

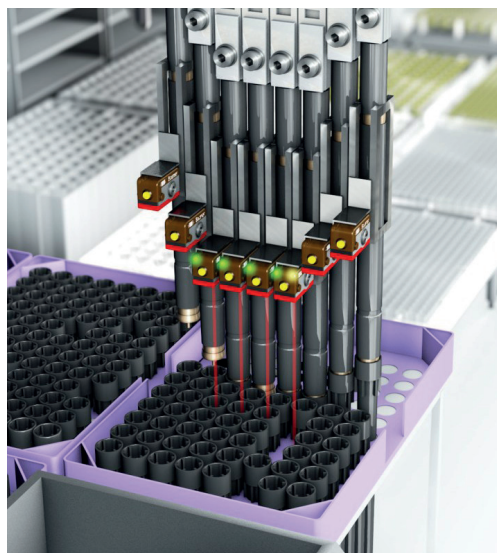
# Sensors in lab automation: guaranteeing process safety

Increased automation in lab technology also increases the ways in which sensors can be utilized to help support and ensure that a wide variety of tasks involved in automated lab processes are properly executed. This is exactly why sensor and measuring instruments manufacturer Baumer has developed a wide variety of solutions that ensure automated lab processes are reliable, precise and efficient.

Labs are where new diseases, vaccines or even artificial ingredients are studied and further developed. Growing automation in lab processes thus contributes to economic efficiency. Even in the labs themselves, activities such as pipetting or analyzing samples are primarily conducted today by machines. Machines work more efficiently and more precise than people. Sensors are visibly at work behind the scenes ensuring high process safety even with increased throughputs and speeds. Valuable samples especially call for precise measurements with good repeatability. Sensors must also be able to withstand harsh chemical substances or feature a respective hygienic design.

The ways in which the different sensor solutions can be utilized in lab automation is very extensive. They provide reliable support at the numerous interfaces of the lab process. One of their most frequent tasks is measuring the fill level of liquids in analysis processes. Baumer utilizes a wide variety of sensor technologies for this. In addition, very small containers such as microtiter plates and test tubes are used. Level control can ensure that replacing or refilling a container can be scheduled in advance, and Baumer offers various sensor technologies for accomplishing this. The portfolio range includes capacitive, photoelectric and ultrasonic sensors. For example, with the 09 series of ultrasonic sensors, Baumer is meeting the challenge of being able to quickly and precisely measure fill levels in these containers.

Filling the microtiter plates with the liquid to be analyzed is an important part of the workflow. Sensors measure the fill level of the microtiter plate



With optical sensors type and number of pipette tips are determined.

wells after a small amount of the substance has been pipetted into the container and before the analysis process actually begins. The sensors are thus able to check whether the amount is sufficient for the analysis or if too much liquid has been put in. Doing this keeps waste to a bare minimum. Important qualities that system manufacturers and users require of sensors are primarily precision with good repeatability and a high slew rate. Furthermore, very little space is available for measuring the fill level. Some of the individual well openings only have a diameter of 3 mm. The sensor must be able to detect the smallest deviations in the shortest amount of time through such narrow openings.

Conventional ultrasonic sensors operate by sending cone-shaped sound waves. Because of this, their measuring spot size is too large to be able



Author:  
Stefan Diepenbrock  
Manager Public Relation,  
Baumer  
sdiepenbrock@baumer.com  
www.baumer.com

to take a measurement inside openings that have a diameter of less than 10 mm. By working closely with customers, Baumer was able to develop the 09 series to circumvent this limitation. These ultrasonic sensors are only 9 mm wide and are equipped with a special nozzle that focuses the sound waves, thereby enabling the sensor to take measurements inside the very small openings of a microtiter plate. Depending on the installation procedure, the nozzle can be attached to the front or side of the sensors. The nozzle can be detached and replaced which makes it easier to clean the sensor. Naturally, these sensors are also capable of taking measurements in larger openings.

The sensors achieve a very high resolution and repeat accuracy of up to 0.1 mm, which in a 384-well microtiter plate, corresponds to a volume resolution of 1  $\mu$ l. It has a very fast response time of only 7 ms. Thanks to the special housing width of only 9 mm, the sensors are ideally suited for cascading. Using this approach, eight sensors mounted in a row can scan a 96-well microtiter plate in a single pass.

