

Half Full or Half Empty?

Level Monitoring with the aid of an automation system

Level monitoring in closed tanks is a measurement process often required in the chemical or food industries. With the aid of an automation system, many additional useful functionalities can be implemented, culminating in automatic inventory control. JUMO GmbH & Co. KG, based in Fulda, Germany, successfully uses this system on its own company premises.

Pressure transmitters or level probes are used for hydrostatic level measurement in vented tanks or for determining the level, for example, in drinking water wells. The measuring principle in this process is based on the hydrostatic pressure in a liquid or gas. This is generated by the height of the liquid column above the measuring device (SI unit: meter of water). The pressure increases with increasing depth regardless of the direction. For instance, a 10 meter water column (mH₂O) is equivalent to 0.98 bar (approx. 1 bar).

The measured hydrostatic pressure p is used to calculate the current filling level h . In the process, the ambient pressure p_0 , the temperature-dependent product density ρ , and gravity g are taken into account.

$$h = p - p_0 / (\rho * g)$$

Relative pressure measurement devices automatically compensate for the fluctuating ambient pressure. These are influenced by such factors as weather conditions or altitude. Furthermore, the density of a gas or liquid depends on the temperature so that it affects the accuracy of the level measurement and therefore the filling height. For example, the density of water at 5 °C is 999.964 kg/m³, after heating to 30 °C, this value drops to 995.645 kg/m³.

The most accurate measurement of the fill level in closed tanks is achieved with differential pressure transmitters such as the JUMO dTRANS p20 DELTA. In this case, one differential pressure transmitter with two pressure separators is used in each tank. During installation, the measuring device is connected to the floor and the cover of the container using pipelines. If

hygienic requirements must be fulfilled, then suitable pressure separators with capillary lines are installed instead.

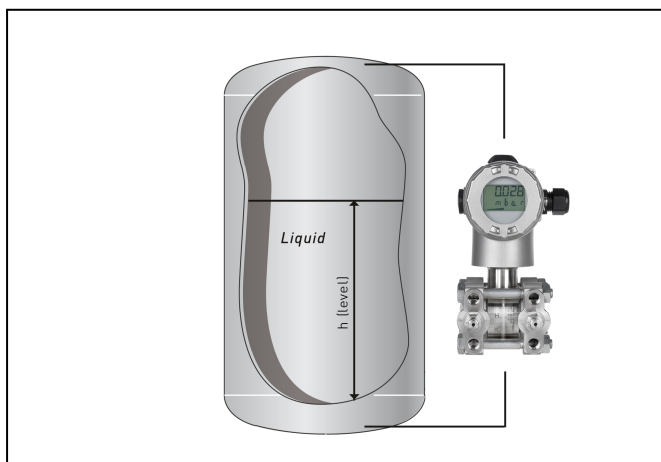


Fig. 1: JUMO dTRANS p20 DELTA differential pressure transmitters in closed tanks

With a transmitter linearity of 0.07% as well as the linearities of the pressure separators and capillaries, a highly precise measurement of the filling level accurate to within a centimeter can be obtained according to the tank size.

The JUMO dTRANS p20 pressure transmitter combines maximum precision with simple operation. It is used to measure the relative pressure and absolute pressure of gases, vapors, and liquids. The integrated LCD display shows the measured values and device data. The case and sensors are manufactured from high-grade stainless steel. Various front-flush-mounted process connections are available to meet hygiene requirements, including the EHEDG certified PEKA connection system.

A special high-temperature version which can withstand temperatures of up to 200 °C is available for measurement tasks involving hot media and lines. Pressure separators can also be connected for particular process technology applications. The transmitter is programmable. As a result it is readily adaptable to a variety of different measurement tasks. A convenient setup program is available as an accessory to enable operation via the interfaces. A rotary knob makes manual operation on site – even in Ex-areas – very convenient and quick. When measuring the filling level from the outside, the JUMO dTRANS p30 or the JUMO DELOS SI can be used. The JUMO MAERA S28 level probe is particularly suitable for use in water wells. JUMO has an innovative pressure transmitter with wireless data transmission in its product range for wireless applications.

