Installation Manual

Bently Nevada™ Asset Condition Monitoring

14 mm Proximity Transducer System 7200 Series

Part Number 74756-01
Rev. G (07/07)

imagination at work

Contact Information

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Additional Information

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Contents

1. SYSTEM OVERVIEW

1.1 INTRODUCTION

The 7200 Series 14 Millimetre Proximity Transducer System is a noncontacting, shaft vibration and relative position measurement system. The system includes a probe and Proximitor. Figure 1-1 shows a typical system.

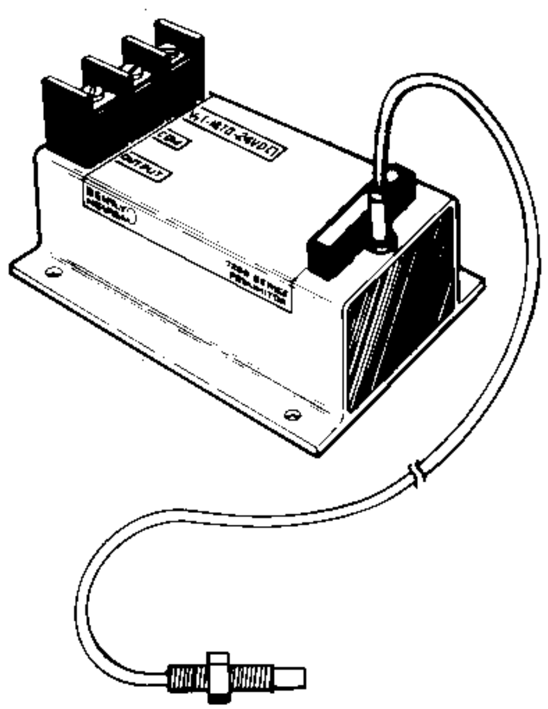


Figure 1-1. 14 mm Proximity Transducer System

The transducer system measures the gap between the probe tip and an observed metal surface and converts this distance to a proportional negative dc voltage. The system measures both static (fixed) and dynamic (changing) distances. The output signal is fed to a monitor to determine such things as radial vibration and axial thrust position.

Probes are available in different configurations to accommodate a variety of applications and to aid in installation. The probe tip is approximately 14 mm (0.55 inches) in diameter. The system offers a linear measuring range of 160 mils (4.06 mm) beginning at 20 mils (0.51 mm) from the probe face. Also, the system scale factor is 100 mV/mil (3.94 V/mm).

Two Proximitor types are available, each calibrated to a specific cable electrical length. Probe cables are designed to achieve a system length of 5.0 or 9.0 metres (16.4 or 29.5 feet). All cables are trimmed to an electrical length which can be longer or shorter than the stated physical length. Cables are available with or without ETFE (fluoropolymer) armor.

The probes come with the serial number and part number printed on a label. The label is protected by a piece of clear FEP tubing. During installation, user identification can be placed under another piece of shrinkable FEP tubing. The tubing is shrunk when heat is applied.

The probe signal and the input power are transmitted between the Proximitor and a standard Bently Nevada monitor through a 3-wire shielded signal cable (provided by the user in most cases). The Proximitor can be up to 1000 feet (305 metres) from a monitor without degradation of performance.

Probes are compatible with most petrochemical environments. Strong acids with a pH of less than 4, strong bases with a pH greater than 10, and some organic solvents may damage the probes. Contact the nearest Bently Nevada Corporation office for details about probes that operate in harsh environments.

Standard versions of the components of this system are shown in Appendix A. Specifications are listed in Appendix B, and Appendix C shows scale factors and sensitivity curves.

1.2 PROXIMITY MEASUREMENTS

The probe radiates radio frequency energy from the probe tip coil. As a conductive material (such as a machine shaft) approaches the probe tip, eddy currents are induced into that material. The closer the conductive material comes to the probe tip, the greater the magnitude of the eddy currents. As the eddy currents increase, the power energy radiated from the probe tip is absorbed and there is a corresponding loss in power detected at the Proximitor. If the probe-to-shaft gap remains constant, the Proximitor output signal remains constant; if the gap changes, the output signal changes accordingly.

The 14 Millimetre Proximity Transducer System is primarily intended for measuring the axial thrust motion of large machine rotors. Its relatively large linear measuring range may be required for thrust position measurements on large machines. Probes mounted to measure thrust position should be located within 12 inches of the thrust collar. Thrust position probes mounted at the machine end opposite the thrust collar do not provide adequate protection since they also measure differential expansion. Typically, two probes are used so that if one is damaged or fails, thrust position can continue being monitored. See Figure 1-2.

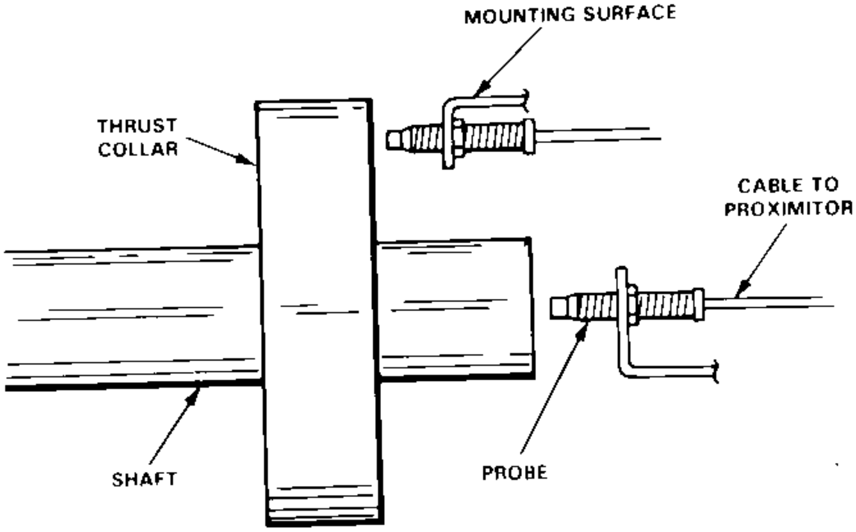


Figure 1-2. Typical Thrust Position Probe Mounting

This transducer system can also be mounted to measure radial vibration. Typically, two probes are mounted 90 degrees apart along the radial axis of a shaft. This enables vibration to be analyzed at all angles along the radial plane. Radial vibration probes should be mounted within 6 inches of the bearing under surveillance. See Figure 1-3.

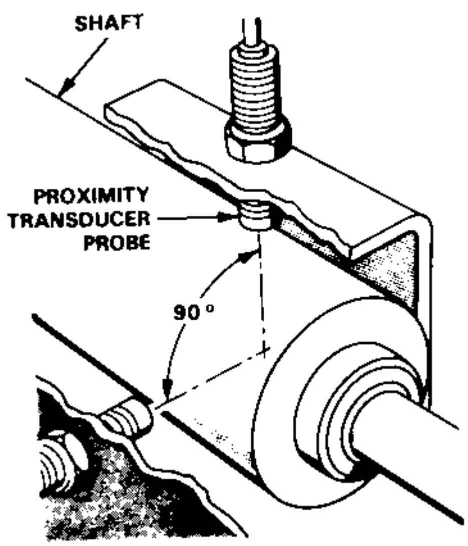


Figure 1-3. Typical Radial Vibration Probe Mounting

2. INSTALLATION

2.1 INTRODUCTION

This section covers inspection, storage, and installation of equipment as well as the actual installation procedures for the probe and Proximitor.

2.2 RECEIVING INSPECTION AND STORAGE

All equipment should be removed from shipping containers and visually inspected to ensure there is no shipping damage. If shipping damage is apparent, file a claim with the carrier and submit a copy to Bently Nevada Corporation. Include part and serial numbers on all correspondence. If no damage is apparent and the equipment is not going to be used immediately, Bently Nevada Corporation recommends returning the equipment to the shipping container and resealing. The equipment should be stored in an environment free from potentially damaging conditions such as high temperature, excessive humidity, or a corrosive atmosphere. See Appendix B for environmental specifications.

The equipment is durable; however, reasonable handling care should be exercised during installation. When cable connectors are part of the equipment, they must be properly protected from physical abuse or contamination by oil, water, or other substances by wrapping them with FEP tape or another connection protective device.

CAUTION

Do not use adhesive electrical tape; oil mist will dissolve the adhesive causing connector contamination.

2.3 INSTALLATION CONSIDERATIONS

Bently Nevada probes and Proximitors are calibrated to AISI E4140 series steel. Most AISI 1000 and AISI 4000 Series steel present a response curve similar to the AISI E4140 Series steel. However, copper, aluminum, brass, tungsten, or other types of metals present a different response curve. If the metal to be observed has significantly different magnetic and electrical properties than AISI E4140 steel, follow the recalibration procedure in Section 3. If it is necessary for the probe to observe a plated area, contact the nearest Bently Nevada Corporation office for assistance.

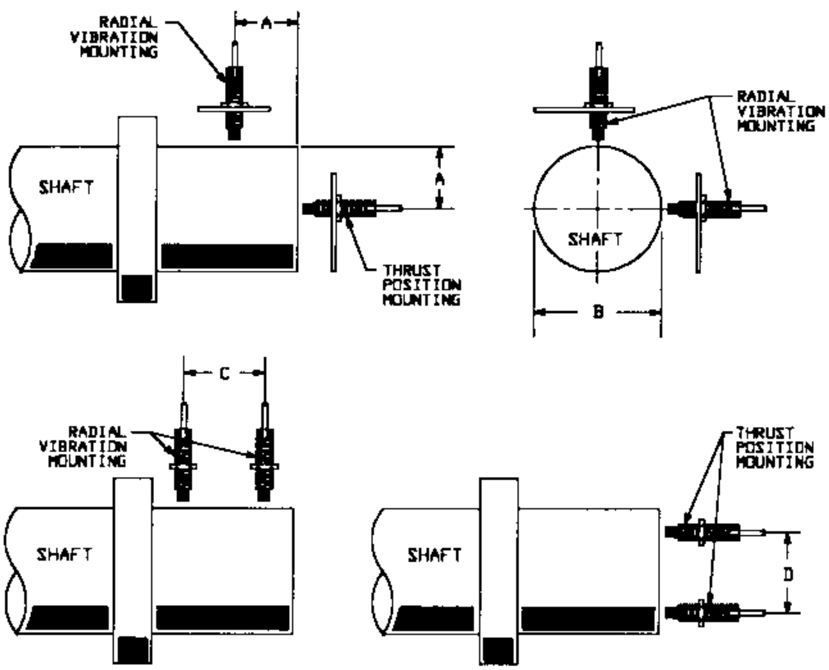
Proper installation requires the observed surface to be free of irregularities such as hammer marks, scratches, holes, or keyways. Any type of plating (including chrome) normally results in a nonuniform plating thickness. Residual magnetism, surface irregularities, and other conditions in the observed surface can cause electrical or mechanical runout which will introduce error in the Proximitor output.

