

APPLICATION REPORTS²⁰²⁰



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Reliable conveying of suitcases, accurate monitoring of brewing processes, efficient municipal vehicle service.

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Maintenance

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can be found on our website at:
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Baggage position control and measurement using a 3D sensor

Summer time is peak travel season. During this busy time of the year, maximum efficiency is paramount for airports all over the world. Fast and reliable handling of large amounts of baggage must be ensured to meet the tight flight schedule, with bags sometimes travelling several kilometres between check-in and aircraft. Each delayed flight not only costs nerves and time, but also a lot of money. In a high-speed baggage handling system of the BEUMER Group, 3D sensors from ifm ensure highest levels of efficiency and an error-free performance.

The BEUMER Group is an international manufacturing leader in intralogistics in the fields of conveying, loading, palletising, packaging, sortation and distribution technology. The BEUMER Group and its group companies and sales agencies provide their customers with high-quality system solutions and an extensive customer support network around the globe and across a wide range of industries, including airport baggage handling.

With its autover® Independent Carrier System, the BEUMER Group offers the right solution for the daily baggage handling challenge. On a passive rail system, intelligent transport vehicles called BEUMER autocar® carriers, which are driven by contactless power transmission, transport each item of checked baggage safely to its correct destination. BEUMER autover® is already in use at major airport hubs such as Dubai, Moscow, Nice, Gdansk and Montreal. With Denver and London Stansted, further hubs will soon be putting the system into operation.

3D safety check for the suitcase roller coaster



"With a throughput of up to 900 items of baggage per hour and transfer point,

our system achieves a high handling speed," says BEUMER Group HLC Software Engineer Michael Baumeister, who is responsible for constantly improving the BEUMER autover®.

Hundreds of BEUMER autocar® carriers can travel simultaneously at speeds of up to 10 metres per second along the roller coaster-like rail system with its tight curves, steep inclines and declines of up to 18° and long straights to transport the passengers' suitcases, bags and out-of-gauge baggage.

"Each carrier collects a single item of baggage, providing 100% tracking and traceability during transport."

■ Optimal placement of baggage

The second important factor besides reliable tracking is the correct positioning of the baggage items. From check-in, the baggage items are carried by conveyor belt to the BEUMER autover® system. Before being picked up by a BEUMER autocar® carrier, each piece of baggage is detected and measured by an O3D camera positioned above the conveyor belt. The camera operates on the time-of-flight principle. While laser scanners, which rely on a similar principle, use only one pixel for the measurement, the O3D camera has 23,000 pixels arranged in a matrix. In this way, the camera can detect objects and scenes in three dimensions at a glance.

■ Optical detection improves performance of BEUMER autover®

"We use the camera to check compliance with the permitted outer dimensions, that is, length, width and height of the baggage items", says Baumeister. "We do this because we can reach physical limits when transporting baggage due to the very high transport speeds, for example in bends. This is why it is important for us to determine the baggage position, e.g. whether a suitcase is in an upright position before it enters our transport system. The O3D camera from ifm allows us to do this very reliably before loading."

If an upright suitcase is detected, the staff in charge at the airport is either advised to bring the suitcase into the correct lying position or the travel behaviour, especially the speed in bends, of the BEUMER autocar® is adjusted preventively due to the expected instability.

ifm's O3D camera convinced Michael Baumeister and his team because of its highly accurate recognition and measurement capabilities, but also because of the potential the image evaluation offers in terms of perspective.

"Theoretically it is also possible to determine the position by means of a light grid", says Baumeister. "However, the use of the 3D camera has a decisive advantage. The temporary storage of the captured images helps us in the rare case of a complaint from a passenger or the airport. On the one hand, we can determine to the nearest second when and in what

“ We use the camera to check compliance with the permitted outer dimensions, that is, length, width and height of the baggage items

condition a piece of baggage was fed into the BEUMER autover®. For this purpose, we also store the dimensions and positions. Another benefit is the easy parameter setting of the camera and the evaluation of the image data using the ifm Vision Assistant, which can display the measured baggage items in various 2D and 3D views. This allows us to analyse warning messages that occur and to continuously improve the control system.”

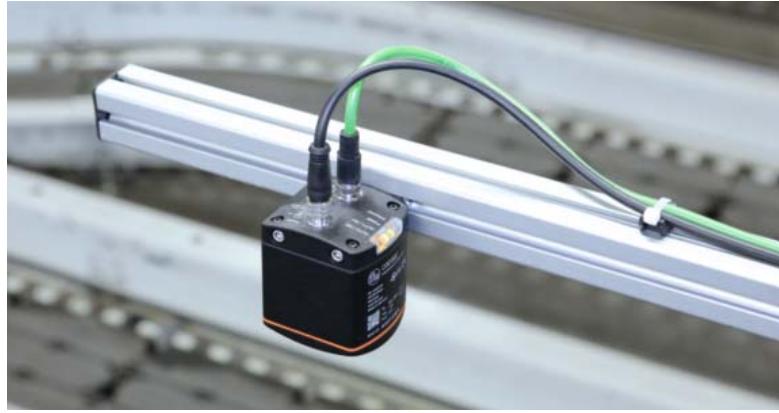
According to Baumeister, the optical baggage detection system will be capable of indicating rare scenarios such as extended trolley handles even more reliably in the future.

“This situation hardly ever occurs, as this is already monitored at check-in. But there is still the possibility that the trolley gets jammed in the system, which would cause a delay in the process. We want to avoid even such unlikely scenarios at all costs.”

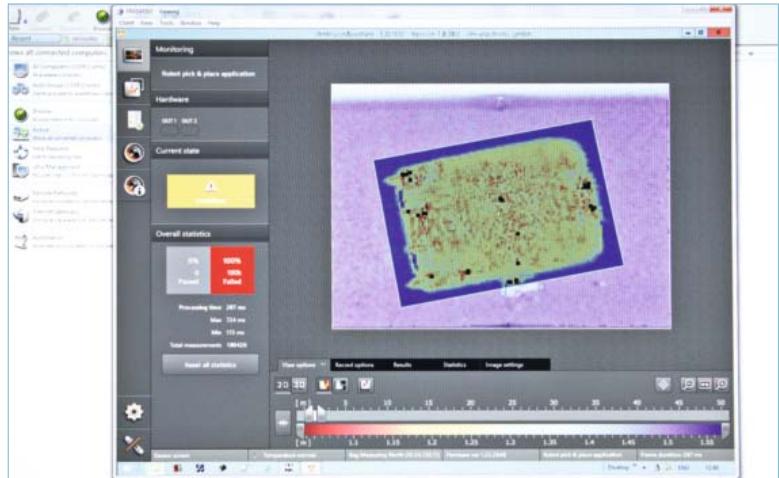
■ Conclusion

With the O3D camera from ifm, the BEUMER Group is able to ensure the correct placement of baggage items at a critical interface – the baggage transfer from the in-feeding conveyor belt to the independent carrier system. The system can then fully harness its high degree of efficiency – to the benefit of the airport operator, the airlines, and the passengers.

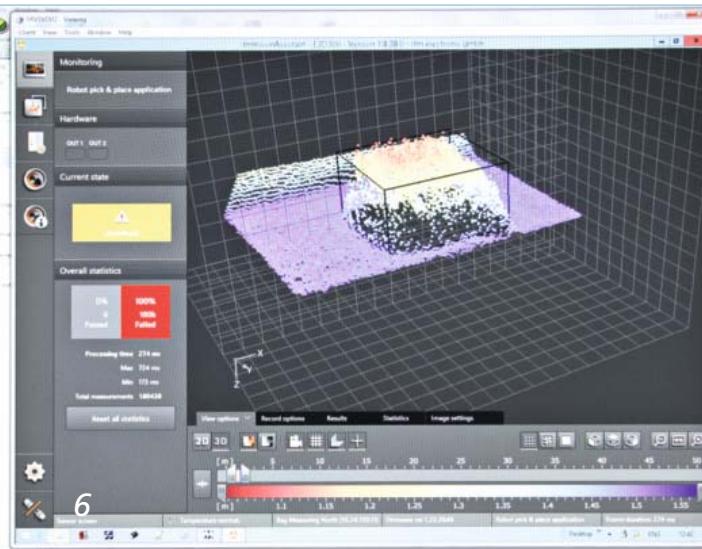
3D inspection: Thanks to 23,000 pixels, baggage items are displayed in three dimensions.



The O3D camera detects the three-dimensional dimensions of the piece of luggage from above.



The baggage position can be checked with the ifm Vision Assistant using a 2D image. The camera also provides distance and grey-scale images.





Giving sight to robots



3D vision sensor for plug and play integration into gripper applications from Universal Robots

The perfect combination of powerful hardware and easy-to-use software makes it possible to easily implement vision sensors in gripper applications from Universal Robots.

The core element of the ifm vision sensor is a 3D camera chip. It creates a 3D image using PMD technology and time of flight measurement.

The UR+ plugin ensures smooth and quick integration of the sensor. It detects any object, even moving ones, and transmits its exact position and dimensions to the robot control. Never before was gripper navigation so easy! ifm – close to you!



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ifm.com/gb/o3d

the top

View from

Not only vehicles but also the production facilities for the locations worldwide are made at the main plant of the German car manufacturer Opel in Rüsselsheim.

3D camera replaces several sensors for position monitoring

The automotive manufacturer Opel in Rüsselsheim relies on innovative technology in production. At a welding robot various stamped and deep-drawn metal sheets are welded to form a supporting element of the bodywork. A 3D camera monitors the position and the fixing of the sheet metal parts.



The operator places several prepared sheet metal parts on top of each other so that a welding robot can weld them together at several points to form one piece. Toggle clamps are used to fix the sheet metal parts. They are L-shaped levers which fold down and fix the sheet metal in the equipment from the top.

Usually dozens of sensors are installed at that point to monitor the correct position of the clamps and the presence of the workpieces. Because only if the component is detected as "present" and all clamps have been signalled to be "closed", would the controller release the welding process.



“ Using the O3D sensor from ifm, we can replace the conventional sensors and detect positions visually.

The 3D sensor simultaneously monitors several positions.

At Opel people thought about how to optimise this position detection. The idea: The O3D sensor from ifm looks at the scene from above.

Claus Moog, Supervisor Operation Planning, Electric & Commissioning at fixture and plant engineering at Opel in Rüsselsheim: “In 2017, we considered how to design our tools more cost effectively and efficiently. At first we started with analysing the market of different vision sensors and eventually came across the company ifm. Using their O3D sensor, we can replace the conventional sensors and detect positions visually.”



Several prepared sheet metal plates are welded together to form a subassembly.

“ The use of the O3D sensor provides us with completely new possibilities.

■ The O3D sensor

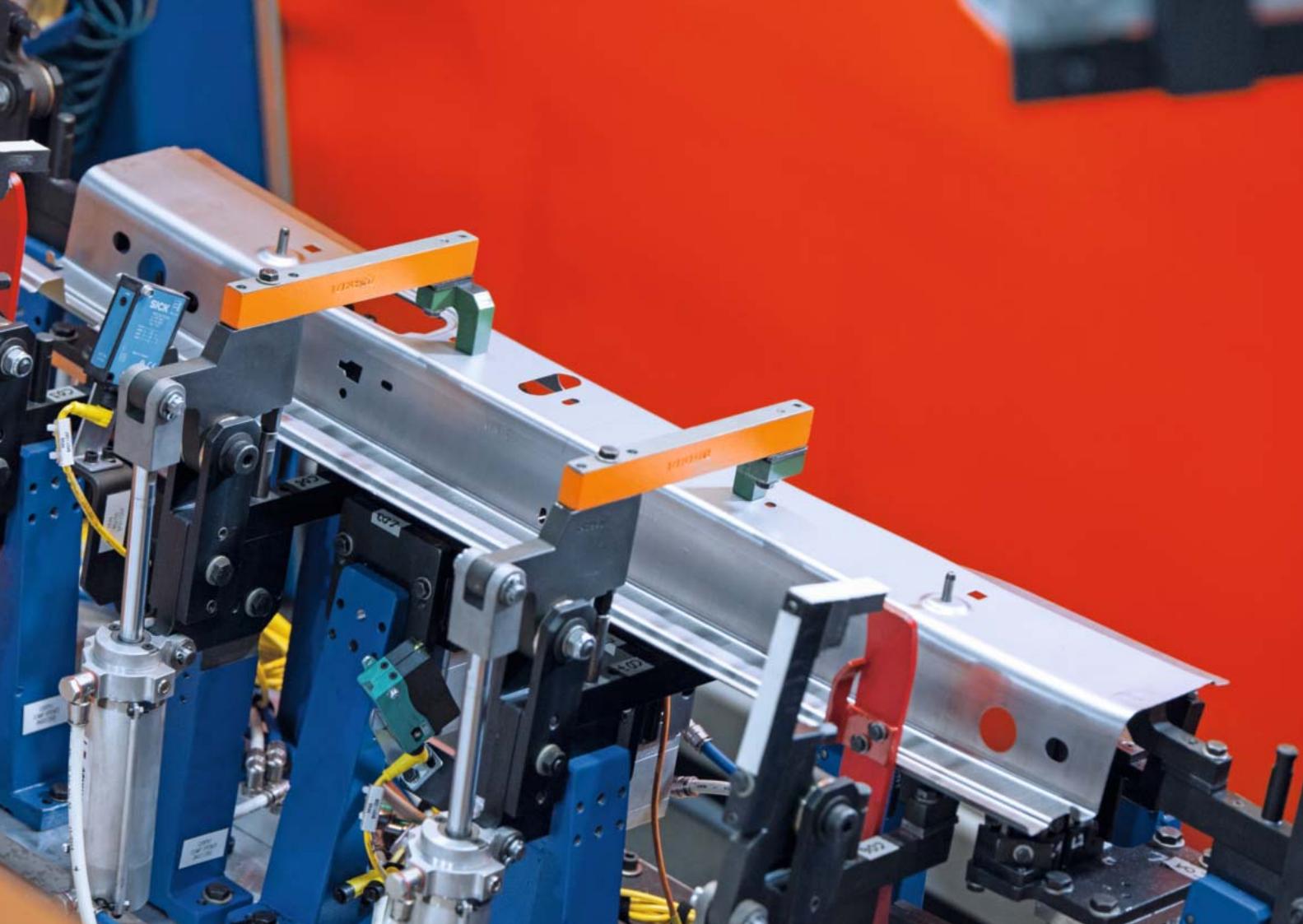
ifm's O3D302 vision sensor is a 3D camera with integrated image evaluation. The resolution of the PMD image sensor is 176 by 132 pixels. For each of the 23,232 pixels the sensor supplies a precise distance value – up to 25 times per second. In contrast to laser scanners, the ifm 3D sensor has no moving parts. Therefore, it is especially robust, small and cost effective.

