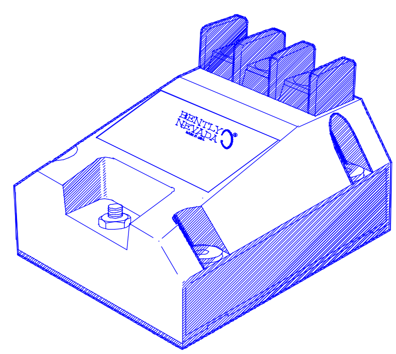
Part number 86130-01
Revision U, November 1999

3300 5 mm and 8 mm PROXIMITY TRANSDUCER SYSTEM

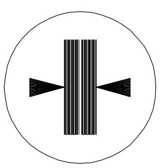
MANUAL

BENTLY NEVADA®
MADE IN U.S.A.

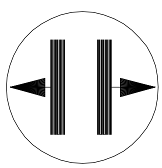


Bently Nevada Corporation
1617 Water Street
Minden, Nevada 89423 USA
Telephone (800) 227-5514 or (775) 782-3611
Fax (775) 782-9259

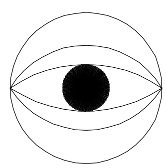
This manual uses the following symbols to indicate actions in maintenance and troubleshooting procedures.



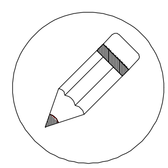
Connect



Disconnect



Observe



Record

Contents

Related Documents

The following documents contain additional information that you may find helpful when you install the transducer.

Installing the Transducer

Best Practices Document - Proximity Probes and Related Accessories: The Installation and Application of Eddy Current Proximity Transducers (AN028).

Guidelines for Grounding (Earthing) Bently Nevada Rotating Machinery Information Systems (AN013).

Installation of Electrical Equipment in Hazardous Areas (AN015).

Transducer Installation Accessories

31000/32000 Proximity Probe Housing Manual (124200-01).

Electrical and Mechanical Runout

“Glitch”: Definition of and Methods for Correction, Including Shaft Burnishing to Remove Electrical Runout (AN002).

API 670, Third Edition, Section 4.1.2: Machine Shaft Requirements for Electrical and Mechanical Runout. Available from the American Petroleum Institute, Publications and Distribution, 1220 L Street NW, Washington DC, 20005, USA.

Reference

Performance Specifications for the 3300 5 mm and 8 mm Transducer System (155687).

Bently Nevada Glossary (133055-01).

European CE Mark for Bently Nevada Proximity Transducer Systems (AN072) (included in this manual).

Section 1 — System Description

The 3300 Series Proximity Transducer System measures machine vibration and the position of a shaft or other machine part relative to the location of the probe tip. The system consists of a 5 mm or 8 mm proximity probe, an extension cable and a Proximitor® sensor.

The components of the 3300 Transducer System are designed to work as a single unit and are calibrated for a target material that is AISI 4140 steel. The system measures displacement by using the eddy current principle and provides a negative voltage proportional to the distance between the target and the probe tip. This voltage signal may be applied to a monitor, portable instrumentation or diagnostic equipment.

Application Advisory

The 3300 Proximity Transducer is designed for measuring position or vibration within a frequency range of 0 to 6.5 kHz. Typical applications of this system include radial vibration and position, axial position and Keyphasor® measurements.

Application Alert

Although the terminals and connector on the Proximitor® sensor have protection against electrostatic discharge, take reasonable precautions to avoid electrostatic discharge during handling.

Receiving, Inspecting, and Handling the System

The probe, extension cable and Proximitor® sensor are shipped as separate units and must be interconnected at the installation site by the user. Carefully remove all equipment from the shipping containers and inspect the equipment for shipping damage. If shipping damage is apparent, file a claim with the carrier and submit a copy to the nearest Bently Nevada office. Include part numbers and serial numbers on all correspondence. If no damage is apparent and the equipment is not going to be used immediately, return the equipment to the shipping containers and reseal until ready for use.

Store the equipment in an environment free from potentially damaging conditions such as high temperature or a corrosive atmosphere. See Specifications, pages 21, 23 and 24 for environmental specifications.

Customer Service

Bently Nevada provides product service throughout the world. If you cannot contact your local product service representative, call the Bently Nevada corporate headquarters:

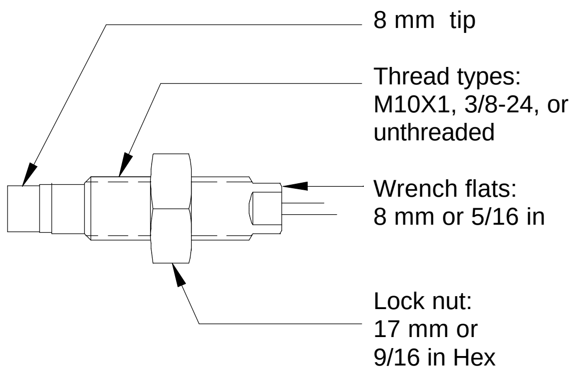
Toll Free from within the United States: 800-227-5514
or from anywhere: 702-782-3611

Section 2 — Installation

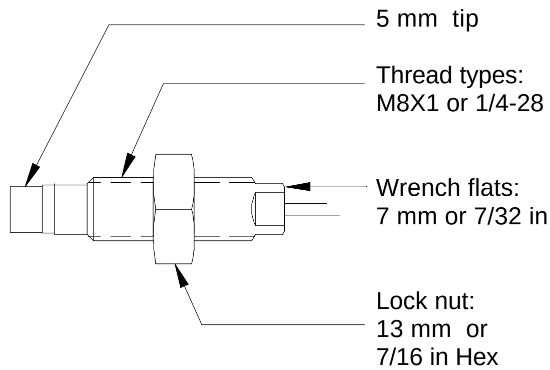
This section contains a checklist of items that you must consider when you install a 3300 Transducer system. For detailed information about designing installations for specific applications refer to document AN028.

Installing the Probe

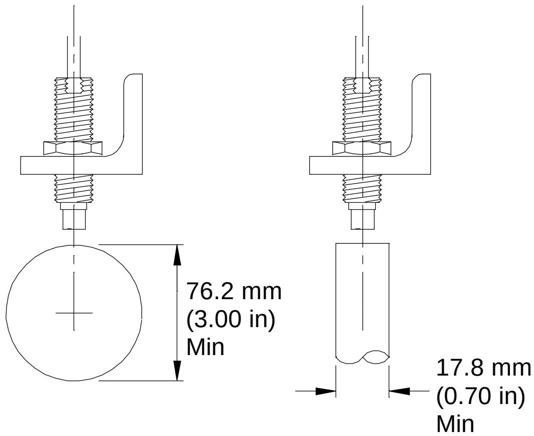
The following figures show the probe sizes and the minimum values for probe separation, side clearance and target configuration. Refer to Specifications for proper torque and the dimensions of the thread.



