

ICS Series

Inductive round sensors

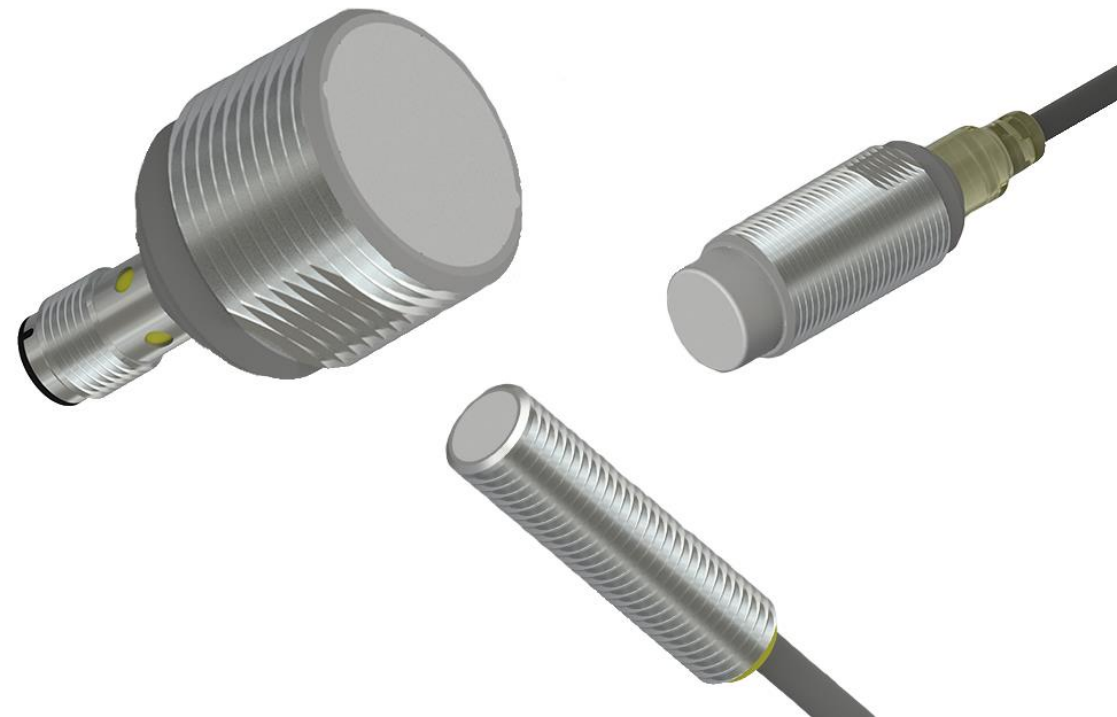




Switch off your limits



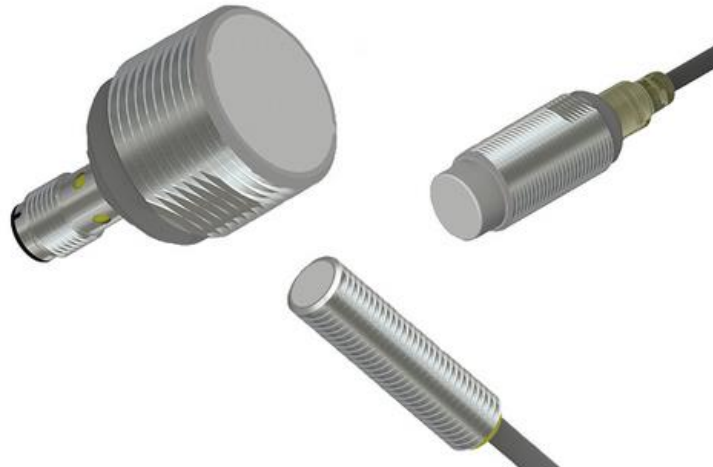
New product category
PROXIMITY SENSORS



Website – www.comepi.eu

Sensori Induttivi - Cilindrici

Sensori induttivi cilindrici, disponibili in differenti dimensioni (M8, M12, M18, M30) e connessioni elettriche. Ideali per rilevare la presenza di oggetti metallici in maniera affidabile e precisa.



Sensori induttivi - M8



Sensori induttivi - M12



Sensori induttivi - M18



Sensori induttivi - M30

Online catalogue



Available series and standard models

ICSXA Series – M8 with stainless steel enclosure

- ICSXA30F02P1020
- ICSXA30F02P1M8
- ICSXA30N04P1020
- ICSXA30N04P1M8



ICSMB Series – M12 with nickel plated brass enclosure

- ICSMB30F04P1020
- ICSMB30F04P1M12
- ICSMB30N08P1020
- ICSMB30N08P1M12



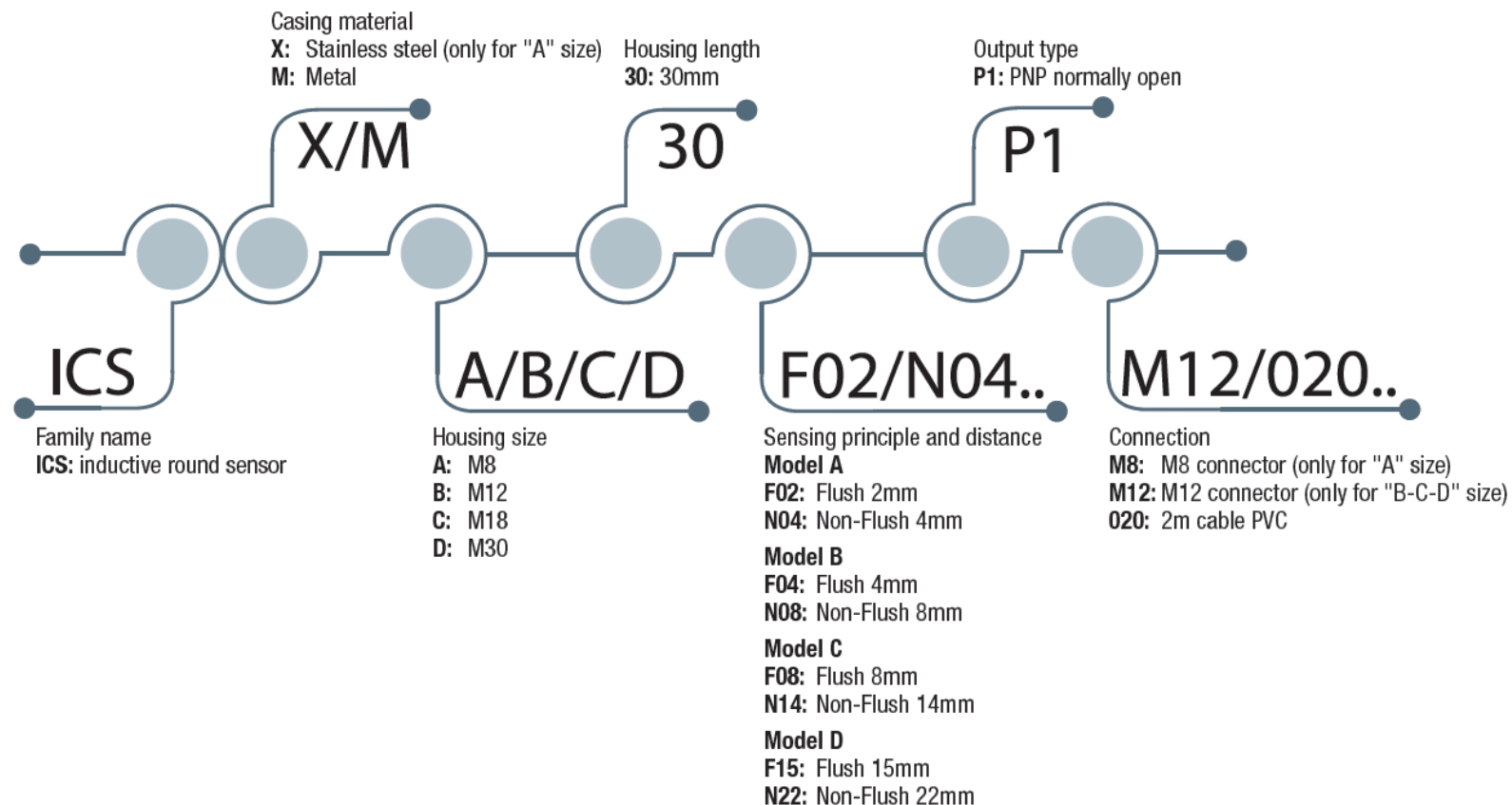
ICSMC Series – M18 with nickel plated brass enclosure

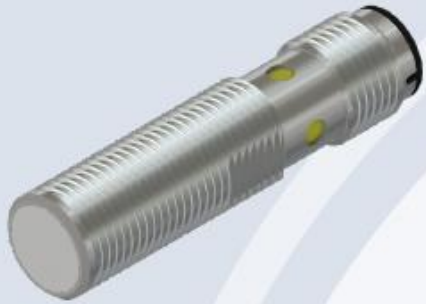
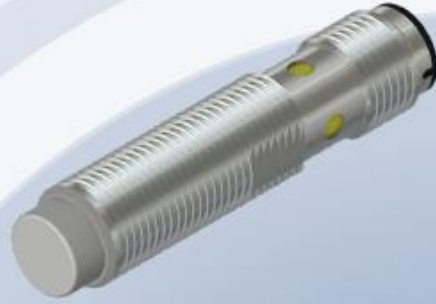
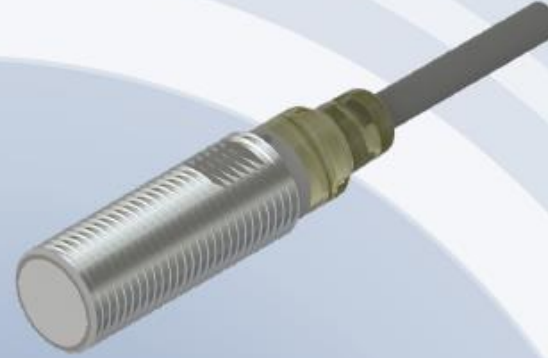
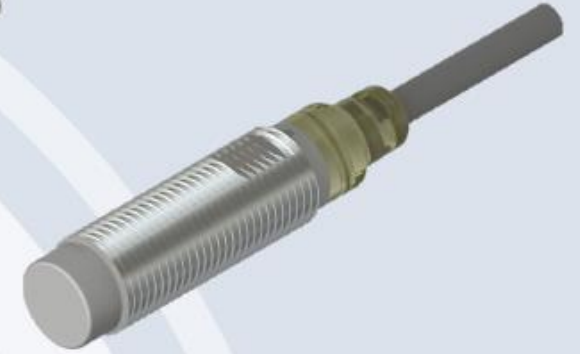
- ICSMC30F08P1020
- ICSMC30F08P1M12
- ICSMC30N14P1020
- ICSMC30N14P1M12



ICSMD Series – M30 with nickel plated brass enclosure

- ICSMD30F15P1020
- ICSMD30F15P1M12
- ICSMD30N22P1020
- ICSMD30N22P1M12

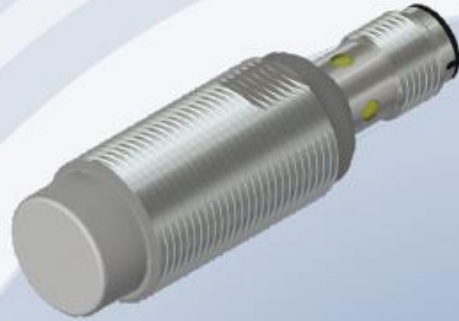
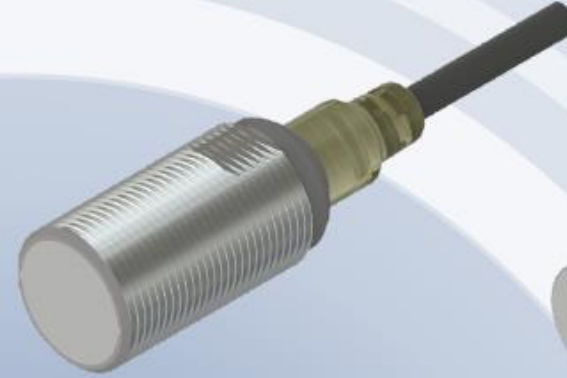



