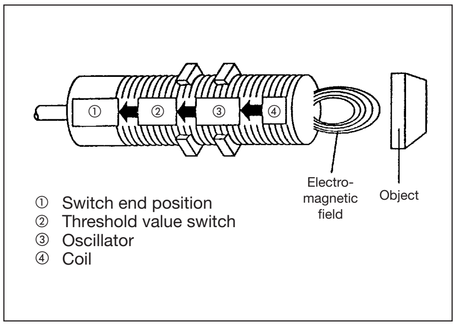
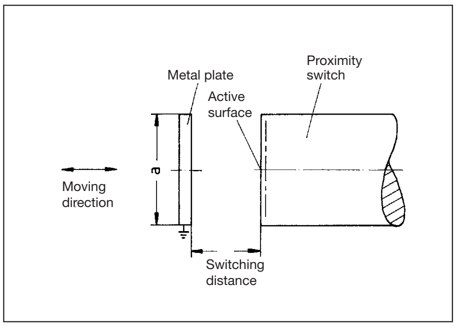
Inductive sensors

Principle of operation
In general, inductive proximity switches consist of four basic elements: the coil, an oscillator, a triggering circuit and an output switching device with short-circuit protection. The oscillator generates a high-frequency electromagnetic field, which is emitted from the coil, this in turn radiates from the sensor's sensing surface. When a metallic object enters this electromagnetic field, eddy currents are induced within the material. These eddy currents draw energy from both the electromagnetic field and the oscillator. This withdrawal of energy is called damping and increases when the metallic object is moved closer to the sensing surface. The trigger circuit activates the output switching device when a defined damping value is exceeded. For proximity switches in DC voltage units, the output switching device can be either an NPN transistor, which switches the connected load to the negative pole, or a PNP transistor, which switches the load to the positive pole. In AC voltage units a thyristor or triac can be the trigger circuit.



Sensing distance
The sensing distance of a proximity sensor is determined by the diameter of the coil used. This means that the larger the coil and diameter of the sensor, the longer the sensing range will be. The size and material of the object to be detected also affects the sensing distance.

Measuring plates
The measuring plate used to specify the sensing distance of a proximity sensor consists of a steel square (ST37) with a thickness of 1 mm. The side length is equal to the diameter of the active surface of the sensor, or three times the operating distance, whichever is greater.



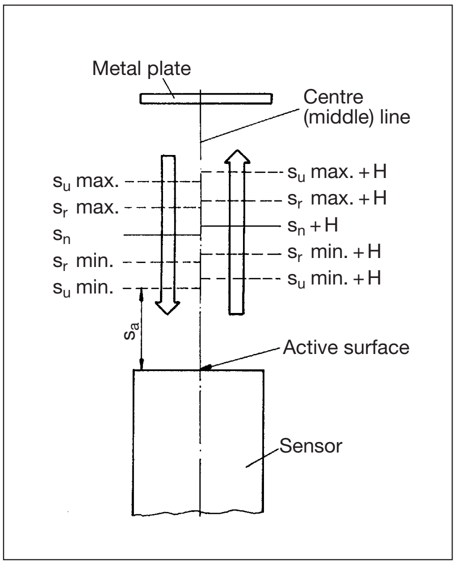
Nominal sensing distance: Sn
The nominal sensing distance of different models is a function of the diameter of the sensing coil.

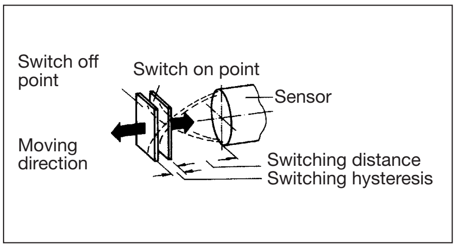
Real sensing distance: Sr
The real sensing distance is the sensing distance measured with nominal voltage and temperature. It must be between 90% and 110% of the nominal sensing distance.

Effective sensing distance: Su
The effective sensing distance is measured within the range of the admissible temperatures and voltages and must be between 90% and 110% of the real sensing distance.

