Eddy Probe Systems Catalog

- Probes and drivers
- Mounting devices
- Housings
- Pressure feedthroughs
- Calibrators and simulators
- Accessories

Contents

The SKF brand now stands for more than ever before, and means more to you as a valued customer.

While SKF maintains its leadership as the hallmark of quality bearings throughout the world, new dimensions in technical advances, product support and services have evolved SKF into a truly solutions-oriented supplier, creating greater value for customers.

These solutions encompass ways to bring greater productivity to customers, not only with breakthrough application-specific products, but also through leading-edge design simulation tools and consultancy services, plant asset efficiency maintenance programmes, and the industry's most advanced supply management techniques.

The SKF brand still stands for the very best in rolling bearings, but it now stands for much more.

SKF – the knowledge engineering company

Overview and introduction for eddy probe systems

Introduction

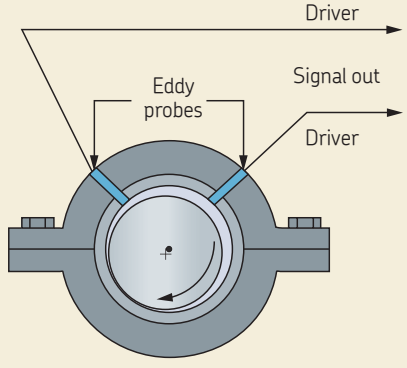
Effective protection of rotating machinery requires that the proper type of measurement be performed. The most suitable type of transducer may then be defined. Finally, specific application circumstances (frequencies of interest, operating temperatures, mounting requirements) are considered to select the optimum transducer. The chart to the right provides general guidelines for determining the most effective type of measurement.

Shaft relative motion

Shaft relative motion is the radial vibration of the shaft journal relative to the bearing. This method of vibration measurement is preferred for journal bearings, since it directly relates to permissible clearances. In machines with relatively light rotors and stiff heavy casings (turbines and compressors), almost all of the shaft's vibration energy is dissipated as displacement (exhibit low transmissibility), which can only be measured as shaft relative motion.

An eddy probe, mounted to or through the bearing, observes the shaft to provide this measurement. An additional eddy probe is often installed 90° from the first, in an orthogonal arrangement, to increase monitoring and diagnostic capabilities (voting logic and shaft orbit display).

Eddy probes mounted to observe the shaft



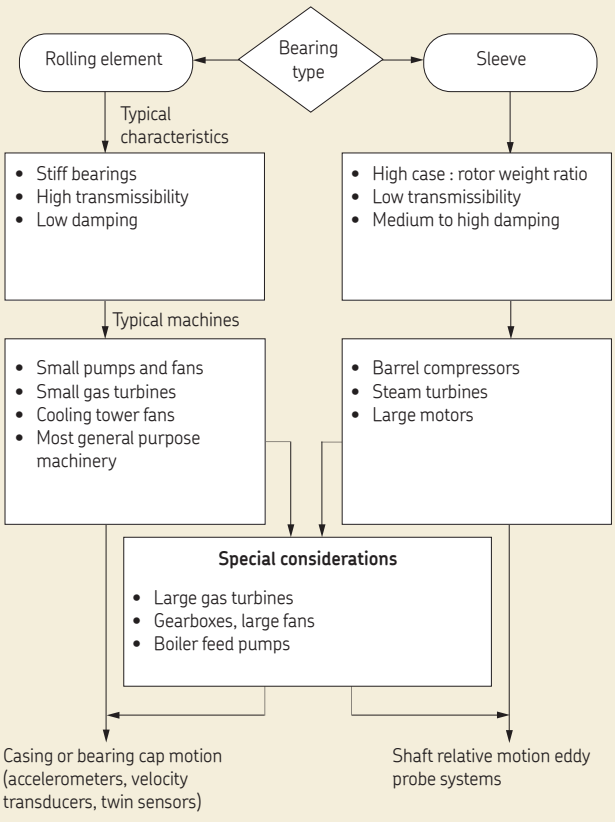
Eddy probe systems

The eddy probe is used to measure radial or axial shaft motion. It is mounted through or to the side of a bearing cap and observes the shaft's movement relative to its mounting position. An eddy probe system is comprised of a probe, a driver (oscillator demodulator) and an extension cable.

Eddy probe systems have excellent frequency response. They have no lower frequency limit and are used to measure shaft axial position as well as vibration.

While eddy probe systems offer excellent high frequency response, displacement at typical blading and gear mesh frequencies is quite small (an accelerometer may be used to augment the eddy probe system when high frequencies are a concern).

Frequency considerations



Frequency considerations

Shaft relative measurements always use eddy probes and are indicated in terms of displacement. Bearing cap or casing measurements, however, may use accelerometers or velocity transducers, either of which may be conditioned to indicate in terms of acceleration, velocity or displacement.

The frequency range of interest and the desired measurement terms are critical factors in transducer selection. Vibration presented in terms of velocity is generally accepted as a valid indication of destructive energy across the entire range of frequencies, whereas displacement and acceleration levels must always be evaluated considering the frequency content.

High frequency measurements (rolling bearings, gear mesh and blade passage) are best made using an accelerometer and presented in terms of acceleration, which is typically strong at these frequencies.

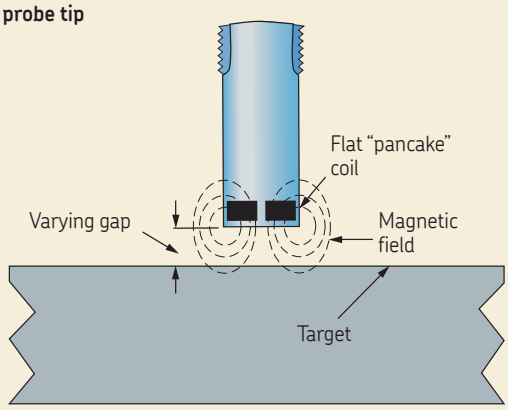
Low frequency (less than 15 Hz) bearing cap vibrations need special treatment. The frequency response of most reasonably priced velocity transducers starts dropping off between 10 and 20 Hz, and although accelerometers commonly respond down to 3 Hz, acceleration is very weak at low frequencies. The best solution is to integrate the accelerometer's signal to read out in terms of velocity. Double integration to displacement would provide the strongest signal, but, except in very special cases, it is inadvisable because of significant low frequency instability associated with the integration process.

Note: Eddy probe, displacement probe and proximity probe are all synonyms for the similar products manufactured and supplied by various companies.

The versatile eddy probe

The eddy probe system is a field proven method for reliably detecting various machine displacement parameters. The probe's simplicity and rugged design enables it to withstand the temperatures and chemicals typically encountered in the harsh machine environment.

Eddy probe tip

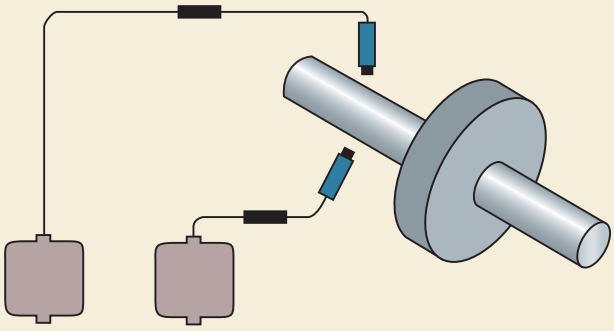


How it works

The tip of the eddy probe contains an encapsulated wire coil that radiates the driver's high frequency signal into the observed target as a magnetic field. The driver outputs a DC voltage representing the field strength. As a conductive surface approaches the coil, eddy currents are generated on the target surface, which decreases the field's strength, resulting in a decrease of the driver's DC output.

The driver linearizes and normalizes its output to a specific sensitivity, usually 7,87 mV/µm (200 mV/mil), throughout its working range. The signal's DC bias, representing the average probe gap, and its AC component, profiling surface movement and irregularities, is readily used in many applications, some of which are shown in the following diagrams.

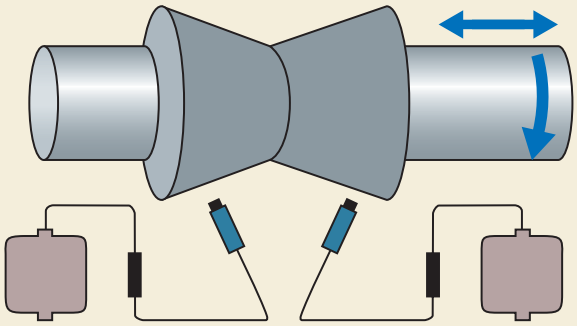
Radial motion of rotating shafts



Shaft vibration is represented as a varying DC voltage that may be used for monitoring, balancing or analysis. Using two probes separated by 90°, shaft orbit may be derived and X-Y voting logic monitoring may be used.

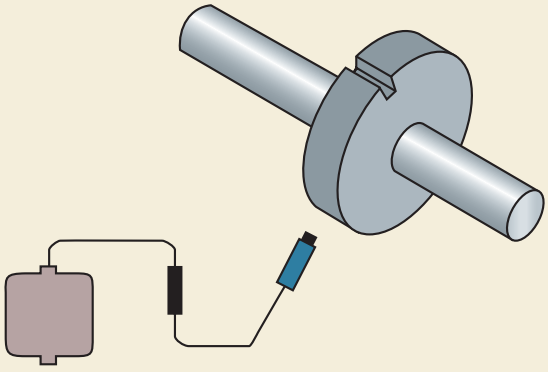
The eddy probe is rigidly mounted to the machine case and observes a ramped section of the shaft or a perpendicular shaft collar. The DC output voltage represents the axial shaft position and varies as the shaft and/or case experience thermal movement. Differential expansion monitoring confirms acceptable rotor/case growth rates.

Differential expansion



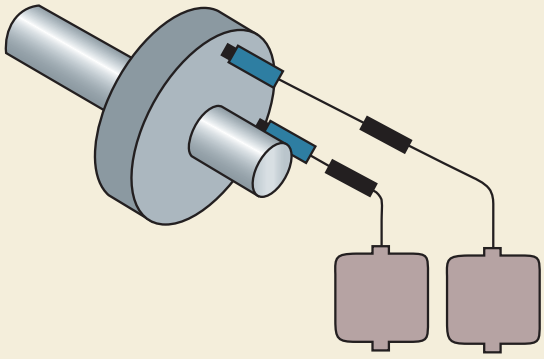
As the eddy probe observes the passage of a hole or keyway on a shaft or collar, the driver outputs a voltage pulse. This pulse may be used to generate a speed display or, along with vibration data, it can also be used to perform dynamic balancing. Multiple events per revolution (such as a gear) may also be observed by the eddy probe for speed determination.

Key phasor/speed



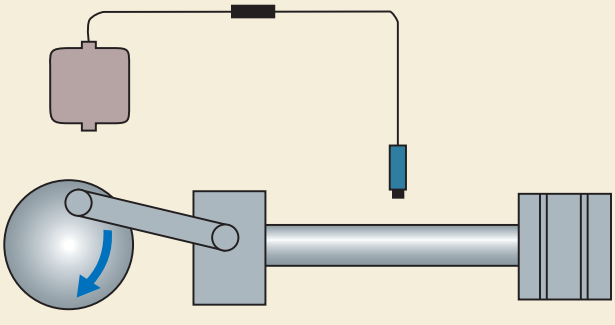
Shaft axial (thrust) position is represented by the average DC voltage and is normally used for monitoring. Two probes are recommended to permit voting protection (especially on systems armed for automatic shutdown).

Axial (thrust) position



As the piston rings, rider rings and cylinder liners wear, allowing the rod to gradually drop, the probe gap widens. The driver's DC voltage output may be used to determine when rings should be turned/replaced before damage to the piston occurs.

Rod drop



Selecting an eddy probe system

A wide variety of SKF systems are offered to meet the requirements of virtually any application. Probe range is limited largely by the probe's diameter. The standard SKF probe diameters are 5 mm *(0.20 in.)* (CMSS 65), 8 mm *(0.31 in.)* (CMSS 68) and 19 mm *(0.75 in.)* (CMSS 62). The following should be considered when selecting a system.

Range

Range is the gap over which the system must accurately operate.

Sensitivity

Must be compatible with monitors or other companion instruments.

System length

The physical length of the systems is approximate to the electrical length. Excess cable in certain installations is typically coiled and tied with no harmful effects.

Probe case

The size of the probe mounting case may be a factor in some installations (several case options are available, indicated under ordering information).

Some eddy probe options

Armor

A flexible stainless steel jacket protects the cable. It is recommended when the cable is not protected by conduit. It is available on probe cables and extension cables, but is not compatible with cable packing glands.

Certification

Approved probes and drivers can be supplied with either non-incendive or intrinsic safety approvals. Non-incendive products are supplied with FM (Factory Mutual) certification tags attached. Intrinsically safe products are supplied with triple agency approval certification tags attached (ATEX [Sira], FM [Factory Mutual Systems] and CSA [Canadian Standards Association]).

Certifications

ATEX (Sira)

FM (Factory Mutual Systems)

CSA (Canadian Standards Association)

CE mark CE

Beginning January 1996, the European Community requires equipment sold in their area to be a CE marked product. Because sensors have an active component, such as the integrated circuit amplifier, the sensor should have the CE mark.

A word about ...

Probe tips

SKF uses Ryton for eddy probe tips because it is simply the best material for the job. Ryton has high dimensional stability, reducing probe coil shape variations with temperature and humidity and maintaining system accuracy, linearity and resolution. Ryton is a "super plastic" that has no known solvent below 205 °C *(400 °F)* and therefore highly resistant to the acids, bases and solvents handled by process machinery.

Installation

Major considerations include temperatures, pressures and mechanical stress to which the probe, driver and cables are subjected. It is essential that the probe be rigidly mounted, yet easily adjusted (SKF mounting accessories are ideal for this). If long cable runs between the driver and monitor are required, consult **table 1** to determine the maximum recommended wire length (use three-conductor shielded wire).

Table 1

Maximum recommended wire length

Wire size (AWG)	Distance (maximum)
22	150 m *(500 ft.)*
20	300 m *(1 000 ft.)*
18	600 m *(2 000 ft.)*
16	900 m *(3 000 ft.)*

Target material

Standard systems are calibrated to observe 4140 steel. As recommended by the American Petroleum Institute (API) Standard 670, probe calibration should be verified on a target with the same electrical characteristics as the shaft. The SKF CMSS 601 static calibrator and the driver trim control permit verification and convenient field calibration within a ±5% range on the shaft itself. Response is dependent upon the conductance of the target material, as illustrated on the chart below. Drivers may be special ordered for calibrated response to different metal types. Customers will be requested to provide samples of the metal types.

Runout

Because the eddy probe works on the principle of conductivity, shaft irregularities (flat spots, scratches, plating, hardness variations, carbon inclusions, magnetized regions, etc.) may produce false vibration signals. API Standard 670 recommends that combined total electrical and mechanical runout does not exceed 0,25 mils maximum. Some irregularities, such as plated shafts, cannot be reduced to an acceptable level with traditional methods (peening, knurling, etc.).

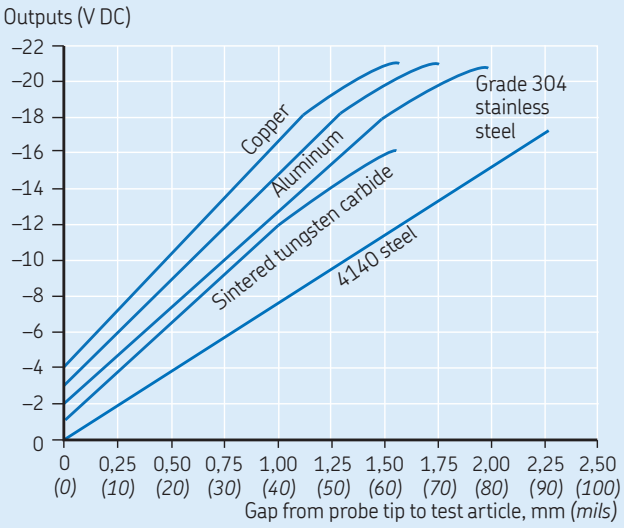
Intrinsic safety

SKF monitors provide current limited power to eddy probe systems that meet safety requirements of most applications. However, if intrinsic safety barriers (Zener barriers) will be used, consult the local sales representative to make sure that range, linearity and power requirements will be met.

API Standard 670

The American Petroleum Institute has published Standard 670 as an aid to the procurement of standardized non-contacting vibration, axial position and temperature monitoring systems. The standard is based on the accumulated knowledge and experience of petroleum refiners and monitoring system manufacturers. API Standard 670 is a valuable reference tool for all machinery users and manufacturers and is highly recommended as a guide for defining, purchasing and installing machinery monitoring systems.

System response varies with the target material



API 670 was written to define reliable protection systems for rotating equipment operating in the harsh conditions found in oil production, refining and chemical processing. SKF Ryton based eddy current probes were designed using a unique temperature chamber to test the probes over the wide temperature range required by API. The output sensitivity of conventional eddy current probe systems typically falls off as temperature increases. A unique probe winding technique was developed by SKF that strives to maintain output sensitivity over the specified temperature range.

"Super tough" eddy current probe systems are thoroughly field tested and proven, with thousands of units installed.

SKF has been using Ryton in its transducer designs for many years. Ryton's strength approaches that of metal. The material is now beginning to be used in the manufacture of automobile engine camshafts. That's what we mean when we say "super tough".

Table 2

Standard eddy probe systems from SKF

System	Usable range	Sensitivity	System length	Standard case	Comments
CMSS 65 / CMSS 665	2 mm *(80 mils)*	7,87 mV/µm *(200 mV/mil)*	5 m *(16.4 ft.)*	1/4-28	Standard system
CMSS 68 / CMSS 668	2,3 mm *(90 mils)*	7,87 mV/µm *(200 mV/mil)*	5 m *(16.4 ft.)*	3/8-24	Meets intent of API 670
CMSS 68 / CMSS 668-1	2,3 mm *(90 mils)*	7,87 mV/µm *(200 mV/mil)*	10 m *(32.8 ft.)*	3/8-24	Long system length
CMSS 68 / CMSS 668-2	2,3 mm *(90 mils)*	7,87 mV/µm *(200 mV/mil)*	15 m *(49.2 ft.)*	3/8-24	Long system length
CMSS 62 / CMSS 620-2	1,5 to 7,6 mm *(60 to 300 mils)*	1,97 mV/µm *(50 mV/mil)*	10,8 m *(35.4 ft.)*	1-12	Long range
CMSS 68 / CMSS 668H-5	0,4 to 4,1 mm *(15 to 160 mils)*	3,94 mV/µm *(100 mV/mil)*	10 m *(32.8 ft.)*	3/8-24	Long range

SKF's eddy current probes are available in a variety of case mounting configurations and length options to meet difficult installation requirements.

Ryton is impervious to any solvent at temperatures up to 205 °C *(400 °F)*. For this reason, SKF driver housings are also made of this same super tough material. An added benefit is that there is no longer a need to electrically isolate drivers during installation to prevent troublesome ground loops. Ryton's proven resistance to extreme harsh environments protects the complex electronics required to operate eddy current probes. An internal sealing system protects these components from moisture ingression and corrosion. This increases system reliability by eliminating the need to totally encapsulate these components. Due to its unique construction, both the driver housing and the internal circuits react to severe thermal excursions at the same rate. This reduces internal stresses created by routine machinery transients or load changes, providing for a longer driver life.

SKF drivers are EMI/RFI shielded and the mounting scheme allows them to fit the same "footprint" as previous SKF driver housings, or they can be snapped onto type C-DIN rails for high density applications and quick installation. The compression connector for terminating the power and signal wiring further aids in the ease and cost of installation. A fixed connector version is also available.

SKF's eddy current probe systems are constantly temperature and performance tested in a continuing effort to improve what is already the best probe available for the measurement of vibration in rotating equipment. They are available with armored and fiberglass sleeving, and may be offered ATEX (Sira)/CSA/FM certified.

The small tip diameter (5 mm *(0.2 in.)*) of the CMSS 65 eddy current probe systems, coupled with the stringent controls under which they are produced, effectively reduces calibration error due to shaft curvature. This makes the CMSS 65 an exceptional choice for measuring vibration in small diameter shafts. The CMSS 65 is available in 5 m *(16.4 ft.)* systems (probe with integral cable or a combination of probe cable and extension cable) and has a typical usable range of 0,2 to 2,3 mm *(10 to 90 mils)* with a 7,87 V/mm *(200 mV/mil)* sensitivity. A specific CMSS 665 driver is required for each of the standard lengths, which are shown in **table 2**.

The larger tip diameter (8 mm *(0.3 in.)*) of the CMSS 68 SKF transducer is used for large diameter shafts as well as long range axial position (thrust) measurements. The CMSS 68 is available in 5, 10 or 15 m *(16.4, 32.8 or 49.2 ft.)* systems and has a typical usable range of 0,2 to 2.5 mm *(10 to 100 mils)* with a 7,87 V/mm *(200 mV/mil)* sensitivity. The CMSS 668H-5 driver provides a usable range of 0,4 to 4,0 mm *(15 to 160 mils)* with a sensitivity of 3,94 V/mm *(100 mV/mil)*; it is available only as a 10 m *(32.8 ft.)* system.

Table 3

Temperature conversion table

Fahrenheit to Celcius: °C = 0,556 × (°F – 32)
Celsius to Fahrenheit: °F = (1,8 × °C) + 32

Common °C and °F equivalents

°C		°F	°C		°F
–40	=	–40	+40	=	+105
–20	=	–5	+50	=	+120
–10	=	+15	+60	=	+140
–5	=	+25	+70	=	+160
0	=	+30	+80	=	+175
+5	=	+40	+90	=	+195
+10	=	+50	+100	=	+210
+20	=	+70	+150	=	+300
+30	=	+85	+200	=	+390

Table 4

Length conversion table

mil to µm: µm = mil × (25,4 × 10^{-6})
µm to mil: mil = µm / (25,4 × 10^{-6})

Common mil and µm equivalents

mil		µm or mm	mil		µm or mm
1	=	25,4 µm	80	=	2,0320 mm
5	=	127,0 µm	90	=	2,2860 mm
10	=	254,0 µm	100	=	2,5400 mm
20	=	508,0 µm	110	=	2,7940 mm
30	=	762,0 µm	120	=	3,0480 mm
40	=	1,0160 mm	130	=	3,3020 mm
50	=	1,2700 mm	140	=	3,5560 mm
60	=	1,5240 mm	150	=	3,8100 mm
70	=	1,7780 mm	200	=	5,0800 mm

1 m = 39 in. = 1.7 ft.
1 in. = 0,0254 m = 25,4 mm

Common meter, inch and foot equivalents

m		in.		ft.
0,5	=	19.7	=	1.7
1,0	=	39.4	=	3.3
5,0	=	196.9	=	16.4
10,0	=	393.7	=	32.8
15,0	=	590.6	=	49.2
20,0	=	787.4	=	65.6
25,0	=	984.3	=	82.0

Eddy probe systems

CMSS 65 / CMSS 665 series

5 mm eddy probe system, Ryton–based eddy current transducers

Option now available with either the standard removable/reversible connector or the optional permanent fixed connector.

Introduction

The eddy probe is used to measure radial or axial shaft motion. It is mounted through or to the side of a bearing cap and observes the shaft's movement relative to its mounting position. An eddy probe system comprises a probe, a driver (oscillator demodulator) and an optional extension cable.

Eddy probe systems have excellent frequency response. They have no lower frequency limit and are used to measure shaft axial position as well as vibration.

Specifications

CMSS 65 eddy current probe system

Unless otherwise noted, the following specifications apply to a complete CMSS 65 eddy current probe system, at 23 °C *(73 °F)*, with a –24 V DC supply and target of AISI 4140 steel, comprising of:

- CMSS 65: Eddy current probe
- CMSS 958: Extension cable
- CMSS 665 or CMSS 665P: Driver

Note: These specifications may vary with different options and systems.