Since the 3D image is evaluated in the sensor, external image evaluation is not needed. The distance between the clamp and the sensor is evaluated via definable

positions in the camera image (called ROIs, region of interest). The integrated evaluation detects if the tension lever is “open” or “closed”. The events are transferred to the controller using the integrated Ethernet interface via TCP/IP, PROFINET IO or EtherNet/IP. The live camera image can also be provided.

Using the “Vision Assistant” software, the user can easily set the sensor parameters, define ROIs or configure the output function, for example. This software is available both for Windows PCs and for iPads.





The individual components are fixed by means of a clamp in the fixture. Their positions ("open", or, as in this photo, "closed") are monitored by a 3D sensor from the top.

■ Looking down from above

Two of these sensors are installed above the welding system, one in the placement area (component placed), the other in the actual welding area. Both look down from above to the sheet metal to be welded and their clamps in the installation equipment.

Fabian Gulla application engineer for image processing and robotics in plant construction at Opel, explains the function of the sensors, "We use the sensor for distance measurement. To do so, we have defined several regions of interest which we detect. For once, there is the clamp and its end positions, and then there is the component as such, i.e. present or not present. You could, of course, also detect this using several one-dimensional photoelectric sensors if you align one sensor to each area. The advantage of the O3D is that you only need one sensor and can then redefine ROIs in the software. We have aligned the ROIs to the end

positions of the clamps and the workpieces and then we simply use the distance measurement for detection: 'Is a component present' or 'Has the clamp reached its end position?'"

■ Cost savings

Instead of many sensors only one single 3D sensor simultaneously detects the position at several points in the equipment. Using the O3D vision sensor, approx. 80 % of the conventional sensors can be replaced in this plant.

Claus Moog: "Usually, 30 to 40 sensors would be installed on the tool. Now we need only 10 sensors for the detection of actuators in concealed installation positions, which the vision sensor cannot detect. That means we could replace a major part of the sensors. We could achieve cost savings amounting to about 20 to 30 %."



ifm VisionAssistant for parameter setting and visualisation of the O3D camera.

Furthermore, we have compared how much power conventional sensors use and how much the O3D consumes. Here again, significant cost savings result."

There are even more saving potentials by reducing cabling, installation accessories and I/O points at the controller.

■ Visualisation

For transparency in the process, Opel have installed a monitor for visualisation in the plant. Besides graphic process visualisation, the O3D can also provide a live image.

Fabian Gulla explains: "The standard display shows the operator which components are to be placed and if the components are correctly positioned in the tool. Currently, these are graphics that have to be designed and animated by a programmer and are composed of several images. Different markers are added which show the operator which components are still missing and which he still needs to place. Thanks to the live image, the advantage of the ifm sensor is that we have assigned end positions to the clamps and components, which are visualised in the image. The red-green colour change



*Free installation space:
No more sensors are required in the area of
the welding tongues and weld spatter.*

symbolises to the operator if a workpiece has been placed and if the clamp is open or closed. This does not mean any more programming work because the sensor parameters have to be set anyway and the live image is provided by the sensor."

■ Space saving

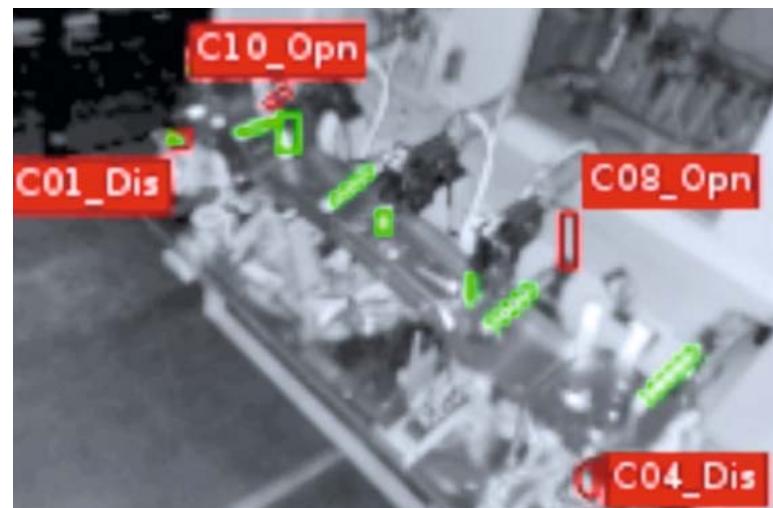
Due to the fact that instead of several sensors, now only one sensor is needed for the detection of several positions and this sensor is installed high above the plant, there are advantages for the construction of the plant.

Claus Moog: "The use of the O3D sensor provides us with completely new possibilities; for example, we have more construction space and more space for accessibility to welding tongues. Furthermore, we can eliminate the susceptibility to failure of conventional sensors. Since the sensor is installed high above the welding area, weld spatter cannot reach it which would damage it over time as is possible with conventional sensors installed close to the welding tongues."

“ We believe that the use of vision sensors will establish itself in the future because using the vision sensors we can create artificial intelligence which is not yet possible like this today.



Visualisation ensures transparency and indicates the operating steps to the operator.



The live image of the 3D sensor with regions of interest marked in colour.

■ Prospects

The experience made in this pioneer plant at Opel is overall positive. This will influence future developments in plant construction.

Claus Moog: “We believe that the use of vision sensors will establish itself in the future because using the vision sensors we can create artificial intelligence which is not yet possible like this today.”

Fabian Gulla adds, “In the context of cameras we will be able to make enormous progress. For example, robot grippers and suckers can be made considerably more flexible and therefore considerably more intelligent. However, this does not only concern the subject of cameras but, for example, also technologies such as IO-Link, artificial intelligence, deep learning or machine learning. At any rate, there will be many new things. It is always a question of consideration: What makes sense, what fits my price-performance segment and: Do I generate added value for the company or the application at the end of the day?”

The O3D vision sensor was introduced in close cooperation with the developers of the vision sensor.

Fabian Gulla: “The cooperation with ifm is very good. We had several meetings directly with the developers. So we could gain insight into important findings such as ‘how does the sensor work?’, ‘what do I have to note?’, ‘what size must my clamp be so that it can be reliably detected?’” .

■ Conclusion

Fewer sensors, simpler plant construction, no interference due to weld spatter – the vision sensor as a monitoring system provides numerous advantages and considerably reduces the plant cost. Other production plants can also be equipped with the vision sensor and thus optimised.

Engine production without turbulences

GKN Aerospace is one of the world's largest suppliers for the aerospace industry.

Sensors monitor the production process and make maintenance calculable

The Swedish company GKN Aerospace from Trollhättan produces high-precision parts for aircraft engines and for aerospace industries. The machine tools have sensors that ensure maximum transparency and the highest product quality.

GKN Aerospace is the worldwide leading cross-technological supplier of aerospace technology. With 50 production sites in 15 countries, the company supplies over 90 % of the aircraft and engine manufacturers in the world. They develop and manufacture innovative intelligent systems and technologies for aerospace, that are used for example in cargo planes and in the world's largest passenger aircraft. The company also works on space technology. For instance they produced the rocket nozzle of the well known Ariane 5.

Mikael Alm, Industrial IoT Engineer at GKN: "We produce components for aircraft engines. In my department ND Digital we work on precise machine tools. We monitor our machines with the help of sensors, so that everything works perfectly and nothing unexpected happens. We use different sensors to ensure a flawless production process. For about 3 years we have been using vibration sensors from ifm. They monitor the spindles in our machine tools."



Machine tool for high-precision metalworking.



There are various operations in metalworking that are fully automated carried out by computers. Milling heads work their way through the metal with high rotational speeds. Cutting tools create shafts to the micromillimetre and drills place exact drilling holes. This is how high-precision components for aircraft turbines, among others, are manufactured in the shortest amount of time.

Ensuring fault and trouble-free machining of the workpiece is of the utmost priority. This is the only way to continuously guarantee high product quality. Due to the high machining speed and process forces, quickly reacting diagnostic systems are required, that immediately detect damage occurring on the tool or collisions during machining and that stop the process immediately thus preventing damage to the machine and the workpiece. Permanent vibration diagnosis has proven to be the optimum procedure.

■ Minimum unbalances reveal problems

The centrepiece of this system is a highly sensitive and extremely reliable vibration sensor from the sensor specialist ifm electronic, that is mounted directly onto the spindle housing. The vibration sensor of type VSA is a small micromechanical acceleration sensor that continuously detects vibration on non-rotating machine surfaces.

The VSA is so sensitive that it detects even the slightest damage on a milling head that itself only has the size of a millimetre due to occurring unbalance. Changes in the cutting forces that may, for example, be caused by a blunt drill or too much swarf are detected and reported to a diagnostic unit on account of the changed vibration characteristics. At GKN, the evaluation unit VSE100 is from ifm. It processes signals from up to four vibration sensors and can trigger a warning or machine stop in case of a fault. The data is transmitted to the higher-level controller via Ethernet.

Limit values for vibration and collision detection can be stored in the machine controller for each tool and for every step in the process. To determine them in advance, a program cycle is carried out in the teach mode. Individual vibration data and adjustable tolerance values are stored in the controller for each tool. If those values are exceeded during machining, this is interpreted as an error and provides a warning message or stops the machining depending on the amplitude of the vibration.

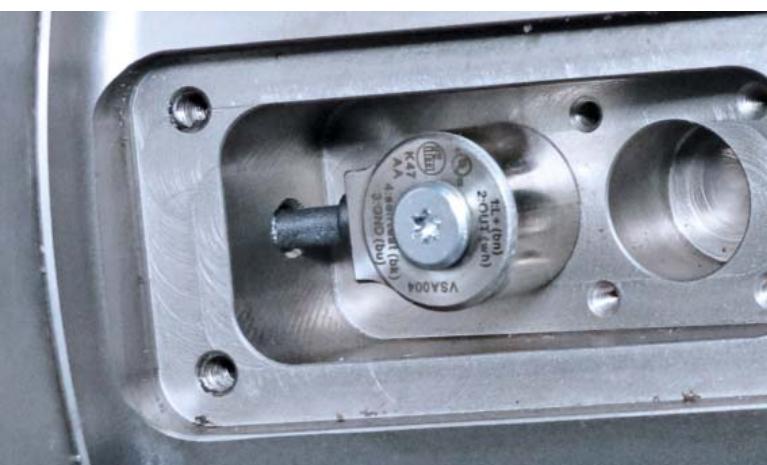
Another protective function is spindle condition monitoring. Wear on the bearings of the complex spindle mechanics is detected and signalled on the basis of unusual vibration characteristics. This provides the user with additional safety.



For transparency and optimisation: The Smartobserver software collects, visualises and analyses all sensor data.



Constantly listening:
Vibration sensor VSA004 from ifm placed right on the spindle.



Pressure sensors monitor the pressure
in the cooling circuit.

■ Further sensors

The evaluation system has two analogue inputs, where additional sensors for monitoring measuring parameters can be integrated. GKN uses countless PN7 pressure sensors to constantly control the pressure in the cooling pipe. A pressure drop could stop the cooling process and damage the tool and workpiece. This is why sensors signal if the operating pressure is too low in a case of fault.

Mikael Alm: "I work with sensors from ifm since I started working at GKN Aerospace. ifm has a good and broad selection of sensors, so that there is always a solution that suits our requirements."

GKN connected all sensors to the central controller via the AS-i bus system. A two-wire flat cable transmits signals from up to 127 sensors with the help of AS-i IO-modules to the AS-i master. Bus wiring significantly reduces the cabling costs and provides a higher flexibility of installation.

■ Evaluation

GKN uses Smartobserver to monitor and analyse the machine condition. This software was especially developed by ifm for condition monitoring of installations.

“ The combined solution of ifm's sensors and software will help us understand and improve our equipment in future as it does now.



The VSE100 evaluation unit detects the smallest deviations and gives a signal in case of exceeded limit values.

All measured values of the sensors meet here. Next to illustrating all process values and their limits, the software creates for example trend analyses, helping to optimize the production process.

Mikael Alm explains, "It is very important for us to understand what happens during the production process. Our products are very expensive and we have to be able to make improvements when the processes are not entirely true. We can use the collected data from Smartobserver in our own analysis tool, thus making precise assessments and acting accordingly."

The extensive alarm management of the ifm software allows condition-based maintenance of the machines.

Mikael Alm's conclusion is, "For many years I worked with this type of maintenance and it works the way it is supposed to. The combined solution of ifm's sensors and software will help us understand and improve our equipment in future as it does now. ifm provides excellent customer support which has always helped us finding a solution to our problems."

The close cooperation with the customer is also reflected in the ifm slogan, "ifm – close to you".

■ Conclusion

With the help of sensors and Smartobserver, machine tools can be monitored automatically and reliably. Faults are detected in time and the maintenance operation is calculable and condition-based. This does not only save costs, but it also ensures maximum availability and the highest product quality.



Reduces wiring: AS-i modules collect sensor data and transfer it to the controller via the 2-wired bus cable.

Automated tradition

The company "Leksands Knäckebröd" was founded in 1920 and has been family-owned since then, today in the 4th generation.

Typical of Leksands' crisp bread:
the round shape with a hole in the middle.

Sensors support the crisp bread production in Sweden

What is the most typical Swedish product? It does not take long to give the answer: crisp bread. In the little town of Leksand in Central Sweden, there is Sweden's largest producer of the traditional round crisp bread. Also involved: ifm as the automation specialist.

While the recipes are still the same after about 100 years, the production process is completely different now. Production is automated according to the latest state-of-the-art technology. To ensure that the systems run smoothly, different sensors monitor the production process – from the supply of the ingredients to the dispatch area.

Capacitive sensors detect the flour through the walls of the pipes.

Peter Joon, Managing Director at Leksands Knäckebröd: "We use many sensors since this is a very modern production and a highly automated process. Since we have a very high productivity of 99.6 %, we need sensors we can trust and which are of high quality. Today we use many sensors from ifm. They are of high quality and function very well with our products."

Lars Ohlner, Automation Engineer at Leksands Knäckebröd adds, "We use products from ifm because they are easy to configure and which are cost effective; they simply function reliably. We mainly use photoelectric and



“ Since we have a very high productivity of 99.6 %, we need sensors we can trust and which are of high quality. Today, we are using many sensors from ifm.



capacitive sensors and some flow sensors. This should ensure a high degree of automation, good automation and a reliable process.”

