Industrial Sensor Selection Guide

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Introduction

Industrial sensors are the eyes, ears, sight and touch of industrial machines and processes. They provide real time feedback of a host of physical parameters which are used to control the machine and manufacturing processes.

Sensors are also used to provide operator safety, identifying product defects and collecting data.

They are an extremely important in industry. Providing the data needed to improve efficiency and optimise production.

To perform their important function, industrial sensors need to be able to withstand harsh environments. This means they are resilient to physical shocks and vibrations. They must also be able to operate in temperature extremes and be immune to electromagnetic interference.

Sensors are utilised in all industries, including:

- Manufacturing

- Food & Beverage

- Pharmaceuticals

- Automotive

- Aerospace

- Medica

What Sensors Do

Sensors detect a physical property and provide a feedback signal (input) from which a controller will generate an event (output). The output could be to stop/start a motor, pump or fan. It could be used to cause an actuator to move or ensure a safety gate isn't opened. Sensor outputs could be used for collecting data and monitoring product quality. Another important use of sensors is their use in condition-based maintenance. For example, vibration and temperature sensors are used on motors to indicate early signs of bearing failure.

How Many Types of Sensors Are There?

Sensor Type	What It Does	Applications
📍 Position sensor	Detects position or orientation of an object	Precise control – robotics, automotive systems
🕛 Pressure sensor	Measures force exerted by a liquid or gas	HVAC, automotive braking systems, industrial processes
🌡 Temperature sensor	Monitors heat levels	Climate control, electronics, manufacturing processes
😓 Humidity sensor	Measures moisture content in air	Environmental control – buildings, farming, weather
💪 Force sensor	Detects mechanical force applied to an object	Scales, industrial machines, touch-sensitive devices
🔊 Vibration sensor	Detects & measures oscillations in machinery	Predictive maintenance, fault diagnosis
🎥 Motion sensor	Detects movement or presence of nearby object	Security, automatic lighting, touch-free interfaces
🌊 Flow sensor	Measures rate of fluid movement	Water management, chemical processing, fuel systems
📊 Level sensor	Determines height of material within container	Inventory management, safety systems, process control

Sensor Selection Criteria

These are the 12 criteria to consider when selecting a sensor:

1. Accuracy & sensitivity

2. Output signal/compatibility

3. Size & mounting

4. Energy & voltage

5. Resolution & range

6. Response speed

7. Linearity

8. Environment

9. Certs & standards

10. Connectivity

11. Warranty

12. Cost

1. Accuracy & Sensitivity

How **precisely** can the sensor match your equipment's actual value? This trait is vital for applications where precise measurements are crucial, such as:

- Quality control processes

- Lab instruments

- Medical devices

The sensor's ability to maintain accuracy over time and under varying conditions can influence the life span of the product. Don't neglect the impact on downtime, either – a sensor that slips in performance could cost your company thousands of dollars per hour.

Sensitivity is a similar trait, but focuses on the sensor's ability to detect small changes. In situations where monitoring is happening off-site, this one's crucial. Sensitivity may also be a top priority in situations where you need to accurately measure:

- Turbulence

- Noise

- Pulsation

2. Output Signal & Compatibility

Make sure you can actually integrate the sensor into existing systems. If the sensor can't accurately communicate with the rest of the device or the platform that needs the data to keep things running smoothly, issues are inevitable.

Pay attention to the form of the signal **– analog or digital –** a sensor produces in response to its measurements. The type of output signal affects how the receiving device can read and act on the data.

Compatibility matters in more ways than one. Beyond analog-versus-digital, you should also consider:

- Voltage levels

- Current requirements

- Communication protocols

3. Size & Mounting

Size and mounting method are underrated aspects of sensor selection, impacting both the sensor's integration and operational efficiency within a system.

The sensor's size will **impact the space available for other components** in the full assembly. A compact, lightweight sensor is often necessary in constrained spaces or in applications where the sensor must be integrated into existing structures without significant modifications:

- Compact machinery

- Portable devices

- Wearable technology

Mounting considerations are equally important, as the method of attaching the sensor to the assembly can affect its stability and accuracy. Some sensors require specific mounting hardware or brackets to ensure they remain securely in place, especially in environments subject to vibration, movement, or other physical stresses. Don't forget that the mounting fixture itself can also impede the effectiveness of nearby components.

