

# Radiation Resistant Proximity Transducer System

## Bently Nevada\* Asset Condition Monitoring

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### Description

The Radiation Resistant Proximity Transducer System consists of:

- a 0.300 or 0.420 Radiation Resistant probe
- a Radiation Resistant extension cable
- a XL Radiation Resistant ProximitoR\* Sensor

The Bently Nevada Radiation Resistant Proximity Transducer System permits machinery monitoring on pumps, motors, and other rotating machinery operating in gamma-radiation environments.

The Radiation Resistant Proximity Transducer System maintains its signal integrity better than standard Bently Nevada systems when exposed to gamma-radiation environments. The systems are available with probe diameters of 0.300 and 0.420 inches, each with different linear ranges. The 0.300 system comes in 15-, 40-, and 110-foot lengths while the 0.420 system is available in the 15-foot length only. The longer 40- and 110-foot systems allow you to remotely locate the ProximitoR Sensor minimizing the rate of radiation exposure and extending the operational life of the ProximitoR Sensor.

The 330280 ProximitoR Sensor is backward compatible and interchangeable with the 36363 0.300 ProximitoR Sensor, and the 330281 ProximitoR Sensor is backward compatible and interchangeable with the 23268 0.420 ProximitoR Sensor.

The Radiation Resistant Proximity Transducer System is compatible with 3300 and 3500 Series Monitoring Systems that have been modified to use the previous 36363 or 23268 Radiation Resistant Systems. Please contact your local sales professional for information on specific monitor modifications.

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### ProximitoR Sensor

The XL ProximitoR Sensor incorporates numerous improvements over previous designs. Its physical packaging permits high-density DIN-rail installation. It can also be mounted in a traditional panel mount configuration, where it shares an identical "footprint" to older 4-hole mounted ProximitoR Sensor designs. Both mounting base options provide electrical isolation, and eliminate the need for separate isolator plates. Improved RFI/EMI immunity allows the XL ProximitoR Sensor to achieve European CE mark approvals without requiring special shielded conduit or metallic housings, resulting in lower installation costs and complexity.

The XL's SpringLoc terminal strips require no special installation tools and facilitate faster, more robust field wiring connections by eliminating screw-type clamping mechanisms that can loosen.



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## Specifications

Unless otherwise noted, the following specifications are for a Proximitor\* Sensor, extension cable and probe at +22°C (+72 °F) with a -24 Vdc power supply, a 10 kΩ load, and an AISI E4140 steel target. Unless noted, these specifications apply before irradiation.

### Electrical

Accepts one non-contacting Radiation Resistant Proximity Probe and Extension Cable.

### Power:

Requires -17.5 Vdc to -26 Vdc without barriers at 18 mA maximum consumption. Operation at a more positive voltage than -23.5 Vdc can result in reduced linear range.

### Output Resistance:

50 Ω

### 0.300 Probe dc resistance (nominal) (Rprobe):

1.6 Ω + 0.426 Ω/m (0.130 Ω/ft)

### 0.420 Probe dc resistance (nominal) (Rprobe):

2.5 Ω + 0.410 Ω/m (0.125 Ω/ft)

### Extension cable dc resistance (nominal)

Center conductor (Rcore):

0.36 Ω/m (0.11 Ω/ft)

Shield conductor (Rjacket):

0.023 Ω/m (0.007 Ω/ft)

### Extension cable capacitance (nominal):

63 pF/m (19.2 pF/ft)

### Field wiring:

0.2 to 1.5 mm<sup>2</sup> (16 to 24 AWG) Recommend using 3-conductor shielded triax cable field wiring. Maximum length of 305 metres (1,000 feet) between the XL Proximitor Sensor and the monitor. See the frequency response graph for signal roll off at high frequencies when using longer field wiring lengths.

### Linear Range:

0.300 inch, 15-foot system:

Linear range begins at -4.5 Vdc, approximately 0.5 mm (20 mils) from target and is from 0.5 to 1.75 mm (20 to 70 mils).

0.300 inch, 40-foot system:

Linear range begins at -4.5 Vdc, approximately 1 mm (40 mils) from target and is from 1 to 2.25 mm (40 to 90 mils).

0.300 inch, 110-foot system:

Linear range begins at -4.5 Vdc, approximately 1 mm (40 mils) from target and is from 1 to 2.25 mm (40 to 90 mils).

0.420 inch, 15-foot system:

Linear range begins at -5.0 Vdc, approximately 1.0 mm (40 mils) from target and is from 1.0 to 3.3 mm (40 to 130 mils).

**Incremental Scale Factor (ISF)**

0.300 inch, 15-foot system:

3.94 mV/ $\mu$ m (100 mV/mil)  $\pm$ 15% including interchangeability error when measured in increments of 0.25 mm (10 mils) over the 1.25 mm (50 mil) linear range.

0.300 inch, 40-foot system:

3.94 mV/ $\mu$ m (100 mV/mil)  $\pm$ 17% including interchangeability error when measured in increments of 0.25 mm (10 mils) over the 1.25 mm (50 mil) linear range.

0.300 inch, 110-foot system:

3.94 mV/ $\mu$ m (100 mV/mil)  $\pm$ 20% including interchangeability error when measured in increments of 0.25 mm (10 mils) over the 1.25 mm (50 mil) linear range.

0.420 inch, 15-foot system:

3.94 mV/ $\mu$ m (100 mV/mil)  $\pm$ 15% including interchangeability error when measured in increments of 0.25 mm (10 mils) over the 2.25 mm (90 mil) linear range.

**Frequency Response:**

15-foot systems:

0 to 10 kHz: +0, -3dB, with up to 305 metres (1000 feet) of field wiring.

40-foot system:

0 to 9 kHz: +0, -3dB, with up to 305 metres (1000 feet) of field wiring.

110-foot system:

0 to 5 kHz: +0, -3dB, with up to 305 metres (1000 feet) of field wiring.

**Mechanical**

**Probe tip material:**

Fiberglass reinforced epoxy with anhydride curing.

**Probe case material:**

300 series stainless steel

**Probe and Extension cable specifications:**

85  $\Omega$  coaxial, Tefzel® insulated cable.

**Proximator sensor material:**

A308 aluminum

**Extension cable armor (optional):**

Flexible stainless steel with Tefzel® outer jacket.

**Tensile strength (maximum rated):**

133 N (30.0 pounds) probe case to probe lead and probe lead to extension cable connectors.

**Connector material:**

Gold-plated brass

**Probe case torque:**

33.9 N•m (300 in•lb)

**Total System Weight (typical):**

1.0 kg (2.2 lb)

## Environmental Limits

### Probe operating and storage temperature range:

-29 °C to +150 °C (-20 °F to +302 °F)

### Extension Cable operating and storage temperature range:

-29 °C to +150 °C (-20 °F to +302 °F)

### Proximitor sensor operating and storage temperature range:

-51 °C to +100 °C (-60 °F to +212 °F)

### Relative humidity:

Less than a 3% change in Average Scale Factor (ASF) when tested in accordance with IEC standard 68-2-66.

### System radiation limit:

6.0 Mrads (gamma maximum integrated dose)

**Note:** We recommend a maximum 6 Mrads exposure. See the Summary Testing Report at the end of this document for more details.

### Radiation degradation factor:

After 6.0 Mrads gamma:

<b>0.300 System</b>	15-Foot System	40-Foot System	110-Foot System
Average scale factor change	-5.7%	-12.2%	-17.0%
Voltage change at linear range end	-0.4V	-1V	-1.1V

<b>0.420 Proximitor</b>	15-Foot System
Average scale factor change	-21.6%
Voltage change at linear range end	-0.56V

## Electrical Classification

Complies with the EMC and low voltage directive

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## Ordering Information

### Radiation Resistant Probes

#### 36448

0.300 inch, 3/8-24 UNF thread, 5/16 inch wrench flats, without armor

#### 27482

0.300 inch, 3/8-24 UNF thread, 5/16 inch wrench flats, with armor

#### 36447

0.300 inch, M10 × 1 thread, 8 mm wrench flats, without armor

#### 36446

0.300 inch, M10 × 1 thread, 8 mm wrench flats, with armor

### Part Number – AXX – BXX – CXX

**A:** Unthreaded Length Option

Specifications and Ordering Information  
Part Number 141595-01  
Rev. F(07/13)

*English thread configurations:*

Maximum unthreaded length: 8.8 in  
Minimum unthreaded length: 0.0 in  
Example: **0 4** = 0.4 in

**Note:** Unthreaded length must be at least 0.8 inches less than the case length. Order in increments of 0.1 inch.

*Metric thread configurations:*

Maximum unthreaded length: 230 mm  
Minimum unthreaded length: 0.0 mm  
Example: **0 6** = 60 mm

**Note:** Unthreaded length must be at least 20 mm less than the case length. Order in increments of 10 mm.

**B:** Overall Case Length Option  
*English thread configurations:*

Order in increments of 0.1 inch  
Maximum case length: 9.6 in  
Minimum case length: 0.8 in

Example: **2 4** = 2.4 in

*Metric thread configurations:*

Order in increments of 10 mm  
Maximum case length: 250 mm  
Minimum case length: 20 mm

Example: **0 6** = 60 mm

**C:** Total Electrical Length Option  
**1 8** 18 inches (0.46 metre)  
**3 6** 36 inches (0.91 metre)  
**36448 and 27482 Probes only**  
**7 2** 72 inches (1.82 metre)

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**Reverse Mount Radiation Resistant Probes**

**27485 – AXX** 0.300 inch, 3/8-24 UNF threads

**A:** Total Electrical Length Option  
**1 8** 18 inches (0.46 metre)  
**3 6** 36 inches (0.91 metre)

**19056 – AXX** 0.420 inch, 3/8-24 UNF threads

**A:** Total Electrical Length Option  
**3 6** 36 inches (0.91 metre)

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**0.300 Radiation Resistant Extension Cable**

**27490 – AXXX-BXX**

- A:** Cable Length Option  
**0 0 9 0** 9.0 feet (2.74 metres)  
**0 1 2 0** 12.0 feet (3.66 metres)  
**0 1 3 5** 13.5 feet (4.12 metres)  
**0 3 4 0** 34.0 feet (10.36 metres)  
**0 3 7 0** 37.0 feet (11.28 metres)  
**0 3 8 5** 38.5 feet (11.73 metres)  
**1 0 4 0** 104.0 feet (31.70 metres)  
**1 0 7 0** 107.0 feet (32.60 metres)  
**1 0 8 5** 108.5 feet (33.08 metres)

- B:** Armor Option  
**0 0** Without armor  
**0 1** With armor

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**0.420 Radiation Resistant Extension Cable**

**127502 – AXX**

- A:** Armor Option  
**0 0** Without armor  
**0 1** With armor  
**Note:** Length = 12.0 feet (3.66 metres) only

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**0.300 inch Radiation Resistant Proximito Sensor**

**330280 – AXX--BXX**

- A:** System Length Option  
**0 1 5** 15 feet (4.6 metres)  
**0 4 0** 40 feet (12.2 metres)  
**1 1 0** 110 feet (33.5 metres)

- B:** Mounting Option  
**0 0** Panel Mount Hardware  
**0 1** Din Mount Hardware

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**0.420 inch Radiation Resistant Proximito Sensor**

**330281 – AXX--BXX**

- A:** System Length Option  
**0 1 5** 15 feet (4.6 metres)

- B:** Mounting Option  
**0 0** Panel Mount Hardware  
**0 1** Din Mount Hardware

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## Accessories

**175462-01**

Manual

**02173100**

Tefzel® bulk field wire. 1.0 mm<sup>2</sup> (18 AWG), 3-conductor, twisted cable, drain wire, and aluminum shield. Specify length in feet.

**138492-01**

Replacement panel-mount mounting pad

**138493-01**

Replacement DIN-mount mounting pad

**148722-01**

XL Test Plug. The XL Test Plug contains three small test pins attached to three color-coded wires 1 metre in length, each terminated in a banana plug. The 3-pin adapter plugs into the test pinholes on XL-style Proximitor Sensors. It is used to check the performance of the Proximitor Sensor from the test pin holes in the terminal strip without requiring the removal of the field wiring.

