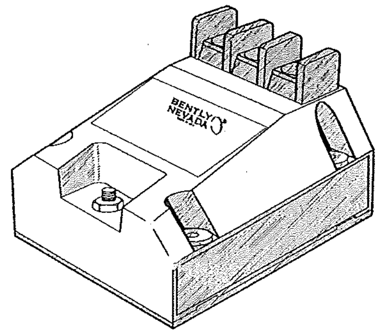
Part No. 128133-01
Revision B, March 1999

3300 RAM PROXIMITY TRANSDUCER SYSTEM

MANUAL

BENTLY NEVADA®



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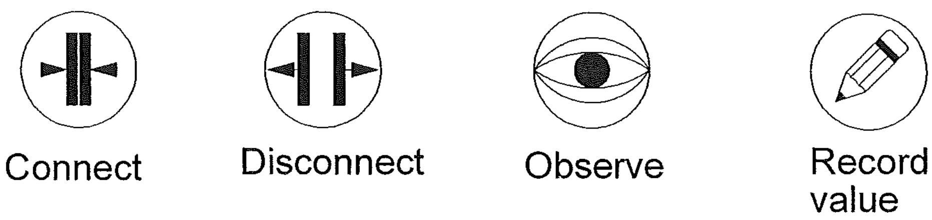
This manual uses the following symbols:



European CE mark for Bently Nevada Proximity Transducer Systems

CE

In this Document is a list of the proximity transducer systems that have the CE mark, applicable standards used for certification, and installation instructions required for compliance.

Proximity Transducer Systems are electronic devices typically used in industrial applications. These systems have been certified using one Technical Construction File (TCF) and declaration of conformity because they are similar in design and application. A Proximity Transducer System consists of a Proximitor® sensor (or transmitter), proximity probe, and extension cable (except for the 25 mm DE transducer which is a single unit).

TCF through TÜV Rheinland of North America A Technical Construction File has been prepared through TÜV Rheinland of North America (TÜV Rheinland File Number: P9472350.01). The certificate of compliance is for Directive 89/336/EEC (EMC Directive). The applicable Generic Norms are: EN50081-2 and EN50082-2.

Installation Instructions
(reference Figure 1) These instructions are an addition to the product manuals.

All Proximitor® Sensors ① and Transmitters ① must be mounted inside an EMI (Electromagnetic Interference) shielded enclosure ④ with a cover.

Compliant Systems and Component Part Numbers

#	Model Names	Model Numbers
1	3300 5mm & 8 mm	330100, 330101, 330102, 330103, 330104, 330105, 330106, 330130, 330140*, 330141*, 330171, 330172, 330173, 330174, 330255**
2	3300 RAM	330900, 330901, 330902, 330903, 330904, 330905, 330906, 330930**
3	7200 14 mm	81305, 81723, 81724, 81725, 83936**
4	35 mm Extended Range	76679, 76680, 76681, 76682, 76683, 76684**
5	50 mm Extended Range	24582, 24583, 24710, 28480**
6	25 mm Differential Expansion	102241, 102242, 102243, 102244**
7	990 Vibration Transmitter	990 (uses RAM probe and cable components)**
8	991 Thrust Transmitter	991 (uses RAM probe and cable components)**
9	3300 REBAM®	330600, 330601, 330602, 330603, 330604, 330630**

includes all options and all approval versions of the base model numbers listed
*--not included in TCF, reference justification document 159863.
**--any proximity transducer, proximity probe, or extension cable which works correctly with the listed modules.

Testing and Test Levels

Title	EN55022 Emission	EN 61000-4-2 (IEC 801-2) ESD	ENV50140 (IEC 801-3) Rad. RFI	ENV50140 Rad. RFI	EN 61000-4-4 (IEC 801-4) EFT	IEC 801-5 Surge	ENV50141 (IEC 801-6) Cond. RFI	EN 61000-4-8 (IEC 1000-4-8) Mag. Fields
Testing Levels	Emission Class A	8kV; 15kV①	10V/m②	10V/m③	1kV④	0.5kV④	10V⑤	30A/m, 50Hz
Criteria	n/a	A	A	A	B	A	B	A

These notes listed below apply only to the table "Testing and Test Levels"
① discharge method: Contact; Air
② 27-1000 MHz sweep with 80% 1 kHz sine wave amplitude modulation
③ 900 MHz dwell with 100% 200 Hz square wave modulation
④ lines tested: I/O
⑤ 150 kHz-80 MHz sweep with 80% 1 kHz sine wave amplitude modulation

The 3300 REBAM® Proximity Transducer System, due to its inherent sensitivity, is susceptible to EMI at levels EN50082-2. Special EMC (Electromagnetic Compatibility) protection measures may be necessary to achieve reliable measurements. Each unique installation must be considered.

Proximity Probes All probes must be mounted in an EMI shielded environment (i.e. typically a machine casing ⑥). All probe cables ② and extension cables, running from the point exiting the machine to the EMI shielded enclosure, must be inside metal conduit ⑤ (or equivalent) with the conduit grounded at the machine and the enclosure.

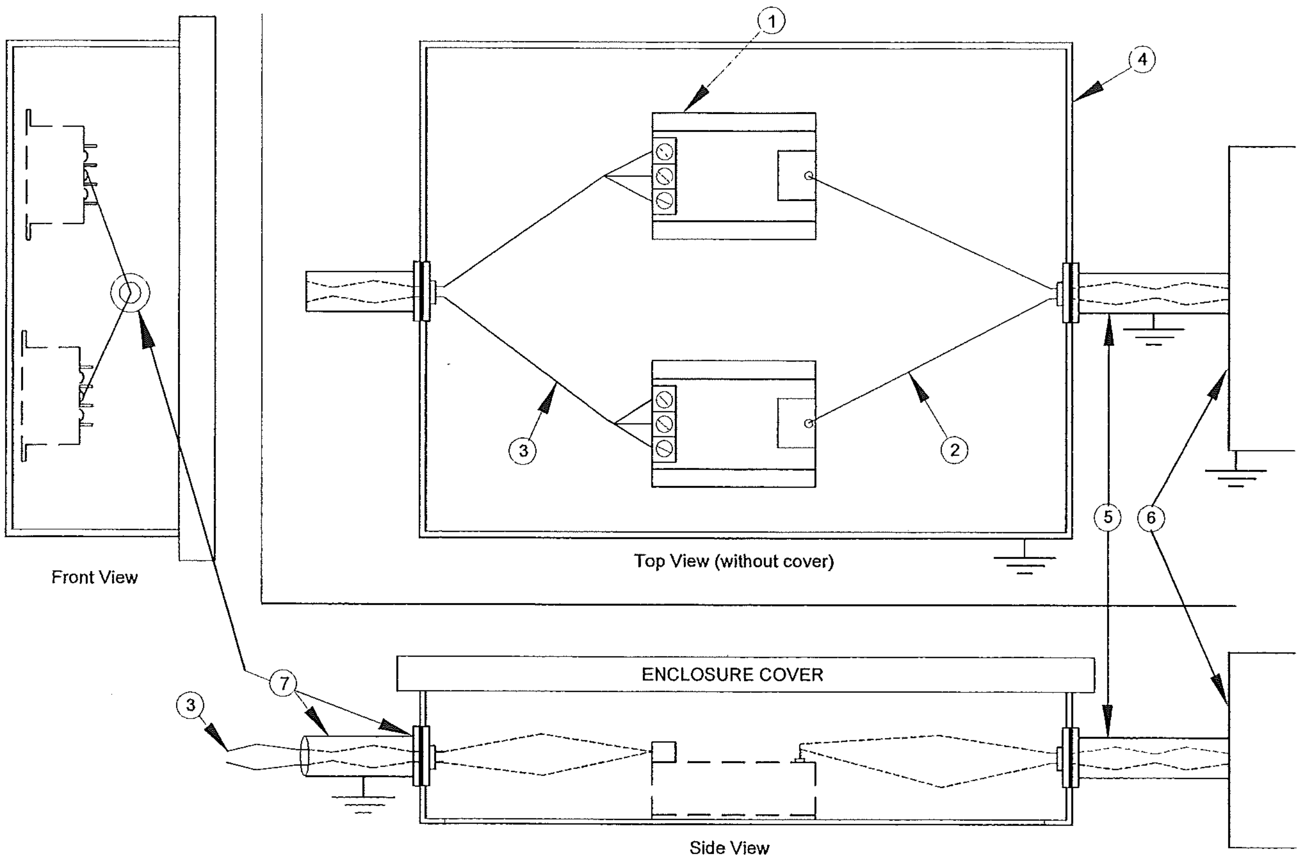
Field Wiring All field wiring ③, from the Proximitor® Sensor enclosure ④ to a receiving unit (i.e. monitor), must be shielded from EMI energy. Acceptable EMI shielding includes solid metal conduit or multi-conductor cable with both a foil and braid shield.