In the long term, mounting also plays a part in how easily users can perform maintenance or modifications to the build. These are factors you should account for in the initial design phase, while you still have the room.

4. Energy & Voltage Requirements

The sensor's electrical requirements are crucial for effective operation and must match your power supply capabilities. In IoT scenarios, for example, the sensor must operate within the capabilities of the system without overloading the surrounding grid.

By taking all energy and voltage considerations into account, your sensor can meet technical requirements while integrating efficiently with your system's power setup.

5. Resolution & Range

Resolution is the smallest increment of measurement a sensor can detect. This impacts its ability to pick up on tiny differences in whatever it's quantifying.

You should value a high-resolution sensor if precision is key to your operation. For instance, in a temperature-control system for a laboratory, a high-res sensor can maintain specific conditions by detecting even the slightest warming and cooling.

When selecting a sensor, consider the smallest change in measurement that needs to be detectable, and ensure the sensor's resolution can meet or exceed it.

Range is the span of measurement a sensor can accurately cover. Think maximums and minimums.

A sensor with a range too narrow might not capture the full data you need. One with an excessively broad range may lack precision in your specific range of interest. It's on you (or a distributor with technical product know-how) to find a middle ground.

For example, in an industrial process with volatile pressure levels, a sensor should cover the highest and lowest possible pressures. This ensures accurate monitoring of safety and efficiency in nearly any condition.

6. Response Speed

The basic definition of response speed is the time it takes for a sensor to react to a change whatever it's measuring, and output a corresponding signal. From there, the topic gets trickier.

To ensure efficiency and safety, you'll need to distinguish between the different types of sensor responses:

| Response Type	What It Measures	Relevant To …
Time to first reading	How quickly sensor can give initial data after activation or change in conditions	When you need data ASAP after it fires up or in times of rapid change
Recovery time after a measurement	How long until sensor can accurately collect data again	Cyclic or repetitive measuring where you can't afford a delay
Time to stabilize on an accurate reading	Time needed for output to reflect an accurate measurement	When precision & reliable, data-backed decisions are critical

Evaluate the need for speed in your application. Look at data sheets that compare sensors based on similar working conditions, as there are other factors that impact response time:

- **Technology type** – Capacitive and inductive proximity sensors, for example, typically respond faster than some photoelectric sensors

- **Signal processing** – Analog sensors might offer quicker responses compared to digital sensors that require signal conversion and complex processing

- **Environment** – Choose a sensor whose response speed won't falter in any tough conditions in your application, such as high temperature or humidity

7. Linearity

In sensor selection, linearity refers to how well the output signal changes proportionally to the input physical parameter. This is crucial for **applications where you need precise measurements.**

Choosing a sensor based on linearity involves evaluating how well the sensor's output corresponds to the actual measured values. The sensor should be able to maintain a predictable back-and-forth across the entire range of possible values. High-linearity sensors **make data interpretation and system calibration easier** since the output signal directly correlates to the measured parameter without needing complex conversions.
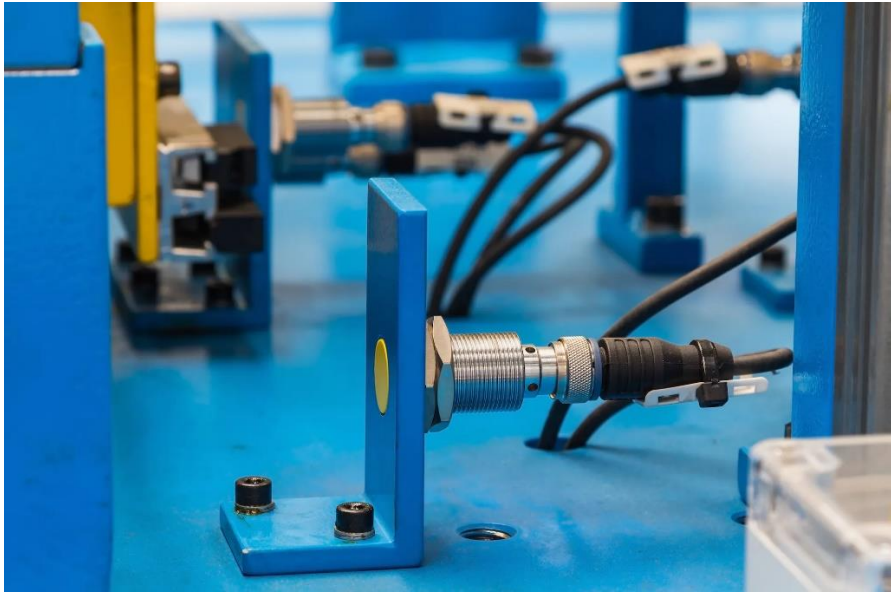
An accurate look into changes of environment is valuable to high-precision applications like:

- Robotic positioning

- Quality control

- Medical monitoring

When selecting a sensor, look for its linearity specification. Manufacturers list this as either a percentage of the full scale or rate of measurement error over the sensing range.

