

Inductive vs Capacitive Proximity Sensors

Quick reference for target material, sensing distance, environment, metal correction factors and capacitive relative permittivity.

Fast rule: start with inductive for a metal machine target. Start with capacitive for plastic, glass, liquid, powder or pellets when the required range is short and the environment is stable enough for a dielectric threshold.

1. Selection matrix

Application / condition	Inductive	Capacitive
Metal part, gear tooth, end position	Best starting point	Can detect metal, but usually less selective
Plastic / glass object	No	Good candidate
Liquid / powder / pellets	No direct detection	Good candidate; verify real product
Oil / dust around a metal target	Usually robust	May be affected if deposits change capacitance
Through non-metal tank wall	No	Possible; wall and product must be tested
Long distance > typical proximity range	Check long-range model	Often consider photoelectric / ultrasonic instead

2. Inductive target correction factors

Target material	Typical factor vs steel	Approx. range if Sn = 10 mm
Mild steel / Fe360	1.0	10 mm
Stainless steel	0.60-1.00	6-10 mm
Aluminium	0.30-0.45	3.0-4.5 mm
Brass	0.35-0.50	3.5-5.0 mm
Copper	0.25-0.45	2.5-4.5 mm

Typical values only. The exact reduction factor depends on sensor design and target. Factor 1 sensors are designed to keep the reduction factor at or near 1 for common metals; verify the exact model datasheet.

3. Capacitive relative permittivity

Material	Approx. relative permittivity	Practical implication
Air	~1.0	Reference background; very small dielectric effect
PTFE / low-k plastics	~2.0-2.4	Harder to distinguish from air at small target volume
Common plastics	~2-4	Usually detectable at short range; geometry matters
Ethanol	~24	Produces a much larger dielectric change than most plastics
Water at ~20 C	~80	Strong dielectric response; moisture can also shift threshold

Permittivity varies with material, temperature and measurement frequency. The table is for selection intuition, not calibration.

4. Installation checks

1. Confirm target material and minimum target size.
2. Check flush / non-flush mounting clearances.
3. Apply the model-specific metal reduction factor for inductive sensing.
4. For capacitive sensing, test the real product, vessel wall, moisture and residue.
5. Set the working gap inside the assured operating region, not at the catalogue maximum.
6. Match PNP/NPN, NO/NC and supply voltage to the controller separately from the sensing principle.

Standards note: IEC 60947-5-2:2019 covers proximity switches, including inductive and capacitive types. Use the exact manufacturer datasheet for rated sensing distance, operating distance, mounting clearances, switching frequency and limits.