

# DOUBLE ACT

THE FIRST DUAL PRESSURE SENSOR WITH INTEGRATED REDUNDANCY FOR SAFETY-CRITICAL MOBILE HYDRAULIC APPLICATIONS MAKES THE COMMON SOLUTION OF DOUBLING UP FOR LUCK SEEM SUPERFLUOUS

A typical safety-critical load monitoring application (Palfinger)



▶ For utility vehicles today, safe working conditions are increasingly mandated by legislation and voluntary codes of practice. Automated load-monitoring systems using pressure transmitters are becoming instrumental in creating safe working environments. They play an important part in making certain that machine control systems used in utility vehicles, including cranes, lifting platforms and forklift trucks, perform with precision, accuracy and, most importantly, reliability.

'Failsafe' is the keyword that drives system designers to be ever more creative, and system redundancy is a design concept that helps to meet these regulatory requirements. Pressure transmitter-based systems must guarantee that systematic failures within hydraulic controls are eliminated and

random error functions are identified, so that all moving parts are shut down if a dangerous condition exists.

### State-of-the-art technology

In typical load and load-moment monitoring applications in the mobile hydraulics sector, pressure is measured at the hydraulic cylinder of the boom, the hydraulic pump of the traction drive or at the pressure reservoir of the brake system. Any malfunction of a transmitter may lead to a critical condition of the system.

A malfunction may be caused by extreme environmental conditions (EMC, humidity, shock and vibration) or physical damage. It can also be caused by abnormal operating conditions, including an overload of the sensor caused by pressure spikes. Erratic software failures in the subsystem

program or a defective electronic component may also be a source of an incorrect transmitter and/or system output signal.

Machine designers take many preventative steps to provide a continuously safe operating condition. One easy, practical and common solution is to use two pressure sensors at the same measurement point. A redundancy check of the two output signals is made in the machine logic control circuit to detect any unexpected deviation in transmitter readings.

The disadvantages of this approach are that an additional pressure port with separate sealing is required, as are additional electrical connectors with mating connectors. A larger number of electrical components within the control system are required to use two individual sensors. From a safety

standpoint, this increased complexity may just present additional opportunities for failure.

**The answer: '2 in 1' sensor MHS-1**

Wika's MHS-1 pressure transmitter offers the first integrated, dual pressure sensors manufactured specifically for safety-critical and safety-related applications in mobile hydraulics. Dual (two-channel) pressure measurement, separate electrical signal processing and two independent 4-20mA output signals enable a redundant monitoring for pressure measurement points at the controller. In other words, the customer just needs a single pressure port with one sealing and one mating connector with one cable.

It is now, for example, possible for channel one to be a sensor with 0-600 bar measuring range and a 4-20mA proportional electrical output signal, and for channel two to be 0-1,000 bar for 4-20mA. Logically, it is important that the sensor with the smaller measuring range is selected for the maximum possible system pressure, as both sensors share a single mechanical process connection. The use of two identical pressure ranges or a reverse scaling of the second signal (such as 20-4mA) is also possible. This enables easy monitoring of the measurement point by adding both signals within the machine control, because normally the result should always be constant.

A random hardware or software error of the safety-critical load-monitoring system can be detected by monitoring the two sensor signals in the control system, and the actuator can be set to a safe state if a hazardous condition is detected. Therefore, the probability of a dangerous failure is substantially reduced.

This solution increases the process safety and is also cost-effective because the mechanical and electrical installation costs are clearly lower than installing two individual pressure sensors.

**TÜV-certified safety**

The current machinery standard EN 954-1 will become obsolete by the end of 2009. The new European Machinery Directive (2006/42/EC) refers to two global standards that are generally applicable in the safety technology world. The MHS-1 is designed to meet both safety standards: ISO 13849-1 (Performance Level - PL); IEC 61508 (Safety Integrity Level - SIL).

The ISO standard covers the whole range of available control systems (electrical, hydraulic, pneumatic and mechanical) while the IEC is focused on electrical/electronic systems.

The Wika product is certified by the German TÜV (Technical Inspection Agency), a recognised and independent test laboratory. The requirements of the new Machinery Directive, which became mandatory in Europe in December 2009, were already met by the new sensor.

Safety-related characteristics available from Wika for the pressure sensor include Mean Time to Failure (MTTF) values. A complete safety-related control system (sensor, controller and actuator) can be evaluated by the user quickly and easily. The MHS-1 achieves the Safety Integrity Level SIL 2 in accordance with IEC 61508 and Safety Category 3 Performance Level d in accordance with ISO 13849-1.

**Robust design for tough conditions**

In consideration of the typically harsh environmental conditions under which mobile hydraulics must work, the metal thin-film sensor technology has clear advantages compared with other technologies to withstand the rough off-highway conditions.

Wika's hermetically sealed, welded, dry thin-film measuring cell with its sputtered Wheatstone bridge offers long-term stability even in applications with high dynamic load changes. Thin-film sensors feature excellent resistance to pressure spikes in hydraulic systems.

In addition, the proven Wika CDS (Capillary Damping System) integral to the process connection minimises the possibility of sensor failure due to cavitation or micro-diesel effects.

Changes in temperature usually influence the measurement of pressure in all sensor technologies, and therefore a compensation for temperature effects is necessary. With Wika's metal thin-film technology, the temperature compensation occurs directly on the sensor by laser-trimming special resistors integrated into the applied measuring bridge.

The electronics are designed for harsh EMC conditions up to 100V/m. The robust laser-welded stainless-steel housing and the tested ingress protection of IP 69K for high-pressure wash-down, including the electrical connection, are designed for the extreme conditions often encountered in mobile hydraulics.

The transmitter has not only been designed to meet the above specification but also extensively tested to fulfil all these requirements. A large number of tests have been run in order to prove the suitability of the MHS-1 for tough environmental conditions.



LEFT: Wika pressure transmitter MHS-1  
RIGHT: Redundant dual sensor MHS-1

**Customer-specific designs**

Wika has various safety-evaluated designs available for a variety of applications, both with and without sensor overload detection. Either a redundant single-sensor or a redundant dual-sensor concept makes this possible. With two individual sensors, designed for different ranges, the sensor with the lower range will get an offset at a certain overload pressure. This can be detected by monitoring both sensor signals in the machine control.

The company's flexible instrument assembly and modern production system support custom designs. The sensor product lines have been certified in accordance with the automotive standard ISO/TS 16949:2002, which is valid throughout the world, to ensure first-class quality.

The MHS-1 is the latest pressure measurement solution specially developed for safety-critical mobile hydraulic applications. Already successfully established in this target market are the MH-1 for heavy-duty applications; the MH-2 for high OEM quantities, with an excellent price/performance ratio; and the D-20-9 with a standardised digital CANopen interface for bi-directional communication. This ensures the company can always offer the right product depending on the customer requirements. **ivt**

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