ICSMB30F04P1M12

ICSMB30N08P1M12

ICSMB30F04P1020

ICSMB30N08P1020

Nickel plated brass enclosure

Flush	Non Flush	Flush	Non Flush
Sensing distance 4mm	Sensing distance 8mm	Sensing distance 4mm	Sensing distance 8mm
PNP NO output			
Max operating frequency 2kHz			
M12 connector		2m length PVC cable	

LED for signaling and diagnostic


ICSMC30F08P1M12

ICSMC30N14P1M12

ICSMC30F08P1020

ICSMC30N14P1020

Nickel plated brass enclosure

Flush	Non Flush	Flush	Non Flush
Sensing distance 8mm	Sensing distance 14mm	Sensing distance 8mm	Sensing distance 14mm

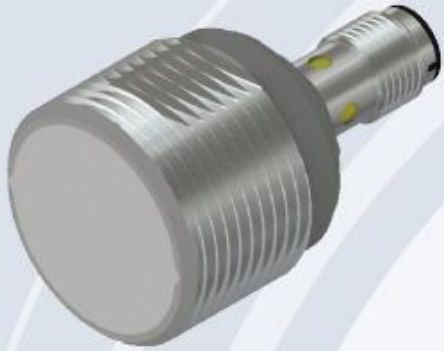
PNP NO output

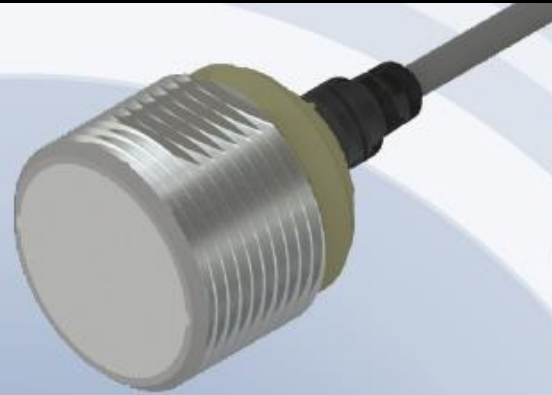
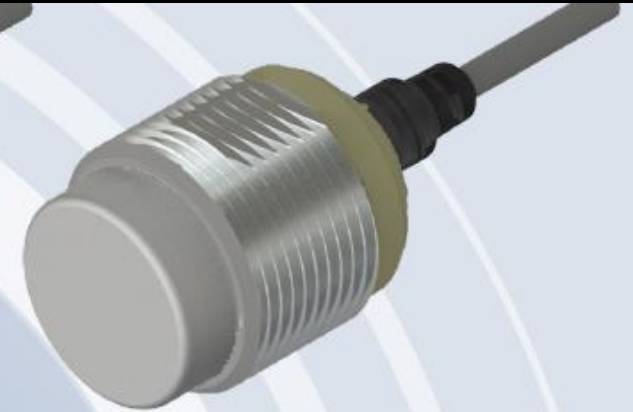
Max operating frequency 2kHz

M12 connector

2m length PVC cable

LED for signaling and diagnostic


ICSMD30F15P1M12

ICSMD30N22P1M12

ICSMD30F15P1020

ICSMD30N22P1020

Nickel plated brass enclosure

Flush	Non Flush	Flush	Non Flush
Sensing distance 15mm	Sensing distance 22mm	Sensing distance 15mm	Sensing distance 22mm

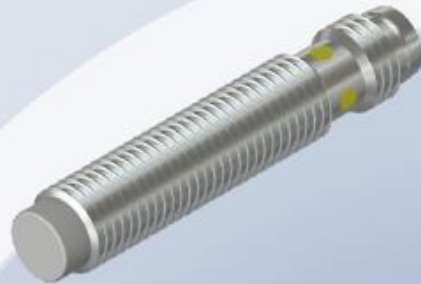
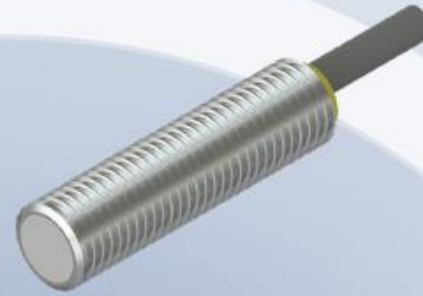
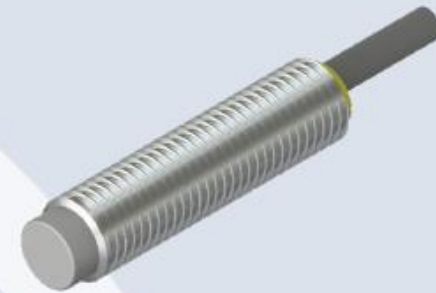
PNP NO output

Max operating frequency 2kHz

M12 connector

2m length PVC cable

LED for signaling and diagnostic


ICSXA30F02P1M8

ICSXA30N04P1M8

ICSXA30F02P1020

ICSXA30N04P1020

Stainless steel enclosure

Flush	Non Flush	Flush	Non Flush
Sensing distance 2mm	Sensing distance 4mm	Sensing distance 2mm	Sensing distance 4mm

PNP NO output

Max operating frequency 2kHz

M8 connector

2m length PVC cable

LED for signaling and diagnostic

Proximity sensors

Sensors that are able to detect the presence of an object in the nearness, without there being actual contact with it.

There are different technologies, with different characteristics of range, operating frequency and possibility of use, as well as of material that can be detected:

Inductive

Metallic objects

Capacitive

Non metallic objects

Magnetics

Magnetic targets

Ultrasound

Echo return signal

Optical

Light beam reflection

What is an inductive sensor?



The inductive sensor is a contactless proximity sensor, which signals the absence or presence of any metal object, while ignoring non-metallic objects.



The inductive sensor is characterized by reliability and ease of use, qualities that make this device the best choice of sensor for many applications in automation and robotics.



When use an inductive sensor?

- If the material to be detected is a conductive metal
- If it is necessary to detect a component at a distance less than 22mm
- If in the environment of use there is presence of dust and dirt (not metallic)
- When the number of operations required is particularly high
- When the operating frequency is particularly high



Example of application:

COMEPI electrical durability test machine

- High number of operations required
- Usage environment with dust and lubricating grease
- Up to 2 operations per second



Inductive sensors – Main features

01 Sensing face

- Flush
- Non-flush

02 Fixing

- Easy mounting
- Two nuts for sensor fixing
- Four sizes for sensor: M8, M12, M18, M30

03 Signalling

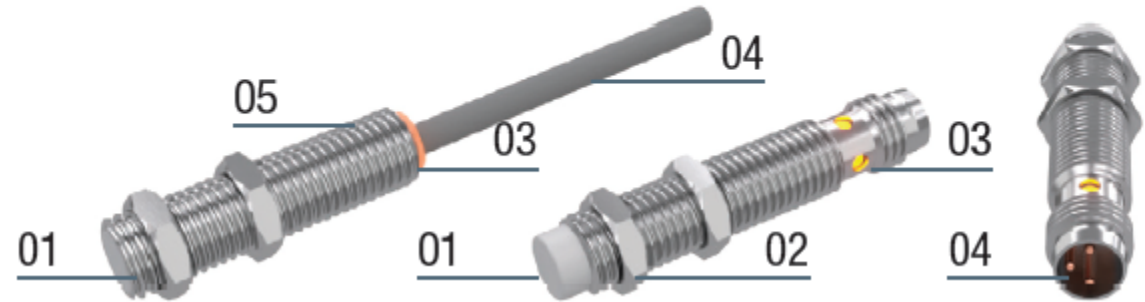
- Yellow LED visible from every angle
- Flashing output: short circuit or overload indication

04 Connection

- M8 connector
- M12 connector
- 2m cable PVC

05 Main features

- Accurate sensing and suitable for fast speed operations
- Assured traceability and best application control
- Environmentally friendly potting material

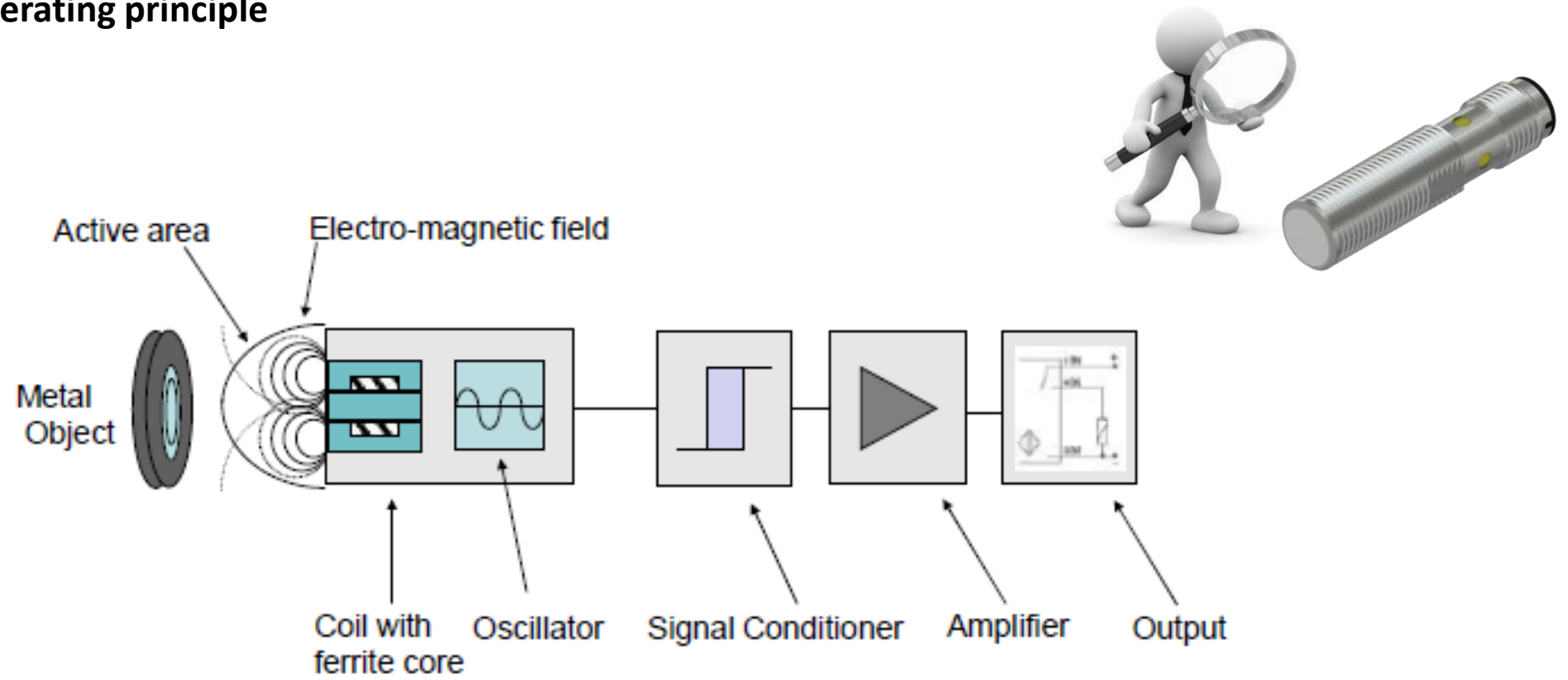


APPROVALS: UL 508

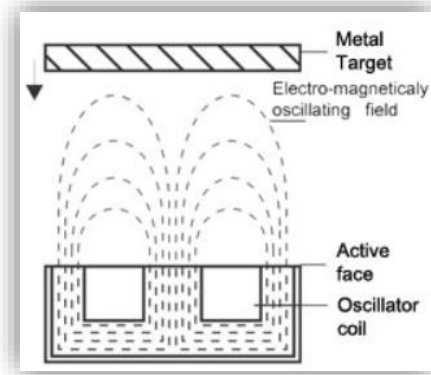
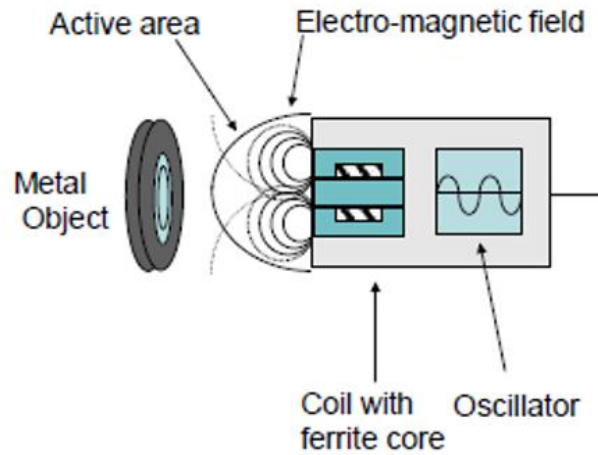
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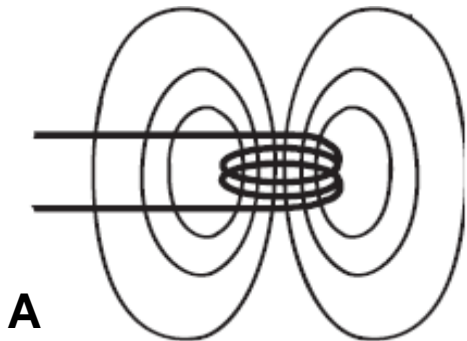
Inductive sensors – Operating principle