Some particularly innovative sensors as example:

■ Capacitive sensors

The main ingredients of crisp bread are rye meal and finely ground rye and wheat flour. They are supplied to the mixing tools via various pipes.

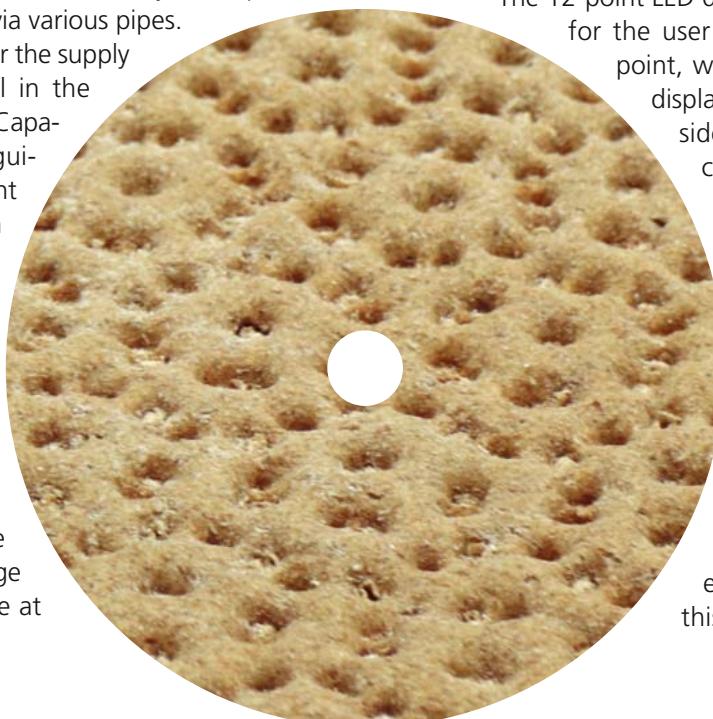
Capacitive sensors monitor the supply at the pipes or the level in the temporary storage tanks. Capacitive sensors are distinguished by detecting different materials, even through the tank wall, unless they are of metal. If a pipe is no longer completely filled with flour, the capacitive sensor detects this state and sends a switching signal to the controller.

Often, several capacitive sensors are used on storage tanks or silos, for example at

the very top, to signal a possible overflow in time or at the very bottom of the silo to signal a critical empty state. Potentiometers are used to adjust the sensors after installation. the switch point is adjusted depending on the wall thickness of the pipe and the type of the medium to be detected. The new KI6000 sensors from ifm are to be set particularly precisely. Since they have a unique LED signal display for the perfect switch point setting.

The 12-point LED display makes it much easier for the user to set the optimal switch point, which is in the centre of the display. The green LEDs on either side of the switch point indicate the reliability of the switch point. Deposits, material changes etc. are directly displayed on the sensor and the user can readjust perfectly the switch point as needed. That means that an imminent error can be detected in good time and avoided.

If help is needed with the effects of process changes this is much easier to explain



“ ifm is our first choice when it comes to sensors because they have the products we need.

and rectify with the clear switch-point visualisation. Over the phone the user can describe the LED behaviour and a support engineer can easily advise corrective measures.

By using non-contact potentiometers, the new units have the high protection rating IP 69K and are perfectly suited for medium temperatures up to 110 °C. Moreover, different functions such as PNP/NPN or NC/NO can be selected. The ifm sensors are equipped with IO-Link and prepare the user optimally for Industry 4.0.

■ O6 photoelectric sensor

Diffuse reflection sensors are installed at various places in production. They monitor the flow of material on conveyor belts. These are, for example, individual slices of crisp bread but also completely packed products in the dispatch area.

In most cases, they use the ifm diffuse reflection sensors of type O6 at Leksands Knäckebröd.

Their optical performance is excellent. They are distinguished by a particularly noise-immune background suppression while the range of up to 200 mm is independent of the object colour. This is important since the crisp bread slices have a different surface depending on the type and recipes.

Even in the event of vapour, dust and highly reflective environments the automatic sensitivity compensation

Distance measurement for position detection across longer distances: O1D with time of flight technology.



The ifm O6-series diffuse reflection sensors monitor the flow of material.

guarantees a reliable function. The clean round light spot in the operating area ensures a consistent light distribution in the light cone. Scattered light around the light spot is avoided. The compact O6 WetLine is perfectly sealed. The two setting potentiometers are fitted with a double seal. Front pane and potentiometer are embedded flush to allow residue-free cleaning. These compact powerful units from ifm can also be supplied as through-beam and retro-reflective systems.

The particularly resistant stainless steel housing with protection rating IP 68 / IP 69K ensures reliable use even

The amount of water for dough production is precisely detected by means of magnetic-inductive flow meters.





under severe conditions and ensures an extremely long life time. The O6 sensors are now also available as versions with IO-Link. Via this interface, the range, sensitivity, light-on / dark-on modes, switching delay or deactivation of the operating elements can, for example, be set remotely.

■ O1D distance sensor

When position detection across longer distances is of importance, the O1D distance sensor is a cost-effective and also very precise problem solver. Thanks to laser beam and time of flight measurement, it provides reliable and precise distance measurement with a long range of up to 10 m. It is ideal for applications with background suppression.

Thanks to the innovative on-chip time-of-flight process with PMD technology, the detection is independent of

*100 years of Swedish tradition:
Leksands are Sweden's largest producers of crisp bread.*



the object colour or its surface, e.g. mat or shiny. O1D is insensitive to extraneous light up to 100,000 lux and remains unaffected even if direct sunlight hits the sensor or object thus operating reliably and accurately at all times. The user can choose switching outputs, analogue outputs or IO-Link for data provision.

■ MID flow sensor

Besides the grain, water is an elementary part of the crisp bread dough. In the field of dough production, a magnetic-inductive flow meter from ifm is used.

These units feature high accuracy, measurement dynamics and repeatability. They are suited for conductive media as from 20 µS/cm. The 4-digit alphanumeric LED display is highly visible. Besides the volumetric flow, the units also measure temperatures from -10...70 °C. Furthermore, an additional measuring point is no longer needed thanks to the integrated temperature monitoring. The robust compact housing, use of resistant materials and pressure rating up to 16 bar allow flexible use.

Using the IO-technology, process values are not only available via the analogue output but also digitally. Conversion losses during measured value transmission are a thing of the past. Saving all sensor parameters not only allows an easy replacement of sensors but also a simple and quick configuration and remote parameter setting. The user is well prepared for Industry 4.0 with the new IO-Link functionality.

■ Continuing with ifm in the future

At Leksands, they have been using the reliable and long-life sensors from ifm for a long time. No wonder that you can find ifm sensors which are older than 25 years in some places in the plant. Also in the future, they want to tackle new challenges in automation with ifm as their partner.

Peter Joon: "For the future we have to develop sensors that can perceive the different colours of the bread and their shades. ifm is part of the development of these sensors. We have created a new area which is based mainly on ifm products and which has proved its worth so that we will further develop our future areas with sensors from ifm."

He concludes, "ifm is our first choice when it comes to sensors because they have the products we need."

Automatic machine protection

The Swedish company Scania located in Södertälje near Stockholm is one of the world's largest manufacturers of heavy-duty utility vehicles.

Vibration monitoring protects machine tools

The Swedish vehicle manufacturer Scania is one of the world's largest manufacturers of utility vehicles, buses as well as ship's and industrial engines. The plant in Stockholm produces, among other things, powerful engines for trucks and buses. Sensors are monitoring the automated production.

Sensor technology is used to prevent unplanned production downtime. It constantly monitors the condition of machines and installations. If any limit values are exceeded, the maintenance staff will receive an automatic message or, in critical situations, the machine will even be stopped automatically to avoid any damage.

Robert Bergkvist, automation engineer for IT and automation questions at Scania says, "We are, for example, using flow and level sensors as well as common inductive sensors to have an overview of our production

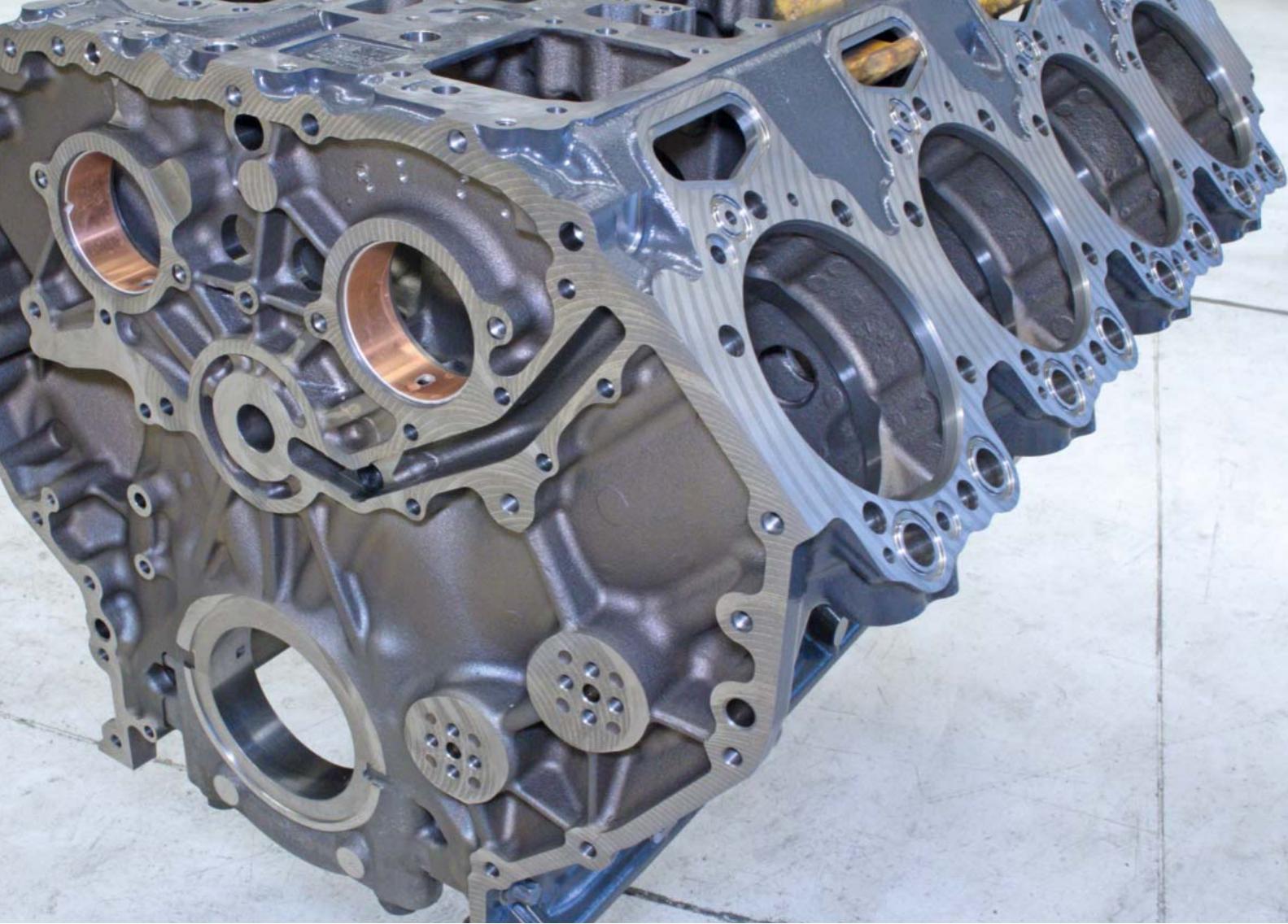
lines. What is more, the sensor data is of very great value to us. It helps us when we make all kinds of decisions concerning maintenance options. The data is also very useful to optimise the processes. What is more, the sensor data is of very great value to us. It helps us when we make all kinds of decisions concerning maintenance options. The data is also very useful to optimise the processes."

■ Diagnostics explained using the example of a machine tool

Scania uses countless machine tools. It seems as if the milling heads were cutting through butter when they work their way through metal blocks while lathe chisels are creating shafts to the nearest millimetre and drills are accurately placing boreholes. All process steps are fully automated and carried out by computer-controlled lathes and milling machines. They create moulds for cylinder heads or shafts for engines in the twinkling of an eye.

To meet the high quality standards, machine tools must guarantee flawless and trouble-free workpiece machining. The high machining speed and the great process forces require quickly responding diagnostic systems that will immediately detect any damage to the tool or any collision in the machining process, so that it will be





“We are, for example, using flow and level sensors as well as common inductive sensors to have an overview of our production lines.

stopped instantly to prevent damage to the machine or the workpiece. Permanent vibration diagnostics has proven to be the ideal solution to reduce damage to a minimum.

■ Tiny fault, dramatic consequences

You can hardly imagine how great the process forces actually are when you see how easily the milling heads cut through the material with extreme rotational speeds. However, the tools are in fact subjected to extreme mechanical stress.

5-axis machine tool to lathe, drill and mill large metal blocks.



Even if their quality is at its best, no operator will be able to prevent that tools will break while they are in use. Even a tiny mechanical defect may have serious consequences if it occurs during the machining process. A broken tooth of a milling head, for example, can damage the workpiece and make it useless. When this happens to a complex workpiece, such as an engine block, the damage may become very expensive. Not only would the expensive workpiece become useless, but the required quantity could no longer be produced. The production process would be severely disrupted.

■ Unusual vibration indicates tool failure

This is why Scania provide their tool machines with an automatic fault detection system. The centrepiece of this system is a highly sensitive and extremely reliable vibration sensor from the sensor specialist ifm electronic.

"We monitor the vibration on the motor spindle, so that we can replace it in time before it breaks. What is more, the diagnostic software shows us the condition of the spindles and whether we need to adapt any process parameters," says Robert Bergkvist.

Thanks to the sensor data, the process efficiency can be increased to a maximum without the risk of critical machine conditions like a lathe chisel being driven too fast into the material.

This is where ifm's compact VSA vibration sensor joins in to help. It is firmly screwed into a borehole in the spindle head housing. There, it continuously detects the vibration characteristics during the machining process. The micro-mechanical accelerometer is so sensitive that it will detect even the slightest unbalance caused by a missing tooth on a milling head that itself only has the size of a millimetre. Changes in the cutting forces that may, for example, be caused by a blunt drill or too much swarf will be detected and reported on account of the changed vibration characteristics.

Individual tolerance limits can be assigned to teach tool, for example, warning and a switch-off thresholds. In case of the latter, the rotating tool spindle will be stopped via the command "stop spindle advance", so that the head can be removed from the workpiece. This reliably prevents that the expensive workpiece will be damaged.