EMI Shielded Enclosures and EMI Shield Grounding Enclosures made of metal typically provide EMI shielding. Covers should be electrically connected to the enclosure or have overlap with the sides of the enclosure, both is preferable. BNC Proximitor® Sensor Housings and Probe Housings, which are made of metal, provide adequate EMI shielding.

Grounding EMI shields ⑦ at the point of entrance to the Proximitor® sensor enclosure ④ and any subsequent junction enclosure is required. The shield must be maintained around the wiring as it is grounded to the enclosure.

Exposure of the systems when the EMI shielding is removed (i.e. enclosure cover) will increase EMI susceptibility.

Figure 1



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Related Documents

The following documents contain additional information that you may find helpful when you install the transducer. This manual refers to these documents by number.

Installing the Transducer

Proximitor Probes and Related Accessories (Bently Nevada application note AN028)

Guidelines for Grounding Bently Rotating Machinery Information Systems (Bently Nevada application note AN013)

Installation of Electrical Equipment in Hazardous Areas (Bently Nevada application note AN015)

European CE mark for Bently Nevada Proximity Transducer Systems (Bently Nevada application note AN072)

Transducer Installation Accessories

31000/32000 Proximity Probe Housing Manual (Bently Nevada part number 124200-01)

Electrical and Mechanical Runout

"Glitch": Definition of and Methods for Correction, including Shaft Burnishing to Remove Electrical Runout. (Bently Nevada application note AN002)

API 670, third edition, Section 4.1.2: Machine Shaft Requirements for Electrical and Mechanical runout. (Available from the American Pertroleum Institute, Publications and Distribution, 1220 L Street N.W., Washington D.C., 20005. Phone: (202) 682-8375.)

Reference

Performance Specifications for the 3300 RAM Transducer System (Bently Nevada document number 158239).

Bently Nevada Glossary (Bently Nevada document L1014).

System Description

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

The components of the 3300 RAM 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 Notice

The 3300 RAM Proximity transducer is designed for measuring position or vibration within a frequency range from 0 to 10 kHz. Typical applications of the system include radial vibration and position, axial position, and Keyphasor® sensor measurements.

CAUTION

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

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 20, 21, and 22, 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:

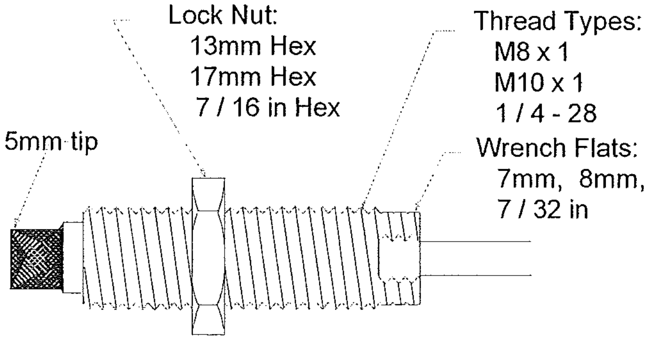
800-227-5514 Monday through Friday, 8:00 a.m. to 5:00 p.m. Pacific time
702-782-3611 Any time
or
702-782-9230 Product Service FAX

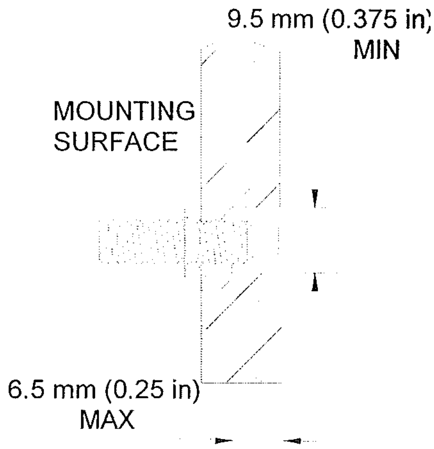
Installation

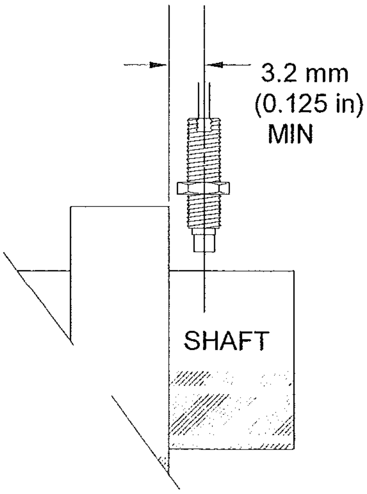
This section contains a checklist of items that you must consider when you install a 3300 RAM Transducer System. For detailed information about designing installations for specific applications refer to Bently Nevada application note AN028.

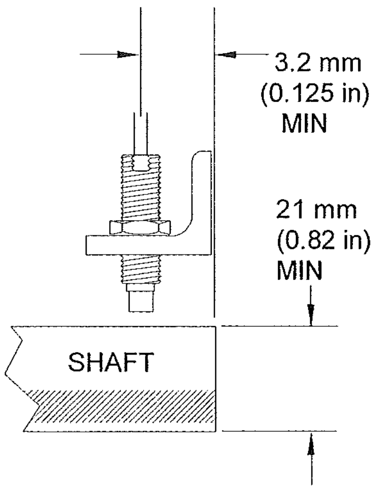
Installing the 3300 RAM Probe

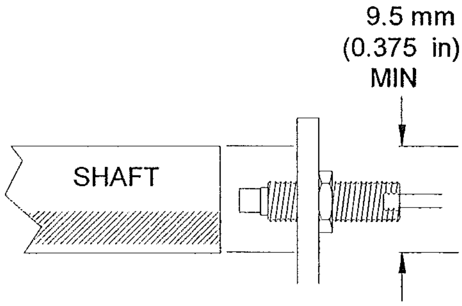
The following figures show the dimensions of the probe and the minimum values for side clearance and target configuration. Refer to Specifications for proper torque and the dimensions of the thread.



