



XS-ZTR SERIES

Extreme environment LVDT

SPECIFICATIONS

- Cryogenic/high-temperature operation
- Gamma and neutron radiation resistant
- 2500 PSI [172 bar] operating pressure
- 100% inorganic material construction
- Stroke ranges of ± 0.1 and ± 0.25 inch
- Hermetically sealed
- Stainless steel housing
- Imperial or metric threaded core

The **XS-ZTR Series** of LVDTs were specifically designed for measuring displacements in extremely high and very low, cryogenic temperature environments. The XS-ZTR will operate continuously from **-320 to +1020°F** [-195 to +550°C], and will survive non-operating temperatures of up to +1200F [650°C]. It is also capable of performing within specification after radiation exposure to a total integrated neutron flux of 3×10^{20} NVT or 3×10^{24} n/m², and gamma-ray total integrated dose radiation of 10^{11} rad or 10^9 Gy.

The XS-ZTR is made exclusively from inorganic materials, specifically selected for their compatible expansion coefficients in order to minimize thermally induced stresses. The coil windings are of ceramic insulated precious metal alloys, while all seams and joints are either welded or brazed with high temperature alloys. The leads are sheathed in stainless steel, with conductors composed of nickel with magnesium oxide insulation. These cables can be terminated to a sealed header or connector if required.

As most inorganic insulation materials are hygroscopic, the entire coil assembly is hermetically sealed inside a stainless steel case. This prevents moisture accumulation, insulation leakage, and protects the coil from hostile surrounding media while allowing the core to move freely.

The XS-ZTR Series is compatible with all Measurement Specialties LVDT signal conditioners, controllers and readouts.

For moderate temperature and radiation applications, consider using our **HR-Z** series LVDT, mild radiation resistant.

FEATURES

- Extreme operating temperature range
- Radiation resistant
- Single or dual cable configurations
- Optional sealed header or connector
- Special temperature calibrations available
- Calibration certificate supplied with each unit

APPLICATIONS

- Material testing in pressurized autoclaves
- Nuclear reactor containment vessel bolt tension
- Nuclear reactor valve position
- Cryogenic medicine
- Jet engine thrust vectoring feedback
- Roll gap on steel hot strip and slabbing mills

RADIATION RESISTANCE

Certain applications require resistance to a combination of gamma radiation, neutron radiation and high temperature. Before considering detailed specifications and suitability for a particular application, a review of the following working definitions and equivalents is appropriate.

Total integrated neutron flux

The total integrated neutron flux (also called neutron fluence) is the neutron flux integrated over time.

Neutron flux: the total distance travelled by all neutrons per unit time and volume

Formula for neutron flux: $\text{number of neutrons/volume} \times \text{distance/time} = \text{neutron density} \times \text{velocity}$

Neutron density: number of neutrons (n) per unit volume

Formula for total integrated neutron flux:

$\text{neutron density} \times \text{velocity} \times \text{time} = \text{neutron density} \times \text{distance}$

Unit for total integrated neutron flux:

$n/m^3 \times m = n/m^2$ (n: number of neutrons; m: meter)

or

NVT (n/cm^2)

Conversion: $1 \text{ NVT} = 10^4 \text{ n/m}^2$

Gamma-ray total integrated dose (TID) radiation

The absorbed dose of ionizing radiation is the amount of energy deposited per unit of mass.

Units: *rad (radiation absorbed dose): radiation that will deposit 0.01 Joule of energy per kilogram of matter*

Gy (Gray): radiation that will deposit 1 joule of energy per kilogram (SI unit)

Conversion: $1 \text{ Gy} = 100 \text{ rad}$

All radiation produces some damage, therefore, the issue becomes how much radiation and what kind of radiation can an object sustain while maintaining its operation specification. At best, this can only be an estimate.

When radiant energy falls on an object, equal amounts of energy from different sources may result in greatly differing amounts of damage depending on the form of radiation, i.e. gamma rays, neutrons, etc. These different sources may also result in qualitatively different kinds of damage. One method to quantify these differences is to determine the rate of radiation that a unit can withstand without instantaneous and unacceptable damage. Another method is to determine the total integrated flux that can be absorbed before "wear-out" damage from radiation occurs. The distinction between rate of flux and total integrated flux must be kept clearly in mind.

There is no direct relationship between neutron fluence and gamma radiation. If we assume equal energy dissipation from differing sources, the energy absorbed by the unit will vary with its absorption cross section. If we try to equalize damage, there is even more uncertainty because of the qualitative differences of the damage caused by various forms of radiation.

PERFORMANCE SPECIFICATIONS

| ELECTRICAL SPECIFICATIONS | | |
|---------------------------------------|---------------------|-------------------|
| Parameter | XS-ZTR 100 | XS-ZTR 250 |
| Stroke range | ±0.10 [±2.54] | ±0.25 [±6.35] |
| Sensitivity V/V/inch [mV/V/mm] | 1.3 [51] | 0.3 [12] |
| Output at stroke ends (*) | 130mV/V | 75mV/V |
| Phase shift | -8° | +20° |
| Input impedance (PRIMARY) | 95Ω | 100Ω |
| Output impedance (SECONDARY) | 250Ω | 80Ω |
| Non-linearity (Room temperature only) | ±0.5% of FR maximum | |
| Input voltage | 3 VRMS sine wave | |
| Test input frequency | 2.5kHz | |
| Input frequency range | 400Hz to 5kHz | |
| Null voltage | 0.5% of FRO maximum | |

