
Photo: baier & michels / Rüdiger Dunker

Pressure-resistant closure and sealing: the b&m-KL Plug, here the steel variant for drilled hole diameters of 12 mm.

Closing and sealing systems

# The somewhat different plugs

If one wants economical injection molding and die casting one must keep unit numbers and process reliability high and cycle times as low as possible. The correct temperature of tools and plants plays an important role here. A new solution significantly reduces the risk of leaks in drilled holes and flow channels, and transforms installation and disassembly processes that have hitherto been time-, waste- and cost-intensive.

By Andreas Wollny

What is a closing and sealing system that was originally developed for vehicle components doing in tools, as well as plants in the die casting and injection molding industries? The short answer is that it is doing its job. In more detail, it is establishing itself as an intelligent alternative to conventional solutions – with a reliable sealing function up to 30 bars of operating pressure, with simpler installation without creating any waste, and a non-destructive disassembly process.

The history of the b&m-KL Plug began in the late 2010s in an application laboratory at baier & michels, in Ober-Ramstadt. Inspired by customer queries, the developers worked on a sealer that was intended to significantly improve the interplay between quality, cost efficiency and environmental footprint, particularly in cooling and lubricant circuits. "Our aspiration was to create a completely new system that would convince in direct comparisons with, say, expanders, screw caps or press-in spheres," recalls Constantin Egold, Technical Product Manager.

## A variety of materials

This goal was to be achieved with a variety of materials, particularly steel, stainless steel and aluminum. A radical idea ultimately paved the way: the designers took the technology of a blind rivet and integrated it in a closed blind rivet nut (Fig. 1). The result is an one-piece weight-optimized (due to its structure) closing and sealing element

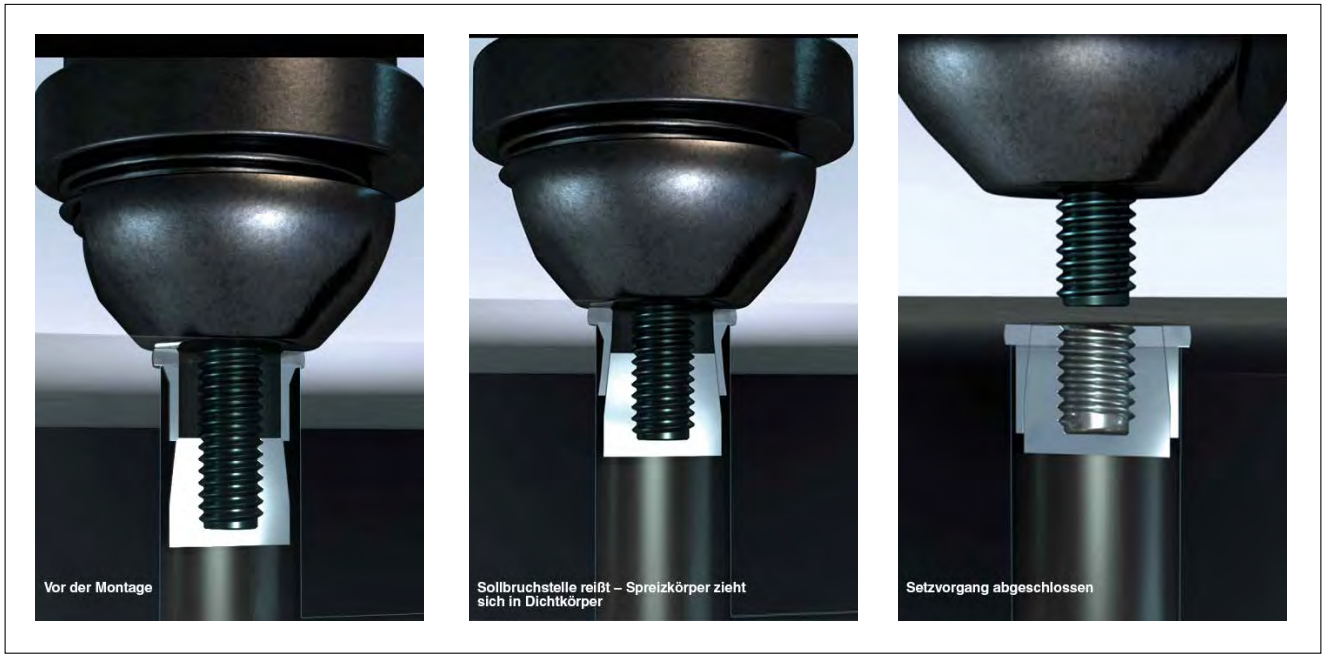


**Fig. 1: b&m integrated the technology of a blind rivet in a closed blind rivet nut (left: before assembly, middle: predetermined breaking point tears – spreading element is pulled into the sealing body, right: assembly process completed).**

that is suitable for hole dimensions of from 8 to 24 mm and can handle temperatures of from -40°C to +200°C. Whereby correct material pairing is important here: the component and the b&m-KL Plug should come together with linear thermal expansion coefficients that match one another.

