

SENSOR DATA SHEET

Extreme Environment

For high pressure,
low temperature,
and
high temperature
applications



KAMAN

800-552-6267

kamansensors.com

Extreme Environment

FEATURES

- > For applications requiring high accuracy, high reliability, and structural integrity.
- > Operating temperatures from -320°F to +1000°F (+1200°F short term).
- > Displacement systems *withstand* pressures up to 3500 or 5000 psi.
- > Dual-coil sensor design effectively minimizes radiation effects.
- > Hermetically sealed and laser welded.
- > Unaffected by environmental contaminants.

HIGH PRECISION SENSORS FOR EXTREME ENVIRONMENTS



Kaman Measuring Systems manufactures a line of high-precision sensors and systems specifically for extreme environment applications. These include three displacement measuring systems, all able to operate at high temperatures.



The high temperature products in this catalog were initially designed for NASA and the nuclear power industry — applications requiring high reliability, accuracy, and structural integrity. The same engineering skill and technology that went

into Kaman's +2000°F microphone for measuring the dB level of jet engine exhaust noise, *in* the exhaust, went into the design and manufacture of this superior line of high temperature products.



Kaman originally developed the high temperature displacement sensor to measure steam turbine shaft runout in nuclear power plants. They are also used to measure nuclear fuel rod position/vibration, since these inductive sensors are unaffected by radiation and most other environmental contaminants.

This specialized line of high temperature sensors features precise operation at up to +1000°F continuous and +1200°F short term. They have resolution and repeatability comparable to Kaman's conventional line of high precision systems.

All of Kaman's high temperature transducers are made with sealed, all laser-welded Inconel housings and use metal-jacketed, mineral-insulated cable.

The displacement transducers *withstand* pressures: KD-1925 greater than 5000 psi; KD-1950 and KD-1975 up to 3500 psi.



Extreme Environment

HIGH TEMPERATURE DISPLACEMENT SENSORS

FEATURES

- > Operating temperatures from -320°F to +1000°F
- > Excellent linearity
- > Rugged all welded construction
- > Ideal for high pressure environments
- > Hermetically sealed
- > Small error band
- > Corrosive gas or liquid environments
- > KDM-8200 electronics for the KD-1925, KD-1950 and KD1975

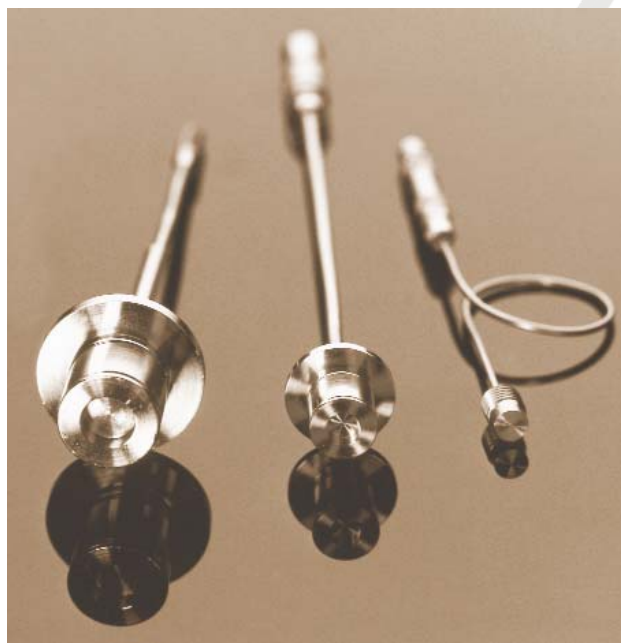
TYPICAL APPLICATIONS

- > Nuclear reactors
- > Steam and gas turbines
- > Turbine and rocket engines
- > Chemical processes
- > Research projects
- > High temperature processing

KD-1925, KD-1950 AND KD-1975 DISPLACEMENT SENSORS

Kaman's high-temperature displacement sensors provide accurate noncontacting measurement of conductive surface motion in hostile environments. Thermal compensation techniques that maintain sensitivity and linearity with small zero shifts make these accurate high temperature measurements possible.