Electrical

- Usable range: 2 mm (0,2 to 2,3 mm); *80 mils (10 to 90 mils)*
- Sensitivity: 7,87 mV/µm *(200 mV/mil)*
- Linearity: ±25,4 µm *(1 mil)* of best straight line over 2 mm *(80 mil)* range
- Frequency range: DC to 10 kHz (600 000 CPM), down maximum of 3 dB at 10 kHz
- Driver signal output:
  - Impedance: Minimum calibrated load resistance of 3 kΩ; output is protected against miswiring
  - Voltage: Nominal 7,87 mV/µm *(200 mV/mil)* corresponding to –18 V DC at 2,3 mm *(90 mils)* with –24 V DC supply
- Power supply requirements: 15 mA from –24 to –30 V DC
- Interchangeability:
  - Probes, extension cables and drivers are compliant to API 670 requirement and may be interchanged with 5% or less performance change without recalibration
  - All units are factory calibrated at 23 °C *(73 °F)*
  - Trim calibration adjustment on driver provides duplication of characteristics after replacement of any component

Environmental and mechanical

CMSS 65 probe

- Operating temperature range: –35 to +175 °C *(–30 to +350 °F)* (**Note:** Ex i regulations restrict upper limit to 100 °C *(210 °F)*)
- Differential pressure: To 4 bar *(60 PSI)*
- Materials:
  - Case: Grade 300 stainless steel
  - Tip material: Ryton
  - Connectors: Nickel plated stainless steel; weatherproof, sealable
  - Cable: Coaxial with fluorine based polymer insulation; high tensile and flexible strength
- Mounting: Recommend minimum clearance of 1/2 probe tip diameter around the probe tip to maintain factory calibration

CMSS 958 extension cable

The temperature ranges, connectors and cable are the same as the CMSS 65 eddy current probe.

CMSS 665 and CMSS 665P drivers

- Operating temperature range: 0 to 65 °C *(30 to 150 °F)*
- Connections (Power, Signal, GND):
  - Five terminal removable and reversible compression terminal block accepting up to 2 mm^2 *(14 AWG)* wire
  - Three connections necessary per block (–24 V DC, GND, Signal)
  - The CMSS 665P has a permanent fixed connector with the same connection characteristics
- Mounting: C-DIN rail mount that bolts onto the driver enclosure, or the standard four 4,8 mm *(0.19 in. or #10)* clearance holes in a square on 63,5 mm *(2.5 in.)* centers

System performance

The following performance characteristics apply for the CMSS 65 eddy current probe system in addition to quoted nominal specifications:

- Extended temperatures: With 1 m *(3.3 ft.)* probe and 4 m *(13.1 ft.)* extension cable operating in a range of –35 to +120 °C *(–30 to +250 °F)* and driver in the range of 0 to +65 °C *(30 to 150 °F)*
- Sensitivity: ±10% of 7,87 mV/µm *(200 mV/mil)*
- Linearity: ±25,4 µm *(±1 mil)* of best straight line over 2 mm *(80 mil)* range
- Minimum target size:
  - Flat surface: 10 mm *(0.39 in.)*
  - Shaft diameter: 15 mm *(0.59 in.)*

Hazardous area approvals

North America

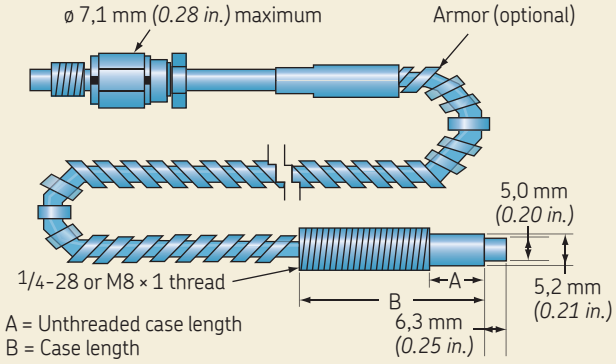
- Approvals granted by Factory Mutual (FM) and Canadian Standards Association (CSA)
- **Class I, Division 1 Groups A, B, C, D** when used with intrinsically safe Zener barriers or galvanic isolators; contact your local SKF sales representative for details
- **Class I, Division 2 Groups A, B, C, D** when connected with National Electric Code (NEC) without Zener barriers or galvanic isolator; contact your local SKF sales representative for details

Europe

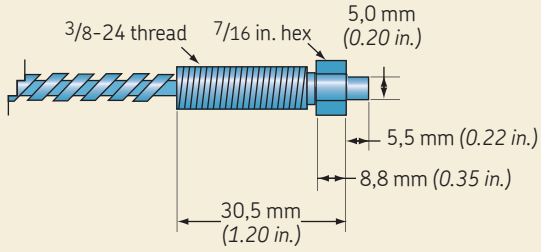
- Certification to ATEX directive
  - Drivers: Ex II 1 G EEx ia IIC T4 ($–20 \le T_a \le +75$ °C) *($–5 \le T_a \le +165$ °F)*; certificate number BAS02ATEX1168X
  - Probes: Ex II 1 G EEx ia IIC T4 or T2; certificate number BAS02ATEX1169
  - System: EEx ia IIC T4 or T2 (as per schedule); certificate number Ex 02E2170
- Intrinsic safety requires use of Zener barriers; contact your local SKF sales representative for details

Note: See ordering details for probe and driver designations for hazardous area approved models.

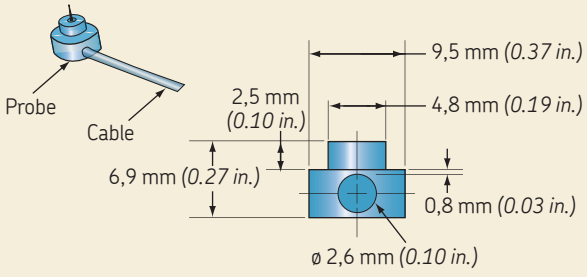
Standard mount case



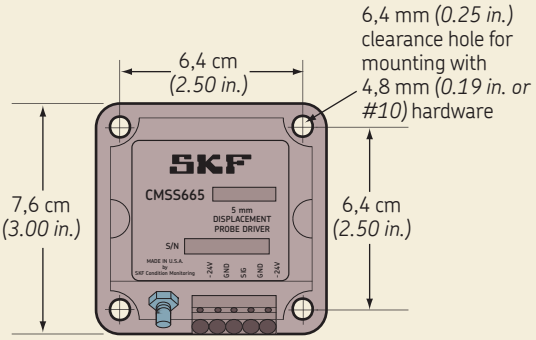
Reverse mount case



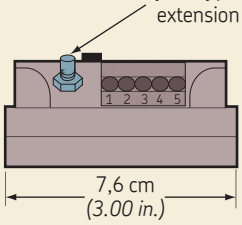
Button (disk) probe



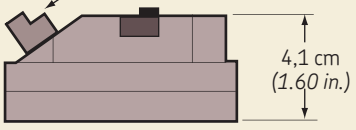
CMSS 665 dimensions



Connector: Stainless steel jack-type mates with CMSS 958 extension cable



Removable or permanent fixed connector: Terminal strip type rated for 250 V, 10 A, 14 AWG maximum wire size



Ordering information – Part 1: Eddy current probe

Ordering information

CMSS 65 Eddy current probe.
(SKF standard: CMSS 65-002-00-12-10)

Part number **CMSS 65–aab-cc-dd-ee**

aa	**Cable**
00	Standard
01	Armored
02	Fiberglass sleeved
07	CSA/FM/SIRA (ATEX) (Intrinsically Safe) certified
08	CSA/FM/SIRA (ATEX) (Intrinsically Safe) certified and armored
09	FM (non-incendive)
0B	FM (non-incendive) armored

b	**Case**
2	1/4-28 threads (standard)
3	M8 × 1 threads
0	3/8-24 threads
1	M10 × 1 threads
4	No case
E	Button probe (Fiberglass)

cc	**Unthreaded case length**
00	Fully threaded
01 to 50	2,5 to 127,0 mm *(0.1 to 5.0 in.)* (unthreaded)
51 to 99	129,5 to 251,5 mm *(5.1 to 9.9 in.)*
RM	Reverse mount, 3/8-24 threads

dd	**Case length**
00	Standard: No case
08	Standard: 2,0 cm *(0.8 in.)*
12	Standard: 3,0 cm *(1.2 in.)*
15	Standard: 3,8 cm *(1.5 in.)*
20	Standard: 5,1 cm *(2.0 in.)*
25	Standard: 6,4 cm *(2.5 in.)*
30	Standard: 7,6 cm *(3.0 in.)*
40	Standard: 10,2 cm *(4.0 in.)*
47	Standard: 11,9 cm *(4.7 in.)*
60	Standard: 15,2 cm *(6.0 in.)*
90	Standard: 22,9 cm *(9.0 in.)*
09 to 59	Special: 2,3 to 15,0 cm *(0.9 to 5.9 in.)*
91 to 99	Special: 23,1 to 25,1 cm *(9.1 to 9.9 in.)*

ee	**Overall length***
05	0,5 m *(1.6 ft.)*
10	1,0 m *(3.3 ft.)* (standard)
5A	5,0 m *(16.4 ft.)*

* Length is nominal electrical; physical length may vary.

Compatible systems:

- 0,5 m probe / 5,0 m system: CMSS 958-xx-045 / CMSS 665
- 1,0 m probe / 5,0 m system: CMSS 958-xx-040 / CMSS 665
- 5,0 m probe / 5,0 m system: CMSS 665

The 5A units have an integral cable and mate directly to the driver.

Reverse mount case and button (disk) probe:

- Reverse mount case: **CMSS 65-aa0-RM-12-ee**
- Button (disk) probe: **CMSS 65-aaE-00-00-ee**

Ordering information – Part 2: Extension cable

Ordering information

CMSS 958 Extension cable.
(SKF standard CMSS 958-00-040)

Part number **CMSS 958–aa-bbb**

aa	**Cable**
00	Standard
01	Armored
02	Fiberglass sleeved
09	CSA/FM/SIRA (ATEX) (Intrinsically Safe) certified
0A	CSA/FM/SIRA (ATEX) (Intrinsically Safe) certified and armored
0H	FM (non-incendive)
0J	FM (non-incendive) armored

bbb	**Length (compatible system listed)**
030	3,0 m *(9.8 ft.)* (CMSS 665, 2,0 m *(6.56 ft.)* CMSS 65)
040	4,0 m *(13.1 ft.)* (CMSS 665, 1,0 m *(3.28 ft.)* CMSS 65)
045	4,5 m *(14.8 ft.)* (CMSS 665, 0,5 m *(1.64 ft.)* CMSS 65)
090	9,0 m *(29.5 ft.)* (CMSS 665-1, 1,5 m *(3.28 ft.)* CMSS 65)
095	9,5 m *(31.2 ft.)* (CMSS 665-1, 0,5 m *(1.64 ft.)* CMSS 65)

Ordering information – Part 3: Driver (SKF standard: CMSS 665)

Drivers containing "P" in the model number denote those models with a permanent fixed connector.

Driver (5 m system) – CMSS 665 / CMSS 665P

7,87 mV/µm *(200 mV/mil)*. Use with:

- 1,0 m probe and 4,0 m extension cable
- 0,5 m probe and 4,5 m extension cable
- 5,0 m probe

Driver (10 m system) – CMSS 665-1 / CMSS 665P-1

Use with a 1 m probe and 9 m extension cable or a 10 m probe.

- Usable range: 2 mm (0,25 to 2,30 mm); *80 mils (10 to 90 mils)*
- Sensitivity: 7,87 mV/µm *(200 mV/mil)*, ±10%
- Linearity: ±38 µm *(1.5 mil)* from best straight line

Enhanced environmental protection – CMSS 665-8 / CMSS 665P-8

Specifications for an enhanced environmental protection driver are the same as for the standard driver; however, the enhanced environmental protection driver is also filled with potting material to provide an additional measure of protection when operated in adverse environmental conditions.

- Sensitivity: 7,87 mV/µm *(200 mV/mil)*

Hazardous area approval (Intrinsic Safety) with 4140 stainless steel target – CMSS 665-16-9 / CMSS 665P-16-9

This driver is CSA/FM/SIRA (Intrinsically Safe) certified for a 5 m system. Use it with CSA/FM/SIRA (Intrinsically Safe) certified 1 m CMSS 65 probe and 4 m CMSS 958 extension cable. For intrinsic safety installations, drivers must be installed with intrinsic safety (I-S) barriers.

Barriers

- For FM approval:
  - Power: Stahl 8901/30-280/085/00
  - Signal: Stahl 8901/30-199/038/00
- For CSA and SIRA approval:
  - Power/Signal: MTL 7096 Dual (neg)

Contact your local SKF sales representative for details.

- Usable range: 1,15 mm (0,25 to 1.4 mm); *45 mils (10 to 55 mils)*
- Sensitivity: 7,87 mV/µm *(200 mV/mil)*
- Linearity: ±25,4 µm *(1 mil)* from best straight line over 1,15 mm *(45 mil)* range

CMSS 665-16-xx / CMSS 665P-16-xx*

These are CSA/FM/SIRA (Intrinsically Safe) certified drivers for a 5 m system calibrated for shaft materials other than standard 4140 stainless steel. Use this driver with CSA/FM/SIRA (Intrinsically Safe) certified 1 m CMSS 65 probe and 4 m CMSS 958 extension cable. For intrinsic safety installations, drivers must be installed with intrinsic safety (I-S) barriers (see *CMSS 665-16-9*).

- Usable range:
  - Best attainable for specific shaft material provided
  - Customer to provide identification of shaft material and sample (approximately 5,1 cm *(2.0 in.)* diameter disk, 1,3 cm *(0.5 in.)* thick)
  - Range not expected to exceed the 1,1 mm *(45 mils)* of standard unit
- Sensitivity: 7,87 mV/µm *(200 mV/mil)*, ± to be determined percentage of 7,87 mV/µm *(200 mV/mil)* dependent on the shaft sample material (–24 V DC supply)
- Linearity: ± the minimum deviation (in µm or mils) from the best straight line attainable for the sample shaft material provided

* xx = System calibrated for shaft materials other than standard 4140 stainless steel. For custom configurations, please contact an SKF sales representative.

Hazardous area approval (non-incendive) with 4140 stainless steel target – CMSS 665-20-00 / CMSS 665P-20-00

This FM (non-incendive) certified driver for the 5 m system is used with the FM (non-incendive) certified 1 m CMSS 65 probe and CMSS 958 extension cable.

- Usable range: 2 mm (0,25 to 2,25 mm); *80 mils (10 to 90 mils)*
- Sensitivity: 7,87 mV/µm *(200 mV/mil)*
- Linearity: ±25,4 µm *(1 mil)* of best straight line over 2 mm *(80 mil)* range

Note: All circuit boards used in SKF CMSS 665 series drivers are conformal coated as standard procedure.

CMSS 68 / CMSS 668 series

8 mm eddy probe system, Ryton–based eddy current transducers

Option now available with either the standard removable/reversible connector or the optional permanent fixed connector.

Introduction

The eddy probe is used to measure radial or axial shaft motion. It is mounted through or to the side of a bearing cap and observes the shaft's movement relative to its mounting position. An eddy probe system comprises a probe, a driver (oscillator demodulator) and an optional extension cable.

Eddy probe systems have excellent frequency response. They have no lower frequency limit and are used to measure shaft axial position as well as vibration.

Specifications

CMSS 68 eddy current probe system

Unless otherwise noted, the following specifications apply to a complete CMSS 68 eddy current probe system, at 23 °C (73 °F), with a –24 V DC supply and target of AISI 4140 steel, comprising of:

- CMSS 68: Eddy current probe
- CMSS 958: Extension cable
- CMSS 668 or CMSS 668P: Driver

Note: These specifications may vary with different options and systems.

Electrical

- Usable range: 2,3 mm (0,2 to 2,5 mm); *90 mils (10 to 100 mils)*
- Sensitivity: 7,87 mV/µm *(200 mV/mil)*
- Linearity: ±25,4 µm *(1 mil)* of best straight line over 2,3 mm *(90 mil)* range
- Frequency range: DC to 10 kHz (600 000 CPM), down maximum of 3 dB at 10 kHz
- Driver signal output:
  - Impedance: Minimum calibrated load resistance of 3 kΩ; output is protected against miswiring
  - Voltage: Nominal 7,87 mV/µm *(200 mV/mil)* corresponding to –18 V DC at 2,3mm *(90 mils)* with –24 V DC supply
- Power supply requirements: 15 mA from –24 to –30 V DC
- Interchangeability:
  - Probes, extension cables and drivers are compliant to API 670 requirement and may be interchanged with 5% or less performance change without recalibration
  - All units factory calibrated at 23 °C *(73 °F)*
  - Trim calibration adjustment on driver provides duplication of characteristics after replacement of any component

Environmental and mechanical

CMSS 68 probe

- Operating temperature range: –35 to +175 °C *(–30 to +350 °F)* (**Note:** Ex i regulations restrict upper limit to 100 °C *(210 °F)*)
- Differential pressure: To 4 bar *(60 PSI)*
- Materials:
  - Case: Grade 300 stainless steel
  - Tip material: Ryton
  - Connectors: Nickel plated stainless steel; weatherproof, sealable
  - Cable: Coaxial with fluorine based polymer insulation; high tensile and flexible strength
- Mounting: Recommend minimum clearance of 1/2 probe tip diameter around the probe tip to maintain factory calibration

CMSS 958 extension cable

The temperature ranges, connectors and cable are the same as the CMSS 68 eddy current probe.

CMSS 668 and CMSS 668P drivers

- Operating temperature range: 0 to 65 °C *(30 to 150 °F)*
- Connections (Power, Signal, GND):
  - Five terminal removable and reversible compression terminal block accepting up to 2 mm^2 *(14 AWG)* wire
  - Three connections necessary per block (–24 V DC, GND, Signal)
  - The CMSS 668P has a permanent fixed connector with the same connection characteristics
- Mounting: C-DIN rail mount that bolts onto the driver enclosure or the standard four 4,8 mm *(0.19 in. or #10)* clearance holes in a square on 63,5 mm *(2.5 in.)* centers

System performance

The following performance characteristics apply for the CMSS 68 eddy current probe system in addition to quoted nominal specifications:

- Extended temperatures: With 1 m *(3.3 ft.)* probe and 4 m *(13.1 ft.)* extension cable operating in a range of –35 to +120 °C *(–30 to +250 °F)*, and driver in the range of 0 to 65 °C *(30 to 150 °F)*
- Sensitivity: ±10% of 7,87 mV/µm *(200 mV/mil)*
- Linearity: ±25,4 µm *(1 mil)* of best straight line over 2,3 mm *(90 mil)* range
- Minimum target size:
  - Flat surface: 16 mm *(0.63 in.)*
  - Shaft diameter: 24 mm *(0.93 in.)*

Hazardous area approvals

North America

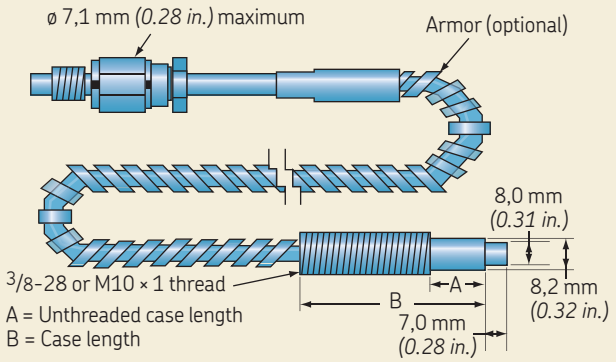
- Approvals granted by Factory Mutual (FM) and Canadian Standards Association (CSA)
- **Class I, Division 1 Groups A, B, C, D** when used with intrinsically safe Zener barriers or galvanic isolators; contact your local SKF sales representative for details
- **Class I, Division 2 Groups A, B, C, D** when connected with National Electric Code (NEC) without Zener barriers or galvanic isolator; contact your local SKF sales representative for details

Europe

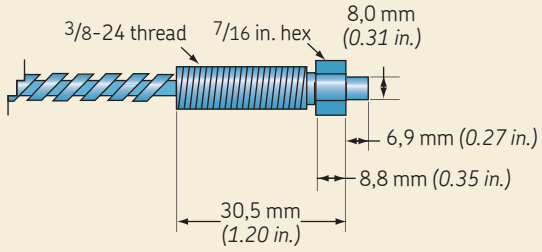
- Certification to ATEX Directive
  - Drivers: Ex II 1 G EEx ia IIC T4 (–20 ≤ T_a ≤ +75 °C) *(–5 ≤ T_a ≤ +165 °F)*; certificate number BAS02ATEX1168X
  - Probes: Ex II 1 G EEx ia IIC T4 or T2; certificate number BAS02ATEX1169
  - System: EEx ia IIC T4 or T2 (as per schedule); certificate number Ex 02E2170
- Intrinsic Safety requires use of Zener barriers; contact your local SKF sales representative for details

Note: See ordering details for probe and driver designations for hazardous area approved models.

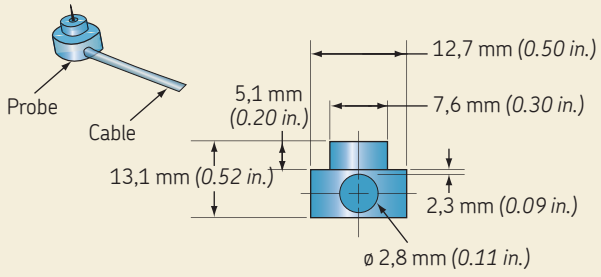
Standard mount case



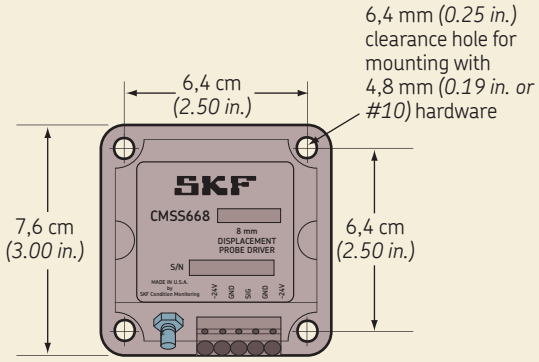
Reverse mount case

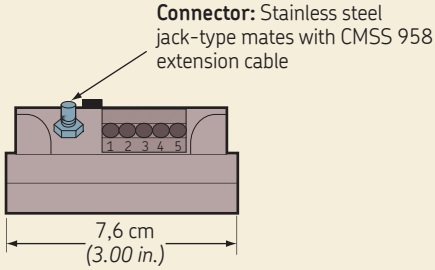


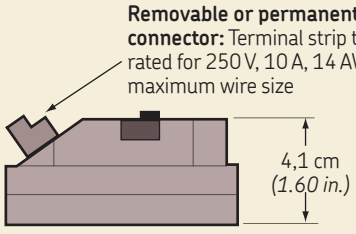
Button (disk) probe



CMSS 668 dimensions







Ordering information – Part 1: Eddy current probe

Ordering information

CMSS 68 eddy current probe.
(SKF standard: CMSS 68-000-00-12-10)

Part number **CMSS 68–aab-cc-dd-ee**

aa	**Cable**
00	Standard
01	Armored
02	Fiberglass sleeved
07	CSA/FM/SIRA (ATEX) (IS) certified
08	CSA/FM/SIRA (ATEX) (IS) certified and armored
09	FM (non-incendive)
0B	FM (non-incendive) armored
14	Standard for CMSS 668H-5 use
15	Armored for CMSS 668H-5 use
16	Fiberglass sleeved for CMSS 668H-5 use

b	**Case**
0	3/8-24 threads (standard)
1	M10 × 1 threads
4	No case
E	Button probe (Fiberglass)

cc	**Unthreaded case length**
00	Fully threaded
01 to 50	2,5 to 127,0 mm *(0.1 to 5.0 in.)* (unthreaded)
51 to 99	129,5 to 251,5 mm *(5.1 to 9.9 in.)*
RM	Reverse mount, 3/8-24 threads

dd	**Case length**
00	Standard: No case
08	Standard: 2,0 cm *(0.8 in.)*
12	Standard: 3,0 cm *(1.2 in.)*
15	Standard: 3,8 cm *(1.5 in.)*
20	Standard: 5,1 cm *(2.0 in.)*
25	Standard: 6,4 cm *(2.5 in.)*
30	Standard: 7,6 cm *(3.0 in.)*
40	Standard: 10,2 cm *(4.0 in.)*
47	Standard: 11,9 cm *(4.7 in.)*
60	Standard: 15,2 cm *(6.0 in.)*
90	Standard: 22,9 cm *(9.0 in.)*
09 to 59	Special: 2,3 to 15,0 cm *(0.9 to 5.9 in.)*
91 to 99	Special: 23,1 to 25,1 cm *(9.1 to 9.9 in.)*

ee	**Overall length***
05	0,5 m *(1.6 ft.)*
10	1,0 m *(3.3 ft.)* (standard)
5A	5,0 m *(16.4 ft.)*
AA	10,0 m *(32.8 ft.)*
FA	15,0 m *(49.2 ft.)*

* Length is nominal electrical; physical length may vary.