The various techniques for eliminating electrical and mechanical runout are described in several papers available from Bently Nevada Corporation, including:

- Dealing with "Glitch". Where does Electronic Vectorial Runout Compensation Fit In? (Application Note 004)

- "Glitch": Definition of and Methods for Correction, including Shaft Burnishing to Remove Electrical Runout. (Application Note 011)

The electromagnetic fields of probe tips mounted too closely together will cross-couple, causing a small amplitude ac signal to be superimposed on the Proximitor outputs. To prevent cross-coupling mount the probes so that the distance between the tips is at least as large as that shown in the Figure 2-1.



A = 28 mm (1.1 inches) minimum
B = 82 mm (3.2 inches) minimum
C = 64 mm (2.5 inches) minimum
D = 61 mm (2.4 inches) minimum

Figure 2-1.   Cross-Coupling

Because the electromagnetic field also extends outward from the side of the probe tip, it is necessary to remove all conductive material from around the tip as shown in Figure 2-2. If this is not done, false information will be generated. Side view can be avoided by proper gapping of the probe or by removing conductive material by counterboring.

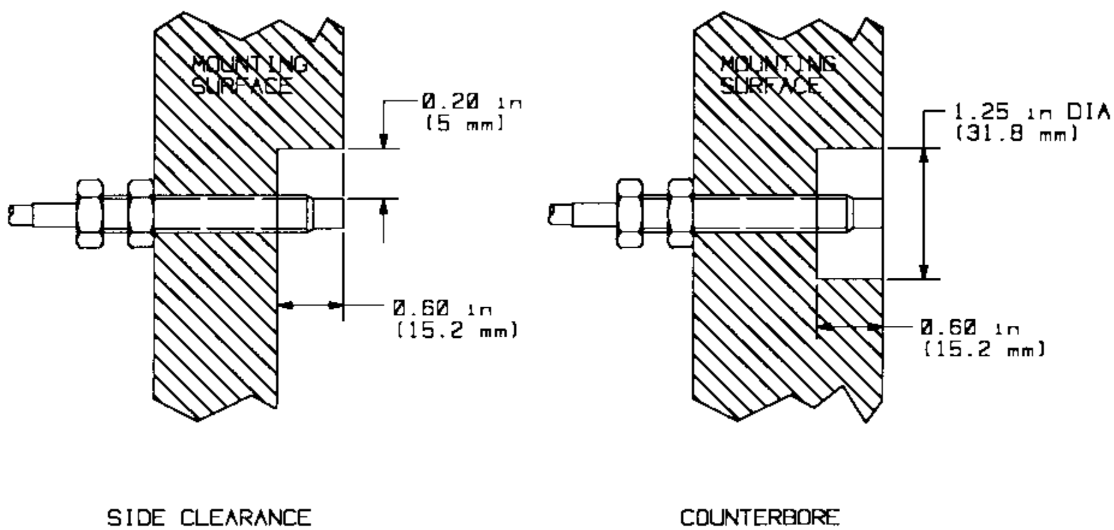


Figure 2-2. Proper Probe Tip Side Clearance

Brackets or other structural members used to mount probes must be rigid. When using a mounting bracket, it should be field checked for resonant frequency. The resonant frequency should be at least ten times machine running speed. Brackets must support the probe in a position perpendicular to the observed surface. The probe axis can vary 15 degrees from perpendicular without affecting the performance of the transducer system.

Probes may be mounted through existing machine hardware such as the bearing cover of a machine case. Many times it is advantageous to use an external mounting adapter, allowing the probes to be removed and replaced, or gapped again without taking the machine apart. For more information on mounting brackets and adapters, contact your nearest Bently Nevada office for information on transducer accessories.

2.4 PROBE INSTALLATION

Perform the following procedure to assure proper probe installation. The observed surface must remain motionless while gapping the probe. The probe can be gapped mechanically or electrically. Use either steps a and b or steps a and c.

a. Before installing the probe into its mounting hole, ensure the tapped hole is free of foreign material. If necessary, use an appropriate tap to clean the threads. Before the probe is threaded, disconnect the probe integral cable from the Proximitor or make sure it is free to turn to prevent twisting the lead.

b. The probe can be gapped mechanically. Thread it into the mounting and use a nonmetallic feeler gauge to set the gap. A nonmetallic feeler gauge must be used to prevent scratching of the probe tip or the observed surface.

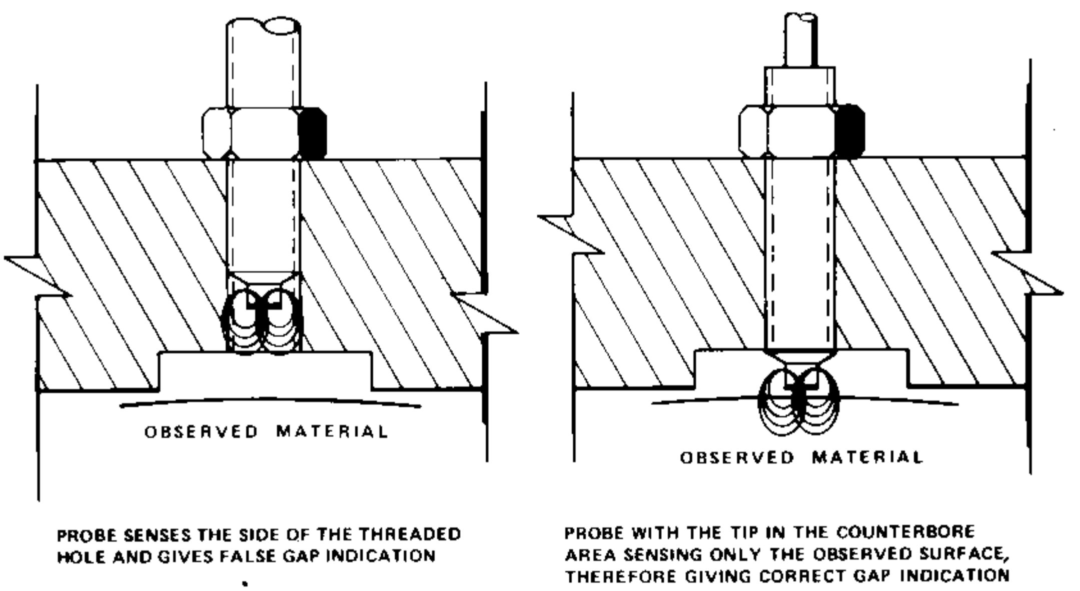


Figure 2-3. Gap Indications During Mounting

c. The probe can also be gapped electrically by connecting the probe cable to the Proximitor (see CAUTION below). Apply the proper input voltage (-18 Vdc or -24 Vdc) to the Proximitor. Connect a digital multimeter to the Proximitor output. Thread the probe into the mounting, and observe the transducer output voltage. As the probe is threaded, the transducer output voltage remains low or gives a false reading because it is sensing the surrounding mounting material. See Figure 2-3. As the probe tip extends through the mounting, the transducer output voltage will increase to its maximum output and then decrease as it approaches the observed surface. By cross-referencing this voltage with the probe calibration curve in Appendix C, the proper gap can be set.

d. When the probe is properly gapped, secure it by tightening the jam nut (locknut). Care should be taken so the jam nut is not secured so tightly the threads are stripped.

CAUTION

Remember, to prevent twisting, disconnect the probe from the Proximitor when threading the probe. Reconnect it to take readings.

Axial position probes should be gapped when the machine is not running so that the rotor can be placed at a known position with respect to the clearances in the thrust bearing.

After the probe is secured in position, the probe cable must be securely fastened to prevent fatigue failure caused by oil flow, moving air, or singular stress conditions. A clip or cable holding device will work as long as it does not exert enough force on the cable to cause the FEP insulation to cold flow. Cold flow is change in dimension or distortion caused by the sustained application of force.

Sometimes it is necessary to seal around the probe cable. Sealing creates a special problem, because the cable is insulated with FEP which will cold flow and cannot be subjected to high pressure exerted by some gland seals. If the pressure differential across the seal area is one atmosphere or less, a simple seal (such as duct seal putty) can be used. If the differential pressure is greater than one atmosphere, a special probe must be used. Contact your nearest Bently Nevada office for more information.

Before the probe is installed, make sure its electrical length is equal to the electrical length required by the Proximitor.

Before routing the cable, insert an identification label (provided by the user) under the clear FEP sleeve at the end of the cable, if desired. Secure the label by applying heat to shrink the tubing. The heat source should not exceed 300° F (149° C).

The cable should be routed inside conduit connected to the enclosure which contains the Proximitor. Where the cable is installed in a conduit, care must be taken not to rub or cut the cable on sharp or rough surfaces. Protect the connector from contamination by covering or taping prior to pushing through the conduit.

If it is undesirable or not possible to route the cable inside conduit, armored cable should be used. Use clips or similar devices to secure the armored cable to supporting surfaces. Route the cable through protected areas to reduce the chance of physical abuse. The armor should be terminated at the Proximitor enclosure.

If the connector on the cable ever needs replacement, check with Bently Nevada Corporation for installation procedures, connector part numbers, and the required tools.

2.5 PROXIMITOR INSTALLATION

The Proximitor should be mounted in an enclosure that provides protection from mechanical damage and contamination. Weatherproof sheet metal or explosion-proof cast-aluminum housings provide optimum protection from mechanical damage and undesirable climatic conditions. In corrosive or solvent environments, the enclosure should be purged with clean, dry compressed air or inert gas to protect the Proximitor. The protective enclosure should be free of material such as loose metal parts that could short-circuit Proximitor terminals. Excess cable and uninsulated armor must be secured away from Proximitor terminals. The excess cable, for example, can be secured with clamps to the enclosure lid or housing wall.

Bently Nevada Corporation recommends placing as many Proximitors as possible in the same protective enclosure, provided that all can be installed without altering the electrical length of the probe-to-Proximitor cabling. Enclosing multiple Proximitors decreases installation costs and simplifies the routing of cables from the Proximitors to the monitors. Check with the nearest Bently Nevada Corporation office for information on available Proximitor housings.

Before installing power and signal connections, make sure the Proximitor supply voltage is within a range of -17.5 Vdc to -26 Vdc, referenced to supply common. The exact voltage depends on the requirements of the monitor being used with the system. When used with a -24 Vdc power source, the 14 Millimetre Proximity Transducer System offers a linear range of approximately 160 mils (4.06 mm). As the power source decreases (-18 Vdc for instance) there is a decrease in the linear range. See Appendix C.

Field wiring from the Proximitor to the monitor is generally provided by the user unless a specific request is made to have Bently Nevada Corporation do the fabrication. Shielded three-wire cable should be used.

