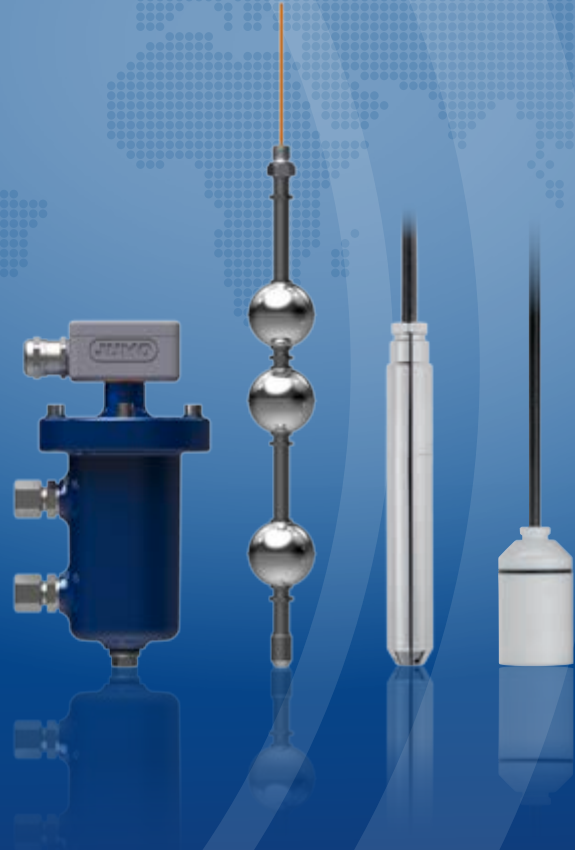




More than **sensors + automation**



Point and Continuous Level Measurement

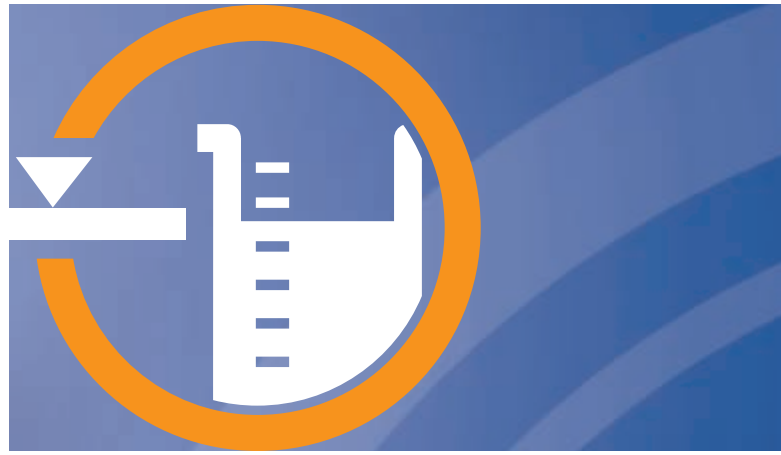
Innovative solutions for the toughest requirements



Contact:

Phone: +49 661 6003-0

Email: sensors@jumo.net



Dear Reader,

In this brochure we focus on the basic principles of point and continuous level measurement through level probes, float switches, and level transmitters.

When it comes to level probes JUMO can look back on sound experience in hydrostatic level measurement. We are also a long-term supplier of floats from the JUMO metal technology field, so that we are able to make excellent use of this expertise. Effective immediately we are extending our portfolio to include point value measurement through float switches as well as level measurement through level transmitters via floats.

This brochure aims to provide an overview and sense of orientation about the two measuring principles in level measurement. Of course we will assist you in selecting the most suitable product for your measuring task.

As JUMO is not only a component supplier but also system supplier, we will present options for the implementation of complete measuring point solutions. What distinguishes us is the unique production depth of the JUMO component range that we customize to the customer's requirements.

Our global sales structure as well as our reliable expert service provide support for you with every step that you take together with JUMO. This applies to all phases including product consultation, installation, calibration, or for questions during operation.

We view consistent product quality, high plant availability, and maximum cost effectiveness of your machines and plants as being at the heart of a successful collaboration. Consequently, we place the highest demands on ourselves by introducing, continuously assessing, and improving quality standards. One result of this philosophy is that the measuring devices are subject to thorough testing and detailed inspection at our own test laboratory.

The reliability that our products and staff ensure for our customers is another fundamental pillar of our family-run company.

Further information about our products can also be found at www.jumo.net.



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Hydrostatic level measurement

Level probes are used for continuous level measurement in ventilated tanks or to determine the level in open waters. The measuring principle is based on hydrostatic level measurement using relative pressure. This involves the complete immersion of the level probe in the liquid. For applications in pressurized tanks such as steam boilers, we offer differential pressure transmitters for determining the level.