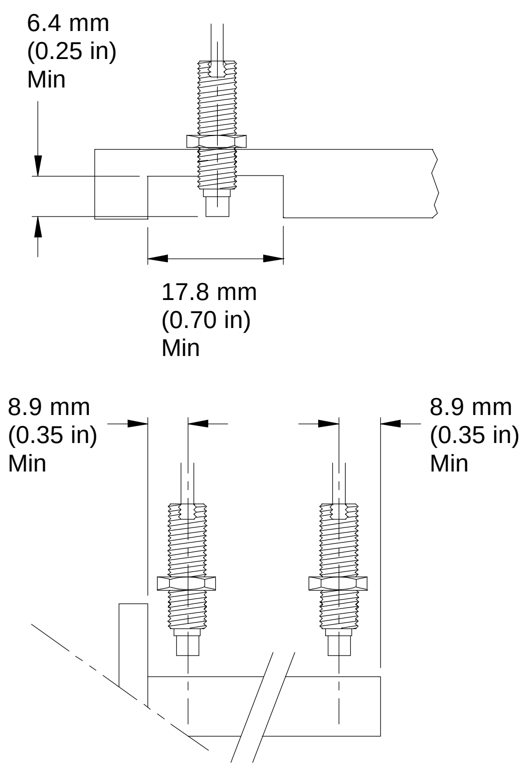
8 mm Probe Sizes



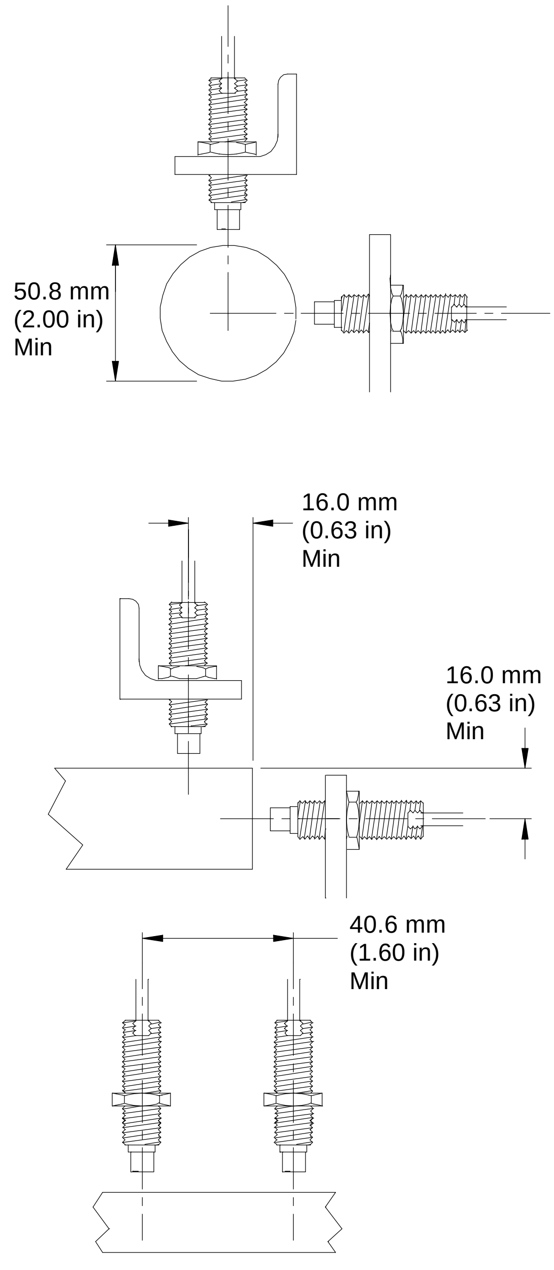
5 mm Probe Sizes



**5 mm & 8 mm Probe
Target Sizes**



**5 mm & 8 mm Probe
Mounting Dimensions**

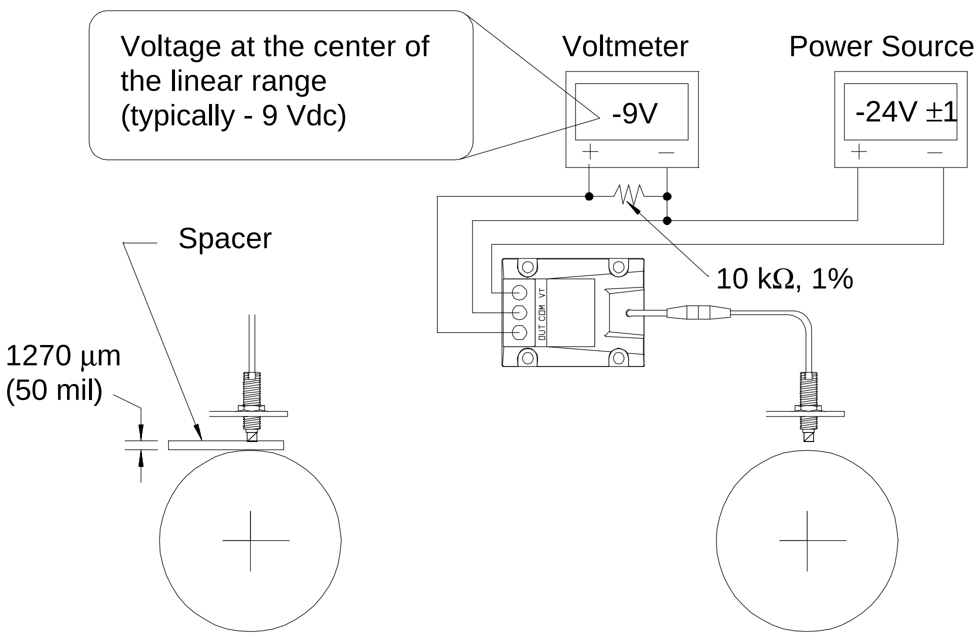


**5 mm & 8 mm Probe-to-Probe
Separation Due to Cross Talk**

Application Alert

Mounting dimensions and target size affect the scale factor of proximity transducer systems. The minimum recommended dimensions above were chosen to minimize error yet retain flexibility for different mounting situations. Consult performance specification 155687 to determine the effect of each of the above factors for your particular installation.

Adjust the distance between the probe tip and the shaft using one of the methods shown in the following figure. The electrical method for setting the probe gap is preferred. (Refer to document AN028.)

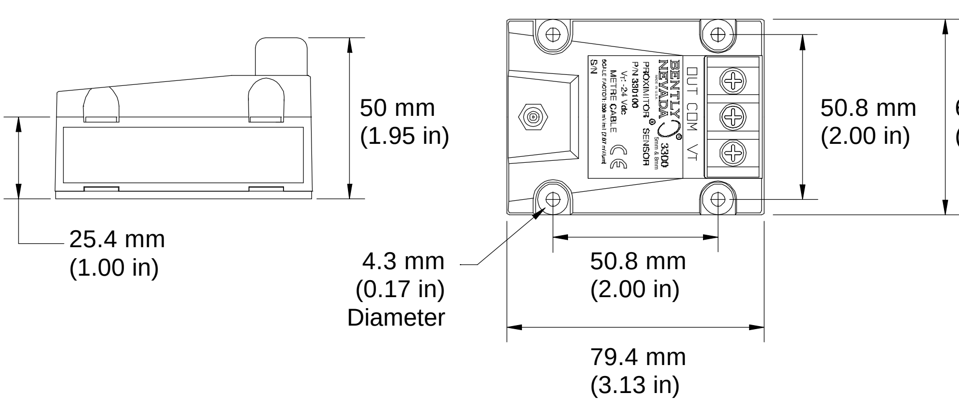


Mechanical Method

Electrical Method (preferred)

Mounting the Proximitor® Sensor

Mount the Proximitor® sensor in a location that is compatible with its environmental specifications (page 21).   Consider the local electrical codes and the presence of hazardous or explosive gas at the installation site. (Refer to document AN015.)



Routing the Extension Cable and Field Wiring

Route the extension cable using the following guidelines. (Refer to document AN028).