**04310310**

XL Proximitor Sensor Panel-mount Screws. Package includes four 6-32 UNC thread forming mounting screw.

**04301007**

3/8-24 Probe Lock Nut with safety wire holes. Single probe lock nut with two holes drilled through the nut in order to secure the lock nut in place with safety wire.

**04301008**

M10 x 1 Probe Lock Nut with safety wire holes. Single probe lock nut with two holes drilled through the nut in order to secure

the lock nut in place with safety wire.

**00510400**

Male extension cable connector for probes and extension cables.

**00510401**

Female extension cable connector.

**163356**

Connector Crimp Tool Kit. Includes connector installation instructions, and carrying case.

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## Product Disposal Statement

Customers and third parties, who are not member states of the European Union, who are in control of the product at the end of its life or at the end of its use, are solely responsible for the proper disposal of the product. No person, firm, corporation, association or agency that is in control of product shall dispose of it in a manner that is in violation of any applicable federal, state, local or international law. Bently Nevada Inc. is not responsible for the disposal of the product at the end of its life or at the end of its use.

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## Compliance and Certifications

### EMC

Standards

### Electrical Safety

Standards

EN61010-1

European Community Directives:

Low Voltage Directive 2006/95/EC

EU Declarations of Conformity are available from [www.bently.com](http://www.bently.com)

# Graphs and Figures

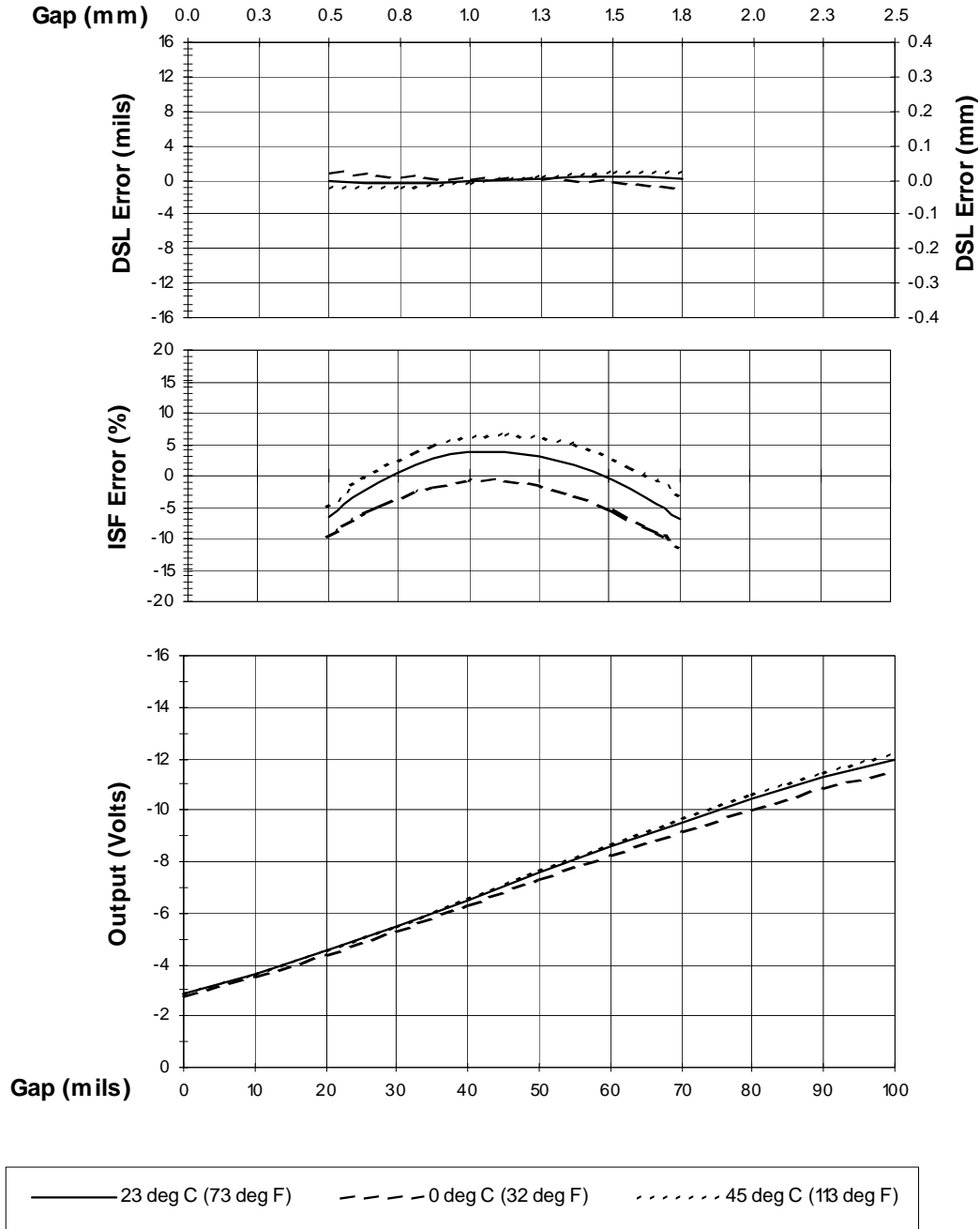


Figure 1: Typical Radiation Resistant 0.300" 15-ft System over ambient Temperature Range