Proper isolation and shield grounding ensures that a minimum amount of noise will be induced in the signal conductor. Bently Nevada Corporation recommends electrically isolating all Proximitors. The Proximitor protective housings manufactured by Bently Nevada Corporation can be ordered to include the isolation kits. For retrofit and conversion situations, Bently Nevada Corporation offers a Proximitor Isolation Kit (BNC P/N 19094-01).

The probe is internally isolated to provide shield isolation at the probe end. The probe cable shield is physically connected to the Proximitor case which is isolated with FEP insulation. Figure 2-4 shows the field wiring and shield grounding connections made to 7000, 7200, and 9000 Series monitors.

The shield of each field wiring cable should be earth grounded at only one end; the other end should not be grounded. All shields of field wiring connected to the monitors in the same rack should connect to the same earth ground to avoid ground loops. If safety barriers are not used in the field wiring, each monitor-end shield connects to the COM terminal of the respective rack signal module. The signal module COM terminals are connected to ground by a user-installed jumper wire connecting a specific remote reset terminal (common) to the earth ground. If safety barriers are used, shields are connected to the earth ground bus, and the jumper wire between the remote reset terminal and earth ground must not be installed.

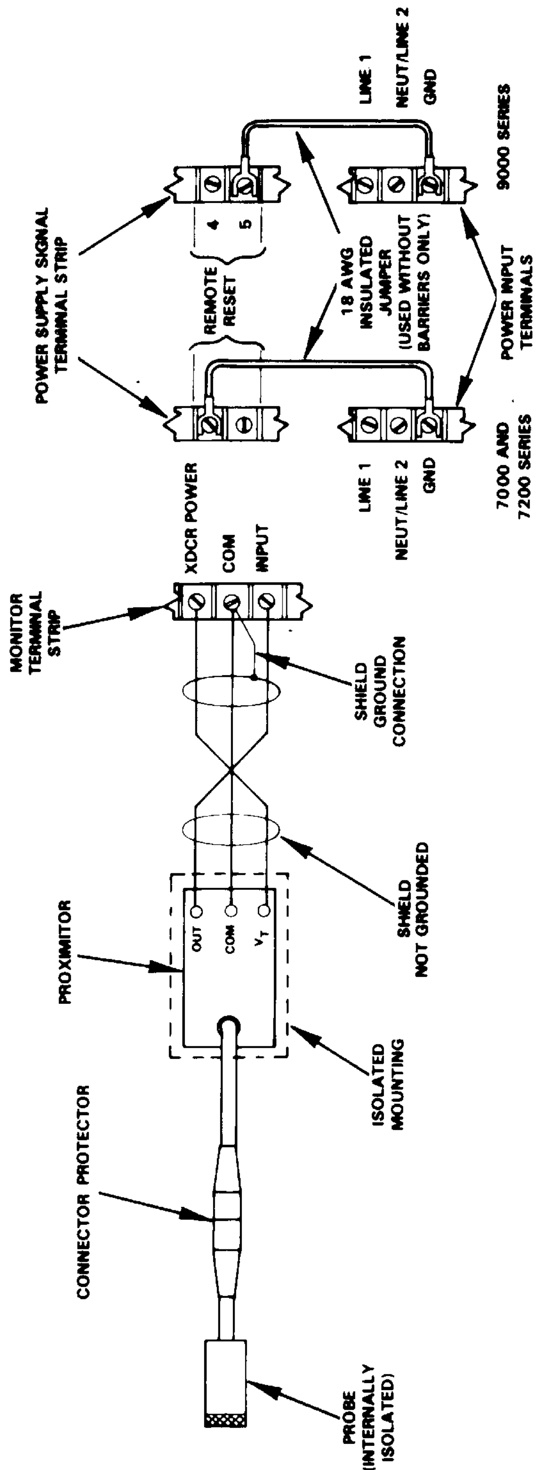


Figure 2-4. Field Wiring and Shield Grounding for 7000, 7200, and 9000 Series Monitors

3. MAINTENANCE

3.1 INTRODUCTION

This section contains calibration and troubleshooting procedures. The recommended maintenance equipment is given in Table 3-1. If the recommended equipment is not available, equivalent instruments can be used. Any maintenance performed by the user, other than that which is specified herein, may void the warranty.

Table 3-1. Recommended Maintenance Equipment

MAINTENANCE EQUIPMENT	RECOMMENDED EQUIPMENT
Digital Multimeter	Hewlett-Packard Model 3465 A/B
Test and Calibration Kit	Bently Nevada Corporation Model TK3-2E or TK3-2G
Variable Resistor	0 to 10k ohms
Soldering Iron	Weller Model SP23
Power Supply	Hewlett-Packard Model 6215A

3.2 CALIBRATION CHECK

Successful completion of the following procedure assures proper transducer calibration.

a. Connect test equipment as shown in Figure 3-1.

b. Adjust the spindle micrometer on the TK3 test and calibration kit until it indicates 20 mils (0.51 mm).

c. Insert the probe into the TK3 probe holder. Adjust the probe in the holder until the digital multimeter indicates -2.00 ±0.01 Vdc and tighten the probe in the fixture. Do not contact the probe tip.

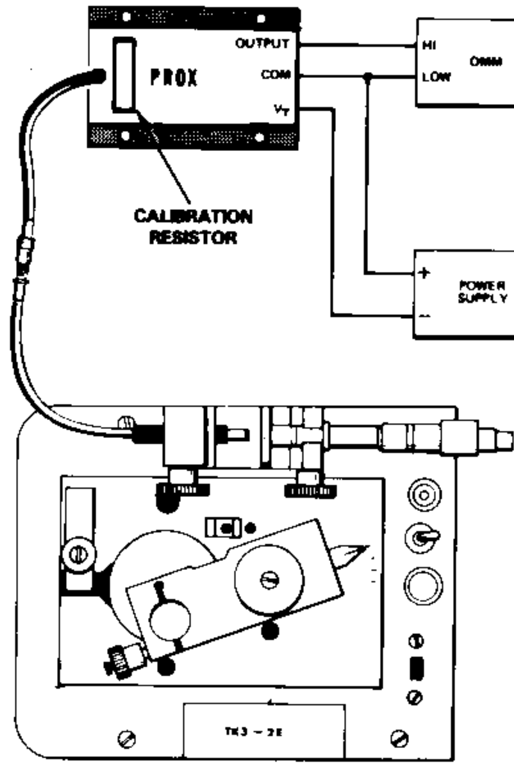


Figure 3-1. Test Equipment Setup

d. Adjust the micrometer to a 15 mil (0. 38 mm) indication, then back to a 20 mil (0. 51 mm) indication and record the output voltage. Going to the 15 mil (0. 38 mm) indication first will eliminate any play in the micrometer before taking the 20 mil reading.

e. Increase the gap in 20 mil increments by adjusting the micrometer. Record the voltage indication at each increment.

f. Either plot each voltage indication obtained in step e or compare each to the desired calibration curve in Appendix C.

g. If the transducer is out of tolerance (refer to the specifications), recalibrate.

3.3 RECALIBRATION

Perform the following procedure to recalibrate the transducer.

a. Remove the protective assembly from the calibration resistor on the Proximitor (use a screwdriver to pry away the outer barrier). Desolder and remove the calibration resistor (see Figure 3-1).
b. Attach the variable resistor between the calibration resistor terminals.
c. Perform the calibration check (Page 3-1) and adjust the variable resistor as appropriate until the desired calibration curve is obtained.

NOTE

Increasing the resistance between the calibration terminals will decrease the Proximitor output voltage and slope of the calibration curve; decreasing the resistance will cause the Proximitor output voltage and slope of the calibration curve to increase.

d. When the desired average scale factor is obtained, remove the variable resistor from the calibration terminals and use the digital multimeter to measure its resistance. Select a 1% tolerance resistor (or two in parallel) equal to the measured resistance of the variable resistor.
e. Solder the resistor(s) between the calibration terminals.

CAUTION

To prevent damage to components, do not leave the soldering iron in contact with the Proximitor terminals too long.

f. Remove the room-temperature vulcanizing compound from the epoxy fiberglass shroud.
g. Install the shroud over the calibration resistor(s) and encapsulate with room-temperature vulcanizing compound that does not have an acid base.

3.4 TROUBLESHOOTING

The troubleshooting procedure in Table 3-2 helps the user interpret and isolate faults in an installed transducer system. Before beginning the procedure, ensure the system has been installed correctly and all connectors have been secured properly in the correct locations.

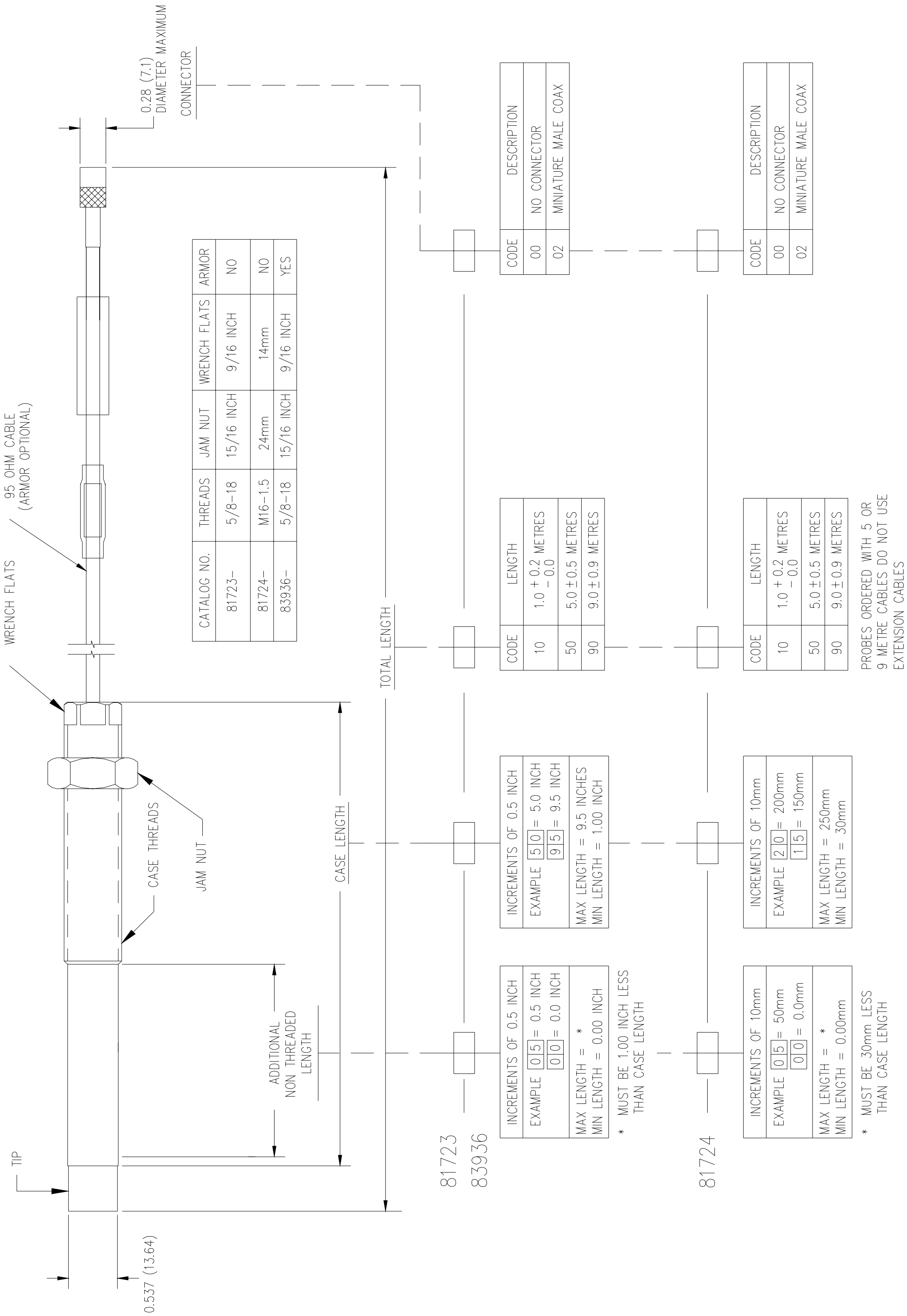
When a malfunction occurs, locate the fault indication in the left-hand column of Table 3-2. Then, refer to the center column which lists the probable causes for each fault indication, and the right-hand column which lists the procedure to isolate and correct the fault. Use a digital multimeter to perform voltage and resistance measurements.