Compatible systems:

- 0,5 m probe / 5,0 m system: CMSS 958-xx-045 / CMSS 668
- 1,0 m probe / 5,0 m system: CMSS 958-xx-040 / CMSS 668
- 5,0 m probe / 5,0 m system: CMSS 668
- 10,0 m probe / 10,0 m system: CMSS 668
- 15,0 m probe / 15,0 m system: CMSS 668

The 5A, AA and FA units have an integral cable and mate directly to the driver.

Reverse mount case and button (disk) probe:

- Reverse mount case: **CMSS 68-aa0-RM-12-ee**
- Button (disk) probe: **CMSS 68-aaE-00-00-ee**

Ordering information – Part 2: Extension cable

Ordering information

CMSS 958 Extension cable.
(SKF standard CMSS 958-00-040)

Part number **CMSS 958–aa-bbb**

aa	**Cable**
00	Standard
01	Armored
02	Fiberglass sleeved
09	CSA/FM/SIRA (ATEX) (Intrinsically Safe) certified
0A	CSA/FM/SIRA (ATEX) (Intrinsically Safe) certified and armored
0H	FM (non-incendive)
0J	FM (non-incendive) armored
50	Standard for CMSS 668H-5 use
51	Armored for CMSS 668H-5 use
52	Fiberglass sleeved for CMSS 668H-5 use

bbb	**Length (compatible system listed)**
040	4,0 m *(13.1 ft.)* (CMSS 668, 1,0 m *(3.28 ft.)* CMSS 68)
045	4,5 m *(14.8 ft.)* (CMSS 668, 0,5 m *(1.64 ft.)* CMSS 68)
090	9,0 m *(29.5 ft.)* (CMSS 668-1, 1,0 m *(3.28 ft.)* CMSS 68)
095	9,5 m *(31.2 ft.)* (CMSS 668-1, 0,5 m *(1.64 ft.)* CMSS 68)
140	14,0 m *(45.9 ft.)* (CMSS 668-2, 1,0 m *(3.28 ft.)* CMSS 68)

Ordering information – Part 3: Driver (SKF standard: CMSS 668)

Drivers containing "P" in the model number denote those models with a permanent fixed connector.

Driver (5 m system) – CMSS 668 / CMSS 668P

7,87 mV/µm *(200 mV/mil)*. Use with:

- 1,0 m probe and 4,0 m extension cable
- 0,5 m probe and 4,5 m extension cable
- 5,0 m probe

Driver (10 m system) – CMSS 668-1 / CMSS 668P-1

Use with a 1 m probe and 9 m extension cable or a 10 m probe.

- Usable range: 2,3 mm (0,25 to 2,5 mm); *90 mils (10 to 100 mils)*
- Sensitivity: 7,87 mV/µm *(200 mV/mil)* ±10%
- Linearity: ±38 µm *(1.5 mil)* from best straight line

Driver (15 m system) – CMSS 668-2 / CMSS 668P-2

Use with a 1 m probe and 14 m extension cable or a 15 m probe.

- Usable range: 2,3 mm (0,25 to 2,5 mm); *90 mils (10 to 100 mils)*
- Sensitivity: 7,87 mV/µm *(200 mV/mil)* ±10% at 23 °C *(73 °F)*
- Linearity: ±38 µm *(1.5 mil)* from best straight line over 2,3 mm at 23 °C *(73 °F)*

Driver (extended range) – CMSS 668H-5 / CMSS 668HP-5

Use with a 1 m probe and 9 m extension cable or a 10 m probe.

- Usable range: 3,6 mm (0,4 to 4,0 mm); *145 mils (15 to 160 mils)*
- Sensitivity: 3,94 mV/µm *(100 mV/mil)* ±10% at +23 °C *(73 °F)*
- Linearity: ±25,4 µm *(1 mil)* from best straight line over 3,6 mm at 23 °C *(73 °F)*

Enhanced environmental protection – CMSS 668-8 / CMSS 668P-8

Specifications for an enhanced environmental protection driver are the same as for the standard driver; however, the enhanced environmental protection driver is also filled with potting material to provide an additional measure of protection when operated in adverse environmental conditions

- Sensitivity: 7,87 mV/µm *(200 mV/mil)*

Hazardous area approval (Intrinsic Safety) with 4140 stainless steel target – CMSS 668-16-9 / CMSS 668P-16-9

This driver is CSA/FM/SIRA (Intrinsically Safe) certified for a 5 m system. Use it with CSA/FM/SIRA (Intrinsically Safe) certified 1 m CMSS 68 probe and 4 m CMSS 958 extension cable. For intrinsic safety installations, drivers must be installed with intrinsic safety (I-S) barriers.

Barriers

- For FM approval:
  - Power: Stahl 8901/30-280/085/00
  - Signal: Stahl 8901/30-199/038/00
- For CSA and SIRA approval:
  - Power/Signal: MTL 7096 Dual (neg)

Contact your local SKF sales representative for details.

- Usable range: 1,6 mm (0,25 to 1,9 mm); *65 mils (10 to 75 mils)*
- Sensitivity: 7,87 mV/µm *(200 mV/mil)*
- Linearity: ±25,4 µm *(1 mil)* from best straight line over 1,15 mm *(45 mil)* range

CMSS 668-16-xx / CMSS 668P-16-xx*

These are CSA/FM/SIRA (Intrinsically Safe) certified drivers for a 5 m system calibrated for shaft materials other than standard 4140 stainless steel. Use this driver with CSA/FM/SIRA (Intrinsically Safe) certified 1 m CMSS 68 probe and 4 m CMSS 958 extension cable. For intrinsic safety installations, drivers must be installed with intrinsic safety (I-S) barriers (see *CMSS 668-16-9*).

- Usable range:
  - Best attainable for specific shaft material provided
  - Customer to provide identification of shaft material and sample (approximately 5,1 cm *(2.0 in.)* diameter disk, 1,3 cm *(0.5 in.)* thick)
  - Range not expected to exceed the 1,651 mm *(65 mils)* of standard unit
- Sensitivity: 7,87 mV/µm *(200 mV/mil)*, ± to be determined percentage of 7,87 mV/µm *(200 mV/mil)* dependent on the shaft sample material (–24 V DC supply)
- Linearity: ± the minimum deviation (in µm or mils) from the best straight line attainable for the sample shaft material provided

***** xx = System calibrated for shaft materials other than standard 4140 stainless steel. For custom configurations, please contact an SKF sales representative.

Hazardous area approval (non-incendive) with 4140 stainless steel target – CMSS 668-20-00 / CMSS 668P-20-00

This FM (non-incendive) certified driver for the 5 m system is used with the FM (non-incendive) certified 1 m CMSS 68 probe and CMSS 958 extension cable.

- Usable range: 2,3 mm (0,25 to 2,5 mm); *90 mils (10 to 100 mils)*
- Sensitivity: 7,87 mV/µm *(200 mV/mil)*
- Linearity: ±25,4 µm *(1 mil)* of best straight line over 2,3 mm *(90 mil)* range

Note: All circuit boards used in SKF CMSS 668 series drivers are conformal coated as standard procedure.

CMSS 62 / CMSS 620 series

19 mm eddy probe system

For long range (wide gap) measurements.

- 1,5 to 7,6 mm *(60 to 300 mils)* usable range at 1,96 V/mm *(50 mV/mil)* sensitivity
- 10,8 m *(35.4 ft.)* overall cable lengths
- Dependable eddy current operation
- Readily interchangeable on-site
- Durable, high-temperature probe tip
- Rugged, long life connectors

Introduction

The CMSS 62 eddy probe, when used with a CMSS 620-2 driver, has a usable range that is typically 1,5 to 7,6 mm *(60 to 300 mils)*. The standard output sensitivity of the system is 1,96 V/mm *(50 mV/mil)*.

The CMSS 62 packs a long range into a rugged industrial probe. It is used extensively in those applications involving large position measurement. Differential expansion measurement is an ideal application for the CMSS 62.

The CMSS 62 is available in several probe case configurations and environmental options to meet a wide range of installation requirements.

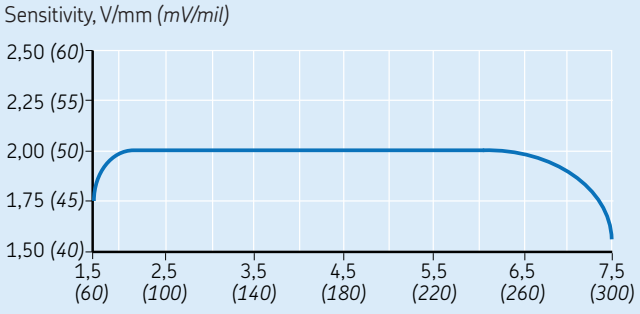
Specifications

The following specifications apply to a system including the CMSS 62 eddy probe, CMSS 620-2 driver and CMSS 900 extension cable.

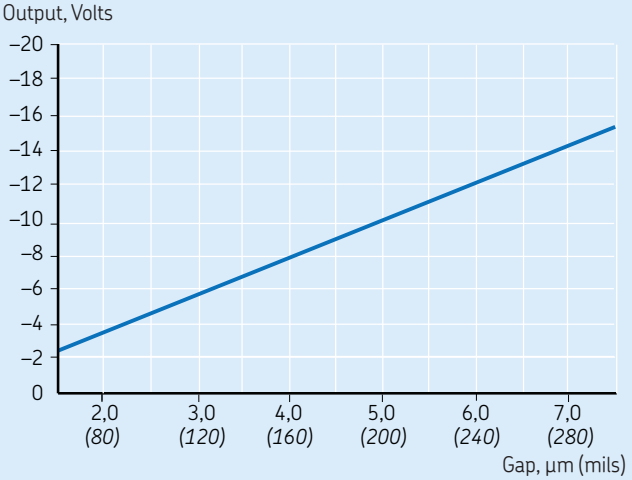
Electrical

- Usable range: 1,5 to 7,6 mm *(60 to 300 mils)*
- Sensitivity: 1,96 V/mm *(50 mV/mil)*, ±10% (–24 V DC supply) at 23 °C *(73 °F)*
- Linearity: ±2 mil of best straight line from 2 to 7 mm *(80 to 280 mils)* gap, ±10% of 1,96 V/mm *(50 mV/mil)* sensitivity from 2 to 7 mm *(80 to 280 mils)* absolute gap at 23 °C *(73 °F)*
- Frequency range: Static to 600 000 CPM; down to 3 dB at 600 000 CPM
- Driver signal output:
  - Impedance: 30 Ω
  - Current: 4 mA maximum
  - Voltage:
    - Nominal: 1,96 V/mm *(50 mV/mil)*
    - Maximum output: –19 V with –24 V supply
- Power: –24 V DC

Typical CMSS 62 / CMSS 620-2 performance: sensitivity vs. gap



Typical CMSS 62 / CMSS 620-2 performance: output vs. gap



Note: Performance specifications are based on a 4140 steel target. Consult an SKF sales representative for calibration requirements on other materials.

CMSS 620-2 driver

- Operating temperature range: –35 to +65 °C *(–30 to +150 °F)*
- Calibration probe temperature: 23 °C *(73°F)*
- Connections (power, output, common): Three terminal barrier strip (accepts 3,5 mm *(0.14 in. or #6)* spade lugs)
- Mounting holes: Four 4,8 mm *(0.19 in. or #10)* clearance holes in a square on 63 mm *(2.5 in.)* centers
- Interchangeability:
  - Probes and drivers may be interchanged with 10% or less performance change without calibration
  - All units factory calibrated
  - Trim calibration adjustment on driver allows duplication of replacement

Environmental and mechanical

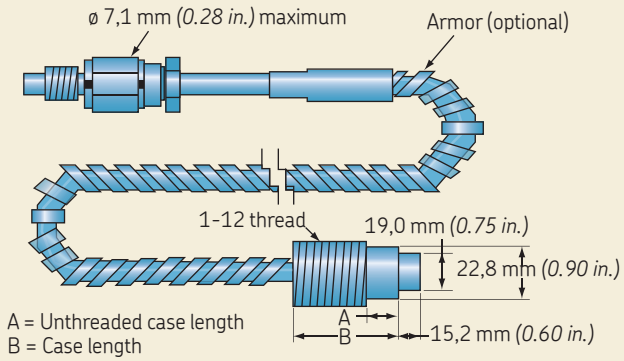
CMSS 62 probe

- Operating temperature range: –35 to +175 °C *(–30 to +350 °F)*
- Case material: Grade 300 stainless steel
- Connections: Stainless steel; weather-proof, sealable
- Cable: Coaxial with fluorine based polymer insulation; high tensile and flexural strength
- Mounting: Any position

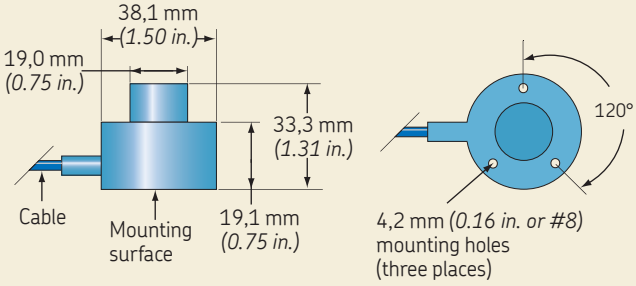
CMSS 900 extension cable

- Operating temperature range: –35 to +120 °C *(–30 to +250 °F)*
- Connections: Stainless steel; weather-proof, sealable
- Cable: Coaxial with fluorine based polymer insulation; high tensile and flexural strength

Standard mount case



Button (disk) probe



Ordering information – Part 1: Eddy current probe

Ordering information

CMSS 62 eddy current probe.
(SKF standard: CMSS 62-000-00-30-20)

Part number **CMSS 62–abc-dd-ee-ff**

a **Calibration temperature**
0 25 °C *(75 °F)*; operation < 95°C *(200 °F)* (use CMSS 620-2 driver)

b **Cable**
0 Standard
1 Radiation-resistant
4 Armored
5 Armored and radiation-resistant
8 Fiberglass sleeved
9 Radiation-resistant, fiberglass sleeved

c **Case**
0 1-12 2A threads (standard)
4 No case
5 Button (disk) probe
6 RIght angle cable exit 1-12 2A threads

dd **Unthreaded case length**
00 Fully threaded
01 to 50 2,5 to 127,0 mm *(0.1 to 5.0 in.)* (unthreaded)

ee **Case length**
00 Standard: No case
10 Standard: 2,5 cm *(1.0 in.)*
15 Standard: 3,8 cm *(1.5 in.)*
30 Standard: 7,6 cm *(3.0 in.)*
35 Standard: 8,9 cm *(3.5 in.)*
50 Standard: 12,7 cm *(5.0 in.)*

ff **Overall length**
10 1,0 m *(3.3 ft.)*
20 2,0 m *(6.6 ft.)* (standard)
40 4,0 m *(13.1 ft.)*

Button (disk) probe:

- **CMSS 62-ab5-00-00-ff**

Ordering information – Part 2: Extension cable

Ordering information

CMSS 900 Extension cable.
(SKF standard CMSS 900-00-088)

Part number **CMSS 900–ab-ccc**

a **Cable**
0 Standard
1 Armored
2 Radiation-resistant
3 Armored and radiation-resistant
4 Fiberglass sleeved
5 Fiberglass sleeved and radiation-resistant

b **Connectors**
0 Both straight
1 One right angle
2 Both right angle

ccc **Length***
068 6,8 m *(22.3 ft.)*: use with 4,0 m *(13.1 ft.)* probe and CMSS 620-2 driver
088 8,8 m *(28.9 ft.)*: use with 2,0 m *(6.6 ft.)* probe and CMSS 620-2 driver
098 9,8 m *(32.2 ft.)*: use with 1,0 m *(3.3 ft.)* probe and CMSS 620-2 driver

Note: Radiation-resistant probes must use radiation-resistant extension cables and driver.

* Probe overall lengths and extension cable lengths are nominal and will vary to meet electrical interchangeability requirements. Contact your local SKF sales representative for unlisted options.

Ordering information – Part 3: Driver (SKF standard: CMSS 620-2; radiation-resistant CMSS 620-6)

Use with:

- 1,0 m *(3.3 ft.)* probe and 9,8 m *(32.2 ft.)* extension cable
- 2,0 m *(6.6 ft.)* probe and 8,8 m *(28.9 ft.)* extension cable
- 4,0 m *(13.1 ft.)* probe and 6,8 m *(22.3 ft.)* extension cable

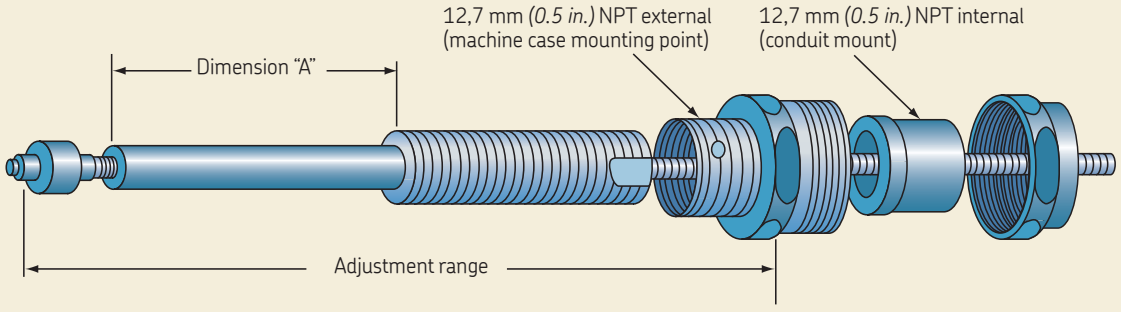
Eddy current probe installation accessories

CMSS 904

Probe holder

The CMSS 904 probe holder provides a rigid mount with provision for external gap adjustment. Conduit may be readily mounted at the cable exit. The CMSS 904 provides 19,1 mm *(0.75 in.)* of adjustment range after installation; a set screw securely locks the adjustment. It is recommended that probes be ordered with a case length of 30,5 mm *(1.2 in.)* or use the standard reverse mount probe.

Dimensions



***By trimming the stinger, the working range of the long CMSS 904 is 10,2 to 19,7 cm* (4.00 to 7.75 in.) *from mounting surface to probe tip (combination of stinger length and adjustment inside threaded stock); the range of the short CMSS 904 is 6,4 to 12,1 cm* (2.50 to 4.75 in.).**

Ordering information

CMSS 904 Probe holder.

Part number	**CMSS 904–ab-ccc**
a	**Probe thread**
0	3/8-24 CMSS 65 / CMSS 68 reverse mount standard*
b	**Other options**
0	None required
ccc	**Dimension "A" "stinger" depth**
025	Short: 19,1 to 63,5 mm *(0.75 to 2.5 in.)***
055	Long: 36,8 to 139,7 mm *(1.45 to 5.50 in.)***

* CMSS 65 / CMSS 68 3/8-24 reverse mount eddy probe is recommended configuration offered in either 5 or 8 mm versions.

** "Stingers" may be cut down in the field within the indicated ranges.

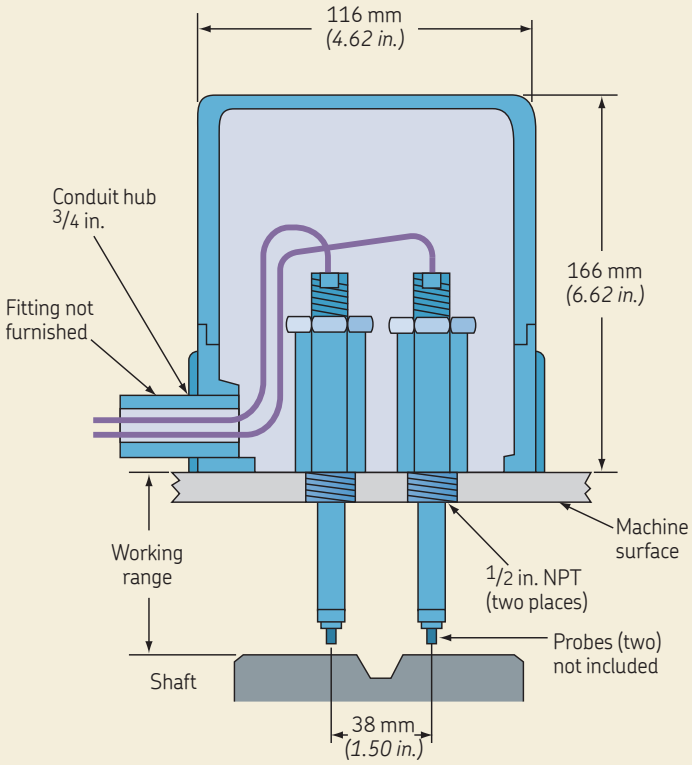
CMSS 912

Dual axial probe adapter

The CMSS 912 dual axial probe adapter provides mounting and protection for two parallel probes for measuring axial thrust position. The probes are mounted on adapters that are installed directly on the machine case through 1/2 in. NPT-threaded holes. The adapters provide for easy gapping of the probes. The enclosure bolts directly to the machine case and protects the probe installation. A removable cover provides access to the installed probe.

It is recommended that probes be ordered with a case length of 30,5 mm *(1.2 in.)* and an overall length of 0,5 or 1,0 m *(1.6 or 3.3 ft.)*.

Dimensions



Ordering information

CMSS 912-1 Dual axial probe adapter. Working range* 27,9 to 56,7 mm *(1.10 to 2.35 in.)*; probe thread 1/4-28 CMSS 65 standard.
CMSS 912-3 Dual axial probe adapter. Working range* 19,1 to 50,8 mm *(0.75 to 2.00 in.)*; probe thread 3/8-24 CMSS 68 standard.
CMSS 912-4 Dual axial probe adapter. Working range* 24,1 to 127,0 mm *(0.95 to 5.00 in.)*; probe thread 3/8-24 CMSS 68 standard.

* Working range with field trim of probe holder.

CMSS 911

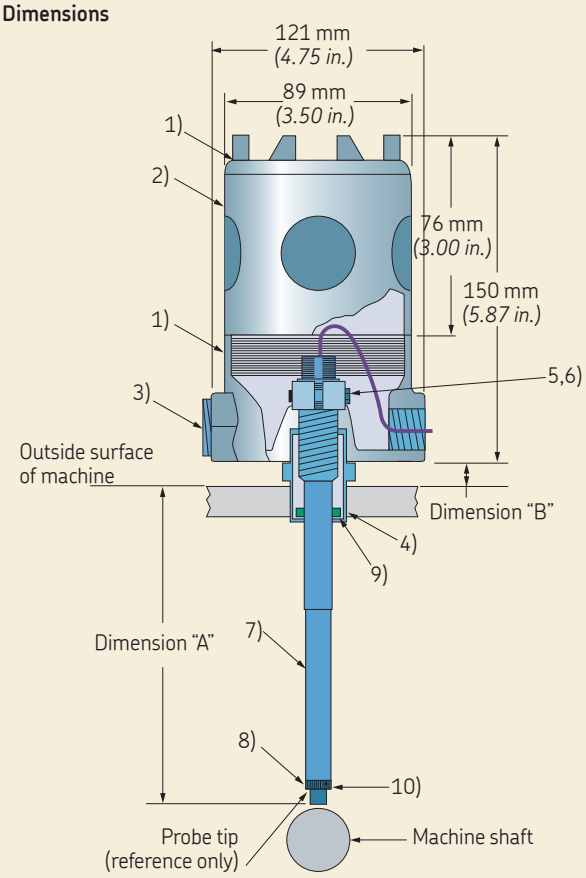
Probe holder / dual sensor holder with housing

CMSS 911 probe holder

The CMSS 911 probe holder with housing offers an adjustable probe mount with a variety of penetration depths. The integral housing protects the probe cable exit and permits easy access for probe adjustment without machine disassembly. It is recommended that reverse mount probes be used or that standard case probes be ordered with a case length of 30,5 mm *(1.2 in.)* and an overall cable length of 0,5 or 1,0 m *(1.6 or 3.3 ft.)*. The housing has four 3/4 in. NPT hubs for conduit attachment (three close-up plugs provided).