Kaman's sensors feature laser-welded Inconel construction, making them perfect for a variety of extreme environment applications. The sensors use the versatile KDM-8200 family of signal conditioning electronics. Single channel systems are available in the NEMA-enclosed KDM-8200 or bench-top/ rack-mountable KDM-8200. The NEMA enclosure houses an internal power supply, digital panel meter and window kit. Up to eight measuring channels are available in the rack mountable KDM-8200. *(See Kaman's Series 8000 data sheet for a complete description and additional specifications for these electronics.)*



From left to right, KD-1975, KD-1950 and KD-1925 high temperature displacement sensors

Each sensor has dual coils inside the corrosion-resistant case. In operation, an electromagnetic field generated by the active coil penetrates the front of the sensor to induce eddy currents in a conductive target within the sensor's range. Changes in target displacement result in impedance variation in the active coil. This variation is detected by the signal conditioning electronics and converted to a linear analog output signal.

The symmetrical design of the dual coils compensates for constant and slowly changing temperatures from -320°F to +77°F or from 77°F to +1000°F. Measurement quality is unaffected by most corrosive gasses and liquids and most other environmental contaminants such as oil, dirt, radiation, and stray RF and magnetic fields.

The cabling has two sections joined by a LEMO[®] transition connector: a high-temperature metal-sheathed, mineral-insulated section designed to the same environmental specifications as the sensor, and a flexible section of Teflon[®] jacketed, twisted pair, coax cable for connection to the electronics unit.

Extreme Environment

HIGH TEMPERATURE DISPLACEMENT SENSORS

SIGNAL CONDITIONING ELECTRONICS



KDM-8200 3U/84 HP



KDM-8200 3U/42 HP



KDM-8200 NEMA enclosure

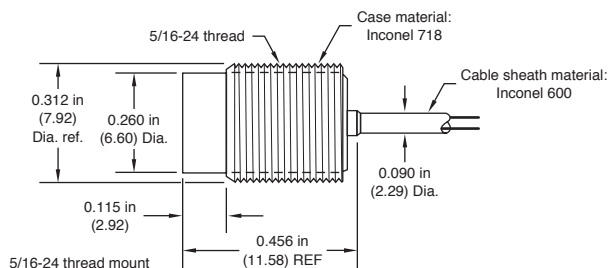
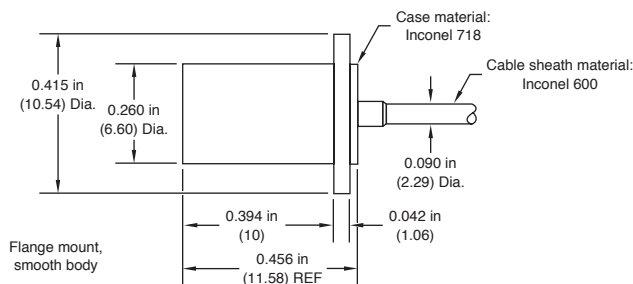
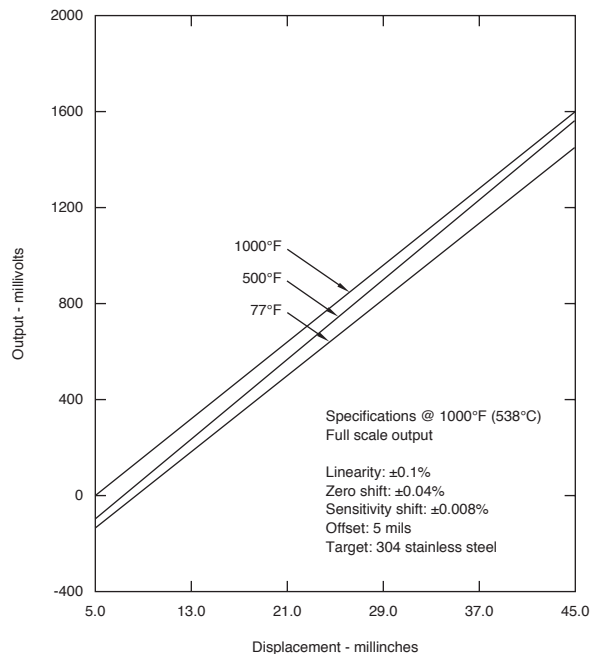
Extreme Environment