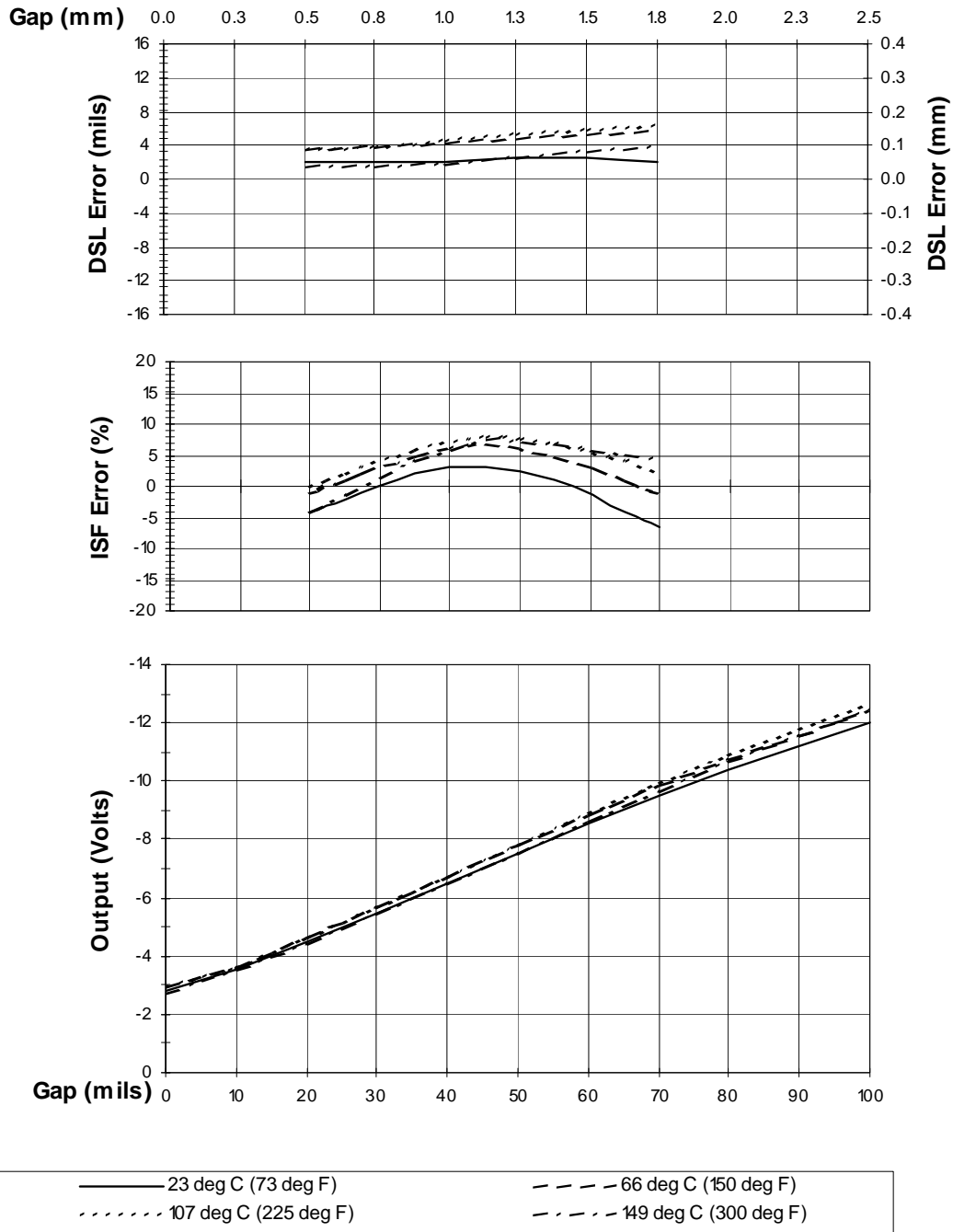


Figure 2: Typical Radiation Resistant 0.300" 15-ft Probe Only @ Th



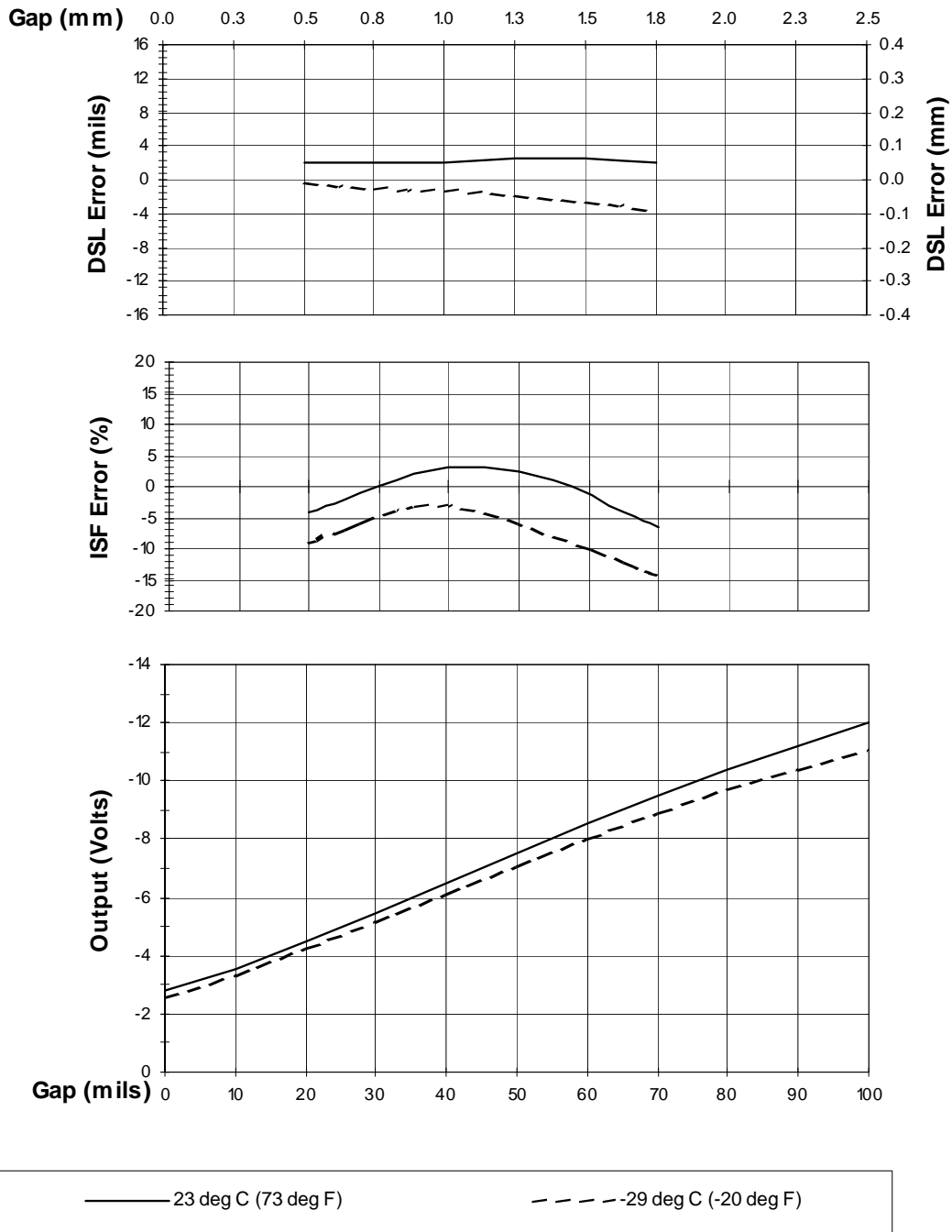
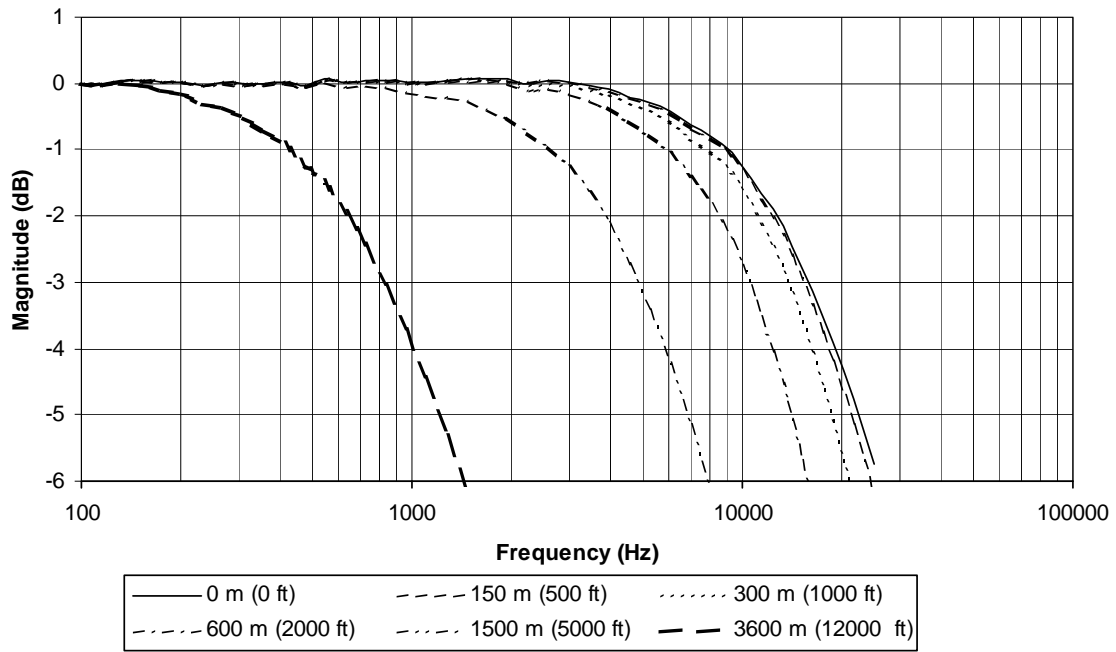
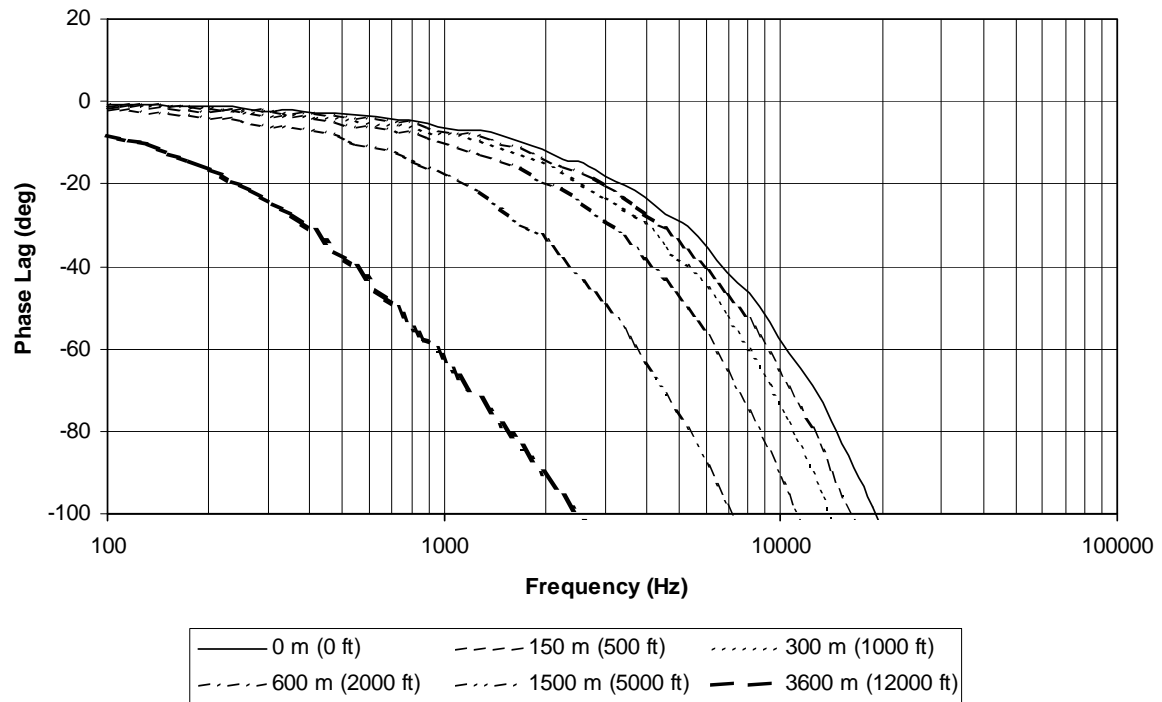


Figure: 3 Typical Radiation Resistant 0.300" 15-ft Probe Only @ Tc



**Figure 4: Frequency Response, typical Radiation Resistant 0.300" 15-ft System with varying lengths of field wiring attached, no barriers**



**Figure 5: Phase Response, typical Radiation Resistant 0.300" 15-ft System with varying lengths of field wiring attached, no barriers**

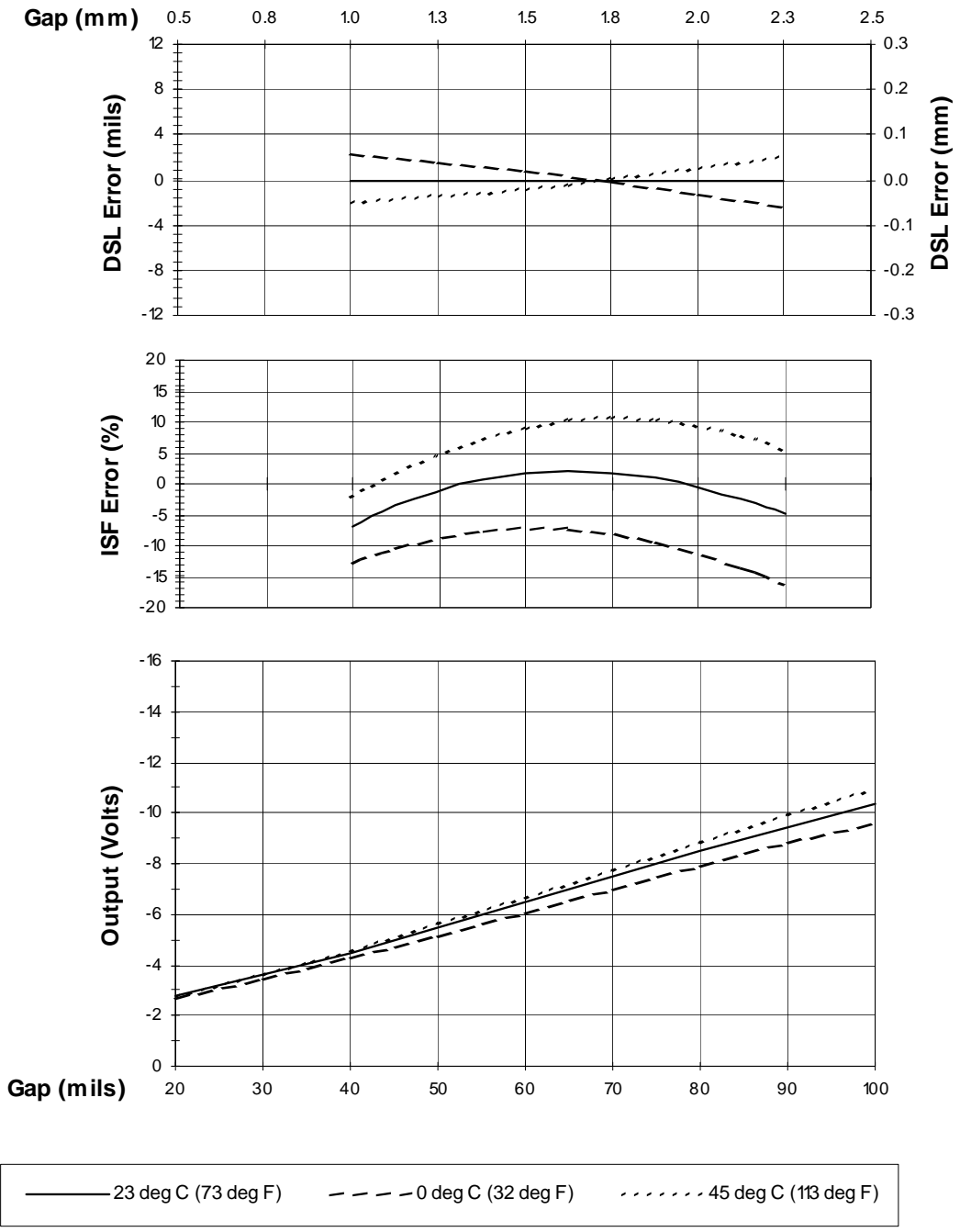


Figure 6: Typical Radiation Resistant 0.300" 40-ft System over ambient Temperature Range