Inductive sensors – Operating principle

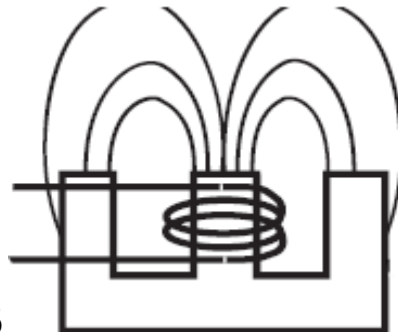


A magnetic field is generated by the flow of current inside a coil



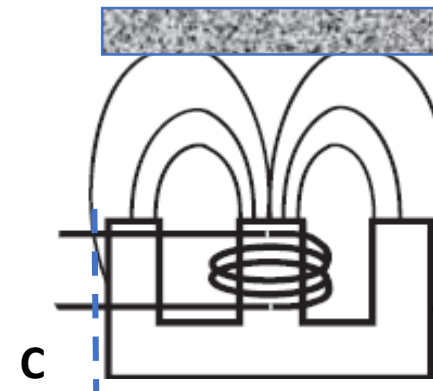
A

A ferrite core directs the magnetic field towards the front



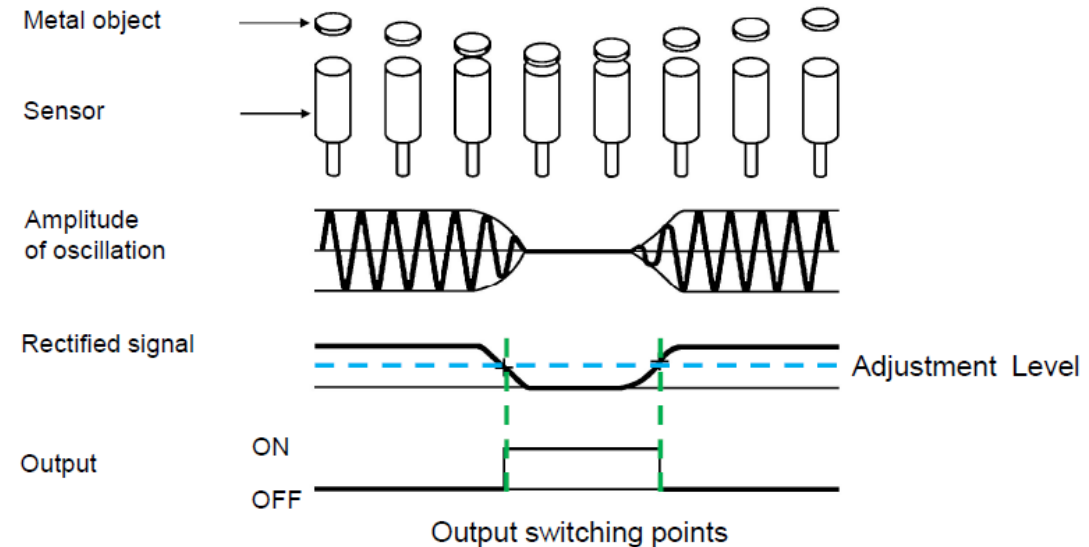
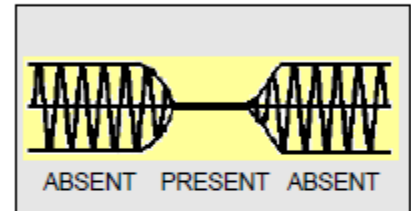
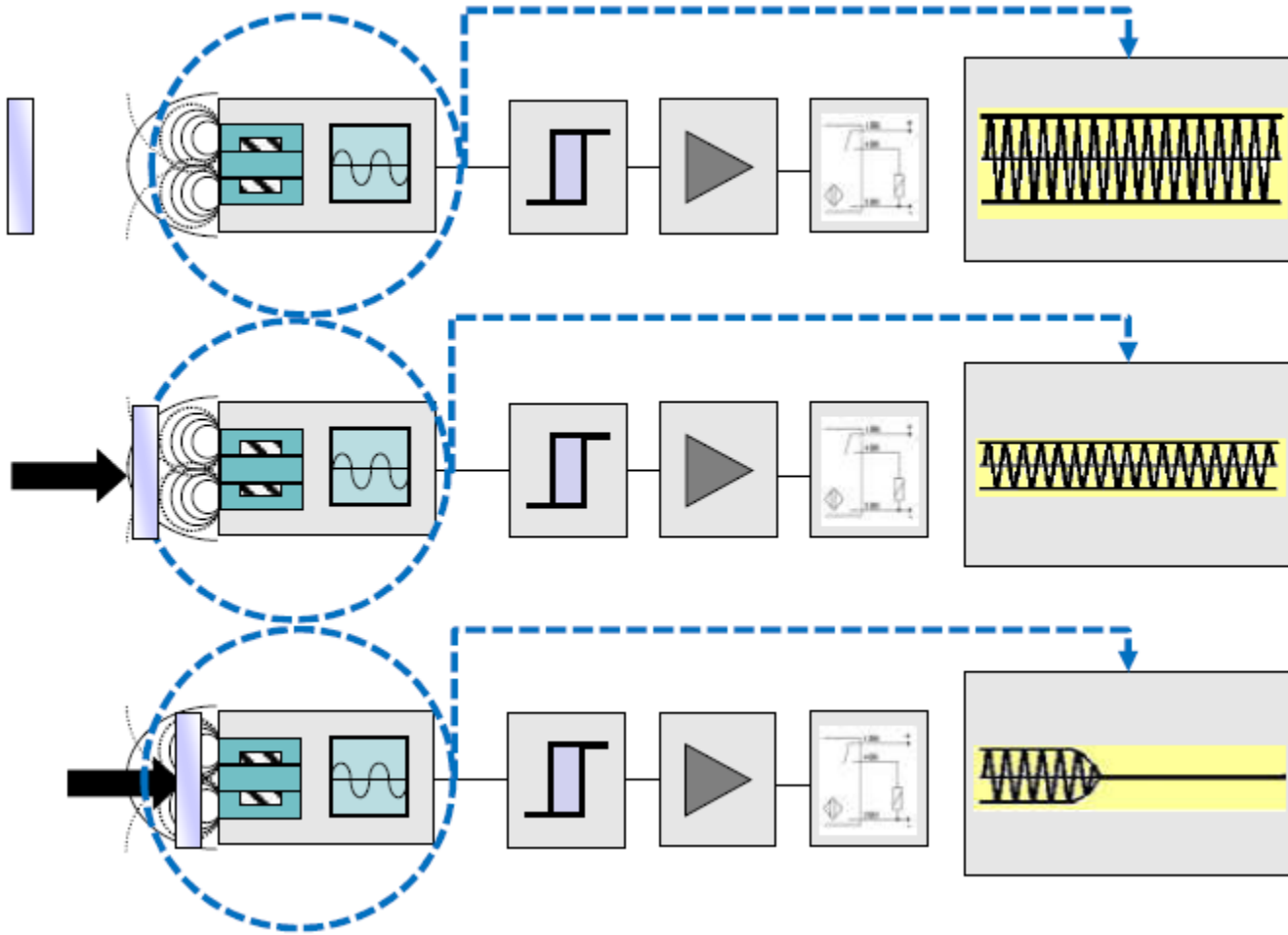
B

Any lateral shielding further directs the magnetic field, while the position of the metal target influences and modifies it.



C

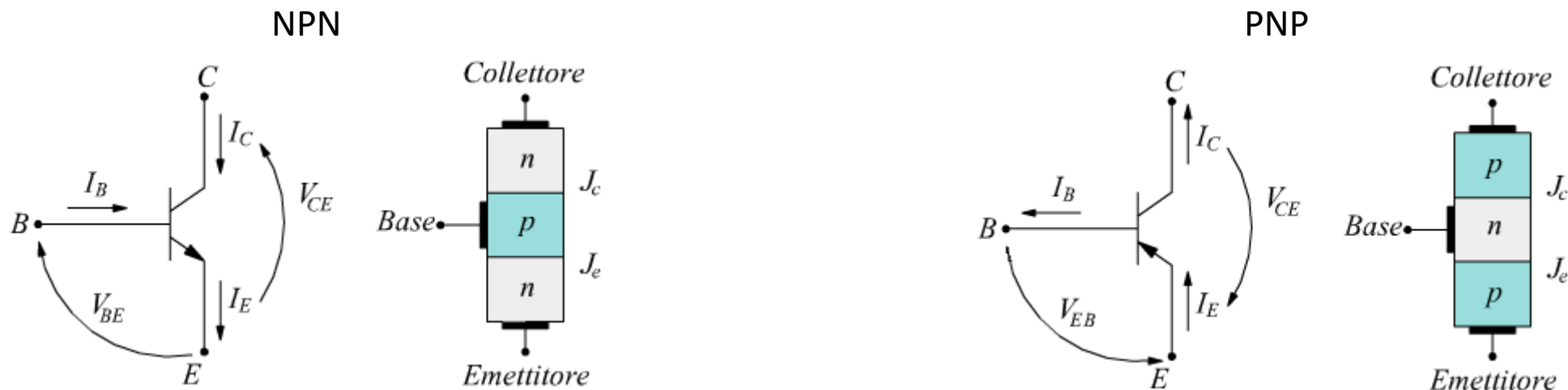
Inductive sensors – Operating principle



Inductive sensors - Output

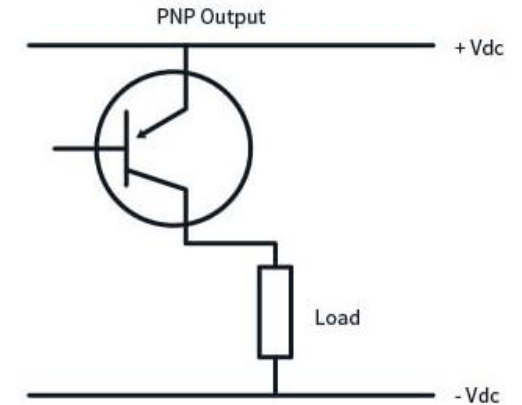
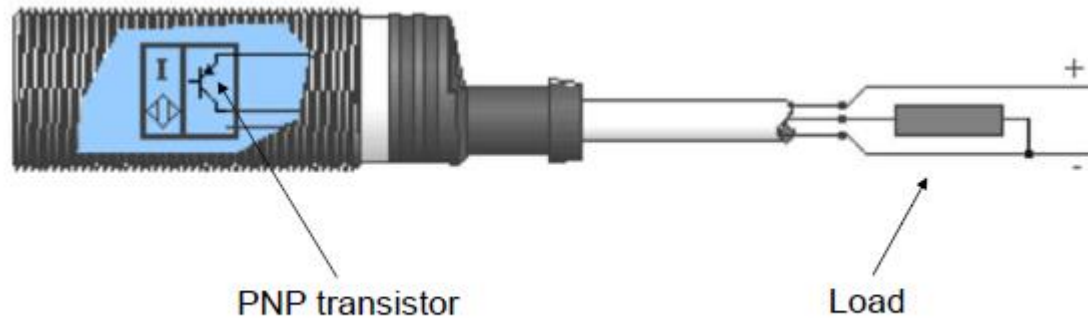
The switching of the output signal from the sensor takes place through an electronic component, a BJT transistor which is controlled in current to allow it to function as a switch, exploiting its interdiction and saturation zones.