Table 3-2. Fault Isolation and Correction

FAULT INDICATION	PROBABLE CAUSE	ISOLATION AND CORRECTION
Voltage between Prox. COM and V_T terminals not within range of -17.5 to -26 Vdc.	1. Faulty power source. 2. Faulty wiring between power source and Proximitor.	Disconnect output wiring from power source. Measure power source output voltage. If not within range of -17.5 to -26 Vdc, replace the power source. If power source output voltage is within range of -17.5 to -26 Vdc, fault exists in wiring between power source and Proximitor or in the Proximitor. Reconnect wiring at power supply and disconnect at Proximitor. If voltage at wire terminals which connect to Proximitor is not correct, replace faulty wiring. If voltage is correct, replace Proximitor.
Voltage between Prox. OUTPUT and COM terminals remains at zero volts.	1. Short circuit in field wiring or instrument connected to Proximitor OUTPUT terminal. 2. Faulty Proximitor.	Disconnect wiring from Proximitor OUTPUT terminal. Remeasure voltage between Proximitor OUTPUT and COM terminals. If a voltage other than zero is measured, replace field wiring or instrument that was connected to Proximitor OUTPUT terminal. If voltage is zero, replace Proximitor.
Voltage between Prox. OUTPUT and COM terminals remains at more than zero and less than 1 volt.	1. Short circuit in probe. 2. Short circuit in probe cable. NOTE: A gap of less than 10 mils between the probe tip and observed surface could cause an indication like a short circuit.	Disconnect cable from Proximitor. Remeasure voltage between Proximitor OUTPUT and COM terminals. If unchanged, replace Proximitor. If within a few volts of the voltage between Proximitor COM and V_T terminals, a short circuit exists in probe cable. Clean probe cable connector with solvent such as Freon. Reconnect probe lead to Proximitor. Remeasure voltage between Proximitor OUTPUT and COM terminals. If still zero volts, replace the probe.
Voltage between Prox. OUTPUT and COM terminals remains within a few volts but is not identical to the voltage between COM and V_T terminals.	1. Faulty Proximitor 2. Open circuit in probe. NOTE: A gap between the probe tip and observed surface that is too large for the transducer to measure could cause an indication similar to an open probe circuit.	Disconnect probe cable from the Proximitor. Using a small piece of wire, short the center pin to the outer shell of the coaxial connector on the Proximitor and remeasure the output voltage. If the voltage is not 0.6 to 0.8 volts, replace the Proximitor. If the voltage is between 0.6 and 0.8 volts, an open circuit exists in the probe. Using the DMM set to the resistance function, measure the outer conductor and the inner conductor of the probe. Normal resistance of the probe measured center to outer is 3 to 9 ohms. Replace faulty probe.
Voltage between Prox. OUTPUT and COM terminals remains identical to voltage between COM and V_T terminals.	1. Short circuit in wiring between Proximitor OUTPUT and V_T terminals. 2. Faulty Proximitor.	Remove wiring from Proximitor OUTPUT terminal. Remeasure voltage between Proximitor OUTPUT and COM terminals. If voltage is less than supply, a short circuit exists in wiring between Proximitor OUTPUT and V_T terminals. If voltage is unchanged, replace Proximitor.

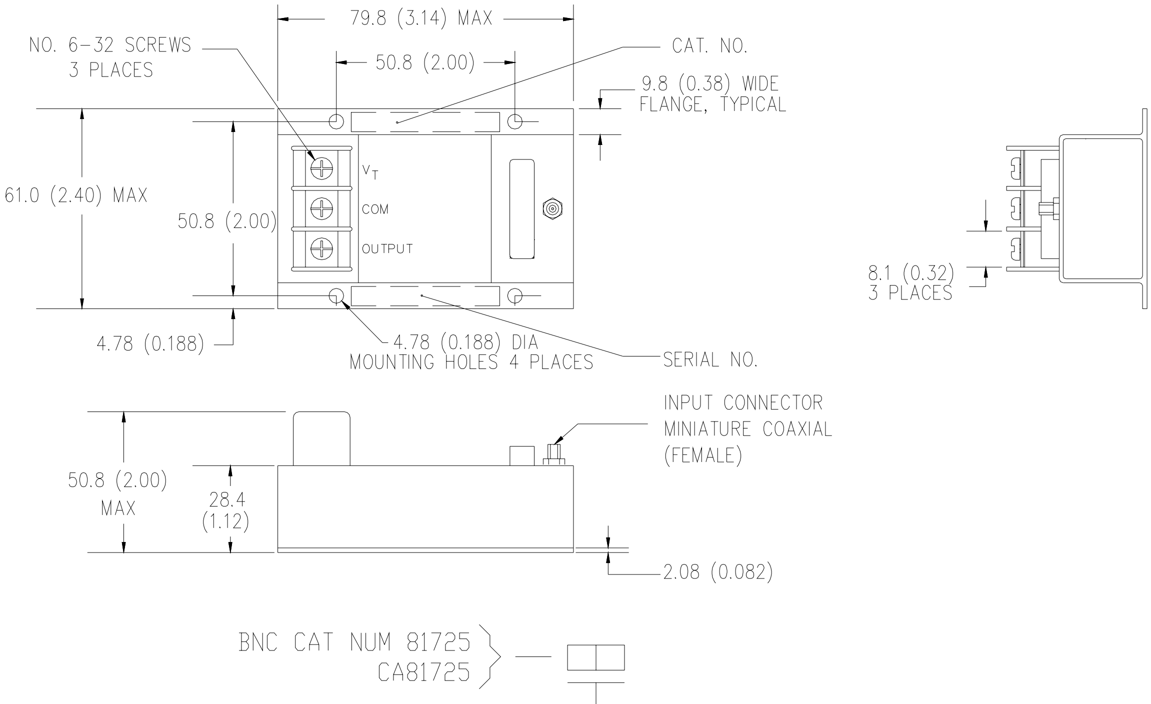
4. APPENDIX A

DRAWINGS AND ORDERING INFORMATION



CATALOG NO.	THREADS	JAM NUT	WRENCH FLATS	ARMOR
81723-	5/8-18	15/16 INCH	9/16 INCH	NO
81724-	M16-1.5	24mm	14mm	NO
83936-	5/8-18	15/16 INCH	9/16 INCH	YES

Figure A-1. 14 mm Probe Ordering Information



DASH NO.	DESCRIPTION
01	FOR 14mm (.55 INCH) PROBE AND 5M (16.4 FEET) CABLE LENGTH
02	FOR 14mm (.55 INCH) PROBE AND 9M (29.5 FEET) CABLE LENGTH