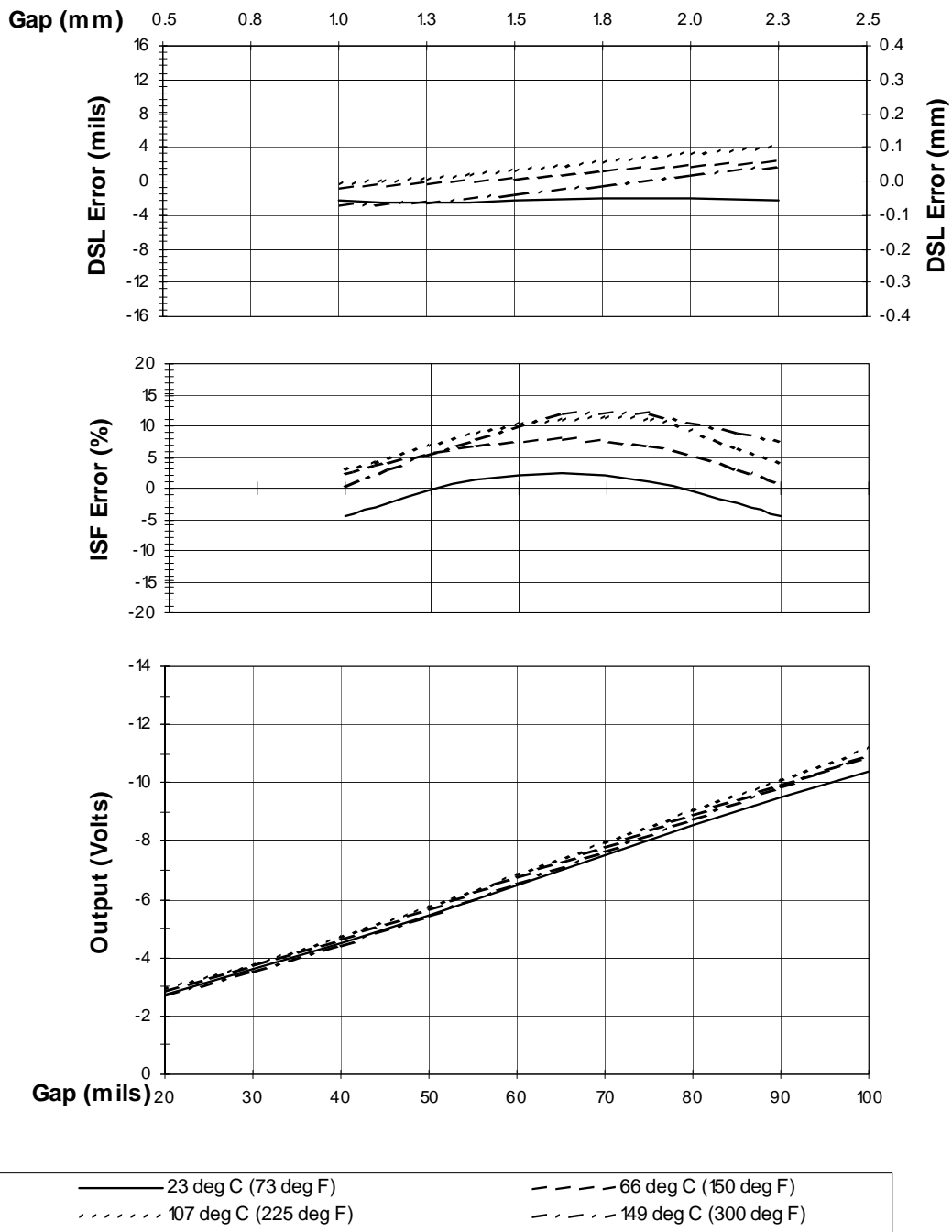


Figure 7: Typical Radiation Resistant 0.300" 40-ft Probe Only @ Th

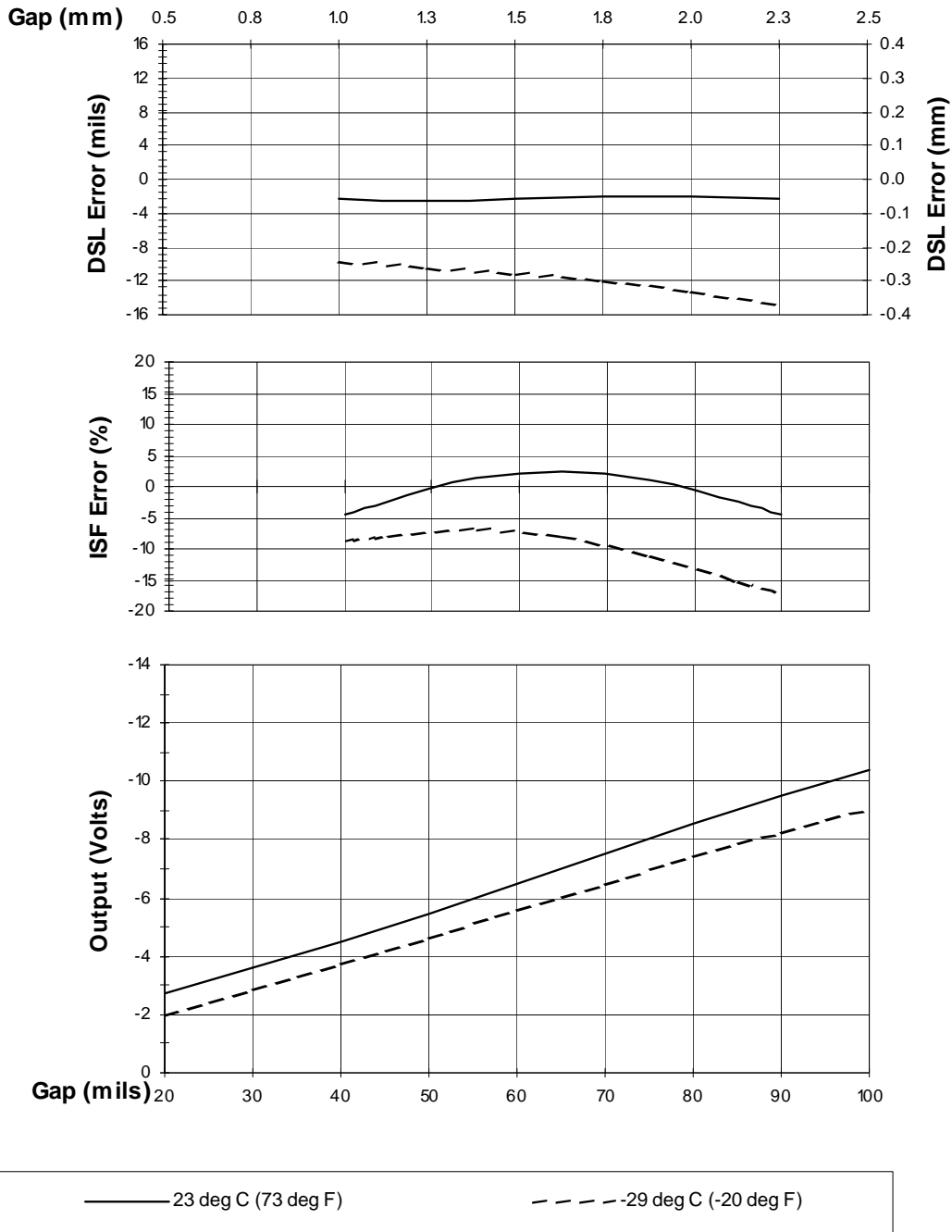


Figure 8: Typical Radiation Resistant 0.300" 40-ft Probe Only @ Tc

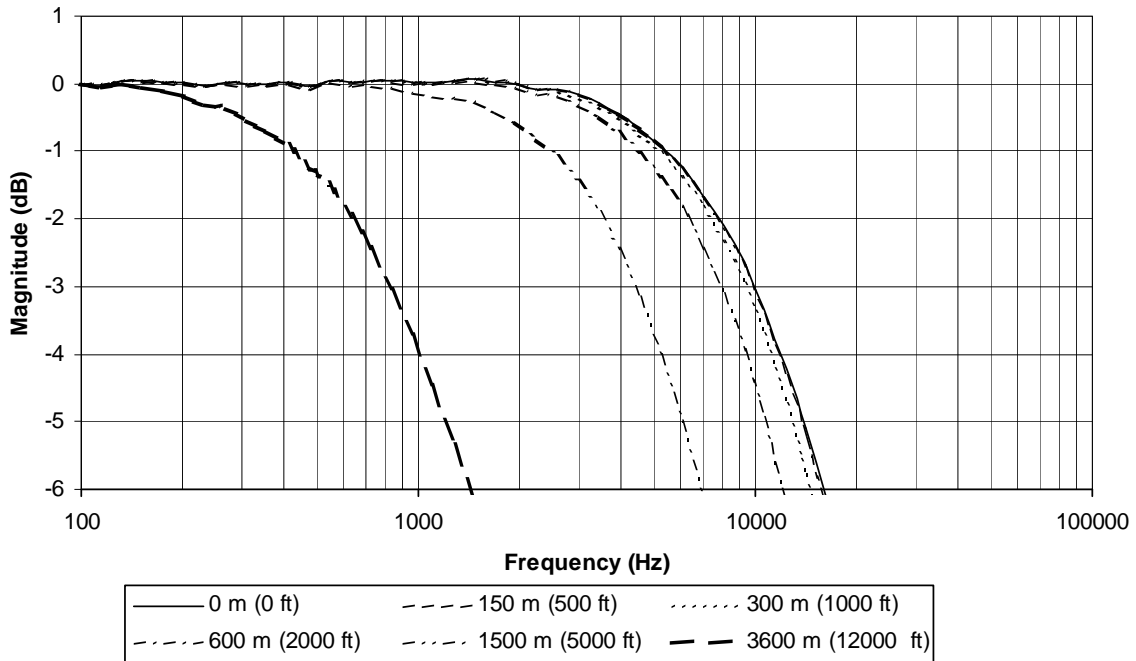


Figure 9: Frequency Response, typical Radiation Resistant 0.300" 40-ft System with varying lengths of field wiring attached, no barriers

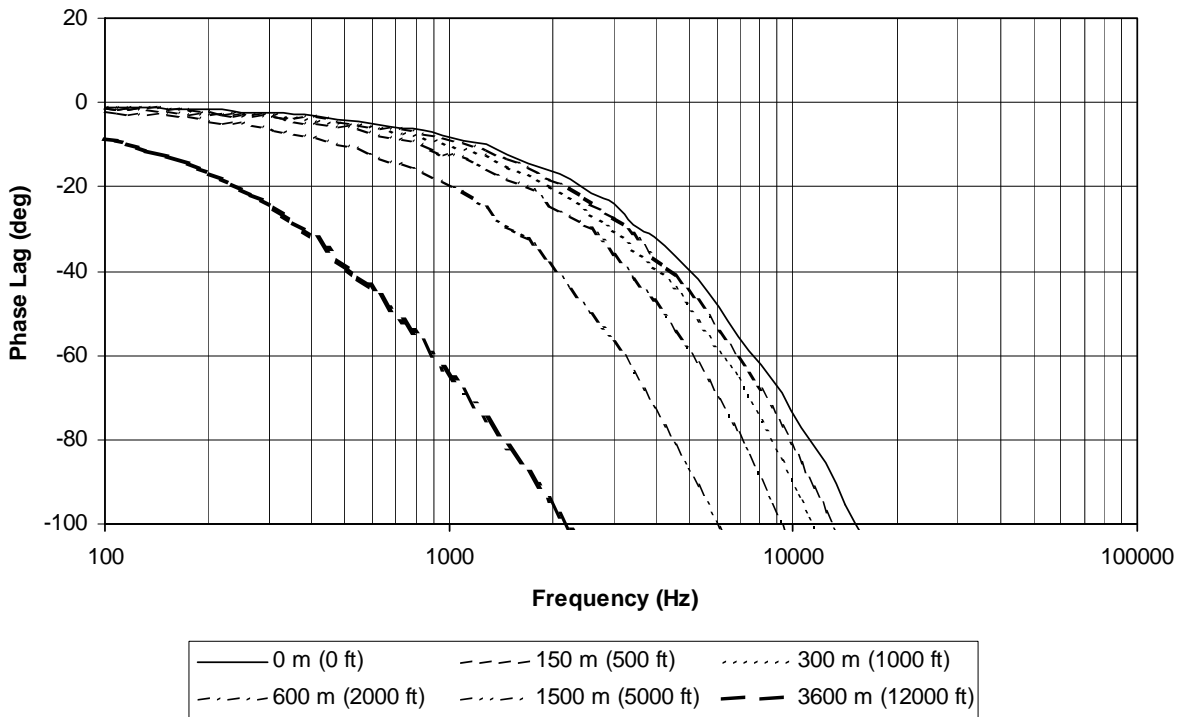


Figure 10: Phase Response, typical Radiation Resistant 0.300" 40-ft System with varying lengths of field wiring attached, no barriers

