



SENSORS AUTOMATION

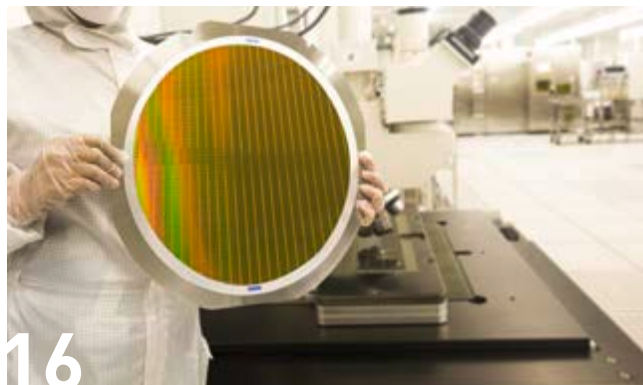
Issue 1/2020

Open fire

Sagas,
science,
sensors



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IN THE SPOTLIGHT



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ABOUT US

27 **Additional Chief Executive Officer at JUMO**

Dimitrios Charisiadis responsible for 3 business areas as of 2020



Dear Reader,

The current customer magazine is "hot stuff" in the literal sense because, this time, we chose the title "Fire". As a follow-up to the previous issue ("Water"), we are also placing the focus of the magazine on an element.

And with good reason: as sensor specialists, we certainly feel at home in all the elements, but temperature has always been particularly special to us. Company founder Moritz Kurt Juchheim began the JUMO success story with glass thermometers over 70 years ago. Even today, temperature measurement technology continues to be our most important pillar, ranging from platinum thin-film sensors to complete automation solutions.

Temperature remains one of the key measurands in many industrial applications, including the interconnected Industry 4.0 realm. As a result, our development team of physicists and design engineers is constantly working to successfully bring this significant measurand into the digital era with new products and technologies. The best example here is JUMO plastoSENS technology, which allows us to manufacture temperature sensors with high-performance plastics in an injection molding process.

JUMO has more important news: in this editorial, we are happy to send our greetings as a team of three for the first time. We cordially welcome Dimitrios Charisiadis as an additional Chief Executive Officer. Read more on page 27 of this issue.

We hope you enjoy reading our magazine.

Bernhard Juchheim Michael Juchheim
Chief Executive Officers and General Partners

Dimitrios Charisiadis
Chief Executive Officer

*Fire in itself is neither good nor evil.
When it cooks a meal for you, you
bless the fire and say "How good it is!"
And when it burns your finger, you say
"What a nuisance it is!"*

(Indian proverb)



Open fire

Sagas, science, sensors

Humanity has always had an ambivalent relationship with fire. It guided us through dark nights, warmed our food, and allowed us to manufacture tools. On the other hand, it has injured us and has burned our belongings time and again. But what is fire, really?

The universe – it all started with a big bang!

Around 13.8 billion years ago, things got hot – very hot. The event known as the “big bang” marked the beginning of the universe as we know it today. One singularity generated matter, space, and time. Many theories surround this event, but it is widely accepted that the first hundredth of a second after the big bang, temperatures of around 100 billion degrees Celsius seared the universe. 3 to 4 minutes later, the temperature had already cooled to “just” 900 million degrees Celsius. →

Fire is a good servant, but a bad master!

(German proverb)

Today the empty space of the universe is a frigid place with a temperature of -270 degrees Celsius. This is why proximity to the sun is absolutely necessary for humanity's survival. Temperatures of over 5 000 degrees Celsius prevail on the surface of this gas sphere consisting of helium and hydrogen. The sun is expected to continue providing warmth for another 5 billion years.

Humanity – always fire and flame

Human evolution is closely linked to fire. The heat that fire provided was not the only significant aspect. Fire also provided protection from wild animals and the opportunity to heat and therefore store food. Traces of burned bones and parts of plants in a South African cave indicate that Homo erectus already began using fire over a million years ago. The oldest lighter is supposedly nearly 800 000 years old as the earliest flint stone discovered comes from that the time period. The first iron ore and copper mines are over 5 000 years old.

The history of fire is often shaped by myths and fairytales. According to the ancient Greeks, the Titan Prometheus gave humanity fire after stealing it from Zeus, the father of the gods. Nordic mythology tells tales of the

fiery region of Muspelheim. It is also impossible to think of Christianity's hell without fire.

The earliest scientific discussion of fire also took place in ancient Greece. According to the theory of Four Elements, water, air, fire, and earth are eternal and unchangeable basic elements which form the variety of substances through mixing. This belief continued to prevail long into the Middle Ages.

Even in our seemingly enlightened era we are still mystifyingly intrigued by fire. Whether celebrating solstice, sitting around a cozy fireplace, or enjoying New Year's celebrations – fire represents security and fellowship.

The chemistry – facts instead of flames

Our current chemical and physical perspective began to develop during the Age of Enlightenment. Researchers recognized that fire is an oxidation process during which combustion takes place. A chemical reaction is the cause. During this reaction, substances known as "oxidizing agents" absorb electrons from another element. The result of this exothermic reaction is heat and visible light.

The emissions on the visible spectrum, which we see as light, are also the result of energy conversion.



In 1592 Galileo Galilei developed the first usable thermometer. The temperature was read off a water column, which changed its level depending on the temperature. But the thermometer began to provide the first real benefits once a temperature scale was developed that had 2 defined fixed points.

However, the 35 scales used in the 18th century were not uniform. Daniel Gabriel Fahrenheit was the first to introduce a standard that we know as the Fahrenheit measuring unit today. Soon mercury was used instead of water because it expanded more uniformly. Swedish astronomer Anders Celsius developed a temperature scale in 1742 that only had 2 fixed points – the freezing point and boiling point of water.

But why does the temperature scale actually start at zero? Ultimately, temperature is nothing more than the movement of particles. If nothing moves, we say it is 0 Kelvin.