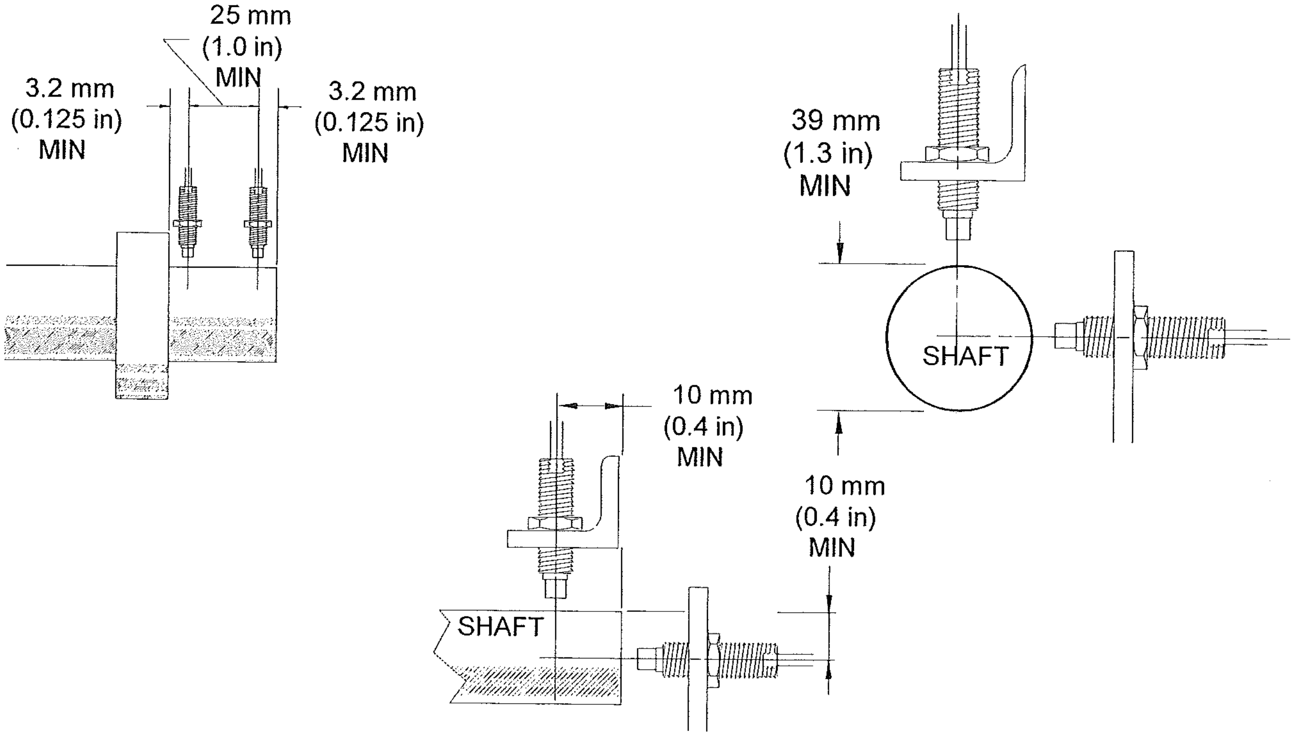




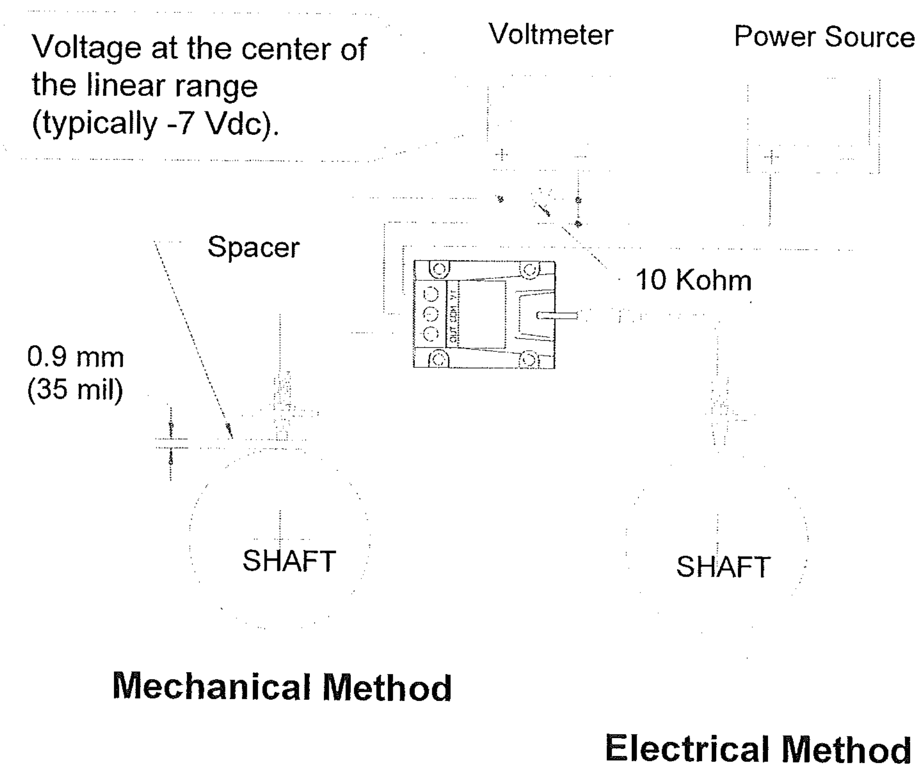




The following figures show the minimum values for probe separation:

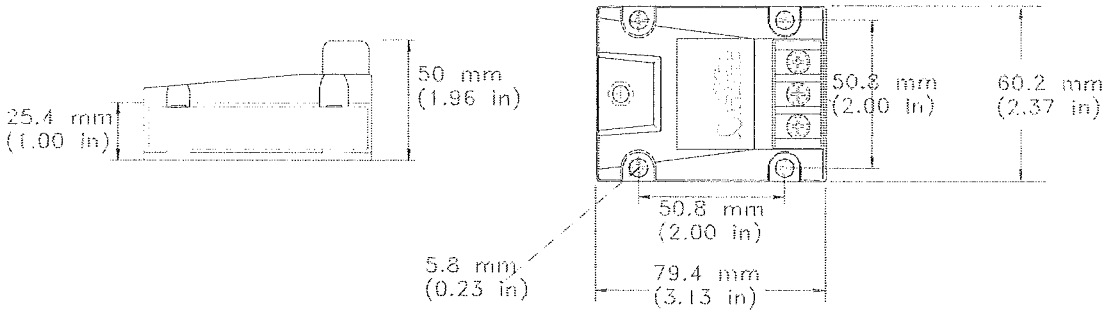


Adjust the distance between the probe tip and the shaft using one of the methods shown in the following figure.



Mounting the Proximitor® Sensor

Mount the Proximitor® sensor in a location that is compatible with the environmental specifications of the Proximitor® sensor. Consider the local electrical codes and the amount of hazardous or explosive gas at the installation site. (Refer to application note AN013.)



