SICK has a wide range of photoelectric, electromagnetic and ultrasonic sensors available to solve demanding industrial applications. SICK also offers a complete line of rotary and linear encoders. This selection guide is used with the Industrial Sensors Catalog (part number: 7028071). These tools will enable users to select the appropriate sensor technology, and then narrow the search to a specific model number.

Key sensing technologies from SICK:

**Photoelectric**
- Standard photoelectric sensors are ideal for applications such as counting, ensuring parts presence, sorting, automatic routing and positioning.
- High-performance sensors measure from up to 1.1 km distance micron level thickness and identify registration marks without needing to use different contrast sensors for registration mark color changes. Moreover, SICK offers application-specific sensors such as vision, measuring light grids, luminescence and color sensors.

**Electromagnetic**
- Inductive sensors detect metals, enabling die protection on presses, counting, and positioning of a robot arm.
- Capacitive sensors detect non-metal objects. Applications include controlling the level of granules or verifying product reserve.
- Magnetic sensors detect magnetic objects. E.g: object detection through non-ferrous material such as plastic containers/pipes.
- Magnetic cylinder sensors detect piston position in pneumatic cylinders.

**Ultrasonic**
- Ultrasonic sensors can be used in applications such as fill level detection of silos/tanks, sag control and counting.

**Angular, Positional, and Length Measurement**
- Encoders provide angular, position and length feedback for servo drives and controls such as material handling (conveying and warehousing technology, stage construction, navigation), and in manufacturing (packaging machinery, machine tools, robots). The HIPERDRIVE® is an integrated drive system with absolute positioning suitable for all kinds of format adjustment in machines and installations.

Selecting a specific sensor is a 3-step process:
- Use the selection charts on pages 2-4 of this guide to determine the best sensing technology for a particular application.
- Refer to the recommended Selection Tables in the Industrial Sensors Catalog (part number: 7028071), found throughout the catalog on the pages listed*.
- Use the table to determine the best sensor type (or model), then refer to the corresponding catalog page to choose the exact sensor needed.

* You can also search and select sensor products from SICK at www.sickusa.com
Photoelectric sensors are used for a wide range of applications, including presence detection, positioning, sorting, routing, counting, etc. The function of a photoelectric sensor is detection through the transmission of light. This chart will help users select the best photoelectric sensor technology for an application.

SICK also offers a wide range of fiber-optic sensors for proximity and through-beam applications. Go to page 846 of the SICK Industrial Sensors Catalog for Selection Table.
Electromagnetic sensors are used for sensing at shorter distances, when the environment is dirty. Ultrasonic sensors are also used in dirty environments, but for longer ranges. For distance measurement in dirty environments, linear/wire draw encoders can be used.
High performance sensors provide a diverse set of functions for many applications. Use the descriptions below to identify the best SICK high performance sensor technology for your needs.

**Distance measurement**

Do you need distance measurement from x meters to y meters?

**Optical Displacement Sensors**

Do you need to measure minute variations, noses or unevenness with high accuracy?

**Conveyor Sensor**

Do you need to control product flow on a conveyor?

**Contrast Sensor**

Is there a contrast between the target and the background or are you trying to detect a registration mark?

**Color Sensor**

Do you need to verify the product is the correct color?

**Luminescence Sensor**

Does the target or background have luminescence? Can you use fluorescent additives as registration marks?

**Light Grid**

Do you need to detect presence or size of a wide variety of parts over a large window?

**Vision Sensor**

Do you need a vision sensor?

**Rotary encoders, Linear encoders, and HIPERDRIVE®**

Is this a motion control application?

**SICK’s distance measurement sensors provide up to 1.2 m distance at +/- 10 mm resolution measurement. Distance measurement sensors provide accurate non-contact position information for numerous applications. Some of these applications include: AGVs, rack car positioning, roll diameter measurement, product displacement.**

**OD displacement sensors** are a sensing and measuring system in one easy-to-use, easy-to-install, compact package. The intelligent micro-controller technology makes it possible to integrate both sensing and measuring functions into a single device. It can measure with ultra-precision and reliably detect the presence of objects such as those found in the automotive, electronics, packaging, and robotics industries. OD sensors can detect a variety of distances with up to 1 micron meter accuracy.

**ZoneControl™** is the SICK offering of ZPA (zero pressure accumulation) control solutions. ZoneControl consists of integrated ZPA systems designed for accumulation conveyors and all the necessary peripherals and accessories to support the system. The ZoneControl family of products offers multiple ZPA solutions, all of which are similar in their function, but accommodate different types of conveyors by using a variety of mounting configurations. Often used for retrofit of mechanical limit switches that connect to existing pneumatics.

**Contrast sensors** can be used in a variety of applications, including positioning data processing forms, positioning labels, cans or tubes, and recognizing items that can be placed in a specific order. The contrast sensor can also be used to detect patterns on the object. If the contrast sensor is used to detect a pattern, the background is the area around the registration mark and must be in contrast to the mark. Web control is one application used in packaging machines. For sensors can be used for registration control as well.