8. Environmental Durability

"Durability" has always been a broad engineering term, and that doesn't change with electronic sensors. Here, you should define it in three ways: **electrical, physical, and chemical.** You've already learned about electrical considerations, so here are the basics for the other two threats:

	Types	Locations
Physical	Vibration, pressure, wear, ingress of debris	Aerospace, factory floors, construction, deep-sea
Chemical	Temperature, water, salt, hazardous substances, UV light	Extreme temps, chemical processing, farming, pharmaceutical, outdoors

You might have hopes and dreams of years of reliable performance in severe environmental conditions. Those dreams aren't unrealistic, but they do mean you'll have to pay up for an industrial-grade sensor. A residential sensor, for example, doesn't come with the promise of temperature or weather resistance.

9. Certifications and Standards Compliance

The importance of certifications and standards compliance largely depends on your application and industry. Chances are you already have at least some marching orders for adherence – we're talking about electricity here.

Electronic component standards usually account for:

- Safety

- Reliability

- Durability

If you're not comfortable with your level of knowledge in selecting compliant parts, talk to an experienced distributor. If you can't trust the sensor to do its job, how can you trust the full assembly to do *its* job?

10. Connectivity Options

Sensors available for today's projects can connect and communicate with other devices and systems at warp-speed. This communication can occur in a variety of ways and for different purposes:

- **Wired connections:** Some sensors require physical connection to a network or device via Ethernet, USB, or serial ports.

- **Wireless connectivity:** This type of sensor can use Wi-Fi, Bluetooth, Zigbee, or other RF (radio frequency) technologies, transmitting data without a physical connection.

- **IoT integration:** By connecting to Internet of Things networks, some sensors can send data to cloud platforms for analysis, remote monitoring, and integration with other smart systems.

- **Protocol support:** Compatibility with communication protocols like Modbus, CAN bus, and industry-specific options are crucial for integration into existing control systems.

Your application will clearly dictate your needs here.

11. Warranty

The concept isn't much different from an iPhone or a Subaru. A sensor purchase with a warranty that covers a reasonable period will offer more peace of mind than one with a bad or no warranty. A warranty reflects the manufacturer's confidence in its product's durability and performance.

When buying an industrial sensor, weigh the cost-effectiveness of the manufacturer's warranty vs the importance of the component to your operation's function. Here are a few key points to consider:

- **Length –** Reduces risk of incurring additional costs for replacements or repairs

- **Coverage –** Some warranties may cover only parts, while others include labor and even replacement services

- **Terms –** May include limitations on usage, environment, or maintenance requirements

12. Cost

Of course you want to pay as little as possible for any electronic component. But a sticker price isn't the only sign of value in an industrial sensor purchase.

- **Up-front cost –** Depends on type, quality, features, & availability

- **Installation cost –** Often-overlooked labor and equipment expenses for learning, mounting, wiring, & calibrating the system

- **Operation cost –** Energy use, frequency of readings, processing power, & communication bandwidth

- **Maintenance cost –** Effort required to repair, recalibrate, & clean routinely and on-demand. Self-cleaning, self-calibrating, and diagnostic features can reduce the level of human intervention necessary.

In industrial assemblies, quality matters. While you want to pay less, you – and your company – may pay more in the long run by making a short-sighted decision.

Sensor Selection & Your Project

The importance of sensors in today's world should give you a clue to how much you should **value quality and fit**. They're pivotal to safety, efficiency, and performance, from wearable health monitors to driverless car cameras.

Sensors with faster response times are essential for applications requiring real-time feedback, such as automation safety systems and dynamic process controls. Elsewhere, environmental and size constraints may limit your options. It all comes down to your components, your assembly, and your operation.

Contact us to discuss your sensor needs.

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