Measuring method for ventilated tank with level probe or pressure transmitter



Measuring method for closed tank with differential pressure transmitter

Point and Continuous Level Measurement

Hydrostatic level measurement

Continuous level measurement via level probe

Level probes continuously measure hydrostatic pressure. Here, the gravitational pressure of the liquid column located above the sensor is measured. This measuring principle allows the measurement of liquids and gases. The most commonly used units are meter water column (mWS), bar, pound-force per square inch (psi), and megapascal (MPa). For the purpose of calculating the current level height h , the formula

$$h = \frac{(p - p_0)}{(\rho \times g)} \text{ [m]}$$

is applied. In this formula, p represents the current measured pressure, p_0 stands for the ambient pressure, ρ denotes the medium density, and g constitutes the constant acceleration due to gravity. The formula refers to undisturbed liquids in containers or open waters.

Advantages of level probes – JUMO MAERA



























































































































































































































































































- Proven hydrostatic measuring principle with a high degree of reliability and low maintenance
- Widespread measurement method that is unaffected by media properties such as dust, foam, steam, or conductivity
- Level measurement independent of container geometry and installations
- Simply, subsequent installation from above in the measuring point
- Linear output signal to the fill level enables simple conversion
- High degree of chemical resistance as different material is available
- Used in containers, tanks, basins, and water wells
- Level measurement possible up to 300 m



Calculation of the hydrostatic pressure: $p = p_0 + \rho \times g \times h$



Level probe product overview

Point and Continuous Level Measurement

Hydrostatic level measurement



✓ suitable/available
– not suitable/available



Type		JUMO MAERA S28 Level probe, type 404392	JUMO MAERA S29 SW Level probe, type 404393	JUMO dTRANS p33 Level probe, type 404753
Application	Outdoor mounting ¹ Indoor mounting ¹	✓ ✓	– ✓	– ✓
	Approval	ACS	DNV GL, ATEX	ATEX
	Integrated overvoltage protection	✓ ²	–	–
	Temperature probe Pt100 (optional)	✓ ²	–	–
Technical data	Measuring range	2.5 to 100 mWS 0.25 to 10 bar	1 to 100 mWS 0.1 to 10 bar	2.5 to 100 mWS 0.25 to 10 bar
	Medium temperature	0 to +50 °C		
	Sensor	Piezoresistive silicon sensor		
	Accuracy (linearity)	±0.2 % (> 2.5 bar) ±0.3 % (≤ 2.5 bar)	±0.3 %	±0.5 %
	Overall accuracy at 20 °C in % of the end value	±0.3 % (> 2.5 bar) ±0.5 % (≤ 2.5 bar)	±0.5 %	±0.6 %
	Output signal	4 to 20 mA two-wire		
	Cable material	PE, FEP, PUR, EPR	FEP	PE
	Housing material	Stainless steel	Titanium	Stainless steel

¹ These recommendations are based on many years of experience. However, in individual cases they may not be fully applicable.

We would be happy to provide further information, including additional applications.

² Only for stainless steel version with an output signal of 4 to 20 mA two-wire.



Selecting a suitable level probe

A wide range of criteria is taken into consideration when selecting a level probe that is suitable for the respective application. This makes it necessary to clarify certain issues in advance. These include the medium in which the level probe must perform measurements, the existing temperatures, and the density of the medium. It is also necessary to gather information on the maximum height to be measured and the cable length. We are happy to provide you with specialist advice for selecting the right level probe.

Sensor (measuring cell)

When using the level probe with an integrated measuring cell, you can choose between different materials that are in contact with the medium based on the application in question. Variants made of stainless steel, ceramic, and titanium are therefore available. Depending on requirements, sensors can be implemented according to the capacitive or the piezoresistive measuring principle. The measuring range to be selected depends on the maximum liquid column that is to be measured as well as the density and temperature of the medium. The density of a medium is temperature-dependent. These dependencies are listed in tables. For example, the density of water is 999.964 kg/m³ at 5 °C. When it is heated by 25 K, the density falls to 995.645 kg/m³. The formula for hydrostatic pressure is applied to calculate the suitable measuring range (see page 5).

Process connection

The process connection of the level probe must be selected according to the features of the liquid and its properties on the base of the container. A closed connection protects the measuring cell from damage (e.g. due to relatively large solids in the medium). On the other hand, an open system offers advantages for contaminated or high-viscosity media or if a risk of deposit formation exists. A process connection with a thread can be used to fasten the level probe on the base of the tank.



Closed system



Open system



Protective cap



Notes on product selection

Cable

Special cables are normally used for transmitting the measurement data of a level probe. These cables are routed outdoors and in the tank or water well. As a result, various influences act on the cable. These include solar radiation, temperature fluctuations, and the respective medium. The primary factor when selecting the cable material is its chemical resistance to the medium while taking account the temperatures and concentrations of this medium. Cable sheaths must be chosen according to the application in question. UV resistance is indicated for all cables. To prevent problems ranging from measuring value errors to failure of the device, pressure compensation is achieved using an integrated pressure equalization hose that does not allow any moisture to penetrate. The penetration of liquid into the pressure equalization hose can be prevented using a pressure compensation filter.

Furthermore, the bending radius of the cable must not fall below the preset value, as otherwise insufficient ambient pressure compensation due to kinking might occur. The cable can also be lengthened for signal transmission in a cost-effective manner by using the optionally available terminal case with pressure compensation.