However, the era of liquid-filled thermometers is slowly but surely coming to an end. In industrial sectors today, platinum thin-film sensors or thermocouples are used to measure temperature. In the private sector electronic products are also becoming increasingly more common than the traditional glass tubes. ■

The heat of the fire provides energy to the individual atoms (ions) in a burning gas. As a result, the electrons that circle the nucleus jump to a new, higher energy level. After a brief period, the electrons fall back to the lower level and emit the additional energy again – but now as light instead of heat.

The flame of a candle normally reaches up to 1 400 degrees Celsius. The highest measurable flame temperature under ideal conditions is around 6 000 degrees Celsius. That is more than twice as hot as the optimum combustion of natural gas. These sorts of extreme temperatures occur when the molecules dicyanoacetylene and ozone react with each other under the enormous pressure of 40 bar.

The physics – air, water, mercury, platinum?

People have always wanted to measure things to gain understanding. Fire is no exception, of course. Today, temperature is the second-most common measured measurand right after time. As early as the second century, an air thermometer was developed in Byzantium. Its operating principle was based on the fact that air expands with heat and contracts with cold.

JUMO The measure of all things

JUMO measures temperature – and has been doing so since 1948. The company has been the global market leader in the area of temperature probes for heat meters for years. Company founder Moritz Kurt Juchheim began production in Fulda, Germany with 6 employees who manufactured glass thermometers. Today the portfolio comprises a massive spectrum ranging from exhaust gas temperature monitors to dial thermometers. Platinum thin-film sensors and RTD temperature probes are successfully used in a wide range of applications: from room temperature measurement in building technology to high temperature measurements in industrial furnace construction – there is hardly an industry in which JUMO temperature measurement technology cannot be found.

JUMO innovations

Products that make
life easier



2



1



1 Sensor for digital optical oxygen measurement

JUMO digiLine O-DO S10

The latest optical technology in fluorescence quenching and digital signal processing enables the sensor to conduct oxygen and temperature measurements in the measurement medium with long-term stability. The sensor housing is made from PVC so that the JUMO digiLine O-DO S10 can be used in both fresh and salt water. Possible application areas for the sensor include fish breeding applications, sewage treatment plants, and other areas of water and wastewater engineering.

Using the innovative, user-friendly connection concept from the JUMO digiLine bus system the sensor can be easily and quickly connected to the digiLine master via Plug and Play. The modern data management system that is integrated in the sensor is also innovative. This system acquires and logs relevant operating data over the sensor's entire lifecycle to optimize processes and procedures. This includes the acquisition of operating hours as well as functions designed to enable predictive maintenance such as early notifications when calibration work is required or a sensor cap needs to be replaced. An RS485 Modbus RTU interface and an analog output (4 to 20 mA) enable easy integration of the system with field devices and process control systems.

2 New multifunctional four-wire transmitter

JUMO dTRANS T06 Ex

The new JUMO dTRANS T06 Ex multifunction four-wire transmitter in a mounting rail case is suitable for use in challenging SIL and Ex applications. Its measurement input features 22-bit resolution with selectable noise suppression and is extremely precise. The SIL option fulfills the requirements of SIL 2/SIL 3 according to DIN EN 61508 and PL c/PL d according to DIN EN ISO 13849. JUMO dTRANS T06 Ex also meets the ATEX and IECEx requirements up to zone 0. A particularly high galvanic isolation guarantees the highest degree of reliability. Intuitive operation takes place via 4 keys and an LCD, which can also be used to display information about the measuring point.

A special setup program was developed to ensure easy SIL configuration. As a special feature, the device display can also be used to access a connection diagram that is based on the configuration. The compact mounting rail case and the encoded plug-in terminals enable the device to be quickly installed into control cabinets. In addition, the device can be reliably replaced when performing calibration and maintenance work. The universal input can process a variety of sensor or standard signals. All the important information regarding the transmitter can be queried and visualized via an RS485 interface.

3 Screw-in RTD temperature probe

JUMO MarineTemp

The JUMO MarineTemp screw-in RTD temperature probe is certified by Bureau Veritas. It is the preferred choice for temperature measurement in liquid and gas media in shipping. Here, a decisive criterion is the reliable sealing feature when vacuum and overpressure occurs. The thermometer is available with a two-wire or four-wire circuit for temperature ranges between -50 and +400 degrees Celsius. The intelligent design of the RTD temperature probe with a fixed measuring insert allows temperatures to be measured under standard conditions. The terminal head (form B or BUZ) is suitable for ambient temperatures between -40 and +100 degrees Celsius. Per default, a Pt100 temperature sensor according to DIN EN 60751, class B in a two-wire circuit is installed in the measuring insert. Versions of class A or AA are also possible. Versions with a remote protection tube are available for quicker response times. A transmitter with an operating temperature range from -40 to +85 degrees Celsius can be integrated into the terminal head as an optional extra. ■

Systematic silo temperature monitoring

Reliable storage of grain



Over 45 million metric tons of grain are harvested annually in Germany. In addition to water content, temperature is one of the most important measurands used to ensure quality during storage.

The top-selling grain is wheat, which makes up nearly half of the overall harvested amount. A significant portion of grain is stored until it is further processed. Even in June – which is shortly before the harvest – up to 8 million metric tons of grain are still available in silos and similar storage facilities.

Numerous parameters must be considered when storing grain. These include drying and ventilation until the grain can be stored as well as the prevention of mycotoxin formation from mold.

If the moisture or water content of the grain is too high, germination begins which causes the temperature to rise. →

High temperatures and increased water content lead to massive respiratory and quality losses.

Respiration loss not only reduces the grain mass, but also causes the humidity in the silo to increase, which can encourage pest and mold infestations.

A possible pest infestation can be detected by constant temperature monitoring. Among other things, the increase in temperature after reaching the storage temperature is a possible sign for the occurrence of grain weevils.

Unlike other types of grain, the germination capacity and germination energy of malting barley is crucial for further parts of the process. This means that malting barley requires sufficient ventilation. Temperature monitoring therefore also plays an important role for this type of storage.

ATEX approval is necessary because grain silos are considered potentially explosive areas due to the dust they contain. Dust inevitably accumulates during the treatment and processing – in the form of particle adhesion, grain abrasion, and ultimately as finely ground grain flour.