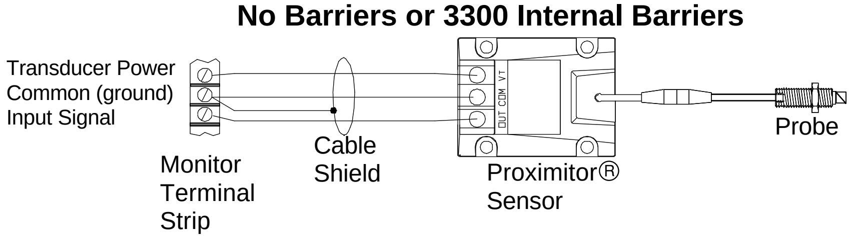
- Check that the extension cable and probe lead length add to equal the Proximitor® sensor system length. (For example, a 9 metre Proximitor® sensor will work with an 8 metre extension cable and a 1 metre probe.)
- Secure the extension cable to supporting surfaces by using mounting clips or similar devices.
- Identify the probe and both ends of the extension cable by inserting labels under the clear Teflon sleeves and applying heat to shrink the tubing.
- Join the coax connectors between the Proximitor® sensor, extension cable and probe lead. Tighten connectors as follows:

Connector Type	Tightening Instruction
Two 3300 XL gold "click" type connectors	Finger tight
Two non-XL connectors ("non-click") or one non-XL connector and one 3300 XL connector	Finger tight plus 1/8 turn using pliers

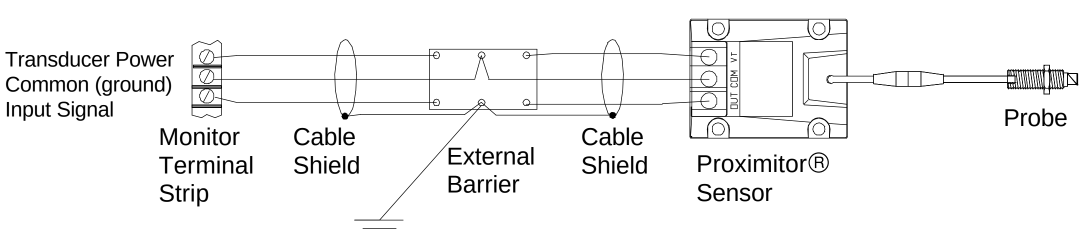
- Use either a connector protector or self-fusing silicone tape to insulate the connection between the probe lead and the extension cable. DO NOT use self-fusing silicone tape to insulate a connection made inside of a machine.
- If the probe is in a part of the machine that is under pressure or vacuum, seal the hole where the extension cable leaves the machine by using appropriate cable seals and terminal boxes.

Use the following wiring diagrams to connect the field wiring between the Proximitor® sensor and the monitoring instruments. (Refer to documents AN013 and AN015.)

No Barriers or 3300 Internal Barriers



External Barriers



Section 3 — Maintenance and Troubleshooting

This section shows how to verify that the system is operating properly, adjust the system and identify parts of the system that are not working properly.

The transducer system does not require verification at regular intervals. You should, however, verify operation by using the scale factor verification on page 7 if any of the following conditions occur:

- components of the system are replaced or disturbed
- the performance of the system changes or becomes erratic
- you suspect that the transducer is not calibrated correctly

Use the adjustment procedure on pages 8 through 10 when a special calibration is required. For target materials other than AISI 4140 steel and for other special applications, contact your local Bently Nevada office.

> **Note: Hazardous Locations**
> Area must be free of hazardous material before any maintenance or troubleshooting can be performed.

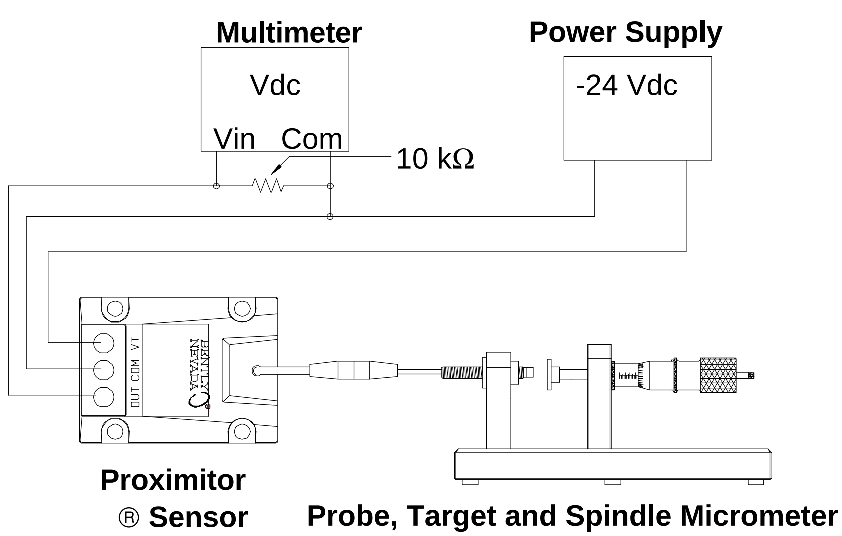
The scale factor verification and the adjustment procedure require the following instruments and equipment:

Digital multimeter	spindle micrometer	fixed resistor, 10 kΩ 1%
soldering iron and solder	power supply (-24Vdc ±1)	

The special calibration procedure requires the following additional items:

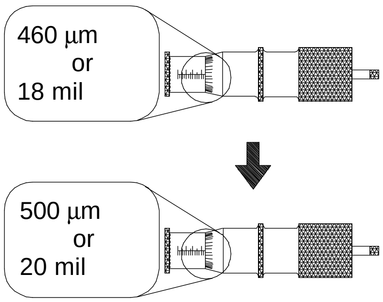
variable resistor, 0 to 100 kΩ
vulcanizing compound (for example, Dow 3110 RTV)

The scale factor verification and the adjustment procedure both use the test setup as shown in the following figure:



Scale Factor Verification

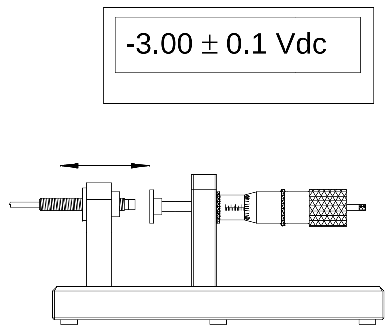
1



Compensate for mechanical backlash and adjust the spindle micrometer for electrical zero.

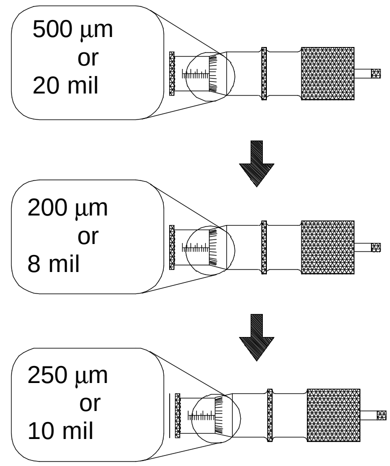
2

Multimeter



Adjust gap to electrical zero by moving the probe.

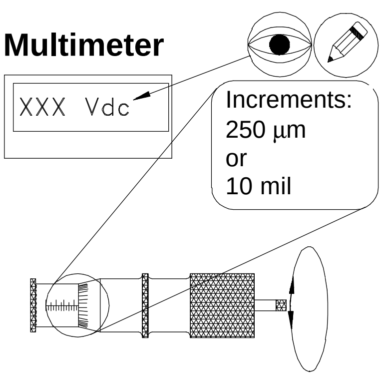
3



Compensate for mechanical backlash in the micrometer and adjust to the start of the linear range.