Overvoltage protection

Overvoltage protection or lightning protection is recommended above all for outdoor applications. This includes applications in deep water wells or free-field measurements. The overvoltage protection protects the level probe from destruction caused by possible lightning striking the surrounding body of water. Overvoltage protection is already integrated into the JUMO MAERA S28 and JUMO MAERA F27 level probes.



End of cable with pressure equalization hose



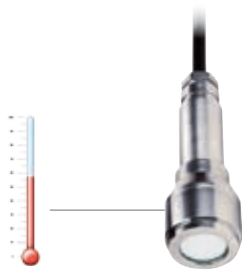
Overvoltage protection in event of lightning strike



Notes on product selection

Integrated temperature probe

The temperature probe integrated into the level probe measures the medium temperature. This is important in applications featuring changes in temperature as the temperature-dependent density influences the accuracy of the measurement. As a result, it is possible to combine two measurands in one product so that a straightforward installation is possible.



Integrated temperature probe

This way to your product

The "Level" checklist is a tool you can use to compile all the relevant requirements of your application in a clear and concise manner. This ultimately leads to fast and efficient order processing. The checklist can be accessed using the following link: http://www.jumo.de/en_DE/support/product-service/checklist.html

Checklist



Approvals

Numerous applications make increased demands on the products. Some of these include explosion protection, drinking water, and shipbuilding. Suitable level probes can be individually configured according to your requirements.



Approvals

Point and Continuous Level Measurement

Hydrostatic level measurement

Accessories

Terminal case with pressure compensation element

The terminal case acts as a link between the end of the level probe cable and the cable to the downstream evaluation unit (such as a paperless recorder). The terminal case features protection type IP65.

Cable clamp

The cable clamp holds the level probe in a liquid at a defined depth. As a result, an individually suitable probe height above the base of the tank during installation can be achieved.

Sealing screw

The sealing screw acts as a cable passage and cable fastening for such applications as closed containers or water wells with a well head. It therefore makes a contribution to a secure installation by protecting the cable sheath against damage.

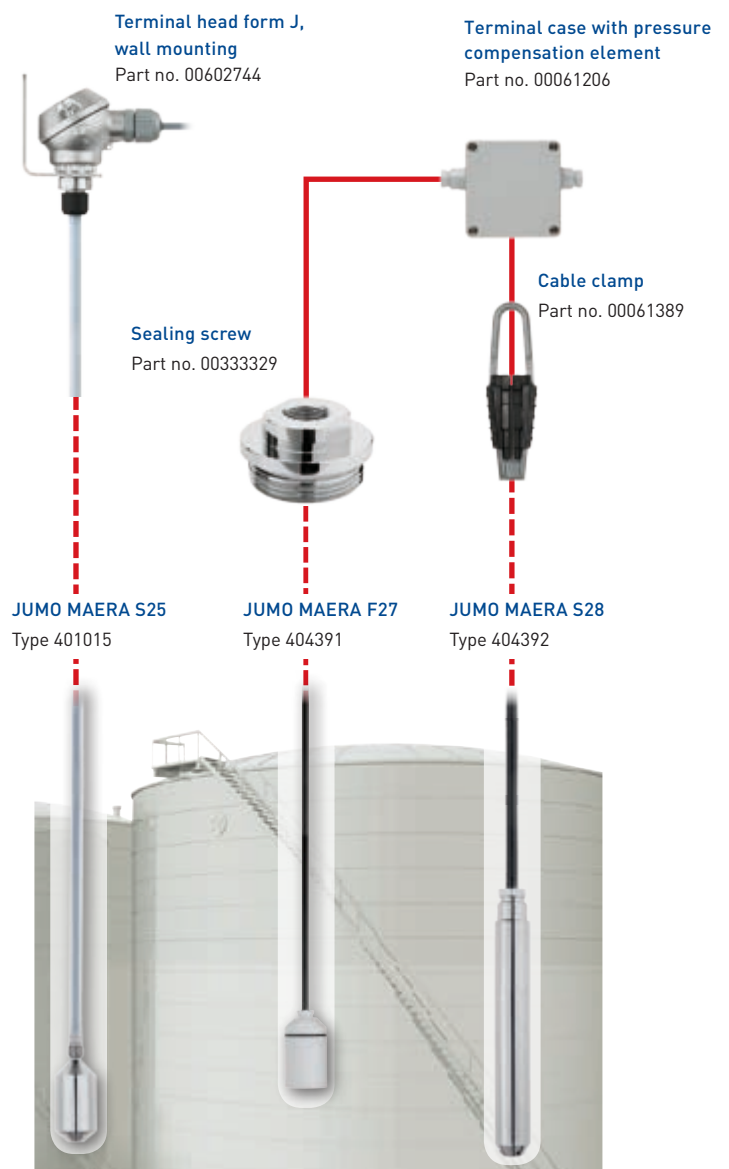
Terminal head

The terminal head is applied with the level probe JUMO MAERA S25 (type 401015). This terminal head is used to mount the level probes in the best possible way and features protection type IP67. Tank cover and wall mounting variants are available.