Routing the Extension Cable and Field Wiring

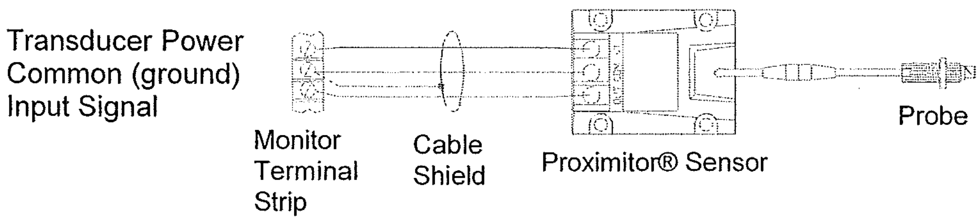
Route the extension cable using the following guidelines. (Refer to application note AN028).

Check that the Proximitor® sensor, extension cable, and probe belong to the same system. (For example, a 7 metre Proximitor® sensor will not work with a 4 metre extension cable and a 1 metre probe.)

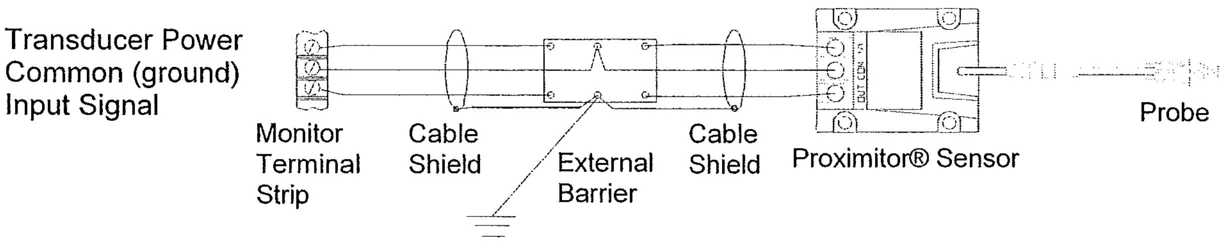
- Secure the extension cable to supporting surfaces by using mounting clips or similar devices.
- Identify both ends of the extension cable by inserting labels under the clear Teflon sleeves and applying heat to shrink the tubing.
- Insulate the connection between the probe lead and the extension cable.
- 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.
- Secure the coax connectors between the extension cable and the probe lead with the torque specified on pages 21 and 22.

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

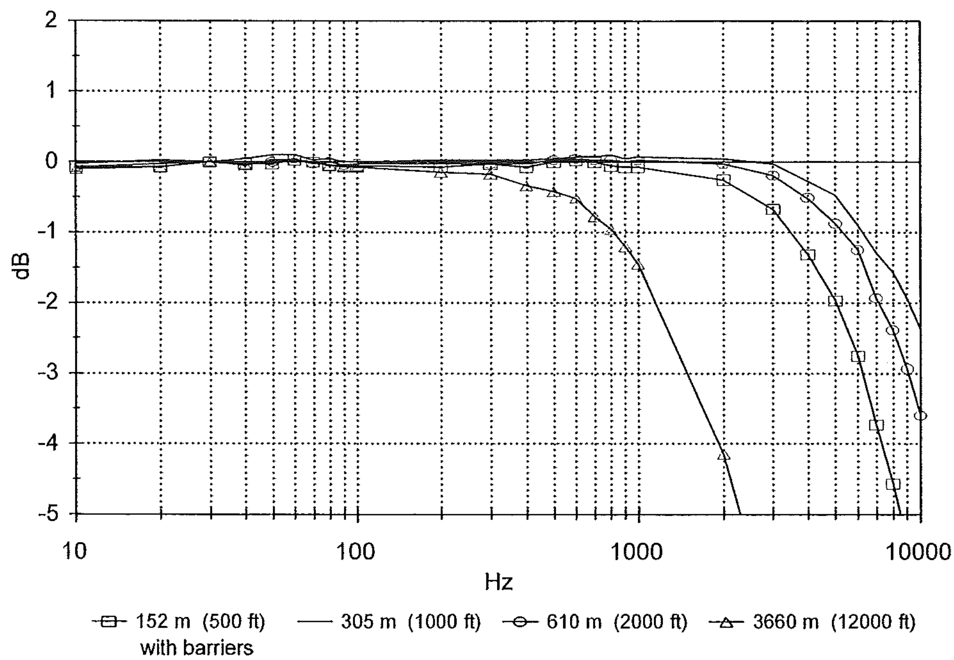
No Barriers



External Barriers



Use the following frequency response graph as a guideline for determining maximum field wiring length for 18 gauge wire.



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 8 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

The adjustment procedure on pages 9 and 10 is included for your information. For target materials other than 4140 steel and for other special applications, contact your local Bently Nevada office.

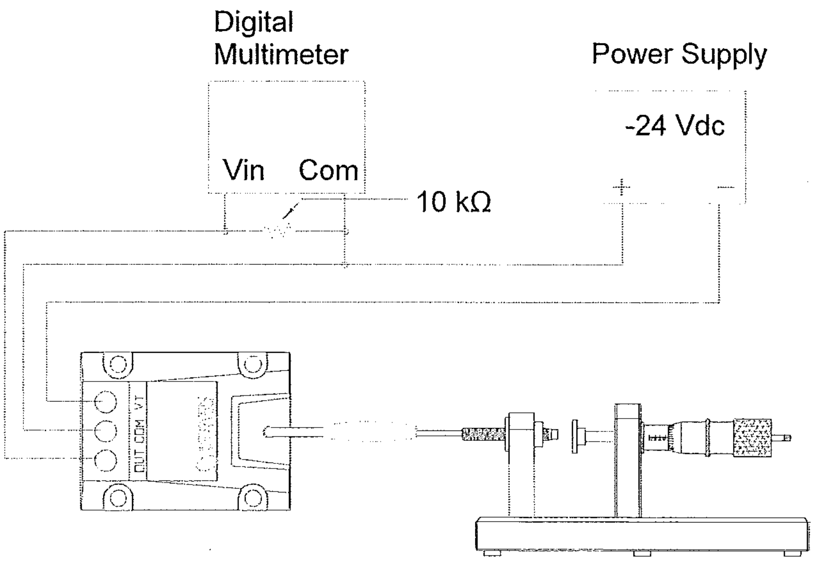
The scale factor verification and the adjustment procedure require the following instruments:

digital multimeter	spindle micrometer	fixed resistor, 10 kΩ
soldering iron and suppiles	power supply	

The adjustment procedure also requires the following items:

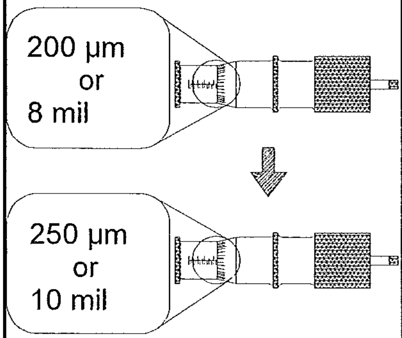
variable resistor, 0 to 50 kΩ
vulcanizing compound (for example Dow 3110 RTV)