4

Multimeter



	Adjust Micrometer to...		**Record Voltages**	**Calculate Scale Factor**	
n	**μm_n**	**or mil_n**	**Vdc_n**	**ISF_n (Incremental Scale Factor)**	**ASF (Average Scale Factor)**
1	250	10	________		
2	500	20	________	________	
3	750	30	________	________	
4	1000	40	________	________	
5	1250	50	________	________	
6	1500	60	________	________	
7	1750	70	________	________	
8	2000	80	________	________	
9	2250	90	________	________	________

$$ISF_{n\ (mV/\mu m)} = \frac{Vdc_{n-1} - Vdc_{n}}{0.25}$$

$$ASF_{(mV/\mu m)} = \frac{Vdc_{250\ \mu m} - Vdc_{2250\ \mu m}}{2}$$

$$ISF_{n\ (mV/mil)} = \frac{Vdc_{n-1} - Vdc_{n}}{0.01}$$

$$ASF_{(mV/mil)} = \frac{Vdc_{10\ mil} - Vdc_{90\ mil}}{0.08}$$

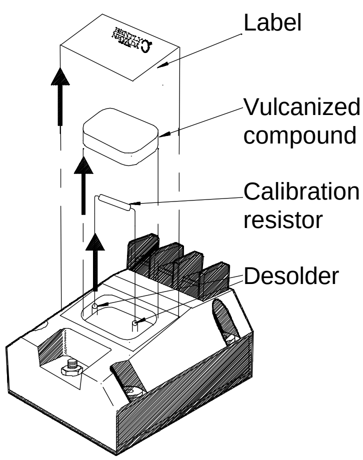
If the incremental scale factor (ISF) or the average scale factor (ASF) of the system is out of tolerance, contact Bently Nevada Corporation for further information on possible calibration problems or perform the following adjustment.

Adjustment Procedure

Application Alert

Electrostatic discharge on the exposed calibration resistor terminals can cause the accuracy of the system to go out of specification or cause the system to fail. Use a grounding strap or equivalent precaution during this procedure.

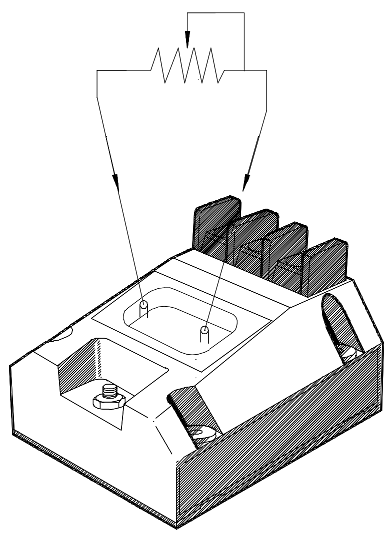
1



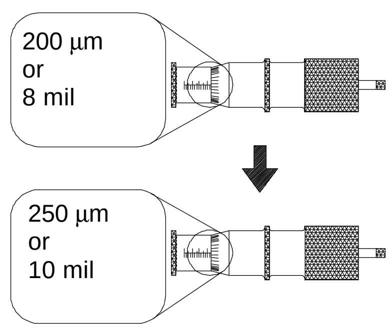
Use a grounded tip soldering iron with less than a 60 watt rating. Leave the iron in contact with the Proximitor® sensor terminal for less than 10 seconds.

2

Attach a 0 to 100 kΩ variable resistor.

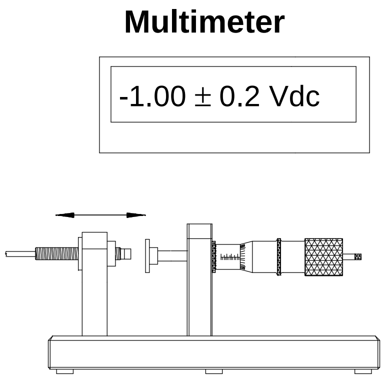


3



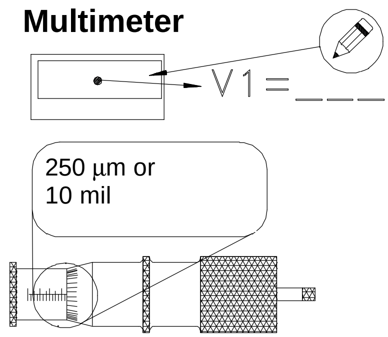
Compensate for mechanical backlash in the micrometer and adjust to start of the linear range.

4

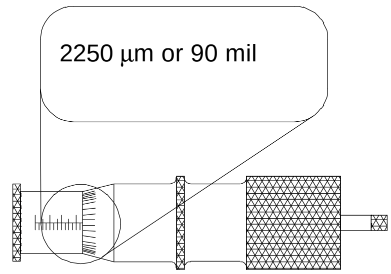


Adjust gap by moving the probe for an output of -1.00 ± 0.20 Vdc.

5

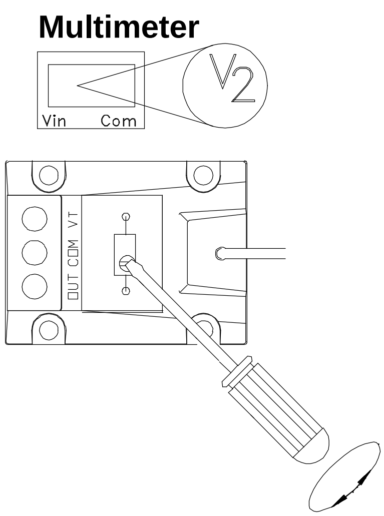


6



Set micrometer to end of the linear range.

7



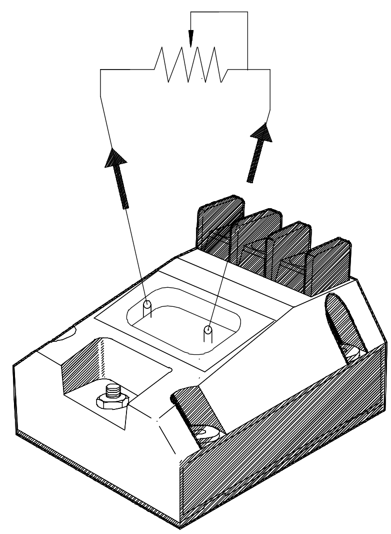
Adjust the variable resistor until the measured voltage (V2) equals

$(-|V_1| - 16\ \text{Vdc}) \pm 0.16\ \text{Vdc}$

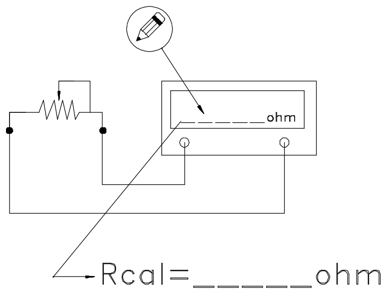
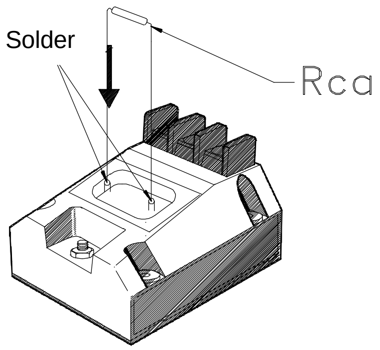
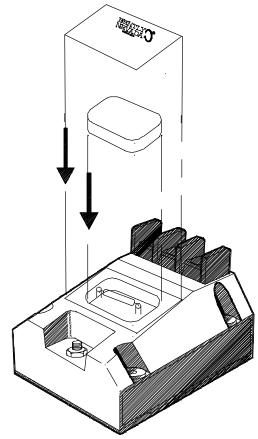
8

Repeat steps 3 through 7 until the variable resistor is not changed.