Evaluation unit

JUMO diraVIEW (type 701510) – digital indicator with LCD display for on-site display of the most diverse process variables

JUMO LOGOSCREEN 600 (type 706520) – the JUMO LOGO-SCREEN 600 paperless recorder features a resistive touchscreen and an intuitive, icon-based operation and visualization concept that makes it very easy to use.





Recommendations for the use of level probes

- ✓ suitable
– Not suitable



	Type	JUMO MAERA S25 Level probe, type 401015		JUMO MAERA S26 Level probe, type 402090		JUMO MAERA F27 Level probe, type 404391	
		Probe	Cable	Probe	Cable	Probe	Cable
Application	Wastewater	–	–	✓	FEP	✓	FEP
	Well water (without salt content)	✓	PE	✓	PE	✓	FEP
	Drinking water	–	–	✓ ¹	PE	–	–
	Heating oil	✓	PA	✓	FEP	✓	FEP
	Car washes	✓	PE	✓	PE	✓	FEP
	Fuel: diesel	✓	PA	✓	FEP	✓	FEP
	Seawater	–	–	–	–	✓ ²	FEP
	Caustic soda (20 %, 20 °C)	–	–	✓ ¹	PE	✓ ^{1,2}	PE
	Rainwater	✓	PE	✓	PE	✓	PE
	Sulphuric acid (50 %, 20 °C)	–	–	–	–	✓ ²	PE
	Swimming pools (disinfectant: chlorine)	–	–	–	–	✓ ²	FEP

These recommendations are based on many years of experience. However, in individual cases they may not be fully applicable.
We would be happy to provide further information, including additional applications.

¹ Seal: EPDM.

² PTFE variant.

Point and Continuous Level Measurement

Hydrostatic level measurement



✓ suitable
– Not suitable



	Type	JUMO MAERA S28 Level probe, type 404392		JUMO MAERA S29 Level probe, type 404393		JUMO dTRANS p33 Level probe, type 404753	
		Probe	Cable	Probe	Cable	Probe	Cable
Application	Wastewater	✓	FEP	✓	FEP	✓	PE
	Well water (without salt content)	✓ ¹	FEP	✓	FEP	✓	PE
	Drinking water	✓ ¹	PE	–	–	–	–
	Heating oil	–	–	✓	FEP	✓	PE
	Car washes	✓	PE	✓	FEP	✓	PE
	Fuel: gasoline	–	–	–	–	✓	PE
	Fuel: diesel	✓	FEP	✓	FEP	–	–
	Seawater	–	–	✓	FEP	–	–
	Sodium hydroxide (20 %, 20 °C)	✓ ¹	PE	✓	FEP	–	–
	Rainwater	✓	PUR	✓	FEP	✓	PE
	Swimming pools (disinfectant: chlorine)	–	–	✓	FEP	–	–

These recommendations are based on many years of experience. However, in individual cases they may not be fully applicable.

We would be happy to provide further information, including additional applications.

¹ Seal: EPDM.