**The CSML, CS81 and CS84 color sensors** are compact and powerful for color detection of either opaque or transparent targets. Color sensors can be used for the automation of all industrial processes where color is a factor.

**If you are trying to sense an ultraviolet mark on an irregular background, such as a camel horn, that can’t be read reliably, then a luminescence sensor may help. The sensitivity of the device can be adjusted to the optimum setting for the fluorescent material. The background that the fluorescent material is applied to doesn’t affect the level of detection reliability.**

**The automation light grid sensors** are specifically designed for use in parts ejection applications or any processes where product positioning varies occur. They can also be used to detect objects, determine the height or length of objects or detect irregularly shaped objects, or verify that manual operators have performed proper operations.

**The sensor compares the current image with the images it has been taught. When an image appears in the view finder, which coincides sufficiently with the taught information, the corresponding output is triggered. Some applications include: pattern matching, presence monitoring, shape verification, position and dimension verification, object detection, completeness verification, and data code detection.**

**Displacement, position, angle - in industrial automation where positions have to be precisely determined, you can use an encoder. The same applies when determining speed and acceleration. Encoders can have a resolution of micrometers or few thousands of a degree. Compared to incremental encoders, absolute encoders have one decisive advantage - they do not need an initializing reference. Generally, robotics and positioning applications require an absolute encoder and machine tool and packaging applications, such as speed control, require an incremental encoder. The HIPERDRIVE® integrated positioning drive represents the optimum alternative to manual change-overs, particularly in those machines with several adjustment axes.**
Standard Photoelectric Sensor Technology Definitions

**Background suppression** is accomplished by means of light triangulation in which a focal distance is defined by mechanical or electronic adjustment of the sensor. Devices with background suppression suppress events occurring outside the active sensing range.

**Background rejection** is an ultra-precise form of background suppression. Background rejection sensors can detect the slightest difference from the object to the background.

**Clear material sensors** require only a small change in received light for the sensor to trigger. The design of the device has a stabilized and constant light output and a stabilized receiving and switching threshold element. In addition to clear objects, this type of device can be used to detect small objects, including objects smaller than the effective light beam.

**Divergent proximity (diffuse) sensors** send light out in a broad beam with a negative focal point. As a result, the light spot gets large very fast. Divergent sensors can see many objects in a broad area, but they have a very short range.

**Energetic proximity (diffuse) sensors** send light out in an infinite focus concentrated beam. Energetic type sensors typically have a longer range and a medium sized light spot. It has to be pointed directly at the target object. Sensing range/switching point can be set by adjusting the sensitivity. The sensors are ideal for detecting a light object in front of a dark background. All sensing distance specifications for diffused mode are based on a target with a 90% reflectivity such as white paper. If the reflectivity of the target is significantly less, then the sensing distance will be reduced.

**Fixed focus**, triangulation type photoelectric devices have optics set for specific angles. Fixed focus is a type of limited background suppression. The area where detection of an object can take place is where the angle of acceptance and the angle of divergence cross.

**Foreground suppression** targets with shiny or irregular surfaces reflect light in many directions, causing false readings. Foreground suppression sensors solve this problem because they do not detect the object directly, but detect the presence of the object by the lack of light being reflected by the background. The background is used as a reflector by the sensor and anything that passes between the sensor and the background is detected.

**Reflex sensors or retro-reflective sensors** contain both the sender and receiver in a single housing. Light is returned by a reflector. Since only the sensor needs to be wired, this type of sensor is much more cost-effective than a through-beam sensor. Reflex sensors feature a long sensing range, which is dependent on the type of reflector used in the system.

**Fork or slot sensors** contain both the sender and receiver in a single housing. Slot sensors excel in applications in the printing and paper industries. Slot sensors are also ideal for label detection because they can sense labels on backing. Applications include: label detection, printing and paper industries.

A photoelectric through-beam sensor consists of two devices: a light sender and a light receiver. The sensor switches when an object passes through the light beam. The primary advantage of the through-beam sensor is its long sensing range and precise triggering. Because of their high resource power, through-beam sensors are ideal for harsh application environments.

**V-Type proximity (convergent proximity, diffuse) optics** produce a small light spot at a defined distance. This results in the ability to detect small objects with repeatable switch points, albeit at a shorter range than energetic types.

Advanced Photoelectric Sensor Technology Definitions

**Color sensors** are small, compact and powerful for color detection of either opaque or transparent targets. Consequently, they can be used for the automation of all industrial processes where color is a factor, such as sorting colored products.

**Contrast sensors** provide high speed, reliable registration in one sensor. Up to three LEDs select the best light source to detect the contrast. Contrast sensors recognize colors as grayscale values. At a constant sensing range, up to 30 gray tones on a scale ranging from black to white can be distinguished.

**Roller conveyor sensors** are specifically designed for accumulation and loading and unloading applications on roller conveyors. These sensors automatically function as accumulating conveyor systems without the need for additional control elements.