Figure A-2. 14mm Proximitor Ordering Information

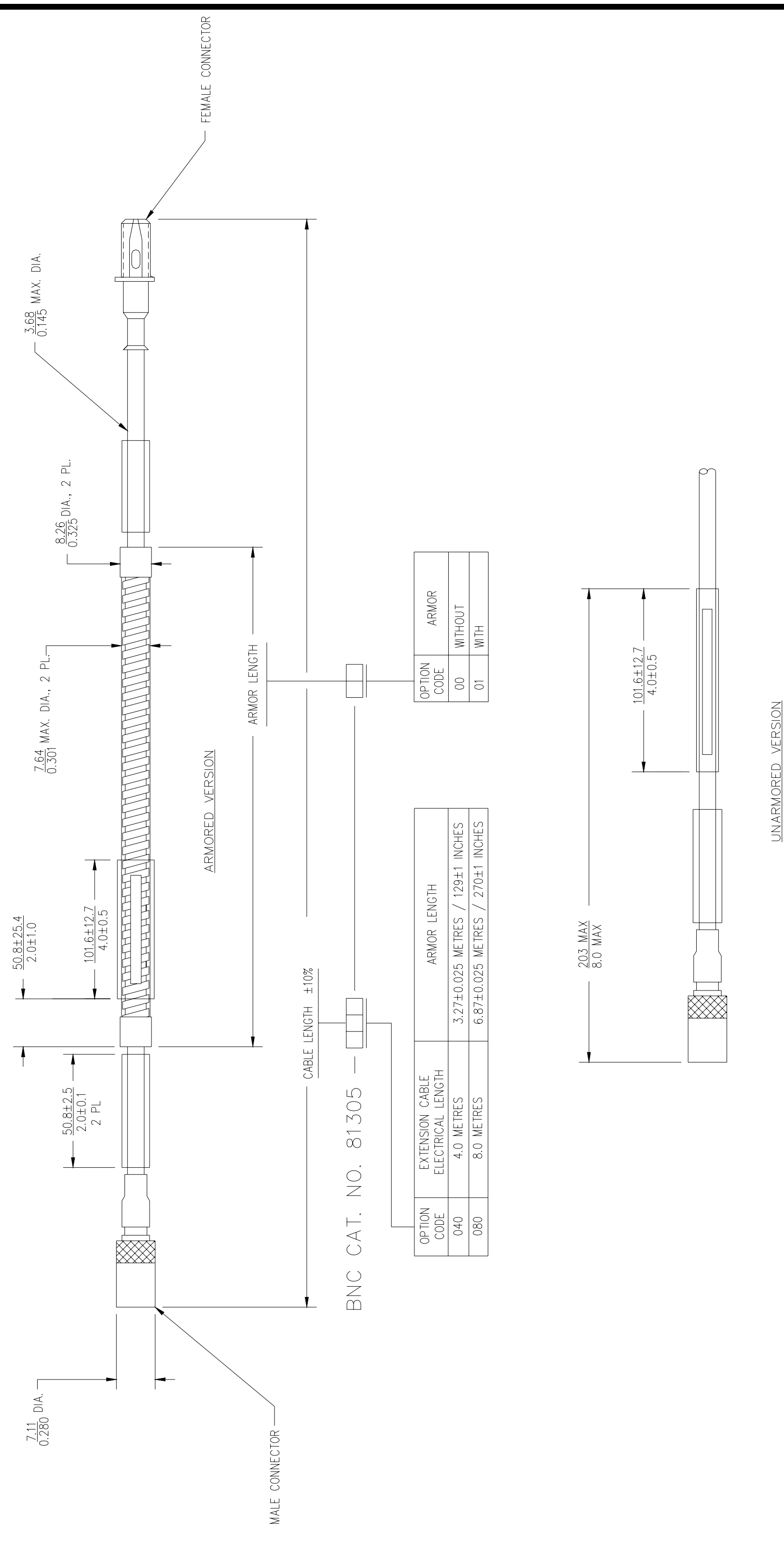


Figure A-3. 14mm Extension Cable Ordering Information

5. APPENDIX B

SPECIFICATIONS FOR THE

14 MM PROXIMITY TRANSDUCER SYSTEM

SPECIFICATIONS FOR THE 14 MM PROXIMITY TRANSDUCER SYSTEM

SYSTEM PERFORMANCE

The following specifications apply at 72° F (22° C) with -24.0 ± 0.l Vdc supply, 10k ohm load, and AISI E4140 steel target; and when test equipment is used with accuracy as specified by BNC Specification 150980.

A. Calibrated Range	160 mils (4.06 mm) beginning at -2.0 Vdc -- approximately 20 to 180 mils (0.51 to 4.57 mm)
B. Average Scale Factor Over Calibrated Range	
Typical (90%)	100 ± 3.0 mV/mil (3.94 ±0.12 V/mm)
Worst Case (99.7%)	100 ± 7.0 mV/mil (3.94 ±0.28 V/mm)
Bench Calibration	Can be adjusted with the Proximitor calibration resistor for exactly 100 mV/mil (3.94 V/mm)
C. Incremental Scale Factor (Derivative) Over Calibrated Range in 20 mil (0.51 mm) Increments	See Appendix C, Figure C-1
Typical (90%)	100 ± 10 mV/mil (3.94 ± 0.39 V/mm)
Worst Case (99.7%)	100 ± 16 mV/mil (3.94 ± 0.63 V/mm)
Bench Calibration, average scale factor adjusted for 100 mV/mil (3.94 V/mm)	100 ± 10 mV/mil (3.94 ± 0.39 V/mm) in 20 mil (0.51 mm) increments over 160 mil (4.06 mm) range starting at -2.0 Vdc

D. Deviation from best straight line -- approximately 20 to 180 mils (0.51 to 4.57 mm). Error is referenced to the straight line which is centered to yield minimum error and which has a 100 mV/mil (3.94 V/mm) slope.

Typical (90%)	Less than ± 4.5 mils (0.11 mm)
Worst Case (99.7%)	Less than ± 6.5 mils (0.17 mm)

E. Gap at -4. 0 Vdc	40 ± 12 mils (1.02 ± 0.30 mm)

F. Temperature Sensitivity

Probe and 1 foot (0.305 metres) of cable	See Appendix C, Figure C-2
Probe and 9 metres of cable	See Appendix C, Figure C-3
Cable Only	See Appendix C, Figure C-4

14 MM PROXIMITORS

The following specifications apply at 72°F (22°C) with AISI E4140 steel target and when test equipment is used with accuracy as specified by BNC Specification 150980.

A. Calibration Range	160 mils (4.06 mm) beginning at -2.0 Vdc -- approximately 20 to 180 mils (0.51 to 4.57 mm)
B. Interchangeability Error	
1. Average Scale Factor Change	
Typical (90%)	Less than 2.0 mV/mil (79 mV/mm)
Worst Case (99.7%)	Less than 4.0 mV/mil (157 mV/mm)
2. Voltage Change (Maximum)	
At midrange, 100 mils (2.54 mm)	1. 4 Vdc
Near beginning of range, 20 mils (0.51 mm)	0. 9 Vdc
C. Supply Sensitivity	See Appendix C, Figure C-5
D. Supply Voltage Range	-18 Vdc to -24 Vdc
E. Current Draw	13 mA max with 10k ohm load 24 mA max with output shorted
F. Output Resistance	50 ohms
G. Short Circuit Duration	Continuous
H. Output Load	Calibrated into a 10k ohm resistive load
I. Frequency / Phase Response	See Appendix C, Figures C-6 and C-7

J. Output Noise	Less than 10 millivolts peak-to-peak when terminated into a 0.01 microfarad capacitor load or a standard Bently Nevada monitor plus any high frequency noise which may be present on the supply
K. Indication of Fault Conditions	If the probe or extension cable opens or shorts, the output goes to within 2 volts of supply or within 1 volt of common
L. Effects of Incorrect Field Wiring	When used with 7200 or 9000 monitors, the Proximitor can be wired incorrectly in any manner with no resulting damage
M. Materials	
Coaxial Connector	Gold-plated stainless steel
Barrier Strip	Polypropylene
Case	Aluminum; Finish - gold chromate conversion process
Calibration Terminals	Gold-plated brass
Calibration Resistor Sealant	Silicone
Calibration Terminal Grommet	FEP
Label	Mylar (acetate laminate finish)
N. Environmental Restrictions	
Storage Temperature	-60° F to 212° F (-51° C to 100° C)
Operating Temperature Range	-60° F to 212° F (-51° C to 100° C)
Relative Humidity from 35° F to 212° F (2° C to 100° C)	100% non-submerged (except connector)

14 MM PROBES

The 7200 14 mm probe is available in many case styles, with or without armored probe cable, and with or without a connector. The following specifications apply at 72° F (22° C) with AISI E4140 steel target and when test equipment is used with accuracy as specified by BNC Specification 150980.

A. Calibration Range	160 mils (4.06 mm) beginning at -2.0 Vdc -- approximately 20 to 180 mils (0.51 to 4.57 mm)
B. Interchangeability Error	
1. Average Scale Factor Change (over calibration range)	
Typical (90%)	Less than 4 mV/mil (157 mV/mm)
Maximum (99.7%)	Less than 8 mV/mil (315 mV/mm)
2. Voltage Change at Same Physical Gap (Maximum)	
At midrange gap, 100 mils (2.54 mm)	2.2 Vdc
Near beginning of range, 20 mils (0.51 mm)	1. 8 Vdc
C. DC Resistance (Typical)	
Probe Coil	3.5 ohms
Lead Center Conductor	0.354 ohms/ft (1.16 ohms/metre)
Lead Shield	0.017 ohms/ft (0.06 ohms/metre)
D. Insulation Resistance	Capable of withstanding a minimum of 500 Vac rms at 60 Hz between probe case and electrical circuit with less than 1 mA current flow.

E . Inductance	0.025 mH
F. Materials	
Lead Jacket and Core	FEP/TFE
Tip	Polyphenylene Sulfide (PPS)
Case	300 Series Stainless Steel
Armor (if Applicable)	ETFE
Shrink Tubing	FEP
Connector	Silver-plated brass with TFE dielectric insert, stainless steel nut
G. Case Torque (Maximum Rated)	
5/8-18 Case	400 inch-pounds (45.2 newton-metres)
M16 x 1.5 Case	560 inch-pounds (63.3 newton-metres)
H. Torque (Maximum Rated)	
Tip to Case	1 inch-pound (0.11 newton-metres)
Tip to Lead	1 inch-pound (0.11 newton-metres)
I. Tensile Strength (Maximum Rated)	
Tip to Case	5 lbs (2.27 kg)
Case Connector	30 lbs (13.61 kg)
J. Temperature	
Storage	-30° to 350° F (-34° to 177° C)
Operating	-30° to 350° F (-34° to 177° C)
K. Relative Humidity from 35° to 212° F (2° to 100° C)	100% non-submerged (except connector)

14 MM EXTENSION CABLES

A. Electrical Characteristics

The following specifications apply at 72° F (22° C) with AISI E4140 steel target and when test equipment with accuracy as specified by Bently Nevada Corporation specification 150980 is used. Typical is defined as 90% (2 sigma) of extension cables built, and worst case is defined as 99.7% (3 sigma) of extension cables built.

1. Calibration Range	160 mils (4.06 mm) beginning at -2.0 Vdc, approximately 20 to 180 mils (0.51 mm to 4.57 mm)
2. Interchangeability Error with 14 mm System	
a. Average Scale Factor Change	
i Typical	Less than 1.3 mV/mil (51 mV/mm)
ii Worst case	Less than 2.4 mV/mil (94 mV/mm)
b. Voltage Change at Same Gap (Max)	
i At midrange 120 mils 3.0 mm)	0.7 Vdc
ii Near beginning of range, 20 mils (0.51 mm)	0.4 Vdc
3. DC Resistance, Nominal	
a. Center conductor	0.354 ohms/ft (1.16 ohms/metre)
b. Shield	0.017 ohms/ft (0.06 ohms/metre)
4. Capacitance	15.4 pF/ft (50.5 pF/metre)
5. Characteristic impedance	95 ohms