*Micro-mechanical VSA accelerometer
for screw mounting in the housing wall of rotating drives.*

■ Collision detection

Another function of vibration monitoring is collision detection. In series production, the entire milling, lathing and drilling process is usually tested by means of a simulation. Program-related collisions between the tool and the workpiece will be detected reliably and considered in the programming. In particular when fabricating individual components, programming flaws may lead to collisions between the tool and the workpiece or machine parts. In this case, the machine will be stopped as quickly as possible to minimise the damage to the machine and the workpiece.

■ Spindle monitoring

Another protective function offered by vibration diagnostics is spindle condition monitoring. The vibration characteristics of the rolling bearing element are measured in a reference run and saved as "good value". If the bearings in the complex spindle mechanics are worn, this will be detected due to unusual vibration characteristics. If configurable tolerances are exceeded, an error message will be given. This guarantees permanent condition monitoring offering the operator additional safety.

■ How does vibration diagnostics work?

ifm's VSA vibration sensor is a micro-mechanical accelerometer. It continuously detects the vibration on non-rotating machine surfaces.



*Processes the vibration signals from up to four sensors:
the VSE100 evaluation unit.*

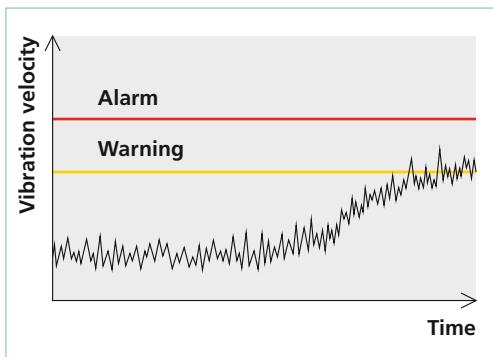
It is connected to the corresponding VSE evaluation unit. The evaluation unit evaluates the sensor signals of up to four vibration sensors and sends them directly to the machine control system. This ensures easy and stable integration.

Limit values for vibration and collision detection can be stored in the machine controller for each tool. To determine them in advance, a program cycle is carried out in the teach mode. Separate vibration data will be stored in the controller and provided with adjustable tolerance values. Individual limit value setting is possible down to each cut.

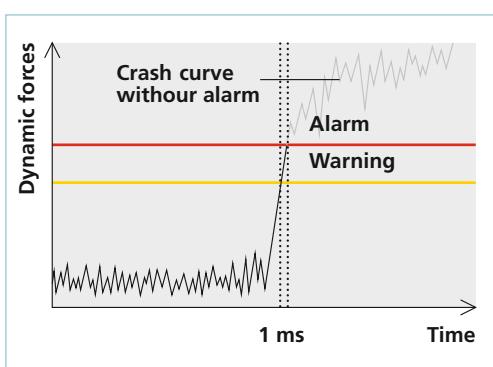
Exceeded tolerance values during the machining process are interpreted as a fault and will, depending on amplitude of the vibration, lead to a warning message or even stop the machining process.

Conclusion

Tool breakage, collision or bearing damage: process monitoring based on vibration diagnostics cannot prevent them. However, by stopping the machine, the damage will not get worse while additional consequential damage to the workpiece and the machine will be effectively prevented. Permanent vibration diagnostics even detects imminent problems and will notify the maintenance staff with a warning message. This ensures efficient machine capacity utilisation and maximum machine protection.



It is possible to set individual warning and switch-off thresholds for each tool.



Collisions are detected on the basis of the vibration characteristics within a millisecond. The machining process will be stopped immediately to prevent serious consequential damage.

Flexible sensors for individual beer



IO-Link sensors guarantee an optimum brewing process

A variety of individual beers – this characterises the regional brewery "Skanderborg Bryghus" in the Danish town of Skanderborg. Unlike large commercial breweries, this brewery is largely promoted and operated by beer lovers on a voluntary basis.

The demand was so immense that only three years after its foundation the brewery had to be expanded significantly. On this occasion, modern sensors from ifm were implemented to monitor the numerous tanks.

The regional brewery in Skanderborg, Denmark that is mainly run by beer aficionados working voluntarily offers a wide range of individual beers.

Allan Pedersen, Technical Manager of Skanderborg Bryghus, "present from day one", explains, "*In 2015 our company started with a brewing capacity of 125,000 litres of beer per year. In 2018 and 2019 we significantly expanded the brewery that now has a capacity of 4 million litres per year.*"

The large expansion of the plant was carried out by the company GEA.

Kåre Hjortkjær, GEA Denmark, was responsible for the electrical work. "*GEA is an international engineering company. We make process systems for different industries. For this project we developed a completely new*

“ Since the planning phase to the present day ifm has proven a valuable partner.



brewery. It was our responsibility to decide on all sensors to be used in this brewery. There were no requirements for certain product brands from the brewery. The price was, of course, part of the decision. All the factors we considered pointed to ifm. We selected the sensors needed for process monitoring because of their flexibility and focussed on the hygienic design. One requirement, for example, was to detect the level in a tank and to differentiate between beer and CIP liquid. We decided on sensors from ifm because we know the company from many years of good and close cooperation. We measure pressure and temperature at several points in each tank

Level sensor LMT from ifm as overflow prevention at the top of the tank.

and also monitor level. To do so, we installed several ifm sensors at each tank. The controller visualises how much beer is in the tank and what temperature it has. The many sensors make it possible to run the brewing process automatically so that production can be controlled with a minimum of employees.”

Allan Pedersen adds, “GEA installed more than 300 ifm sensors. We can remotely set, calibrate and monitor them via IO-Link. We are happy that we can use the complete solution of a supplier instead of having to buy components from different manufacturers.”

Most ifm sensors are installed at the numerous tanks. Three types of sensors are used especially frequently.

■ Resistant pressure sensor ensures a smooth process

An ifm pressure sensor, type PI2795, is mounted at the bottom of the tank. The level is determined via the hydrostatic pressure the beer in the tank exerts on the sensor's measuring cell. The measuring range of the sensor is -1 to 4 bar. It is resolved in steps of 0.005 bar. The measured value is transmitted to the plant controller via an analogue signal or IO-Link. Since the tank geometry is known the controller calculates the exact contents in litres from the measured pressure.

The measuring cell is mounted flush in the process connection, especially for use in food applications. This prevents build-up at the measuring point and allows residue-free cleaning, for example, during CIP cleaning. An important feature for the brewery: The sensor is



*Numerous tanks are precisely monitored
for level and temperature.*

designed for medium temperatures up to 80 °C. The sensor housing is made of stainless steel and has the protection rating IP 68 / 69K. Therefore, it is resistant to high-pressure cleaning with aggressive cleaning agents.

■ Intelligent level sensor ensures process reliability

The LMT102 is an electronic point level sensor for hygienic applications. When installed at the lower end of the tank, it signals empty state, when installed in the upper part it is used for overflow prevention. A second function of the sensor: it can differentiate different media. For the brewery this exactly means that the sensor detects if beer or CIP liquid is in the tank. In addition to point level detection, this information adds to the process reliability because a mixture of product and cleaning agents can reliably be excluded.

Especially in the food industry build-up and foam often make a reliable level detection difficult. As opposed to the vibration forks often used, the electronic point level sensor LMT from ifm ignores build-up. In the brewing process this ensures that foam does not affect level detection.

The smooth surface of the PEEK tip does not allow dirt or medium residue to adhere. Furthermore high-quality materials such as stainless steel and PEEK meet all requirements for demanding hygienic areas. Flush sealing is ensured by pressing the measuring probe onto the metal sealing edge of the adapter. This avoids dead space and contamination. Approvals such as EHEDG and 3-A certify the food conformity.

“ GEA installed more than 300 ifm sensors. We can remotely set, calibrate and monitor them via IO-Link.

■ Precise temperature sensor for demanding applications

The temperature of the beer is exactly monitored in the upper, middle and lower part of the tank using ifm temperature transmitters of the series TA22 that have a high accuracy over the whole temperature range. Thanks to the good dynamic response they quickly react to temperature changes. These sensors also feature a hygienic design to meet the high requirements in the food and beverage industry.

■ IO-Link – the perfect basis for intelligent control

All sensors used in the brewery feature IO-Link. Advantage: As an alternative to the analogue signal, they also transmit the measured values as digital values. This avoids, for example, inaccuracies which may occur when AD converters are used. In addition, IO-Link allows extensive and easy parameter setting. Thus, the level sensor LMT can be adjusted to different media via IO-Link. For the pressure sensors it is, for example, possible to adjust switch points via the controller. This offers maximum flexibility, for example, when formulas are changed. Moreover, IO-Link transfers the diagnostic data of the sensors to the controller. The LMT level sensor, for example, signals heavy build-up that prevents a reliable detection or differentiation of media.



Pressure sensors for hydrostatic level detection (left) and temperature transmitters (right) are used to ensure a reliable brewing process.

■ Strong partner

Apart from high-performance products, ifm is distinguished by their close contact with customers.

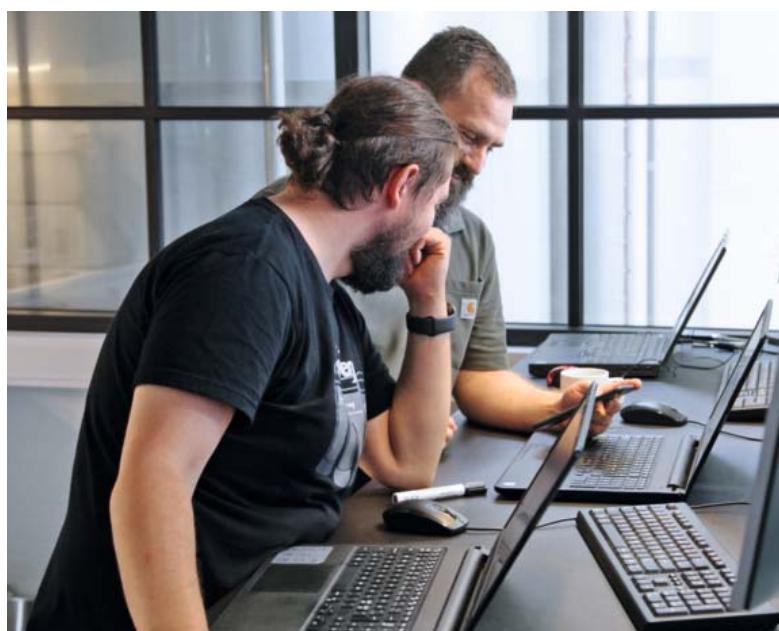
Kåre Hjortkjær from GEA emphasises, "Since the planning phase to the present day ifm has proven a valuable partner. We know the process and ifm knows their devices, so we can work well together."

Allan Pedersen from Skanderborg Bryghus sums up the cooperation, "I have been working with ifm since 1999 and I am very satisfied. We get support on site at all times and inspirations to implement our applications easily and reliably."

■ Conclusion

ifm offers a wide range of powerful sensors to monitor the processes in the brewery reliably and at low cost. IO-Link sensors not only offer a maximum of automation and safety but also an optimum product quality.

Both OEMs and customers appreciate the particularly close contact with customers according to the slogan "ifm – close to you!"



Thanks to IO-Link measured values are reliably monitored at the control desk. Parameter setting and diagnostics of each sensor are also centralised.



Cleaning machine 4.0

Industrial parts cleaning digitised down to the sensor level

For the digitisation of their industrial cleaning machines, the French company Mecanolav counts on ifm. By connecting intelligent IO-Link sensors with the Smart-observer software, Mecanolav has become the first company to offer cleaning machines on the market that are fit for Industry 4.0.

The data is collected by IO-Link masters, stored and visualised using the Smart-observer software. This is how monitoring and maintenance can be ensured for each connected machine around the globe.

The family-owned company from the French Normandy makes washing systems to clean machined workpieces for the automotive and aviation industries.

Mecanolav is a family-owned company from Normandy. The company was founded in 1924 and today has about 40 employees. It produces cleaning machines for mechanical components that are used in the automotive and aviation industries. As a rule, the workpieces are washed and dried in the cleaning machine within 30 seconds after mechanical processing, e.g. pressing. Various sensors are used in the system, especially pressure, flow, level and temperature sensors. In addition, laser sensors are used to detect the position of the components. Their common feature is that all sensors allow digital communication via IO-Link.

Managing Director Matthieu Vollois: “*Most of the sensors we use are in fact from ifm. We have chosen to digitise our machines because this is the road to the future. Industry 4.0 is coming, and we want to be the first on the market to offer fully connected cleaning machines.*”



“ *Industry 4.0 is coming,
and we want to be the first
on the market to offer fully
connected cleaning machines.*

■ The individual processes at a glance

The level in the water tank is controlled with an LR2050 level sensor. It features a probe and detects the level by means of guided wave radar. Four switch points are programmed via IO-Link. Two of them detect the high and low levels. The third, upper switch point serves as overfill protection. The fourth, lower switching point serves as run-dry protection. It protects the suction mechanism of the wash pump and also ensures that the heating unit is constantly below the water surface.

The water temperature is controlled and monitored by a TA2437 temperature sensor. The target value is 60 °C. If the temperature drops below 45 °C due to a malfunction of the heating unit, a switch-off will occur as the cleaning agent will no longer be effective.

While the machine is running, water is pumped out with a pump and filtered with a bag filter. A PN7094 pressure sensor behind the filter checks the filter for contamination. The target value is 5 bar. At 3.5 bar a warning alarm is triggered, and at 3 bar the alarm is triggered.

During rinsing of the metal parts, an SM9000 flow meter controls the flow rate required for cleaning. To ensure optimum cleaning of the workpieces, a flow rate of 150 l/min is necessary. The SM9000 flow meter also

features a total quantity meter and measures the medium temperature. The water circuits are controlled via valves. Behind each valve, a PN7094 pressure sensor ensures the correct water pressure (5 bar).

In both drying circuits the air flow is monitored with an SD2000 air meter. For the workpiece to dry completely, the flow rate must be 250 m³/h.

When lifting the part to be cleaned at the beginning of the cleaning cycle and lowering it at the end of the cycle, an O5D100 laser sensor detects the presence of the part carrier.

In addition, an IO-Link DV2510 light tower clearly indicates the machine and alarm state.

■ Vibration analysis

Four VSA001 acceleration sensors in combination with the VSE002 diagnostic electronics monitor the rotating elements of the cleaning machine for wear and malfunctions. These include the wash pump, the rotary engine of the mechanical ramp, the fan for the extraction of vapours and the servo motor. Early detection of imminent mechanical damage to the bearings enables condition-based maintenance. Unplanned failures are reliably avoided.