| ENVIRONMENTAL SPECIFICATIONS & MATERIALS | |
|--|---|
| Operating temperature | -320 to +1020°F [-195 to +550°C] |
| Non-operating temperature | -455 to +1200°F [-270 to +650°C] |
| Radiation resistance | |
| Total integrated neutron flux: | 3 x 10 ²⁰ NVT or 3 x 10 ²⁴ n/m ² maximum |
| Gamma-ray total integrated dose: | 10 ¹¹ rad or 10 ⁹ Gy maximum |
| Operating pressure | 2,500 psi [172 bar] maximum |
| Shock survival | 10 g (11ms half-sine) |
| Vibration tolerance | 10 g up to 2KHz |
| Housing material | AISI 304 Series stainless steel |
| Electrical connection, standard | Cable with six lead-wires, 28 AWG solid nickel, MgO insulated, 72 inches [180 cm] long, and 3/16 inch [4.8mm] diameter stainless steel sheath; 1/2 inch [12.7mm] minimum bend radius |
| Electrical connection, optional (<i>Consult factory</i>) | Pair of 2-conductor, 1/16 inch [1.6 mm] diameter stainless steel sheathed cables. Particularly suitable for applications where the cables are routed through an arduous path within the reactor |

Notes:

Dimensions are in inch [mm]

All values are nominal unless otherwise noted

Electrical specifications are for the test frequency indicated in the table

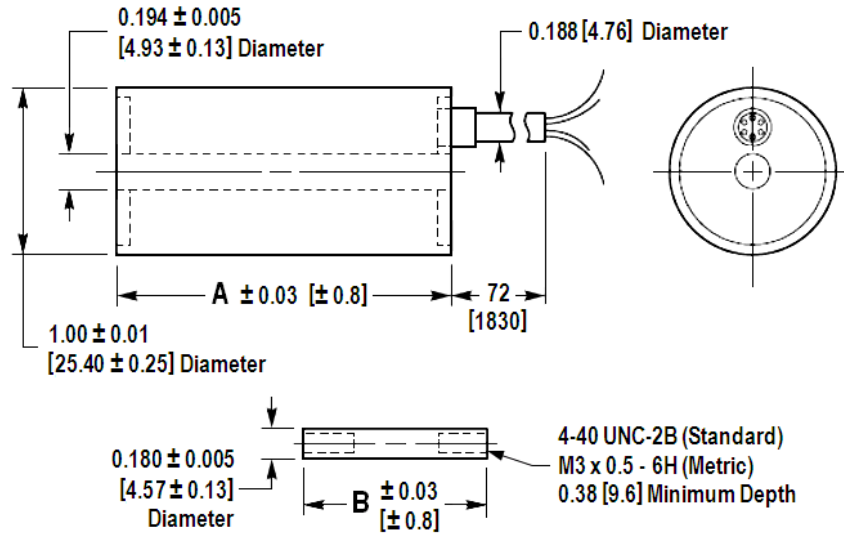
(): Unit for output at stroke ends is millivolt per volt of excitation (input voltage)*

FR: Full Range is the stroke range, end to end; FR=2xS for ±S stroke range

FRO (Full Range Output): Algebraic difference in outputs measured at the ends of the range

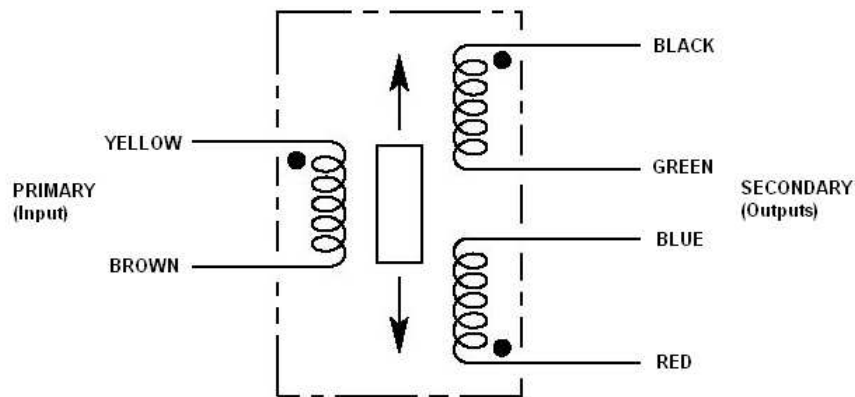
MECHANICAL SPECIFICATIONS

| Parameter | 100 XS-ZTR | 250 XS-ZTR |
|----------------------|-------------|-------------|
| Main body length "A" | 2.51 [63.8] | 3.83 [97.3] |
| Core length "B" | 1.35 [34.3] | 1.35 [34.3] |
| Body weight, oz [g] | 2.3 [65] | 4.1 [116] |
| Core weight, oz [g] | 0.09 [2.5] | 0.28 [7.9] |



Dimensions are in inch [mm]

WIRING INFORMATION



Connect Green to Blue for differential output

XS-ZTR SERIES

Extreme environment LVDT

ORDERING INFORMATION

| Description | Model | Part Number |
|-----------------|------------|--------------|
| ±0.10 inch LVDT | XS-ZTR 100 | 02560825-000 |
| ±0.25 inch LVDT | XS-ZTR 250 | 02560826-000 |

OPTIONS

| Description | Model | Part Number |
|---|-------|--------------|
| Metric threaded core option (M3x0.5-6H threads) | All | XXXXXXXX-006 |

ACCESSORIES

| Description | Part Number |
|---|--------------|
| Core connecting rod, 6 inches long, 6-40 threads | 05282946-006 |
| Core connecting rod, 12 inches long, 6-40 threads | 05282946-012 |
| Core connecting rod, 24 inches long, 6-40 threads | 05282946-024 |
| Core connecting rod, 36 inches long, 6-40 threads | 05282946-036 |
| Core connecting rod, 6 inches long, M3x0.5 metric threads | 05282977-006 |
| Core connecting rod, 12 inches long, M3x0.5metric threads | 05282977-012 |

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