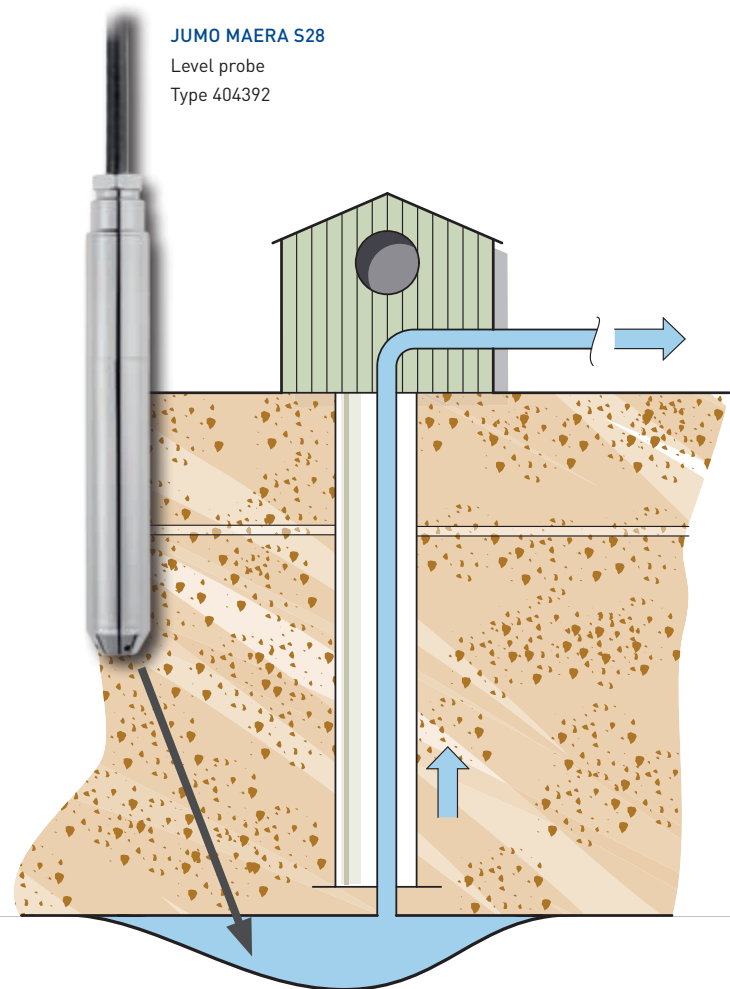
Deep water well application

Application

Mineral water manufacturers and water suppliers have to monitor and check the groundwater level using deep water well or groundwater measuring points. To obtain mineral water or supply drinking water, water wells are drilled. Water is then removed from these wells using powerful pumps. However, this removal of water must not be performed in an arbitrary manner, as this could cause long-term damage to the natural balance of the Earth's water cycle (the transport and storage of water). Therefore, level probes are lowered into the water well/borehole in addition to the pump to measure the groundwater level. If, in dry periods or in the event of excessive water removal, an insufficient amount of water is formed as a result of which the groundwater level falls below a specific limit value, measurements will quickly detect this state and the pump will be switched off. In regular operation, on the other hand, the volume of water that is pumped away is recorded using electromagnetic flowmeters such as the JUMO flowTRANS MAG S01. This enables precise detection of the flow rate or the flow velocity to ensure optimum use of the water well capacity.

Mine shaft application

A similar principle is also applied in mine shafts. In this context, however, water is pumped in as opposed to being removed. The water contributes to the stabilization of the shaft. It also protects people and nature against potentially fatal catastrophes.



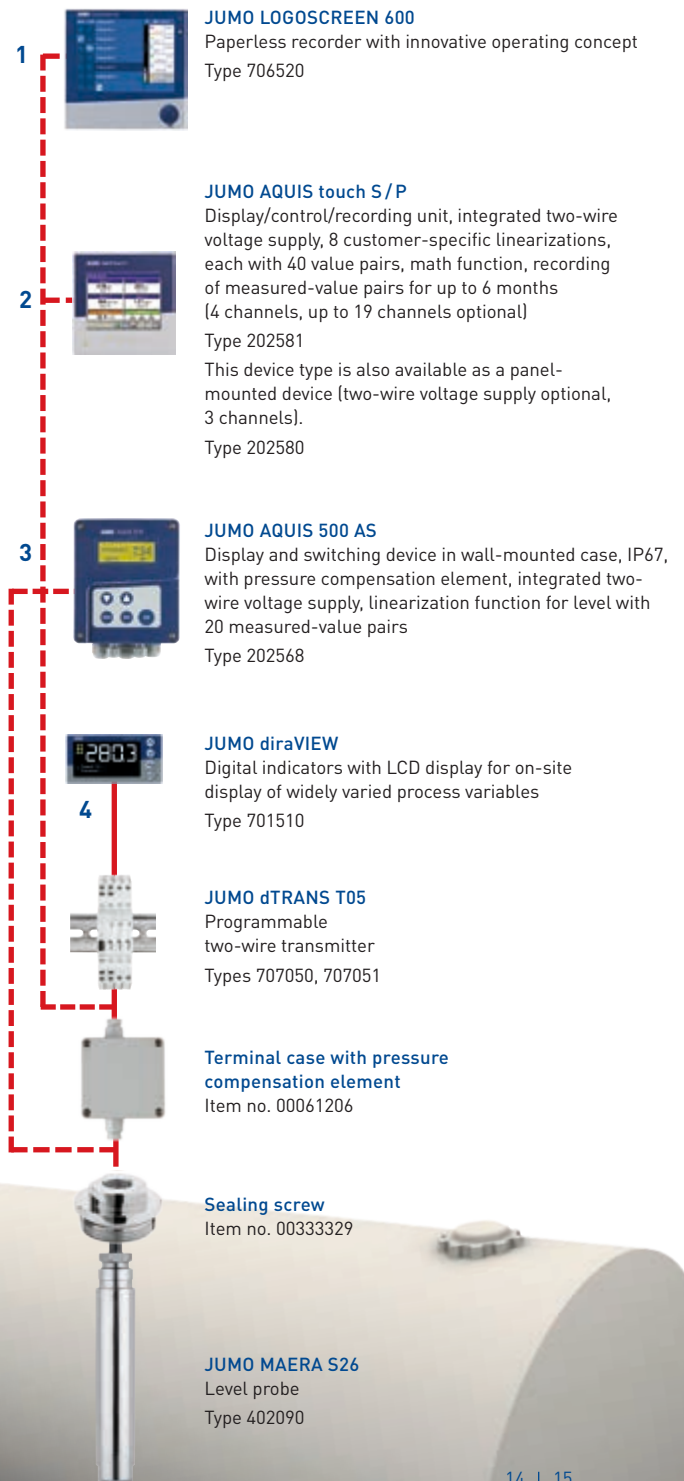
Diesel tank application

Application

In regions with poor infrastructure, plants are often operated using diesel engines. Operation, maintenance, and repair are particularly costly factors in this case. One example here is the filling of the diesel tanks. As a result of large distances between the individual plants, reliable information about the current level in the tanks is particularly important for safe plant operation as well as the involved costs. For example, the correct information can help the supplier or your own personnel in performing efficient route planning for tank filling. In addition, our JUMO mTRON T system enables further options such as alarm messages via texts/emails as well as paperless recorder functions including web server. The connection of proven measurement technology and state of the art automation solutions in the form of inventory monitoring opens the door to Industry 4.0. JUMO level probes make a decisive contribution to the cost-effectiveness and secure availability of a plant.