The airflow used for drying
is measured using the SD2000.



 **IO-Link**

■ Head start with IO-Link

Today IO-Link sensors offer completely new options. For example, additional sensor data is generated to achieve maximum efficiency and cost savings. This allows process transparency from the machine to ERP to optimise your existing automation. Furthermore IO-Link has a lot more to offer:

“ We need a good service and good support. We receive this support from ifm. ”

The entire measured value transmission is digital. Transmission that is prone to errors and conversion of analogue signals is replaced. The digitally transmitted measured values can be directly displayed in the control room.

IO-Link data transfer is based on a 24 V signal and is therefore extremely insensitive to external influence. IO-Link sensors are connected with standard M12 connectors. Screened cables and associated grounding are no longer necessary.

The IO-Link master saves all parameters of the connected sensors. After replacement the previous parameters are automatically written to the new sensor. It is no longer necessary to look up the required sensor settings.

IO-Link ensures unambiguous device identification. Sensors with IO-Link capability are clearly identified by vendor and device ID. Exclusive use of original spares is ensured.

The standardised parameter setting allows locking of the operating keys on the device. This rules out any chance of values being incorrectly set. Documentation of the parameters is possible at any time.

With IO-Link, the transfer of process and service data takes place simultaneously. Wire-break or short-circuit is immediately detected by the master. The diagnostic data can be accessed even during operation.

No additional analogue cards are required for the controller. Space is saved in the control cabinet since the IO-Link I/O modules rated IP 67 are located outside the cabinet.

Mecanolav relies on the AL1102 IO-Link masters with Profinet and eight ports and the AL2330 IO-Link I/O modules from ifm.



The SD9000 from ifm monitors flow and temperature of the cleaning liquid.



All sensors and actuators communicate with the controller via IO-Link modules.

“ ifm offers Mecanolav a complete solution ranging from intelligent sensors to the collection of data that is made available via the Smartobserver.

■ Production data acquisition with the Smartobserver

The ifm software Smartobserver is used to monitor and analyse all sensor data.

Michel Astier, Sales Manager for the automotive industry: „*ifm offers Mecanolav a complete solution ranging from intelligent sensors to the collection of data that is made available via the Smartobserver. The Smartobserver is used to visualise all sensors and actuators on the machine, which makes maintenance a lot easier. Moreover, we can visualise this data anywhere around the globe using a web browser, no matter where the machine is actually located.*“

The Smartobserver also offers the corresponding tools for condition-based maintenance, in this case vibration monitoring.

■ Conclusion

Digital communication down to the sensor level in combination with powerful software for analysis and visualisation forms the basis for the digital factory and Industry 4.0. Mecanolav has followed this path successfully with the support of automation specialist ifm.

Mecanolav Managing Director **Matthieu Vollois**: „*ifm is not only a very innovative, but also a very reliable company, which is particularly important to us. With ifm we not only have support in France, but also in the whole world. We need a good service and good support. We receive this support from ifm.*“

ifm – close to you!

How Champagne automatically becomes a quality product



The robot's 3D sensors allow for independent work in the vineyards

Before the exquisite grapes are harvested and used to produce a fine Champagne, the vines need to be cared for over the course of several months. An autonomously driving robot relieves the winemakers of this work. Eight electronic "eyes" in form of 3D cameras ensure an autonomous navigation through the vineyards.

The young company Vitibot in Champagne (France) makes self-driving robots to work in vineyards.

A vineyard somewhere in the Champagne region in France: as if by magic, the four-wheeled robot rolls along the rows of vines systematically, makes a turn at the end of each line and starts working on the next row.

"Bakus" is the name of this autonomously driving vehicle, developed and manufactured by the relatively young company Vitibot in the French city of Reims. Founder Cédric Bache is not only an engineer, but also the son of a winemaker. Thus he precisely knows the challenges which modern viticulture must face. Enough reason for him to found the company Vitibot in 2016.

The goal: coming up with solutions together with a team of 50 people to automatise most of the work in the vineyards. The result after two years of development is now the autonomously driving robot "Bakus", ready for series production.

It is a moving "Tooling platform".

After two years of development and tests, the first autonomously driving robots are now ready for series production.





*Automatised working on the vineyard:
the "Bakus" of the French company Vitibot.*

Jocelyn Vermillet, Senior Manager for mechanics at Vitibot: "The machine meets the requirements of our customers, the winemakers, who want to automatise all tasks in the vineyard. We produce everything ourselves, from body to chassis, drive, controller on to machining tools. With this stand-alone solution, the winemaker can act a lot more flexibly and can take care of tasks automatically (which used to be carried out by hand and be very time-consuming) during the day as well as by night."

Various tools are attached to the vehicle which take care of different tasks on the field like loosening earth, cutting leaves and weeds and spraying the plants.

"Bakus is capable of precisely spraying the plants at the right spot with exactly the right dose. We can thereby cut the amount of pesticides by half. This does not only save money but also preserves the environment," says Jocelyn Vermillet.

*For various types of work,
tools can be mounted below the vehicle.
Here: hooks for loosening the ground.*

“We wanted a solution that would work reliably by day and night. That is why we decided for the 3D cameras from ifm.



In cooperation with ifm we found a solution that meets our needs.

■ Powerful performance

The electrically powered robot takes its energy from batteries with a capacity of 80 kWh. This enables 10 hours of autonomous work, before the battery needs to be charged again for two hours. Its all-wheel drive and the four big, individually driven and steered wheels provide for maximum agility even on rough terrain, while at the same time they enable turning manoeuvres where space is restricted. Even steep slopes with a 45 % gradient pose no problem to the Bakus.

Cédric Bache is the founder and Managing Director of Vitibot: *"This machine is special in the way that it's not just electrically powered, but also drives completely autonomously. It is placed by the winemaker at a corner of the vineyard and runs through the entire field on its own. Bakus follows the vine rows and as soon as it reaches the end, it lifts its tools and starts working on the next row."*

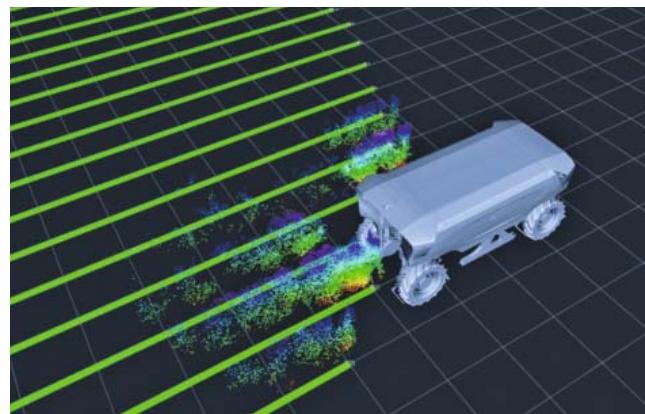
■ Autonomous navigation

What makes Bakus unique is its autonomous navigation and obstacle detection. The vehicle is equipped with eight precise 3D cameras from ifm: two cameras at the front, back and on the sides.

Cédric Bache explains, *"The 3D cameras use time of flight technology and can capture the surroundings in three dimensions. With the software developed by ourselves we can depict the surroundings around the vehicle via the transferred image data. The software offers two functions: on the one hand, it enables an autonomous navigation through the rows of the vines and on the other hand, we can detect obstacles and stop the vehicle in time. In order to navigate our machine safely, we need sensors that can "see" by day and by night. We have experimented with LIDAR-based systems, but they came with a lot of restrictions. Other solutions were too expensive to bring on the market. We have also tested solutions on the basis of standard cameras. However, this also proved to have difficulties: during the day with too much brightness, during the night with too little light. We wanted a solution that would work reliably by day and night. That is why we decided for the 3D cameras from ifm. Their image sensor transmits a clear 3D image of the surroundings no matter what the light conditions are."*



Autonomous turning manoeuvre: thanks to several 3D cameras potential obstacles are avoided and the Vitibot can drive through the rows with the vines perfectly centred below the vehicle.



The software puts the point cloud images from the eight cameras together into a three dimensional image of the environment. This serves the robot to navigate autonomously through the fields.



*The "eyes" of the robot:
PMD cameras from ifm generate a 3D image of their
surroundings thanks to time of flight technology.*

■ The 3D camera from ifm

The core element of this system is the 3D camera chip from the automation specialist ifm. It creates a 3D image using PMD technology (= photonic mixer device). The resolution of the PMD image sensor is 176 by 132 pixels. For each of the 23,232 pixels the camera supplies a precise distance value – up to 25 times per second. Compared to laser scanners, the ifm 3D camera does not need moveable parts. Therefore, it is especially robust, small, light and cost effective.

With the PMD technology used, the image sensor can work without being influenced by ambient light. Advantage: despite direct sunlight or complete darkness, the camera generates its 3D image.

■ 3D image evaluated by software

Centrepiece of the Bakus is without doubt the evaluation algorithm, which generates a 360° 3D scenery out of the eight 3D camera images.

Damien Legrand, Product Manager 3D Vision at ifm: “Every camera generates a three dimensional point cloud of the scenery in its vision. Complex algorithms create a virtual image of the scenery out of these point clouds, which depicts the direct surroundings around the vehicle,

for instance vines or other objects. This image is then used for the autonomous navigation of the vehicle between the rows of vines and the turning manoeuvre at the end of each row.”

Vitibot Managing Director **Cédric Bache** adds, “It was a real challenge to put the 3D images together. In cooperation with ifm we found a solution that meets our needs.”

■ Conclusion

Autonomous vehicles in viticulture do not only relieve the winemakers of work, they also ensure highest product quality with minimal use of resources, e.g. when it comes to spraying the plants. Additionally, the winemaker can let the vehicle run independently at night without needing a supervising worker. As a result, the winemaker can make a large financial profit by using a robot like this, as he lowers the operating costs for most of the mechanical work on a vine by three quarters.

ifm is contributing by providing 3D cameras, which are essentially the “sensory organs” of the robot. By the way, the close cooperation with the customer is reflected in the ifm slogan “close to you”.

Robust PLC for field applications

The Danish company Agrometer produces pump vehicles used for spreading liquids and substances on agricultural land. The units are controlled by a powerful mobile controller from ifm.



Agrometer was founded in Grindsted in 1977 and is a global supplier for business divisions such as agriculture, the public sector, industry and shipyards.



Many farmers use the slurry produced by their animals as a fertiliser for crop production. However, the average slurry vehicle with slurry tank is at best suitable for small fields.

The Danish company Agrometer headquartered in Grindsted develops solutions that allow quick, cost-effective and soil-friendly spreading of natural fertilisers even on large fields. A hose is used to transport the slurry from a central location to the fields. For this purpose, special vehicles are equipped with a huge hose reel. The electro-hydraulically powered reel unwinds and rewinds the hose as needed while driving across the field. When changing the direction, for example at the end of the field, a guide arm positions the hose in an even radius.



The umbilical injector SRS 1500 is pulled over the field by a tractor to spread slurry.

The performance is remarkable: Up to 200 tons of slurry can be spread per hour. The advantage: As no slurry tank is required on the vehicle, the vehicle weight is reduced. This reduces the soil pressure to a value lower than a footprint. The low self-weight means the farmers can enter their fields early in the year when the soil is still soft. The fertiliser is pumped directly to the machine via pipes and hoses, removing smell issues from the roads. Agrometer builds these slurry spreaders as independent vehicles with a spreading width of up to 30 metres or as trailers for tractors called umbilical injectors.

■ Central PLC for machine control

Both variants combined: The important functions, such as the coiling of the hose, are controlled automatically by a central PLC. A large number of sensors is used to monitor the movement of the hose guide arm and other positioning tasks, which are signalled to the controller via decentralised IO modules. Sensors also monitor the pressure in the slurry pipes or temperature values.

“ So we scoured the market for technologies that could withstand the harsh requirements of mobile applications. We came across ifm.

The self-propelled slurry spreader SDS 8000 can spread up to 200 tons of slurry per hour via the hose.



Oluf Kristensen, Technical Manager at Agrometer, explains, “For our machines, we use the new mobile controllers as well as decentralised IO modules from ifm. They simplify the wiring and maintenance of the machines, which can be set up faster. When developing the machines, we primarily work with the system integrator Pagaard. They supplied us with the complete ifm system and developed the software. Pagaard is also our service partner for error-handling.”

The system integrator Pagaard relies on ifm's “ecomat-Controller”, which is specifically designed for use in mobile machines.

“ For our machines, we use the new mobile controllers as well as decentralised I/O modules from ifm.



Robust decentralised I/O modules receive sensor signals and transmit them to the PLC via CAN bus.



ifm's ecomatController for mobile applications (bottom right) is mounted in the control cabinet outside the vehicle.

Pagaard's Managing Director and co-owner Torben Lund explains the decision to use ifm, "Initially, we were using an industrial PLC at Agrometer. But we soon realised that the durability of industrial products used on mobile machines is a huge challenge, as they are not designed for such purposes. So we scoured the market for technologies that could withstand the harsh requirements of mobile applications. We came across ifm where we had already bought sensors. ifm offers a controller we believe is best suited for this task."

■ Designed for extreme operating conditions

For many decades, ifm has been one of the leading suppliers of robust control systems for mobile use, offering extensive application know-how in this field.

The "ecomat" series comprises PLCs, IO modules and sensors that can withstand the harsh environmental influences of mobile applications.

Slurry, water, permanent condensation or dirt are no problem for the ifm systems for mobile applications. The special mechanical design of the housing and a reliable sealing concept prevent the penetration of moisture. Suitable connectors and connection cables ensure that protection rating IP 69K does not end at the housing connections.

Extreme weather conditions with iciness or blazing heat: The wide temperature range of the control components from ifm allows use in all climatic zones. All sensors and controllers must prove their resistance in cyclical temperature shock tests. Resistant housing materials ensure that salt deposits, as they may be caused by grit in winter, do not affect the products.

Where the going gets tough, the material is exposed to permanent vibrations or extreme impact. This is why the sensors for mobile applications are fully potted. Connectors are protected against unintended loosening by a special vibration protection. The mechanical design of controllers and modules is especially rated for permanent shock and vibration.

The complex electronics is protected against electromagnetic interference as detailed EMC tests have shown. Conducted interference is reliably filtered out and cannot affect the controllers. This ensures that the data exchange via the CAN interfaces functions reliably even under most adverse conditions such as in outdoor applications of transport and logistics.