1 Outlet body **(part number 10699400) GRR-2**
2 Outlet body extension **(part number 10699300) GRCEX-0**
3 Outlet body hub, 3/4 in. NPT (four each)
4 Probe adapter union; 3/4 in. NPT **(part number 30180900)**
5 Probe adapter collar **(part number 30187900)**
6 Hex head steel cap screw **(part number 10702200)**
7 Probe holder ("stinger") **(part number – various, depending on probe holder length)**
8 Jam nut:
– CMSS 68, CMSS 60: 3/8–24 **(part number 30126800)**
– CMSS 65, CMSS 61: 1/4–28 **(part number 30053500)**
9 O-ring union seal **(part number 10711803)**
10 O-ring tip seal **(part number 10711800)**

Dimensions



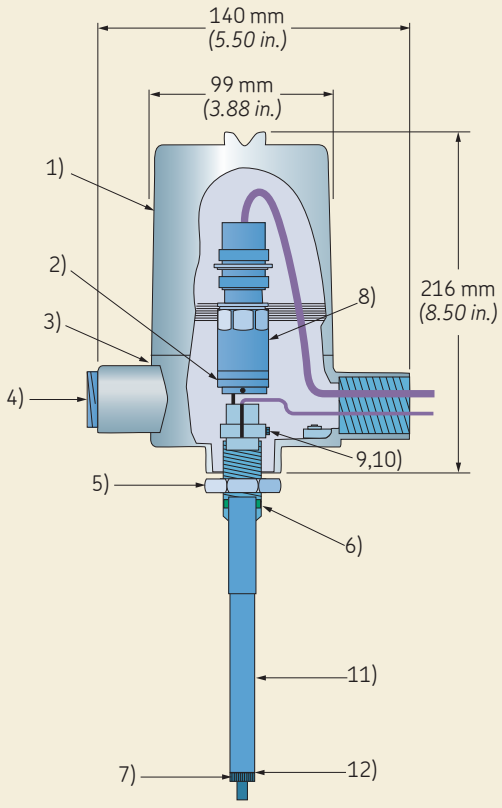
CMSS 911 dual sensor holder

The CMSS 911 dual sensor holder with or without the housing provides for the mounting, adjustment and protection of the eddy probe and also provides for mounting an accelerometer or velocity sensor on the same axis as the eddy probe for absolute vibration measurements. It is recommended that reverse mount probes be used or that standard case probes be ordered with a case length of 30,5 mm *(1.2 in.)* and an overall cable length of 0,5 or 1,0 m *(1.6 or 3.3 ft.)*. The housing has four 3/4 in. NPT hubs for conduit attachment (three close-up plugs provided).

1 Outlet dome **(part number 10699402) 4GOU**
2 Seismic sensor mounting adapter **(part number 301194200)**
3 Outlet body **(part number 10699401) GECXAT-2**
4 End plug **(part number 10746003) CUP-2**
5 Probe adapter union **(part number 30180900)**
6 O-ring union seal **(part number 10711803)**
7 Jam Nut:
- CMSS 68, CMSS 60: 3/8–24 **(part number 30126800)**
- CMSS 65, CMSS 61: 1/4–28 **(part number 30053500)**

8 Seismic sensor accelerometer/velocity
9 Probe adapter collar **(part number 30187900)**
10 Hex head steel cap screw **(part number 10702200)**
11 Probe holder (“stinger”) **(part number – various, depending on length)**
12 O-ring tip seal **(part number 10711800)**

Dimensions

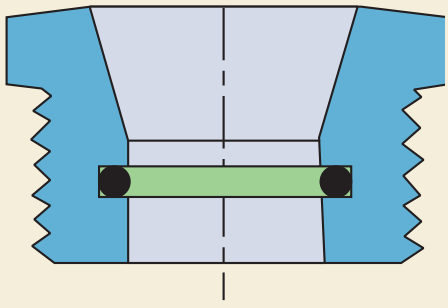


Intermediate support / oil seal

Intermediate support / oil seals are recommended for use with probe holders 203 mm *(8 in.)* or longer in length. They provide support and aid in eliminating/minimizing probe holder resonances causing inaccurate probe measurements. These are for use with probe holders with model numbers CMSS 911-0xx-xxx only.

- Part number CMSS 31194501 (1-12 threads).
- Part number CMSS 31194500 (3/4 in. NPT threads).

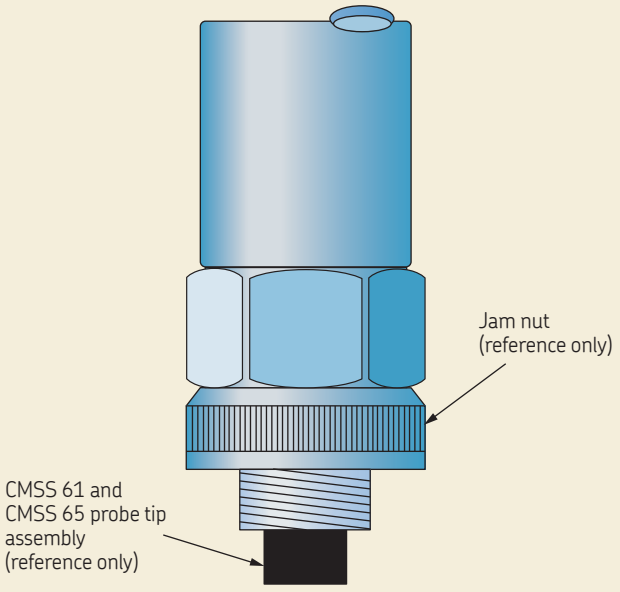
Intermediate support / oil seal



Probe adapter

Part number 30221900 probe adapter 3/8-24 to 1/4-28 is used when installing CMSS 61 and CMSS 65 probes in a probe holder with 3/8-24 threads.

Probe adapter



Ordering information

CMSS 911 Probe holder / dual sensor holder with housing.

Part number **CMSS 911–abc-ddd**

a	**Probe thread**[1]
0	3/8-24 CMSS 65 / CMSS 68 reverse mount standard[2]
1	1/4-28 CMSS 65 standard[3,4]
2	M10 × 1 CMSS 65 and CMSS 68 reverse mount with M10 × 1 case[5]
b	**Dimension "B" adapter length**
0	12,7 mm *(0.5 in.)* (standard)
1	63,5 mm *(2.5 in.)*[2,6]
2	88,9 mm *(3.5 in.)*[7]
3	38,1 mm *(1.5 in.)*[8]
4	177,8 mm *(7.0 in.)*[9]
c	**Other options**
0	None required
1	Probe holder without housing
6	Dual sensor with housing
7	Dual sensor without housing
ddd	**Dimension "A" penetration depth**[10]
	Standard lengths:[11]
020	Short: 25,4 to 50,8 mm *(1.0 to 2.0 in.)*
050	Long: 50,8 to 127,0 mm *(2.0 to 5.0 in.)*
	Non-standard lengths:[10]
060	15,2 cm *(6 in.)*
070	17,8 cm *(7 in.)*
080	20,3 cm *(8 in.)*
090	22,9 cm *(9 in.)*
100	25,4 cm (10 in.)
110	27,9 cm *(11 in.)*
120	30,5 cm *(12 in.)*
130	33,0 cm *(13 in.)*
140	35,6 cm *(14 in.)*
150	38,1 cm *(15 in.)*
160	40,6 cm *(16 in.)*
170	43,2 cm *(17 in.)*

Note: Customers are strongly encouraged to use the CMSS 65 / CMSS 68 reverse mount eddy probe options when mounting probes in CMSS 911 holders.

Note: With the ±17,8 mm *(0.07 in.)* adjustment, these length stingers should meet all length requirements without trimming or cutting to interim custom lengths (e.g., 9.3 in., 10.7 in., etc.).

1 Probe adapter 1/4–28 to 3/8–24 threads, part number 30221900 is required and must be ordered separately when using CMSS 65 / CMSS 61 standard eddy current probes with the larger diameter stingers.
2 This option does not require removal of connector of probe cable during field assembly. CMSS 65 / CMSS 68 3/8–24 reverse mount eddy probe is recommended configuration offered in either 5 or 8 mm versions.
3 This option size stinger only available in the standard 020 and 050 lengths.
4 Eddy probe connector must be removed and reinstalled when using this size threaded stinger.
5 This option provides stingers with M10 × 1 probe threads and can be used with CMSS 65 and CMSS 68 reverse mount probes with M10 × 1 thread cases.
6 Dimension A penetration depth will be 50,8 mm *(2.0 in.)* less than indicated.
7 Dimension A penetration depth will be 76,2 mm *(3.0 in.)* less than indicated.
8 Dimension A penetration depth will be 25,4 mm *(1.0 in.)* less than indicated.
9 Dimension A penetration depth will be 16,5 cm *(6.5 in.)* less than indicated.
10 Indicated depth is center of ±17,8 mm *(0.7 in.)* adjustment range for standard CMSS 911 units. Indicated depth is ±12,7 mm *(0.5 in.)* adjustment range for dual sensor units. API 670 recommends maximum of 20,3 cm *(8 in.)* of free cantilevered length. Use intermediate support / oil seal for longer lengths.
11 Center of adjustment depth may be field cut within the indicated range.

CMSS 920

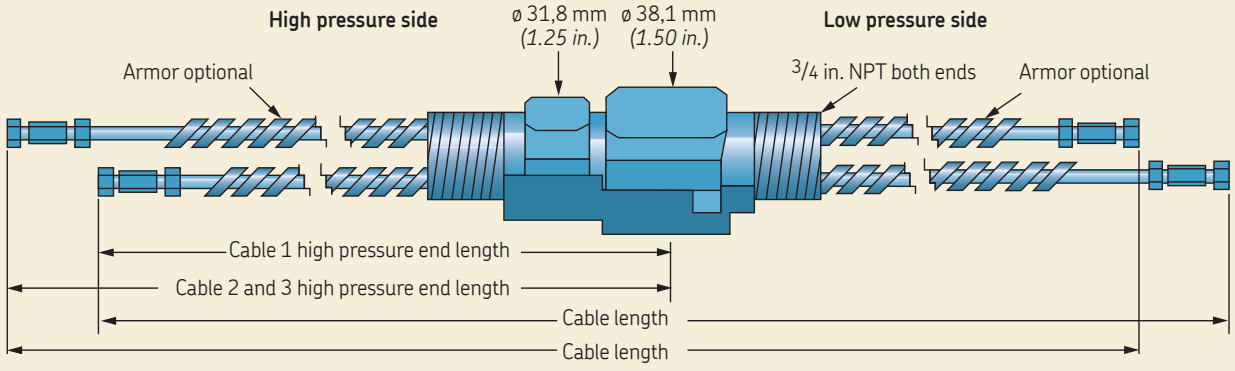
High pressure feedthrough

Introduction

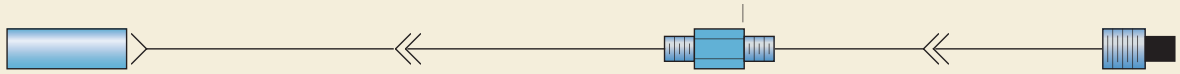
The CMSS 920 is a low cost, general purpose, high pressure feedthrough. The CMSS 920 is principally used to provide a cable exit for internally mounted eddy probes in high pressure areas. The unit is available in configurations for one, two or three cables and the cable lengths on the high pressure and low pressure side may be specified as required to meet particular eddy probe system configurations. The internal modular construction allows configuration to the customer's specifications.

The CMSS 920's bidirectional pressure rating of 2 000 psi enables the unit to withstand both pressure and vacuum, a critical requirement for refrigeration units that are dehumidified under vacuum and pressurized in normal operation. The 3/4 in. NPT mounting threads on either end enable the CMSS 920 to be installed in a smaller hole. An optional 1 in. NPT thread adapter is available and may replace other high pressure feedthroughs with the CMSS 920.

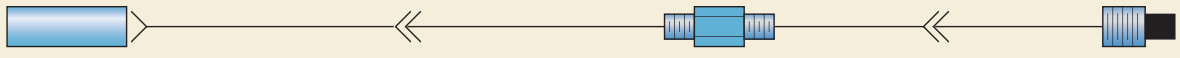
Dimensions



Compatible CMSS 920 systems



5 m systems:	CMSS 665 CMSS 668	CMSS 958-00-030 (3,0 m)	CMSS 920-x0xx-10xxxx-010 (1,0 m)	CMSS 65-00x-xx-xx-010 (1,0 m) CMSS 68-00x-xx-xx-010 (1,0 m)
10 m systems:	CMSS 668-1	CMSS 958-00-080 (8,0 m)	CMSS 920-x0xx-10xxxx-010 (1,0 m)	CMSS 65-00x-xx-xx-010 (1,0 m) CMSS 68-00x-xx-xx-010 (1,0 m)
15 m systems:	CMSS 668-2	CMSS 958-00-130 (13,0 m)	CMSS 920-x0xx-10xxxx-010 (1,0 m)	CMSS 68-00x-xx-xx-010 (1,0 m)



Driver	Feedthrough	Eddy probe
CMSS 665 CMSS 668	CMSS 920-x0xx-45xxxx-000 (4,5 m)	CMSS 65-00x-xx-xx-05 (0,5 m) CMSS 68-00x-xx-xx-05 (0,5 m)

Specifications

Physical

- Case material: Grade 303 stainless steel
- Mounting: Any position, 3/4 in. NPT threads
- Cable length of high pressure end: Increments of 0,1 m *(3.9 in.)*; recommend minimum of 0,2 m *(7.9 in.)*
- Cable quantity: One, two or three cables
- Cable armor: Available
- Customer ID: 38,1 mm *(1.5 in.)* clear heat-shrink
- Torque: 81 to 108 Nm *(60 to 80 ft. lbs.)*

Dynamic

- Pressure/Vacuum: 0 to 2 000 psi bidirectional
- Electrical cable length: As required to meet eddy probe system configuration

Environmental

- Operating temperature range: –35 to +120 °C *(–30 to +250 °F)*

Ordering information

CMSS 920 High pressure feedthrough.
(SKF standard: CMSS 920-1000-100500-010)

Part number **CMSS 920–abcd-eeffgg-hij**

a **Cable quantity**
1 One cable
2 Two cables
3 Three cables

b **Environment**
0 Standard

c **Armor**
0 No armor
1 High pressure end armor
2 Low pressure end armor
3 Both ends armor

d **Case**
0 Stainless steel
1 3/4 to 1 in. thread adapter

ee **Cable length (for CMSS 65 and CMSS 68)***
10 1,0 m *(3.3 ft.)*
40 4,0 m *(13.1 ft.)*
45 4,5 m *(14.8 ft.)*

ff **Cable 1 high pressure end length**
XX Increments of 0,1 m *(3.9 in.)*, minimum 0,2 m *(7.9 in.)*; for example, 25 = 2,5 m *(8.2 ft.)*
00 Cable not used

gg **Cables 2 and 3 high pressure end length**
XX Increments of 0,1 m *(3.9 in.)*, minimum 0,2 m *(7.9 in.)*
00 Cable not used

h **High pressure end connector**
i **Low pressure end connector**
j **Other options**
0 Female (probe or driver mate)
1 Male (CMSS 958 extension cable mate)
3 No connector

* Use the configuration illustrations to determine length and compatible system.

Note: When ordering, customers are requested to provide information to define the eddy probe system; this item will be used to facilitate calibration.

Mounting devices, adapters and packing glands

The basic design and construction of the eddy probes ensures long, dependable service life. However, proper installation is essential; once adjusted to its optimum position, a probe must be absolutely immovable.

Standardized installation devices are offered for this specific purpose. They eliminate the chore of making special brackets or fixtures for each installation. They also help ensure that every eddy probe from SKF will continue to deliver all the accuracy built into it, year after year.

CMSS 903 series

Mounting brackets

CMSS 903 mounting brackets are used in those installations requiring probe mounting in the machine's internal area.

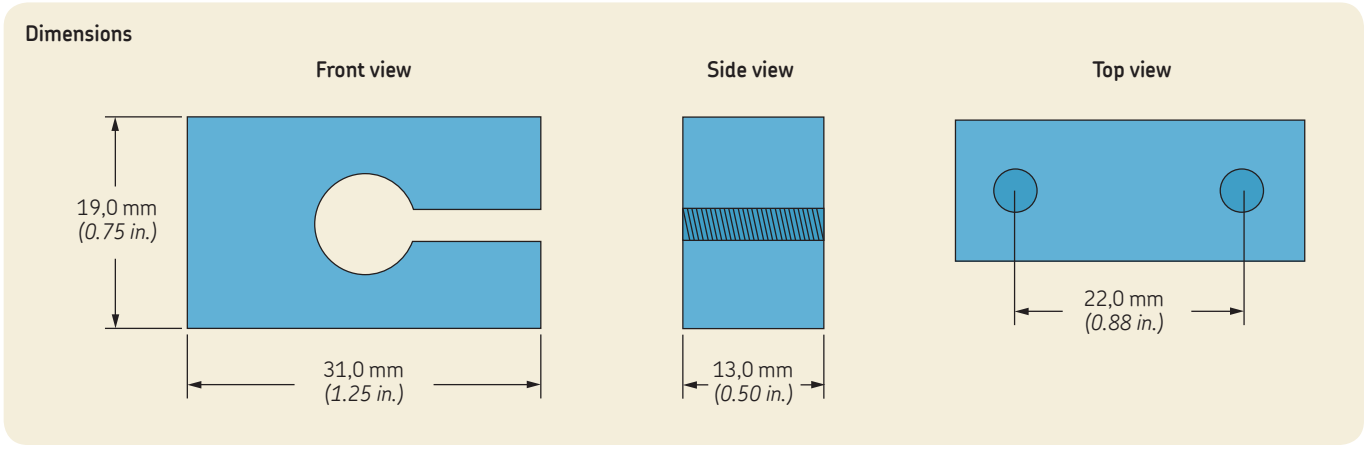
CMSS 903-1 probe holders, made of anodized aluminum, are used to install CMSS 68 series eddy probes on flat machine surfaces. Threaded (3/8-24) and slotted, they ensure a firm grip on the probe, once it is adjusted to final operating position. Two mounting holes accommodate 4,8 mm *(0.19 in. or #10)* high tensile Allen head cap screws (not provided), which are normally secured with safety wires.

CMSS 903-2 probe holders, made of stainless steel, are used for installing CMSS 65 series eddy probes on flat machine surfaces when space is at a premium. They are threaded (1/4-28) and slotted to ensure a firm grip after final adjustment. Mounting holes accommodate two 3,5 mm *(0.14 in. or #6)* high tensile Allen head cap screws with safety wire holes (not provided).

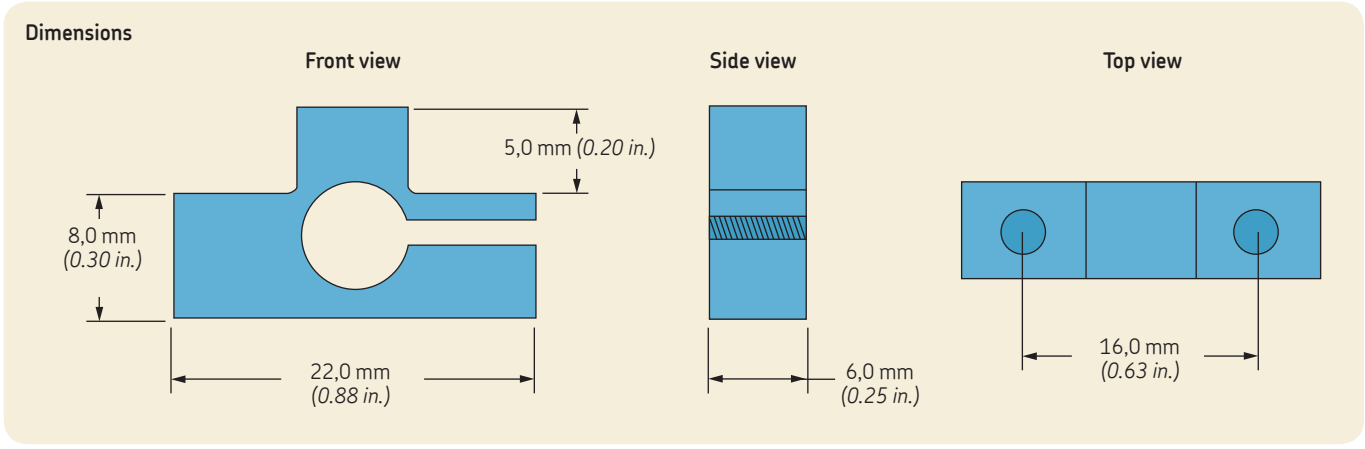
CMSS 903-3 probe holders, made of anodized aluminum, are similar to the CMSS 903-1, but are designed to hold CMSS 65 series eddy probes and, in addition, permit final adjustment where it is not possible to turn the probe itself. This is especially convenient for installation of probes with armored or otherwise protected leads.

The probe is threaded into a sleeve, which mates with a left-hand thread in the main body of the holder. Turning the sleeve then sets the probe position; it is not necessary to turn the probe itself. Both holder and sleeve are slotted to ensure a firm grip on the probe. Mounting holes accommodate two 4,8 mm *(0.19 in. or #10)* high tensile Allen head cap screws with safety wire holes (not provided).

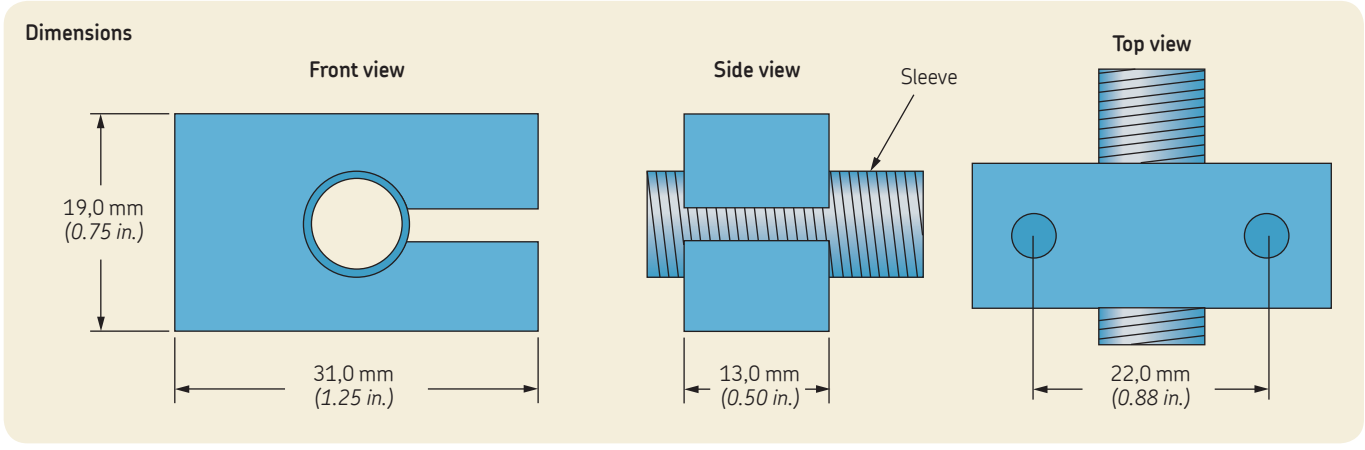
(From left to right) CMSS 903 series probe adapters: CMSS 903-1 probe holder; CMSS 903-3 probe holder; CMSS 903-2 probe holder.