When stirred up, this dust can create a potentially explosive atmosphere which must not be ignited under any circumstances.

Therefore, in addition to the actual production equipment, all applied measuring devices also need to be constructed according to the ATEX directive. In most cases, the silo's headspace is classified as zone 20 – a place in which a potentially explosive atmosphere in the form of a cloud of combustible dust in the air is continuously present for long periods.

Uninterrupted temperature monitoring

Using temperature monitoring as well as the visualization and archiving of data, a storing process that preserves quality and that protects the product can be documented. To this end, JUMO has an ATEX-approved special multipoint temperature probe in its product range that can be used to acquire temperatures at various heights in a grain silo. This probe was developed and produced by JUMO's French subsidiary in Metz.

Probes with up to 50 meters length

The JUMO silo probe can be fastened either to a metal construct or a concrete panel. The aluminum or stainless steel connection housing with protection type IP6X facilitates measurement exchange when the silo is full. In the probe, Pt100 or Pt1000 sensors guarantee a high degree of accuracy and measurement repeatability according to DIN EN 60751. →



APPLICATIONS

The various measuring points can be distributed evenly over a total length of up to 50 meters in the probe tube.

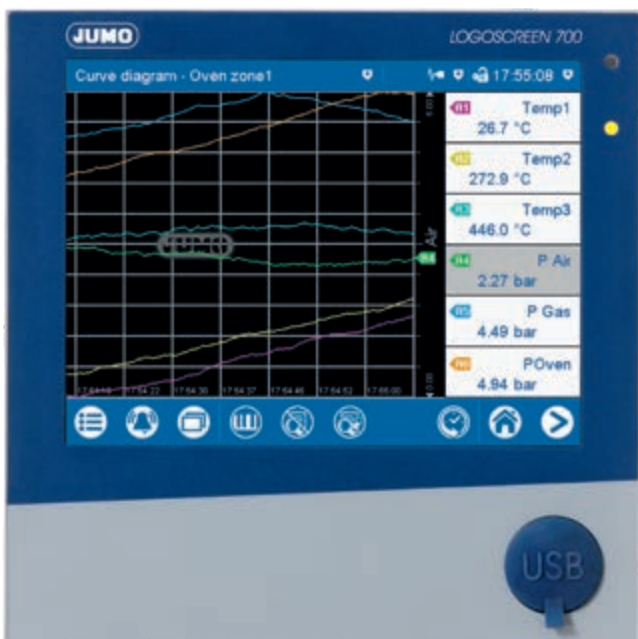
JUMO also provides suitable technology for acquiring and evaluating the data. This ranges from various two-wire transmitters, to paperless recorders like the new JUMO LOGOSCREEN 700, through to complete automation solutions that can be implemented using the JUMO variTRON system. Mobile access to the recorded data is also possible at any time via smartphone using the JUMO Device App. Configuration data can be transferred via USB flash drive so that use of a laptop for the obligatory programming is obsolete. ■

Mobile access to the recorded data is also possible at any time via smartphone.

The JUMO Device App

The JUMO Device App provides the user with mobile access to their process data at all times.

All current process values as well as the alarm and event lists from selected JUMO devices which are networked via Ethernet can be viewed in text form.



Worth knowing

Per-capita consumption of grain in Germany is nearly 80 kilograms. The majority of the grain is in the form of baked goods. In addition to food, grain is also used for animal feed, energy production, and industrial purposes. Globally, an average of 20 percent of produced grain is used as feed. In the EU, that average is 45 percent and, in Germany, it is over 50 percent. Energy-related use in Germany is less than 10 percent of the domestic consumption of grain.

Level measurement in diesel tanks

The right medium in the storage tank?

According to the Federal Statistical Office of Germany, the average price of diesel for end consumers rose by more than 18 percent from 2016 to 2019. Consequently, it would be useful for service station operators to think proactively about fuel storage to increase profitability. A rather rare but nevertheless real danger is when water makes its way into a vehicle's fuel tank during completely normal refueling. A level solution from JUMO solves this problem.

But how is it possible for a mixture of water and diesel to come out of the fuel pump at the filling station? In recent years, water has repeatedly penetrated and contaminated underground diesel or gasoline tanks, especially during heavy rainfall. →





Float switches and level transmitters with floats are now part of the JUMO product portfolio.



Engines do not take well to this at all. The engine may start for a brief time because the 2 fluids do not mix and a certain amount of diesel is left in the injection system. But the driver of this vehicle will not get far. That is because the water sinks to the bottom of the tank and is therefore sucked through the pump first. This can lead to significant damage. The entire fuel system must be cleaned and filters must be replaced.

Innovative combined solution

To prevent this from happening, a diesel tank system manufacturer commissioned JUMO to find an overall solution. In a diesel tank the level should be measured continuously so that messages for refilling can be sent and pump control can be implemented. At the same time, point level measurement should be used to detect possible water ingress.

The solution implemented by JUMO is based on a combination of products from the JUMO NESOS range.

A float switch and level transmitter were integrated into one product so that installation is only possible via a tank opening. In addition, the product series has the necessary approvals for potentially explosive areas. The float switch is useful for the varying density of water and diesel fuel. It is designed to float on the interface between water and diesel, as a result of which an alarm message is possible. The JUMO NESOS combined sensor is designed specifically for application in diesel tanks with its overall length of over 4 meters. Level measurement enables service station operators to determine the actual level of diesel and the average consumption, which helps them to proactively and economically plan for demand.

JUMO has been producing the high-quality floats for more than 40 years. The new series marks the first time a complete product was developed for point level measurement with floats and reed contacts as well as level measurement with floats and reed chains.

In JUMO NESOS devices, a float with an integrated magnet uses its magnetic field to switch one or more reed contacts with rising or falling levels. The proven measurement method is characterized by robust technology as well as cost-saving installation and mounting. It is also maintenance-free and has a very good price-performance ratio.