B. Mechanical Characteristics

1. Materials
   a. Jacket and Core -- FEP/TFE
   b. Shrink tubing -- FEP

2. Tensile strength (connector-to-connector: 30 lbs)

3. Recommended minimum bend radius: 1.00 inch (25.4 mm)

6. APPENDIX C

SCALE FACTORS AND SENSITIVITY CURVES

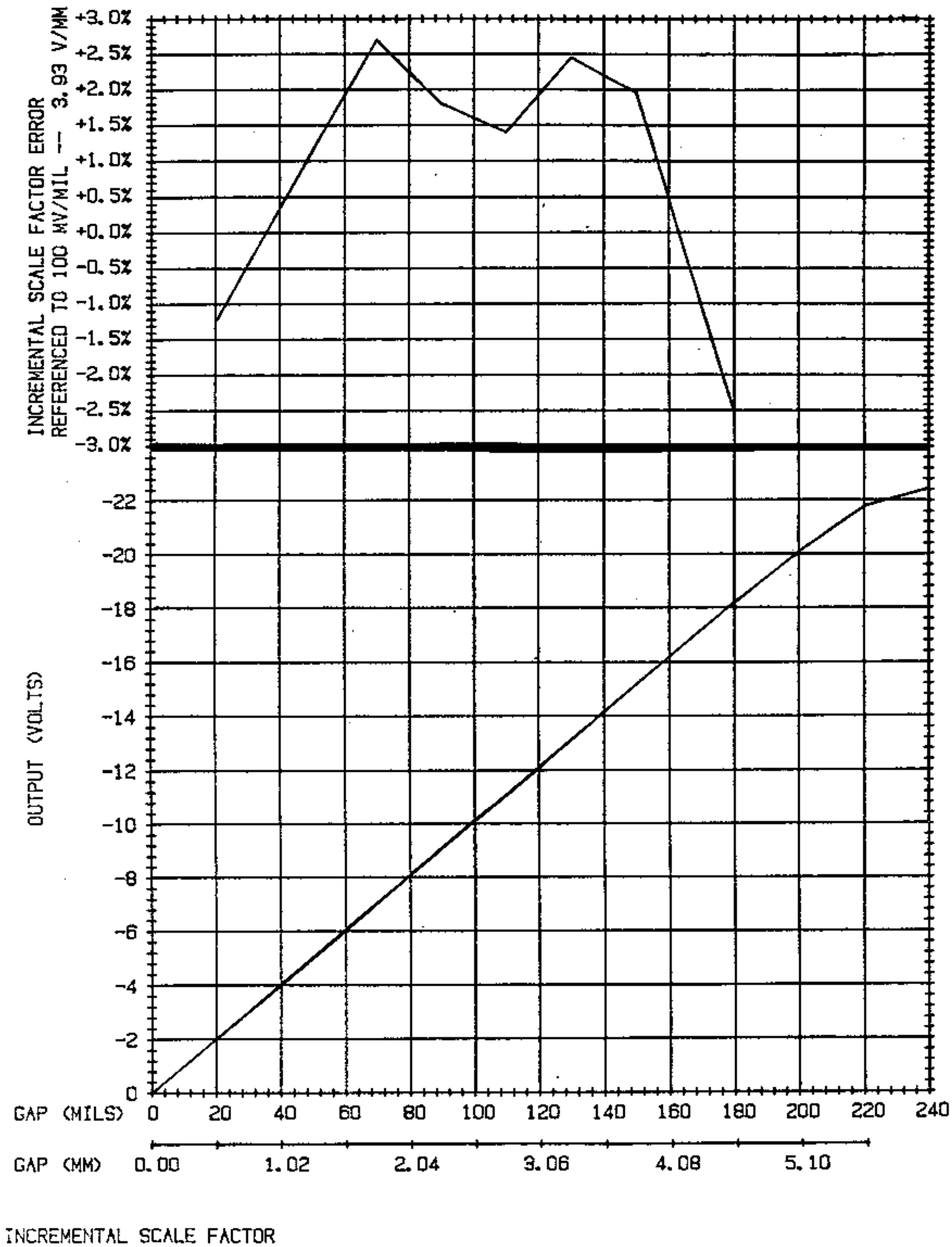


Figure C-1. Incremental Scale Factor