If this measurement technology is then combined with an automation system, it opens up a number of additional possibilities. Thanks to the JUMO dTRANS p20 DELTA and JUMO mTRON T, several nitrogen tanks are monitored at the JUMO premises in Fulda, Germany.



Fig. 2: Installation situation on the tank system

The advantages are clear: the modular design of the JUMO mTRON T offers maximum flexibility. Different input/output modules are available including a multichannel controller module, an analog input module with four or eight channels, a relay module in a 4-channel version, and the configurable digital input/output module with twelve channels.

The 4-channel analog input module is the special feature, and is equipped with universal and galvanically isolated analog inputs for thermocouples, RTD temperature probes, and standard signals. Different measurands such as temperature, pressure, and humidity can therefore be precisely recorded and digitalized using the same hardware. For individual control applications, the system has a PLC (CODESYS V3), program generator and limit value monitoring functions, as well as math and logic modules. The JUMO mTRON T enables simultaneous operation of up to 120 control loops. Furthermore, inputs and outputs of each controller module can be individually expanded and adjusted via expansion slots.

A further advantage is the clear appearance of all recorded values. In addition to enabling visualization, the multifunction panel also enables easy-to-use operation of the controllers and program generators. Moreover, user-dependent access to parameter and configuration data for the overall system is possible. The recording functions of a fully-fledged paperless recorder, including a web server, are also implemented as a special feature in the JUMO system. Proven PC programs are available for extracting and

evaluating recorded data. Using standard predefined screen masks, startup times for the user are considerably reduced.

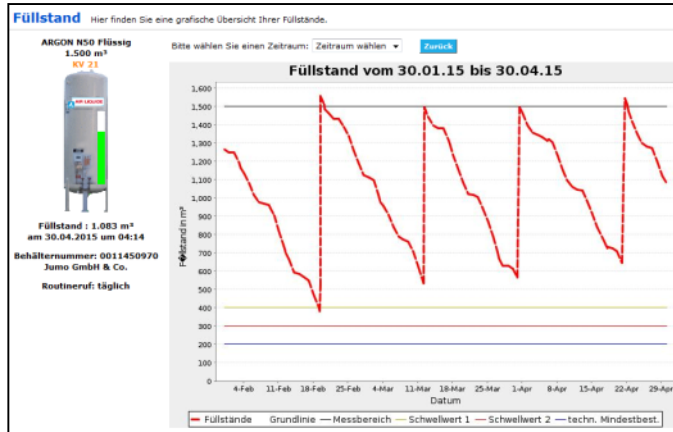


Fig. 3: The automated filling level monitoring process screen

Because the automation system includes an integrated web server, users can conveniently and reliably access the process values. This can be performed either using a PC or also remotely using a smartphone/tablet. Messages – such as alarm messages – can also be sent via SMS text message or email. However, automated filling level monitoring can also be implemented using this functionality. To this end a limit value is defined in the JUMO mTRON T. If it falls below this value, an order process is triggered completely automatically with the supplier via email. Thanks to proven measurement technology and modern automation solutions, this implements an application that successfully opens the door to the much-lauded Industry 4.0.

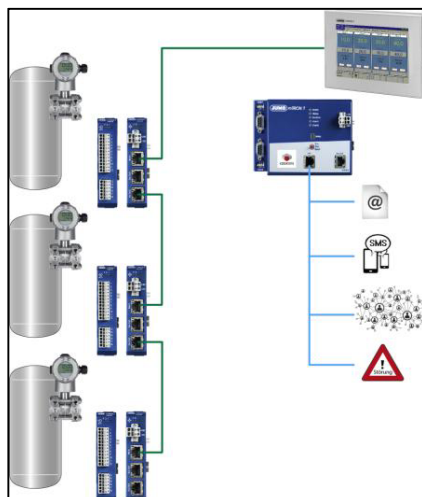


Fig. 4: Schematic diagram of level monitoring with the aid of the JUMO mTRON T automation system

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