Automation system for plant control

Complete plant control can be implemented with the scalable JUMO mTRON T measuring, control, and automation system. The modular component concept combines variable I/O modules with powerful control panels. It is just as impressive in the area of measured value recording as it is for complex control tasks and sophisticated automation solutions. Extremely high-quality universal analog inputs for a wide range of input variables and the JUMO control algorithm that has been proven over the years ensure a high degree of process reliability and the greatest possible transparency. A digital input module is used for the necessary online alerts. As a result, the user can receive information via email on their smartphone.

The JUMO diraVIEW digital indicator directly reports malfunctions on the tank. The basic device of this series is already equipped with 1 analog input, 2 binary inputs, 2 relay outputs, 2 logic outputs, and a voltage supply for two-wire transformers. 3 extension slots can be equipped with additional inputs and outputs as well as with interfaces. Alarm texts are particularly easy to notice due to the color change from green to red. ■



JUMO NESOS float switches for point level measurement can be used within a temperature range of -52 to +240 degrees Celsius and impress with a switching point accuracy of ± 2 millimeters. The switching operation is contact-free, wear-free, and requires no auxiliary energy. Optional extras include variants available with Pt100 or Pt1000 temperature sensors and temperature switches.

Moreover, JUMO NESOS level measuring transformers provide a virtually continuous standard signal from 4 to 20 milliamperes within a temperature range of -52 to +180 degrees Celsius. The dissolution amounts to 5.5 millimeters. Variants with Pt100 or Pt1000 temperature sensors as well as with temperature switches, temperature transmitters, and displays are available as optional extras.

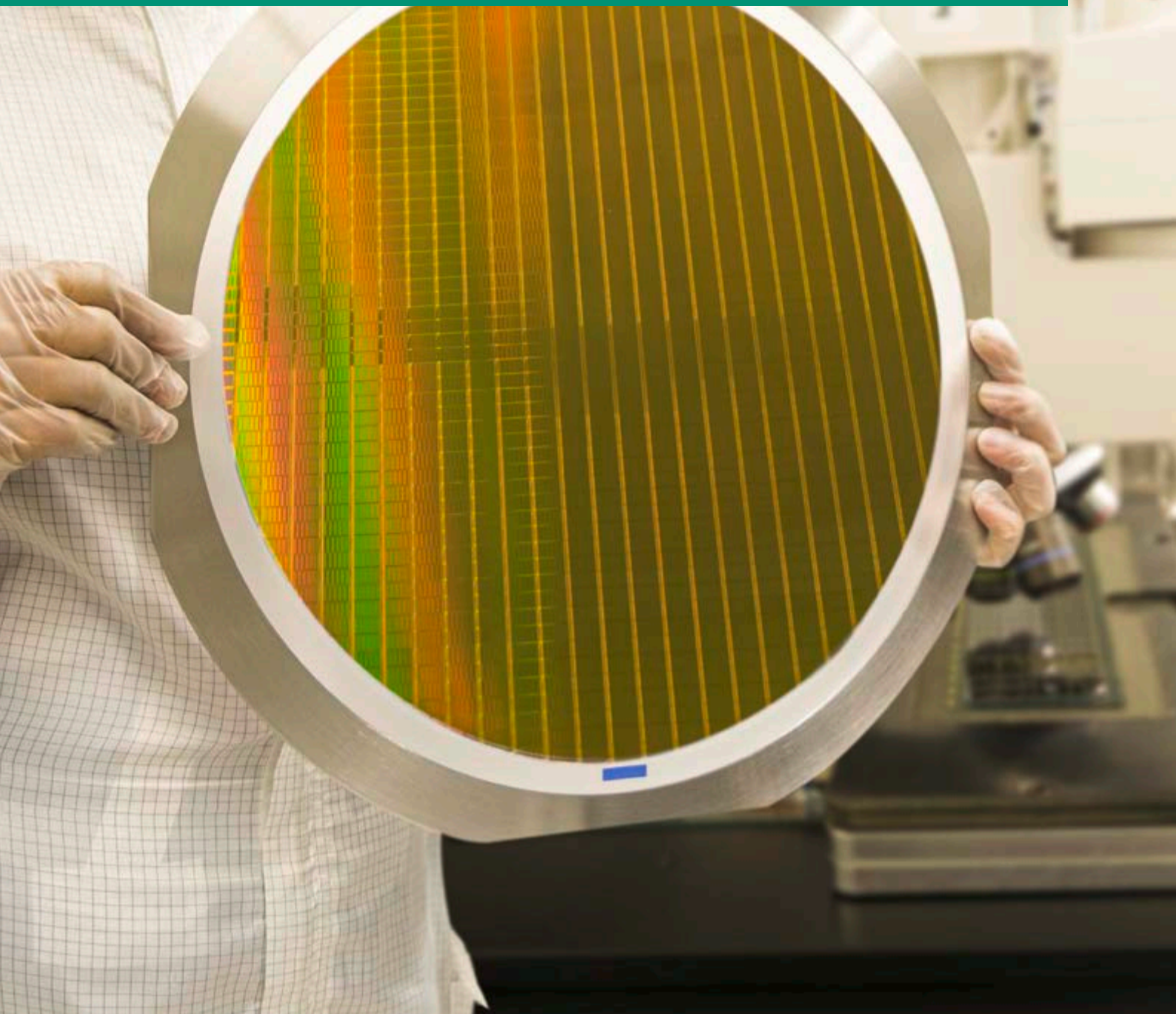


Good to know

The ignition temperature of diesel fuel is between 200 and 350 degrees Celsius. Gasoline ignites at a temperature between 220 and 460 degrees Celsius. In Germany, around 15 million cars with diesel engines are on the road.

Temperature control during semiconductor production

High throughput speeds
with great reliability



As a corporate spin-off of ASM, the Dutch company Levitech produces machines for the semiconductor industry. To achieve the smaller structures and greater uniformity in semiconductors that the market requires, the machine manufacturer had to implement new heat transfer methods. This requires faster temperature correction and above all more precise control. That is why Levitech looked for an alternative to control thermal processes in their Levitor machine. In JUMO, the company from Almere in the Netherlands found the partner with whom the solution could be implemented.