Pagaard Software Engineer Michael Lindbjerg explains, "The voltage of a mobile machine fluctuates strongly. An industrial PLC is not designed for this. A PLC for mobile applications is better suited as it operates with a wide voltage range between 8 and 32 volts."



The yellow guide arm places the supply hose of up to several hundred metres in length on the field in the form of curves, ensuring that the hose is coiled correctly on the drum.

In addition, all ecomat components have an e1 type approval by the German Federal Motor Transport Authority. This allows installation of the units on vehicles without invalidating their operating permit. Beyond the required EMC limit value of the e1 type approval all units have an extended EMC resistance of 100 V/m and withstand pulses from the on-board vehicle supply system without problems.

■ Powerful controller

The ecomatController CR721S used at Agrometer consists of two internal PLC units, one of them certified for safety-related applications up to EN 13849 PL d and EN 62061 SIL cl2. The advantage of this double PLC: Two internal, independently programmable controllers allow for subdivision of the application software if required. Consequently, the safe program part can be executed without interference from the general program execution. Powerful 32-bit multi-core processors ensure fast program execution even with complex control tasks.

The ecomatController CR721S features 68 multifunctional inputs and outputs.

Pagaard Software Engineer Michael Lindbjerg explains the benefits, "All inputs can be configured as digital, analogue or frequency inputs. We used to have problems with the monitoring of our outputs, which

were purely digital in the industry, but the ifm controllers have PWM outputs. This is an important feature in the mobile world, for example for controlling hydraulic valves with pulse-width modulated outputs."

In mobile machines and equipment most functions are carried out by hydraulic systems. Electronic valve and pump control has become a standard in modern machines. ifm's ecomatmobile system provides current-controlled PWM outputs and optimised control functions for the power outputs. This leads to a manufacturer-independent interface between hydraulics and electronics.

■ Conclusion

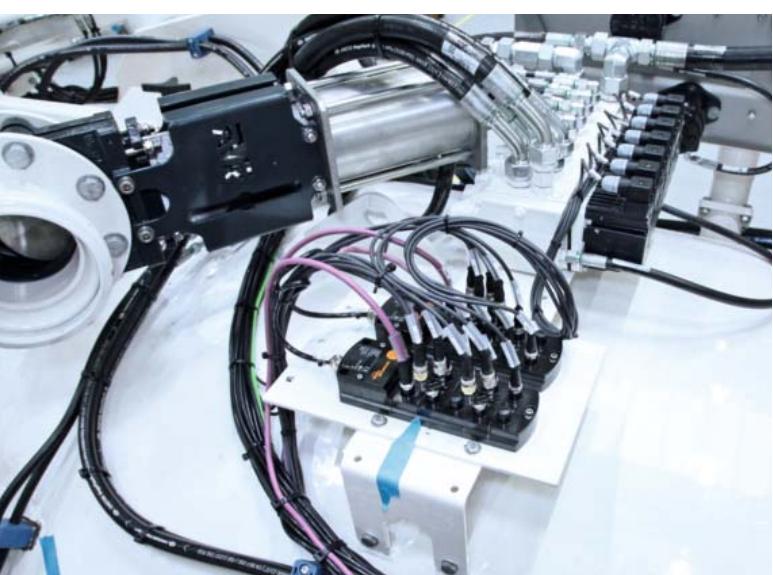
The mobile controllers from ifm ensure ultimate reliability and a powerful performance even in challenging operating conditions. Thanks to their versatile connectivity and functions, they offer maximum flexibility. With this robust PLC, ifm guarantees the quality that is indispensable for harsh mobile applications. ifm – close to you!

A powerful controller for automated pipe cleaning



Automation technology for municipal vehicles

Sensors and control components used in municipal vehicles must meet the highest of demands: Their components are exposed to extreme temperatures, humidity, dust, dirt and vibrations. With the "ecomatmobile" series, ifm offers automation components for these harsh environmental conditions. The company Bucher Municipal uses the ecomatmobile products for its sewer cleaning vehicles.



Decentralised CAN I/O modules outside the vehicle connect the sensors and actuators to the controller.

Bucher Municipal is a global supplier of special vehicles such as refuse collection vehicles, sweepers and winter maintenance equipment. In the Danish city of Silkeborg, at the Competence Center Special Vehicles (CCSV), among others the company manufactures sewer cleaning vehicles.

Brian Munk Andersen, Technology Director at Bucher Municipal in Denmark, explains the structure and function of this vehicle type, "*Sewer cleaning units from Bucher Municipal feature two pump systems. The jetting pump cleans sewers and tanks. With the vacuum pump, we can suck sludge and industrial waste into the tank mounted on the vehicle.*"

With two ifm control units for mobile applications installed outside the vehicle, the vehicle operator can perform a variety of work steps: rotate the boom, unwind and rewind the hose, switch the pumps or empty the sewage water tank. The displays of the dialogue modules show the relevant system parameters and process values and



A sewer cleaning vehicle with the uncoiled jetting and suction pump for sewer cleaning.

Bucher Municipal is a division of **Bucher Industries AG**, a global leading technology group in special fields of mechanical and vehicle engineering.

assist the user in performing the work steps. A control unit inside the vehicle – also supplied by ifm – ensures that the individual processes run smoothly.

"The intelligent control of our sewer cleaning vehicles ensures efficient processes and enables maximum focus on the task, guaranteeing the highest possible added value for our end users," says Andersen.

■ ifm as a partner

For several years now, the automation specialist ifm has been supporting Bucher Municipal as a partner for sensor components and control technology.

Brian Munk Andersen: *"At Bucher Municipal, we have a constant focus on innovation and development. That's why we use automated and intelligent solutions. When we entered into a cooperation with ifm in 2016, we were looking for a reliable supplier of control solutions. ifm offers a wide range of components for our*

product – from sensors to displays and IO systems to controllers. Throughout the development phase, we worked closely with ifm to develop a solution and choose the ideal products. Our vehicles have to operate reliably in very varied conditions such as cold, heat, dust and dirt. This places particularly high demands on the components. Together with ifm, we have created a good and reliable solution with many automated features that offers the operator high quality and safety standards when our machines are on the road."

■ The central components in detail

The core element of the system is the ecomatController CR711S, an extremely robust PLC for mobile applications. What makes it so special is that it has two independent internal PLCs – one of them a certified safety controller. Powerful integrated multi-core processors allow even complex control functions to be processed

**“ Together with ifm,
we have created a good
and reliable solution with
many automated features.**



The BasicDisplay CR0451 indicates the most important parameters on the control panel.

quickly. The application programs can be divided between the two internal PLCs if necessary. Consequently, the safe program part can be executed without interference from the general program execution. This ensures reliable operation even with complex control functions. The controller can be used in safety-related applications up to ISO 13849 PL d and IEC 62061 SIL CL 2.

In addition to its many multifunctional inputs and outputs with diagnostic capabilities, the ecomatController features two Ethernet ports and four CAN interfaces. The CAN interfaces support all important bus protocols (CANopen, CANopen Safety and J1939) as well as the transparent and preprocessed data exchange.

The control functions are easily integrated into the application program thanks to CODESYS programming (version 3.5).

At Bucher, the controller is additionally connected to a GSM radio module.

Brian Munk Andersen: “In many cases, our remote connection allows us to solve issues while the vehicle is still on the road. This saves our customers a lot of time. Only in cases where remote troubleshooting is not possible the municipal vehicle needs to be checked at one of our many service centres.”

The core element at the top right of the control cabinet:
the powerful ecomatController CR711S with two integrated
PLCs (1x standard, 1x safety).





■ I/O modules

Various sensors and actuators are installed on the sewer cleaning vehicle to monitor and control the different work steps and process values. Using decentralised I/O modules, they communicate with the controller via CAN bus.

Brian Munk Andersen explains the benefit: "With CAN units installed at different positions on the truck, we reduce wiring and also achieve greater reliability and an easier operation of the equipment."

The type CR2032 control modules each have 16 ports that can be configured multifunctionally, for example as digital inputs or outputs or as PWM outputs for controlling proportional valves. A controller integrated in the modules enables decentralised evaluation of the sensor signals in advance.

This pre-filtering of the data not only reduces the data flow on the CAN bus to the controller, but also simplifies the application program on the PLC.

The robust metal housing is designed specifically for the harsh outdoor use of mobile machines and offers protection rating IP 67 for high ingress resistance of the connectors.

■ Dialogue modules

A range of displays for mobile applications are mounted outside the vehicle as human-machine interfaces.

Brian Munk Andersen: "On the large display in the main cabinet, the operator can control the entire system and make the basic settings. After this, the system can be operated via the remote control or the operating panels."

Dialogue modules are programmable graphic displays for controlling, parameter setting and operation of mobile machines and installations. They can be used in conjunction with a mobile controller or as a stand-alone solution. Data and device functions are safely transferred via CAN interfaces. The displays feature many freely programmable backlit function keys. The units offer increased EMC levels and an e1 type approval for operation on public roads. Thanks to the high protection rating of the housing, the modules are suited for outside panel and surface mounting as well as for cabin installation. Just like the other ifm components for mobile applications, the displays are vibration resistant and have protection rating IP 67.

■ Conclusion

ifm offers a comprehensive portfolio of products for efficient and reliable automation of functional units on municipal vehicles.

Brian Munk Andersen concludes: "With ifm's solution, we can create a highly automated system that offers us superior reliability and makes the lives of those operating our equipment a lot easier."

ifm – close to you!

Thoughts outside the box]

HeiVi AG, located in Switzerland, is specialised in the planning and project management of heating and air conditioning systems.

Cold storage management by means of “zero volumetric flow” control.

To lower costs and energy consumption, the efficient operation of building maintenance systems is becoming more and more important. This means more than just optimum setting of operating times and temperatures. The building maintenance systems are always to be considered in their entirety. Coordination between the different systems is compulsory.

In the course of the reconstruction of the branch of the Schweizerische Nationalbank in Basel, the entire building maintenance systems were redesigned. The Swiss HeiVi AG was responsible for the planning and project management of the heating and air conditioning systems. The purpose was to reduce the energy consumption, the investment costs and the interfaces and to sustainably optimise the building maintenance.





The magnetic-inductive flow meter SM6500 features high accuracy, repeatability and measurement dynamics.

Peter Heimann, co-founder of HeiVi AG, states: "As planners of demanding heating, ventilation, air-conditioning and cooling systems as well as sanitation facilities, we support architects, building owners and project developers with the implementation of new installations and optimisation processes. Since our target is to obtain maximum energy efficiency and economic efficiency with comfort and ease for our customers, we represent innovative planning in the field of building automation. To achieve this, we often have to think outside the box."

■ Home-made wastefulness

Figure 1 shows the conventional operating principle of the chiller with a performance-controlled compressor. The chiller compressor (M01) controls the temperature of the cold water outlet (B01). The storage charging pump (M02) supplies a constant quantity of water via the cold storage. Two probes in the storage control switch-on and switch-off of the chiller. A storage discharge pump (M03) then supplies the cold water to the consumers.

Since the storage discharge pump (M03) is controlled via the differential pressure of the consumers, the pump only transports the water quantity which the system actually

requires. The result: In turndown operation, the charge mass flow is always much higher than the discharge mass flow. Due to the constant mass flow supplying the chiller, the compressor reduces its capacity only in the discharge operation. Fact is that the advantages of the performance-controlled compressor cannot be used.

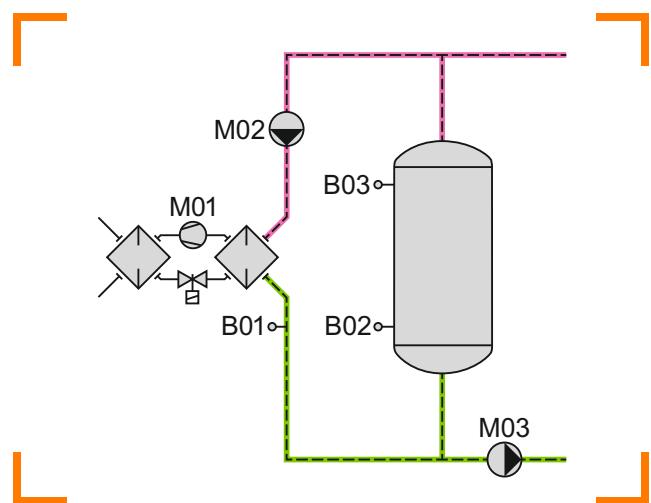


Figure 1:
Conventional model, storage tank charging without ifm sensors

**“Always on board:
 the sensors from ifm.**

■ “Thinking outside the box”

“We have asked ourselves”, says Heimann, “if the storage charging pump and thus also the compressor can be controlled according to the demand to optimise the process.” This is a case of “thinking outside the box”. “During this process we came across the modules from ifm”, continues Heimann.

By means of the ifm volumetric flow sensors of type SM6500, the cold storage is controlled to “zero volumetric flow”. The storage charging pump (M02) controls the difference between storage charge mass flow (G01) and storage discharge mass flow (G02). The storage charge mass flow should, however, be five to ten percent higher than the storage discharge mass flow. In addition, it has to be ensured that the mass flow of the chiller does not drop below the minimum level.

With the “zero volumetric flow” control by means of ifm flow meters, there are numerous advantages. The compressor works in the turndown operation and the performance control of the compressor is fully used. That means lower energy consumption. The energy consumption is minimised by high inlet temperatures in the chiller. Consequently, the chiller can be of smaller dimensions which reduces investment costs. There is additional savings potential because the storage charging pump (M02) in the model (see Figure 2) consumes less energy.

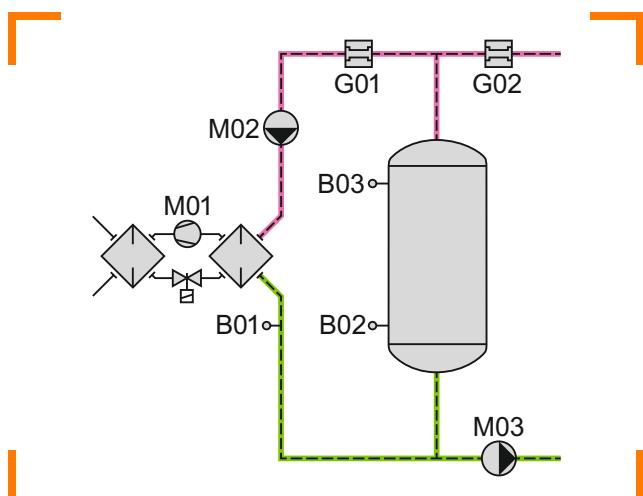


Figure 2: Model storage charging with ifm sensors.

