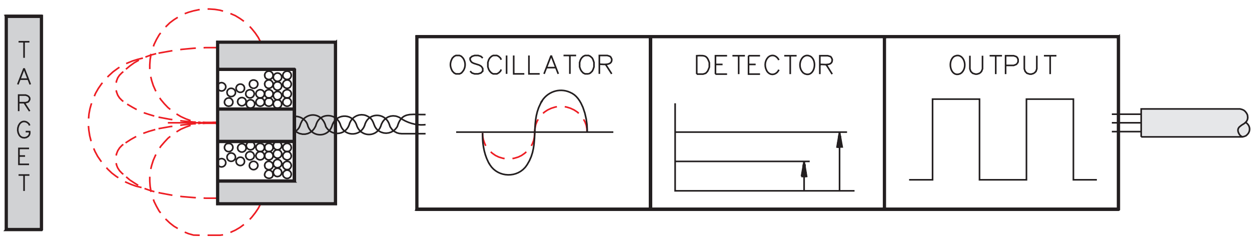
Operating Principle Ferrite Core

Figure 1



An inductive proximity sensor consists of a coil and ferrite core arrangement, an oscillator and detector circuit, and a solid-state output (Figure 1). The oscillator creates a high frequency field radiating from the coil in front of the sensor, centered around the axis of the coil. The ferrite core bundles and directs the electro-magnetic field to the front.

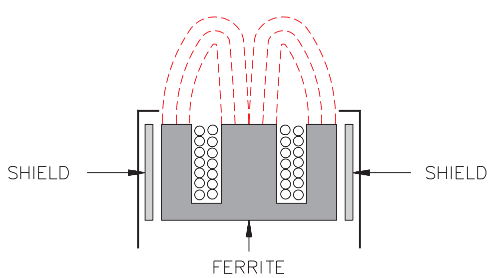
When a metal object enters the high-frequency field, eddy currents are induced on the surface of the target. This results in a loss of energy in the oscillator circuit and, consequently, a smaller amplitude of oscillation. The detector circuit recognizes a specific change in amplitude and generates a signal which will turn the solid-state output "ON" or "OFF". When the metal object leaves the sensing area, the oscillator regenerates, allowing the sensor to return to its normal state.

Embeddable (Shielded) vs. Nonembeddable (Nonshielded)

See mounting characteristics at the front of each section.

Figure 2

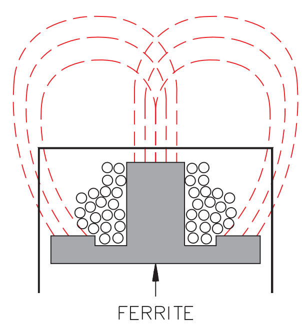
Embeddable (Shielded Sensor)



Embeddable construction includes a metal band that surrounds the ferrite core and coil arrangement. This helps to "bundle" or direct the electro- magnetic field to the front of the sensor.

Figure 3

Nonembeddable (Nonshielded Sensor)

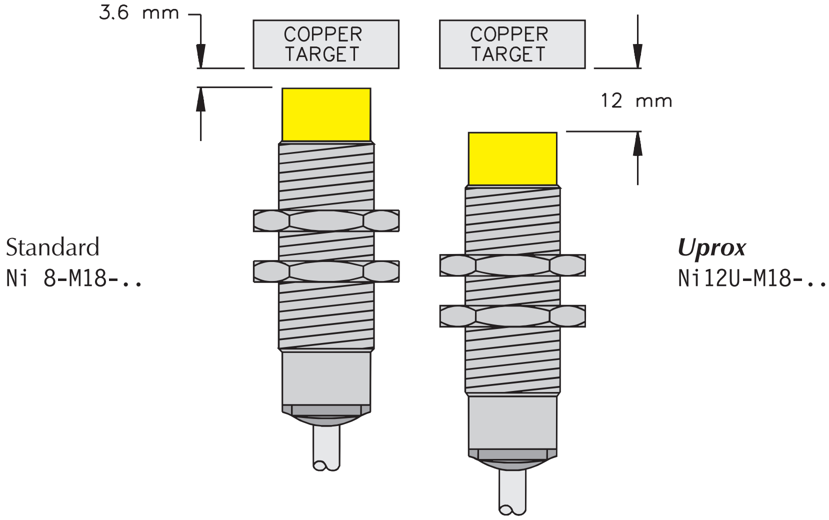


Nonembeddable sensors do not have this metal band; therefore, they have a longer operating distance and are side sensitive.

Uprox ® Characteristics

- **No Correction Factor** - Same rated operating distance for all metals.
- **Extended Operating Distance** - Up to 400% greater than standard inductive sensors when using non-ferrous targets (Figure 4).
- **Weld Field Immunity** - ***Uprox*** is unaffected by strong electromagnetic AC or DC fields because of its unique patented design.
- **High Switching Frequencies** - Up to 10 times faster than standard inductive sensors.
- **Extended Temperature Range** - ***Uprox*** can withstand temperatures up to 85°C (+185°F) with a ±15% temperature drift.