CMSS 903-1 mounts CMSS 68 series probes (3/8–24 case).



CMSS 903-2 mounts CMSS 65 series probes (1/4–28 case).



CMSS 903-3 mounts CMSS 65 series probes (1/4–28 case).

CMSS 30112000 series

Cable packing gland assembly

The CMSS 30112000 series cable packing gland assembly offers a splash-proof cable exit from the machine case. They are available in one or two cable exit versions and with either a 1/2 in. or 3/4 in. NPT male thread for screwing into the machine housing. It is an effective and easily installed low pressure (0,41 MPa; 60 psi) seal. The internal oil-resistant neoprene packing, as well as washers, are split to allow cable installation without connector removal.

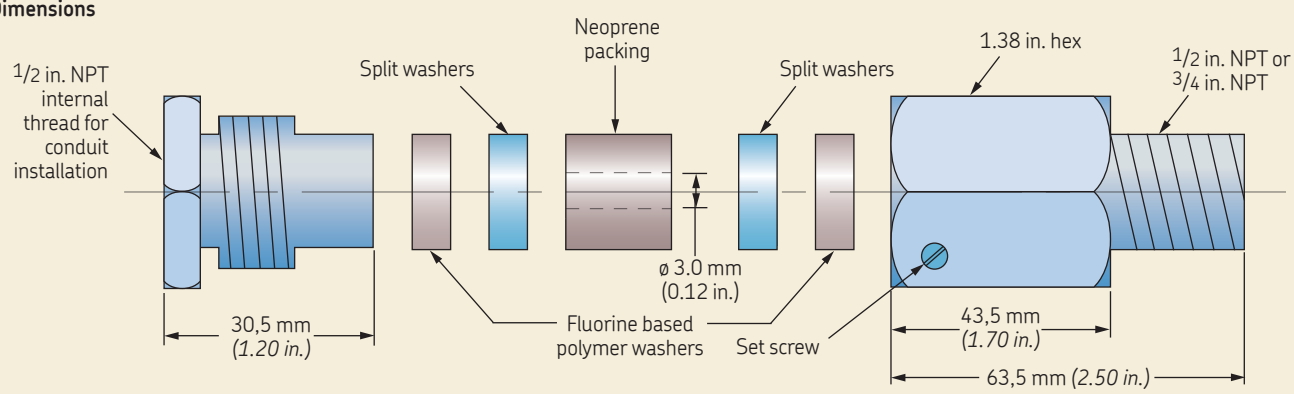
The cable packing glands are typically used for exiting the eddy probe cable or extension cable for internally installed eddy probes. The cable packing gland will not provide a seal for armored cables.

Ordering information

CMSS 30112000 Single cable packing gland with 1/2 in. NPT fitting for cables of 0.125 in. or 0.257 in. diameter.
CMSS 30112000-SPAREKIT Replacement packing elements for rebuild/reuse of the associated housing.
CMSS 30112001 Two cable packing gland with 1/2 in. NPT fitting for cables of 0.125 in. diameter.
CMSS 30112001-SPAREKIT Replacement packing elements for rebuild/reuse of the associated housing.
CMSS 30112003 Single cable packing gland with 3/4 in. NPT fitting for cables of 0.125 in. or 0.257 in. diameter.
CMSS 30112004 Two cable packing gland with 3/4 in. NPT fitting for cables of 0.125 in. diameter.
CMSS 30112006* Two cable packing gland with 1/2 in. NPT fitting for cables of 0.125 in. and 0.200 in. diameter each.
CMSS 30112006-SPAREKIT Replacement packing elements for rebuild/reuse of the associated housing.

* The CMSS 30112006 and 30112007 models have split washers that can accommodate an eddy probe cable and an accelerometer / velocity transducer cable for internal installations of absolute vibration transducers.

Dimensions

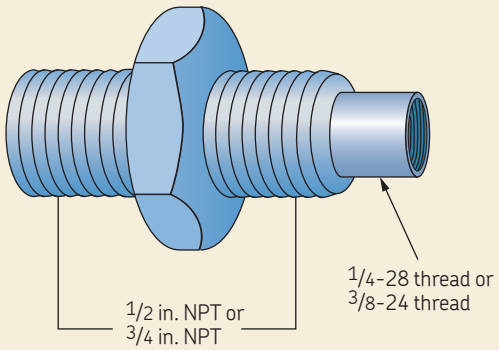


CMSS 30837800

1/2 or 3/4 in. NPT probe adapter

The probe adapter is used to mount a probe with a 1/4-28 or 3/8-24 thread in a machine case that will accept the 1/2 or 3/4 in. NPT fitting. Conduit or a junction box may be mounted on the exterior side of the adapter.

Dimensions



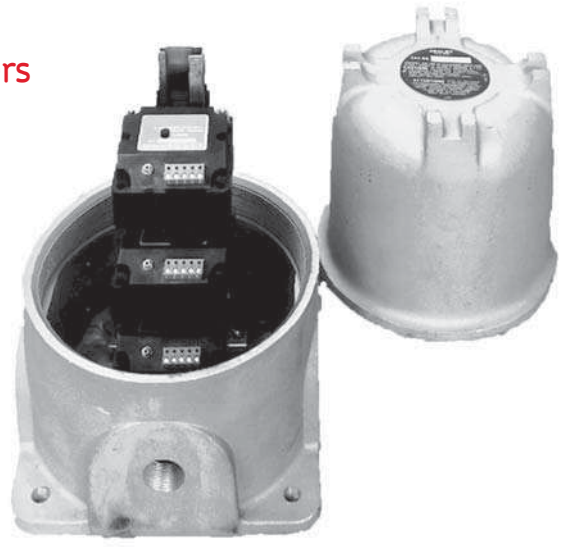
Ordering information

CMSS 30837800 3/8-24 internal thread for CMSS 68 style probes; 1/2 in. NPT external thread.
CMSS 30837801 1/4-28 internal thread for CMSS 65 style probes; 1/2 in. NPT external thread.
CMSS 30837802 3/8-24 internal thread for CMSS 68 style probes; 3/4 in. NPT external thread.
CMSS 30837803 1/4-28 internal thread for CMSS 65 style probes; 3/4 in. NPT external thread.

Drivers: explosion-proof and weather-proof housings

CMSS 31091700

Explosion-proof housings for DIN-rail mount drivers



Explosion-proof housings

Explosion-proof and dust-tight housings:

- Class I, Groups C and D
- Class II, Groups E, F and G
- Class III, UL standard 886
- CSA standard C22.2, number 30 1970

The explosion-proof housing is designed for use in environments classified as hazardous. The housing is manufactured of aluminum alloy with a copper content less than 0,3% maximum. On three sides the bosses are drilled and tapped for 3/4 in. NPT conduit fittings. The dome type housing is specified requiring a minimum of floor space for fixture mounting.

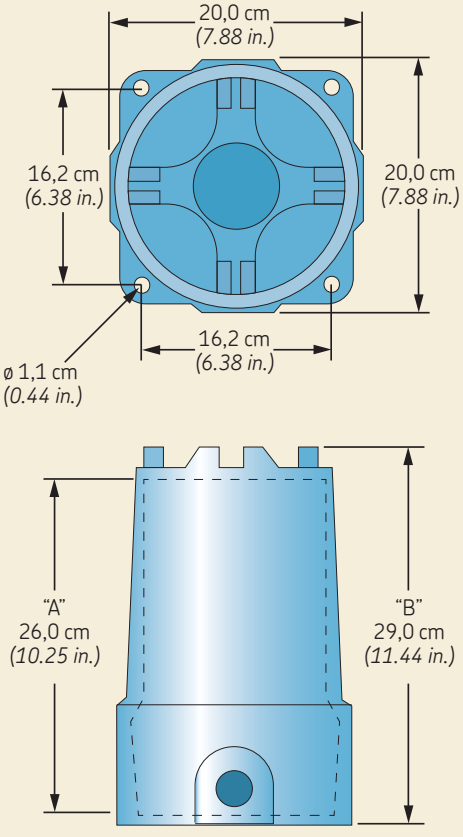
Specifications

- Dimension "A" inside dome: 26,0 cm *(10.25 in.)*
- Dimension "B" overall height: 29,0 cm *(11.44 in.)*
- Diameter cover opening: 17,5 cm *(6.88 in.)*
- Mounting hole size: 1,1 cm *(0.44 in.)*
- Weight: 6,5 kg *(15 lb.)*

The units come with all hardware ready for assembly and installing the drivers.

Note: Please refer to reference information in the back of this catalog for definitions, standards and cross references.

Dimensions



Ordering information

CMSS 31091700 Explosion-proof housing for Ryton DIN-rail mount drivers, for a maximum of four drivers.

Weather-proof housings

Weather-proof housing (NEMA 4 and 4X)

- Meets requirements for NEMA Type 4, Type 4X, Type 12 and Type 13
- UL 508 Type 4 and Type 4X
- CSA Type 4
- IEC 529, IP66 (European Standard)

Weather-proof housings for protection from adverse environmental conditions

The SKF Condition Monitoring product line offers three types of housings to provide protection from adverse environmental conditions for DIN-rail mountable eddy probe drivers.

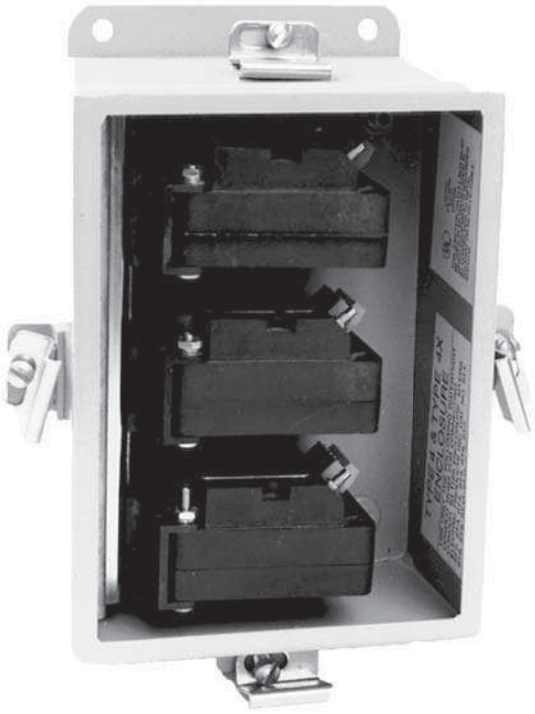
Water-resistant housing

Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water and hose-directed water; undamaged by the formation of ice on the enclosure. The housings are constructed of 14 or 16 gauge steel with seams continuously welded. ***Holes and cable clamp fittings are provided.*** The cover is held in place by steel clamps on four sides of the cover to assure water tight integrity. There is an oil-resistant gasket held in place with oil-resistant adhesive. The finish is ANSI 61 gray polyester powder coating. This housing meets NEMA 4 criteria.

Water- and corrosion-resistant housing (stainless steel)

This housing meets the same criteria as the water-resistant housing in addition to being manufactured of stainless steel to meet the corrosion-resistant criteria. The finish is unpainted polished surface. This housing meets NEMA 4X criteria.

Note: Please refer to reference information in the back of this catalog for definitions, standards and cross references.



Ordering information

Weather-proof housings for Ryton DIN-rail mount drivers.

CMSS 31092100* Weather-proof housing for maximum three drivers.
CMSS 31092200* Weather-proof housing for maximum six drivers.
CMSS 31092300* Weather-proof housing for maximum ten drivers.
- **Area classification – (clamp cover)**
  - NEMA/EEMAC Type 4, Type 12 and Type 13
  - UL50 Type 4, Type 12, Type 13
  - UL508 Type 4, Type 12, Type 13
  - CSA Type 4
  - IEC 529, IP66

CMSS 31092101* Weather-proof housing for maximum three drivers.
CMSS 31092201* Weather-proof housing for maximum six drivers.
CMSS 31092301* Weather-proof housing for maximum ten drivers.
- **Area classification – (stainless steel, clamp cover)**
  - NEMA/EEMAC Type 4, Type 4X, Type 12 and Type 13
  - UL50 Type 4, Type 4X
  - UL508 Type 4, Type 4X
  - CSA Type 4, Type 4X
  - IEC 529, IP66

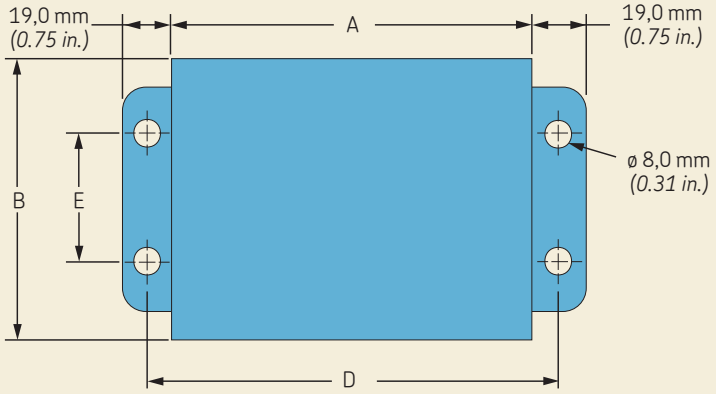
CMSS 31092103* Weather-proof housing for maximum three drivers.
CMSS 31092203* Weather-proof housing for maximum six drivers.
CMSS 31092303* Weather-proof housing for maximum ten drivers.
- **Area classification – (stainless steel, continuous hinge on one side, clamps on other three sides of cover)**
  - NEMA/EEMAC Type 4, Type 4X, Type 12 and Type 13
  - UL50 Type 4, Type 4X
  - UL508 Type 4, Type 4X
  - CSA Type 4, Type 4X
  - IEC 529, IP66

* If it is desired to order a housing with "no holes", then add "–NH" to the right of the model number, e.g., CMSS 31092100-NH.

Weather-proof housing dimensions

Note: Due to changes in housing manufacturer specifications, cover clamps may be located in positions other than depicted in these drawings.

Dimensions



Dimensions

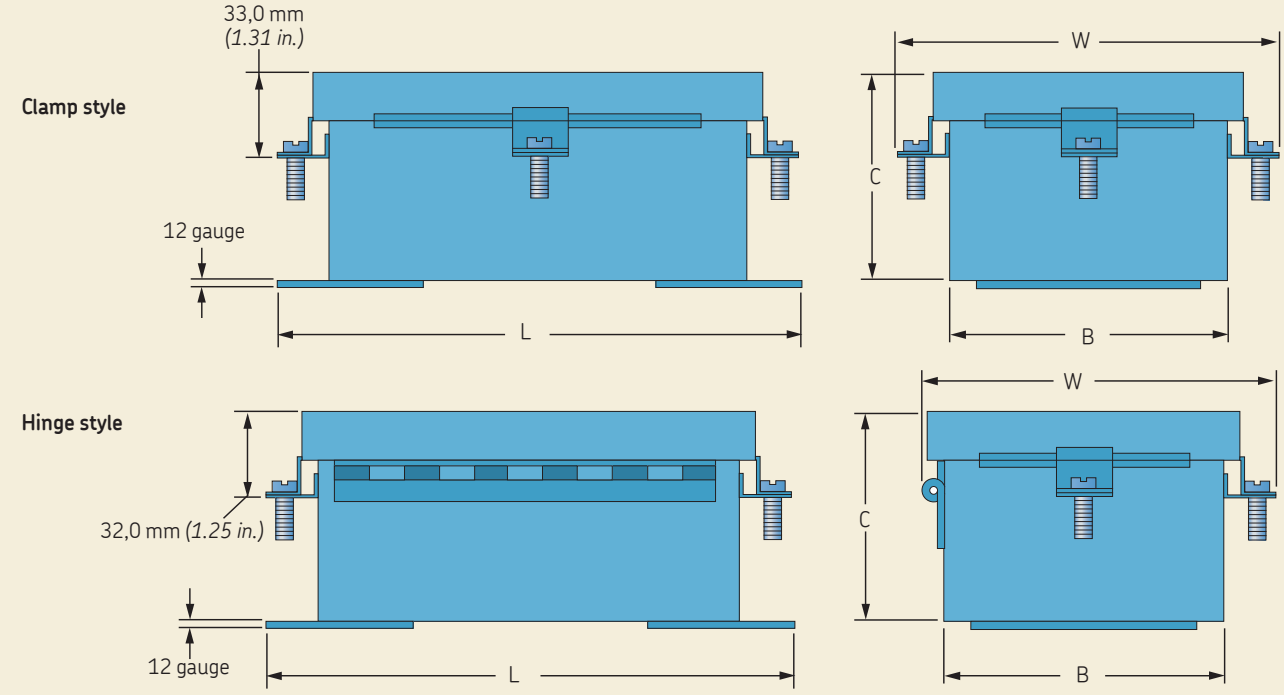


Table 5

Weather-proof housing dimensions

SKF model number	Box size "A" × "B" × "C"	Mounting "D" × "E"	Clamp style overall "L" × "W"	Hinge style overall "L" × "W"
CMSS 31092100 CMSS 31092101 CMSS 31092103	203 × 152 × 89 mm *(8.00 × 6.00 × 3.50 in.)*	222 × 102 mm *(8.75 × 4.00 in.)*	241 × 187 mm *(9.50 × 7.38 in.)*	241 × 176 mm *(9.50 × 6.94 in.)*
CMSS 31092200 CMSS 31092201 CMSS 31092203	254 × 203 × 102 mm *(10.00 × 8.00 × 4.00 in.)*	273 × 152 mm *(10.75 × 6.00 in.)*	292 × 238 mm *(11.50 × 9.38 in.)*	292 × 227 mm *(11.50 × 8.94 in.)*
CMSS 31092300 CMSS 31092301 CMSS 31092303	305 × 254 × 127 mm *(12.00 × 10.00 × 5.00 in.)*	324 × 203 mm *(12.75 × 8.00 in.)*	343 × 289 mm *(13.50 × 11.38 in.)*	343 × 278 mm *(11.50 × 10.94 in.)*

Calibrator

CMSS 601 series

Static calibrator

The CMSS 601 field calibrator provides a convenient, precise method for verifying the voltage output versus the gap of an eddy probe and driver combination. It is especially useful for applications requiring exact calibration (the hot alignment of machinery) or where "targets" of various metal alloys are used.

As recommended by API Standard 670, the CMSS 601 can be used for calibrating an eddy probe on the actual shaft it will monitor. The calibrator's self-centering magnetic base holds the pickup rigidly at 90° to the shaft axis to provide reliable performance characteristics on its "real target". The metal disc supplied with the calibrator may be placed across the V-shaped base as a standardized flat calibration target.

Precision results ... easy-to-use

1. An eddy probe is locked into the proper size adapter with the set screw.
2. The adapter and probe cable are slipped upward through the magnetic base and over the micrometer spindle.
3. The magnetic base is placed on a machine shaft or on the target disc.
4. The probe lead is connected to a matching eddy probe driver through an extension cable.
5. –24 V DC is applied to the driver; the driver's output is connected to a voltmeter.
6. The micrometer spindle is set to read 40 mils.
7. The adapter and probe are vertically positioned to produce a –8 V DC voltmeter reading and then locked in position on the micrometer spindle by the upper set screw. The unit is now ready for use.

To calibrate an eddy probe, the spindle is lowered by the micrometer head to a reading of 10 mils and a voltage reading taken. Readings are taken successively at 5 or 10 mil increments. Fine tuning is available with the calibrate potentiometer on the driver.

The CMSS 601-1 is supplied as a portable kit, complete with standard target disc, an Allen wrench and two adapters to accommodate both CMSS 65 and CMSS 68 eddy probes.

Ordering information

CMSS 601-1 Static calibrator: Standard (Imperial units).
CMSS 601-2 Static calibrator: Metric version (Metric units).
CMSS 601-8 Static calibrator: Metric version for long probe cases, over 60 mm *(2.4 in.)** (Metric units).

* Calibrators for long probes use integral target only; will not observe actual shaft.

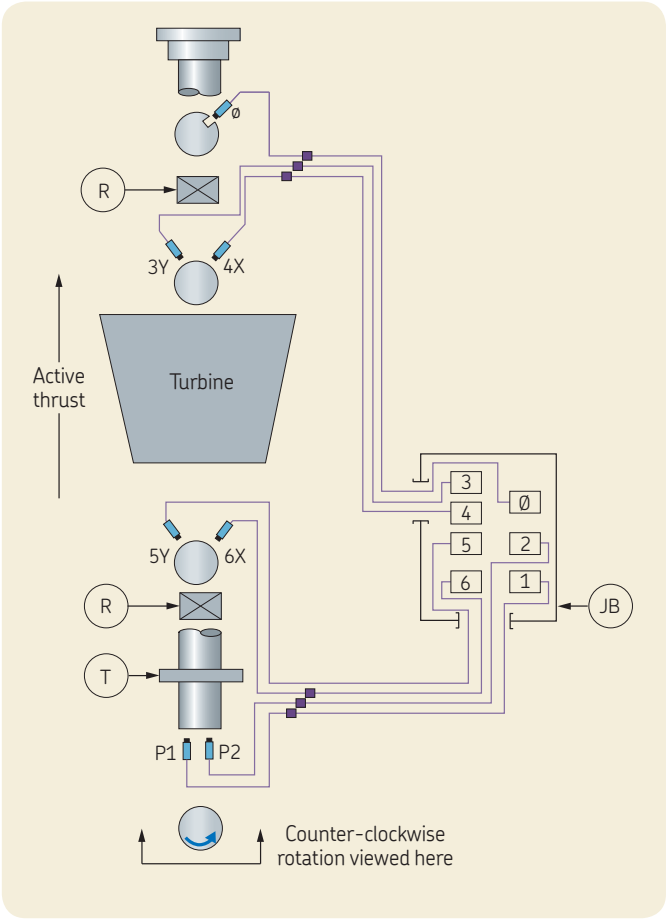
Typical eddy probe arrangement plans, bearing housing mounting and axial probe installation

Typical eddy probe arrangement plans

Turbine

Item	Description
P1	Axial position probe (instrument manufacturer ID data)
P2	Axial position probe (instrument manufacturer ID data)
3Y	Low pressure end radial vibration probe, 45° off top dead center (TDC) (instrument manufacturer ID data)
4X	Low pressure end radial vibration probe, 45° off TDC (instrument manufacturer ID data)
5Y	High pressure end radial vibration probe, 45° off TDC (instrument manufacturer ID data)
6X	High pressure end radial vibration probe, 45° off TDC (instrument manufacturer ID data)
Ø	Phase reference probe, 45° off TDC (instrument manufacturer ID data)
R	Radial bearing (description)
T	Thrust bearing (description)
JB	Junction box

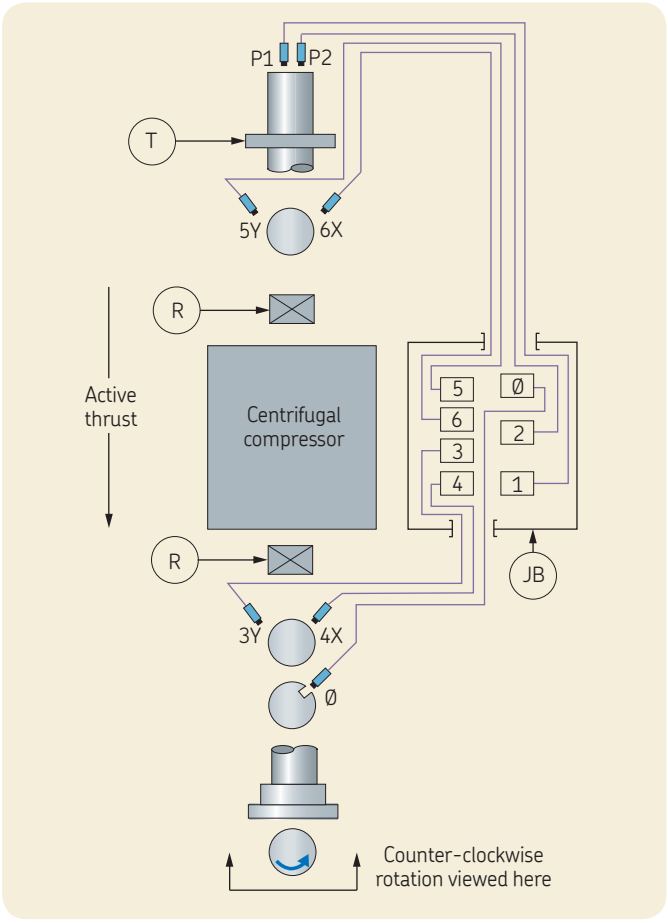
Note: The numbering system shown is based on the higher pressure end equaling a higher device number.