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



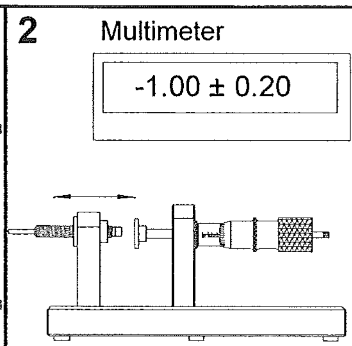
Scale Factor Verification

1



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

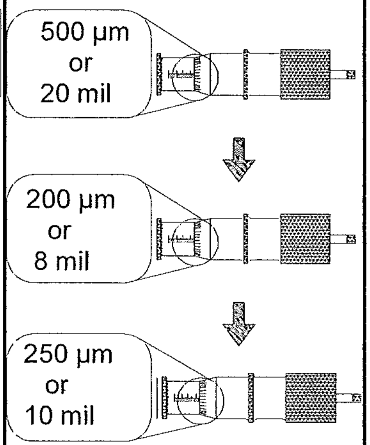
2



Probe, Target, and SpindleMicrometer

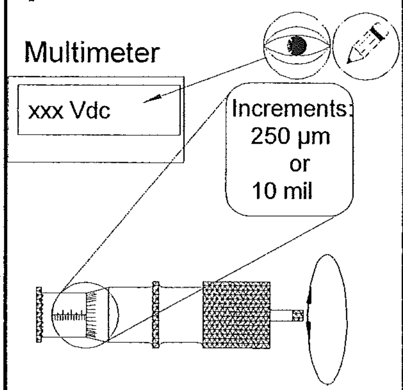
Adjust the probe for electrical zero.

3



Compensate for mechanical backlash. Adjust to the first setting for recording voltages.

4



n	Adjust Micrometer to.. µm	or mil	Record Voltages $mVdc_n$	Calculate Scale Factor: 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	____	____	____

$$ISF_n = \frac{Vdc_n - Vdc_{n-1}}{250\ \mu m} \qquad ASF = \frac{Vdc_{250\ \mu m} - Vdc_{1750\ \mu m}}{1500\ \mu m}$$

$$ISF_n = \frac{Vdc_n - Vdc_{n-1}}{10\ mil} \qquad ASF = \frac{Vdc_{10\ mil} - Vdc_{70\ mil}}{60\ mil}$$

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

CAUTION

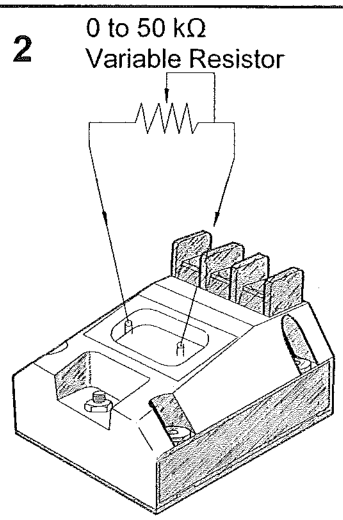
Electrostatic discharge on the exposed calibration resistor terminals can cause the accuracy of the system to go out of specification or cause the system to fail. Use a grounding strap or equivalent precaution during this procedure.

1

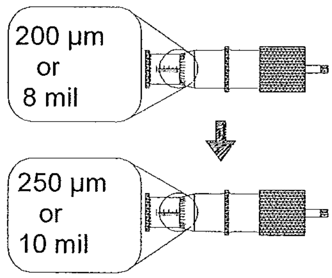
Label
Vulcanizing Compound
Calibration Resistor
Desolder

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

2

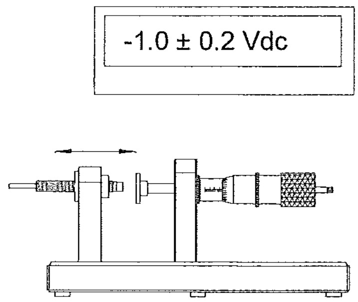


3



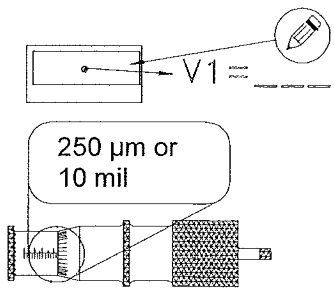
Compensate for mechanical backlash and adjust initial setting to the start of the linear range.

4



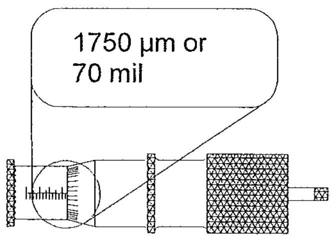
Adjust the probe gap for an output of -1.0 ± 0.2 Vdc.

5



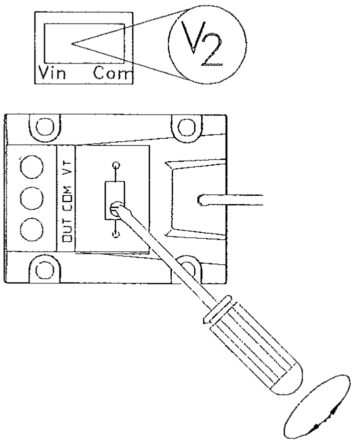
Record the measured voltage as V1.

6



Set the micrometer to the end of the linear range.

7

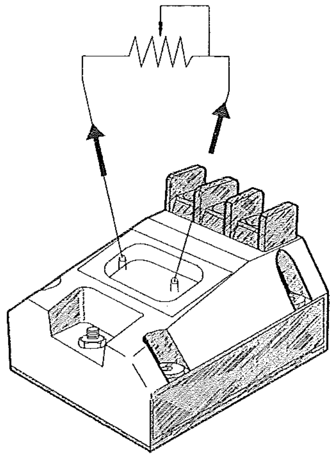


Adjust the variable resistor until the measured voltage (V_2) equals -12 Vdc - $|V_1|$ ± 0.12 Vdc

8

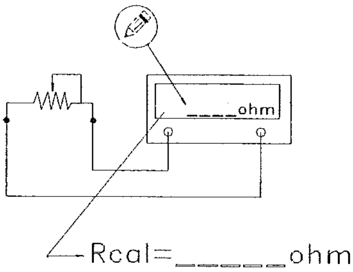
Repeat steps 3 through 7 until the variable resistor is not changed.

9



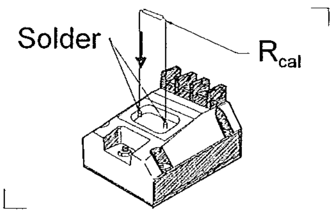
Desolder the variable resistor.

10



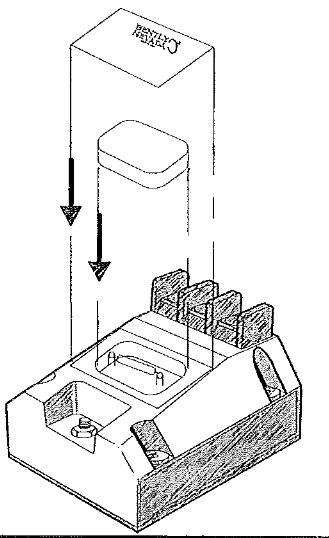
Measure the variable resistor.