The BJT consists of three adjacent N and P doped semiconductor regions
There are two possible versions of transistors that can be obtained:

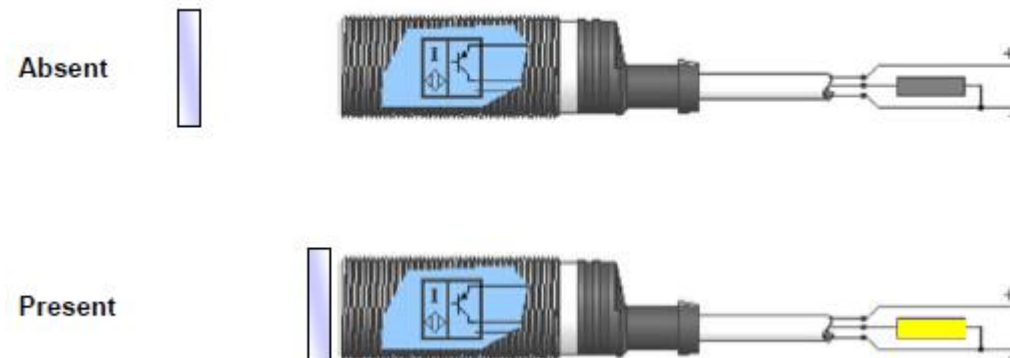


Inductive sensors – PNP output

When the PNP transistor is ON the current starts flowing through the transistor to the load. The output makes available a signal with positive polarity.

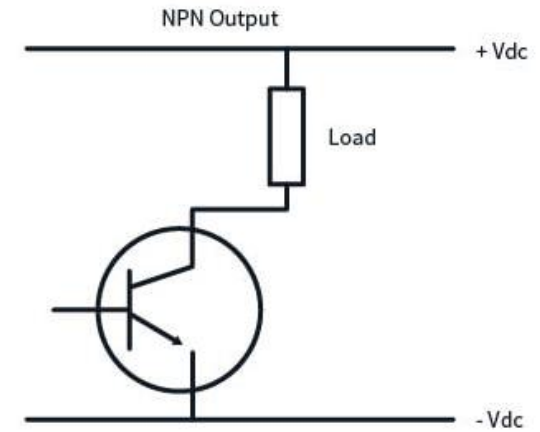
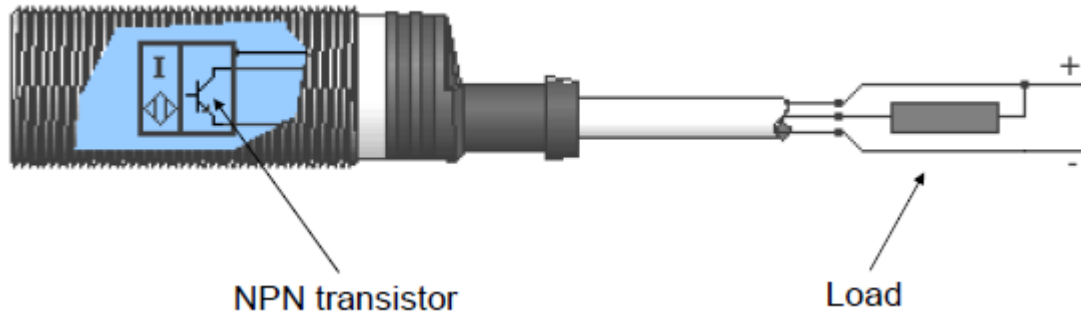


For example, the operation for a PNP type NO output is as follows:

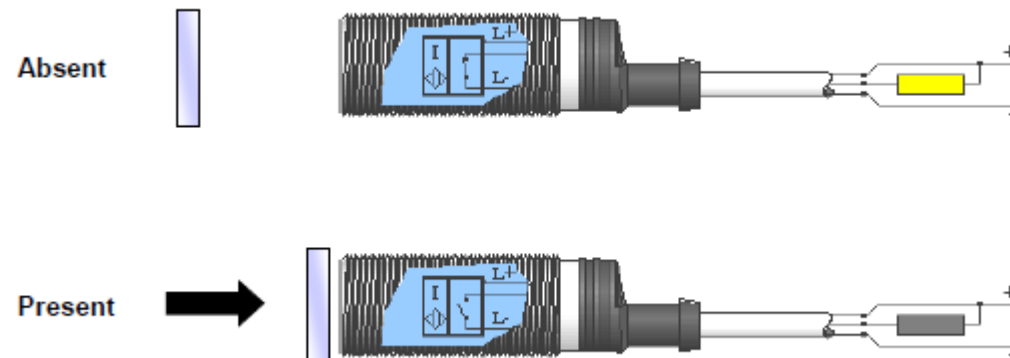


Inductive sensors – NPN output

When the NPN transistor is ON the current starts flowing through the load to the transistor.
The output makes available a signal with negative polarity.



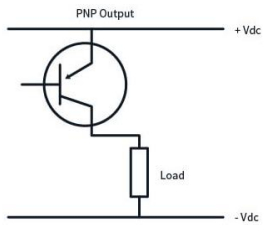
For example, the operation for an NPN type NC output is as follows:



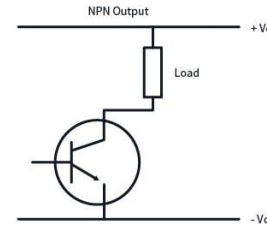


Inductive sensors – Output type – Which one to choose?

The vast majority of times the choice is dictated by the geographical area of the customer or the PLC to be connected.



PNP
type is mainly used in
Europe



In Asia, the NPN type is
still frequently used

Inductive sensors – Normal state of the output

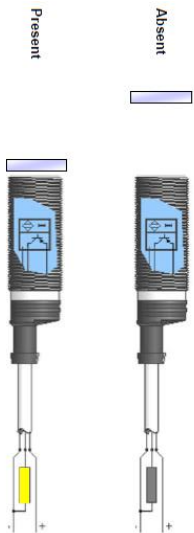
The output can be commanded as an open contact (working in the interdiction zone) or as a closed contact (working in the saturation zone).

The NORMAL situation is that relating to a sensor not activated by the target.

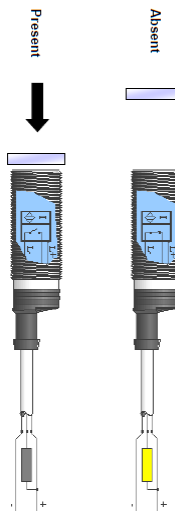
There are three types of normal output status:



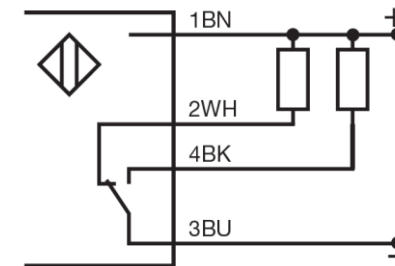
Normally open



Normally closed



1NO+1NC
Antivalent



4 wires connection

Inductive sensors – Construction type

Inductive sensors can be of two types, depending on the shield on the sensitive face.

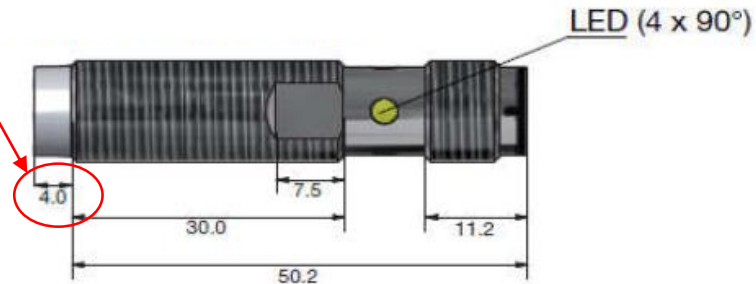
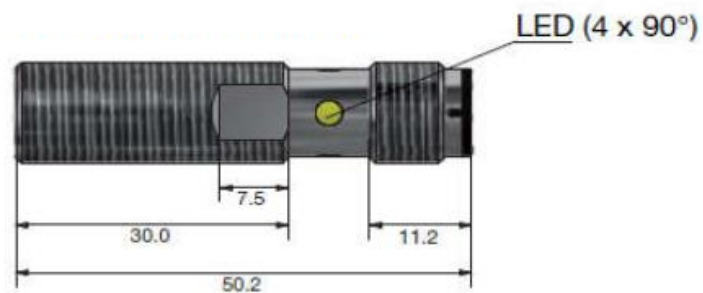
FLUSH



NON FLUSH



In FLUSH sensors the threaded metal part reaches the top of the sensor itself.
In NON FLUSH sensors, on the other hand, it stops a few millimeters from the top.



Inductive sensors – Construction type

FLUSH SENSORS

- They allow flush assembly and total embedding in the metal
- Less sensitive to mechanical damage and dirt accumulation
- They need less distance from each other to avoid mutual interference
- The presence of the shield limits the operating distance of the sensor

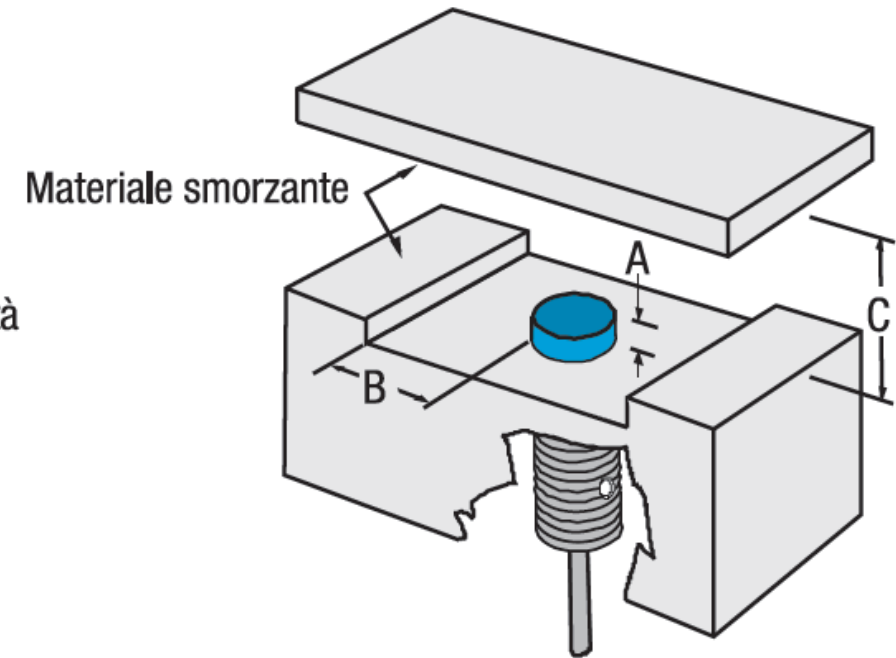
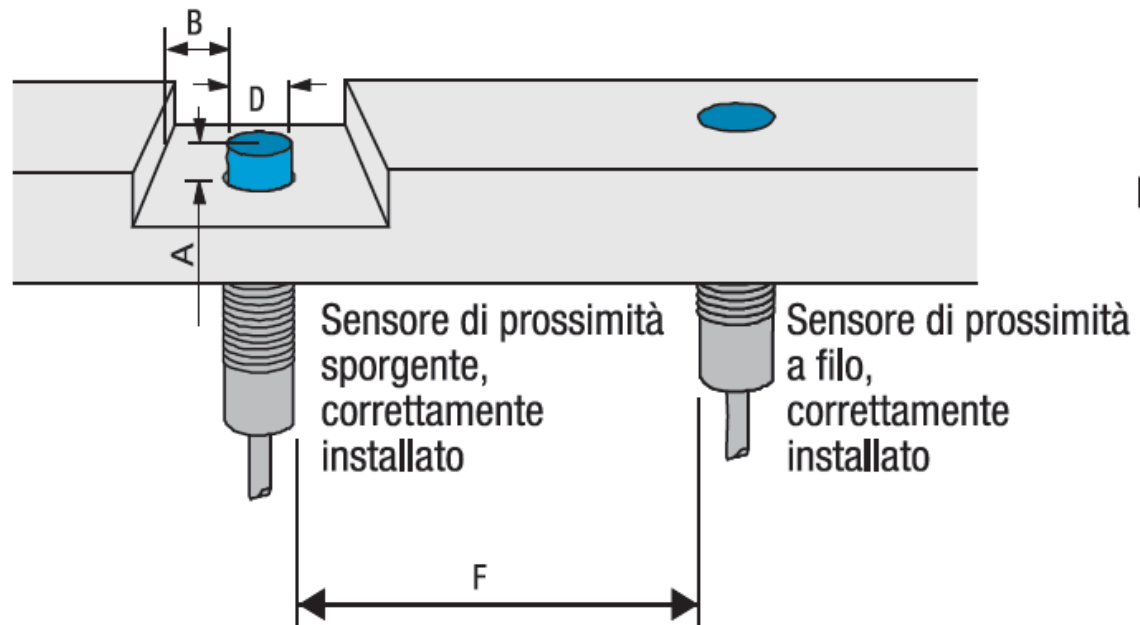