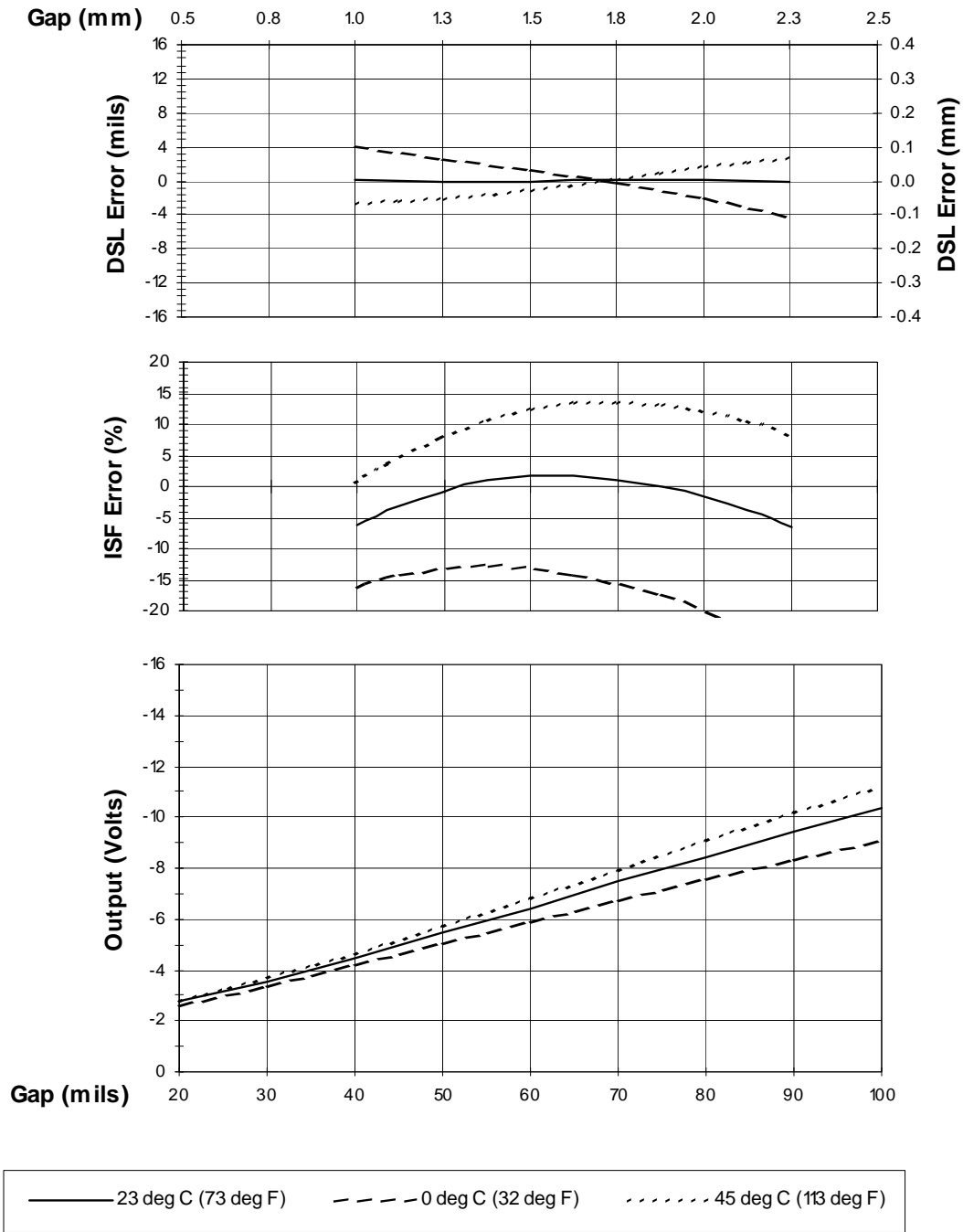


Figure 11: Typical Radiation Resistant 0.300" 110-ft System over ambient Temperature Range



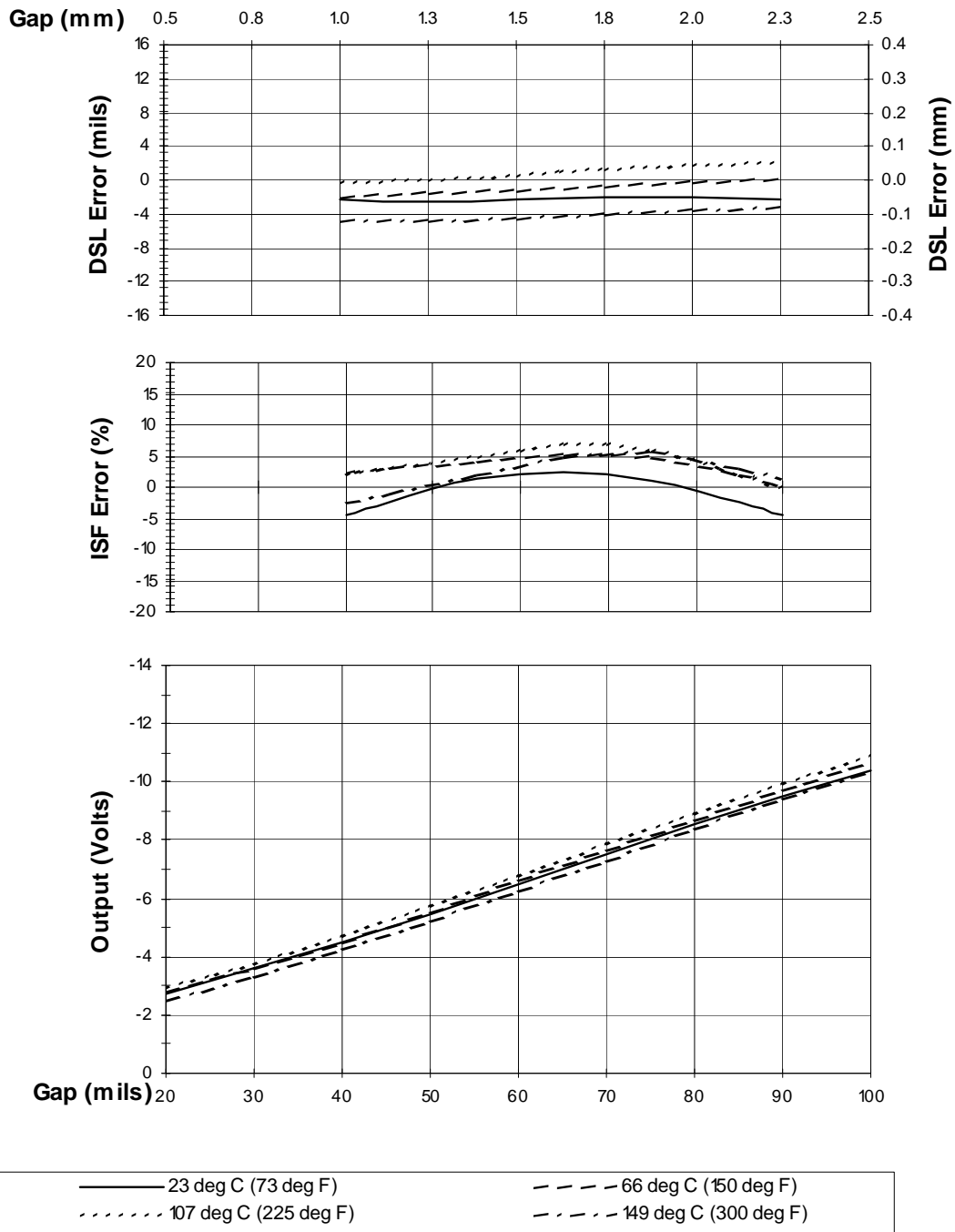


Figure 12: Typical Radiation Resistant 0.300" 110-ft Probe Only @ Th

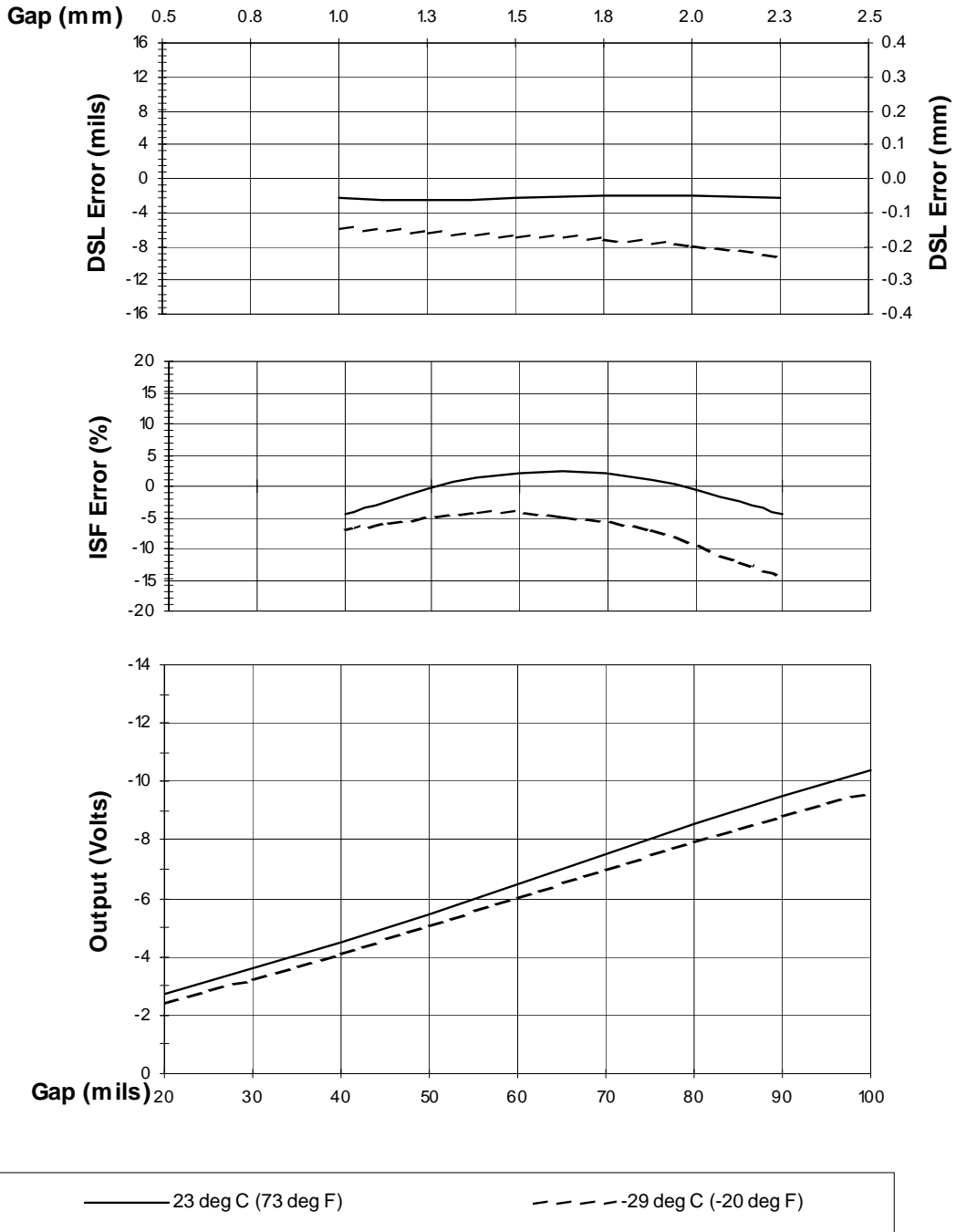
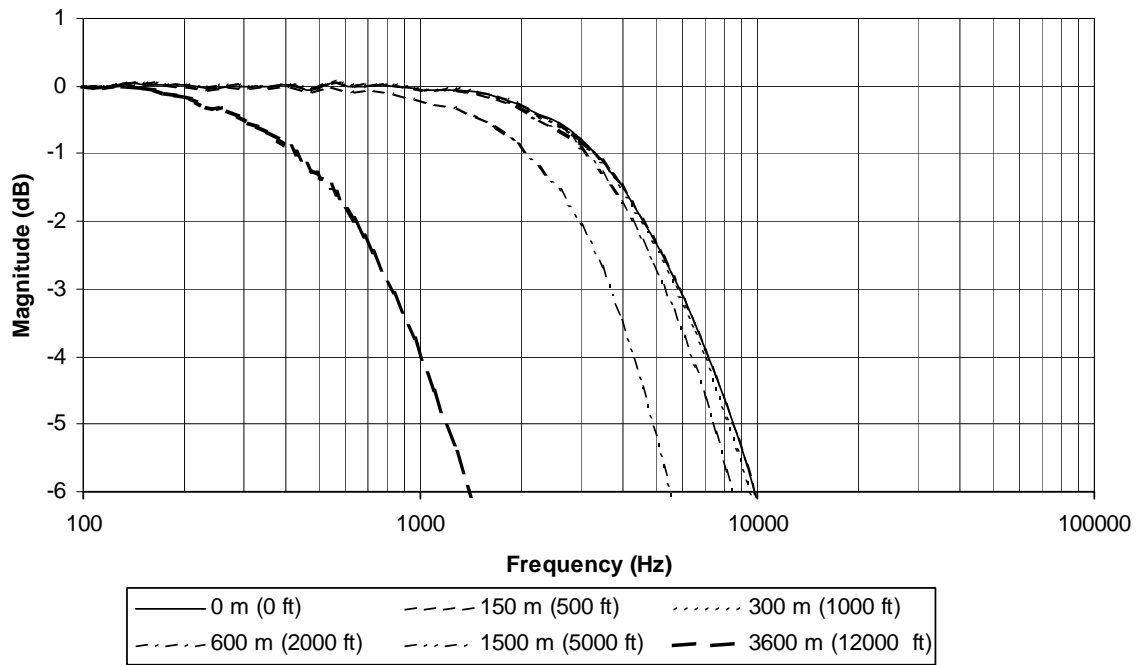
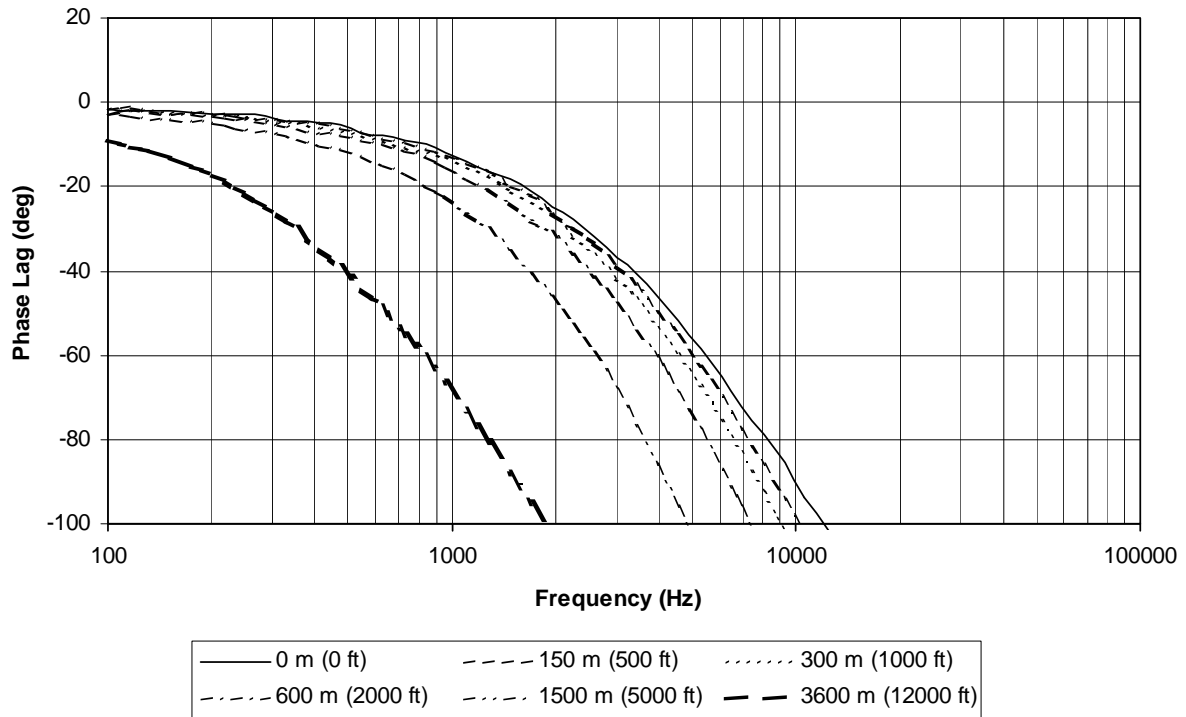