11



Install the new Rcal resistor. Rcal must be a 1% 50ppm/°C resistor or better. Verify the calibration.

12

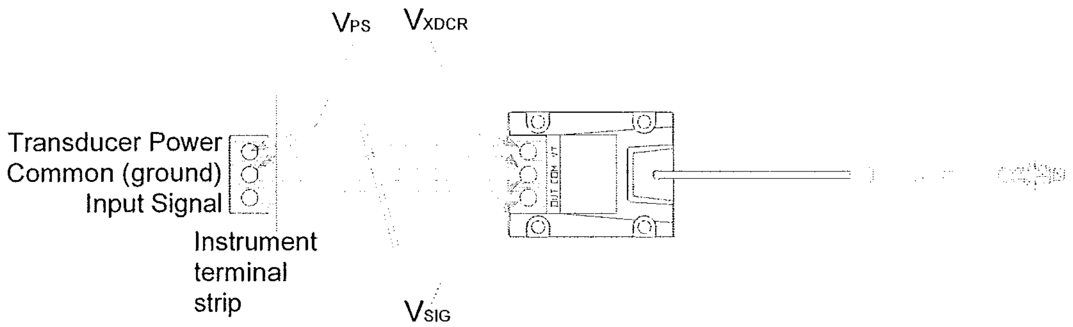


Troubleshooting

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 multimeter to measure voltage and resistance. 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 table:



Symbols for Measured Voltages

Symbol	Meaning	Voltage measured between...
V_{XDCR}	Transducer input voltage	V_T and COM
V_{SIG}	Signal voltage from the transducer	OUT and COM
V_{PS}	Power supply voltage	Power Source and Common

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

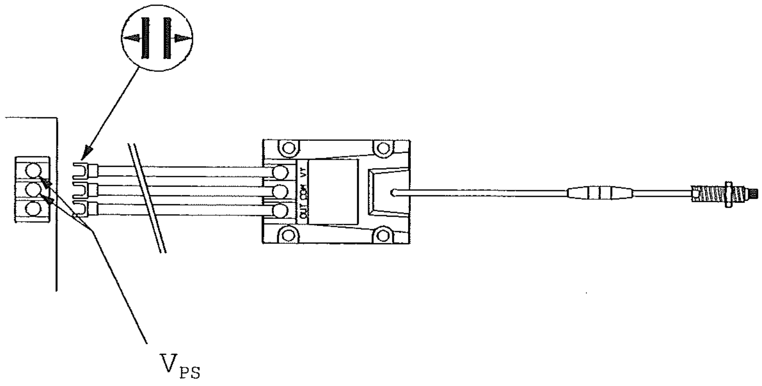
Definitions

Symbol	Definition
A > B	"A" value is more positive than "B"
A < B	"A" value is more negative than "B"
A = B	"A" same value (or very close) to "B"

Fault Type 1: $V_{XDCR} > -23$ Vdc or $V_{XDCR} < -26$ Vdc

Possible Causes:

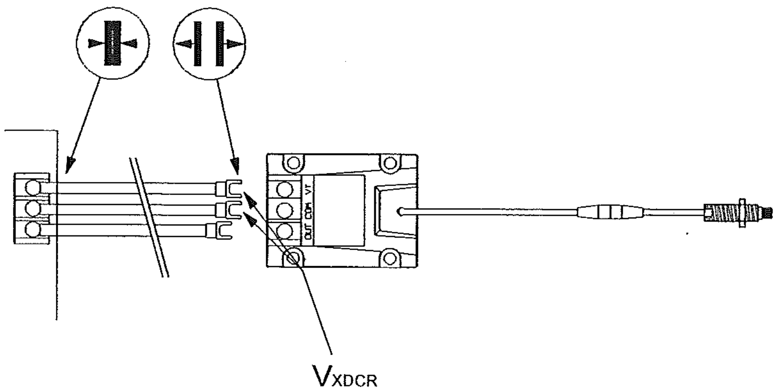
- Faulty power source
- Faulty field wiring
- Faulty Proximitor



Measure V_{PS}:
$V_{PS} > -23$ Vdc or $V_{PS} < -26$ Vdc

Yes → Faulty power source

No ↓



Measure V_{XDCR}:
$V_{XDCR} > -23$ Vdc or $V_{XDCR} < -26$ Vdc

Yes → Faulty field wiring

No ↓

Faulty Proximitor® sensor

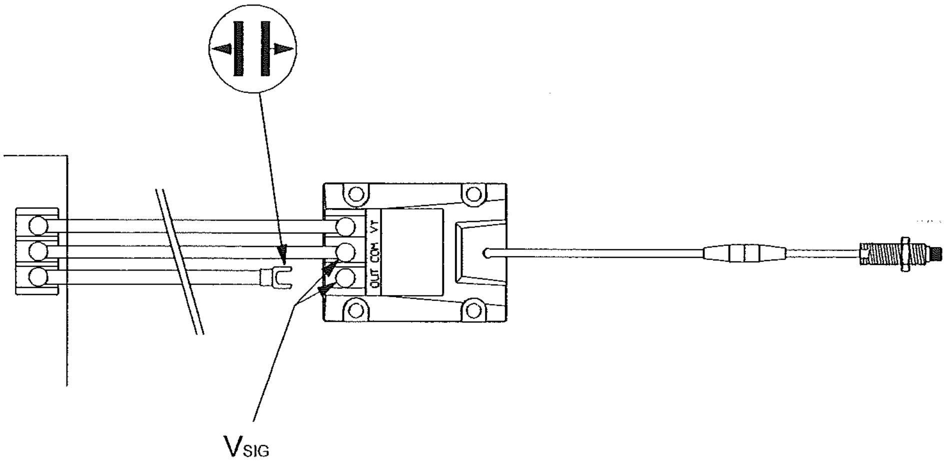
Fault Type 2: V_{SIG} = O Vdc

Possible Causes:

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

Does fault condition type 1 exist?

No



Measure V_{SIG}:
V_{SIG} = 0 Vdc

No → Incorrect power source voltage or short in field wiring or short at Proximitor® sensor terminal connection.

Yes ↓

Faulty Proximitor® sensor

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

Possible Causes:

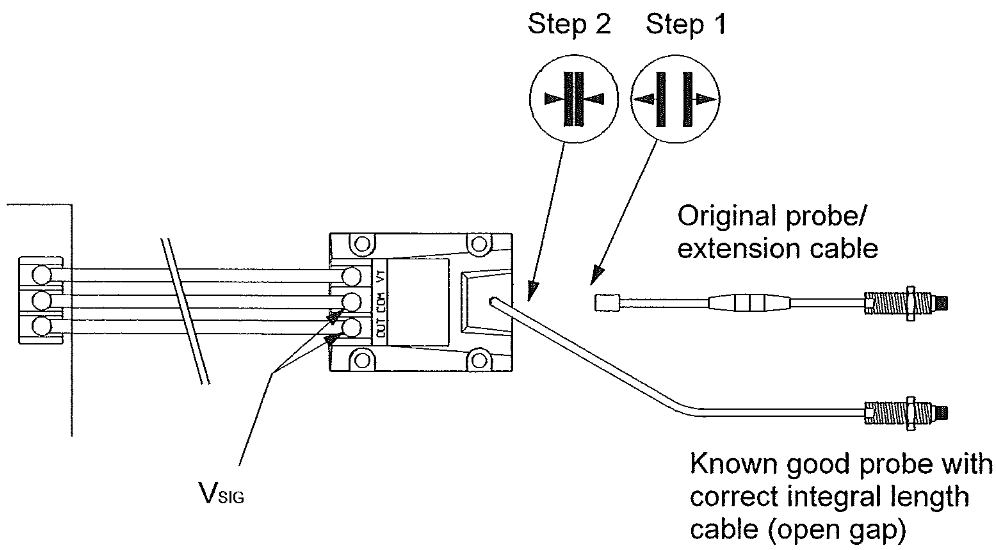
- Probe is incorrectly gapped (too close to target)
- Incorrect power source voltage
- Faulty Proximitor® sensor
- Probe is detecting other material than target
- Short or open circuit in a connector
- Short or open circuit in the probe
- Short or open circuit in the extension cable

Does fault condition type 1exist?