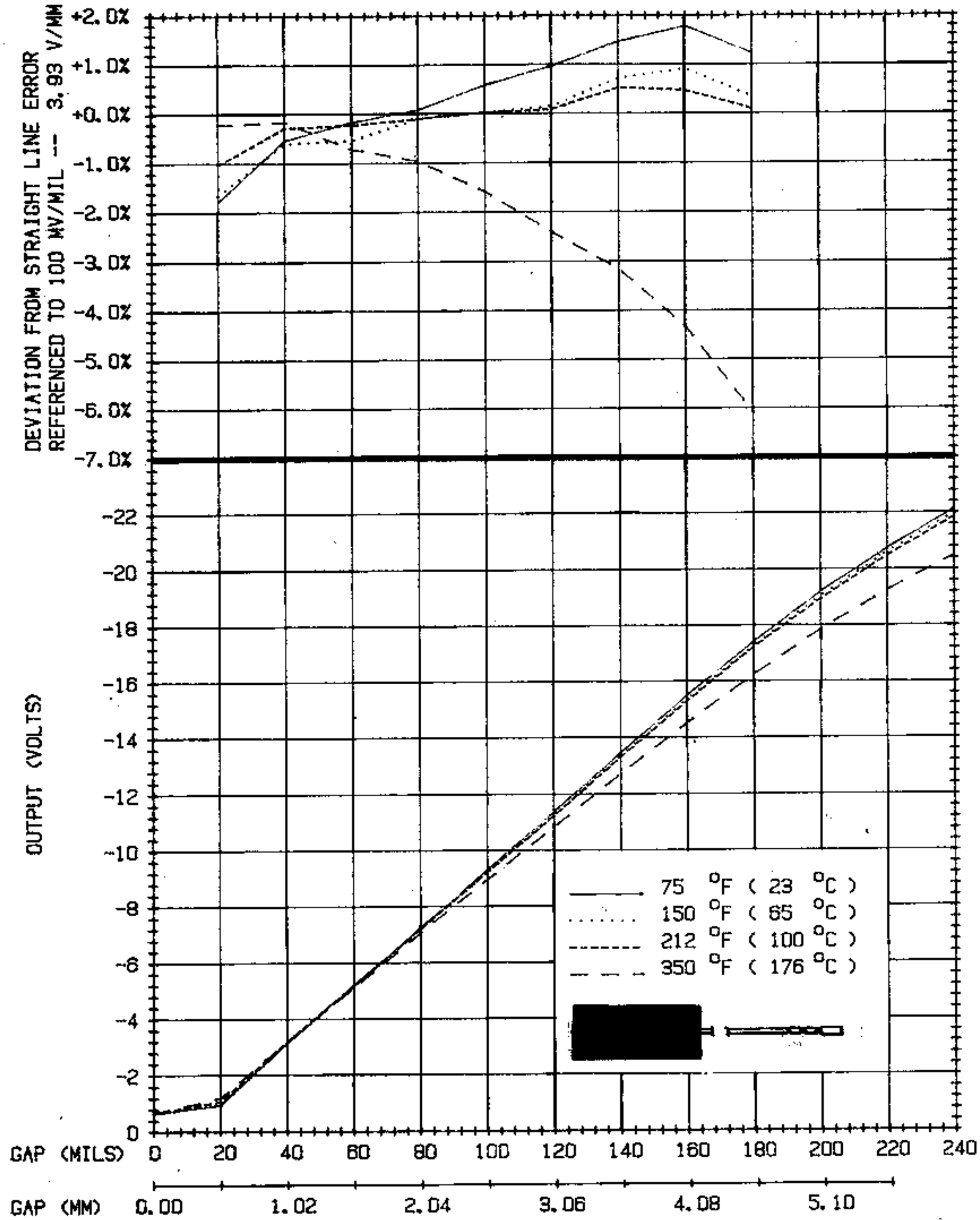


Figure C-2. Probe and One Foot Cable at Temperature

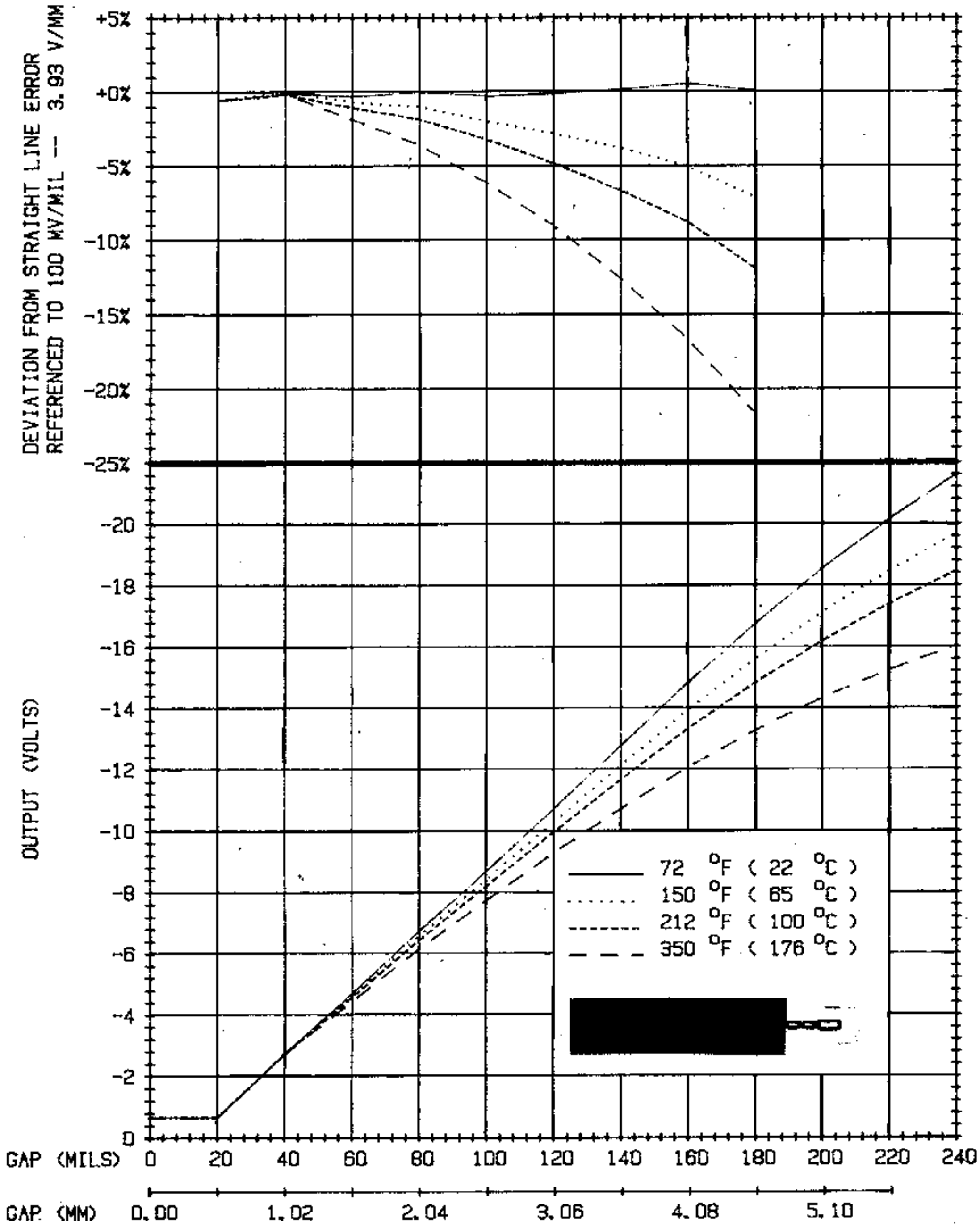


Figure C-3. Probe and 9 Metres Cable at Temperature

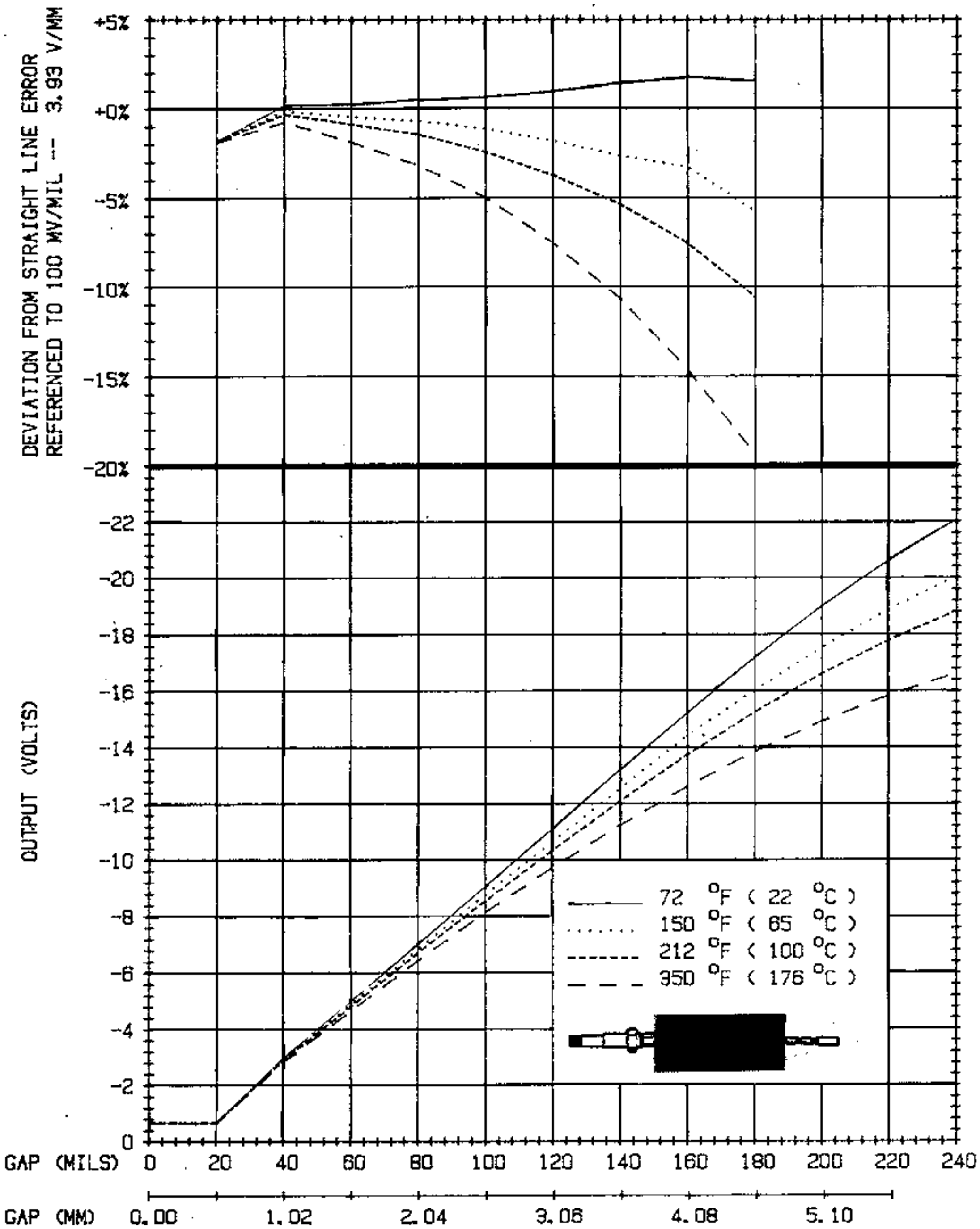


Figure C-4. 9 Metres Cable at Temperature

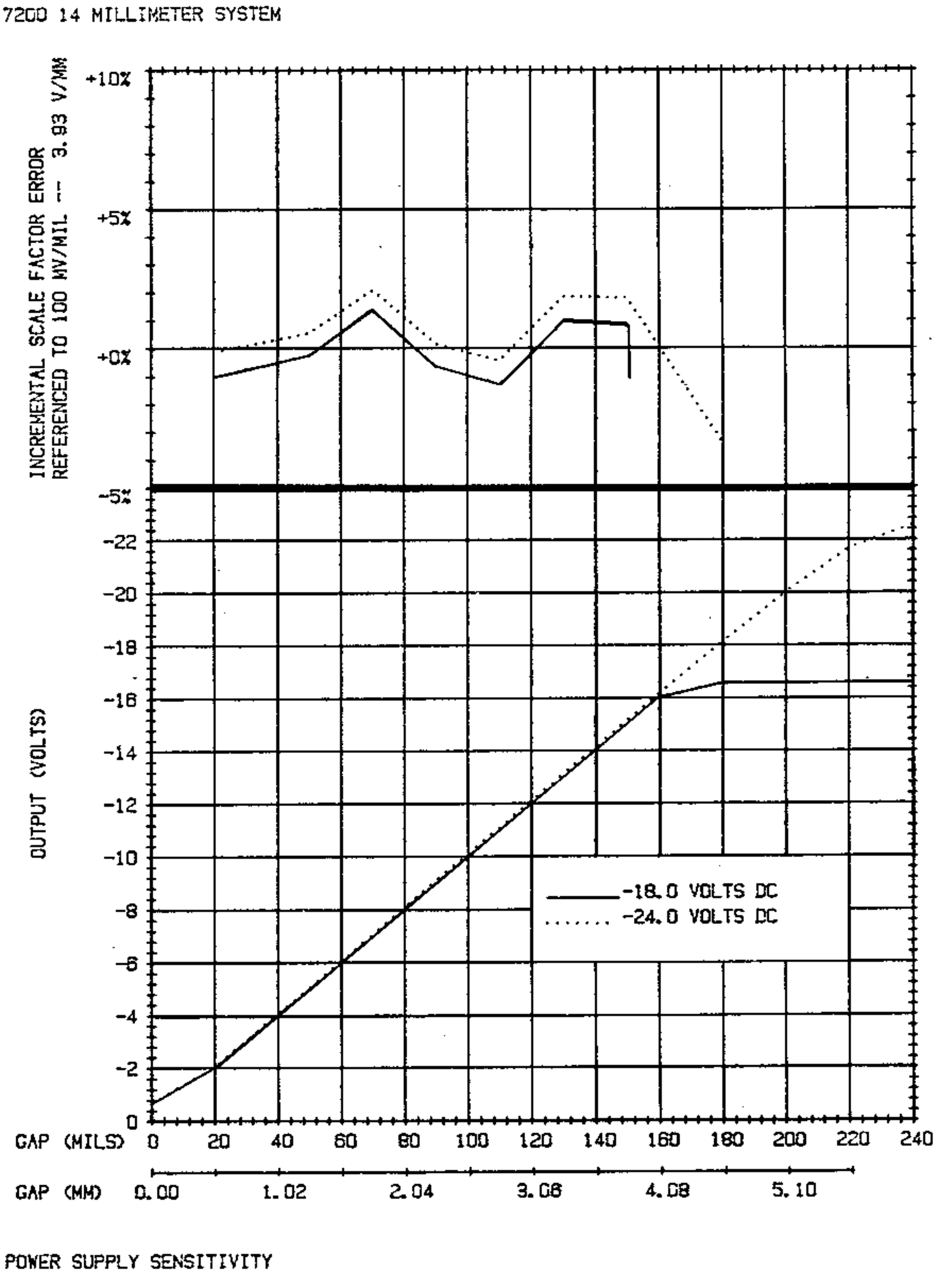