The manufacturing process

The reactor for wafer manufacturing consists of 2 graphite disks that are heated to the appropriate process temperature. To generate optimum results, the disks need to exhibit specific features. Gas is used during this process to cause the wafer to hover between both disks without touching them. To achieve the necessary temperature of 1 200 degrees Celsius, special Kanthal® heating elements are used.

Higher efficiency

Application of innovative methods for heat transfer facilitate very fast heating of the wafer and also very fast cooling. Both sides of the wafer have a uniform opening of 0.15 millimeters to ensure extremely efficient thermal conductivity. The wafer is heated to the temperature of the graphite disks within seconds. These are controlled with a specific heating control system. This is where the thyristor power controller from JUMO comes into play. The JUMO TYA 201 controls the required current and voltage of the Kanthal® heating element in every temperature phase and thereby ensures precise temperature progression during the process. This system enables the wafers to be produced at an optimum temperature that is the same every time.

Faster temperature correction and accurate control in particular are essential to this process.

This is how Levitech meets market requirements and increases throughput speed at the same time. ■



Keeping the overview with JUMO mTRON T Glass density measurement



Glass is a material with very special features. Instead of a melting point, it has a transformation range. When within that range, it slowly becomes softer and then melts. Glass is available in many different types with different compositions, which is why some properties of the material are variable.

Numerous parameters must be monitored during the complex production process. Together with the JUMO Engineering Team, Aerne Analytic e. K., a specialist manufacturer of laboratory equipment, has now developed a measuring device that facilitates fully automatic measurement of density.

Because this type of measuring process takes approximately 1 to 2 hours, significant improvements to the process can result from automation. Moreover, it is possible to perform 6 measurements at once. The technical solution was implemented using the JUMO mTRON T automation system.

Clearly arranged process screen

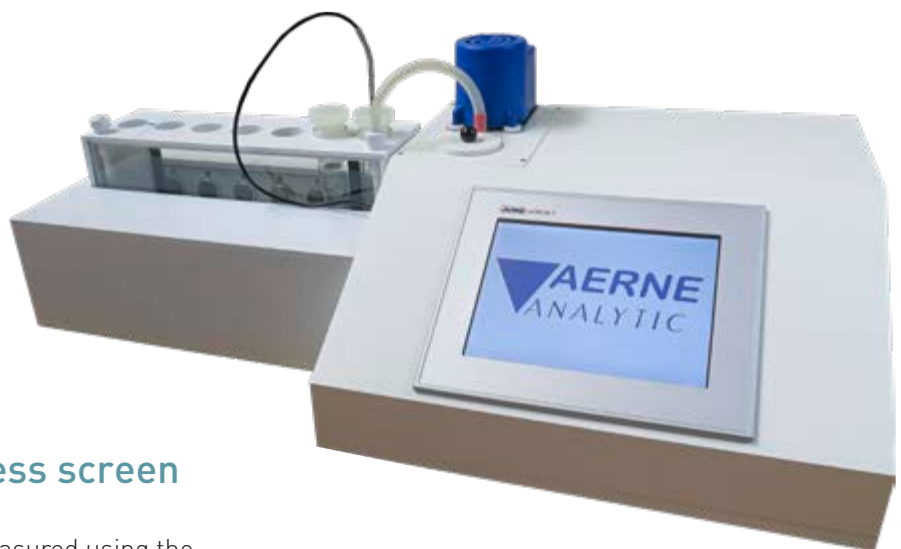
The density of glass samples is measured using the sink-float method developed by M. A. Knight. This means that each of the 6 test jars is filled with 2 glass specimens and 1 additional reference sample. The density of the reference samples is entered into the JUMO mTRON T multifunction panel's clearly arranged process screen. The test jars are filled with a test liquid consisting of a mixture of bromine naphthalene or tetrabromoethane. This liquid is heated indirectly in a water bath with distilled water.

The density of the test liquid must be greater than the density of the glass body when the measurement process begins. This causes the glass to float on the surface. When the measuring process begins, the bath temperature is slowly increased. This naturally also increases the temperature of the test liquid. Its density decreases as the temperature rises. The result is that the glass samples sink quickly or slowly, depending on their own density.

After a certain amount of time, the glass bodies are passed through a light gate that automatically recognizes whether the tested object is the reference sample

Density is an important quality characteristic in glass manufacturing.

or the glass sample. The density of the glass samples is calculated and displayed depending on the various temperatures when they pass through the light gate as well as the associated times.