Figure 4

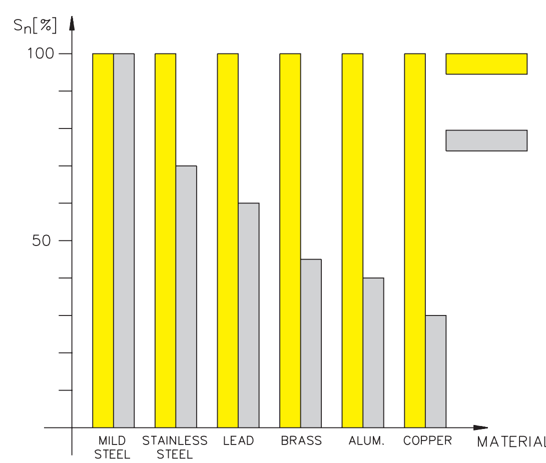


Operating Principle *Uprox* ®

TURCK ***Uprox*** is a patented next generation development of inductive sensors that uses a three-coil system. One coil induces eddy currents on the metal target and the other two coils are affected by these eddy currents. Ferrous and nonferrous metals have the same effect on the two coils. Therefore, all metals, including galvanized metals, have the same rated operating distance.

TURCK standard inductive sensors use a single coil randomly wound around a ferrite core. The single coil both induces eddy currents on the metal target and is affected by these eddy currents. Ferrous and nonferrous metals affect the sensor differently, making it impossible to detect both types of metals at the same rated operating distance.

Figure 5



Operating distances comparison of ***Uprox*** sensors and standard inductive sensors.

Operating Distance (Sensing Range) Considerations

The operating distance (S) of the different models is basically a function of the diameter of the sensing coil. Maximum operating distance is achieved with the use of a standard or larger target. Rated operating distance (Sn) for each model is given in the manual. **When using a proximity sensor the target should be within the assured range (Sa).**

Standard Target

A square piece of mild steel having a thickness of 1 mm (0.04 in) is used as a standard target to determine the following operating tolerances. The length and width of the square is equal to either the diameter of the circle inscribed on the active surface of the sensing face or three times the rated operating distance Sn, whichever is greater.

Operating Distance = S

The operating distance is the distance at which the target approaching the sensing face along the reference axis causes the output signal to change.

Rated Operating Distance = Sn

The rated operating distance is a conventional quantity used to designate the nominal operating distance. It does not take into account either manufacturing tolerances or variations due to external conditions such as voltage and temperature.

Effective Operating Distance = Sr $0.9\ Sn \leq Sr \leq 1.1Sn$

The effective operating distance is the operating distance of an individual proximity sensor at a constant rated voltage and 23°C (73°F). It allows for manufacturing tolerances.

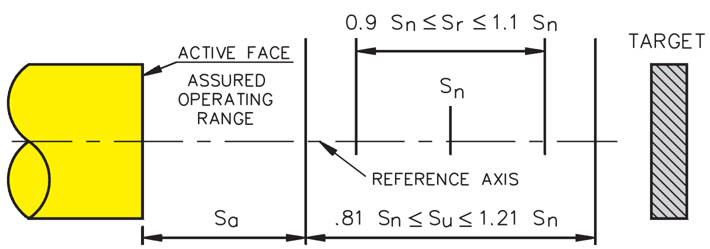
Usable Operating Distance = Su $0.81\ Sn \leq Su \leq 1.21Sn$

The usable operating distance is the operating distance of an individual proximity sensor measured over the operating temperature range at 85% to 110% of its rated voltage. It allows for external conditions and for manufacturing tolerances.

Assured Operating Range = Sa $0 \leq Sa \leq 0.81Sn$

The assured actuating range is between 0 and 81% of the rated operating distance. It is the range within which the correct operation of the proximity sensor under specified voltage and temperature ranges is assured.

Figure 6



Operating Distance (Sensing Range) Considerations

These correction factors apply to standard inductive sensors when a nonferrous target is being detected.
The correction factors are nominal values. Deviations may be due to variations in oscillator frequency, alloy composition, purity and target geometry.

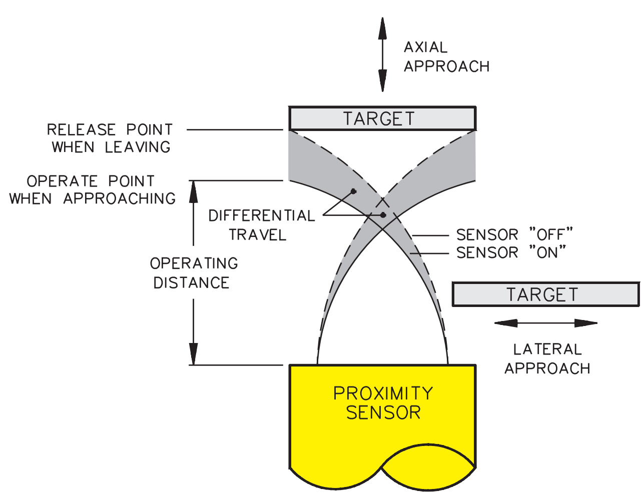
Aluminum foil	1.00
Stainless steel	0.60 to 1.00
Mercury	0.65 to 0.85
Lead	0.50 to 0.75
Brass	0.35 to 0.50
Aluminum (massive)	0.35 to 0.50
Copper	0.25 to 0.45