Special case: horizontal tank

If a liquid is stored in a horizontal cylindrical tank, it must be taken into account that the fill volume will not change in linear proportion to the level height. To ensure a user-friendly display or recording of the measured values, a customer-specific linearization or an integrated math function can be applied. Connection variant 4 (see figure) is briefly explained as an example: the level probe measures the pressure caused by the liquid column. A terminal case acts as a link between the level probe and the JUMO dTRANS T05 transmitter. JUMO dTRANS T05 scales the corresponding standard signal in such a way that a display in liters or cubic meters can be implemented using the JUMO diraVIEW.





Float switch and level transmitter

Float switches are used for point value measurement and level transmitters via floats are used for quasi-continuous level measurement of liquids. The measurement takes place according to Archimedes' principle and is suitable for unpressurized and pressurized tanks.



Point and Continuous Level Measurement

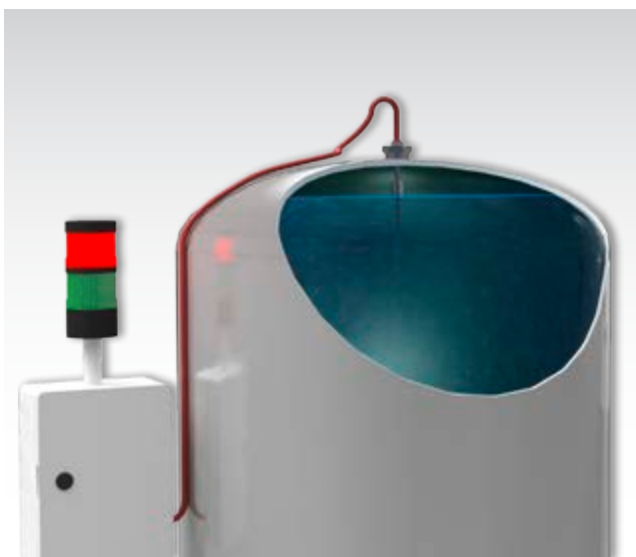
Float switch and level transmitter

Quasi-continuous level and point level measurement via floats

Point and continuous level measurement is carried out according to the Archimedes' principle for liquids. The float moves along the guide tube as the level rises or falls. The magnet in the float actuates the reed contact – or several contacts – installed in the guide tube with its magnetic field. Depending on further switching signal processing and application the switching functions are available as normally open contact, normally closed contact, changeover contact, or bistable response. Further reed contacts allow the transfer of additional information pertaining to "Full" or "Empty" reporting in the filling level. Mounting generally takes place from above or from below via the thread or flange in the tank. Special design types enable side attachment (e.g. via pipes). With the level transmitter, the levels of tanks and containers are transferred with a quasi-continuous standard signal. Instead of a reed contact a reed chain and head transmitter are used for the interpretation of the level. Explosion protection (intrinsically safe and flameproof enclosure) and shipbuilding approvals are available for applications with special requirements.

Advantages of the float switch and level transmitter – JUMO NESOS

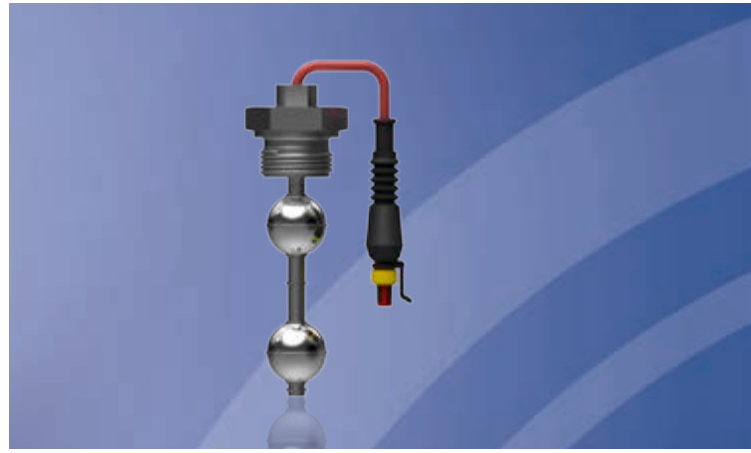
- Proven measurement method with robust technology and low maintenance
- Customer-specific solutions possible – many materials and forms are available for the float; in-house manufacturing of the float with a high production depth
- Point level measurement and level measurement independent of container geometry
- Independent from media properties in which foam formation, conductivity/permittivity (ϵ), pressure, vacuum, steam, condensation have an influence
- Use in industrial, process and process engineering applications
- Quick error check when servicing
- High degree of chemical resistance as different materials are available
- Point level measurement for control of the inputs of PLC, valves, signals, motors, or pumps
- Level measurement with low filling heights 0.1 to 4 m