NON-FLUSH SENSORS

- More attention needs to be paid to the mounting conditions
- They are more sensitive to breakage and accumulation of dirt
- They need a greater distance from each other to avoid mutual interference
- As there is no lateral shielding, the magnetic field is not constrained and the operating distance is greater



Inductive sensors – Construction type & installation



$$A \geq 2 \cdot S_n$$

$$B \geq D \text{ for M8 – M12 – M18 sensors}$$

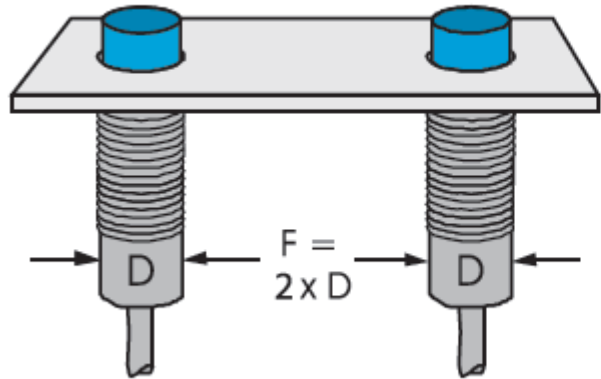
$$B \geq 1,5 \cdot D \text{ for M30 sensors}$$

$$C \geq 3 \cdot S_n$$

S_n = Rated sensing distance

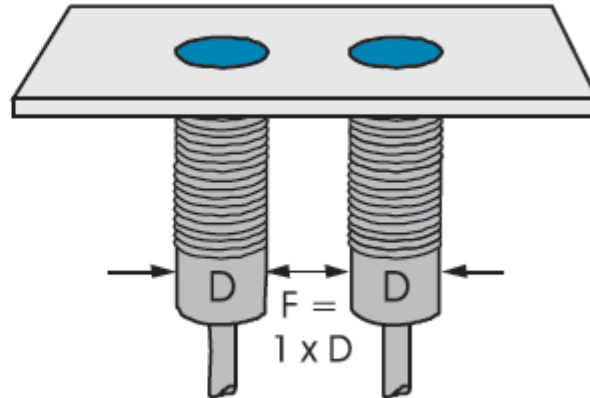
D = sensor diameter

Inductive sensors – Construction type & interferences between sensors



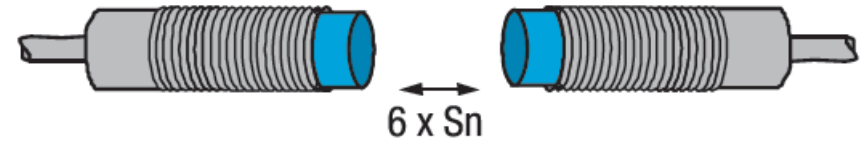
NON-FLUSH SENSORS

$F \geq 2 * D$ for M8-M12-M18 sensors
 $F \geq 4 * D$ for M30 sensors



FLUSH SENSORS

$F \geq D$



For sensors installed facing each other, a distance of at least $6 * S_n$ must be respected

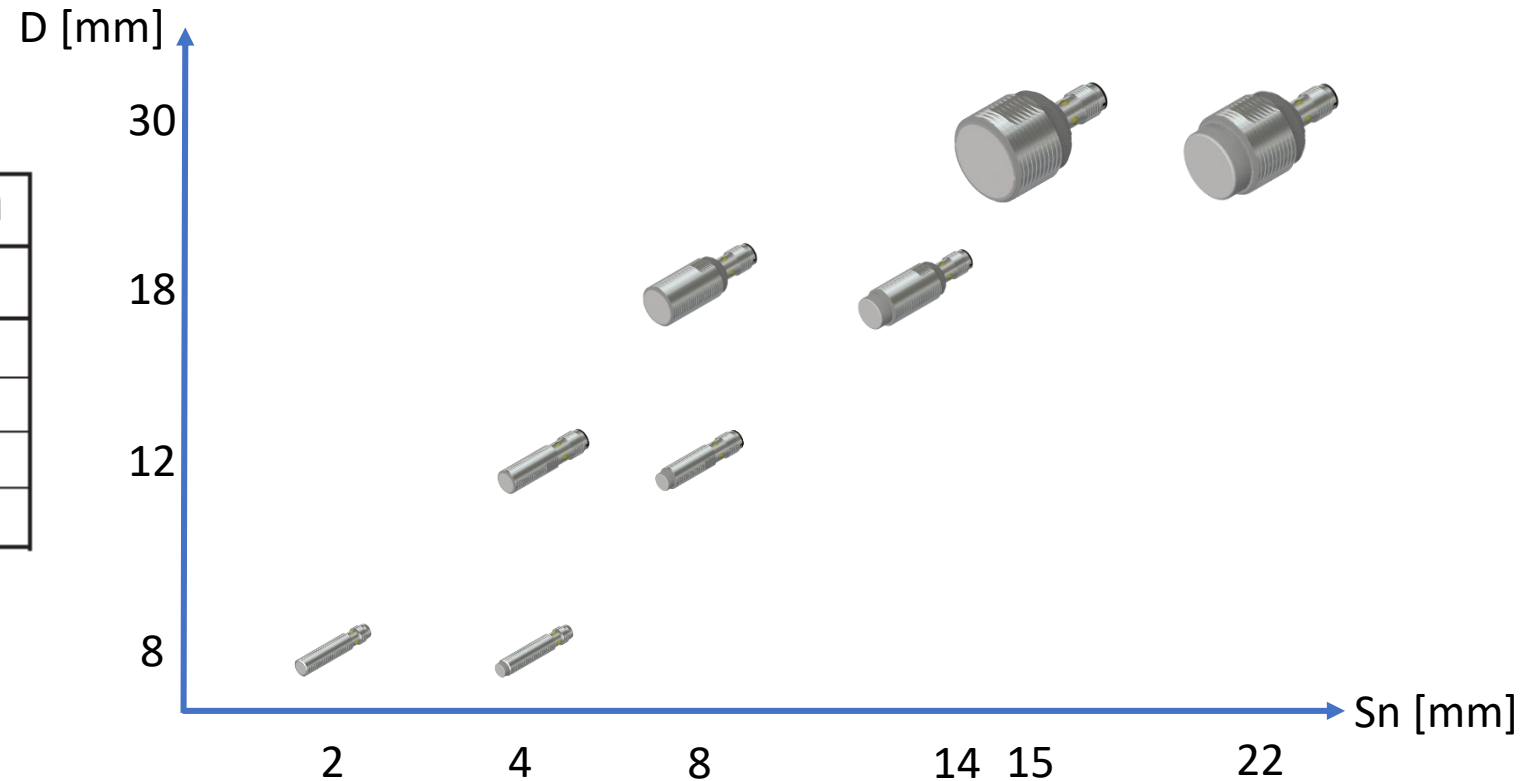
Inductive sensors – Construction type and sensing distance

The construction of the sensor has an influence on the achievable rated operating distance.

The rules to consider are the following:

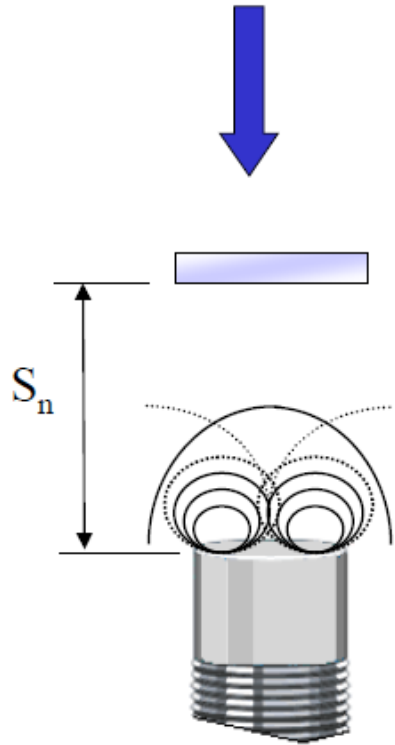
- The larger the sensor diameter the greater the rated operating distance
- NON-FLUSH sensors have longer operating distance than FLUSH sensors

Diameter (mm)	Switching distance Sn	
	flush	non flush
8	2	4
12	4	8
18	8	14
30	15	22



Inductive sensors – Rated operating distance S_n

The sensing distances for proximity sensors are defined by EN 60947-5-2, the reference standard for these products



S_n is the rated operating distance and is a purely theoretical value, measured in laboratory conditions and declared by the manufacturer as catalog data

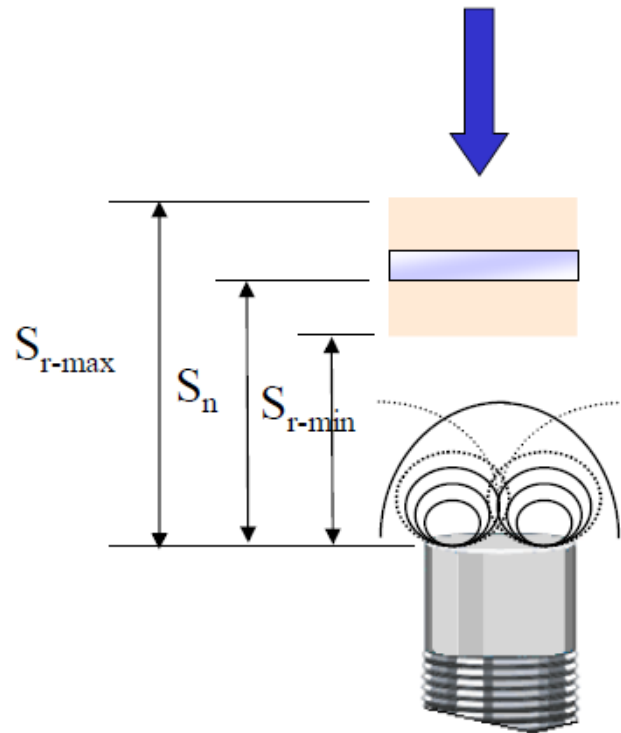
S_n does not take into account some important factors that affect the real parameter:

- Production tolerances
- Power supply of the device
- Operating temperatures
- Target material
- Target size

Diameter (mm)	Switching distance S_n	
	flush	non flush
8	2	4
12	4	8
18	8	14
30	15	22

Inductive sensors – Effective operating distance S_r

The sensing distances for proximity sensors are defined by EN 60947-5-2, the reference standard for these products



S_r is the effective operating distance.