Figure 13: Typical Radiation Resistant 0.300" 110-ft Probe Only @ Tc



**Figure 14: Frequency Response, typical Radiation Resistant 0.300" 110-ft System with varying lengths of field wiring attached, no barriers**



**Figure 15: Phase Response, typical Radiation Resistant 0.300" 110-ft System with varying lengths of field wiring attached, no barriers**

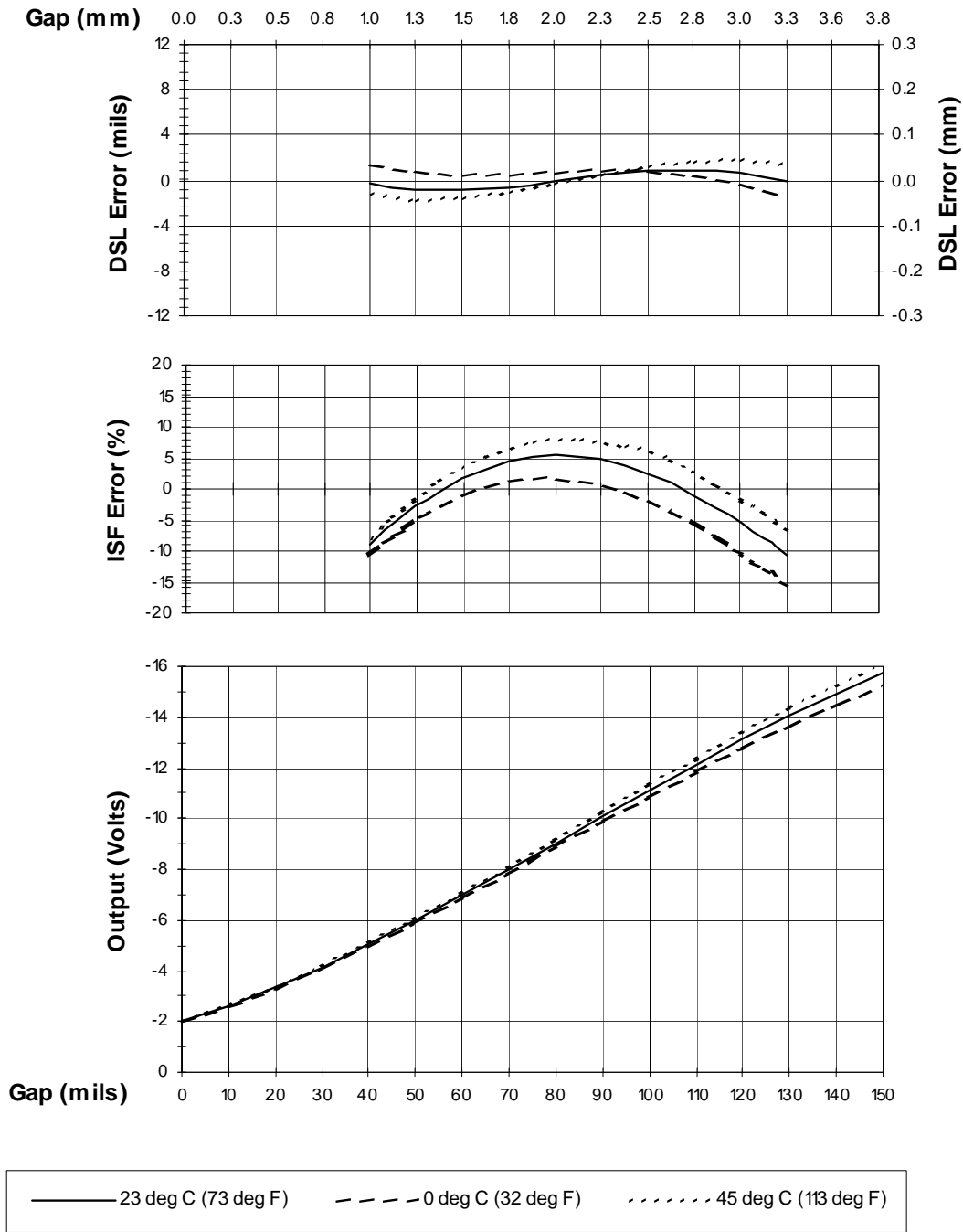


Figure 16: Typical Radiation Resistant 0.420" 15-ft System over ambient Temperature Range