Point level measurement via float switch



Level measurement via level transmitter



Product overview float switch and level transmitter

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Gen. info.	Type	JUMO NESOS R01 LS and JUMO NESOS R02 LS Float switch in miniature and standard version, type 408301/02	JUMO NESOS R03 LS Float switch with reference vessel, type 408303	JUMO NESOS R20 LT Level transmitter via float, type 408320
	Approval (optional)	ATEX, IEC Ex, DNV GL	DNV GL	ATEX, IEC Ex, DNV GL
	Temperature sensor (optional)	✓	✓	✓
Technical data	Temperature switch (optional)	✓	✓	–
	Guide tube length (max.)	0.5 m @ 408301 4 m @ 408302	0.11 m	4 m
	Medium temperature	-52 to +240 °C	-30 to +150 °C	-52 to +200 °C
	Sensor	Reed contact	Reed contact	Reed chain
	Accuracy	± 2 mm (switching point)	± 2 mm (switching point)	Up to 5 mm (resolution)
	Output signals	Up to 5 switching contacts	Up to 5 switching contacts	4 to 20 mA Resistance value, potentiometric
	Switching function	SPST-NO, N/O contact; SPST-NC, N/C contact; SPDT-CO, changeover contact; SPST-NO, N/O contact bistable	SPST-NO, N/O contact; SPST-NC, N/C contact; SPDT-CO, changeover contact	–
	Parts in contact with medium	Stainless steel AISI 316; optional titanium, Hastelloy-C	Stainless steel AISI 316, aluminum; optional titanium, Hastelloy-C	Stainless steel AISI 316; optional titanium, Hastelloy-C
	Process connection	Thread, flange	Reference vessel with compression fitting	Thread, flange
	Electrical connection	Cable, cable with connector, cable socket, round plug M12 × 1, cable socket	Cable socket	Cable, cable socket

Point and Continuous Level Measurement

Float switch and level transmitter

Application recommendation float switch and level transmitter

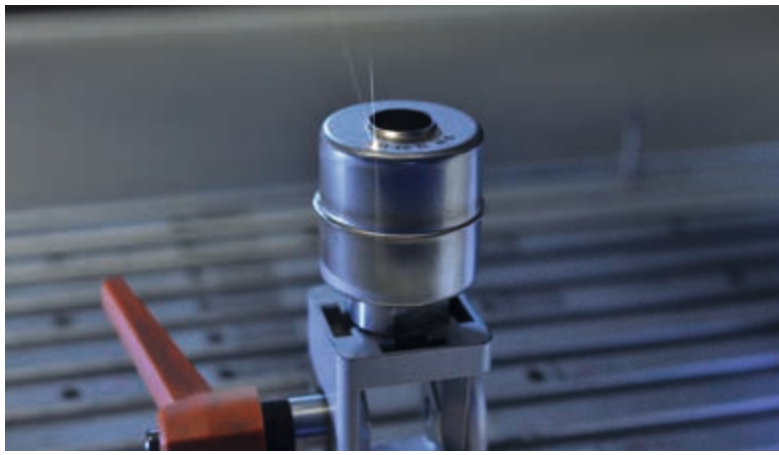
✓ suitable
– not suitable



Type		JUMO NESOS R01 LS and JUMO NESOS R02 LS Float switch in miniature and standard version, type 408301/02	JUMO NESOS R03 LS Float switch with reference vessel, type 408303	JUMO NESOS R20 LT Level transmitter via float, type 408320
Medium	Wastewater ¹	✓	✓	✓
	Drinking water and rainwater	✓	✓	✓
	Coolant	✓	✓	✓
	Mineral and transformer oil	✓	✓	✓
	Fuel: gasoline	✓	–	✓
	Fuel: diesel	✓	✓	✓
	Sodium hydroxide (20 %, 20 °C)	✓	–	✓
	Nitric acid (50 %, 20 °C)	✓	–	✓
	Sulphuric acid (5 %, 20 °C)	✓	–	✓
	Toluol (solvent)	✓	✓	✓
	Acetone (20 °C)	✓	✓	✓
	Ammonia (50 °C)	✓	✓	✓

¹ without components that could damage the float or immobilize it

These recommendations are based on many years of experience. However, in individual cases they may not be fully applicable.
We would be happy to provide further information, including additional applications.



Application tempering equipment

The situation

Tempering equipment is used for heat regulation (e.g. in machine-based production). The tools need to reach a certain operating temperature and also need to cool again after use so that reliable heat regulation is necessary. Tempering equipment usually consists of a liquid container, a circulating pump, a heater, heat exchanger, and temperature controller.