**Luminescence sensors** offer unique sensing solutions. They are able to handle more advanced applications than standard photoelectric proximity sensors. Luminescence sensors react to luminescent pigments, which are activated by the UV light source in the sensor.

**Laser measurement sensors** are an essential aid in the classification, positioning and material flow handling of products. They are excellent for measuring in both short and long distance applications.

**Multi-dimensional sensors** can position objects or sense the height of objects. The Dimensional Multifunctional Position Finder sensor (DMP) is the sensor of choice for automated storage and retrieval systems.

**Automation light grid photoelectric sensors** are a small, non-safety version of light curtains. They are ideal for recording and counting of objects and pick-to-light applications.
Industrial Proximity Sensors (Electromagnetic Sensors)

Inductive sensors detect metallic objects and are suitable for a wide variety of applications such as position polling, transport monitoring, counting pulse generation, speed monitoring and speed direction detection. Inductive sensors are available with various housing shapes and sizes.

Capacitive sensors can detect non-metallic objects and have enhanced sensing ranges for high operational reliability. Some applications include level detection and product availability in a sealed container.

Magnetic proximity sensors are characterized by their large sensing ranges. They detect magnetic objects (usually permanent objects). Applications include object detection through plastic containers/pipes, detection in aggressive media through protective Teflon® walls, detection in high temperature areas, and recognition of coding using magnets.

Magnetic cylinder sensors are used to detect the position of pistons in pneumatic cylinders. Magnets are attached to the piston and sensed through the housing wall by the cylinder sensors. The housing wall could be made of aluminum, brass, or stainless steel.

Ultrasonic Sensors

Ultrasonics sensors are color independent, an excellent solution for detection of liquids, foils and glass, and are stable in harsh environments. Ultrasonic sensors are low maintenance, easy to calibrate and offer long term reliability. The UM 18 double sheet detector is ideal for identifying two or more sheets of material on top of each other. These sensors can also be used for thicker materials such as plastic sheets, board stock, or sheet metal.

Angular, Positional, and Length Measurement Products

Incremental encoders are used when retention of absolute position upon power loss is not required. Examples include velocity control and simple point-to-point applications. Absolute encoders are used when position data must be retained after loss of power. Examples include robotics, lead/ball screws, overhead cranes, and rack and pinion applications.

Linear and wire draw encoders are used when users need linear position as an output with high resolution and repeatability.

HIPERDRIVES (Format Adjustment Drives) are used in product and format changes on machines. The Hiperdrives are usually on a fieldbus system and provide a high level of adjustment accuracy and reproducibility.

Common Questions:

Visible or infrared sensor?
• Visible red light provides easy alignment.
• Infrared can penetrate better through dust and dirty environments.

What is an alarm function?
• Early failure warning for misalignment or contamination.

What is a test input?
• With a test input users can remotely disable the sender LED (light source).

What time settings are available for SICK sensors?
• On-delay: Sensor waits before energizing the output. If the object clears before the sensor time is out, output does not energize.
• Off-delay: The sensor output will stay ON until the set time expires after the object clears the sensor.
• One shot: As soon as the sensor sees the object, the output will be a fixed pulse regardless of the duration for the target to clear.

Why use a laser sensor?
• Laser sensors provide a small light spot in order to precisely sense small targets.
• When selecting a sensor, please be aware of the light spot size versus the target size.
• Laser sensors have longer sensing ranges.

When is a fiber-optic cable used?
• In order to remove the sensor from an environment to avoid the effects of heat, dirt, and liquids.
• In order to have remote adjustability.
• In order to sense in tight spaces.
• When is a NAMUR sensor used?
• NAMUR sensors are used in hazardous locations and are also referred to as intrinsically safe sensors. These sensors must be used with the EN 2 Ex power supply/controller.

Specifying Inductive Proximity Sensors

• How close is the other metal, radially (to the side of the switching face) that you would not want the sensor to “see”? Rule of thumb: If the distance is less than 2x the published range, use a shielded (flush mount) switch. If it is equal to or greater than 2x the published range, use an unshielded (non-flush).

Calculating The Sensing Range For Inductive Sensors

Rated (nominal) sensing range $S_n$: Device characteristics
Real sensing range $S_r = 0.9 S_n = 0.9 S_r = 1.1 S_n$
Useful sensing range $S_u = 0.9 S_r = 0.9 S_u = 1.1 S_r$

Actuation distance $S_a$: The actuation distance is the distance at which a proximity sensor reacts under specified temperature and voltage conditions. It is between 0% and 81% of the rated sensing range. For inductive sensors you will need to correct the nominal sensing range with the correction factor based on the metal type that you are trying to detect.

St37 (Fe) = 1
Nickel chromium = 0.9
Stainless steel (V2A) = 0.8
Lead, brass (Pb, Ms) = 0.5
Aluminum (solid) = 0.45
Copper (Cu) = 0.4