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Heavy-Duty Sensors for Heavy-Duty Transportation

What to look for when choosing sensors for demanding transportation applications.

By Edis Osmanbasic, May 4, 2022

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(Image courtesy of Honeywell.)

Heavy-duty transportation equipment requires heavy-duty sensors.

Industrial vehicles such as excavators, cranes and lift trucks must operate in challenging environments, and must be built to last. These vehicles must be outfitted with specialized sensors that go above and beyond their standard counterparts. Heavy-duty transportation sensors must be hardy, designed to withstand demanding conditions such as high mechanical stress, vibration, extreme temperatures, and exposure to moisture, dirt and dust.

These sensors must be reliable, performing without failure and providing fast and accurate measurements despite their harsh environment. And of course, heavy-duty transportation sensors must be cost-effective, meeting their stringent requirements at a viable price.

In this article, we examine the challenges of heavy-duty transportation and explain what designers need to know about sensors for the industry.

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Applications of Heavy-Duty Transportation Sensors

There are numerous applications for heavy-duty transportation sensors. They help to provide equipment control, position and movement detection, linkage tracking, bucket control, work monitoring, vehicle stability control, operator assistance, performance control, valve control and more.

Excavators, for example, use position sensors in the connections between the boom, bucket and stick. These sensors measure linear or angular position against a fixed reference point, effectively capturing the motion of the equipment.

One of the fundamental challenges of transporting large and heavy items is the high center of gravity, which increases the risk to the vehicle's stability. When operating heavy loads, the load tilt angle must be continuously monitored to perform hydraulic adjustments that keep the tilt angle within specified parameters. The sensors used for this safety-critical operation must be specially designed for heavy-duty applications.

Heavy-Duty Sensors

It is crucial to select the proper sensors for every application. Sensors must suit their environmental requirements and operating conditions, and system designers must ensure they meet specifications for accuracy, reliability, durability and cost. In the heavy-duty transportation industry, it is not always easy to balance these requirements.

Sensors for this industry require rugged packaging to withstand the harsh environments of heavy-duty transportation applications. The sensor housing must prevent moisture ingress that could damage or disable the sensor. Designers should look for sensors with high ingress protection (IP) ratings—ideally a rating of IP69K, the highest IP rating available for transportation equipment. This rating indicates the sensor is protected against foreign objects such as water and dirt, and even pressure washing.



Heavy-duty transportation sensors must operate in harsh environments subject to moisture, vibrations, mechanical shock and more. (Image courtesy of Honeywell.)

Sensors designed to operate in harsh environments must also operate across a wide temperature range, so it is important to select sensors capable of withstanding extreme temperatures. Sensors mounted externally on a vehicle should have an operating temperature up to at least 85°C.

“Designers should look for sensors that provide accuracy, reliability and durability. Most of these applications are in harsh environments, so they need rugged products,” explained Kathy Sung, Regional Customer Marketing Manager for Transportation Products at Honeywell, to [engineering.com](https://www.engineering.com).

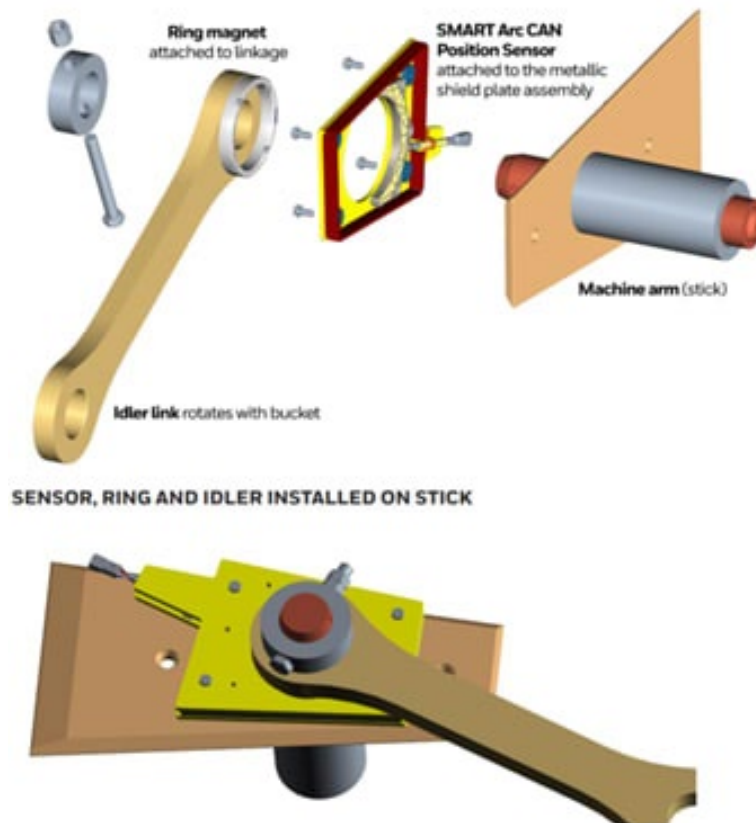
Non-Contact Sensors For Higher Reliability

Sensor reliability is another key aspect of sensors for heavy-duty transportation equipment. Sensors built with non-contact technology are more reliable and longer lasting than the more common electromechanical sensors, as the repeated contact in the latter precipitates wear. Non-contact sensors can last for 35 million cycles or more.

