Industrial
Automation

How to Use Inductive Proximity Sensors in Rotational Speed Monitoring

HOW TO

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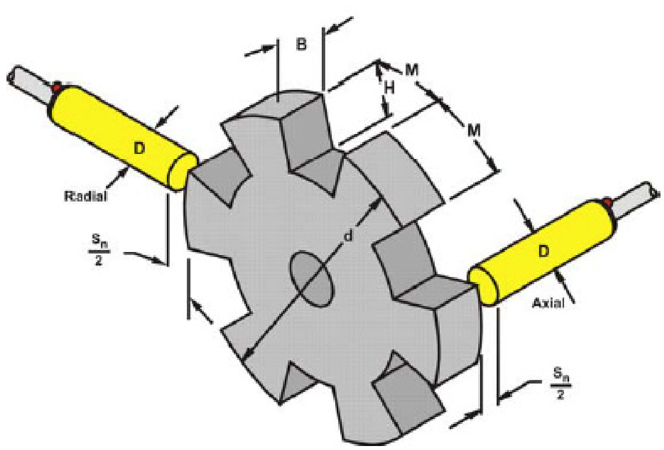
T In today's industrial environments, there is rarely a process that's not monitored. Rotational speed monitoring takes place in many processes to monitor direction, speed and coordination. Commonly implemented in packaging, conveying and mixing applications (among others), rotational speed monitoring is also used as a safety and personnel protection mechanism.

Many different technologies exist that are used as input sources for rotational speed monitors, including inductive proximity sensors, photoelectric sensors, resolvers, encoders and tachometer generators. These devices are used to sense the pulse and/or direction of rotation or a series of rotating targets. The more coordination involved in the processes, the higher the overall production output. Unlike tachometer generators and conventional rotational pulse generators, proximity sensors require no physical connection to the driving element in order to perform motion detection.

In most cases, the speed of a rotating machine part (shafts, gears, cams, etc.) is monitored directly so that special or additional control elements or actuators are not necessary. The measuring time is dependent on the digital input pulse train. The more input pulses per rotation, the shorter the measuring time. When applying inductive sensors the gap or air space between targets must be greater than or equal to the diameter of an embeddable proximity sensor.



Guidelines for Tooth and Gap Widths

<u>For embeddable sensors:</u>

M ≥ D (target size should be ≥ sensor face surface area)

<u>For non-embeddable sensors:</u>

M ≥ (3 x Sn) *

For high speed applications, the sensor response time must be included in the calculation.

<u>For embeddable sensors:</u>

$$M = \frac{N \times d \times \pi \times T + D}{60{,}000}$$

<u>For non-embeddable sensors:</u>

$$M = \frac{N \times d \times \pi \times T + (3 \times Sn)^*}{60{,}000}$$

It is advisable to use a large tooth and increase the gap between the teeth.

* Replace (3 x Sn) with D when (3 x Sn) < D

D =	Diameter of proximity sensor (mm)	
M =	Tooth/gap width (mm)	
d =	Diameter of disc (mm)	
H =	Tooth depth:	Axial mounting H ≥ D
		Radial mounting 2 x Sn
N =	Maximum rotational speed or object (RPM)	
T =	Minimum sensor switching period (1/max. sensor switching frequency) in milliseconds [ms]	
B =	Thickness of disc:	Axial mounting 1 mm minimum
		Radial mounting B ≥ D
$\frac{Sn}{2}$ =	Recommended mounting distance (mm)	

When inductive sensors are used as input devices, the following points should be observed:

- When using mild steel targets, the sensor must be positioned at half of the nominal sensing range. *This does not apply to sensors using Factor 1 technology.*

- The correction factors for non-ferrous targets must also be considered. *This does not apply to sensors using Factor 1 technology.*
- Embeddable and non-embeddable sensors require different targets due to their differing oscillator fields.
- Non-embeddable units require larger metal-free areas around the sensing face.

Rotational speed monitors count pulses, but some are also designed to relay overspeed/underspeed conditions to control equipment. Overspeed monitoring gages whether the pulses have exceeded certain parameters, for example if monitoring a motor driven belt. If the belt breaks the motor subsequently goes faster due to an absence of torque against the load; the increased speed is detected by overspeed monitoring and in turn, shuts down the system. Underspeed monitoring occurs when parameters for safe point detection are implemented, such as in the detection and shutdown of a particular system. Among other things, these methods protect against belt breakage, conveyor slippage and conveyor jamming, and aid in the overall synchronization of the process.

In addition to monitoring pulses and direction, inductive proximity sensors are also used for directional discrimination where two sensors are used to determine the forward and reverse direction of a system. It obtains the direction of rotation by evaluating the sequence and simultaneous damping (trigger) of both sensors for at least one millisecond.

Non-contact proximity sensors provide the user many benefits in these applications versus implementing encoders or tachometer generators. Since the sensor is not in contact with the application, it can be replaced quickly, with practically no maintenance, therefore causing less overall downtime – even if process must be stopped.