Ultrasonic sensors are based on the principle of measuring the propagation time of sound in air. The sensor emits ultrasonic sound waves that are inaudible to the human ear. These sound waves bounce off an object and are picked up again by



With the ultrasonic sensors of the Series 09 liquids can be detected even in small containers like 384 microplates.

the sensor. Having this functionality means the sensors are able to operate without any contact at all. This is especially advantageous in the lab area since neither the medium to be analyzed nor the sensor are contaminated by the measurement process. In addition, an ultrasonic sensor is exceptionally insensitive to relative humidity and dust which allows it to constantly work reliably. Since it operates with sound waves, it can reliably detect a wide variety of media regardless of transparency or color. The consistency of the medium to be examined does not impact the measurement either.

But there are numerous other applications that are able to make lab automation more efficient. For example, vision sensors such as *VeriSens*<sup>®</sup> are used for the important identification and traceability of the samples. With the ID function of *VeriSens*<sup>®</sup>, it is possible to read the coding on test tubes or microtiter plates, such as barcodes, matrix codes or text. The ability to combine several features makes it possible to conduct various inspection tasks in one step.

Precise positioning of pipetting arms is ensured by encoders which Baumer offers in various versions. Depending on the application, either absolute or incremental encoders are used to determine the position information.

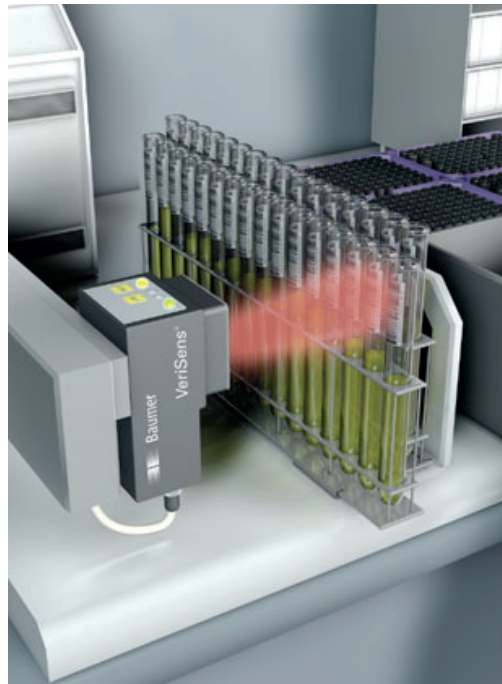
To prevent errors from happening even early on in the sample processing, photoelectric or ultrasonic sensors provide an essential added value in pipette tip recognition by safely identifying the type and number of the pipette tips. Baumer has developed solutions that especially have the required compact housing, a very high resolution of up to 2  $\mu$ m, and an incredibly short response time of less than 1 ms.

## Baumer Group

The Baumer Group is an international leading manufacturer and developer of sensors, encoders, measuring instruments and components for automated image-processing. Baumer combines innovative technology and customer-oriented service into intelligent solutions for factory and process automation and offers a uniquely wide range of related products and technologies. With more than 2,500 employees and production plants, sales branches and agencies in 36 subsidiaries and 18 countries, the family-owned company is always close to the customer. Industrial clients in many sectors gain vital advantages and measurable added value from the worldwide consistency of Baumer's high quality standards and its enormous innovative potential. For further information, visit [www.baumer.com](http://www.baumer.com) on the internet.

Fluid leaks or leakages that go unnoticed can be particularly dangerous and expensive in lab automation. Photoelectric sensors provide a reliable and constant way of monitoring this issue. Baumer's FODK 23 leak-monitoring sensor can detect a leak that is as small as 1 ml. A special Teflon PFA coating makes it also able to withstand chemically aggressive liquids.

Sensors ultimately contribute to the efficiency of lab automation. They are able to recognize errors early on and thus maintain a high level of quality. Sensors ensure flexibility and reliability thanks to their precision and the wide variety of applications that they can be used in.



VeriSens®