“In some heavy-duty transportation applications our [non-contact] Hall-effect rotary position sensors have no limitation on the life cycle,” says Ajibola Fowowe, Global Product Manager at Honeywell.

These sensors—Honeywell’s [RTY Series](#) and [RTP Series](#)—work using a magnetically biased integrated circuit that detects rotary movement of the actuator without any physical contact. Rotation of the actuator changes the magnet’s position relative to the integrated circuit, changing the flux density, which is converted to a linear output. The sensors are designed for harsh transportation and industrial applications, and are IP69K rated with a ruggedized PBT thermoplastic housing.

Another example of a non-contact sensor is the [Honeywell SMART Arc CAN Position Sensor](#). This sensor uses a ring magnet to sense angular position from 0 to 145°. It can be mounted directly on a pinned joint, allowing easy integration in excavators, backhoes, lifts and other heavy-duty vehicles.



Installing the Honeywell SMART Arc CAN position sensor. (Image courtesy of Honeywell.)

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Customizing Heavy-Duty Transportation Sensors

It is also important to consider whether sensors offer any customization, such as a customizable mounting solution to allow the sensor package to fit in a given application. Mounting the sensor in the right place can extend its life span.

Some sensors additionally offer customization through firmware. For example, a position sensor could be configured to output roll, pitch, inclination angles, or the rate of rotation or acceleration. Such sensors have the advantage of being both versatile and adaptable.

For example, the [Honeywell TARS Series](#) of inertial measurement units for heavy-duty transportation applications can be configured to output vehicle angular rate, acceleration and attitude data. The ruggedized sensors measure six degrees of freedom and can be installed in external locations such as the boomstick or bucket of an excavator.



The Honeywell TARS Series ruggedized IMUs measure six degrees of freedom. (Image courtesy of Honeywell.)

Speaking the Right Language

Communication protocols are an important aspect of sensors for heavy-duty transportation equipment. It is crucial to transport the measured data reliably from the sensors to the main control unit. In the past, sensors have outputted analog electrical voltages, usually ratiometric to the supply voltage applied to the sensor. However, the industry today mostly requires digital communication via protocols with rich data and diagnostic content.

The most common communication protocols in the transportation industry are PWM, LIN and SENT. Rapidly gaining in popularity is CAN J1939, a protocol that provides a high-speed, reliable in-vehicle communication system for heavy-duty transportation. The Society of Automotive Engineers (SAE) J1939 standard defines a high-speed Controller Area Network (CAN) for real-time, closed-loop control functions, simple information and diagnostic data exchanges between electronic control units and sensors throughout the vehicle.

What's Next for Heavy-Duty Transportation Sensors?

The future of the transportation industry is the transition from fossil fuels to renewable energy—a transition which is already underway in passenger vehicles.

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In the heavy-duty transportation sector, hybrid solutions are shaping up to be the next step in the journey. There is interest in adopting hydrogen fuel cells as an energy source to power the vehicle's engine. However, it is not just the engine that needs to change. Many other parts of hybrid vehicles, including the sensors, must adapt to this new environment.

Sensor manufacturers are in the midst of understanding the new requirements pertaining to electric vehicles (EVs) and vehicles powered by hydrogen fuel cells. Since hydrogen is a flammable gas, sensors that can detect hydrogen leakage will be increasingly necessary.

As for EVs, there is a danger of thermal runaway events that cause fire or explosion of the battery packs. This necessitates reliable battery management sensors for current, voltage and temperature, as well as pressure sensors and gas-detection sensors to detect the early onset of thermal runaway events.

“Honeywell has electric vehicle current sensors as well as battery safety sensors,” said Fowowe. “We also have safety sensors as well as pressure sensors for thermal runaway detection. We've seen really good success in China with these offerings and we're in the process of globalizing them to the broader markets.”

As the renewable transition continues, we will continue to see new sensor innovations that pave the way for heavy-duty EVs and hydrogen vehicles.

To learn more, visit [Honeywell Transportation Solutions from TTI](#).