KING-GAGE
A NOSHOK Company

Liquid Level Transmitter

Models 4501, 4502, 4503

Effective: January, 2014

DATA SHEET 1100-25 REV 2

AcraSensor™

- **Flush mounting sanitary design**
- **Electronic (4–20 mA) output or pneumatic output**
- **Field replaceable sensor diaphragm**
- **Stable output during**
- **CIP cycles**

Reliable Liquid Level Measurement

These unique pneumatic sensors detect level by sensing hydrostatic pressure created by liquid depth. Acting on the force balance principle, a sensitive diaphragm is exposed to the liquid contents of the tank. Compressed air within the sensor creates a pneumatic pressure that balances the force of the liquid acting against the diaphragm. This compensating pneumatic pressure is directly proportional to the depth of liquid in the tank.

The pneumatic force balance technique is virtually free from long term drift, hysteresis and temperature sensitivity unlike strain measurements (including load cells) since mechanical deflection of the diaphragm is not directly measured. The compensating pneumatic balance pressure which effectively isolates the sensor is converted to a proportional 4–20 mAdc signal or can be directly output to a suitable gauge. In actuality, the sensor is measuring the mass (weight) of fluid matter that can be correlated to units of standardized volume.

Sanitary Configurations

These sensors are especially suited to a wide range of sanitary applications on storage or continuous processing vessels. The unique AcraSensor titanium diaphragm meets the requirements of 3-A and is appropriate for flush mount, clean-in-place installation. An FDA-approved silicone rubber O-ring seal forms a crevice-free, positive compression seal between the diaphragm probe and mounting shell. Flush weld mountings are available with product contact surfaces of 316L stainless.

The level sensor can be alternatively supplied with silicone rubber diaphragm surface. This molded elastomer provides additional material compatibility options. (Quick disconnect sanitary adapters are also available for sensor mounting.)

Conformance to Sanitary Standard

The AcraSensor diaphragm meets the requirements of 3-A 74-07, Sensors and Sensor Fittings and Connections.

AcraSensor ▪ 4–20 mA Output Version

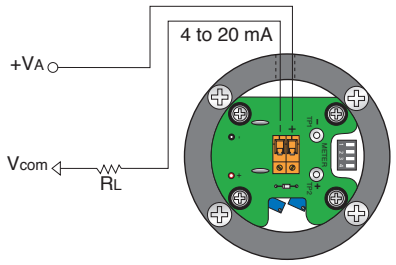
Tank Gauging Applications

Acting on the force balance principle, a pneumatic sensor generates air pressure equivalent to the hydrostatic force created by liquid depth. This pneumatic pressure is directed into the D/P transmitter. Pressure is converted to an electronic 4–20 mAdc output proportional to liquid depth. Twisted pair cabling is used to form the signal loop through which the remote indicator receives the transmitter output. The KING-GAGE indicators shown in these system views correlate the transmitter output to total volume or weight of tank contents. This is determined by using a pressure versus capacity listing corresponding to the actual tank dimensions.

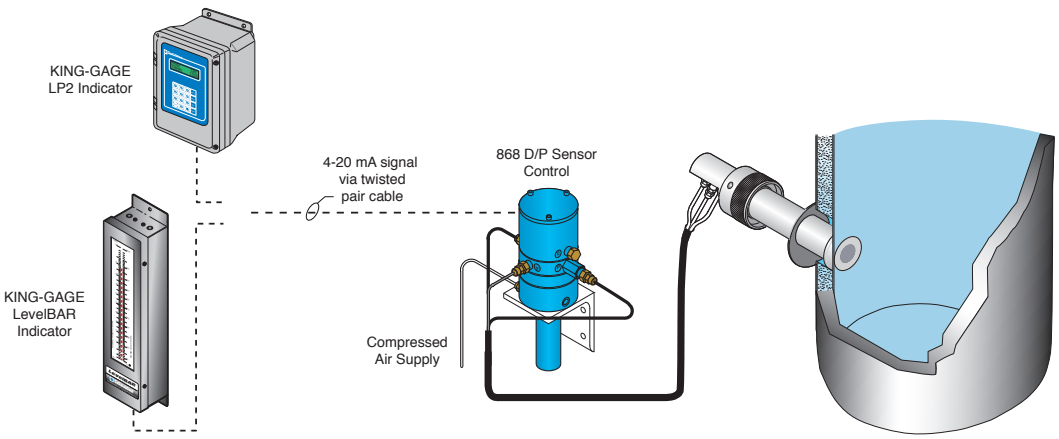
The standard AcraSensor + 868 D/P Sensor Control combination combines accuracy, rugged durability, reduced maintenance and long term stability for liquid level tank gauging. Its integral transmitter converts the pneumatic isolation pressure to a proportional 4–20 mAdc signal suitable for process control or remote level indication.