No → Re-gap the probe. Retest the system.

Yes ↓

Verify the probe gap in the machine.
Is the probe gapped correctly?

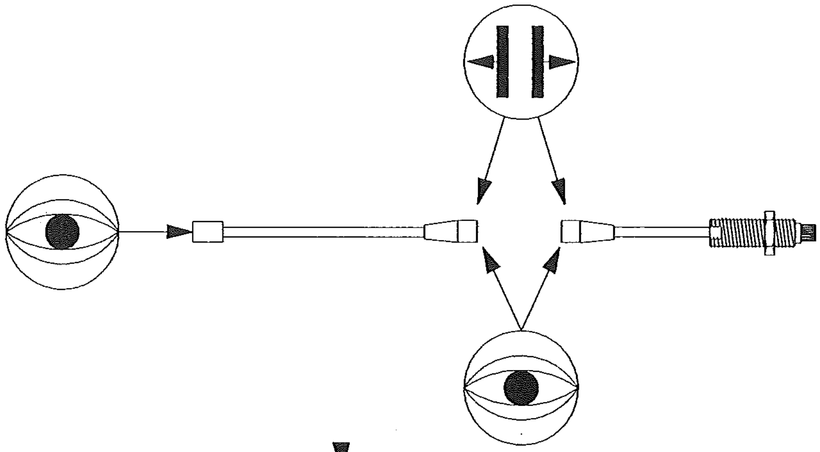


Measure V_{SIG}:
$-1.1\ \text{Vdc} < V_{SIG} < 0\ \text{Vdc}$

No → Incorrect power supply or faulty Proximitor® sensor or probe is being loaded.

Yes ↓

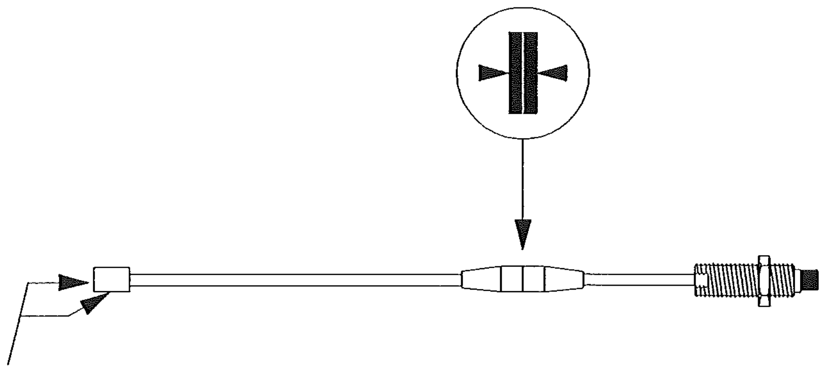
Continues next page



Inspect the connector.
Is there a dirty, rusty, or poor connection?

Yes → Clean connector, reassemble, and retest the original system.

No ↓



R_{TOTAL}

Measure resistance. Is R_{TOTAL} within specifications?

5m system: 5.3Ω ± 0.7Ω
7m system: 5.9Ω ± 0.9Ω

Yes → Retest the original system.

No ↓

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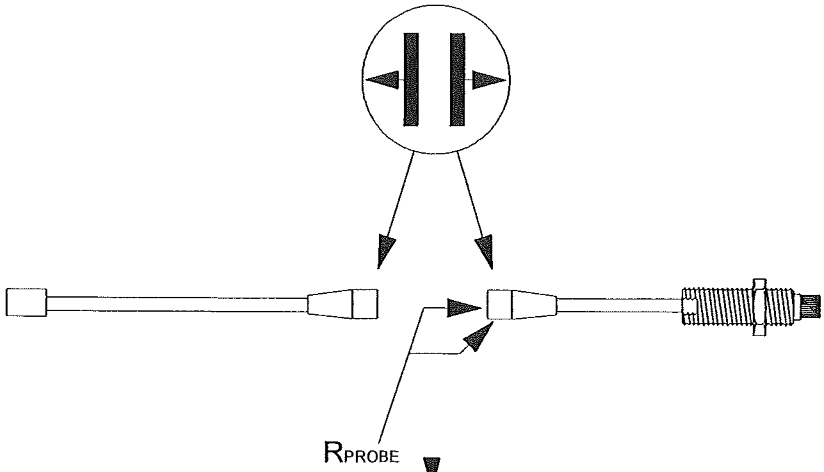
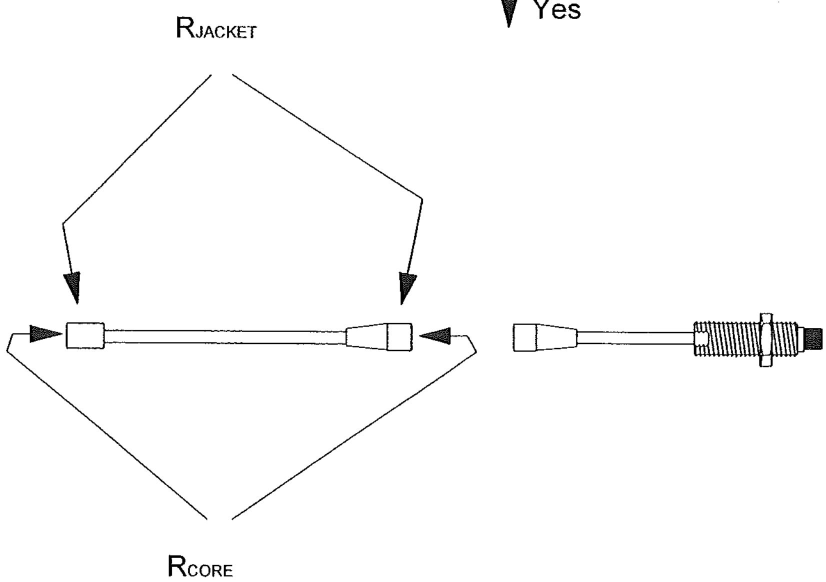


Measure resistance. Is R_{PROBE} within specifications?
1m probe: 4.2 ± 0.5 Ω
0.5 m probe: 4.0 ± 0.5Ω

No → Faulty probe

Yes



Measure resistances. Are R_{JACKET} and R_{CORE} within specifications?