Compressor

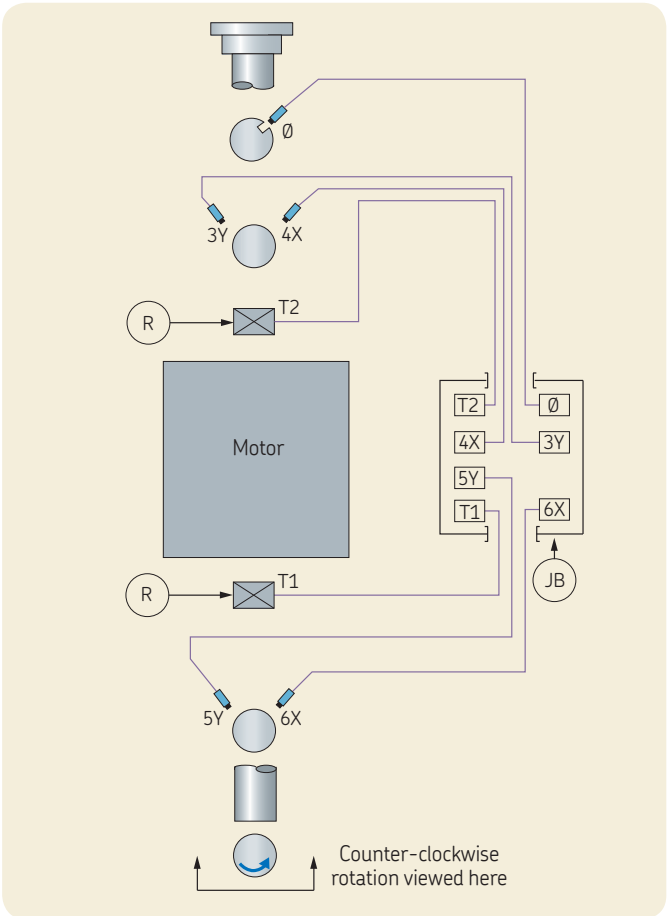
Item	Description
P1	Axial position probe (vendor and model number)
P2	Axial position probe (vendor and model number)
3Y	Low pressure end radial vibration probe, 45° off TDC (vendor and model number)
4X	Low pressure end radial vibration probe, 45° off TDC (vendor and model number)
5Y	High pressure end radial vibration probe, 45° off TDC (vendor and model number)
6X	High pressure end radial vibration probe, 45° off TDC (vendor and model number)
Ø	Phase reference probe, 45° right of TDC (vendor and model number)
R	Radial bearing (description)
T	Thrust bearing (description)
JB	Junction box

Note: The numbering system shown is based on the higher pressure end equaling a higher device number.



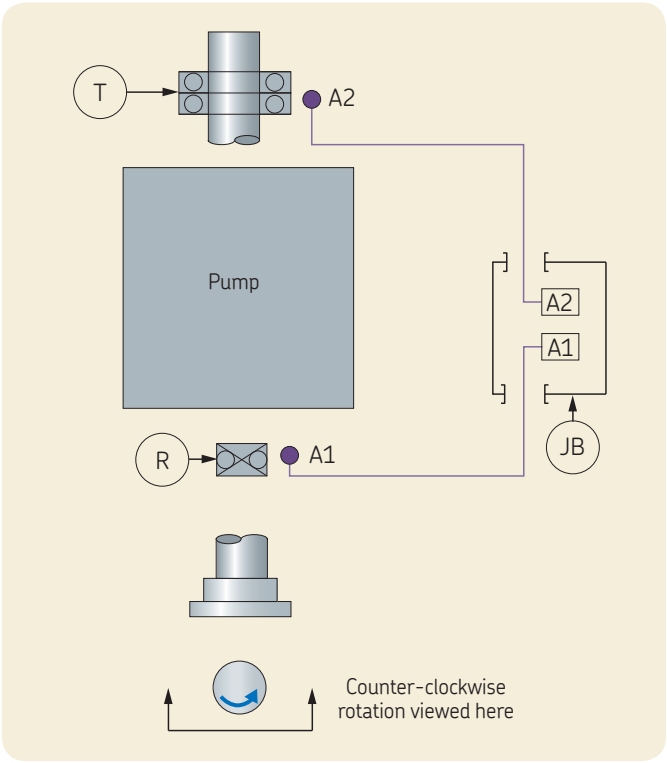
Electric motor

Item	Description
3Y	Coupling end Y radial vibration probe, 45° off TDC (instrument manufacturer ID data)
4X	Coupling end X radial vibration probe, 45° off TDC (instrument manufacturer ID data)
5Y	Outboard end Y radial vibration probe, 45° off TDC (instrument manufacturer ID data)
6X	Outboard end X radial vibration probe, 45° off TDC (instrument manufacturer ID data)
Ø	Phase reference probe, 45° right of TDC (instrument manufacturer ID data)
T1	Outboard end bearing temperature
T2	Coupling end bearing temperature
R	Radial bearing (description)
JB	Junction box



Pump

Item	Description
A1	Coupling end radial horizontal accelerometer, 90° off TDC (instrument manufacturer ID data)
A2	Outboard end radial vibration accelerometer, 90° off TDC (instrument manufacturer ID data)
R	Radial bearing (description)
T	Thrust bearing (description)
JB	Junction box

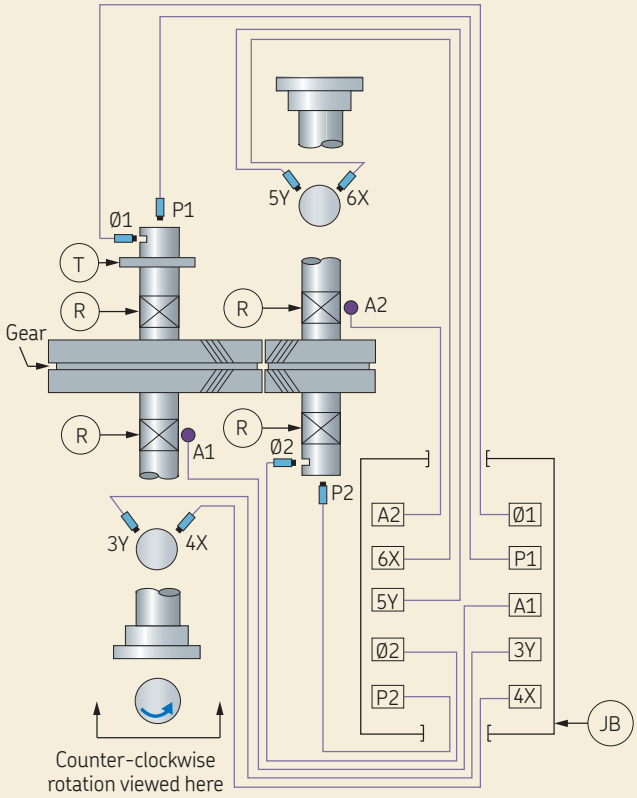


Gearbox (double helical gear)

Item	Description
A1	Input shaft coupling end horizontal radial acceleration, 90° off TDC (instrument manufacturer ID data)
A2	Output shaft coupling end horizontal radial acceleration, 90° off TDC (instrument manufacturer ID data)
P1	Input shaft thrust bearing end axial position probe #1, (instrument manufacturer ID data)
P2	Output shaft thrust bearing end axial position probe #2, (instrument manufacturer ID data)
3Y	Input shaft coupling end Y radial vibration probe, 45° off TDC (instrument manufacturer ID data)
4X	Input shaft coupling end X radial vibration probe, 45° off TDC (instrument manufacturer ID data)
5Y	Output shaft coupling end Y radial vibration probe, 45° off TDC (instrument manufacturer ID data)
6X	Output shaft coupling end X radial vibration probe, 45° off TDC (instrument manufacturer ID data)
Ø1	Input shaft non-coupling end phase reference probe at TDC (instrument manufacturer ID data)
Ø2	Output shaft non-coupling end phase reference probe at TDC (instrument manufacturer ID data)
R	Radial bearing (description)
T	Thrust bearing (description)
JB	Junction box

Note: Oscillator-demodulators and accelerometer signal conditioners should be located in separate junction boxes.

Note: For a single helical gear, a pair of axial probes should be installed at each thrust bearing end.

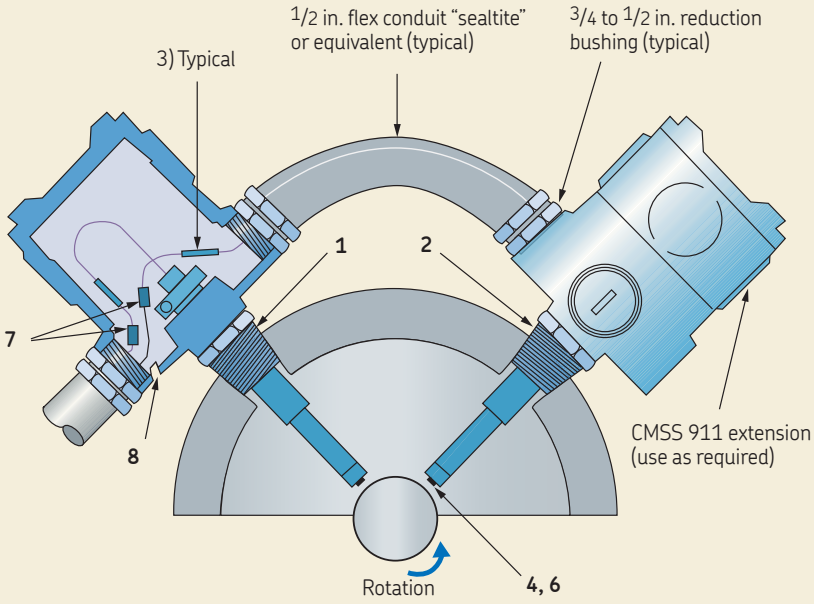


Bearing housing mounting

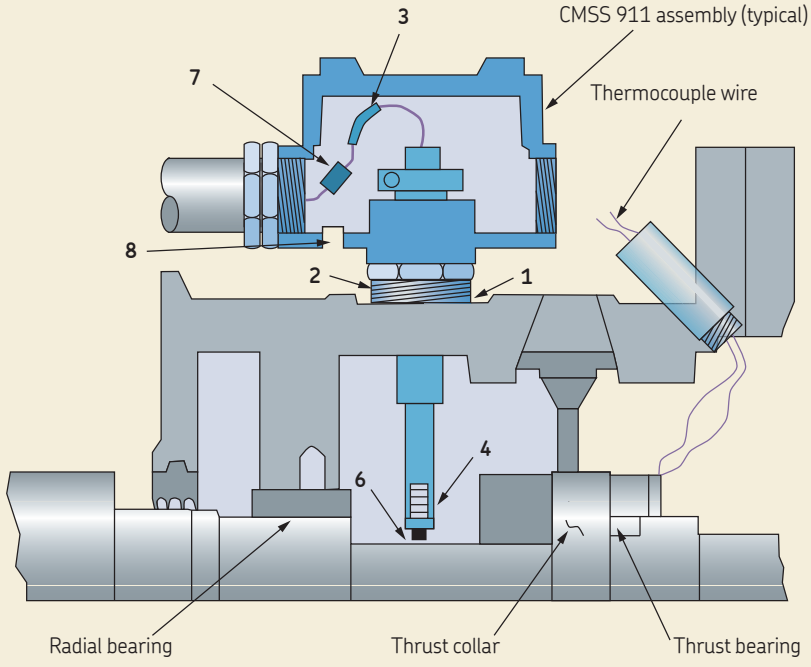
Steps

1. Drill and tap housing for 19.0 mm *(0.75 in.)* thread (typical).
2. Set sealing adapter tight in bearing housing before pulling lead wires.
3. Identify leads prior to installation; use tag numbers as required.
4. Probes must be mounted perpendicular to shaft.
5. Do not pull thermocouple wire and probe lead wires into the same outlet without your Engineering Department's approval.
6. Check gap voltage after CMSS 911 assembly has been installed; set gap at –8.0 in. ±0,5 V (40 ±2.5 mils).
7. Torque mating connectors to 1,02 Nm, ±0,04 Nm *(145 in. oz., ±5 in. oz.)*, then wrap connections with fluorine based polymer tape (typical).
8. Drill 6.4 mm *(0.25 in.)* drain hole in lowest point of box (typical).

End view



Side view

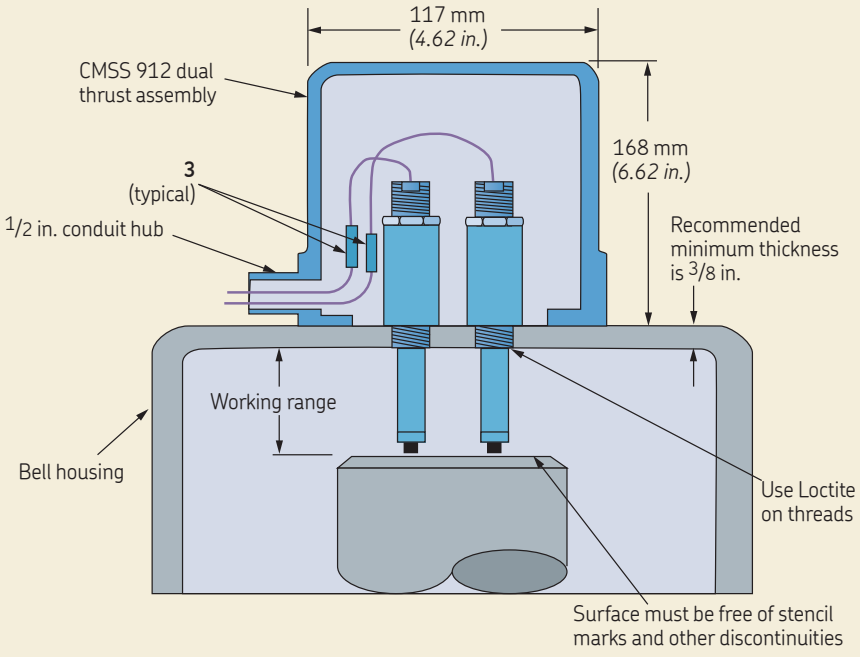


Axial probe installation

Thrust probe installation recommendations

- At least two probes per rotor are recommended.
- Where the probes cannot be changed without shutting down the machine, install spare probes.
- Calibrate probe, cable and driver and record final response curves for primary as well as spare probes. The SKF CMSS 601 static calibrator may be used.
- Try to observe the thrust collar with one probe and the shaft with the other.
- Probes must be mounted within 30,5 cm *(1 ft.)* of the thrust collar.
- Avoid mounting probes through thin plates or bell housings that may bow with thermal expansion.
- Determine the float zone of the rotor by jacking the rotor in both directions. Use up to two tons of pressure.
- Measure the rotor movement with dual indicators on the shaft, the eddy probe voltage change at the driver and the monitor reading (all three should agree).
- Jack the shaft several times each way to verify readings.
- Set the probe gap so that the center of the probe's range is in the center of the float zone.
- Securely lock the probe and any adapters in place.
- Be sure the probe tip has a side clearance of at least 5 mm *(0.20 in.)*.

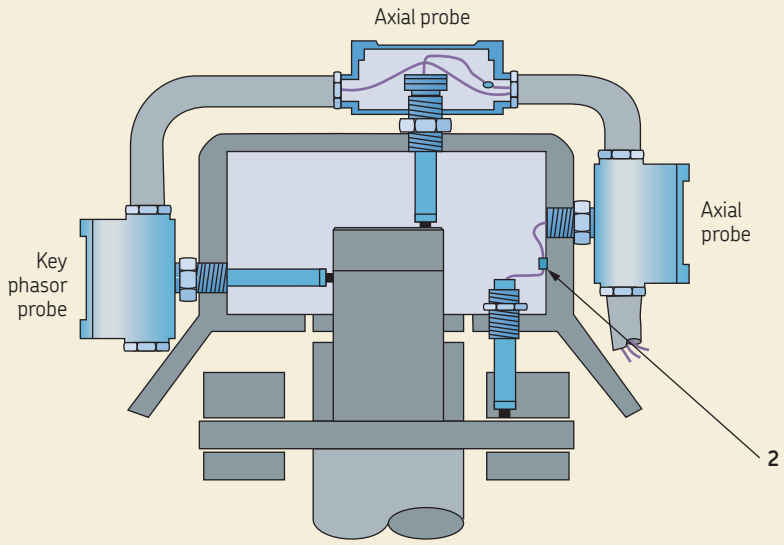
Dimensions



Steps

1. Set sealing adapter tight in housing before pulling lead wires through.
2. Probe lead wires must be secured against internal whipping and rubbings.
3. Identify probe leads prior to installation; use tag numbers as required.
4. Probes must be mounted perpendicular to shaft or surface it is “seeing”.
5. Do not pull thermocouple wires and probe lead wires into the same outlet without your Engineering Department's approval.
6. Check gap volts after CMSS 911 or CMSS 912 assemblies have been installed.
7. Set gap at midpoint of probe range at the center of the shaft float zone.
8. Torque mating connectors to 1,02 Nm, ±0,04 Nm *(145 in. oz., ±5 in. oz.)*, then wrap connectors with fluorine based polymer tape.

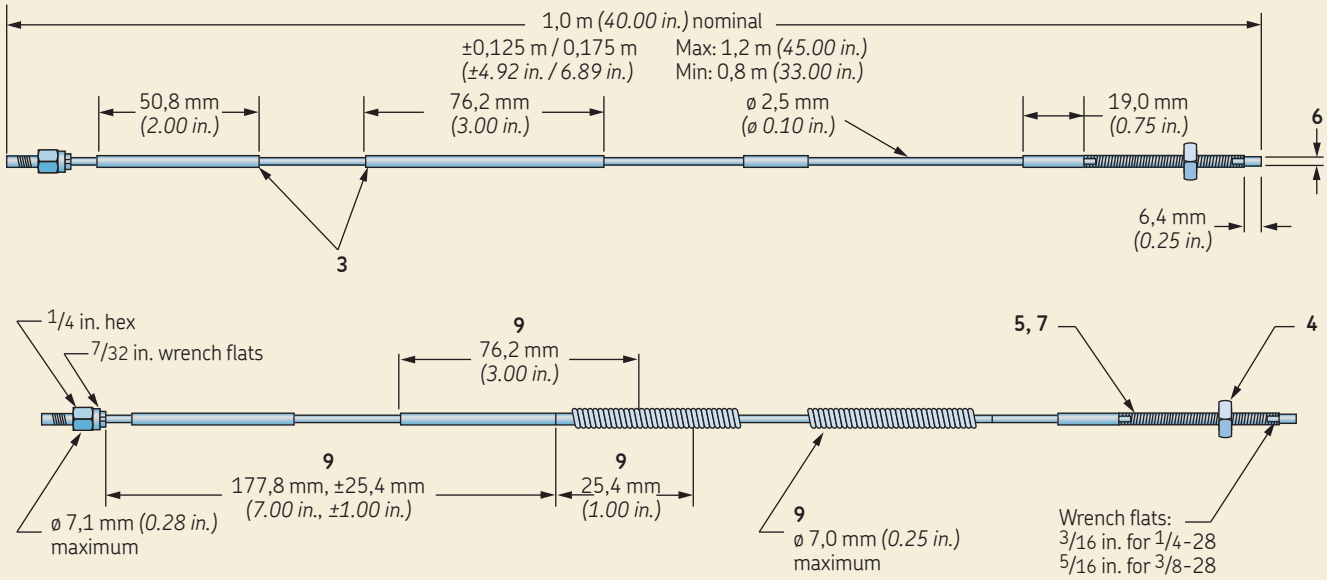
Dimensions



Outline dimensions

5 mm and 8 mm eddy probe outline dimensions

Dimensions

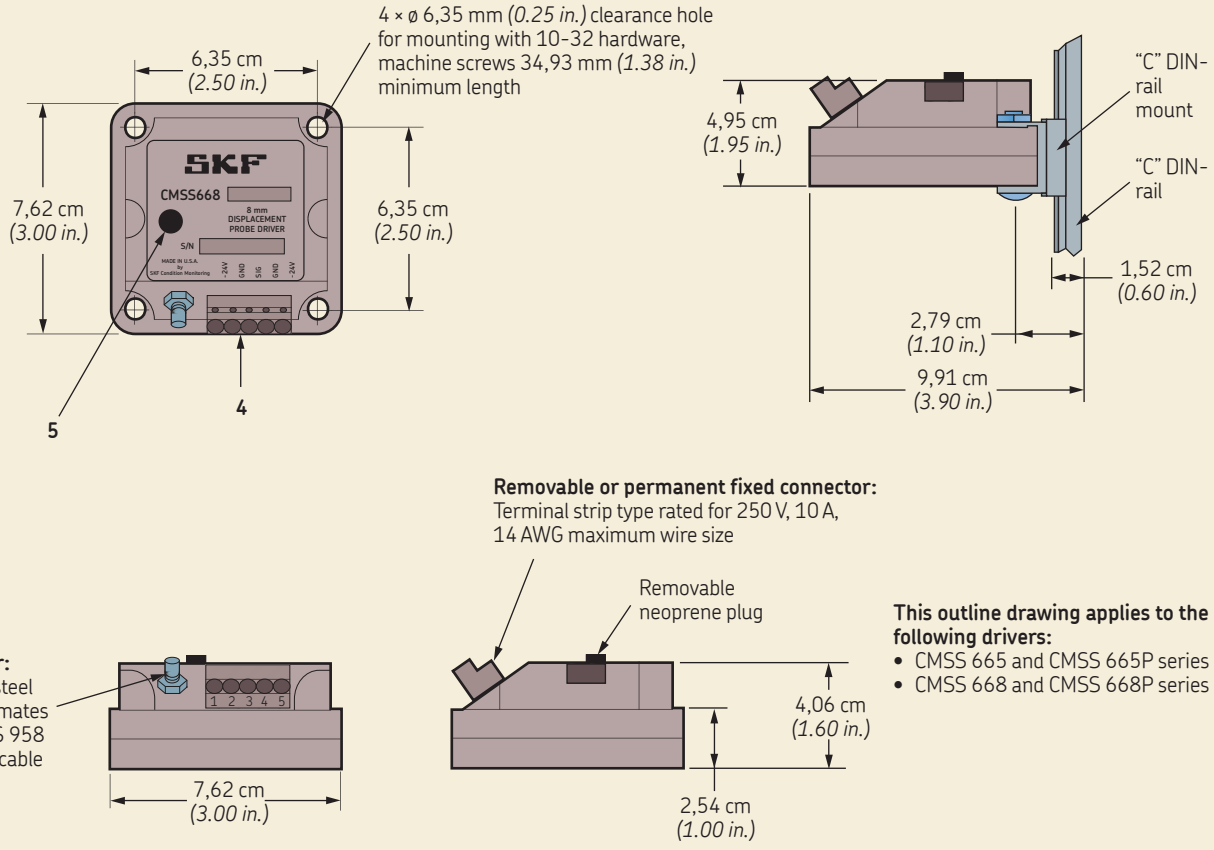


Notes

1 Cable shown with and without flex armor.
2 Drawing applicable to CMSS 65 and CMSS 68.
3 Clear shrink tubing for label identification.
4 13 mm for M8 × 1 thread probe case (7/16 in. for 1/4-28 thread probe case).
17 mm for M10 × 1 thread probe case (9/16 in. for 3/8-24 thread probe case).
5 Probe case length dependent upon probe model number.
6 8 mm *(0.31 in.)* for CMSS 68; 5 mm (0.20 in.) for CMSS 65.
7 1/4-28 or 3/8-24 according to probe model number.
8 All information applies to both models unless otherwise specified.
9 Armored model only.