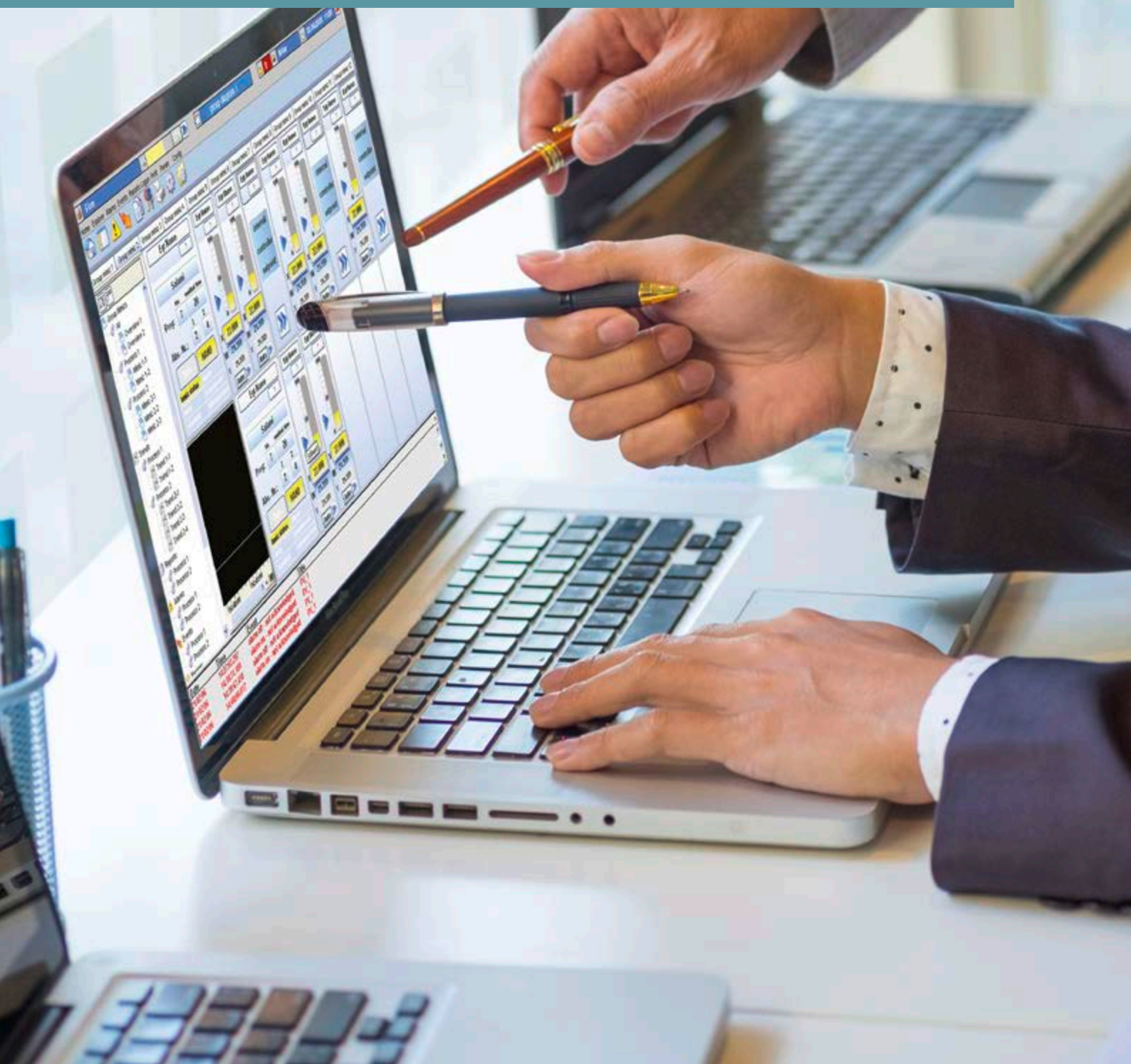
Extreme high degree of measuring accuracy

To achieve the required measuring accuracy of ± 0.0002 grams per cubic centimeter, extremely precise hardware must be used. JUMO RTD temperature probes from the class A category and the highly precise, galvanically isolated JUMO mTRON T four-channel analog input modules make this possible.

Measurement data can be extracted from the JUMO mTRON T multifunction panel using a USB flash drive or Ethernet interface. The JUMO PCA 3000/PCC software package is used to evaluate and visualize the measurement data and results. The form functionality is used to automatically generate a customizable test report. It can be saved as a PDF file or immediately printed out and signed.

What is really secure?

Data security using the example of a JUMO paperless recorder



The topic of "data security" is more relevant than ever. For example, production processes in the pharmaceutical or food industries need to be seamlessly documented to rule out any manipulation. This is the only way to ensure consistently high product quality.

How can companies effectively protect themselves in the age of increasing digitalization? JUMO has also dealt with this topic over and over again as we manufacture measurement and control technology such as recorders.

JUMO introduced the first paper recorder to the market as early as 1964. The need for devices to be tamper-proof was not an issue back then because any interference would be easy to see on the printed strips of paper. That changed with the first paperless recorders. The measured values they recorded were no longer documented on paper. Instead, they were saved as data on a hard disk drive or another storage medium – it is a known fact that data can be manipulated on such devices.

FDA compliant paperless recorder

Ensuring that data is tamper-proof plays a central role for the JUMO LOGOSCREEN 700 because the recorder facilitates FDA-compliant data recording. The Food and Drug Administration (FDA) created requirements for electronic recording and signatures in the Code of Federal Regulations, 21 CFR Part 11. These rules apply when information is electronically generated, changed, saved, and transferred or if this information needs to be accessed.

Taking a look at the "signatures" issue shows how meticulously the FDA approaches these issues. Among

The amount of data generated globally increases by nearly 30 percent every year.



other things a digital signature must include the name of the signatory, the date and time, as well as the meaning of the signature. This signature must be forgery-proof and it must be connected to the document in such a way that it cannot be applied to other documents. Moreover, it

must be possible to assign them to 1 single individual and consist of 2 components such as an identification code and a password.

TÜV-approved security

The JUMO LOGOSCREEN 700 can do all of these things. A special extra code gives the device a TÜV-approved function for ensuring data security. A digital device certificate provides proof that the recording data has not been manipulated in the device, during transfer, or during evaluation.

Additionally, the PC security manager software allows for administration of up to 50 users per device. An electronic signature can be assigned to a batch report, a time range, or for logging off. Issuing authenticated commentaries on the device highlights the flexibility when recording processes that require verification. The use of a digital certificate ensures secure manipulation detection here as well.

Compact knowledge

Temperature

Water boils at 100 degrees Celsius ...

... but only at sea level. The boiling point at the top of Mount Everest is approximately 70 degrees Celsius.

Hot water reaches temperatures of up to 400 degrees Celsius as it streams from hydrothermal vents on the ocean floor.

Cool on the go

The ideal temperature for driving a car is 24 degrees Celsius. Our ability to concentrate begins to wane after that point.

Delicious and affordable

The temperature in a pressure cooker is around 117 degrees Celsius. This saves at least 50 percent time and energy when cooking the food.

The hottest place in the world is Death Valley in the United States

In 1913, 56.7 degrees Celsius were measured there in July. In one Iranian desert, temperatures supposedly reach up to 70 degrees Celsius, although this has not been verified. In comparison: temperatures on Venus can reach up to 500 degrees Celsius.

The highest melting point of all the elements

in the periodic table is wolfram at 5 900 degrees Celsius. Helium has the lowest melting point at -270 degrees Celsius.