HIGH TEMPERATURE DISPLACEMENT SENSORS

KD-1925 DISPLACEMENT SENSOR



Flange mount, smooth body



SPECIFICATIONS

Measuring range* (maximum mechanical offset 0.001 inch)

KD-1925 0.050 inch (1.27 mm)

KD-1925M** 0.035 inch (0.9 mm)

Electronics KDM-8200

Power input (120 Vac)

Output (electrical zero offset up to 50% of measuring range)

KD-1925 0-2 Vdc nominal (50 mV/mil)

KD-1925M** 0-1.75 Vdc nominal (50 mV/mil)

Resolution (at mid range)

Static 30 μ inch (0.00003 inch)

[0.00076 mm]

Dynamic

50 μ inch (0.00005 inch)

[0.0013 mm]

Repeatability

30 μ inch at mid range

Operating temp. range

-320°F TO +77°F or

+77°F to +1000°F (+538°C)

Nonlinearity

Within $\pm 1.5\%$ FSO at customer selected calibration temp.

Typical temperature coefficients (over maximum specified thermal range)

Zero shift 0.03%/°F FSO (0.054%/°C FSO)

Sensitivity shift 0.03%/°F FSO (0.054%/°C FSO)

Frequency response

0-10 kHz (3 dB)

30 kHz available on request

Sensor material

Corrosion resistant high temp. nickel chrome alloy (Inconel 718) welded and hermetically sealed Nickel chrome alloy (Inconel 600) sheathed, mineral insulated

Cable material

Standard cable lengths

Hardline 10 feet

Softline 5 feet

Target material

Conductors - nonmagnetic and magnetic

Operating pressure range

To 5000 psi

Standard mounting configurations

- 5/16-24 thread mount
- Flange mount, smooth body

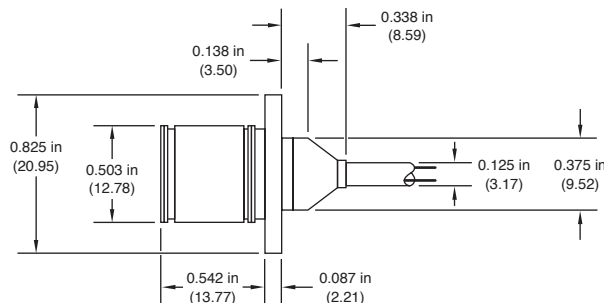
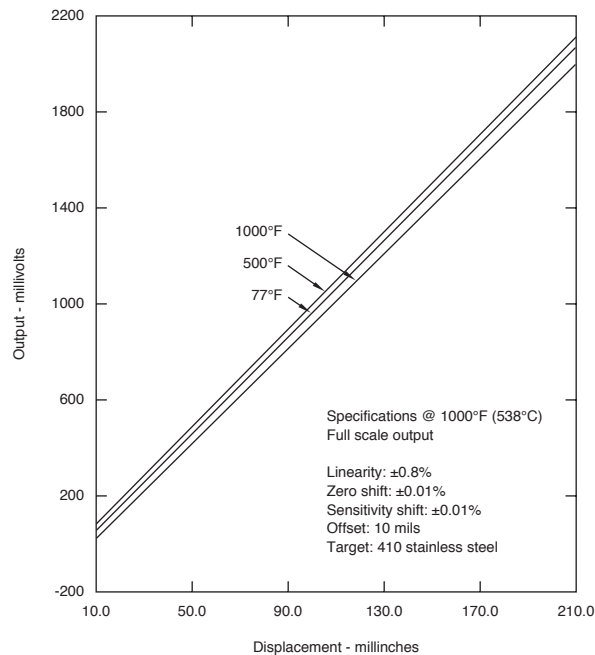
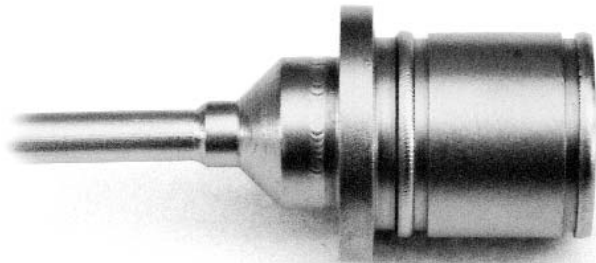
*Change from standard may degrade specifications.