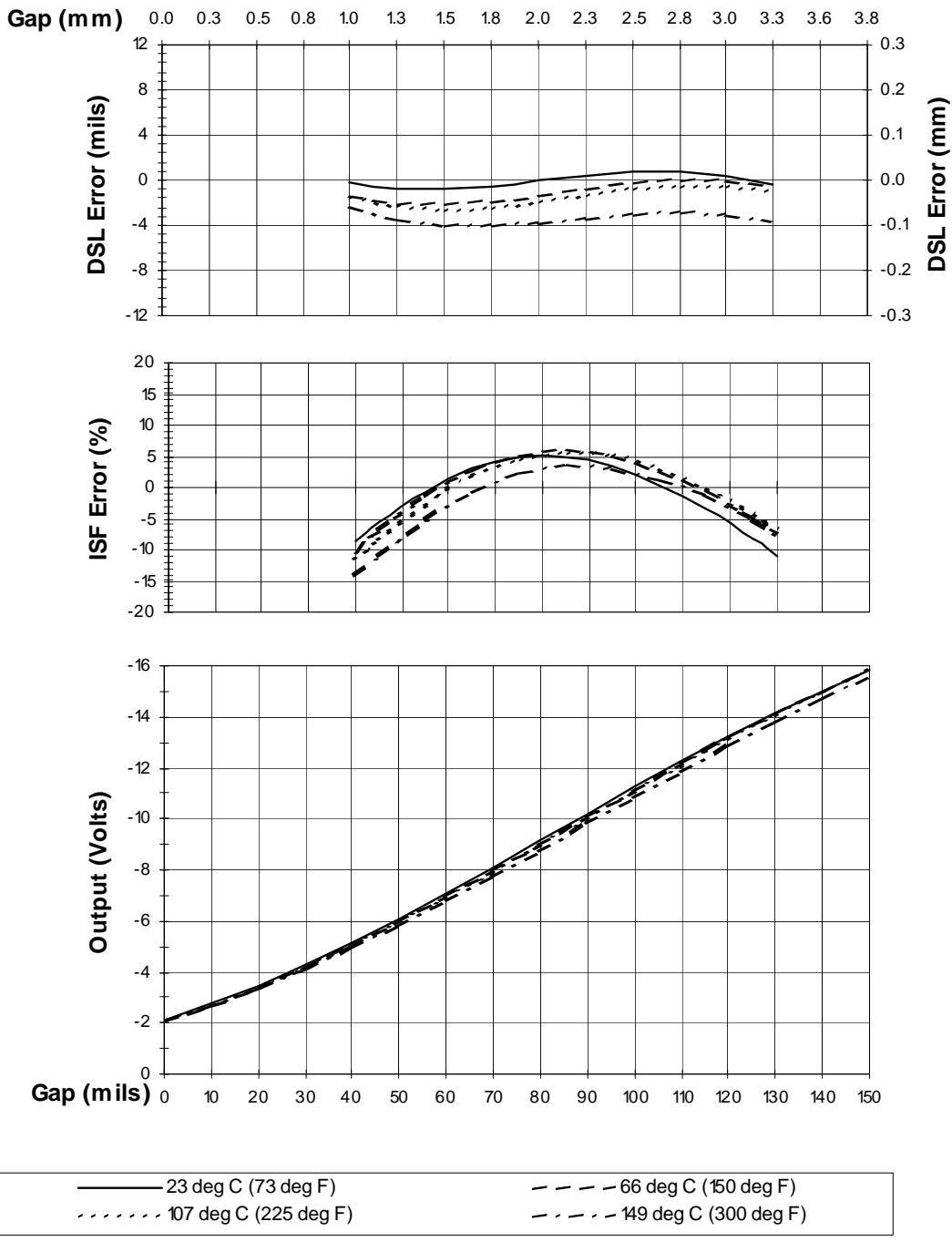


Figure 17: Typical Radiation Resistant 0.420" 15-ft Probe Only @ Th

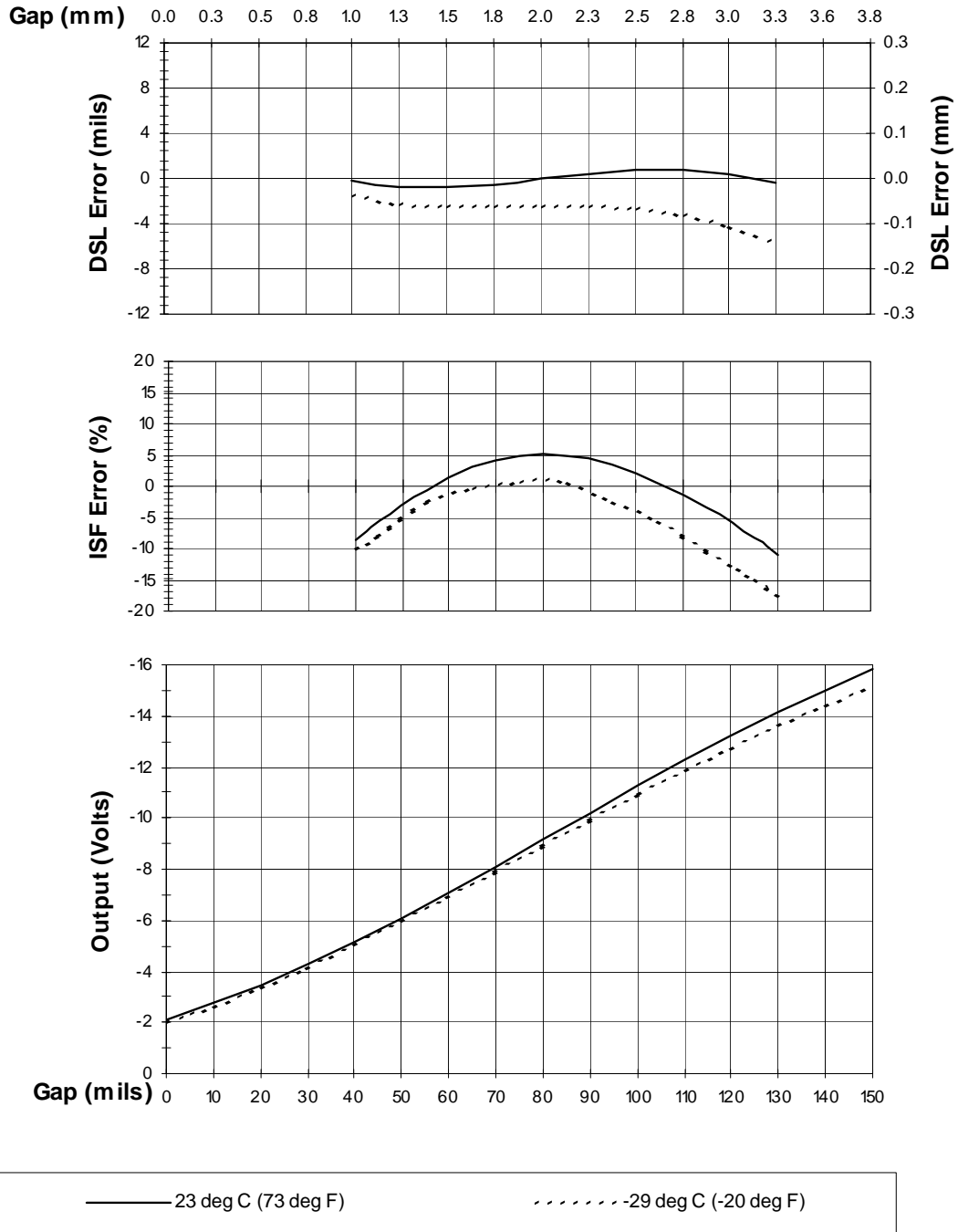
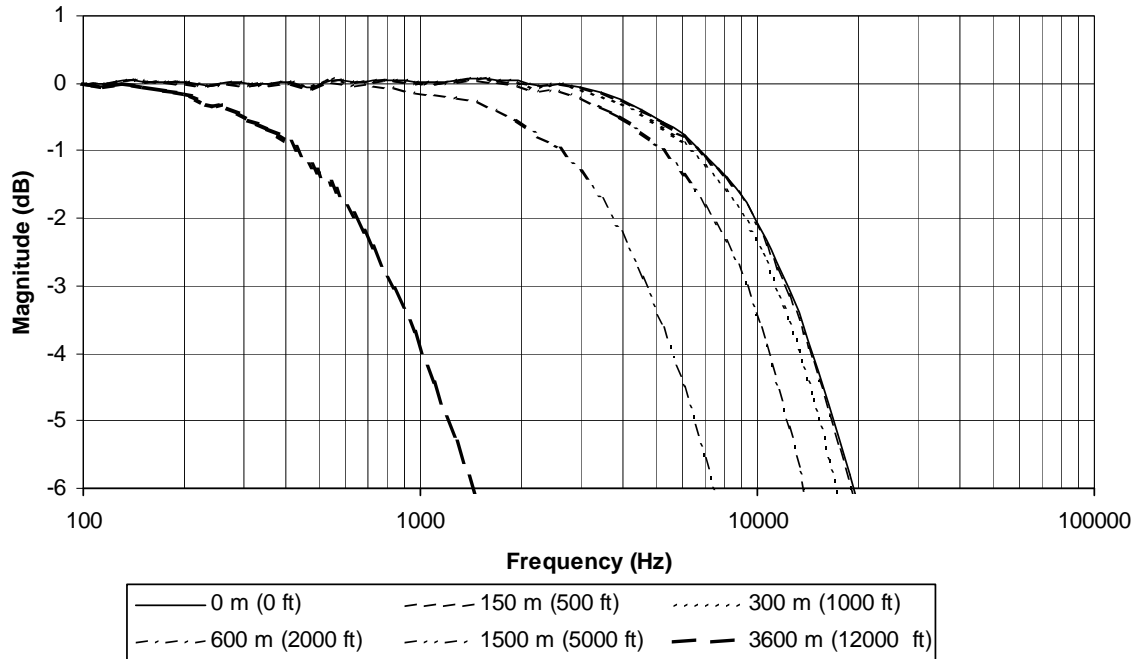
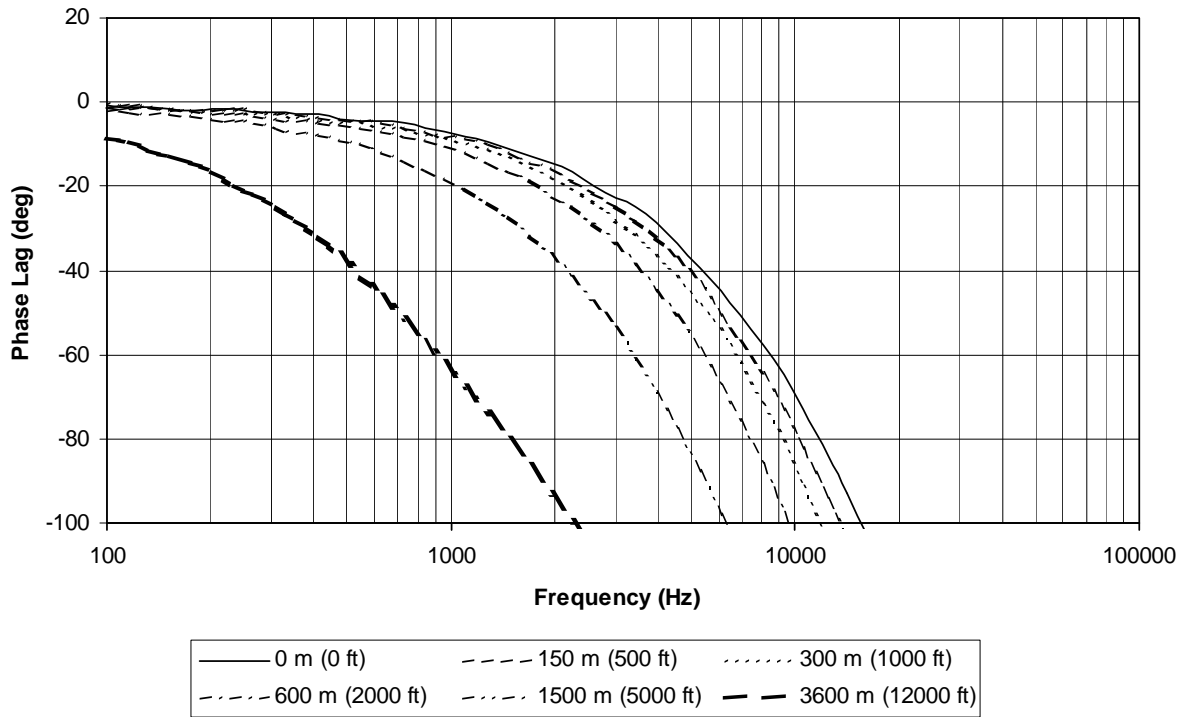


Figure 18: Typical Radiation Resistant 0.420" 15-ft Probe Only @ Tc

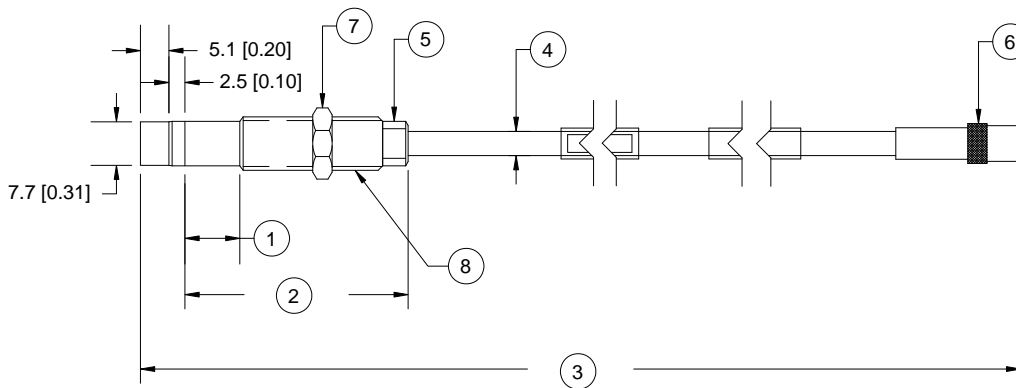


**Figure 19: Frequency Response, typical Radiation Resistant 0.420" 15-ft System with varying lengths of field wiring attached, no barriers**



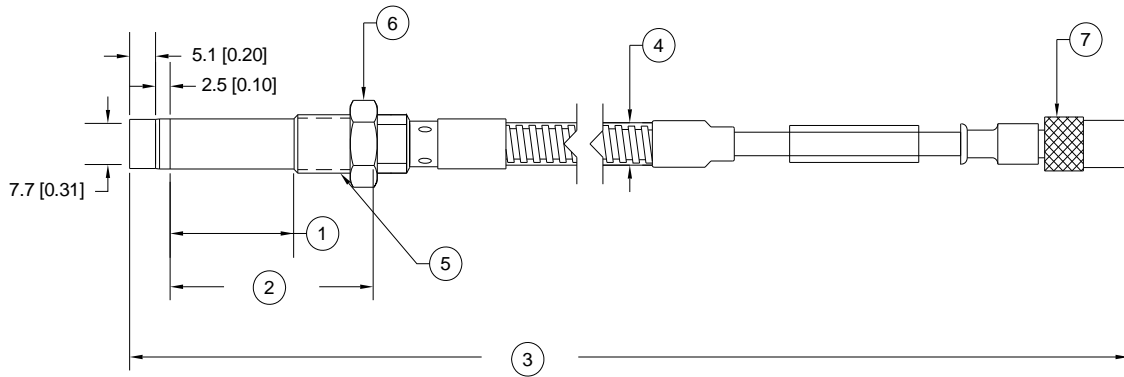


**Figure 20: Phase Response, typical Radiation Resistant 0.420" 15-ft System with varying lengths of field wiring attached, no barriers**