9



Remove variable resistor.

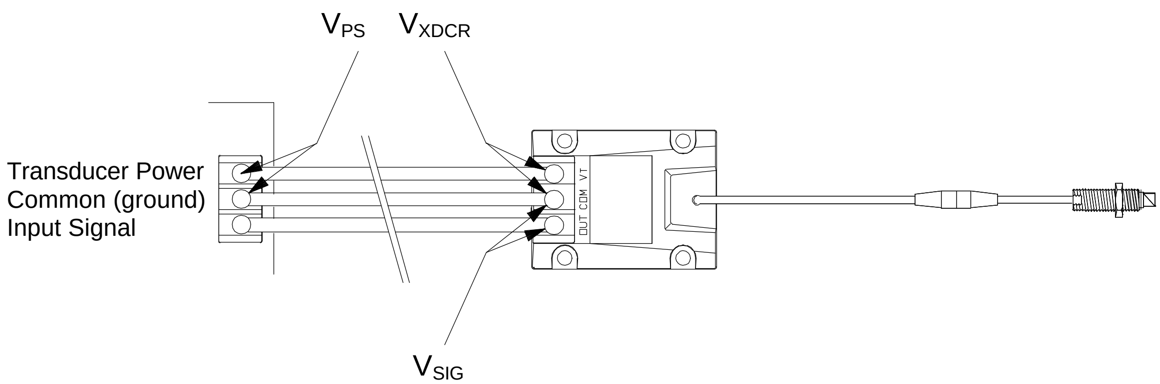
10	11	12
		
Measure and record variable resistor value.	Select a fixed calibration resistor (R_{cal}) based on the variable resistor value. The calibration resistor must have a tolerance of ±1% or better. Solder into place.	Let cool 10 minutes then perform scale factor verification test.

Troubleshooting

This section shows how to interpret a fault indication and isolate faults in an installed transducer system. Before beginning this procedure, be sure the system has been installed correctly and all connectors have been secured properly in the correct locations.

When a malfunction occurs, locate the appropriate fault, check the probable causes for the fault indication, and follow the procedure to isolate and correct the fault. Use a digital voltmeter to measure voltage. If you find faulty transducers, contact your local Bently Nevada Corporation office for assistance.

The troubleshooting procedures use measured voltages as shown in the following figure and tables:



Symbols for Measured Voltages

Symbol	Meaning	Voltage measured between...
V_{SIG}	Signal voltage from the transducer	OUT and COM
V_{PS}	Power supply voltage	Power Source and Common
V_{XDCR}	Supply voltage at transducer	-VT and COM

Note: V_{SIG}, V_{PS}, and V_{XDCR} are all negative voltage values.

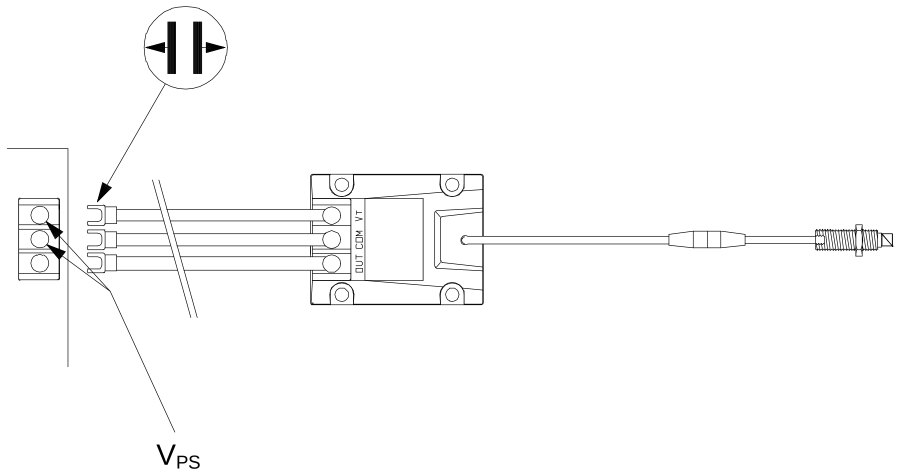
Definitions

Symbol	Definition	Example
A > B	"A" value is more positive than "B"	-21 > -23
A < B	"A" value is more negative than "B"	-12 < -5
A = B	"A" same value (or very close) to "B"	-24.1 = -24.0

Fault Type 1: V_{XDCR} > -17.5 Vdc or V_{XDCR} < -26 Vdc

Possible causes:

- Faulty power source
- Faulty field wiring
- Faulty Proximitor® sensor

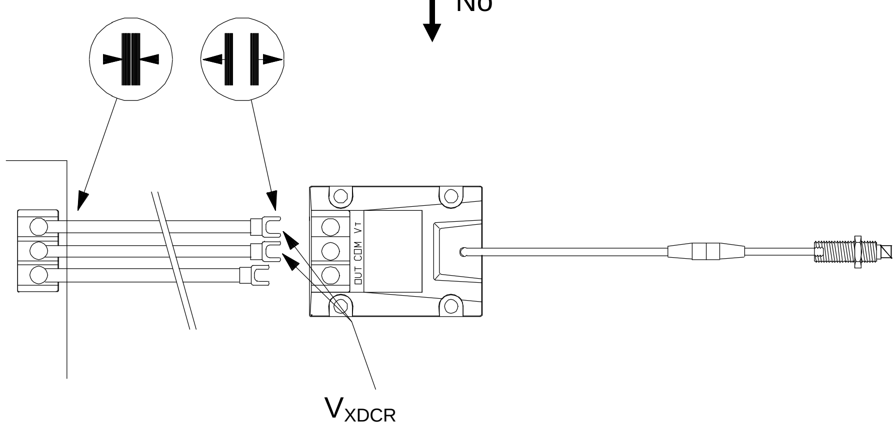


Measure V_{PS}:

V_{PS} > -17.5 Vdc or V_{PS} < -26 Vdc?

Yes → Faulty Power Supply

No ↓



Measure V_{XDCR}:

V_{XDCR} > -17.5 Vdc or V_{XDCR} < -26 Vdc?

Yes → Faulty Field Wiring

No ↓

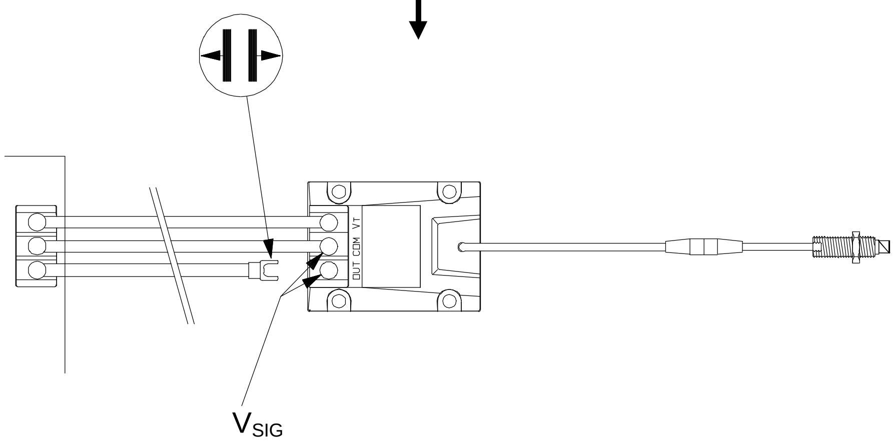
Faulty Proximitor® Sensor

Fault Type 2: V_{SIG} = 0 Vdc

Possible causes:

- Incorrect power source voltage
- Short circuit in field wiring
- Short circuit at Proximitor® sensor terminal connection
- Faulty Proximitor® sensor

Check for fault condition Type 1 on page 12



Measure V_{SIG}:

V_{SIG} = 0 Vdc?