This value is measured by powering the sensor at nominal voltage and with a room temperature of 23°C considering a tolerance of +/- 5°C

The requirement of EN 60947-5-2 is that the effective operating distance S_r is between 90% and 110% of the nominal sensing distance S_n

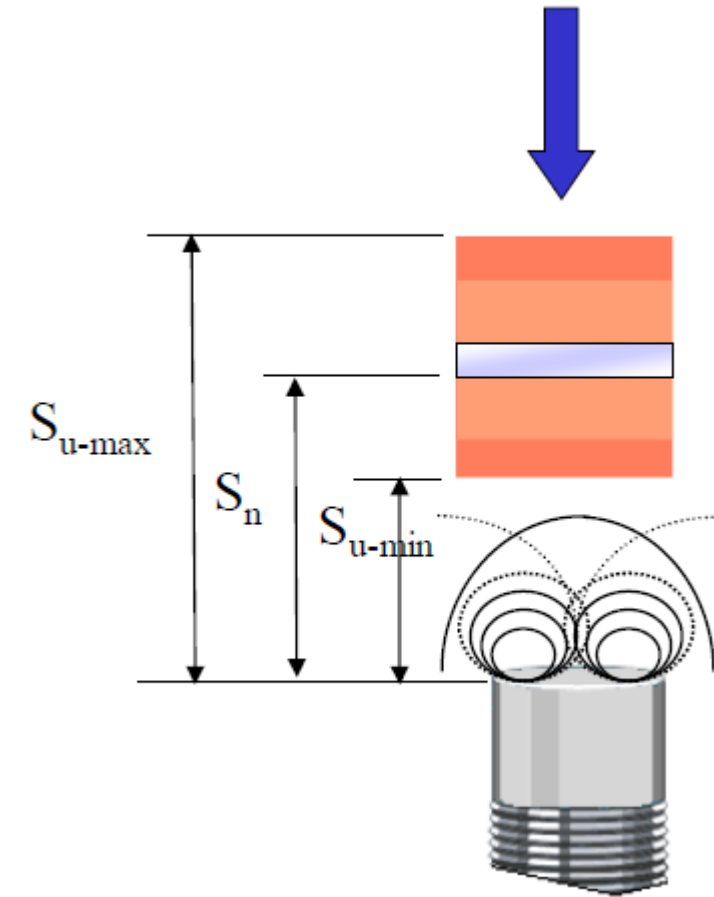
$$S_{r-\min} = 0,9 * S_n$$

$$S_{r-\max} = 1,1 * S_n$$

$$0,9 * S_n \leq S_r \leq 1,1 * S_n$$

Inductive sensors – Usable operating distance S_u

The sensing distances for proximity sensors are defined by EN 60947-5-2, the reference standard for these products



S_u is the usable operating distance.

This value is measured at limit values equal to 85% and 110% of the room temperature and of the rated power supply voltage.

The requirement of EN 60947-5-2 is that the usable sensing distance S_u is between 90% and 110% of the real sensing distance S_r

$$S_{u-min} = 0,9 * S_r = 0,81 * S_n$$

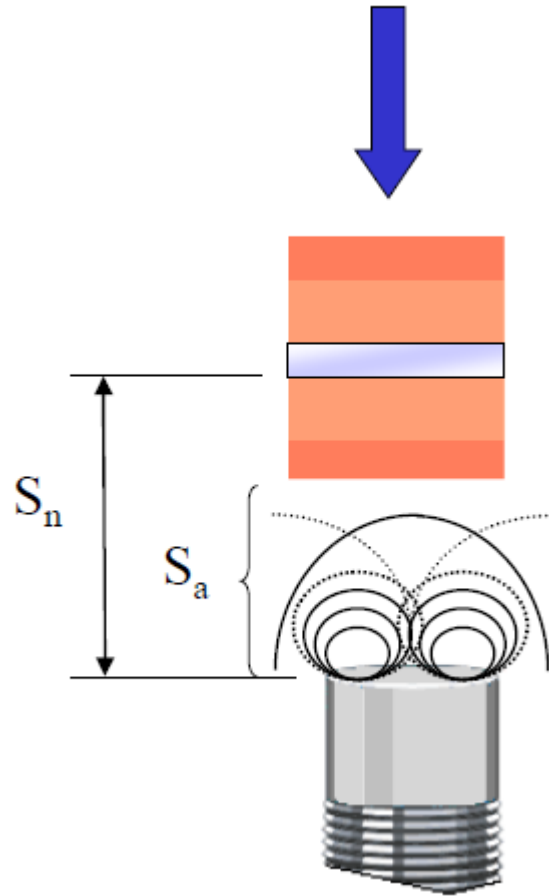
$$S_{u-max} = 1,1 * S_n = 1,21 * S_n$$

$$0,9 * S_r \leq S_u \leq 1,1 * S_r$$

$$0,81 * S_n \leq S_u \leq 1,21 * S_n$$

Inductive sensors – Assured operating distance S_a

The sensing distances for proximity sensors are defined by EN 60947-5-2, the reference standard for these products



S_a is the guaranteed operating distance.

This value is the result of the previous measurements and is between 0% and 81% of the rated operating distance S_n .

The S_a value is the value that can be relied upon in the field.

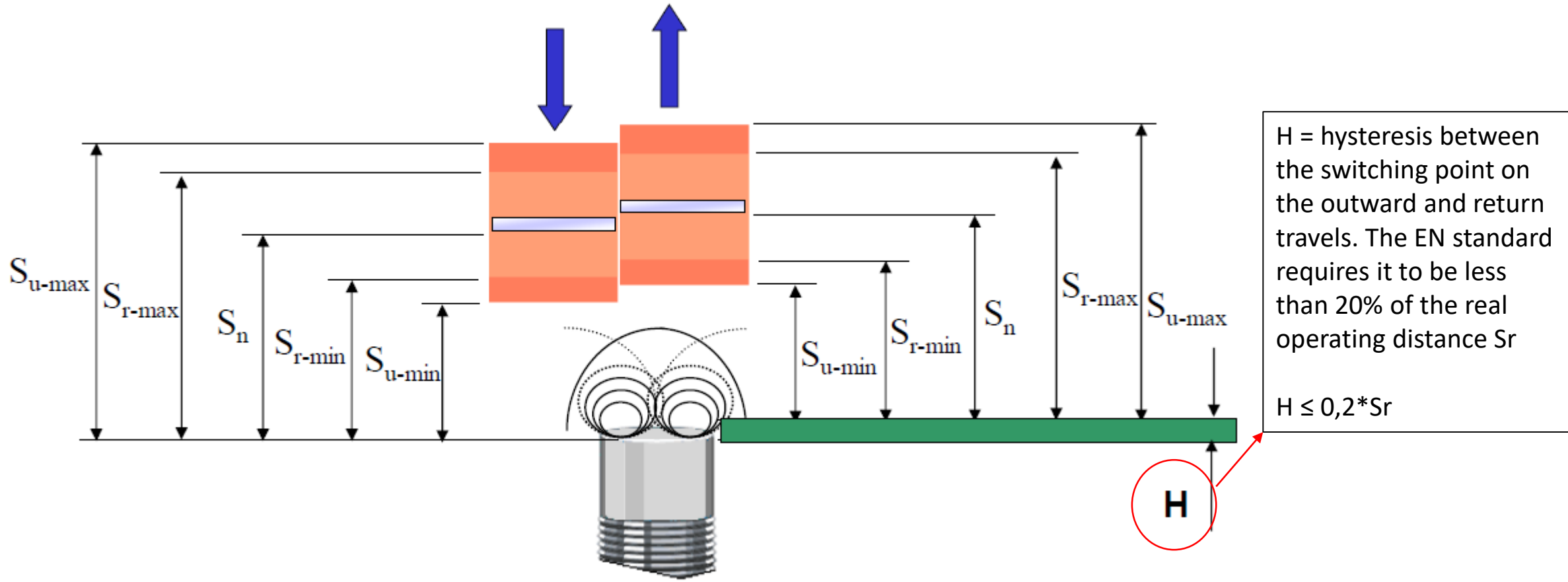
$$0 \leq S_a \leq 0,81 * S_n$$

Pay attention:

N.B. Also in this case, further application considerations must be added, such as temperature, target material and its dimensions.

Inductive sensors – Operating distances resume

The sensing distances for proximity sensors are defined by EN 60947-5-2, the reference standard for these products



Inductive sensors – Operating distance – Effect of the room temperature

The detection distances discussed are considered at room temperature or within the ranges prescribed by the EN 60947-5-2 standard

ICS round sensors have operating temperature ranges equal to:

- $-25^{\circ}\text{C} \dots +70^{\circ}\text{C}$ for ICSM sensors (M12-M18-M30)
- $-25^{\circ}\text{C} \dots +80^{\circ}\text{C}$ for ICSX sensors (M8)



Working at high temperatures can lead to an increase in the S_r -max distance and possibly go into saturation at temperatures above the limit.



Working at temperatures lower than the sensor's operating range can instead reduce the S_r -min, leading to loss of reliability in target detection.

Inductive sensors – Operating distance – Effect of the target material

Different types of material affect the variation of the magnetic field and therefore the oscillation detected. The reference target, described by EN 60947-5-2, has the following characteristics:

- Made of FE360 steel
- With square shape and 1mm thickness
- The side is equal to the sensor diameter or $3 * S_n$ if the sensing distance is greater than the diameter

The use of different materials brings a reduction factor to the distance S_r , which can be resumed in this table:

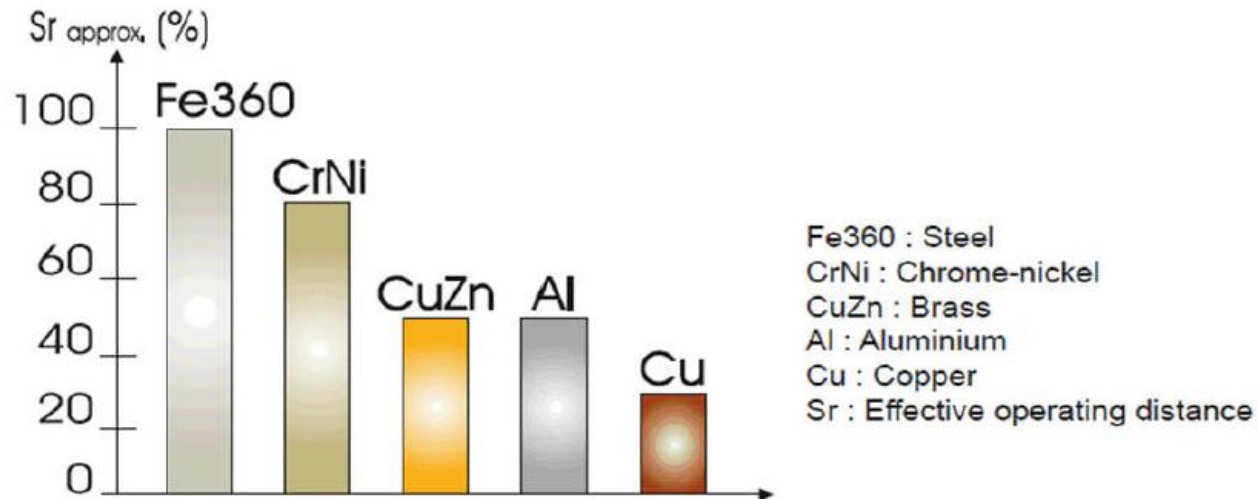


Fig. 7 The rated operating distance is reduced by the use of metals and alloys other than Fe360. The most important reduction factors for inductive proximity sensors are shown in the figure.