**For magnetic targets.

Extreme Environment

HIGH TEMPERATURE DISPLACEMENT SENSORS

KD-1950 DISPLACEMENT SENSOR



SPECIFICATIONS

Measuring range* (maximum mechanical offset 0.005 inch)

KD-1950 0.150 inch (3.81 mm)

KD-1950M** 0.100 inch (2.54 mm)

Electronics KDM-8200 with internal power supply

Power input (120 Vac)

Output (electrical zero offset up to 50% of measuring range)

KD-1950 0-1.5 Vdc nominal

KD-1950M** 0-1.0 Vdc nominal

Resolution (at mid range)

Static 50 μ inch (0.0005 inch) [0.0013 mm]

Dynamic 100 μ inch (0.0001 inch) [0.0025 mm]

Repeatability 100 μ inch at mid range

Operating temp. range -320°F to +77°F or +77°F to +1000°F (+538°C)

Nonlinearity Within $\pm 1\%$ FSO at customer selected calibration temp.

Typical temp. coefficients (over maximum specified thermal range)

Zero shift 0.02%/°F FSO (0.036%/°C)

Sensitivity shift 0.02%/°F FSO (0.036%/°C)

Frequency response 0-10 kHz (3 dB)

Sensor material Corrosion resistant high temp. nickel chrome alloy (Inconel 625) welded and hermetically sealed

Cable material Nickel chrome alloy (Inconel 600) sheathed, mineral insulated

Standard cable lengths

Hardline 10 feet

Softline 5 feet

Optional lengths Available upon request

Target material Conductors - nonmagnetic and magnetic

Operating pressure range To 3500 psi

Standard mounting configurations Flange mount, smooth body

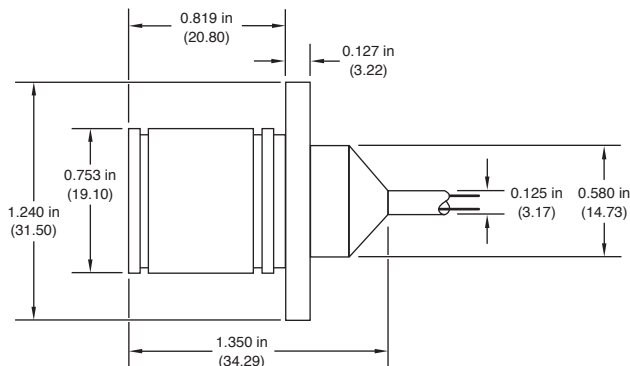
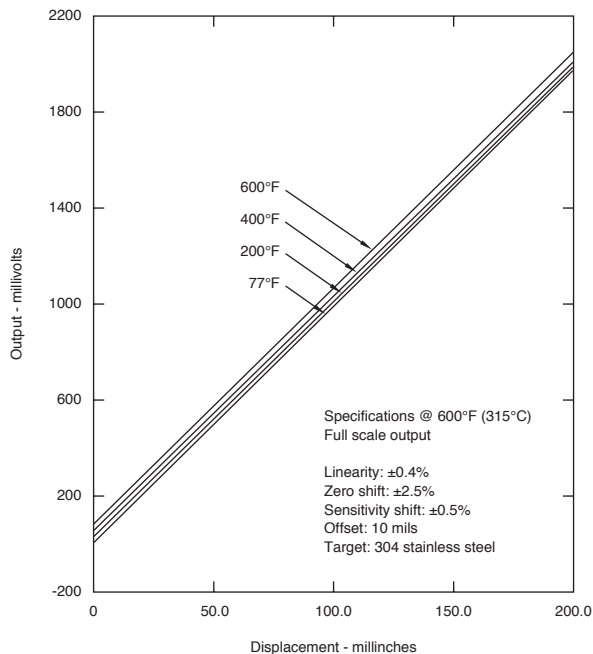
*Change from standard may degrade specifications.