No → Short in wiring or at Proximitor® terminal connection

Yes → Faulty Proximitor® sensor

Fault Type 3: -1 Vdc < V_{SIG} < 0 Vdc

Possible causes:

- Probe is incorrectly gapped (too close to target)
- Incorrect power source voltage
- Faulty Proximitor® sensor
- Probe is detecting other material than target (counterbore or machine case)
- Short or open circuit in a connector (dirty or wet) or loose connectors
- Short or open circuit in the probe
- Short or open circuit in extension cable

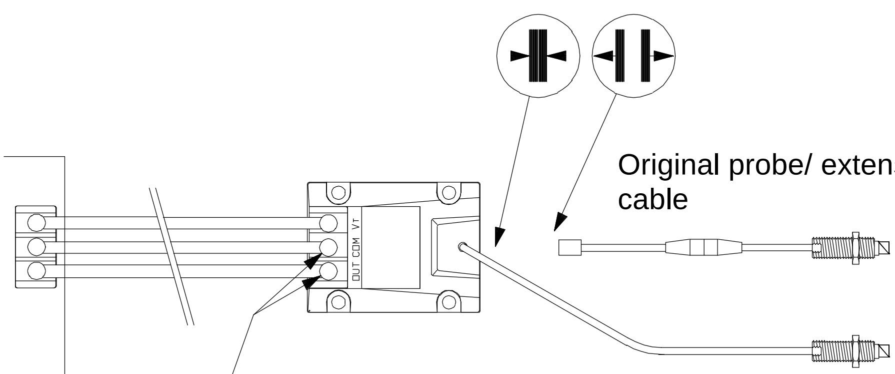
Check for fault condition Type 1 on page 12

↓

Is the probe gapped correctly?
Are counterbore dimensions correct?
(see probe installation on page 2)

No → Re-gap the probe or check counterbore. Retest system.

Yes ↓



↓

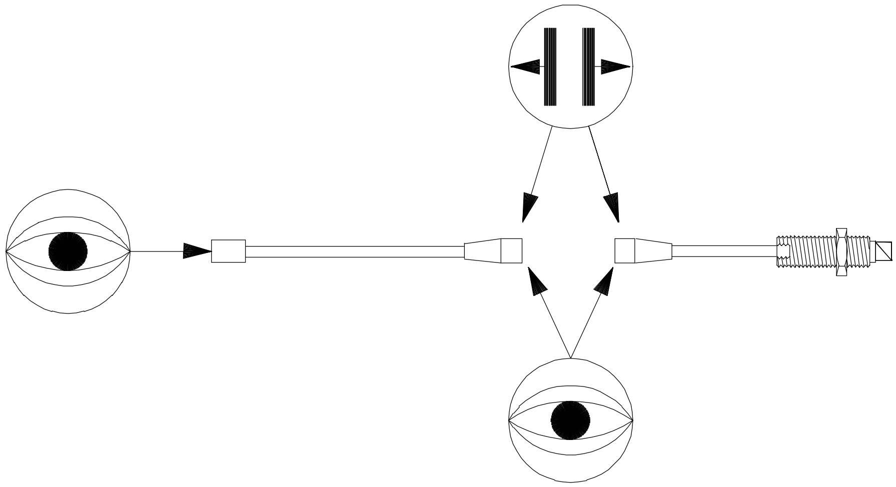
Measure V_{SIG}:

V_{SIG} < V_{XDCR}+1 Vdc?

No → Faulty Proximitor® sensor

Yes ↓

Continues next page

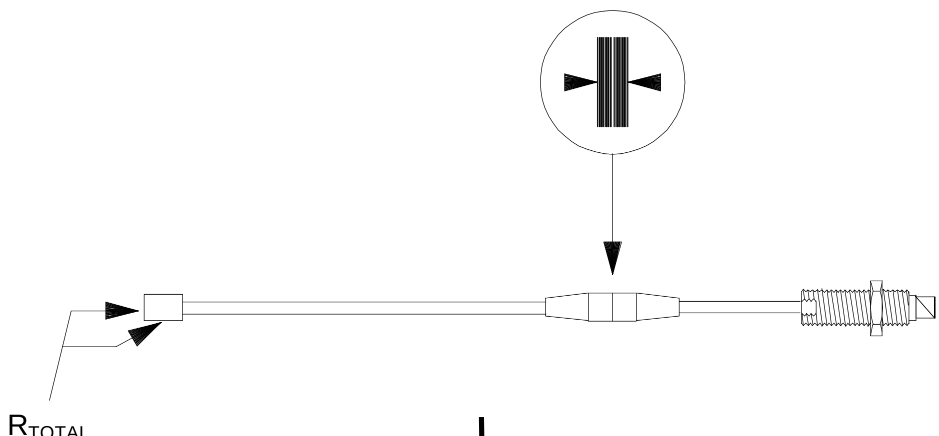


Inspect for clean connection.

Dirty, rusty, poor connection?

Yes → Clean connector (using isopropyl alcohol or electronic terminal cleaner), reassemble, and retest the system.

No ↓



Measure resistance, R_{TOTAL}:

Within specifications?

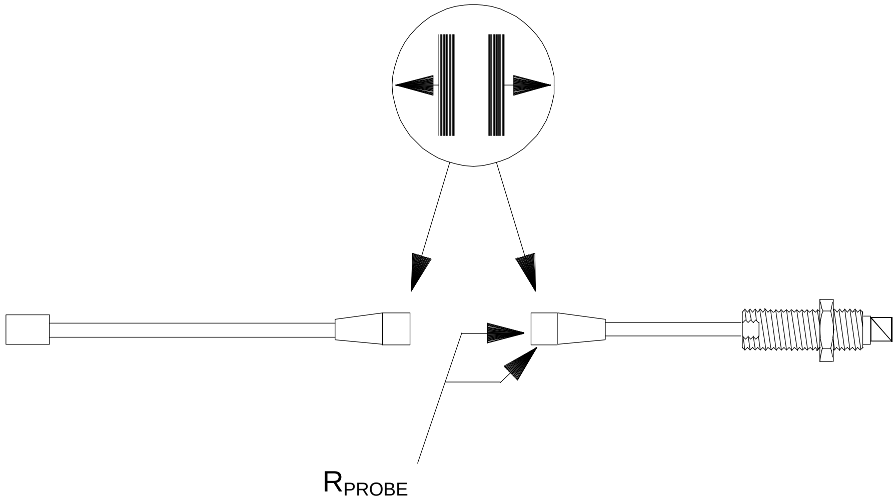
5 m system: 8.75 ± 0.70 Ω

9 m system: 9.87 ± 0.90 Ω

Yes → Retest original system

No ↓

Continues next page

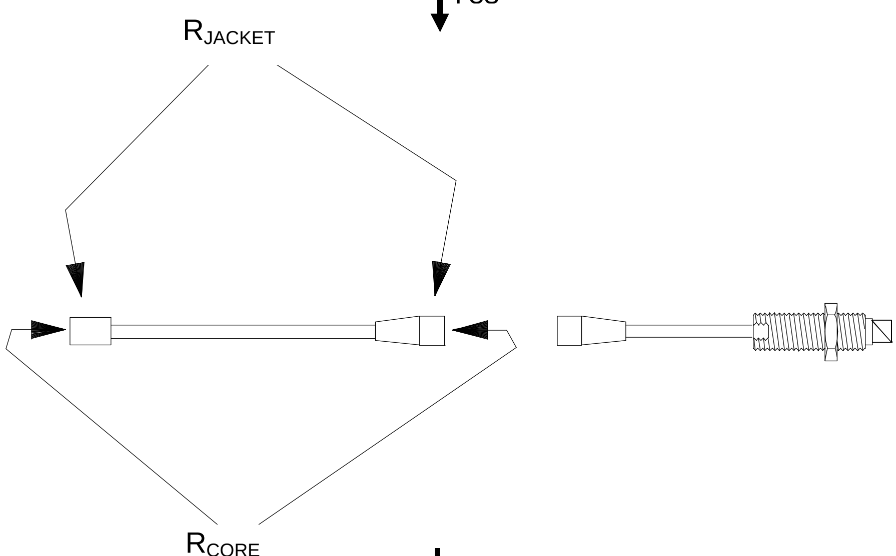


Measure resistance, R_{PROBE}:

Within specifications?
(See probe resistance, page 22)

No → Faulty Probe

Yes ↓



Measure resistance, R_{JACKET} and R_{CORE}:

Within specifications?
(See cable resistance, page 24)

No → Faulty Extension Cable

Yes ↓

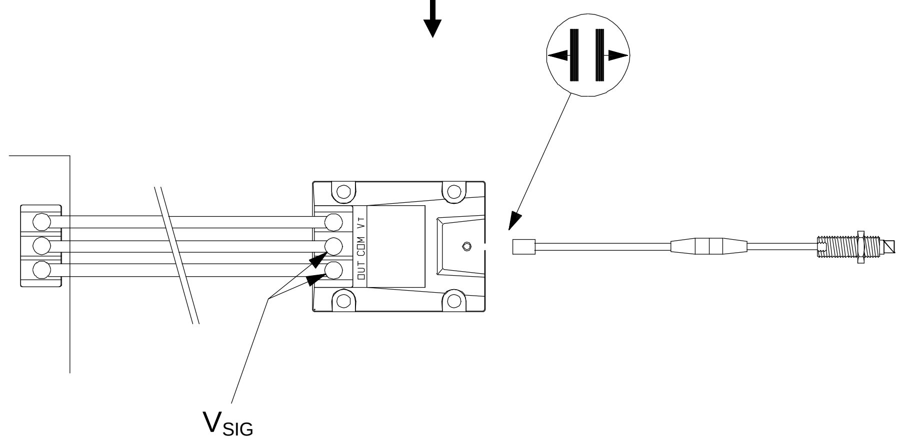
Retest original system

Fault Type 4: $V_{XDCR} < V_{SIG} < V_{XDCR}+2.5$ Vdc

Possible causes:

- Faulty Proximitor® sensor
- Probe is incorrectly gapped (too far from target)

Check for fault condition Type 1 on page 12



Measure V_{SIG}:

-1.2 Vdc $< V_{SIG} < -0.3$ Vdc?

No → Faulty Proximitor® sensor

Yes ↓

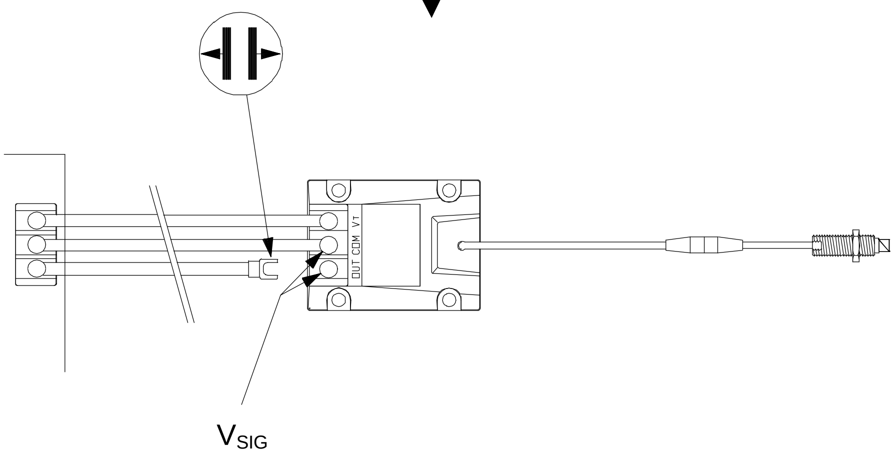
Reconnect system
Regap the probe
Retest system

Fault Type 5: $V_{SIG} = V_{XDCR}$

Possible causes:

- Incorrect power source voltage
- Faulty Proximitor® sensor
- Faulty field wiring (between Out and V_T)

Check for fault condition Type 1 on page 12



Measure V_{SIG}:

$V_{SIG} = V_{XDCR}$?

Yes → Faulty Proximitor® sensor

No → Faulty field wiring (short between OUT and V_T)

Bently Nevada is very concerned when a part fails. Please return the part with a brief note to our corporate headquarters in Minden, Nevada for analysis if you encounter a part that has failed.

Bently Nevada Corporation

Attn: Product Repair Department

1617 Water Street

Minden, Nevada 89423 USA

Section 4 — Specifications

The following specifications apply from 18°C to 27°C (64°F to 80°F) with a Bently Nevada supplied AISI 4140 steel target. Typical is defined as 90% of the devices built meeting the specification, and worst case is defined as 99.7% of the devices built meeting the specification. The calibration range is defined as the 2000µm (80 mil) range from 250µm (10 mil) below -3.0 Vdc to 1750µm (70 mil) above -3.0 Vdc. This range is approximately equivalent to a calibration range of 250µm (10 mil) to 2250µm (90 mil). ASF refers to the Average Scale Factor over the calibration range, and ISF refers to the Incremental Scale Factor, derivative, over the calibration range as measured in 250µm (10 mil) increments.

Application Alert

Operation outside the specified limits will result in false readings, damage to the transducer system and/or loss of machine monitoring.

System

Average Scale Factor (ASF)

Typical	7.87 ± 0.21 mV/µm (200.0 ± 5.4 mV/mil)
Worst case	7.87 ± 0.39 mV/µm (200.0 ± 10.0 mV/mil)
Bench calibration	Can be adjusted with the Proximitor® sensor calibration resistor for exactly 7.87 mV/µm (200.0 mV/mil).

Incremental Scale Factor (ISF)

Typical	7.87 ± 0.51 mV/µm (200.0 ± 13 mV/mil)
Worst case	7.87 ± 0.75 mV/µm (200.0 ± 19 mV/mil)
Bench calibration	7.87 ± 0.31 mV/µm (200.0 ± 8 mV/mil)