Practical exercise:

The ICSMD30N22P1M12 sensor has rated operating distance $S_n = 22\text{mm}$

The result is a real distance in the range:

$$0.9 * S_n \leq S_r \leq 1.1 * S_n \rightarrow 19.8 \leq S_r \leq 24.2$$

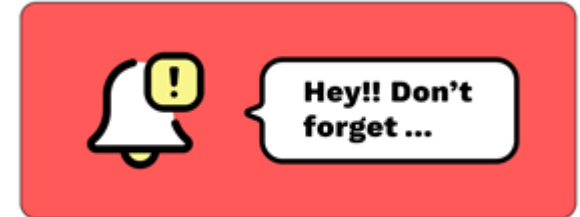
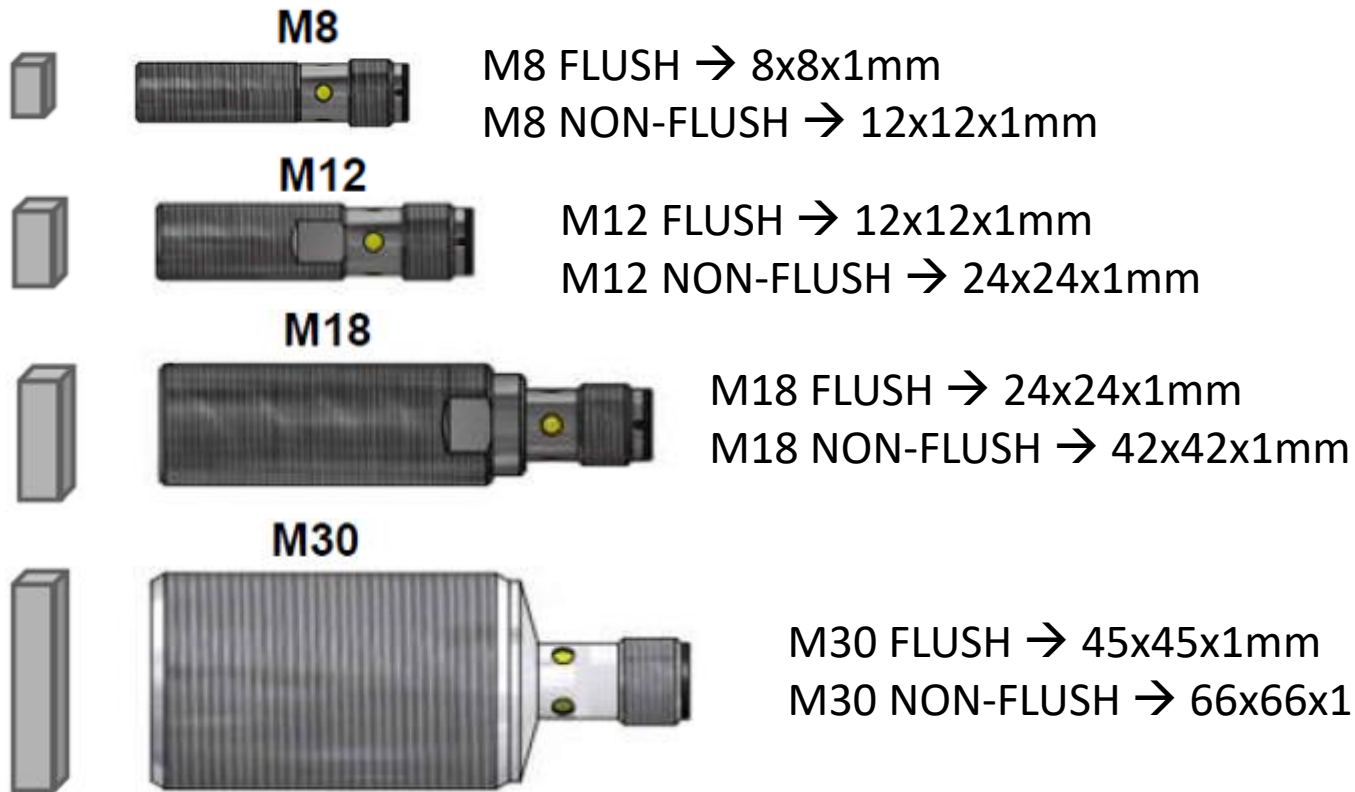
Considering a brass target (derating equal to 50%):

$$19.8 * 0.5 \leq S_r \leq 24.2 * 0.5 \rightarrow 9.9 \leq S_r \leq 12.1$$

It is therefore reasonable to expect that, using a brass target of the correct size, the ICSMD30N22P1M12 sensor detects a distance of at least 9.9mm up to a maximum of 12.1mm

Inductive sensors – Operating distance – Effect of target dimension

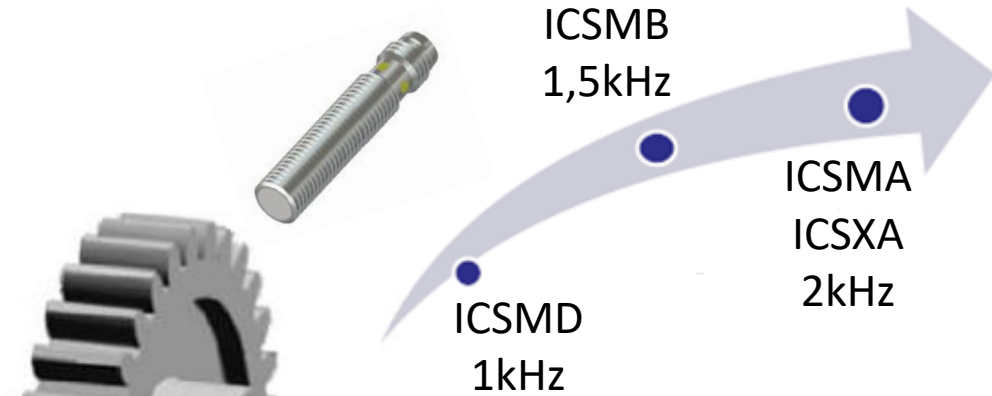
The ideal target, described in EN 60947-5-2, has a thickness of 1mm and a side equal to the diameter of the sensor installed, or three times the nominal sensing distance if larger.



Diameter (mm)	Switching distance S _n	
	flush	non flush
8	2	4
12	4	8
18	8	14
30	15	22

Inductive sensors – Operating frequency and speed measurement

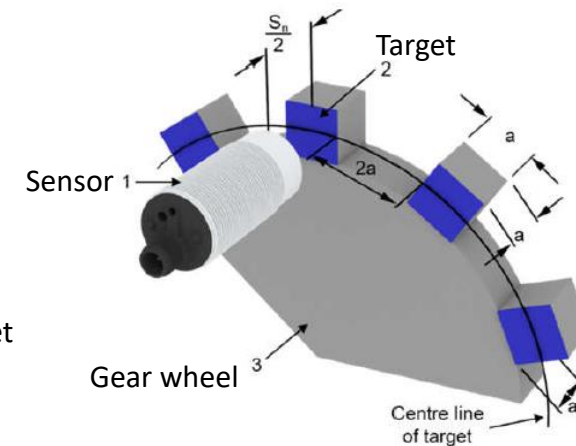
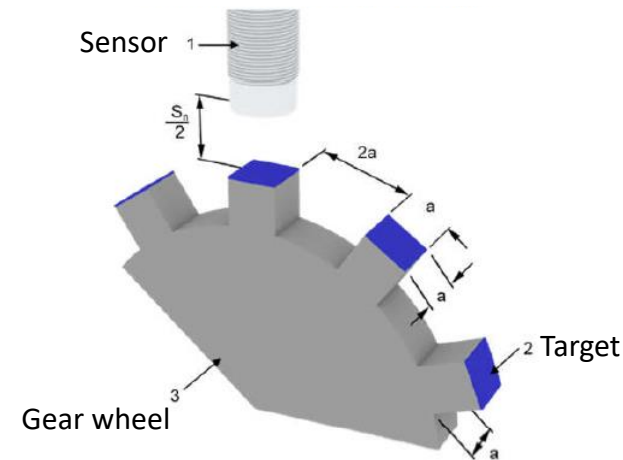
The inductive sensor is the ideal device for operation with particularly high operating frequencies.



The smaller the sensor diameter, the higher the achievable operating frequency



Thanks to this feature and the reliability in detection repeatability, inductive sensors are used to detect the speed of moving parts by processing the operating frequency

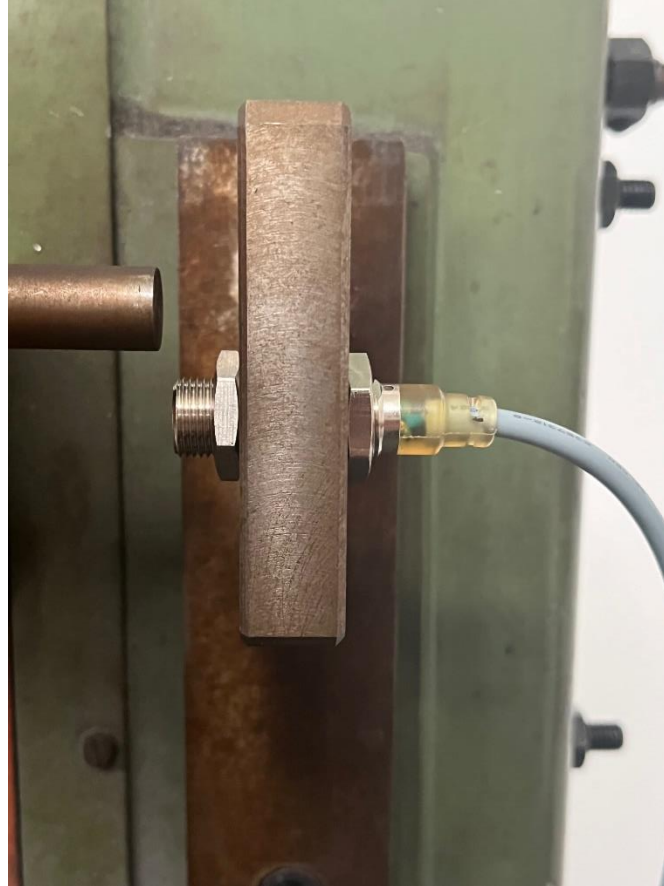


Inductive sensors – Signalling LED

The ICS series inductive sensors are equipped with yellow signaling LEDs, visible from each side of the sensor, which have a dual function:

LED STATUS	NO OUTPUT	NC OUTPUT
OFF	Target not present	Target present
ON	Target present	Target not present
Flashing	Fault	Fault

Fault: overload or short-circuit



Inductive sensors – output connection

The standard versions made available by COMEPI foresee connection with 2m PVC cable or M12 / M8 connector

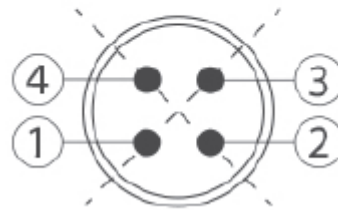
For ICSXA sensors

Connessione M8

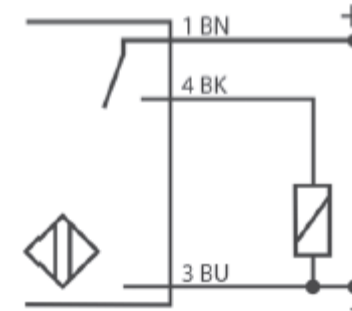


For ICSMB-C-D sensors

Connessione M12



For all versions
2m cable PVC 3 wires

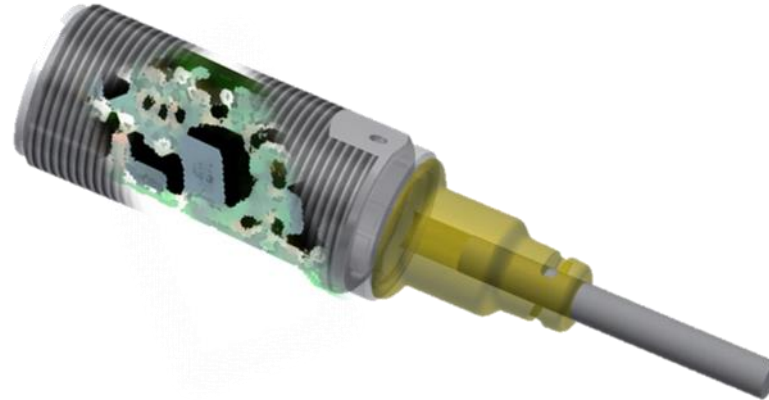


Inductive sensors - Sealing

The internal part of the sensor is completely resin potted.