5 mm and 8 mm eddy probe driver outline dimensions

Dimensions



This outline drawing applies to the following drivers:

- CMSS 665 and CMSS 665P series
- CMSS 668 and CMSS 668P series

Notes

1 Operating temperature range: –35 to +65 °C *(–30 to +150 °F)*

2 Storage: –40 to +65 °C *(–45 to 150 °F)*
Material: Case made from Ryton

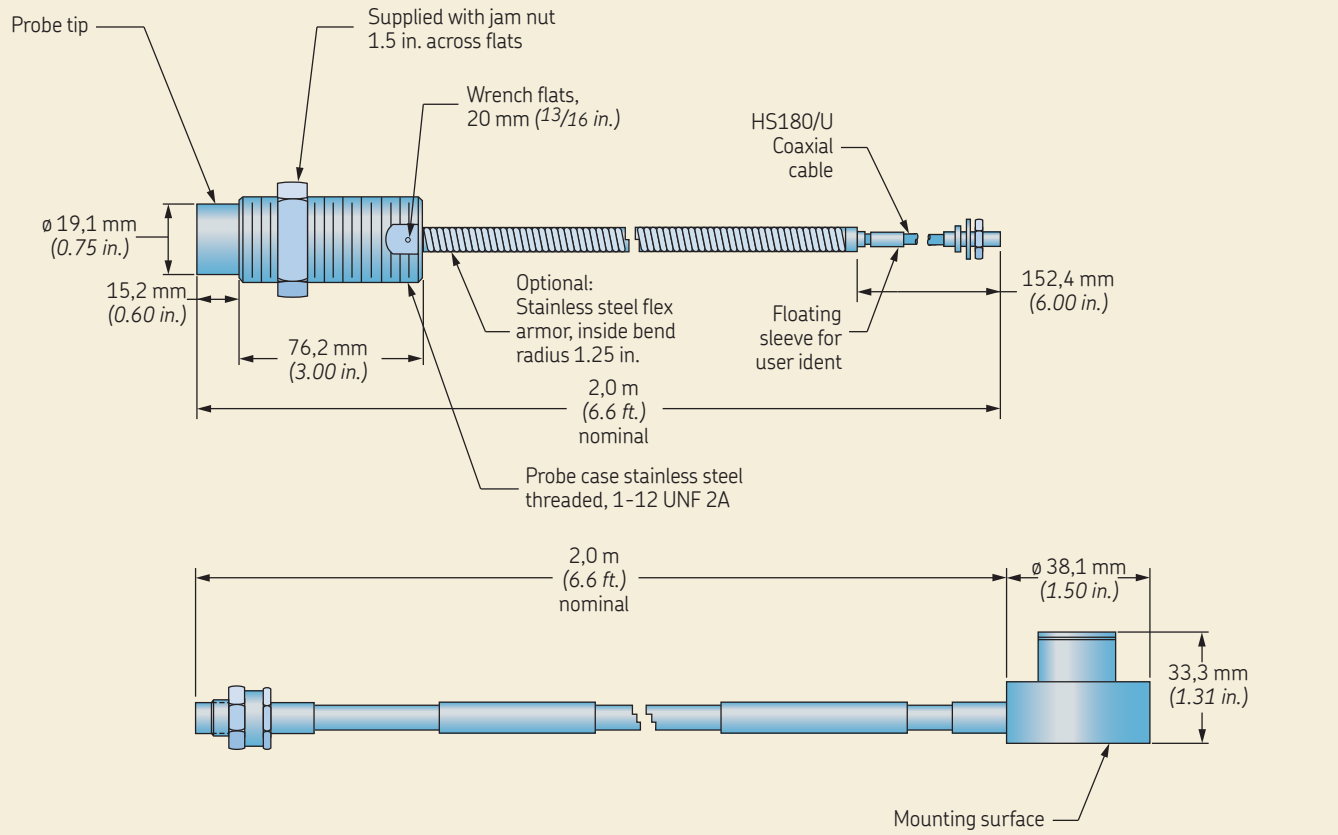
3 Units interchangeable without recalibration.

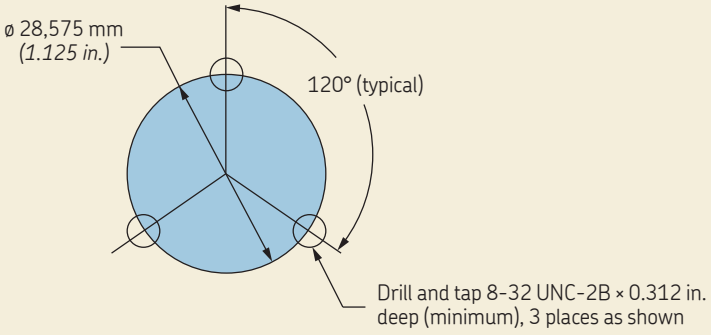
4 Probe driver five-terminal connector shown; removable or permanent fixed connectors available.

5 Access hole for fine trimming of calibration on probe drivers or for range selection on transmitter units.

19 mm eddy probe outline dimensions

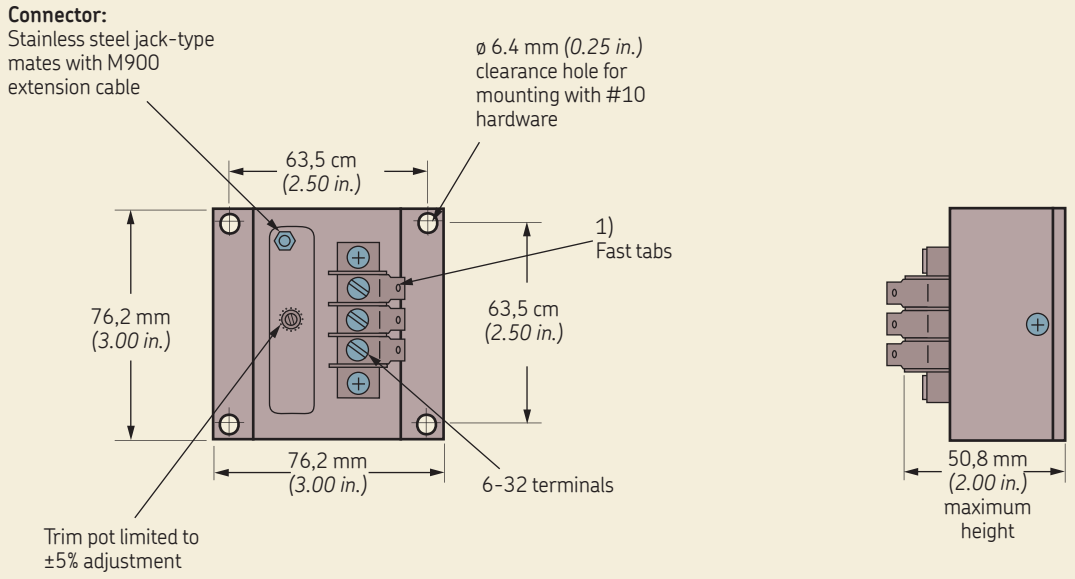
Dimensions





19 mm eddy probe driver outline dimensions

Dimensions

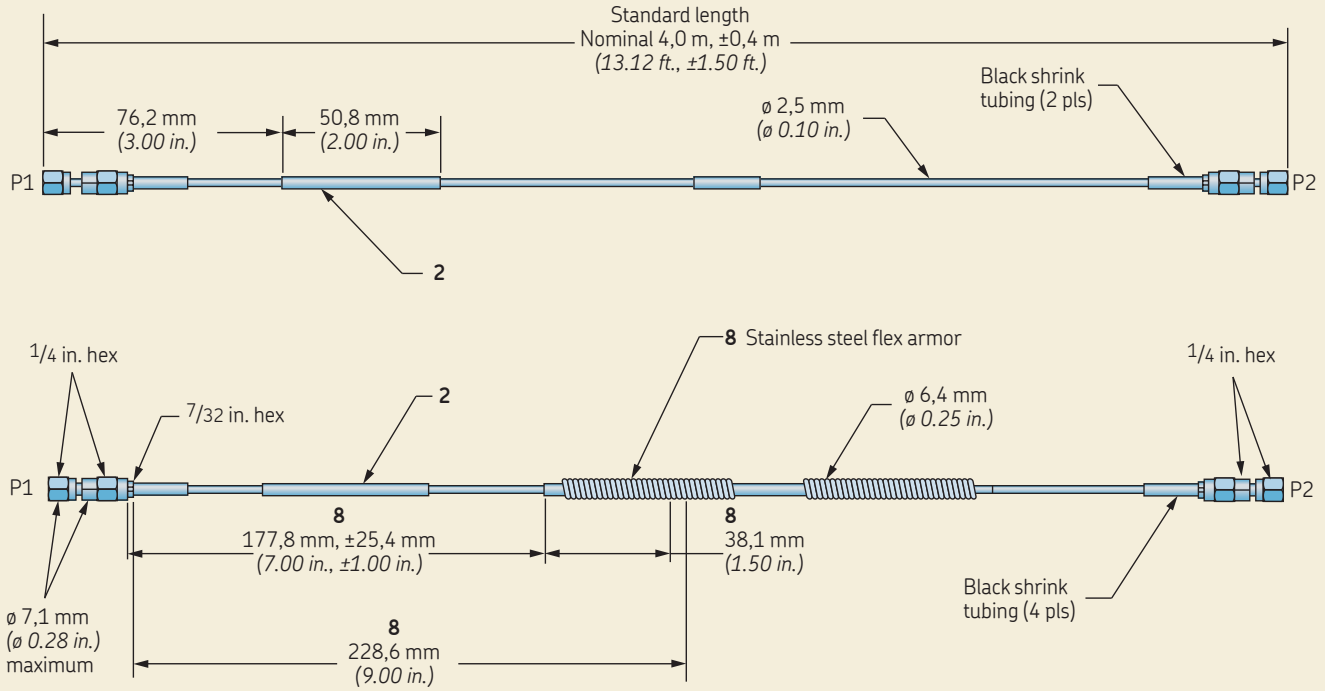


Notes

1. Install fast tabs at terminals for the convenience of field measuring instruments.
2. Units are interchangeable without need for recalibration of the system.
3. Housing material: aluminum (CMSS 620-2) or stainless steel (CMSS 620-6)
4. Operating temperature range: –35 to +65 °C *(–30 to +150 °F)*
   Storage: –40 to +95 °C *(–40 to 200 °F)*

CMSS 958 extension cable outline dimensions

Dimensions

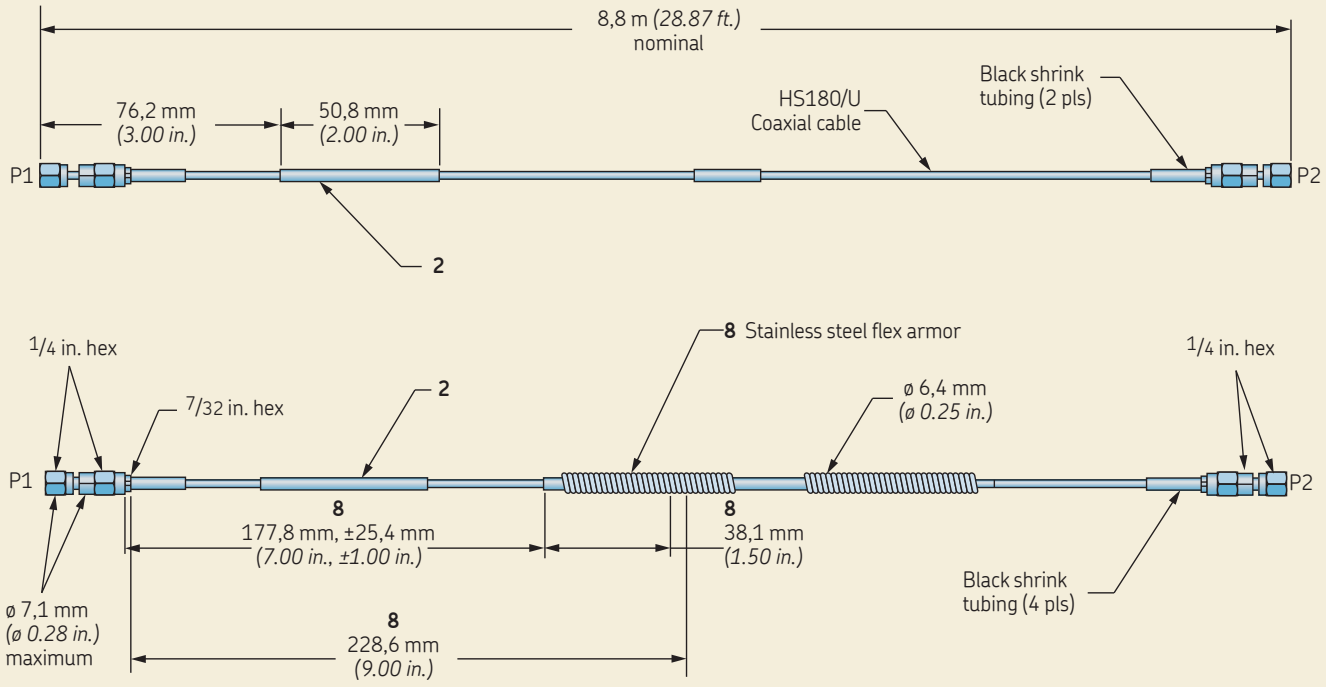


Notes

1 Cable shown with and without flex armor.
2 Clear shrink tubing for label identification.
3 Operating temperature range: –35 to +120 °C
(–30 to +250 °F)
Storage: –40 to +120 °C *(–45 to +250 °F)*
4 Bend radius 34,9 mm *(1.38 in.)* minimum (armored). Bend radius 19,0 mm *(0.75 in.)* minimum (non-armored).
5 High strength steel coax with steel braid shield.
6 Installation direction not restricted (reversible).
7 All information applies to both models unless otherwise specified.
8 Armored model only.

CMSS 900 extension cable outline dimensions

Dimensions



Notes

1 Cable shown with and without flex armor.
2 Clear shrink tubing for label identification.
3 Operating temperature range: –35 to +120 °C
(–30 to +250 °F)
Storage: –45 to +175 °C *(–45 to +350 °F)*
4 Bend radius 34,9 mm *(1.38 in.)* minimum (armored).
Bend radius 19,0 mm *(0.75 in.)* minimum (non-armored).
5 High strength steel coax with steel braid shield.
6 Installation direction not restricted (reversible).
7 All information applies to both models unless otherwise specified.
8 Armored model only.

Agency approvals and hazardous area information

CE mark

European Community Declaration of Conformity.

Manufacturer:

SKF USA Inc.
5271 Viewridge Court
San Diego, California 92123 USA

Product: Eddy current probe systems from SKF

SKF USA Inc. of San Diego, California, USA, hereby declares that the referenced product, to which this declaration relates, is in conformity with the provisions of:

- Council Directive 89/336/EEC (3 May 1989), on the Approximation of the Laws of the Member States Relating to Electromagnetic Compatibility, as amended by:
  - Council Directive 92/31/EEC (28 April 1992)
  - Council Directive 93/68/EEC (22 July 1993)

The above-referenced product complies with the following standards and/or normative documents:

- EN 50081-2, Electromagnetic compatibility – generic emission standard. Part 2: Industrial environment (August 1993).
- EN 50082-2, Electromagnetic compatibility – generic immunity standard. Part 2: Industrial environment (March 1995).

Hazardous area information

Area general information

Review the Hazardous Location Information section to properly define the area in which the sensors and monitoring systems are to be installed, then determine which equipment will meet the specified requirements.

Sensors may either be installed in a Class I, Division 1 (Zone 0, 1) or a Division 2 (Zone 2) hazardous area. However, for installation in these areas, the sensors must be approved by an appropriate agency.

SKF does have eddy probe sensor systems approved for installation in these areas and specific model numbers assigned to easily identify these agency approved options.

It is strongly recommended that intrinsic safety barriers be used for the hazardous area installations as the means of limiting the thermal and electrical energy to the sensor components in Class I, Division 1 (Zone 0, 1) and Division 2 (Zone 2) hazardous areas. The agency approved intrinsic safe sensor components and the intrinsic safety barriers provide for a very high level of safety and aid in the prevention of fire and explosions in your facility.

In field installations, it is recommended that housings be used to provide physical protection for the eddy probe drivers. For CENELEC approved systems, these housings should have a minimum rating of IP20. Other agency approvals do not specify a level of protection for the housings. However, SKF does provide a series of standard housings that can be used for these installations.

Agency approvals

SKF USA Inc. has obtained approvals from the following agencies:

Certified by SIRA to ATEX directive

SIRA intrinsically safe certified equipment is intended for use in Zone 0, 1 as intrinsically safe in accordance with CENELEC European harmonized Standards, [EN50 014 (1977) and EN50 020 (1977)] and is accepted by member countries of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Canadian Standards Association – CSA

CSA intrinsically safe certified equipment is intended for use in Class I, Division 1, Groups A, B, C, D.

Factory Mutual Research, USA – FM

FM intrinsically safe and non-incendive certified equipment is intended for use in Class I, Division 1 and Division 2, Groups A, B, C, D.

To order eddy probe systems with the various agency approvals, please refer to the specific eddy probe model number desired in this catalog, e.g., CMSS 65 or CMSS 68 systems. There is an Options Form available that delineates the specific agency approval desired. Select the appropriate agency approval and the additional configuration requirements for the eddy probe and extension cable. Then select the appropriate driver model number indicated on the following pages.

Intrinsic Safety (I-S) barriers

For use with the CMSS 65 and CMSS 68 series eddy probe systems

The following information provides a listing of the intrinsic safety barriers used by the various testing agencies during the eddy probe approval process. As such, these barriers meet the various agency approvals and allow for the proper operation of the eddy probe systems when properly installed in the hazardous areas. Also included are the parameters for selecting other manufacturers' barriers. However, only the brand named barriers listed have been tested and are verified to work properly with the CMSS 65 and CMSS 68 eddy probe systems.

Factory Mutual – (FM)

Intrinsically safe for Class I, Division 1, Groups A, B, C, D

Entity parameters

- Supply terminals:
  - V_{max} = 30 V DC
  - I_{max} = 245 mA
  - C_i = 0,056 µF
  - L_i = 0,536 mH
- Signal terminals:
  - V_{max} = 24 V DC
  - I_{max} = 60 mA
  - C_i = 0 µF
  - L_i = 0 mH

SKF drawing number 31187500 is applicable.

System approval

Barriers:

- Power/Signal: MTL 796 Dual (neg)

Measurement Technolog Ltd., (MTL)

SKF drawing number 31163200 is applicable.

NOTE: All intrinsic safety installations should be done in accordance with the national installation codes of practice for the particular country at the place of installation.

Canadian Standards Association – CSA

Intrinsically safe for Class I, Division 1, Groups A, B, C, D

System approval

Barriers:

- Power/Signal: MTL 796 Dual (neg)

Measurement Technology Ltd., (MTL)

SKF drawing number 31163200 is applicable.

NOTE: All intrinsic safety installations should be done in accordance with the national installation codes of practice for the particular country at the place of installation.

Certified by SIRA to ATEX Directive (CENELEC standard)

Intrinsic safe code (see below)

System approval

Intrinsic safe code EEx ia IIC T2.

SKF drawing number 31451400 is applicable.

Eddy probe approval

Intrinsic safe code EEx ia IIC T2,
T_a = 100 °C *(210 °F)*

Driver approval

- Intrinsic safe code EEx ia IIC T4,
  T_a = 75 °C *(135 °F)*
  - $V_{max:in}$ = 28 V DC
  - $I_{max:in}$ = 138 mA DC
  - $P_{max:in}$ = 1,0 W
  - C_{eq} = 0,06 µF
  - L_{eq} = 0,5 mH

Suggested barriers

- Power/Signal: MTL796 Dual (neg)

Measurement Technology Ltd., (MTL)

NOTE: All intrinsic safety installations should be done in accordance with the national installation codes of practice for the particular country at the place of installation.

Classes and divisions

Hazardous locations are those areas where a potential for explosion and fire exists because of flammable gases, vapors or finely pulverized dusts in the atmosphere, or because of the presence of easily ignitable fibers or flyings. Hazardous locations may result from the normal processing of certain volatile chemicals, gases, grains, etc., or they may result from accidental failure of storage systems for these materials. It is also possible that a hazardous location may be created when volatile solvents or fluids, used in a normal maintenance routine, vaporize to form an explosive atmosphere.

Regardless of the cause of a hazardous location, it is necessary that every precaution be taken to guard against ignition of the atmosphere. Certainly no open flames would be permitted in these locations, but what about other sources of ignition?

Electrical sources of ignition

A source of ignition is simply the energy required to touch off an explosion in a hazardous location atmosphere.

Electrical equipment such as lighting fixtures and motors are classified as "heat producing", and they will become a source of ignition if they reach a surface temperature that exceeds the ignition temperature of the particular gas, vapor or dust in the atmosphere.

It is also possible that an abnormality or failure in an electrical system could provide a source of ignition. A loose termination in a splice box or a loose lamp in a socket can be the source of both arcing and heat. The failure of insulation from cuts, nicks or aging can also act as an ignition source from sparking, arcing and heat.

Hazardous locations and the National Electrical Code*

The National Electrical Code (NEC) treats installations in hazardous locations in articles 500 through 517.

Each hazardous location can be classified by the definitions in the NEC. Following are interpretations of these classifications and applications.

Class I locations

Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Class I, Division 1

These are Class I locations where the hazardous atmosphere is expected to be present during normal operations. It may be present continuously, intermittently, periodically or during normal repair or maintenance operations. Division 1 locations are also those locations where a breakdown in the operation of processing equipment results in the release of hazardous vapors and the simultaneous failure of electrical equipment.

Class I, Division 2

These are Class I locations in which volatile flammable liquids or gases are handled, processed or used, but in which they will normally be confined within closed containers or closed systems from which they can escape only in the case of accidental rupture or breakdown of the containers or systems. The hazardous conditions will occur only under abnormal conditions.

Class II locations

Class II locations are those that are hazardous because of the presence of combustible dust.

Class II, Division 1

These are Class II locations where combustible dust may be in suspension in the air under normal conditions in sufficient quantities to produce explosive or ignitable mixtures. This may occur continuously, intermittently or periodically. Division 1 locations also exist where failure or malfunction of machinery or equipment might cause a hazardous location to exist while providing a source of ignition with the simultaneous failure of electrical equipment. Also included are locations in which combustible dust of an electrically conductive nature may be present.

Class II, Division 2

A Class II, Division 2 location is one in which combustible dust will not normally be in suspension in the air and normal operations will not put the dust in suspension, but where accumulation of the dust may interfere with the safe dissipation of heat from electrical equipment or where accumulations near electrical equipment may be ignited by arcs, sparks or burning material from the equipment.

Class III locations

Class III locations are those that are hazardous because of the presence of easily ignitable fibers or flyings, but in which the fibers or flying are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.

Class III, Division 1

These are locations in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured or used.

Class III, Division 2

These locations are where easily ignitable fibers are stored or handled.

* All references to the National Electric Code are from the NFPA 70 1990 Edition.

Hazardous location equipment

Class I location equipment

Devices for Class I locations are housed in enclosures that are designed to be strong enough to contain an explosion if the hazardous vapors enter the enclosure and are ignited. These enclosures then cool and vent the products of combustion in such a way that the surrounding atmosphere is not ignited.

Heat producing equipment for hazardous locations must also be designed to operate with surface temperatures below the ignition temperatures of the hazardous atmosphere.

Since the different vapors and gases making up hazardous atmospheres have varying properties, they have been placed in groups based on common flame propagation characteristics and explosion pressures. These groups are designated A, B, C and D, and the equipment selected must be suitable for the group of the specific hazardous gas or vapor, with regard to flame propagation, explosion pressures and operating temperatures.