People are extremely sensitive to fever or hypothermia

Protein in the body begins to coagulate at a temperature of 42.6 degrees Celsius which causes a life-threatening situation. It is also dangerous when the body temperature falls below 35 degrees Celsius because that can lead to life-threatening cardiac arrhythmia.

Worth knowing

5 facts about industrial furnace construction



**JUMO Market Segment Manager
Industrial Furnace Construction**
Christoph Bollgen
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The oldest recovered melting furnace to date is estimated to be 3 600 years old and was discovered in a palace on Crete. Of course JUMO has not been building industrial furnaces for quite as long, but we have managed to create an extensive portfolio of products and solutions in the over 70 years of company history.

Fact 1: Temperature probes

The high temperatures in industrial furnaces often require the use of thermocouples. Depending on the application site, different materials are used for the protective tubes in batch furnaces, continuous furnaces, test furnaces, or smelters. The material used for the pipes is gas-tight ceramics with which temperatures of up to 1 700 degrees Celsius can be achieved. JUMO thermocouples meet the requirements according to AMS2750 and CQI-9.

Fact 2: Control and automation technology

Precise temperature curves are absolutely essential for the often very complex processes involved in firing, annealing, or tempering a wide variety of materials. JUMO process controllers guarantee energy-optimized control of a wide variety of processes. PID control algorithms have an excellent track record in industrial furnaces, regardless of whether they are used in continuous-process or batch furnaces. The JUMO variTRON 500 also provides users with a complete automation system.

Fact 3: Recording and monitoring

Using the devices in the JUMO LOGOSCREEN family of paperless recorders, process data is collected quickly as well as smoothly and then archived in a tamper-proof manner. All recorders provide the following options: online visualization of process data, various limit value monitoring

methods, a remote alarm in case of a malfunction, and the simultaneous recording of batch processes.

By using the compact and user configurable JUMO temperature limiter/monitor or safety temperature limiter/monitor, danger can be recognized early and averted. The devices meet the requirements of DIN EN 61508 (SIL) and DIN EN ISO 13849-1 (PL).

Fact 4: JUMO thermoCOR

The JUMO thermoCOR is a portable measuring system with which plant operators can independently perform SAT and TUS tests on a regular basis with the usual accuracy. The system is calibrated according to the DAkkS (German Accreditation Body) and meets the tolerance limits of the requirements according to the AMS2750 as well as CQI-9 standards.

Fact 5: Calibration laboratory

JUMO's DAkkS calibration laboratory has been performing calibrations for the measurand temperature since 1992. The laboratory has been constantly expanded over time and has been accredited for on-site calibration since 2014.

Contact: sensors@jumo.net

Good to know

You can find all important information about this topic in our industry portal:
<http://en.jumo.de/web/applications>

Important information about the succe

7 at a glance



Trainer for Sensor and Automation Technology
Manfred Schleicher
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1 The measuring principle

Thermocouples consist of 2 metal legs with different thermoelectric properties. As the junction heats up, the free load carriers are accelerated and moved towards the colder end. Charge separation generates a voltage that increases with the temperature and conductivity of the material. The conductivity of both materials is different, which causes both legs to have different voltages. The difference between both voltages (U_{T1}) is a measure for the temperature at the junction or the measuring point.

On the connection side of the field device, 2 partial voltages are generated ($U_{T2a} + U_{T2b}$). The sum of the 2 voltages would also be generated if the thermocouple were to be shorted at this terminal temperature. The sum U_{T2} is thus a measure for the temperature at the connection point, also known as the cold junction. The voltage measured by the field device is a measure for the differential temperature – formed from the measuring point temperature – minus the cold junction temperature.

2 Compensating cables and plug connectors free from thermoelectric voltage

The second voltage (U_{T2}) must be generated at the cold junction. Thermocouples with the corresponding compensating cable are extended up to the field device. Furthermore, plug connectors free from thermoelectric voltage contribute to more accurate temperature measurement.

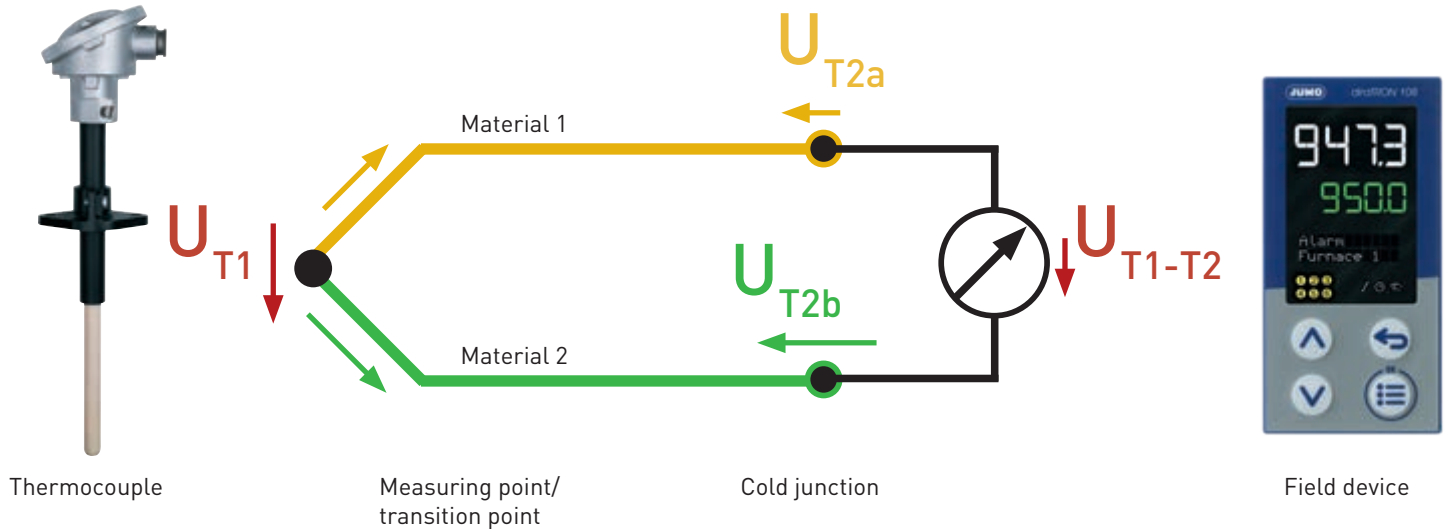
3 Internal temperature compensation

The field device determines the differential temperature from the voltage difference $U_{T1} - U_{T2}$. Cold junction temperature $T2$ is determined with an additional temperature probe. Cold junction temperature $T2$ is added to the differential temperature ($T1 - T2 + T2$). The result of internal temperature compensation is measuring point temperature $T1$.