■ No thermometer needed

Besides the SM6500 flow meters, the branch in Gundelfingen also uses the TD2237 temperature sensors from ifm. As compared to conventional temperature sensors, they feature a digital temperature display. Therefore an additional thermometer is no longer needed. Apart from the fact that the ifm sensors measure quickly and precisely, their digital display facilitates set-up and operation optimisation. Faults in the circuit can be detected at once and be immediately eliminated.



The TD2237 temperature transmitter is distinguished by its short response time and its display.

■ Conclusion

Success confirms Heimann: By now, HeiVi AG have equipped several branches of the Basel Kantonalbank, Cler Bank in St. Gallen and the laboratory of the Baugewerbliche Berufsschule at Zurich with the new process. Always on board: the sensors from ifm.



For optimum temperatures in your processes



Modular or all-in-one

Only an exact process temperature ensures consistent product quality. That is why we recommend temperature sensors from ifm; our solutions stand out due to their high accuracy, fast response time, clear red/green display, easy 3-button handling and large temperature ranges.

Whether as a display and evaluation unit (type TR) for external Pt sensors or as an all-in-one system (type TN) with integrated measuring probe and different process connections: We ensure reliability in your application. ifm – close to you!

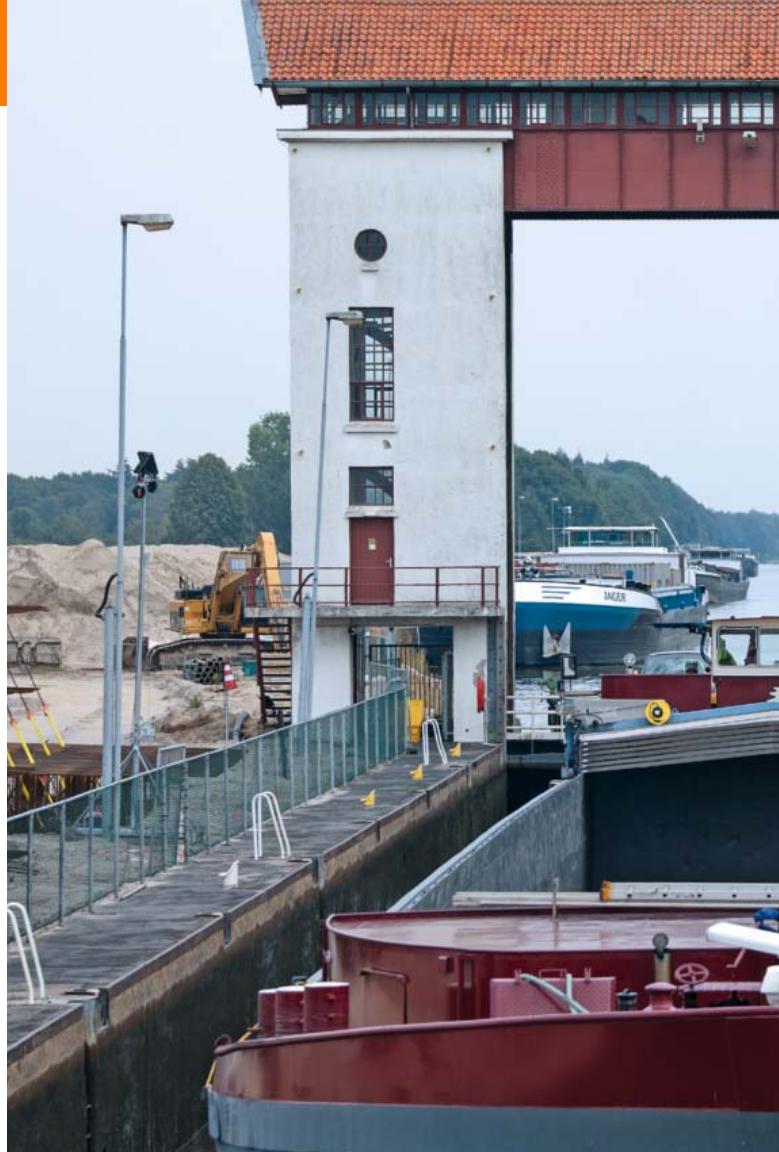


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Smart lock



The lock in Eefde, Netherlands, was built in 1933 and assumes an important function in the region. It is the entrance from the IJssel to the Twente Canal.



Predictable maintenance

Numerous world-wide acting companies aim for World Class Maintenance. The high standards in all corporate sectors lead to an improvement of all processes. These guidelines are also followed for the waterway infrastructure in the Netherlands.

There is a big demand for innovations for maintenance and infrastructure management. In the Fieldlab project "CAMINO", different parties are working together to develop applications to make maintenance of the water infrastructure 100 % predictable using sensors and data analysis. In the context of this project, the Dutch ministry "Rijkwaterstaat" and the project partner Mobilis TBI have initiated a pilot project in the lock complex in Eefde, to test and apply new or innovative technologies to get more insight into the condition of the lock itself, including its close environment. The purpose is to make maintenance of infrastructure works 100 % predictable.



The lock in Eefde (Netherlands) was built in 1933 and is now extended by another lock chamber.



Conventional solutions such as corrective and preventive maintenance activities are no longer sufficient. The challenge is just-in-time maintenance: just in time to prevent that something goes wrong, but not too early so that costs are reduced. This requires a smart approach: intelligent maintenance, for which new developments such as the use of sensor systems, data prediction models, big data and the Internet of Things (IoT) are used. ifm as provider of real-time maintenance solutions is one of the project partners.

All participants contribute with their know-how and experience in the fields of maintenance, monitoring and administration of water systems and structures, measurement and analysis techniques as well as data architecture and storage.

■ Example: Lock in Eefde

The purpose of the project in Eefde is to develop a "smart lock" which automatically indicates the actual condition, analyses it by means of algorithms and automatically suggests improvements of the construction or the required maintenance.

Ruben Ogink, Fieldlab CAMINO Project Manager, World Class Maintenance comments: "*Sluis Eefde is a special project, during which, in my opinion, certainly many partners can learn. Special about this project in the context of Fieldlab CAMINO is not that there are many new technologies which are not used anywhere else, but rather the fact that existing technologies are integrated at one location. The partners can learn a lot from the application, but certainly also from the cooperation. The positive development of this project at the moment is already the fact that different partners from different disciplines such as government, commercial enterprises as well as scientific institutions such as a university work together. So there is investment for everyone to develop their own solutions. ifm is playing an important role in this project because they contribute a lot of knowledge of sensors, applications of these sensors in other industries and a lot of experience which can also be used in this context. And I am very happy with it.*"

**“ ifm’s involvement in this project
is very important for us, as they contribute
a lot of know-how and experience**

■ Avoid failure

The lock in Eefde assumes an important function in the region. It is the entrance from the IJssel to the Twente Canal. Many companies rely on the canal for transport. An unplanned interruption of the lock would cause considerable problems.

The lock was built in 1933. Rijkswaterstaat (the government authority responsible for the infrastructure) wants to have a better control of the maintenance of vital plants.

Angelien van Boxtel, Project Manager Rijkswaterstaat Netherlands, explains: „We try to plan the maintenance of the lock as precisely as possible, so that shipping can prepare for it. In the event of sudden failures or unpredicted maintenance this would not be possible.“

■ Permanent condition monitoring

To ensure smooth operation to open and close the lock and to avoid unplanned downtime, a condition-based maintenance solution was installed. In this respect, project partner ifm has installed a vibration diagnostic unit at the motors and gears of the lock gates. Imminent damage to the bearings leads to changed vibration characteristics. The sensors detect it and signal when threshold values have been reached. So the replacement of the components can be planned and made before a defect causes a sudden standstill.

Ruud Schoenmakers, Asset Manager Mobilis TBI, Netherlands explains: “100 % predictability, that's what we want. This means that preventive or corrective maintenance is a matter of the past. We measure all data, to optimally plan and implement the required maintenance works. We call predictive maintenance when we



Two vibration sensors each, installed slightly shifted, permanently monitor the condition of the rotating bearings.



The VSE-type electronics for vibration evaluation, an ifm synchronisation monitor and the radio gateway to transfer the data to the control station, are installed in a space-saving control cabinet.



measure data, collect data and get information from it to carry out maintenance at the right point of time. The right point of time is determined by a series of predictive and fixed, measurable factors such as the performance of objects, components and systems, failure characteristics, degradation behaviour, but also factors such as weather conditions, water levels and availability of staff as well as operating hours of the locks. On the basis of these measurable and objective factors, we can choose the optimum point of time for the maintenance to avoid unpleasant surprises."

Before, there used to be regular maintenance. But this was expensive and could not completely minimise the risk of unplanned downtime. In addition, components the wear margin of which had not been completely used up yet, were replaced in case of doubt. That again caused unnecessarily high costs. With predictive maintenance, costs are minimised and operational reliability is maximised.

■ No intervention in the existing plant

It was important to the operator to leave the historic lock complex unaffected. Therefore ifm has installed the solution without interfering with the plant or affecting operation in any way. Vibration diagnostics is, so to speak, "slipped over" the plant as an autonomous system.

Ruben Boom, Project Manager Smart Industry, ifm Netherlands, states: "We have placed the sensors with solenoid on the housings of motors and gears instead of screwing them there via a thread to be bored. Because it was important to the customer not to make any changes to the existing machine. One of ifm's strengths is that we

The power train to lift and lower the heavy lock gates. The condition of motors, shafts and gears is permanently monitored by means of vibration diagnostics.

can comply with such special requests of our customers due to our experience and know-how of many years."

Besides the vibration, the temperature of the plant and the humidity are determined by means of sensors and included in the condition assessment. The measured values and the alarms are transferred to the control station via the radio gateway where the data is evaluated and analysed. Moreover, the ifm DS2505 synchronous monitor monitors the left and right chain hoist at the lock gate.

■ Conclusion

Vibration monitoring is only one small module in World Class Maintenance. However, on the basis of the acquired data it helps to better understand the processes, to optimise them and to use these findings for other projects in the future so that the water infrastructure becomes 100 % predictable and failures are avoided.

Ruud Schoenmakers: "At this moment, TBI is building a new lock, in addition to the maintenance of the existing lock. We can use the things that we learn here, for the design and implementation of the new lock. Therefore, the findings we make here on the technical level have a great impact on new objects but also on the renovation task which comes from Rijkswaterstaat."

This project of a "smart lock" shows how all partners benefit from each other and bring forward their own know-how.

On a perfect level



Pressure sensors for aseptic level measurement.

The hydrostatic level detection in tanks is not new. Use in a hygienically demanding environment or even for aseptic processing of viscous media is particularly challenging. The pressure sensors from ifm provide exact measured values even under these adverse conditions. They are a clever alternative to commonly used rod probes or float ball technology.

We are visiting a specialist in the field of aseptic process technology in Kirchberg, Switzerland. In the 80s, they started to build filling stations for dairies, beverages and food mainly for their own needs, but also for OEMs (original equipment manufacturer).

Since April 2012, the company has been part of an international group which is one of the biggest system providers for the food-processing industry with 19,000 employees and an annual turnover of about EUR 5 billion. Together with the parent company, the entire product range in the field of valve technology is covered.

■ Leading specialist in aseptic technology

Aseptic process technology is a field in which absolute precision and reliability are imperative. Highly-sensitive products such as baby food, dairy produce or clinical products are processed using aseptic valves. For this reason, the high quality of the systems and components is very important. *"Right from the start, we specialised on the aseptic process technology and have developed products suited for exactly this area with its special requirements,"* emphasises the managing director of the company.

PI27

**“ Since we started using ifm sensors,
we have not experienced
any production losses any more ”**



A pressure sensor on the tank bottom measures the hydrostatic pressure. Based on this, the precise level can be determined.

“Owing to the very special requirements, we constantly have to develop special solutions which we use for further development.”

■ From the valve to the system solution

The company mainly develops and produces aseptic valves for process systems which are used above all in the food industry. The valves are used, for example, in ultra-heat treatment of milk and other dairy produce. According to the managing directors, the solutions are distinguished by functionality, long-life quality and user-friendly operation.

Moreover, the company also provides system solutions in the field of aseptic filling systems, for example for fully aseptic filling of intermediate bulk containers with a capacity of up to 1,000 litres.

■ Alternative to the rod probe

Extraordinarily high demands on function, design and characteristics apply to components which are used in sterile or aseptic processes. When it comes to the subject of level measurement in containers for filling systems,

specialists often criticise that the frequently used level measurement by means of rod probes or float ball technology is not reliable enough, susceptible to failure and cleaning of such systems is often only possible with complex, highly-hygienic processes. They were looking for a solution providing significantly better values with respect to measurement accuracy, hygiene and reliability. This solution was found with the PI27-type pressure sensor from ifm.

■ Pressure sensor for hygienic areas

It is a full-metal pressure sensor with display. The measuring cell is installed flush without dead space. Deposits are prevented and optimum cleaning is possible.

It consists of high-purity ceramics (99.9 % Al₂O₃). The other materials in contact with the medium are PTFE and stainless steel 1.4435/316L. Together with the surface characteristics of RA < 0.4 / RZ4, the sensor meets all requirements for aseptic applications.

Thanks to the high protection rating IP 68/69K, the hygienic design and the high temperature resistance, the sensor is also resistant to high-pressure cleaning with



Pressure sensors of the PI27 series have a robust stainless steel housing and are resistant to high-pressure cleaning with aggressive cleaning agents.

aggressive cleaning agents common in the food, beverage and pharmaceutical industries.

The parameters are set via the buttons on the sensor. The highly visible display, combined with a user-friendly interface, enables fast and easy set-up.

The units feature two switching outputs which can be programmed as normally open or normally closed. To provide the measured value, one switching output can also be configured as a scalable analogue output.

Moreover, the sensor has an IO-Link interface. It permits external parameter setting or digital measured value transfer. Sensor diagnostics via IO-Link is also possible. This provides additional reliability in application monitoring.

The G1 Aseptoflex Vario process connection with four sealing options and, if required, different adapters, is used for the connection to the process.

“We do not use any rod probes any more”

used. “When the system has to be refilled and cleaned, you have to account for a loss of time of at least four hours. That means a production loss of half a day. Since we use ifm sensors, we have not had these problems any more”, adds the **managing director**.

In addition, the considerably lower investment sum for an ifm pressure sensor as compared to common rod probes, the five-year warranty and ready-to-work functionality of the modules is emphasised.

“We do not use any rod probes any more”, he concludes at the end of the visit.



The high-purity ceramic measuring cell is installed flush without dead space and meets the requirements for aseptic applications.