Reference to the National Electrical Code will indicate that most of the equipment used for Class I, Division 2 applications is the same as that used for Division 1 applications.

Class II location equipment

The enclosures used to house devices in Class II locations are designed to seal out dust. Contact between the hazardous atmosphere and the source of ignition has been eliminated and no explosion can occur within the enclosure.

As in Class I equipment, heat producing equipment must be designed to operate below the ignition temperature of the hazardous atmosphere. However, in Class II equipment, additional consideration must be given to the heat buildup that may result from the layer of dust that will settle on the equipment.

Dusts have also been placed in groups designated E, F and G, based on their particular hazardous characteristics and the dusts' electrical resistivity. It is important to select equipment suitable for the specific hazardous group.

Class III location equipment

Class III locations require equipment that is designed to prevent the entrance of fibers and flyings, prevent the escape of sparks or burning material and operate at a temperature below the point of combustion.

Hazardous location equipment applications

Hazardous location equipment may be required in any area where the presence of flammable gases, vapors or finely pulverized dusts in the atmosphere is sufficient to create a threat of explosion or fire. It may also be required where easily ignitable fibers or flyings are present. The following is a representative (but hardly complete) list of the types of locations and operations requiring hazardous location equipment in at least certain areas.

Class I locations

- Petroleum refining facilities
- Dip tanks containing flammable or combustible liquids
- Dry cleaning plants
- Plants manufacturing organic coatings
- Spray finishing areas (residue must be considered)
- Petroleum dispensing areas
- Solvent extraction plants
- Plants manufacturing or using pyroxylin (nitrocellulose) type and other plastics (Class II also)
- Locations where inhalation anesthetics are used
- Utility gas plants, operations involving storage and handling of liquefied petroleum and natural gas
- Aircraft hangers and fuel servicing areas

Class II locations

- Grain elevators and bulk handling facilities
- Manufacture and storage of magnesium
- Manufacture and storage of starch
- Fireworks manufacture and storage
- Flour and feed mills
- Areas for packaging and handling of pulverized sugar and cocoa
- Facilities for the manufacture of magnesium and aluminum powder
- Some coal preparation plants and coal handling facilities
- Spice grinding plants
- Confectionery manufacturing plants

Class III locations

- Wood working plants
- Textile mills
- Cotton gins and cotton seed mills
- Flax producing plants

Chemicals by groups

Group A – atmospheres

- acetylene

Group B – atmospheres

- acrolein (inhibited)
- butadiene
- ethylene oxide
- formaldehyde (gas)
- hydrogen
- manufactured gases containing more than 30% hydrogen (by volume)
- propyl nitrate
- propylene oxide

Group C – atmospheres

- acetaldehyde
- allyl alcohol
- butyl mercaptan
- n-butyraldehyde
- carbon monoxide
- crotonaldehyde
- dicyclopentadiene
- diethyl ether
- diethylamine
- di-isopropylamine
- dimethylamine
- di-n-propylamine
- 1, 4-dioxane
- epichlorohydrin
- ethyl mercaptan
- n-ethyl morpholine
- ethylene
- ethylenimine
- hydrogen cyanide
- hydrogen selenide
- hydrogen sulfide
- isobutyraldehyde
- isopropyl glycidyl ether
- methyl ether
- methyl formal
- methyl mercaptan
- methylacetylene
- methylacetylene-propadiene (stabilized)
- monomethyl hydrazine
- morpholine
- nitroethane
- nitromethane
- 2-nitropropane
- propionaldehyde
- n-propyl ether
- tetrahydrofuran
- triethylamine
- unsymmetrical dimethyl hydrazine (UDMH 1, 1-dimethyl hydrazine)
- valeraldehyde

Group D – atmospheres

- acetic acid (glacial)
- acetone
- acetonitrile
- acrylonitrile
- allyl chloride
- ammonia
- n-amyl acetate
- sec-amyl acetate
- benzene
- butane
- 1-butanol (butyl alcohol)
- 2-butanol (secondary butyl alcohol)
- n-butyl acetate
- sec-butyl acetate
- butylamine
- butylene
- chlorobenzene
- chloroprene
- cyclohexene
- cyclopropane
- 1, 1-dichloroethane
- 1, 2-dichloroethylene
- 1, 3-dichloropropene
- di-isobutylene
- ethane
- ethanol (ethyl alcohol)
- ethyl acetate
- ethyl acrylate (inhibited)
- ethyl benzene
- ethyl chloride
- ethyl formate
- ethylamine
- ethylene dichloride
- ethylene glycol monomethyl ether
- ethylenediamine (anhydrous)
- gasoline
- heptane
- heptene
- hexane
- 2-hexanone
- hexenes
- isoamyl acetate
- isoamyl alcohol
- isobutyl acrylate
- isoprene
- isopropyl acetate
- isopropyl ether
- isopropylamine
- liquefied petroleum gas
- mesityl oxide
- methane (nature gas)
- methanol (methyl alcohol)
- methyl acetate
- methyl acrylate
- methyl ethyl ketone
- methyl formate
- methyl isobutyl ketone
- methyl isocyanate
- methyl methacrylate
- 2-methyl-1-propanol (isobutyl alcohol)
- 2-methyl-2-propanol (tertiary butyl alcohol)
- methylamine
- methylcyclohexane
- naphtha (petroleum)
- nonane
- nonene
- octane
- octene
- pentane
- 1-pentanol (amyl alcohol)
- 2-pentanone
- 1-pentene
- petroleum naphtha
- propane
- 1-propanol (propyl alcohol)
- 2-propanol (isopropyl alcohol)
- n-propyl acetate
- propylene
- propylene dichloride
- propylene oxide
- pyridine
- styrene
- toluene
- tripropylamine
- turpentine
- vinyl acetate
- vinyl chloride
- vinylidene chloride
- xylenes

Group E – atmospheres

Atmospheres containing combustible metal dusts regardless of resistivity, or other combustible dusts of similarly hazardous characteristics having resistivity of less than 105 Ωcm.

Group F – atmospheres

Atmospheres containing carbon black, charcoal, coal or coke dusts that have more than 8% total volatile material (carbon black per ASTM D1620; charcoal, coal and coke dusts per ASTM D271) or atmospheres containing these dusts sensitized by other materials so that they present an explosion hazard, and having resistivity greater than 102 Ωcm but equal to or less than 108 Ωcm.

Group G – atmospheres

Atmospheres containing combustible dusts having resistivity of 105 Ωcm or greater.

Hazardous locations cross reference

Table 6

Maximum recommended wire length

IEC		North America	
Zone 0	Intrinsically safe apparatus of category ia or other apparatus, both specifically approved for Zone 0.	**Class I, Division 1**	Some users recognize the Zone 0 principle without using the name and would only install apparatus suitable for Zone 0 operation in such areas.
Zone 1	All equipment certified for Zone. Apparatus with type(s) of protection: • "d" flameproof enclosure • "e" increased safety • "i" intrinsic safety (ia and ib) • "o" oil immersion • "p" pressurized apparatus • "q" powder filling • "s" special protection In future: • "m" moulding		Apparatus with type(s) of protection: • Explosion-proof enclosures • Purging • Intrinsic safety • Oil immersion
Zone 2	All equipment certified for Zone 0 or 1. Apparatus with type of protection: • "n" non-sparking/non-incendive	**Class I, Division 2**	All equipment certified for Division 1. Apparatus incapable of creating sparks or hot surfaces capable of ignition in "general purpose" enclosures, ANSI/ISA-S1212-1986.*

* Electrical equipment for use in Class I, Division 2 hazardous (classified) locations.

Industry reference information

What's in a rating?

As a way of standardizing enclosure performance, organizations like NEMA, UL, CSA, IEC and TUV Rheinland use rating systems to identify an enclosure's ability to repel the outside environment. Resistance to everything from dripping liquid to hose-down to total submersion is defined by the ratings system.

While these ratings are all intended to provide information to help you make a safer, more informed product choice, there are differences between them. NEMA, UL and CSA are the organizations most commonly referred to in North America. Their ratings are based on similar application descriptions and expected performance. UL and CSA both require enclosure testing by qualified evaluators in their labs. They also send site inspectors to make sure a manufacturer adheres to prescribed manufacturing methods and material specifications. NEMA, on the other hand, does not require independent testing and leaves compliance completely up to the manufacturer.

In Europe, TUV-IEC ratings are based on test methods that are similar to UL and CSA. Nevertheless, there are differences in how enclosure performance is interpreted. For example, UL and CSA test requirements specify that even a single drop of water entering an enclosure is considered a test failure. In the IEC standards for each protection level (IP), a certain amount of water is allowed to enter the enclosure.

North American enclosure rating systems also include a 4X rating that indicates resistance to corrosion. This rating is based on the enclosure's ability to withstand prolonged exposure to salt water spray.

While a 4X rating is a good indicator that an enclosure can resist corrosion, it does not provide information on how a specific corrosive agent will affect a given enclosure material.

Comparison of specific non-hazardous applications

Outdoor locations

Table 7

Comparison of specific non-hazardous applications (outdoor loctions)

Provides a degree of protection against the following environmental conditions:	Type of enclosure 4	4X	Provides a degree of protection against the following environmental conditions:	Type of enclosure 4	4X
Incidental contact with the enclosed equipment	●	●	Hose-down	●	●
Rain, snow and sleet*	●	●	Corrosive agents		●
Sleet			Occasional temporary submersion		
Windblown dust	●	●	Occasional prolonged submersion		

* External operating mechanisms are not required to be operable when the enclosure is ice covered.

Indoor locations

Table 8

Comparison of specific non-hazardous applications (indoor loctions)

Provides a degree of protection against the following environmental conditions:	Type of enclosure 4	4X	12	13	Provides a degree of protection against the following environmental conditions:	Type of enclosure 4	4X	12	13
Incidental contact with the enclosed equipment	●	●	●	●	Oil and coolant seepage			●	●
Falling dirt	●	●	●	●	Oil or coolant spraying and splashing				●
Falling liquids and light splashing	●	●	●	●	Corrosive agents		●		
Dust, lint, fibers and flyings*	●	●	●	●	Occasional temporary submersion				
Hose-down and splashing water	●	●			Occasional prolonged submersion				

* These fibers and flyings are non-hazardous materials and are not considered Class III type ignitable fibers or combustible flyings. For Class III type ignitable fibers or combustible flyings, see the National Electrical Code, Section 500-6(a).

Enclosures for non-hazardous locations

Table 9

Enclosures for non-hazardous locations

Type designation	Canadian Standards Association (Standard C22.2 Number 94)	NEMA National Electrical Manufacturers Association (NEMA Standard 250) and Electrical and Electronic Manufacturers Association of Canada (EEMAC)
1	General purpose enclosure; protects against accidental contact with live parts.	Enclosures are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment or locations where unusual service conditions do not exist.
2	Indoor use to provide a degree of protection against dripping and light splashing of non-corrosive liquids and falling dirt.	Enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt.
3	Indoor or outdoor use; provides a degree of protection against rain, snow and windblown dust; undamaged by the external formation of ice on the enclosure.	Enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain and sleet; undamaged by the formation of ice on the enclosure.
3R	Indoor or outdoor use; provides a degree of protection against rain and snow; undamaged by the external formation of ice on the enclosure.	Enclosures are intended for outdoor use primarily to provide a degree of protection against falling rain and sleet; undamaged by the formation of ice on the enclosure.
4	Indoor or outdoor use; provides a degree of protection against rain, snow, windblown dust, splashing and hose-directed water; undamaged by the external formation of ice on the enclosure.	Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water and hose-directed water; undamaged by the formation of ice on the enclosure.
4X	Indoor or outdoor use; provides a degree of protection against rain, snow, windblown dust, splashing and hose-directed water; undamaged by the external formation of ice on the enclosure; resists corrosion.	Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water and hose-directed water; undamaged by the formation of ice on the enclosure.
6	Indoor or outdoor use; provides a degree of protection against the entry of water during temporary submersion at a limited depth; undamaged by the external formation of ice on the enclosure; resists corrosion.	Enclosures are intended for use indoors or outdoors where occasional submersion is encountered.
12	Indoor use; provides a degree of protection against circulating dust, lint, fibers and flyings; dripping and light splashing of non-corrosive liquids; not provided with knockouts.	Enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids.
13	Indoor use; provides a degree of protection against circulating dust, lint, fibers and flyings; seepage and spraying of non-corrosive liquids, including oils and coolants.	Enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil and non-corrosive coolant.

The preceding descriptions are not intended to be complete representations of National Electrical Manufacturers Association standards for enclosures nor those of the Electrical and Electronic Manufacturers Association of Canada.

Enclosures for non-hazardous locations (continued)

Table 9 (continued)

Enclosures for non-hazardous locations

Type designation	Underwriters Laboratories Inc. (UL 50 and UL 508)
1	Indoor use primarily to provide protection against contact with the enclosed equipment and against a limited amount of falling dirt.
2	Indoor use to provide a degree of protection against limited amounts of falling water and dirt.
3	Outdoor use to provide a degree of protection against windblown dust and windblown rain; undamaged by the formation of ice on the enclosure.
3R	Outdoor use to provide a degree of protection against falling rain; undamaged by the formation of ice on the enclosure.
4	Either indoor or outdoor use to provide a degree of protection against falling rain, splashing water and hose-directed water; undamaged by the formation of ice on the enclosure; resists corrosion.
4X	Either indoor or outdoor use to provide a degree of protection against falling rain, splashing water and hose-directed water; undamaged by the formation of ice on the enclosure; resists corrosion.
6	Indoor or outdoor use to provide a degree of protection against entry of water during temporary submersion at a limited depth; undamaged by the formation of ice on the enclosure.
12	Indoor use to provide a degree of protection against dust, dirt, fiber flyings, dripping water and external condensation of non-corrosive liquids.
13	Indoor use to provide a degree of protection against lint, dust seepage, external condensation and spraying of water, oil and non-corrosive liquids.
	Underwriters Laboratories Inc. (UL) shall not be responsible to anyone for the use of or reliance upon a UL Standard by anyone. UL shall not incur any obligation or liability of damages, including consequential damages, arising out of or connection with the use, interpretation of or reliance upon a UL standard.

International standards' IP protection classification

IEC Publication 529, Classification of Degrees of Protection by Enclosures, provides a system for specifying required enclosures of electrical equipment. IEC 529 does not specify degrees of protection against risk of explosion or conditions such as moisture (produced, for example, by condensation), corrosive vapors, fungus or vermin.

NEMA Standards Publication 250 does test for environmental conditions such as corrosion, rust, icing, oil and coolants. For this reason, and because the tests and evaluations for other characteristics are not identical, the IEC enclosure classification designations ***cannot*** be exactly equated with NEMA enclosure Type numbers.

Table 10 provides a cross-reference from NEMA enclosure Type numbers to IEC enclosure classification designations. This cross-reference is an approximation based on the most current available information of enclosure test performance and is not sanctioned by NEMA, IEC or any affiliated agency.

To use the table, first find the appropriate NEMA rating along the vertical axis, and then read across the horizontal axis for the corresponding IP rating. ***Do not*** use this table to convert IEC classification designations to NEMA Type numbers.

Table 10

NEMA, UL, CSA versus IEC enclosure type cross-reference (approximate)

Type of enclosure	IP23	IP30	IP32	IP64	IP65	IP66	IP67
4						●	
4X						●	
12					●		
13					●		

● indicates compliance

IEC 529 has no equivalents to NEMA enclosure types 7, 8, 9, 10 or 11.

Specification

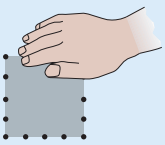
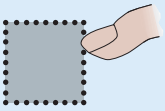
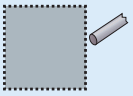
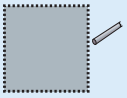
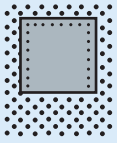
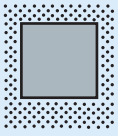
Table 11 shows the IP designation, which is as follows:

- **IPxy**, where:
  IP = Characteristic letters
  x = First characteristic numeral (protection against solid objects)
  y = Second characteristic numeral (protection against liquids)

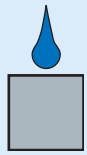
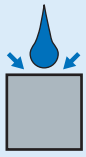
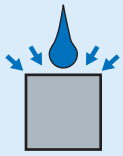
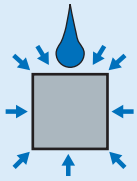
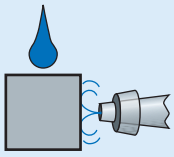
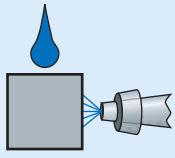
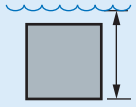
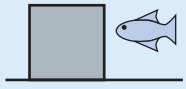
For example, an enclosure with the designation of **IP23** would specify that it is protected against the penetration of solid objects greater than 12 mm *(0.47 in.)* and against spraying water.

IP designation

First Numeral

IP		Tests
0		No protection.
1		Protected against solid objects over 50,0 mm (1.97 in.), e.g., accidental touch by hands.
2		Protected against solid objects over 12,0 mm *(0.47 in.)*, e.g., fingers.
3		Protected against solid objects over 2,5 mm *(0.10 in.)*, e.g., tools and wires.
4		Protected against solid objects over 1,0 mm *(0.04 in.)*.
5		Protected against dust (limited ingress, no harmful deposit).
6		Totally protected against dust.

First Numeral

IP		Tests
0		No protection.
1		Protected against vertically falling drops of water, e.g., condensation.
2		Protected against direct sprays of water up to 15° from vertical.
3		Protected against sprays up to 60° from vertical.
4		Protected against water sprayed from all directions (limited ingress permitted).
5		Protected against low pressure jets of water from all directions (limited ingress permitted).
6		Protected against strong jets of water.
7		Protected against the effects of immersion between 15 cm and 1 m *(between 5.9 in. and 3.3. ft.)*.
8		Protected against long periods of immersion under pressure.

Sources of standards

Underwriters Laboratories Inc.

333 Pfingsten Road
Northbrook, IL 60062

UL 50 Cabinets and Boxes
UL 508 Industrial Control Equipment
UL 870 Wireways, Auxiliary Gutters and Associated Fittings

Electrical/Electronic Manufacturers Association of Canada

10 Carlson Court
Suite 500
Rexdale (Toronto), Ontario,
Canada M9W 6L2

Canadian Standards Association

178 Rexdale Boulevard
Rexdale (Toronto), Ontario,
Canada M9W 1R3

CSA Standard C22.2 Number 94 Industrial control equipment for use in ordinary (non-hazardous) locations

International Electro-Technical Commission

3 rue de Varembé
P. Box 131
CH-1211 Geneva 20
Switzerland

IEC 529 Classification of Degrees of Protection Provided by Enclosures

National Electrical Manufacturers Association

2101 L Street Northwest
Washington, D.C. 20037

NEMA Standards Publication Number 250 Enclosures for Electrical Equipment (1 000 Volts Maximum)

NEMA Standards Publication Number ICS6 Enclosures for Industrial Controls and Systems

American National Standards Institute

1430 Broadway
New York, NY 10018

ANSI Z55.1-1967 Gray Finishes for Industrial Apparatus and Equipment

National Fire Protection Association

Batterymarch Park
Quincy, MA 02269

NFPA 70 National Electrical Code (1990)

SKF – the knowledge engineering company

From one simple but inspired solution to a misalignment problem in a textile mill in Sweden, and fifteen employees in 1907, SKF has grown to become a global industrial knowledge leader. Over the years we have built on our expertise in bearings, extending it to seals, mechatronics, services and lubrication systems. Our knowledge network includes 46 000 employees, 15 000 distributor partners, offices in more than 130 countries, and a growing number of SKF Solution Factories around the world.

Research and development

We have hands-on experience in over forty industries, based on our employees' knowledge of real life conditions. In addition our world-leading experts and university partners who pioneer advanced theoretical research and development in areas including tribology, condition monitoring, asset management and bearing life theory. Our ongoing commitment to research and development helps us keep our customers at the forefront of their industries.

Meeting the toughest challenges

Our network of knowledge and experience along with our understanding of how our core technologies can be combined helps us create innovative solutions that meet the toughest of challenges. We work closely with our customers throughout the asset life cycle, helping them to profitably and responsibly grow their businesses.

Working for a sustainable future

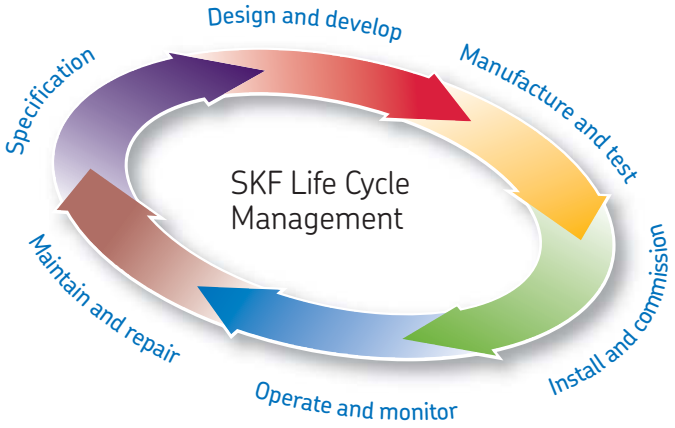
Since 2005, SKF has worked to reduce the negative environmental impact from our own operations and those of our suppliers. Our continuing technology development introduced the SKF BeyondZero portfolio of products and services which improve efficiency and reduce energy losses, as well as enable new technologies harnessing wind, solar and ocean power. This combined approach helps reduce the environmental impact both in our own operations and in our customers'.

SKF Solution Factories make SKF knowledge and manufacturing expertise available locally, to provide unique solutions and services to our customers.

Working with SKF IT and logistics systems and application experts, SKF Authorized Distributors deliver a valuable mix of product and application knowledge to customers worldwide.

Our knowledge – your success

SKF Life Cycle Management is how we combine our technology platforms and advanced services, and apply them at each stage of the asset life cycle, to help our customers to be more successful, sustainable and profitable.



Working closely with you

Our objective is to help our customers improve productivity, minimize maintenance, achieve higher energy and resource efficiency, and optimize designs for long service life and reliability.

Innovative solutions

Whether the application is linear or rotary or a combination of the two, SKF engineers can work with you at each stage of the asset life cycle to improve machine performance by looking at the entire application. This approach doesn't just focus on individual components like bearings or seals. It looks at the whole application to see how each component interacts with the next.

Design optimization and verification

SKF can work with you to optimize current or new designs with proprietary 3-D modeling software that can also be used as a virtual test rig to confirm the integrity of the design.

Bearings
SKF is the world leader in the design, development and manufacture of high performance rolling bearings, plain bearings, bearing units and housings.

Machinery maintenance
Condition monitoring technologies and maintenance services from SKF can help minimize unplanned downtime, improve operational efficiency and reduce maintenance costs.

Sealing solutions
SKF offers standard seals and custom engineered sealing solutions to increase uptime, improve machine reliability, reduce friction and power losses, and extend lubricant life.

Mechatronics
SKF fly-by-wire systems for aircraft and drive-by-wire systems for off-road, agricultural and forklift applications replace heavy, grease or oil consuming mechanical and hydraulic systems.

Lubrication solutions
From specialized lubricants to state-of-the-art lubrication systems and lubrication management services, lubrication solutions from SKF can help to reduce lubrication related downtime and lubricant consumption.

Actuation and motion control
With a wide assortment of products – from actuators and ball screws to profile rail guides – SKF can work with you to solve your most pressing linear system challenges.

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Web: www.skf.com/cm

Patents: US 4,768,380 · US 5,679,900 · US 5,845,230 · US 5,854,553 · US 5,992,237 · US 6,006,164 · US 6,199,422 · US 6,202,491 · US 6,275,781 · US 6,489,884 · US 6,513,386 · US 6,633,822 · US 6,789,025 · US 6,792,360 · WO/2003/048714 · US 5,633,811 · US 5,870,699 · US 6,437,692 · US 7,103,511 · US 7,697,492

PUB CM/P1 12000/1 EN · November 2013

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