Working sensing distance: Sa
(Secured sensing distance)
The working sensing distance heeds the effects of temperature, supply voltage and unit-to-unit variations. Within 0–80% of the nominal sensing distance is guaranteed if all permissible operating conditions are fulfilled.
Sa ≤ 0.8 Sn

Hysteresis: H
Hysteresis is the difference between the switch-on point as the object approaches the sensor, and the switch-off point as the object moves away. Hysteresis is stated as a percentage of the nominal sensing distance. Hysteresis is needed to keep proximity sensors from output "chattering" when subjected to vibration, slowly approaching objects, temperature drift or electrical interferences. Hysteresis is typically 10% of the nominal sensing distance.

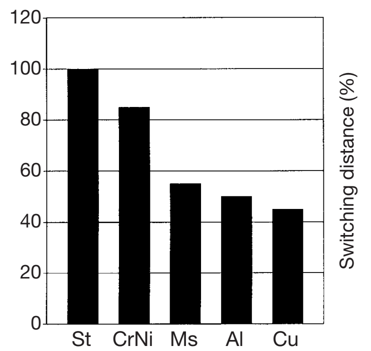




Repeat accuracy
The ability of a sensor to repeatedly detect an object at the same distance away from the sensing surface. Normally there will be a deviation of <5%.

Reduction factors

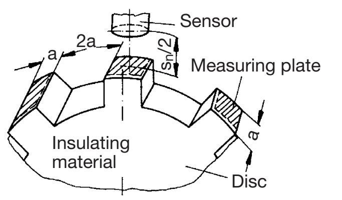
The definition of the sensing distance is based on the measurement of standardised square steel target plates. For other materials with the same dimensions, the sensing distances are reduced as displayed in the following figure:



St = Steel
CrNi = Stainless steel
Cu = Copper
Al = Aluminium
Ms = Brass

Switching frequency

A rotating, non-conductive disk on which the standard target plates are situated (size of plates as defined above) measures the switching frequency.



The distance between the measurement plates and the sensor is half of the nominal sensing distance. The maximum switching frequency is achieved when the switch-on/off output signal falls below 50 ms.

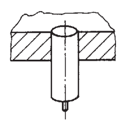
Temperature range

The normal temperature range for most sensors is from –25 °C to +70 °C (–13 °F to + 158 °F). Some sensors are available for use in extended temperature –40 °C to +100 °C applications.

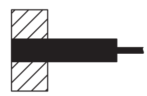
Installation

Inductive sensors contain coils which are wound in ferrite cores to point the radiated electromagnetic field in the direction of use. The core is built in to the enclosure in such a way that the field exits from the active surface. A portion of the magnetic field exits laterally. This is sufficient to prevent the sensor from being flush-installed in metal because it would activate the sensor. If a flush installation in metal is desired, a metal ring is placed around the ferrite core to restrict the lateral radiation of the field. This type of sensor is called a shielded/flush mounted sensor and will have a reduced sensing range compered to that of the unshielded/non-flush mounted type.

Flush installation

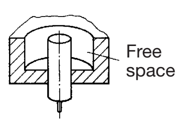


The active surface may be flush with metal surfaces.

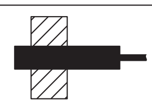


Catalogue symbol for flush installation.

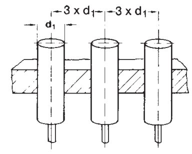
Non-flush installation



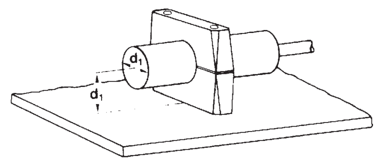
Sensors for non-flush installation must be provided with a free zone, which is three times greater than the diameter of the active surface and 25 mm thick.



Catalogue symbol for non-flush installation.



Minimum distance for the non-flush installation of sensors.



Installation with mounting flange parallel to a steel wall or surface.

Protection types

IP 65
IP 67

Materials

The sensors are encapsulated in thermoplastic housings that are reinforced by glass fibre. The power cable has a PVC or PU sheath.

Standards

All sensors correspond to the specifications of the following European standards, as devised by the European Committee for the Standardisation of Electrotechnology:

EN 60947-5-2	
CE	
IEC 255-5	Level 2
ENV 50140	Level 3
EN 61000-4-2	Level 2 Metal housing Level 3 Plastic housing
EN 61000-4-4	Level 2

NAMUR according EN 60947-5-6