R_{JACKET} :	0.066Ω/m (0.020Ω/ft)
R_{CORE} :	0.220Ω/m (0.067Ω/ft)

No → Faulty extension cable

Yes

Retest original system

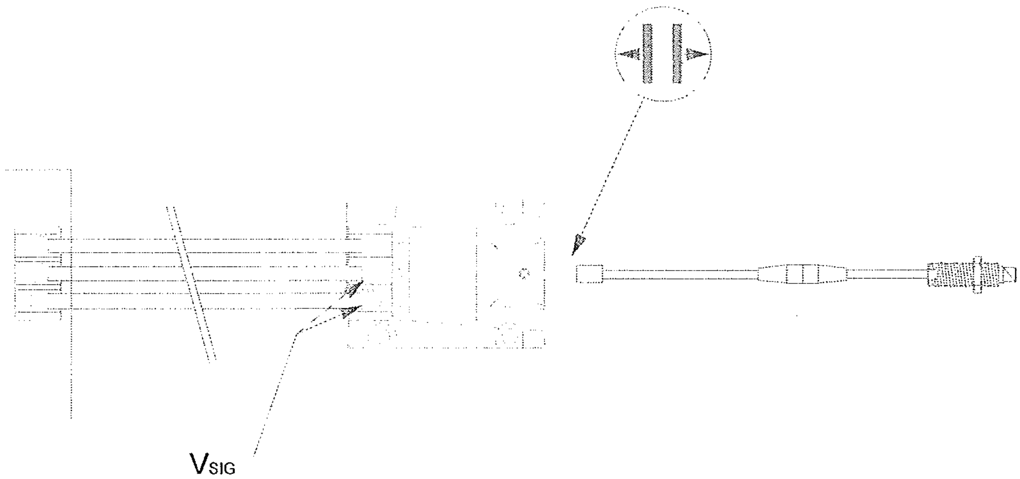
Fault Type 4: $V_{XDCR} < V_{SIG} < V_{XDCR} + 2.5$ Vdc

Possible Causes:

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

Does fault condition type one exist?

No



Measure V_{SIG}:

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

No → Faulty Proximitor® sensor

Yes ↓

Re-connect system
Re-gap the probe
Retest system

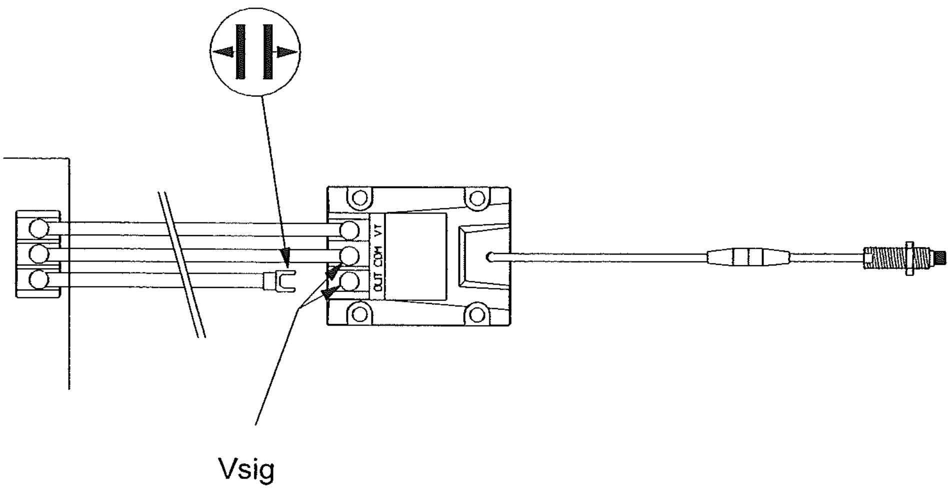
Fault Type 5: $V_{SIG} = V_{XDCR}$

Possible Causes:

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

Does fault condition type 1 exist?

↓ No



↓

Measure V_{SIG}:

$V_{SIG} = V_{XDCR}$

Yes → Incorrect power source voltage or faulty Proximitor® sensor

No ↓

Faulty field wiring
(between OUT and COM)

Specifications

The following specifications apply at 22°C (72°F) with 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 0.25 mm (10 mil) to 1.75 mm (70 mil).

Note

Operation outside the specified limits will result in false readings 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 calibration resistor for exactly 7.87 mV/μm (200.0 mV/mil).

Incremental scale factor (ISF)

Typical	7.87 mV/μm ± 6.5% (200 mV/mil ± 6.5%)
Worst Case	7.87 mV/μm ± 9.5% (200 mV/mil ± 9.5%)
Bench Calibration (Worst Case)	7.87 mV/μm ± 4% (200 mV/mil ± 4%)

Deviation from a Straight Line

This specification covers a range starting at the beginning of the calibration range 250 μm (10 mil) and ending at 1750 μm (70 mils). 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)

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 1000 µm (40 mils) gap:
180 µm (7 mils) (maximum)
At 250 µm (10 mils) gap:
130 µm (5 mils) (maximum)

Supply Sensitivity

Less than 2 mV change in output voltage per volt change in supply 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.

3300 RAM Probe

Interchangeability Error

Average scale factor (ASF) change

Typical:	Less than 0.24 mV/μm (6 mV/mil)
Worst Case:	Less than 0.42 mV/μm (11 mV/mil)

Voltage Difference at Same Physical Gap (maximum)

At 1000 μm (40 mils) gap	4.6 Vdc
At 250 μm (10 mils) gap	3.6 Vdc

DC Resistance (Nominal) (R_{PROBE})

0.5 m Probe	4.0 ± 0.5Ω
1.0 m Probe	4.2 ± 0.5Ω

Connector Torque Requirement

0.5 N·m (5 in lb), or finger tight plus 1/8 turn

Case Types and Torque Limits

1/4-28 or M8x1 Cases	7 N· m (65 in lb)
1/4-28 (first 3 threads)	5 N· m (45 in lb)
M10x1	34 N· m (300 in lb)
M10x1 (first 3 threads)	22 N· m (200 in lb)

Torque (Maximum Rated)

Tip to Case	0.1 N· m (1 in lb)
Case to Lead	0.1 N· m (1 in lb)
Case to SST Armor	0.5 N· m (5 in lb)

Tensile Strength (Maximum Rated)

Tip to Case	2 kg (5 lb)
Tip to Lead	22 kg (50 lb)
Case to Connector	22 kg (50 lb)
Case to SST Armor	22 kg (50 lb)

Recommended minimum bend radius

25 mm (1.0 in)

Weight

20 g to 150 g (0.7 oz to 5.0 oz)

Temperature

Storage	-51°C to +177°C (-60°F to +350°F).
Operating	-34°C to +177°C (-30°F to +350°F).

NOTE: Maximum temp. for sealed ETFE armor is 149°C (300°F).

Relative Humidity

100% condensing nonsubmerged from 2°C to 100°C (35°F to 212°F) with connector protection.

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 1000 µm (40 mil) gap	145 µm (5.8 mils)
At 250 µm (10 mil) gap	100 µm (4.0 mils) (maximum)

DC resistance, nominal

Center conductor (R_{CORE})	0.220 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)

Minimum bend radius

25 mm (1.0 inch)

Connector Torque Requirement

0.5 N·m (5 in lb) (finger tight plus 1/8 turn)

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.