Transmitter Signal Loop

As is typical of two wire transmitters, electrical power to the signal loop is supplied through twisted pair cable. Excitation voltage (+V) is provided by the receiving device or from a separate Vdc power supply installed in the loop. The actual voltage necessary for operation of the system will depend upon the overall load resistance of the loop. In most applications, the KING-GAGE Digital Indicator or LevelBAR indicator provide 24 Vdc excitation to power the transmitter signal loop.



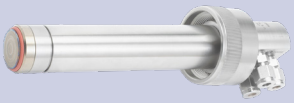
Internal Connections at D/P Sensor Control



AcraSensor System Package with 868 D/P Sensor Control (4–20 mA Output)

AcraSensor + 868 D/P Sensor Control = 4–20 mA Output

The standard AcraSensor + 868 D/P Sensor Control combination combines accuracy, rugged durability, reduced maintenance and long term stability. Designed for liquid level tank gauging, it generates a proportional 4–20 mAdc signal suitable for process control or remote level indication.



AcraSensor

3-Tube Cable

868 D/P Sensor Control

AcraSensor ▪ Pneumatic Output Version

Pneumatic Operation

AcraSensor diaphragm unit is paired with a Sensor Control regulator to provide the continuous 1 CFH (cubic foot per hour) air flow to the underside of the diaphragm to attain pneumatic balance pressure. Constant back pressure regulation maintains a linear 1:1 response throughout the entire operating range to ensure pneumatic pressure is directly equivalent to the hydrostatic head of liquid in the tank.

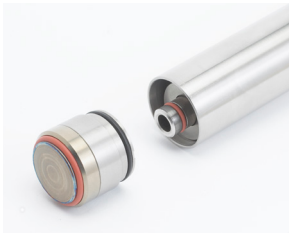
The AcraSensor + 860 Sensor Control combination affords rugged durability and simple maintenance. Used in conjunction with compatible indicators (such as the KING-GAGE LevelBAR), this liquid level sensor can provide reliable operation in even the most challenging environments. Alternative configurations include substitution of a molded silicone rubber diaphragm when appropriate.

Application Notes

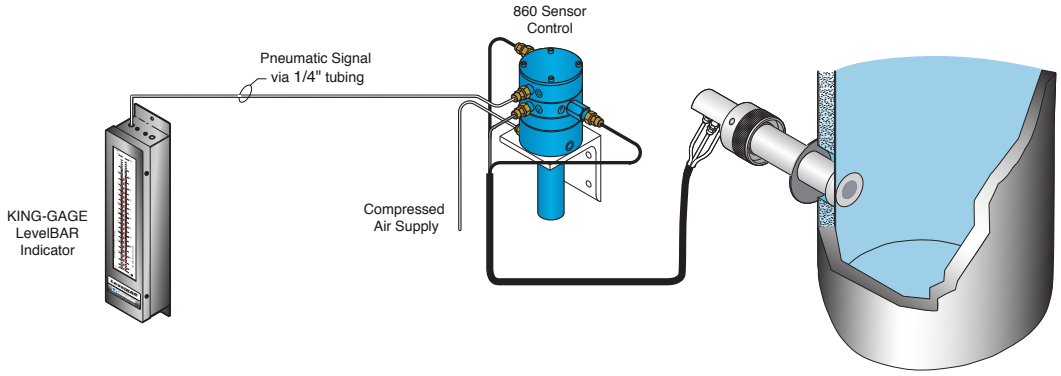
Location of the Sensor Control air flow regulator should be generally no greater than 50 feet (15 m) from the AcraSensor unit. The level sensor includes 15 feet (4.5 m) of bundled 3-tube cable for the pneumatic interconnections with the Sensor Control. Distances greater than 50 feet may increase response time of the sensor to changes in liquid level in the tank.

Compressed Air Supply

Operation of the AcraSensor requires a compressed air/gas source providing supply pressure of 35–150 psig (2.4–10.3 bar). Pneumatic components require instrumentation-grade compressed air that is clean, dry and oil-free to ensure trouble free performance.



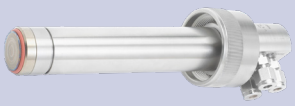
Field Replaceable Sensor Diaphragm



AcraSensor System Package with 860 Sensor Control (Pneumatic Output)

AcraSensor + 860 Sensor Control = Pneumatic Output

The AcraSensor + 860 Sensor Control combination offers rugged durability and simplified maintenance. The pneumatic output pressure can be directed into compatible indicators (such as KING-GAGE LevelBAR) or a remote transducer up to several hundred feet away from the tank.



