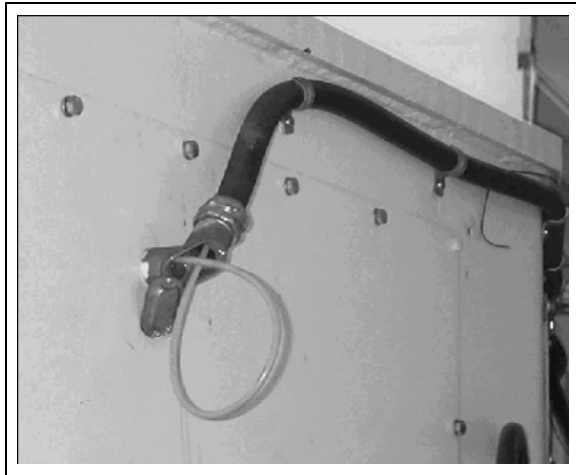


Figure 13 : Pulling a cable inside a flexible conduit.

1. Install a protective conduit between the sensor and the instrumentation cabinet. Protective conduits must be secured with clips on their whole length and connectors at each end.

The maximal length for the cable between the PCS-302 / PCS-304 sensor and the monitoring / acquisition unit is 300m (984 ft).

With a fish tape, pull the cable into the protection conduit with the M12 connector on the sensor end.

Any cable excess can be cut or simply coiled and stored inside the instrumentation cabinet.



## 4. PCS-302/PCS-304 SIGNAL

### 4.1 Signal verification

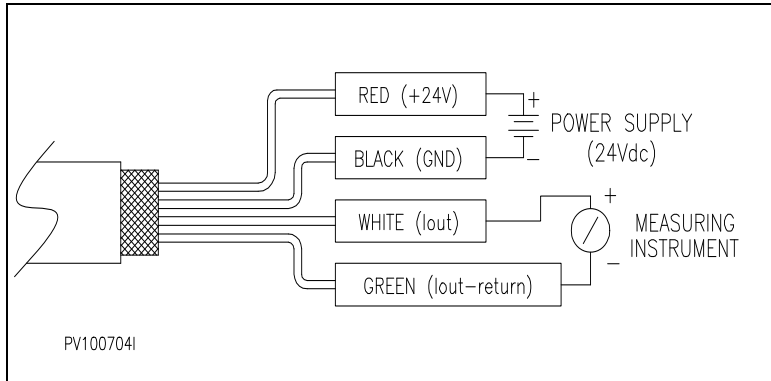


Figure 14 : Measuring the current output

1. Apply 24 VDC supply and connect the current output of the PCS-302/PCS-304 probe to a multimeter (mA mode) on the acquisition side as shown. Check the reading: the signal should be approximately 12 mA. Adjust the mounting nuts as needed. Once the signal has been validated, remember to apply drops of glue or liquid thread locking compound on both mounting nuts to prevent loosening.

With the sensor placed at mid-range distance as recommended during installation (1.3 mm [52 mils] for PCS-302, or 2.5 mm [98mils] for PCS-304), current output should read approximately 12 mA.

Calculated output formula for PCS-302 sensor:

$$\text{distance (mm)} = [ (I_{\text{out}} \text{ (mA)} - 4) / 8 ] + 0.3$$

$$\text{distance (mils)} = [ (I_{\text{out}} \text{ (mA)} - 4) * 5 ] + 12$$

Calculated output formula for PCS-304 sensor:

$$\text{distance (mm)} = [ (I_{\text{out}} \text{ (mA)} - 4) / 4 ] + 0.5$$

$$\text{distance (mils)} = [ (I_{\text{out}} \text{ (mA)} - 4) * 9.8125 ] + 20$$