The challenge

A safe and smooth process means that the tempering equipment heats/cools the tools to avoid plant failure or dangerous situations such as fires. Other than temperature control, a wear-free solution for level measurement is also required as the container is built in the tight machine housing where access is difficult. A device for level measurement needs to be low in maintenance and not very complex in the event that maintenance or repair is required.

The solution

The tank is filled with the float switch in miniature form JUMO NESOS R01 LS with cable and ready-for-use plug. The switching contacts of the float switch are usually designed as normally open contacts with growing levels. Through these the filling valve in the tempering system opens during automatic filling until the contact reports "full". The mechanical measuring principle via float switch – meaning that the switching operation takes place without contact or auxiliary energy – ensures that reliable measurement takes place.



Level has reached minimum



Level optimal in operation

Point and Continuous Level Measurement

Float switch and level transmitter

System solution – JUMO Engineering

JUMO Engineering, the JUMO service branch, combines the expertise and industry-specific experience of our employees in one team. Our engineers and technicians develop customized solutions that are strictly based on your specific requirements. The JUMO Engineering team strongly believes in the importance of providing personalized support and consulting to its customers from initial contact through to startup.

When carrying out the many different industry applications, we always strive for maximum customer benefits. Our innovative engineering services allow us to achieve this goal. We are therefore able to provide comprehensive support from delivery of the right level probe through to fully automated level monitoring in your plants. Here, we work together with you to develop solutions.

Our services

- Feasibility analysis
- Creating a technical concept including product requirements/specification sheet
- Complete project planning and documentation
- Project planning incl. PLC programming, visualization, network technology, etc.
- Continuous project management
- On-site startup
- Training and support

Your advantages

- JUMO, as the central contact partner, develops a technical system solution specifically for you
- You benefit from our team's extensive expertise with all measurement and automation devices
- Global support through experienced specialists
- A flexible, tailored solution to suit your individual needs and application

In a nutshell

- Precise and prompt communication channels.
This saves you time and prevents mistakes!
- Highly developed expertise for maximum flexibility:
You benefit from fully reliable and secure project planning!
- Technology that has proven itself over decades reduces downtimes:
As a result you get excellent plant availability and process reliability!



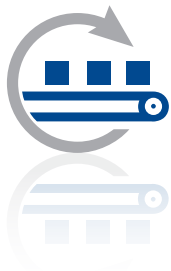


Services & Support

It is the quality of our products that is responsible for such a high level of customer satisfaction. But our reliable after-sales service and comprehensive support are also valued. Let us introduce you to the key services we provide for our innovative JUMO products. You can count on them – anytime, anywhere.

JUMO Services & Support – so that it all comes together!

Manufacturing Service



Are you looking for a competitive and efficient system or component supplier? Regardless of whether you seek electronic modules or perfectly fitting sensors – either for small batches or mass production – we are happy to be your partner. From development to production we can provide all the stages from a single source. In close cooperation with your business our experienced experts search for the optimum solution for your application and incorporate all engineering tasks. Then JUMO manufactures the product for you. As a result you profit from state-of-the-art manufacturing technologies and our uncompromising quality management systems.

Customer-specific sensor technology

- Development of temperature probes, pressure transmitters, conductivity sensors, or pH and redox electrodes according to your requirements
- A large number of testing facilities
- Incorporation of the qualifications into application
- Material management
- Mechanical testing
- Thermal test



Electronic modules

- Development
- Design
- Test concept
- Material management
- Production
- Logistics and distribution
- After-sales service



Metal technology

- Toolmaking
- Punching and forming technology
- Flexible sheet metal machining
- Production of floats
- Welding, jointing, and assembly technology
- Surface treatment technology
- Quality management for materials





Information & Training



Would you like to increase the process quality in your company or optimize a plant? Then use the offers available on the JUMO website and benefit from the know-how of a globally respected manufacturer. For example, under the menu item “Services and Support” you will find a broad range of seminars. Videos are available under the keyword “E-Learning” about topics specific to measurement and control technology. Under “Literature” you can learn valuable tips for beginners and professionals. And, of course, you can also download the current version of any JUMO software or technical documentation for both newer and older products.

Product Service



We have an efficient distribution network on all continents available to all of our customers so that we can offer professional support for everything concerning our product portfolio. Our team of professional JUMO employees is near you ready to help with consultations, product selection, engineering, or optimum use of our products. Even after our devices are commissioned you can count on us. Our telephone support line is available to give you answers quickly. If a malfunction needs to be repaired on site our Express Repair Service and our 24-hour replacement part service are available to you. That provides peace of mind.

Maintenance & Calibration



Our maintenance service helps you to maintain optimum availability of your devices and plants. This prevents malfunctions and downtime. Together with the responsible parties at your company we develop a future-oriented maintenance concept and are happy to create all required reports, documentation, and protocols. Because we know how important precise measurement and control results are for your processes we naturally also professionally calibrate your JUMO devices – on site at your company or in our accredited DAkkS calibration laboratory for temperature. We record the results for you in a calibration certificate according to EN 10 204.



www.jumo.net