AcraSensor

3-Tube Cable

860 Sensor Control

Specifications

Sensitivity
Less than .001 psi (±.02" water/.508 mm water)

Repeatability
Better than ±.002 psi (± .05" water/1.27 mm water)

Accuracy
±.007 psi (±0.2" water/.508 mm water)

Temperature Range
30° to 300°F (0° to 149°C)

Pressure Range
Sensor is a 1:1 pneumatic force balance diaphragm capable of repeating hydrostatic pressure as an equivalent pneumatic output. Functional pressure limit is 130 psi (or 3598 inches @ 1.00 specific gravity) determined by supply pressure (35–150 psi) less 20 psi.

Maximum Depth Measurement
1937 in. water (49.0 m water)

Wetted Materials
Silicone rubber O-ring (meets the requirements of 3-A),
Titanium diaphragm (meets the requirements of 3-A 74-07).

Optional diaphragm materials: Silicone rubber

Fittings/adapter wetted surfaces are typically 316L stainless steel (as supplied by King Engineering).

Air Consumption
Total air consumption of sensor package (including sensor control) is less than 10 CFH or 0.16 scfm.

D/P Sensor Control Combined Accuracy*
0–5 psid transmitter/control ±0.34% FS
0–10 psid transmitter/control ±0.27% FS
0–15 psid transmitter/control ±0.24% FS
0–30 psid transmitter/control ±0.22% FS
0–50 psid transmitter/control ±0.21% FS

Voltage Supply Requirements
14–40 Vdc (unregulated) to power signal loop using 868 D/P Sensor Control.

Compressed Air Supply Requirements
35–150 psig (2.4–10.3 bar); clean, dry air (or inert gas)

*Combined accuracy refers to the primary accuracy of the sensor in combination with the secondary accuracy of the D/P transmitter.

Span Adjustment Range

Transmitter turndown ratio is 3:1 for the 0–15, 0–30, 0–50 psid nominal ranges.

Nominal	Minimum	Range of Adjustment
0–5 psid	0–3 psid	0–83 in. thru 0–138 in. water/ 0–2.1 m thru 0–3.5 m water
0–10 psid	0–3 psid	0–83 in. thru 0–277 in. water/ 0–2.1 m thru 0–7.0 m water
0–15 psid	0–3 psid	0–83 in. thru 0–415 in. water/ 0–2.1 m thru 0–10.5 m water
0–30 psid	0–10 psid	0–277 in. thru 0–830 in. water/ 0–7.0 m thru 0–21.0 m water
0–50 psid	0–15 psid	0–415 in. thru 0–1384 in. water/ 0–10.5 m thru 0–35.1 m water

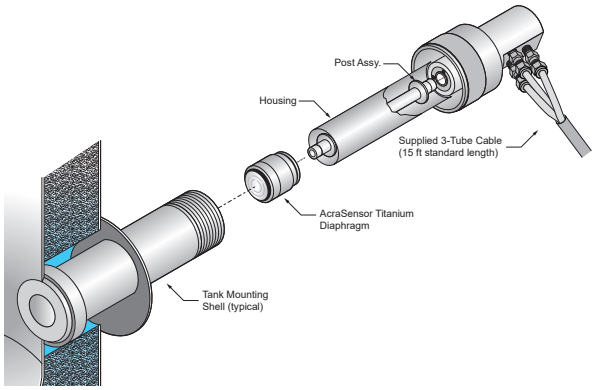
IMPORTANT! Accuracy, linearity, and non-repeatability values are based on nominal range.

Operating Limit (Maximum Pressure)

Pressure above 300% nominal range (overrange) will result in damage to the transmitter (200% may cause a shift in calibration). Burst pressure is 200 psi and will cause catastrophic and physical failure of the pressure element.

Installation

For sanitary flush mount installation, shell is installed through the side of the tank and flush-welded to inner liner. AcraSensor uses a one-piece titanium diaphragm mounted onto a post assembly inserted into the tank shell and clamped into place.



Flush Weld Shells and Retrofit Adapters

Polished stainless steel tank mounting is offered in two lengths for insulated wall vessels and a short version for single wall (non-insulated) tanks. We offer adapter inserts that permit retrofit installation of the AcraSensor unit within an existing sanitary mounting from other manufacturers (e.g., Tank Mate, Cherry Burrell, Anderson Instrument). There is also an adapter for 2" Tri-Clamp quick release fittings available for direct mounting of the AcraSensor unit.