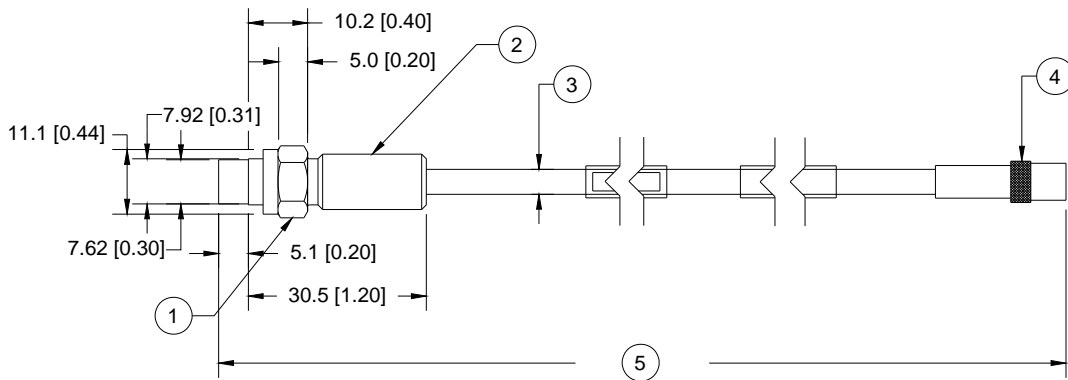
1. Unthreaded Length "AA"	5. 8 (5/16) Wrench Flats, 4 each
2. Case Length "BB"	6. Miniature Male Coaxial Connector 7.23 (0.285) Outside Diameter Maximum
3. Total Length "CC", ±7%	7. 14.3 (9/16) Hex for 3/8-24 thread type 17.0 (0.67) Hex for M10 thread type
4. Coaxial Tefzel® cable 4.3 (0.17) Outside Diameter Maximum	8. Case, 300 Series SST, 3/8-24 UNF-2A or M10 thread

**Figure 21: Radiation-resistant Proximity Probe, standard mount**  
**36448, 3/8-24 UNF-2A threads**  
**36447, M10x1 threads**



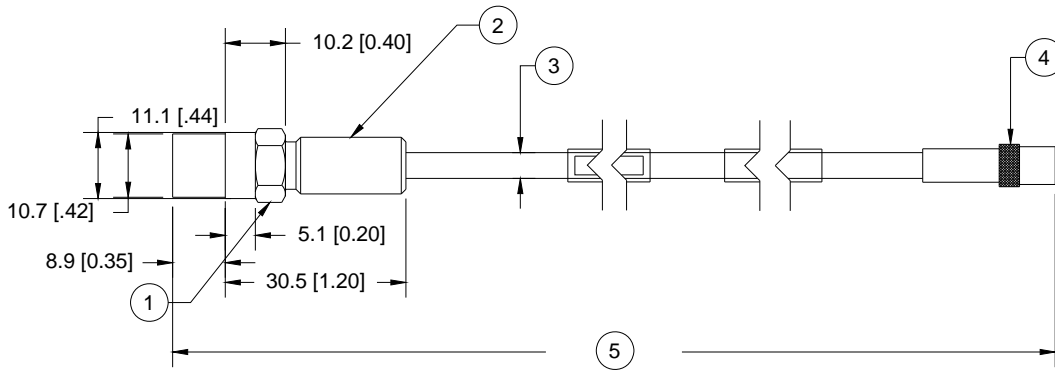
1. Unthreaded Length "AA"	5. Case, 300 Series SST, 3/8-24 UNF-2A or M10 thread
2. Case Length "BB"	6. 14.3 (9/16) Hex for 3/8-24 thread type 17.0 (0.67) Hex for M10 thread type
3. Total Length "CC", ±7%	7. Miniature Male Coaxial Connector 7.23 (0.285) Outside Diameter Maximum
4. Tefzel® Coated Armor, 9.6 (0.377) diameter	

**Figure 22: 0.300" Radiation-resistant Proximity Probe, standard mount armored**  
**27482, 3/8-24 UNF-2A threads**  
**36446, M10x1 threads**



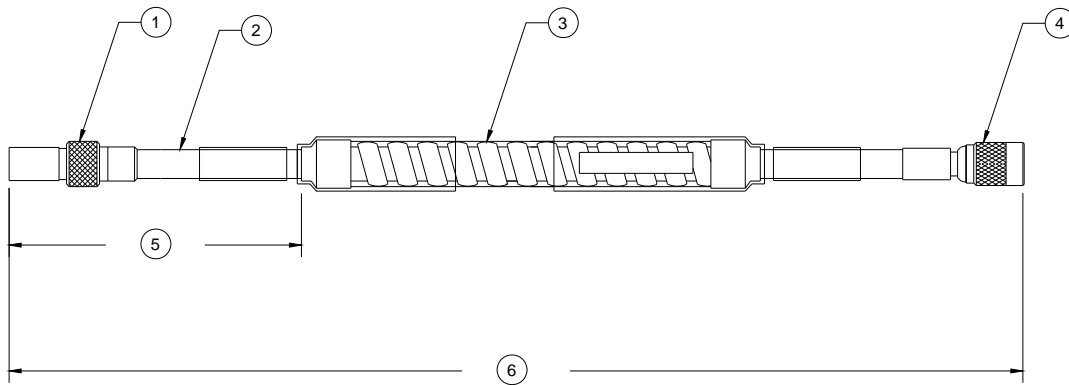
1. 11.1 (7/16) Hex	4. Miniature Male Coaxial Connector 7.23 (0.285) Outside Diameter Maximum
2. Case, 300 Series SST, 3/8-24 UNF-2A	5. Total Length "C", ±7%
3. Coaxial Tefzel® cable 4.3 (0.17) Outside Diameter Maximum.	

**Figure 23: 27485, 0.300" Radiation-resistant Proximity Probe, Reverse Mount, 3/8-24 UNF-2A threads**



1. 7/16 Hex	4. Miniature Male Coaxial Connector 7.23 (0.285) Outside Diameter Maximum
2. Case, 300 Series SST, 3/8-24 UNF-2A	5. Total Length "C", +25%, -10%
3. Coaxial Tefzel® cable 4.3 (0.17) Outside Diameter Maximum.	

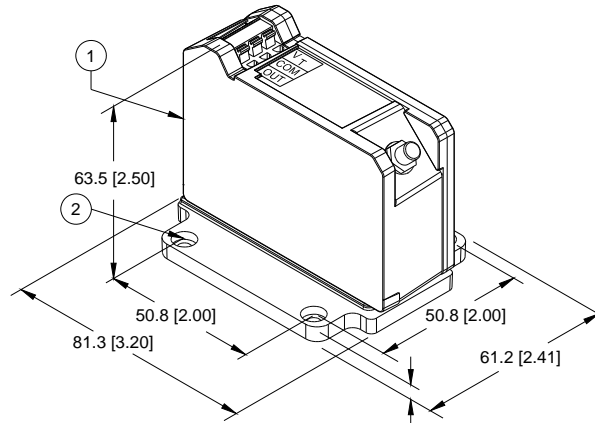
**Figure 24: 19056, 0.420" Radiation-resistant Proximity Probe, Reverse Mount, 3/8-24 UNF-2A threads**



1. Miniature Male Coaxial Connector 7.2 (0.285) Max. Diameter	4. Miniature Female Coaxial Connector 7.2 (0.285) Max. Diameter
2. Coaxial Tefzel® cable 4.3 (0.17) Outside Diameter Maximum.	5. 305 ± 152 (12.0 ± 6), 2 places
3. Tefzel® Coated Armor, 9.6 (0.377) diameter	6. <b>27490 .300 cable</b> , Total Length "A", ±7% <b>127502 .420 cable</b> , Total Length = 12 feet (3.66 metres) +20%/-10%

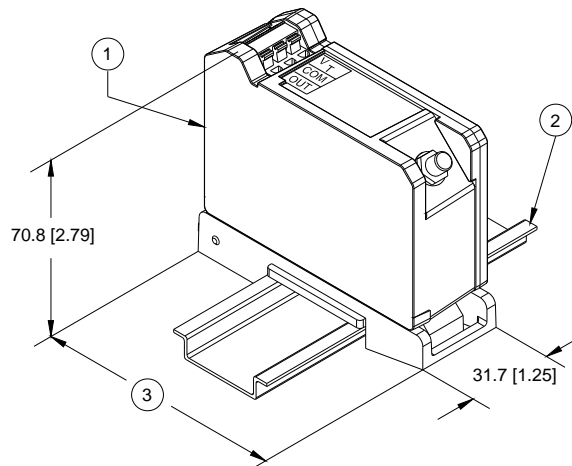
**Figure 25: Radiation-resistant Extension Cable  
27490, 0.300 extension cable**

127502, 0.420 extension cable



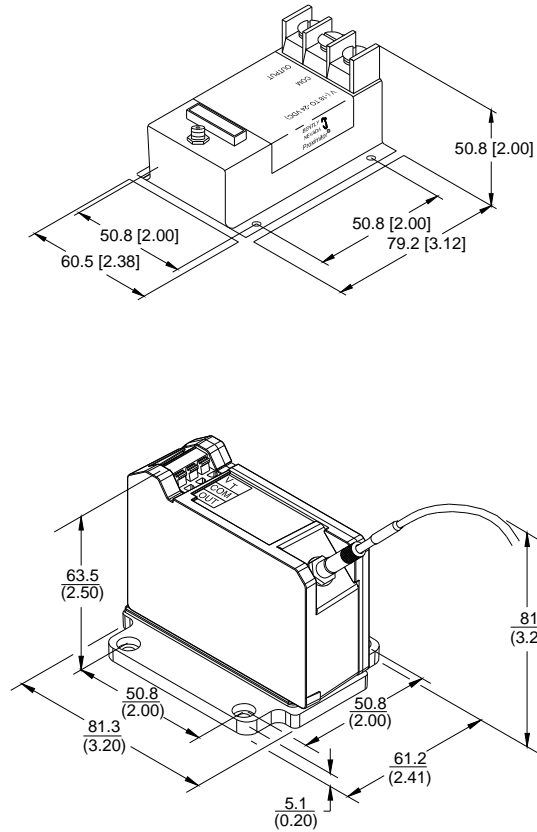
1. Mounting Option "B" = "00"	2. 4.0 (0.158) diameter mounting thru holes, qty 4
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Figure 26: 330280 and 330281, Panel Mount Radiation-resistant XL Proximity Sensor



1. Mounting Option "B" = "01"	2. 35mm DIN rail not included
2. 89.4 (3.52) Additional 3.0 (0.12) clearance required to remove DIN rail	

Figure 27: 330280 and 330281, DIN Rail Mount Radiation-resistant XL Proximity Sensor



**Figure 28: Physical mounting characteristics showing interchangeability of the 3000 and XL Radiation Resistant Proximity Sensors when 4-hole mounting**

**Notes:**

1. All dimensions on figures are in millimeters (inches) unless otherwise noted.
2. Standard mount 0.300 probes supplied with 17 mm or 9/16 inch lock nut.
3. Reverse mount probes not available with armor.
4. Letters inside quotation marks on figures refer to probe ordering options.
5. Stainless steel armor is supplied with Tefzel® outer jacket.
6. Coaxial cable contains Tefzel® dielectric and outer jacket.

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## Summary- Radiation Testing Report

Bently Nevada Inc. completed a series of tests to insure that the product will meet the specifications contained in this document. The information below outlines the details regarding the testing and irradiation. The customer can use this information to validate how the product is used and infer how the product could change with gamma-radiation exposures. Listed below are limitations and boundary conditions.

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### Important items about the testing:

- The Device Under Test (DUT) will have the largest parameter shift when the unit is powered up and being irradiated at the same time.
- The gamma-radiation was from a Co60 source. A number of 16-inch-long rods were placed in a circular pattern around the DUT to establish uniform radiation and exposure levels around the DUT. The length of the rods ensured that the top and bottom of the DUT were also being irradiated, albeit at a slightly lower level. The dosage rate is the sum effect of all of the rays intersecting at the DUT.

The product was not designed or tested:

- to be a part of the control loop as the product design is for monitoring purposes only,
- for LOCA (loss of coolant accident), sometimes called LOC (loss of coolant), events,
- to withstand neutron radiation, or
- for spike or burst events.

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### Observation:

As a note: A number of the units were tested and at no time did any of the units fail. The numbers of units tested at the higher radiation levels did not constitute a significant sample size to guarantee the product at these higher levels. Any observation or extrapolation of this data is not a guarantee of the product performance.

9 Mrads	
ASF Change	Voltage change @ linear range end
-7.61%	-0.57 Vdc

ASF = Average Scale Factor

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1631 Bently Parkway South, Minden, Nevada USA 89423

Phone: 775.782.3611 Fax: 775.215.2873

[www.ge-mcs.com/bently](http://www.ge-mcs.com/bently)