- Correction factors do not apply to **TURCK *Uprox*** ® sensors. These sensors see all metals at the same range.
- **TURCK** also manufactures "nonferrous only" sensors. These sensors will selectively detect nonferrous targets at the rated operating distance. They will not detect ferrous targets; however, ferrous targets positioned between them and a nonferrous target may mask the nonferrous target. The rated operating distance of these sensors is not subject to the correction factors that apply to standard inductive sensors.

Differential Travel (Hysteresis)

The difference between the "operate" and "release" points is called differential travel (See shaded area in Figure 7).
It is factory set at less than 15% of the effective operating distance.
Differential travel is needed to keep proximity sensors from "chattering" when subjected to shock and vibration, slow moving targets, or minor disturbances such as electrical noise and temperature drift.

Figure 7

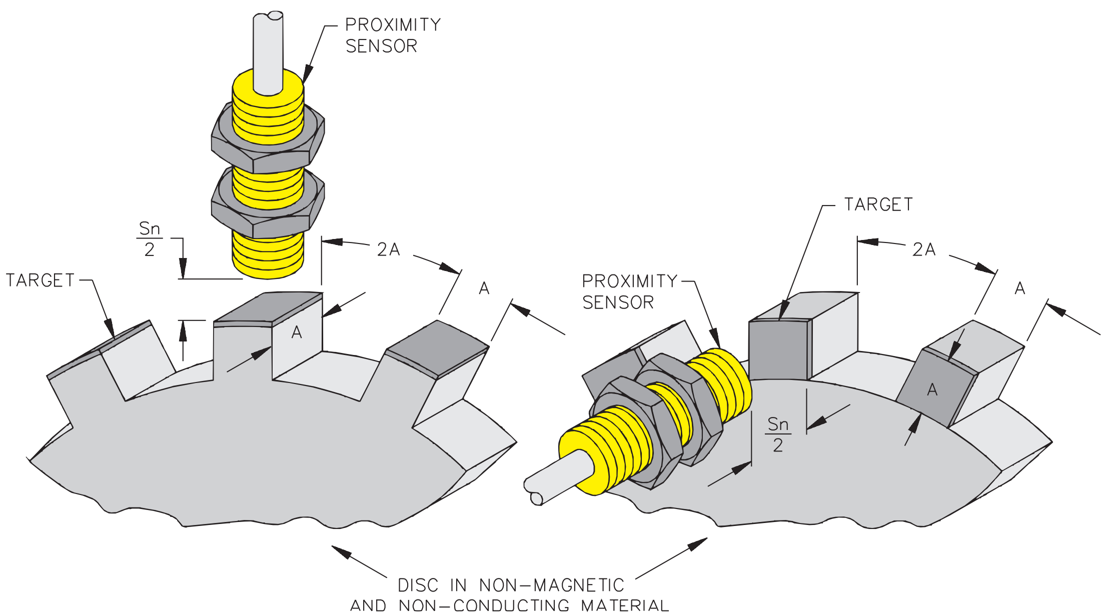


Actuation Mode

Inductive sensors can be actuated in an axial or lateral approach (See Figure 7). It is important to maintain an air gap between the target and the sensing face to prevent physically damaging the sensors.

Maximum Switching Frequency

Minimum parameters for measuring at maximum switching frequency are shown in Figure 8. Using a smaller target or space may result in a reduction of a specific sensor's maximum switching frequency and decrease sensor to target air gap tolerance. See page A40 for determining dimension "A" of **standard target**.



Weld Field Immunity

Many critical applications for proximity sensors involve their use in weld field environments. AC and DC resistance welders used in assembly equipment and other construction machines often require in excess of 20 kA to perform their weld function. Magnetic fields generated by these currents can cause false outputs in standard sensors.

TURCK has pioneered the design and development of inductive proximity sensors that not only survive such environments, but remain fully operative in them.

The limit of the weld field immunity depends on the kind of field (AC or DC), the housing size of the sensor and its location in the field. For example, in an AC or DC weld field, the "/S34" inductive sensors can be positioned one inch from a 20 kA current carrying bus. See Section H for a list of weld field immune sensors.

Reference values for magnetic induction:

	Distance [mm]			
I [kA]	**12.5**	**25**	**50**	**100**
5	80 mT	40 mT	20 mT	10 mT
10	160 mT	80 mT	40 mT	20 mT
20	320 mT	160 mT	80 mT	40 mT
50	800 mT	400 mT	200 mT	100 mT
100	1600 mT	800 mT	400 mT	200 mT

Gauss = 10 x mT