Figure C-5. Typical Proximitor Supply Sensitivity

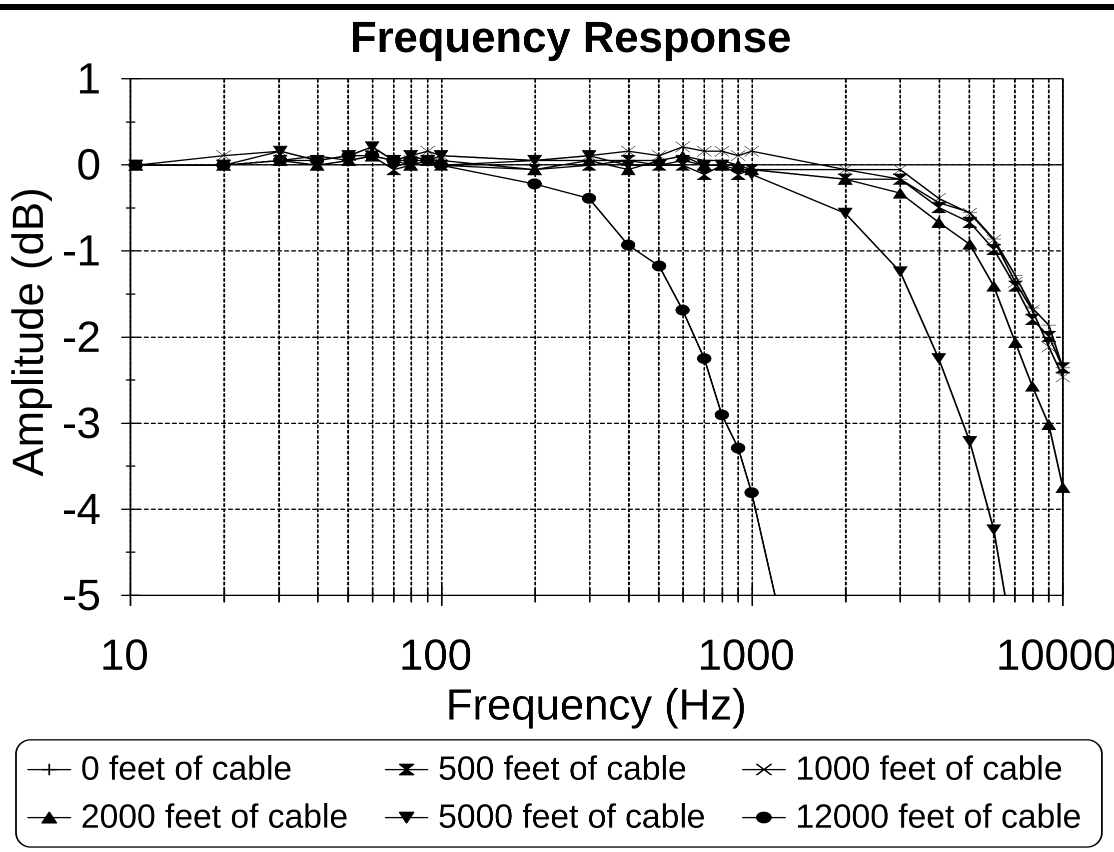


Figure C-6. Frequency Response

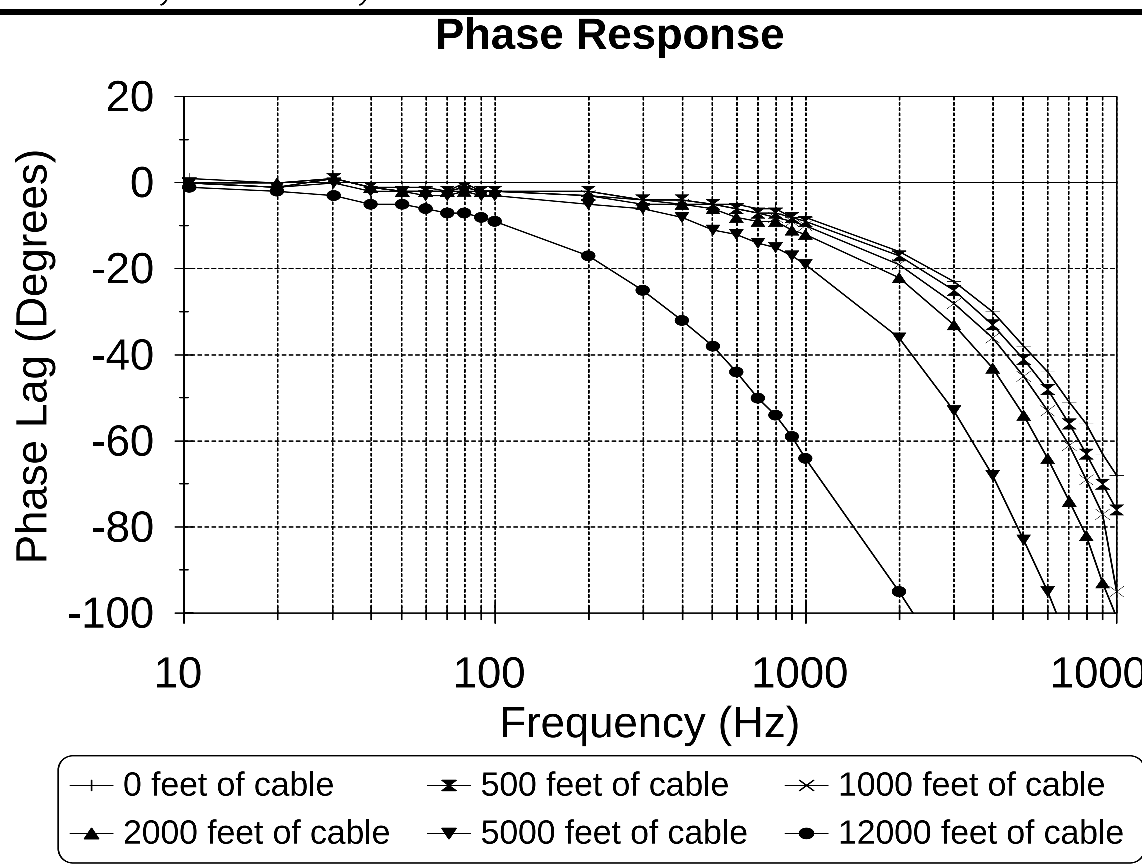


Figure C-7. Phase Response

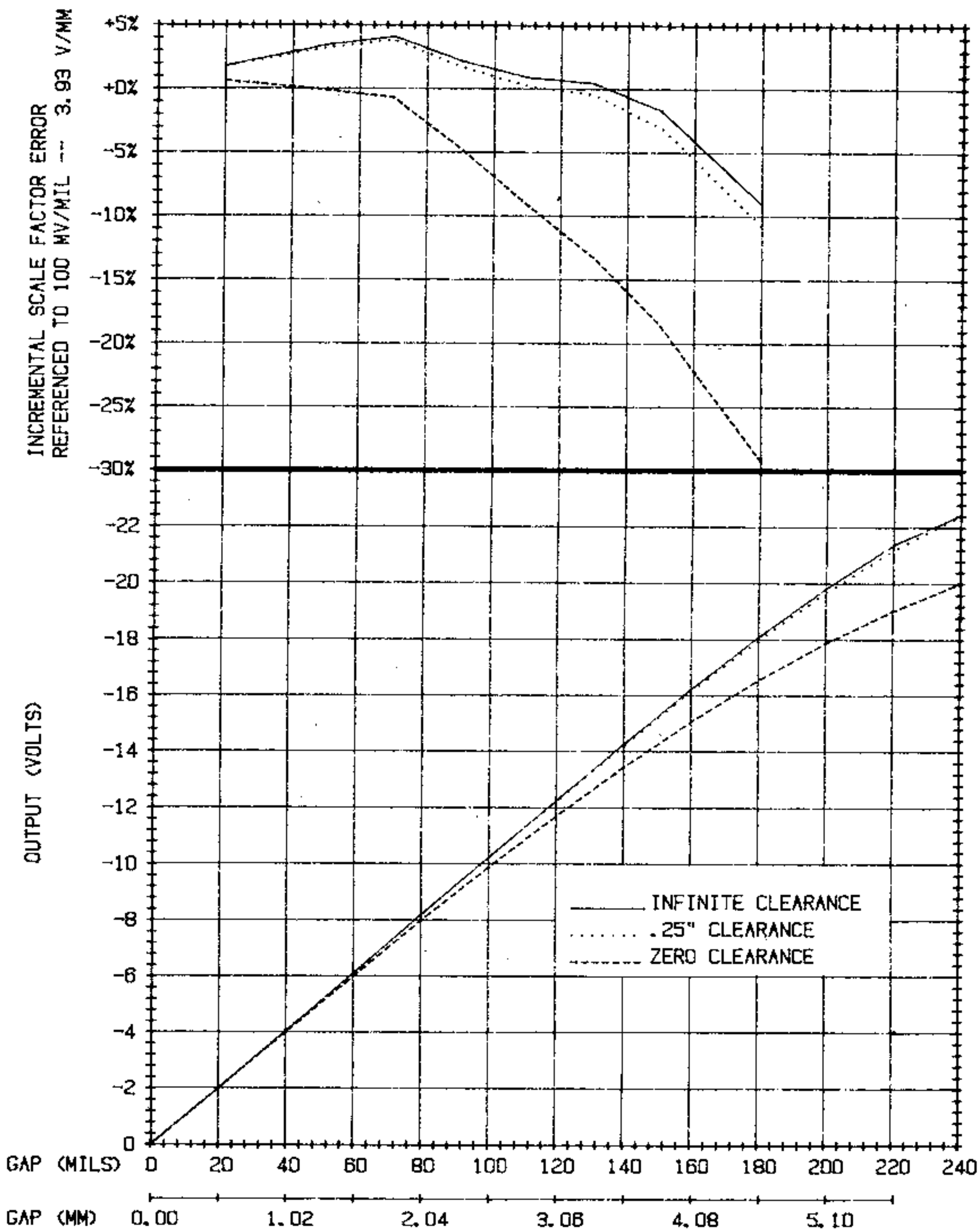


Figure C-8. Effects of Flat Surface Side Clearance

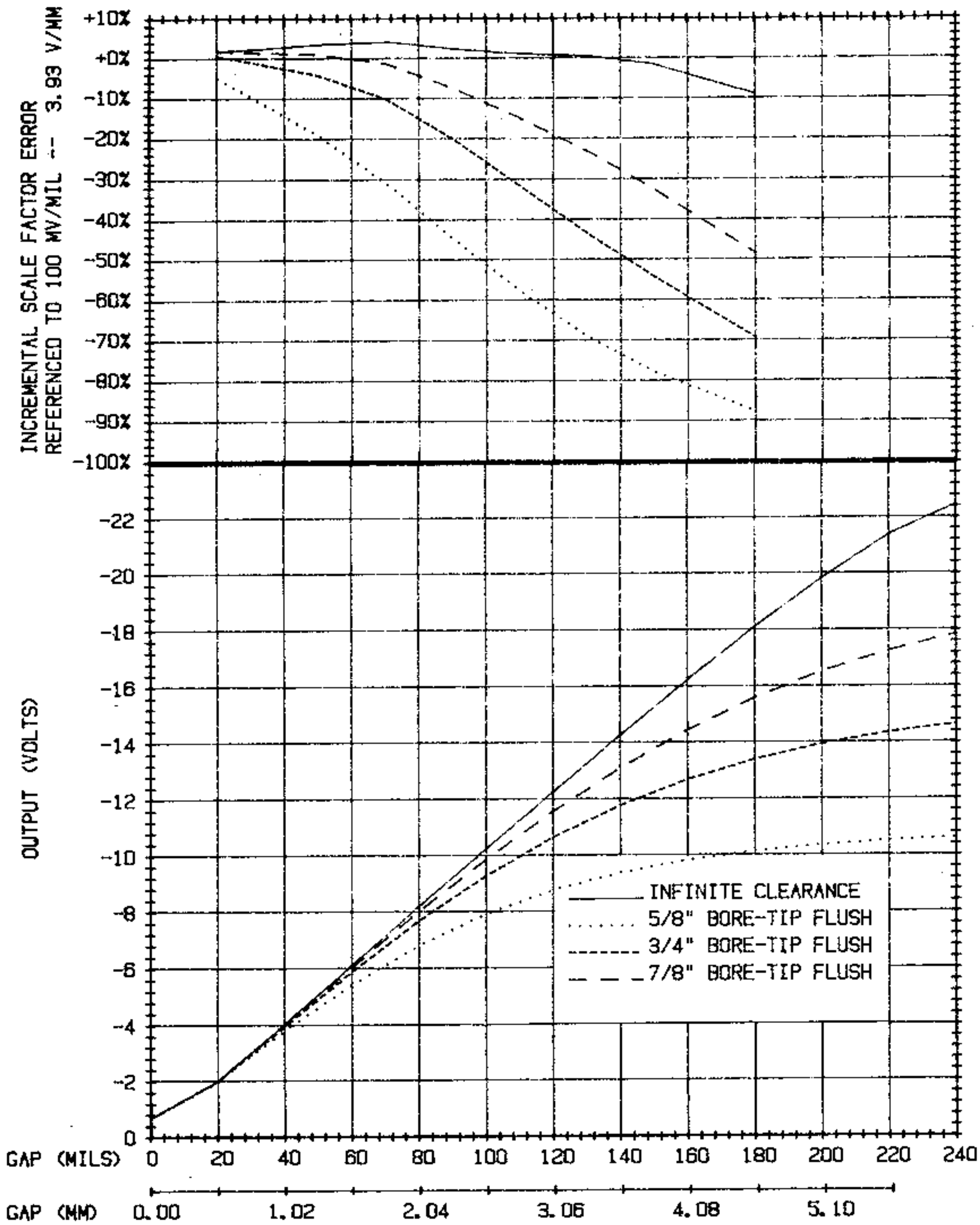


Figure C-9. Effects of Counterbore