This guarantees:

- Solidity of the product
- Greater resistance to impacts and shocks
- Greater resistance to vibrations
- Moisture protection
- High IP protection degree



Inductive sensors – IP protection degree

The ICS series sensors are declared with a degree of protection of parts at IP67, both for the version with cable and with connector

IP6X

Duration: 5 hours

20 test cycles:

5 minutes of ventilation

20 minutes of powder deposition



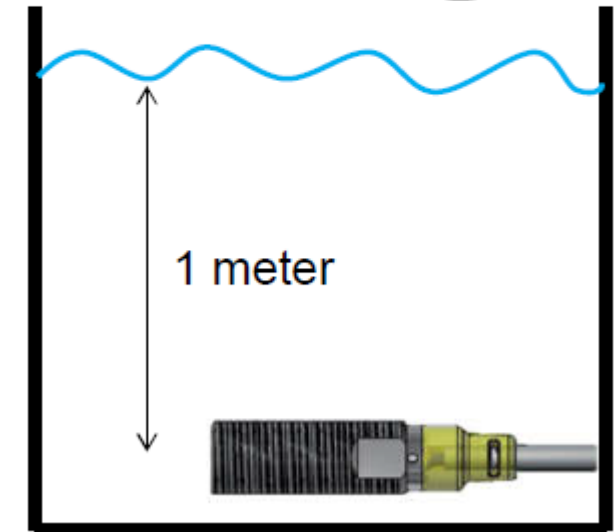
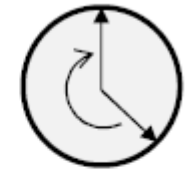
IPX7

Duration: 30 minutes

1 test cycle:

1m deep dive

30 minutes



Inductive sensors - EMC

ICS sensors comply with the requirements of the EMC Directive 2014/30 / EU with the following tests and characteristic values



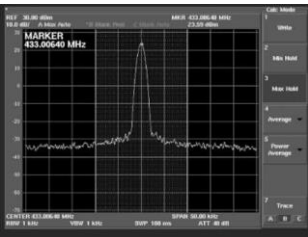
ESD
IEC 61000-4-2
8 kV in air
4 kV contact



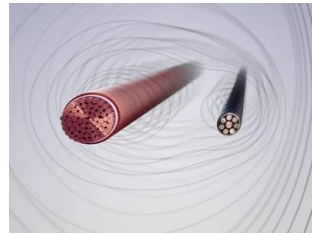
BURST
IEC 61000-4-4
2 kV



**IMMUNITY TO
MAGNETIC FIELDS**
IEC 61000-4-8
30 A/m



**RADIO FREQUENCY
DISTURBANCES**
EN 61000-4-3
3 V/m



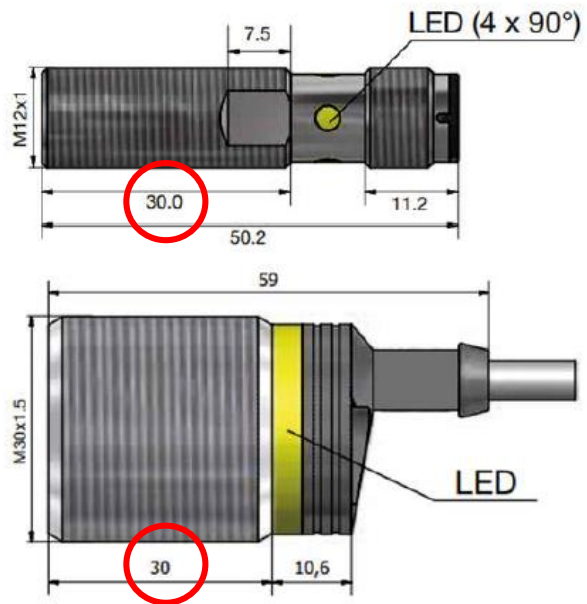
**DISTURBANCES IN
CABLE**
IEC 61000-4-46
3 Vrms

ICS sensors are not suitable for applications with strong high frequency disturbances, such as in welding operations. For these sectors specific products must be used.



Inductive Sensors - Installation

The sensor length $L = 30\text{mm}$ indicates the useful length for installation and adjustment

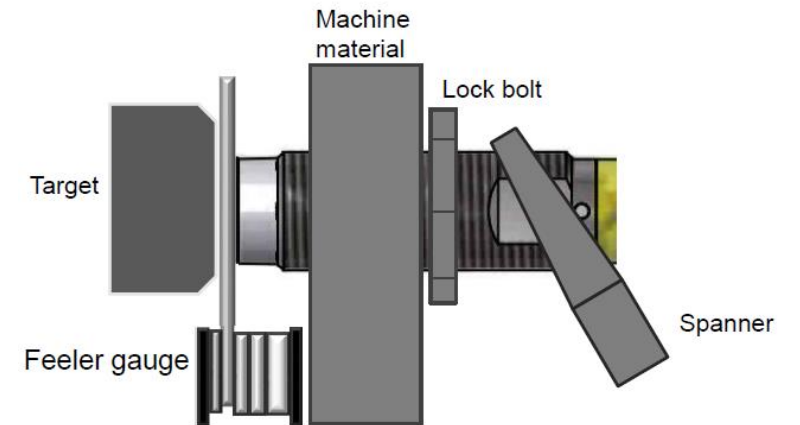


Each sensor is supplied with two hex nuts suitable for installation, which must be done taking into account the reference pairs



Dimensions	Max tightening torque
M8x1	7Nm
M12x1	10Nm
M18x1 FLUSH	20Nm
M18x1 NON-FLUSH	25Nm
M30x1,5	25Nm

Use a thickness gauge to adjust sensors with a short sensing distance

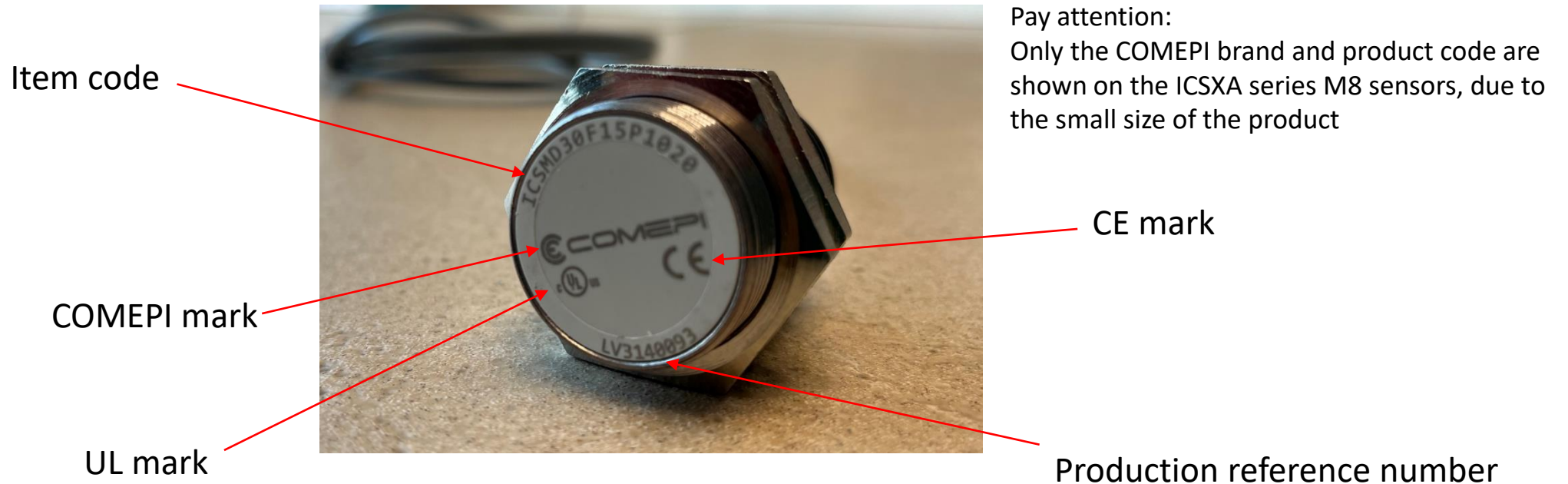


The M12 and M18 sensors have two flat faces to facilitate installation



Inductive sensor – Label and traceability

The traceability of the sensor is always guaranteed thanks to the indelible laser marking positioned on the sensitive face. The marking is very useful in case of spare parts, complaints or reports.



Example of application – Presence detection



Detection of pieces on a track of an automatic line for the production of pushbuttons



Check integrity of tools for automatic machining



Detection of the presence of metal caps on the bottles

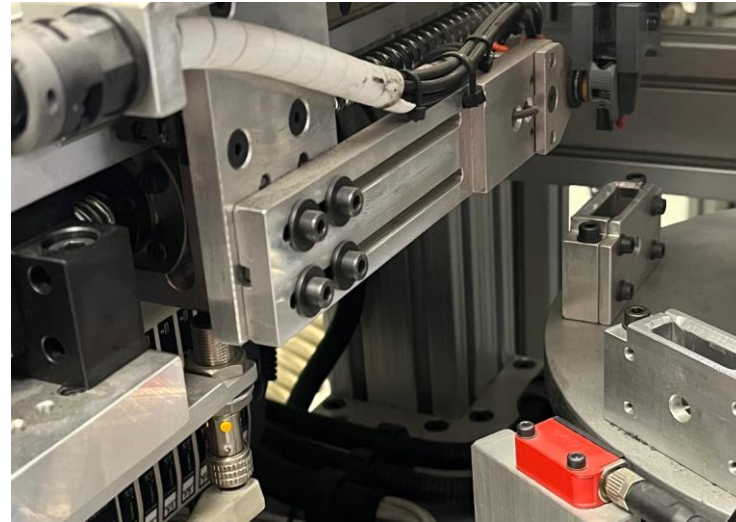


Suction cup call for loading pieces into limit switch production line

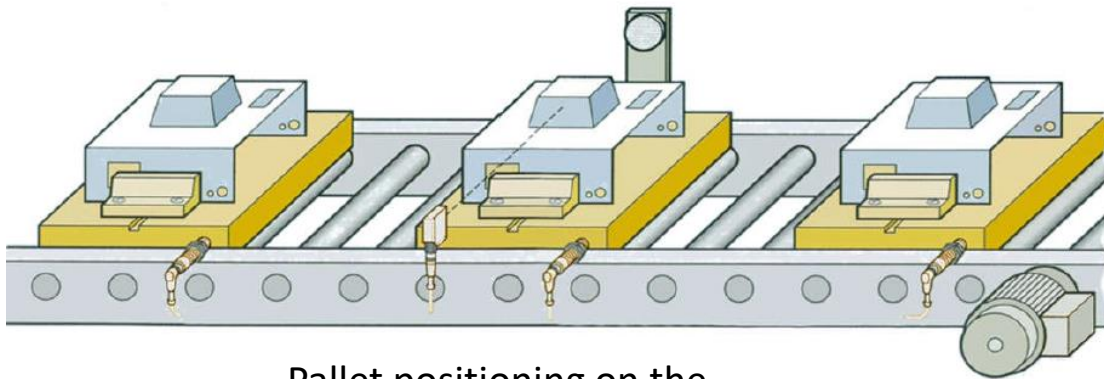
Example of application – Position detection



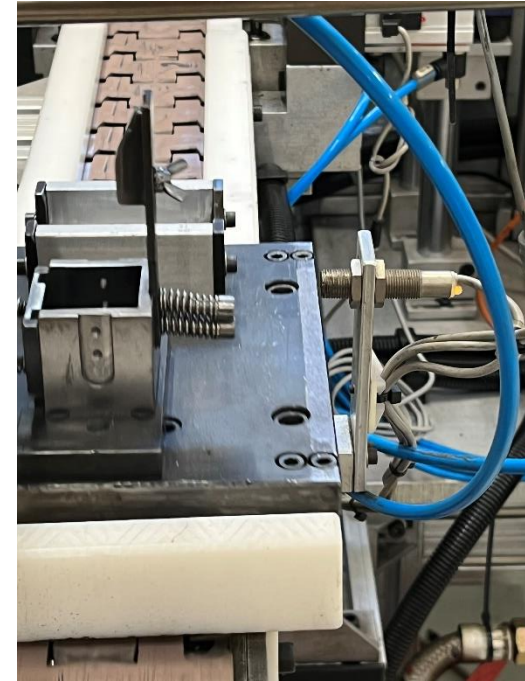
Positioning of machinery parts



Positioning of the moving part of the machinery on the automatic production line for pushbutton contact blocks



Pallet positioning on the production line



Pallet passage detection on automatic limit switch production line

Example of application – Speed detection

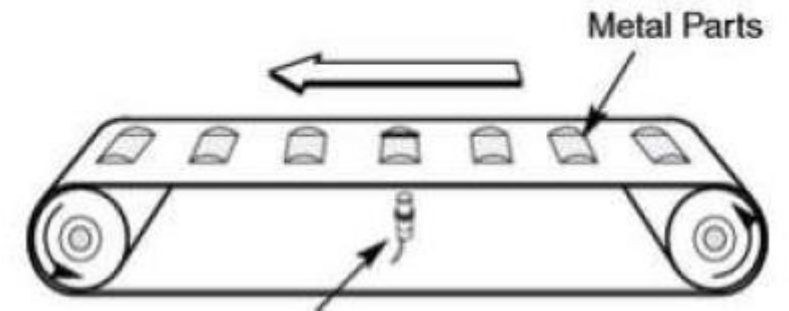


Rotor speed detection of a wind turbine



Speed detection on production lines

Conveyor Belts



Conveyor belt speed detection

 COMEPI
Switch off your limits

For more information: <http://www.comepi.eu/english/contact/>