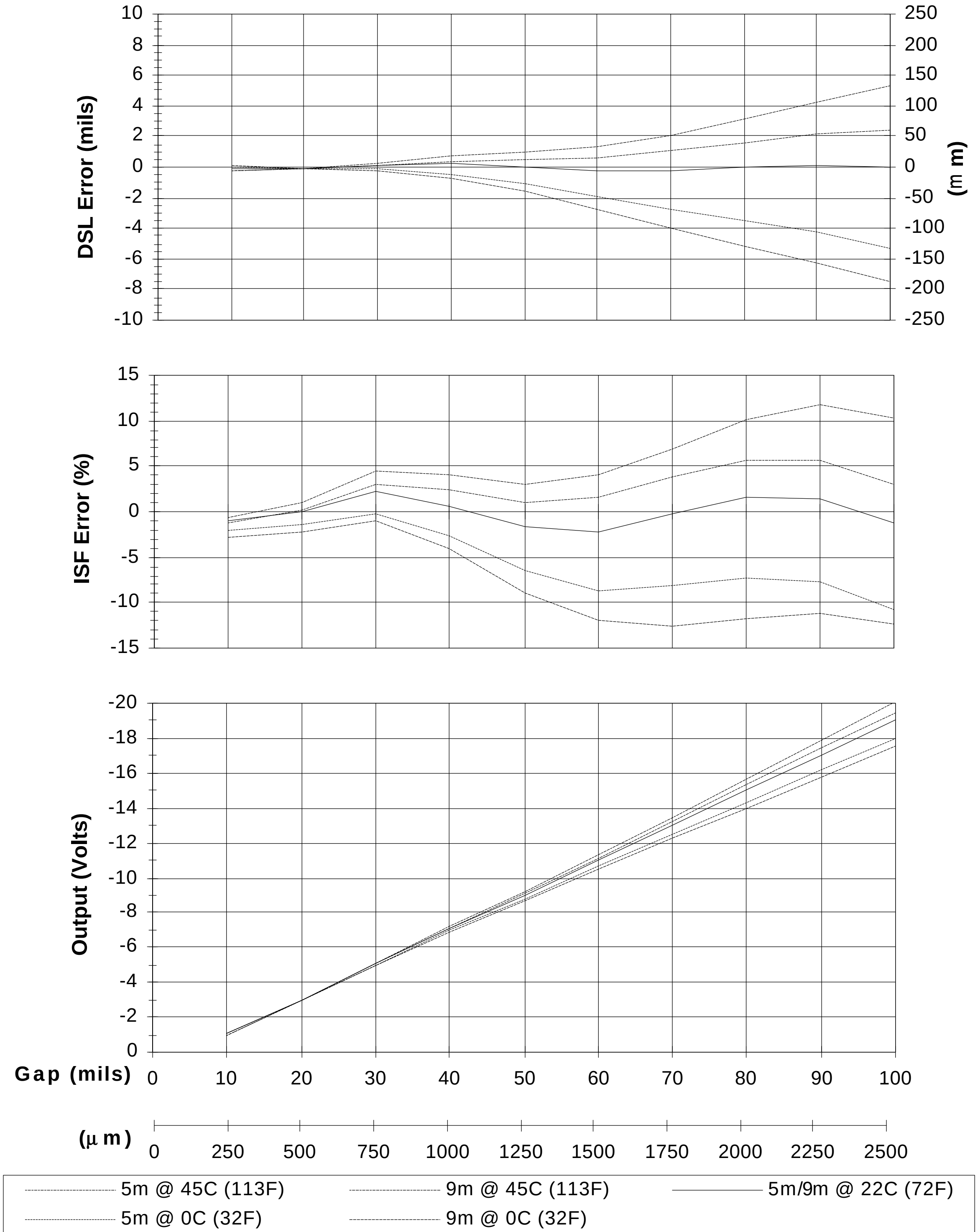
Deviation from Straight Line (DSL)

This specification covers a range starting at the beginning of the calibration range and ending 250 µm (10 mil) after the end of the calibration range. Error is referenced to the straight line which is centered to yield minimum error and which has a 7.87 mV/µm (200 mV/mil) slope over the calibration range.

Typical	Less than ± 38 µm (1.5 mil)
Worst case	Less than ± 58 µm (2.3 mil)
Bench calibration (worst case)	Less than ± 20 µm (0.8 mil)

Frequency Response

Typical 0 to 6.5 kHz (390,000 cpm), -3db



Typical Transducer System Curve

Proximitor® Sensor

Interchangeability error

Average scale factor (ASF) change

Typical	Less than 0.09 mV/µm (2.3 mV/mil)
Worst case	Less than 0.33 mV/µm (8.4 mV/mil)

Apparent gap change

At 1270 µm (50 mil) gap	180 µm (7.1 mil) maximum
At 250 µm (10 mil) gap	130 µm (5.3 mil) maximum

Supply Sensitivity	Less than 2 mV change in output voltage per volt change in input voltage.
Supply voltage range	-17.5 Vdc to -26 Vdc without barriers -23 Vdc to -26 Vdc with barriers (Operation at less than -23.5 Vdc can result in reduced linear range.)
Current draw	12 mA maximum with 10 kΩ load
Output resistance	50 Ω
Output load	Calibrated into a 10 kΩ load
Weight	255 g (9.0 oz)

Temperature

Storage	-51° C to +105° C (-60° F to +221° F)
Operating	-51° C to +100° C (-60° F to +212° F)

Relative Humidity	100% condensing nonsubmerged from 2° C to 100° C (35° F to 212° F) when connectors are protected.

Probe

Interchangeability error

Average scale factor (ASF) change

Typical	Less than 0.25 mV/µm (6.3 mV/mil)
Worst case	Less than 0.42 mV/µm (10.8 mV/mil)

Voltage difference at same physical gap (maximum)

At 1270 µm (50 mil) gap	4.6 Vdc
At 250 µm (10 mil) gap	3.6 Vdc

DC resistance (nominal) (R_{PROBE})

7.3 Ω + 0.28 Ω/m (7.3 Ω + 0.087 Ω/ft)
± 0.5 Ω for probes 2.0 metres and less
± 0.7 Ω for 5.0 metre probes
± 0.9 Ω for 9.0 metre probes

Connector torque

0.565 N•m (5 in•lb) maximum

see page 5 for connector tightening recommendations.

Case torque

	Maximum Rated	Recommended
M10X1 or 3/8-24 cases	33.9 N•m (300 in•lb)	11.2 N•m (100 in•lb)
M10X1 or 3/8-24 cases (first three threads)	22.6 N•m (200 in•lb)	7.5 N•m (66 in•lb)
M10X1 or 3/8-24 reverse mount cases	22.6 N•m (200 in•lb)	7.5 N•m (66 in•lb)
M8X1 or ¼-28 cases	8.5 N•m (75 in•lb)	2.8 N•m (25 in•lb)

Recommended min. bend radius (armored or un-armored cable)

25.4 mm (1.00 in)

Weight

20 g (0.7 oz) typical

Temperature

Storage	-34° C to +177° C (-30° F to +350° F)
Operating	-34° C to +177° C (-30° F to +350° F)

Relative Humidity	100% condensing nonsubmerged from 2° C to 100° C (35° F to 212° F) when connectors are protected.

Cable

Interchangeability error

Average scale factor (ASF) change

Typical	Less than 0.09 mV/µm (2.2 mV/mil)
Worst case	Less than 0.19 mV/µm (4.9 mV/mil)

Apparent gap change

At 1270 µm (50 mil) gap	145 µm (5.8 mil) maximum
At 250 µm (10 mil) gap	100 µm (4.0 mil) maximum

DC resistance, nominal

Center conductor (R_{CORE})	0.222 Ω/m (0.067 Ω/ft)
Shield (R_{JACKET})	0.066 Ω/m (0.020 Ω/ft)

Capacitance	69.9 pF/m (21.3 pF/ft) typical
Recommended min. bend radius (armored or un-armored cable)	25.4 mm (1.0 in)
Connector torque	0.565 N•m (5 in•lb) maximum see page 5 for connector tightening recommendations.
Weight	45 g/m (0.5 oz/ft)

Temperature

Storage	-51° C to +177° C (-60° F to +350° F)
Operating	-51° C to +177° C (-60° F to +350° F)

Relative Humidity	100% condensing nonsubmerged from 2° C to 100° C (35° F to 212° F) when connectors are protected.