4 Short-circuit consideration

The compensating cables consist of materials with the same thermoelectric properties as the thermocouple. A short circuit in the line therefore results in a second thermocouple connected in parallel. The determined temperature then corresponds to an approximation of the average value from the measuring point temperature and the temperature at the short circuit point. The recognition of the short circuit through the field device is not possible.

Successful use of thermocouples



5 Galvanic isolation in the measuring circuit

A short circuit can result between the thermocouple legs and the plant ground in applications with thermocouples. For example, this can happen between the connection of the junction and the protection tube (the goal being faster responsiveness) or due to reduced resistance of ceramic protection tubes when the measurement temperatures are high. In general, galvanic isolation should be used. This can be achieved with a transmitter, a supply isolator, or directly with the analysis unit.

6 Standardized thermocouples

Thermocouples are standardized to meet the DIN EN 60584-1 standard. They are therefore compatible in terms of electrical behavior. The most-applied non-metal elements are types J, K, and N. Elements S and B are expensive elements made from precious metals suitable for use at particularly high temperatures. The highest temperatures can be measured with element B. The standard recommends a maximum temperature of 1 700 degrees Celsius. After respective linearization (J, K, N ...) has been selected in the field devices, automatic conversion to the respective temperature takes place.

7 Information on long-term behavior

The maximum operating temperatures recommended in the standard for thermocouples apply to normal applications in clean air. In general, higher operating temperatures result in a stronger drift behavior. Furthermore, thermocouples change their output signal as foreign atoms enter (from the furnace atmosphere or from the protection tube). The elements must be calibrated regularly and the field device must be adjusted as needed. The intervals must be defined by the user. Ultimately the user needs to decide how long a thermocouple can be used in the respective application. ■

JUMO news

Get everything you need to know the topic in our technical literature "Electrical temperature measurement" and take our e-learning course specifically designed for thermocouples. You can find the overview at: <http://elearning.jumo-en.info>

Digital training documents

NEW for more convenience and sustainability

Digitalization was already introduced at JUMO Campus a long time ago. E-learning courses have been a fixed component of the training opportunities for several years and, in addition, numerous live webinars have also been offered since 2016. After the webinars, the recordings are also available as videos for retrieval at any time – the digital course program currently comprises over 170 videos in German, English, and Spanish.

Now digitalization has also expanded to include training documents: in the past, each seminar participant received a folder with printed training documents. The

drawback: the sometimes quite extensive documentation lead to high paper consumption – every folder contained an average of 130 pages. That weight also needed to be transported home by each participant.



New: digital documents via tablet

To reduce paper consumption and save resources, now each participant receives a tablet at the beginning of the training on which all documents are saved as a PDF file. Each tablet comes with a keyboard and a stylus pen that allow the participant to either write or type their notes. Once the seminar is over, each participant receives a USB flash drive to save the documents and all of their own notes.

Use of digital documents was tested with over 100 participants last year. The feedback was consistently positive: overall user-friendliness was rated with a grade of 1.4 (an "A" grade). Nearly 80 percent of participants preferred the digital documentation.

The advantages

This change will save over 50 000 pages of paper per year. But it is not just the environment that benefits from digitalization. The participants have more convenience: no heavy return transport and instead, easy transfer of the training documents from the USB flash drive to the PC. ■

JUMO news

We invite you to visit one of our numerous seminars and see for yourself how convenient it is. You can find all the training courses at: <http://campus.jumo-en.info>

Additional Chief Executive Officer at JUMO

JUMO Chief Executive Officers and General Partners Bernhard and Michael Juchheim have appointed Dimitrios Charisiadis as the third Chief Executive Officer. He will be responsible for the areas "Sales, Development, and Production". In the future, Bernhard Juchheim will be responsible for "Personnel" and Michael Juchheim for "IT and Finances". Dimitrios Charisiadis has been working with JUMO as the "Sales Director for Germany as well as Global Product and Market Segment Management" since 2017.

Dimitrios Charisiadis is responsible for 3 business areas as of 2020

"Since 2008, our turnover has increased to around EUR 70 million. Over 600 new jobs have been created," emphasizes Bernhard Juchheim. But this success is not a foregone conclusion. It is the result of the company making constant changes and improvements. "It is our declared goal to position JUMO on the market in the long term in such a way that the corporate future for the fourth generation of the founding family is secured."

New global challenges

However, according to Michael Juchheim, the challenges have dramatically increased in the last few years: *"The competitive pressure has grown enormously and issues like Brexit or global trade disputes create additional insecurity. Beyond that, digitalization offers us tremendous opportunities that we now need to seize."*

To meet the broad spectrum of tasks to be tackled, the Managing Partners decided to spread the leadership responsibility across more shoulders. *"This increases our room for maneuvering which gives us greater flexibility and the ability to react more quickly,"* explains Michael Juchheim.

"With Dimitrios Charisiadis, we gained a Chief Executive Officer with comprehensive industry and product expertise as well as someone with years of career experience in a family-owned medium-sized company," adds Bernhard Juchheim.

Dimitrios Charisiadis sees excellent opportunities for the family business: *"The corporate group has enormous economic and technological potential. I look forward to accompanying JUMO on its way into the digital future."* ■

JUMO has experienced positive developments during the last several years!

Michael Juchheim, Bernhard Juchheim, Dimitrios Charisiadis



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