**For magnetic targets.

Extreme Environment

HIGH TEMPERATURE DISPLACEMENT SENSORS

KD-1975 DISPLACEMENT SENSOR



SPECIFICATIONS

Measuring range* (maximum mechanical offset 0.010 inch)

KD-1975 0.200 inch (5 mm)

KD-1975M** 0.100 inch (2.5 mm)

Electronics KDM-8200 with internal power supply

Power input (120 Vac)

Output (electrical zero offset up to 50% of measuring range)

KD-1975 0-2 Vdc nominal

KD-1975M** 0-1 Vdc nominal

Resolution (at mid range)

Static 100 μ inch (0.0001 inch)
[0.0025 mm]

Dynamic 100 μ inch (0.0001 inch)
[0.0025 mm]

Repeatability 100 μ inch at mid range

Operating temp. range -320°F to +77°F or
+77°F to +1000°F (+538°C)

Nonlinearity Within $\pm 1\%$ FSO at customer selected calibration temp.

Typical temperature coefficients (over maximum specified thermal range)

Zero shift 0.01%/°F FSO (0.018%/°C)

Sensitivity shift 0.01%/°F FSO (0.018%/°C)

Frequency response 0-2.5 kHz (3 dB). Higher frequency response available

Sensor material Corrosion resistant high temp. nickel chrome alloy (Inconel 625) welded and hermetically sealed

Cable material Nickel chrome alloy (Inconel 600) sheathed, mineral insulated

Standard cable lengths

Hardline 10 feet

Softline 5 feet

Optional lengths Available on request

Target material Conductors - Nonmagnetic and magnetic

Operating pressure range To 3500 psi

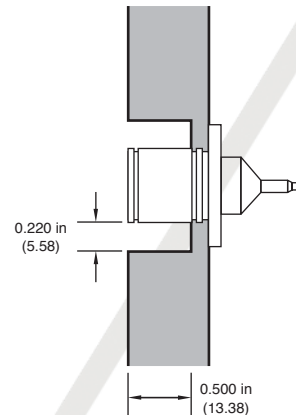
Standard mounting configurations Flange mount, smooth body

*Change from standard may degrade specifications.

**For magnetic targets.

MOUNTING CONSIDERATIONS

KD-1975



Technical drawing of a Kaman calibration fixture showing three views: a side view, a top view, and a detail view of the mounting cavity.

Side View Dimensions:

- "C" ± 0.003
- 2.245 $+0.005$ / -0.000 DIA
- "A - A"

Top View Dimensions:

- 1.750 DIA
- 0.172 $+0.004$ / -0.001 DIA THRU
- 0.250 $+0.004$ / -0.001 DIA THRU
- 0.172 $+0.004$ / -0.001 DIA THRU
- "A" ± 0.002 DIA
- Feature "E" with tolerance 0.002

Detail View Dimensions:

- "B" CUSTOMERS MOUNTING CAVITY INSERTION DEPTH
- "C" REQUIRED SIDE LOADING RING THICKNESS FOR KAMAN CALIBRATION FIXTURE (B · D = C)
- "A" DIA

Notes:

- 0.172 $+0.004$ / -0.001 DIA THRU
- CBORE 0.312 DIA X 0.180 DEEP 3 PLC EQ SPACED AT 120°
- 0.250 $+0.004$ / -0.001 DIA THRU 3 PLC EQ SPACED AT 120°
- 0.172 $+0.004$ / -0.001 DIA THRU
- 63 /
- 0.500
- 1.200 $+0.000$ / -0.002 DIA
- CYLINDRICAL RADIUS OF CURVATURE R CAN BE CONSIDERED FLAT IF:
KD-1925 IF R > 1.75
KD-1950 IF R > 3.50
KD-1975 IF R > 5.00
- TARGET

NOTES - UNLESS OTHERWISE SPECIFIED:

- BREAK SHARP EDGES 0.010 MAX X 45°.

△ SHALL BE IN AS RECEIVED CONDITION. TARGET SURFACE 32 / MAX.

2 SHALL BE IN AS RECEIVED CONDITION.
TARGET SURFACE 32/ MAX.