IO-Link

■ Maximum reliability

“In principle, it is a pressure measuring device”, reports the **managing director** of the company and he explains “but we measure very exact levels with it.”

Since the level has to be exactly maintained, the consequences would be very serious if measurement were not precise. It is important that there is neither overfill nor underfill which occur quite often when rod probes are



 **IO-Link**

IO-Link – we connect you!



More functions: Smart IO-Link sensors from ifm

IO-Link devices protect against tampering, transmit the measured value as a digital value, ensure easy replacement without parameterisation on site, and are available without surcharge. You see, there are many reasons for using IO-Link sensors.

ifm as the technology leader for IO-Link offers the highest number of smart sensors with IO-Link in the market. Take the right step into an innovative future and benefit from the many years of experience which have set benchmarks in functionality and service. ifm – your IO-Link system partner. ifm – close to you!



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Increased safety, lower cost

Intelligent driver assistance system for rear and loading areas.

Modern side loader vehicles are used for waste disposal in an increasing number of cities. Especially during reversing and without a banksman, the driver needs technical support to safeguard the rear and loading area. With the smart 3D sensor, ifm offers a system that not only avoids collisions in the rear area, but also ensures monitoring of the lateral loading area.

Usually, a small team is on the road for emptying waste bins: Besides the driver, other people are busy placing the bins near the kerb and later on manually hook them to the gripper at the rear of the vehicle. To lower costs, the waste disposal company in Paderborn relies on side loader vehicles. The difference to conventional refuse vehicles: The gripper is located at the side instead of at the rear. The vehicle operator manoeuvres the refuse collector parallel to the pavement towards the bin which was placed there before by the residents. The gripper grabs the bin automatically, lifts it until emptying and replaces it automatically on the pavement. Advantage: Instead of several people, only one person, namely the driver, is required which saves personnel and keeps the waste disposal cost for the municipality and the residents at a low level.

Abfallsorgungs- und Stadtreinigungsbetrieb Paderborn (ASP) (waste management and city cleaning) is operated by the City Council of Paderborn and has approx. 150 employees.



■ Collision avoidance

This one-man operation is challenging when reversing, however, for example in dead-end streets: If so far one of the colleagues could act as a banksman, the driver is now on his own. Also the process of lateral loading of containers carries risks, caused by pedestrians, cyclists or simply curious children who could access the hazardous area. Therefore a technical system was installed at the vehicles which is an alternative to the banksman and which is accepted as an alternative by the German Trade Association.

Dietmar Regener, Dr.-Ing., Deputy Operations Manager, ASP Paderborn: "The system can support our drivers during reversing, i.e. the driver is warned in time when somebody is approaching the vehicle. The big advantage of this system is that it does not only give warnings but that it even stops the vehicle if the driver does not react in time. Besides, the system offers another advantage: We do not only monitor the rear area but also the

“ The O3M system from ifm predicts collisions and, if needed, may actively intervene with driving ”



Safe collision avoidance:
The arm of the side loader stops automatically if a person enters the hazardous area.

process of loading containers. And the situation is the same as for reversing, namely that the vehicle monitors the area, warns the driver and, if the driver does not react in time, stops the emptying process of the container so that a dangerous situation does not occur.”

■ Smart 3D sensor for mobile applications from ifm

The O3M system from ifm predicts collisions and, if needed, may actively intervene with driving. The complete intelligence is integrated into the sensor housing and can be configured in a few steps via an easy-to-use operating software. So ifm offers a cost-optimised solution for more safety that can be used for different types of vehicles.

The core element of this system is an integrated 3D camera chip from the automation specialist ifm. It creates a 3D image by means of the PMD technology which provides an exact distance value for each image pixel.

This image information is evaluated by predefined algorithms in the smart 3D sensor.

On the basis of different parameters, the sensor can be set to different installation and operating situations. As soon as a collision is detected, the sensor provides the respective signals - optically as visualisation for the driver but also stop signals, for example to the vehicle controller.

■ Conclusion

The smart 3D sensor is a stand-alone assistance system which supports the driver by reliably preventing collisions.

Dietmar Regener, Dr.-Ing.: “We are now testing a system which has been in use for 3 months already. The first results are very good. Both we, the corporate management, and the drivers are convinced of the systems. The drivers say that it does not impair them in their work but, on the contrary, it supports them. Therefore we have now decided to buy another system for the second side loader and to use the system also for the other vehicles.”

ifm provides a cost-optimised solution which assures automated reliability and also decreases personnel costs.



Precise guidance

ifm ecomatic in Kressbronn, a subsidiary of the ifm group of companies, is specialised in the development, production and distribution of control and evaluation systems.

Sensors monitor the application of 2-component media.

The heat-conductive paste is exactly dosed to the millimetre and applied onto a PCB. The bonding agent is injected into the housing joint with the same precision, before it is glued while well-dosed pressure is applied. Different sensors ensure continuously high production quality.

The 2-component media in the mixer are monitored for temperature and level.



A production plant at ifm in Kressbronn. This is where the new ecomat controllers of the third generation are produced. These controllers for mobile use have to withstand strong stress under adverse environmental conditions, such as in mobile machines where they are exposed to vibrations and moisture. This means special requirements on the production process.

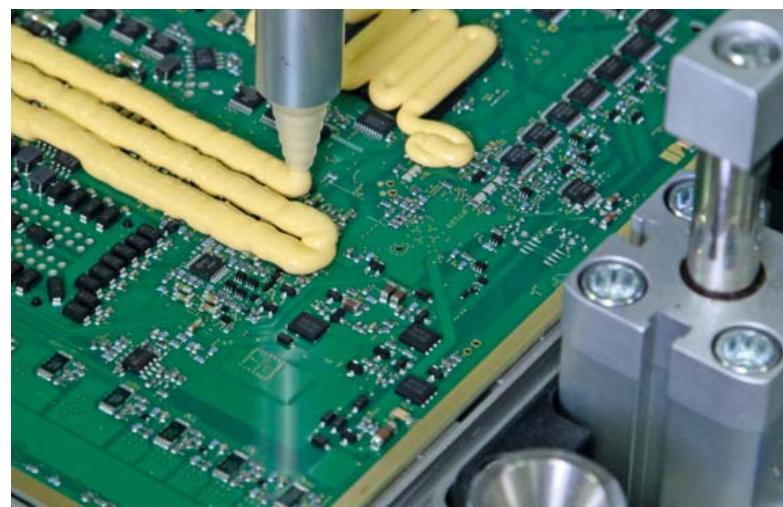
"We had to install a new production system so that we can manufacture the product", says Lothar Gschwind, Industrial Engineer at ifm ecomatic in Kressbronn.

The system comprises four production processes: During the gluing process, a 2-component glue is injected in the





groove along the housing rim and permanently bonds the two housing parts when they are pressed against each other. This ensures ingress resistance according to the protection rating IP 67. Then follows the joining process, which is also carried out automatically to avoid errors caused by manual production. In a third step, the heat-conductive paste is applied onto the PCB. A 2-component heat-conductive paste is precisely applied onto the heat-producing components of the PCB. It bonds with the aluminium die-cast housing which, in turn, dissipates the heat. Finally, the housing is screwed.



Application of the 2-component heat-conductive paste onto the PCB.

Cylinder sensors precisely monitor the end positions of the piston through the cylinder wall.

■ Three companies in cooperation

The specially developed system is the result of cooperation of three companies: The company Fichter Maschinenbau from Eichstetten am Kaiserstuhl has built the system. The company Viscotec from Töging am Inn has specialised on the supply of the 2-component media – here the glue and the heat-conductive paste. And ifm is not only the originator and operator of the system but also the manufacturer of the installed sensors.

Martin Baumann from Fichter Maschinen: "Here we have designed a machine for the company ifm which

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We have designed a machine for the company ifm which carries out various joining processes and two dosing processes for two 2-component materials.



In this system, heat-conductive paste and sealing compound are applied and the product passes through the final joining process.

carries out various joining processes and two dosing processes for two 2-component materials. The heat-conductive paste we use here is of very high viscosity and we had to try hard, in cooperation with the company Viscotec, to provide the dosing pumps with enough material.”

Rolf Aberle from Viscotec explains the special requirements this project has on his company: “We deal with the removal of the materials from the delivery container, the supply, and, if applicable, the treatment up to the dosing head. There is a container pumping system which fills the material from the container into the supply tank via a vacuum and then supplies the material, under controlled pressure, to the dosing head. During this process, level sensors are used for monitoring tasks. Imagine the 2-component glues as below: The two media are homogeneously mixed in a static mixer. The 2-component heat-conductive paste is supplied to the 2-component mixing head via two separate supply lines. The media are homogeneously mixed by means of a static mixing head and then applied onto the PCB.”



Different sensors monitor pressures, temperatures and positions on the system.

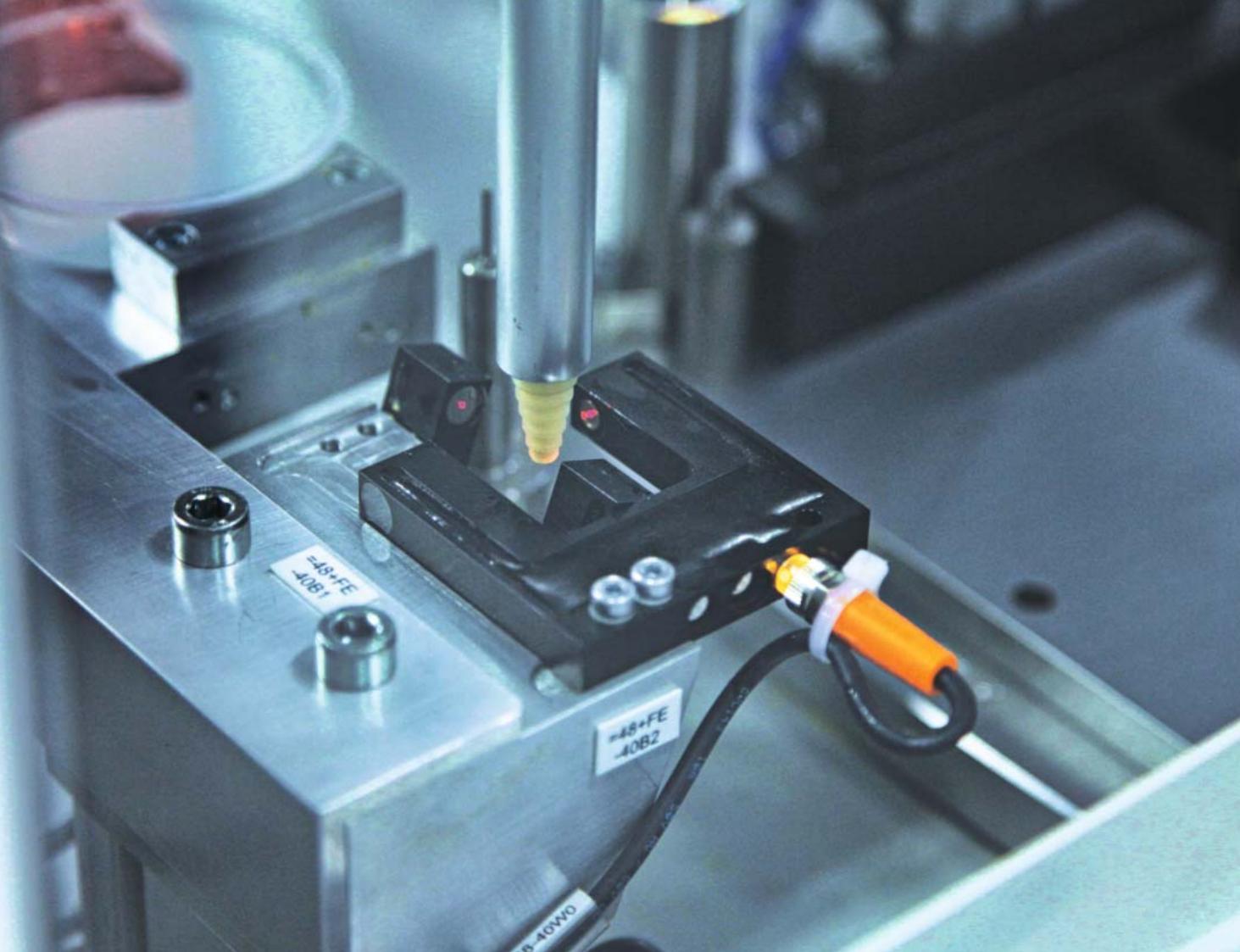
Lothar Geschwind from ifm adds: “This procedure had to be developed so that process safety is ensured, that nothing goes wrong because the automatic system join certain parts and that in the end no reject parts are produced which would cause unnecessarily high production costs.”

■ Efficient sensors

To monitor the complex production process, different sensors from ifm are used.

Numerous ifm PN-type pressure sensors in various pipes precisely monitor the supply of the 2-component media by means of pressure measurement. This ensures a continuously perfect mixing ratio. The ceramic measuring cell of the sensors is long-term stable and overload protected. This ensures continuous product quality, even when pressure peaks occur.

The PQ-type pressure sensors are integrated in the supply lines of the different pneumatically-controlled arms



Two photoelectric fork sensors with fine light beam during the reference movement of the fine nozzle.

and grippers. They detect deviations from the intended operating pressure so that the system can be stopped at once. Expensive scrap is avoided. The two-colour LED display does not only clearly indicate the measured value on site, but the colour change (green/red) accurately visualises the operating status.

The end positions of the pneumatic cylinders are precisely detected by means of ifm cylinder sensors and transmitted to the controller via a switching signal.

Two photoelectric fork sensors with a fine light beam help reference the fine nozzle applying the glue. The needle of the nozzle is moved until it hits the point of intersection of the two light beams where the X and Y axes meet. The starting position is set. The area of application of photoelectric fork and angle sensors is the detection of very small parts. An advantage of photoelectric fork or angle sensors is that transmitting and receiving elements are always perfectly aligned towards each other which is owed to the design. Maladjustment of the fine light beam is almost impossible.

LMT-type level sensors are installed on the tank to monitor the contents. They are suited both for liquid and viscous media. Special feature: They reliably suppress deposits or foam. This ensures precise level detection, even with difficult media.

Moreover, numerous inductive and photoelectric sensors are used for position detection of arms, flaps or other moving elements.

In short: ifm offers a complete range of high-performance sensors for ideal process monitoring.

■ Conclusion

The perfect teamwork of the companies Fichter, Viscotec and ifm shows how demanding application requirements are reliably and efficiently implemented on a compact production machine.



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