When setting with a standard assembly device, the b&m-KL Plug is in two parts and then consists of a sleeve and a threaded internal cone. Its full expansion only requires a residual component wall thickness of 2 mm. "There was a thorough validation phase before we put it on the market," says Product Manager Constantin Egold. This included leakage tests by the TÜV Süd in Garching, and vibration tests overlaid with temperature and pressure tests at the IMA Material Research and Application Technology test center in Dresden (Fig. 2).

Having been put through its paces, the b&m-KL Plug started operation at OEMs and suppliers in automotive construction. It is used wherever flows must be controlled and regulated. The element prevents, for example, the escape of oil in compressor housings, or closes and seals bearing housing covers in turbochargers. "What's interesting about the b&m-KL Plug is its variety," according to Constantin Egold (Fig. 3). Thanks to its properties the system is also suitable, for example, for regulating throughflow in channels carrying media such as a water/glycol mix or oil. And equipped with a temperature sensor

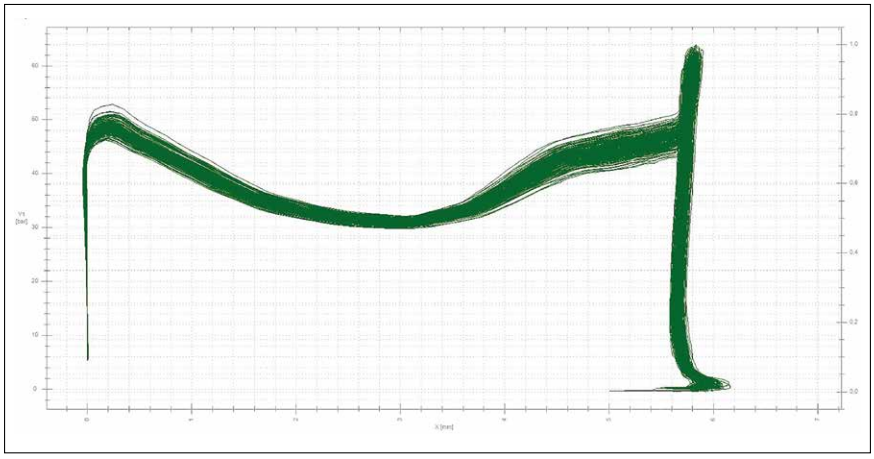

**Fig. 2: Installed process reliability: the setting curve diagram illustrates the pressure and setting path values of about 50 tests. Whereby b&m-KL Plugs made of steel were used for drilled holes with a diameter of 12 mm.**

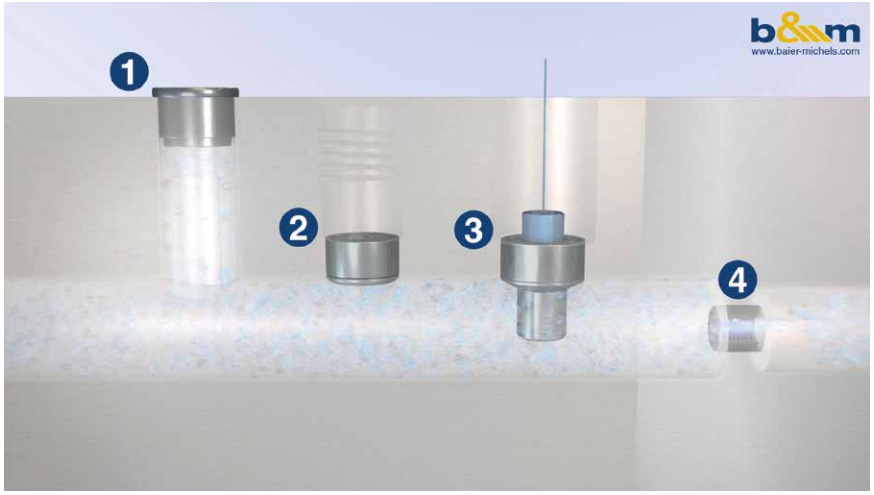


**Fig. 3: Versatile use, suitable for fluids and gaseous media. 1: Closes directly at the surface of a drilled hole, 2: Set lower to reduce the dead space, 3: With a thermowell and sensor in a tempering channel, 4: As a flow regulator between two channels.**

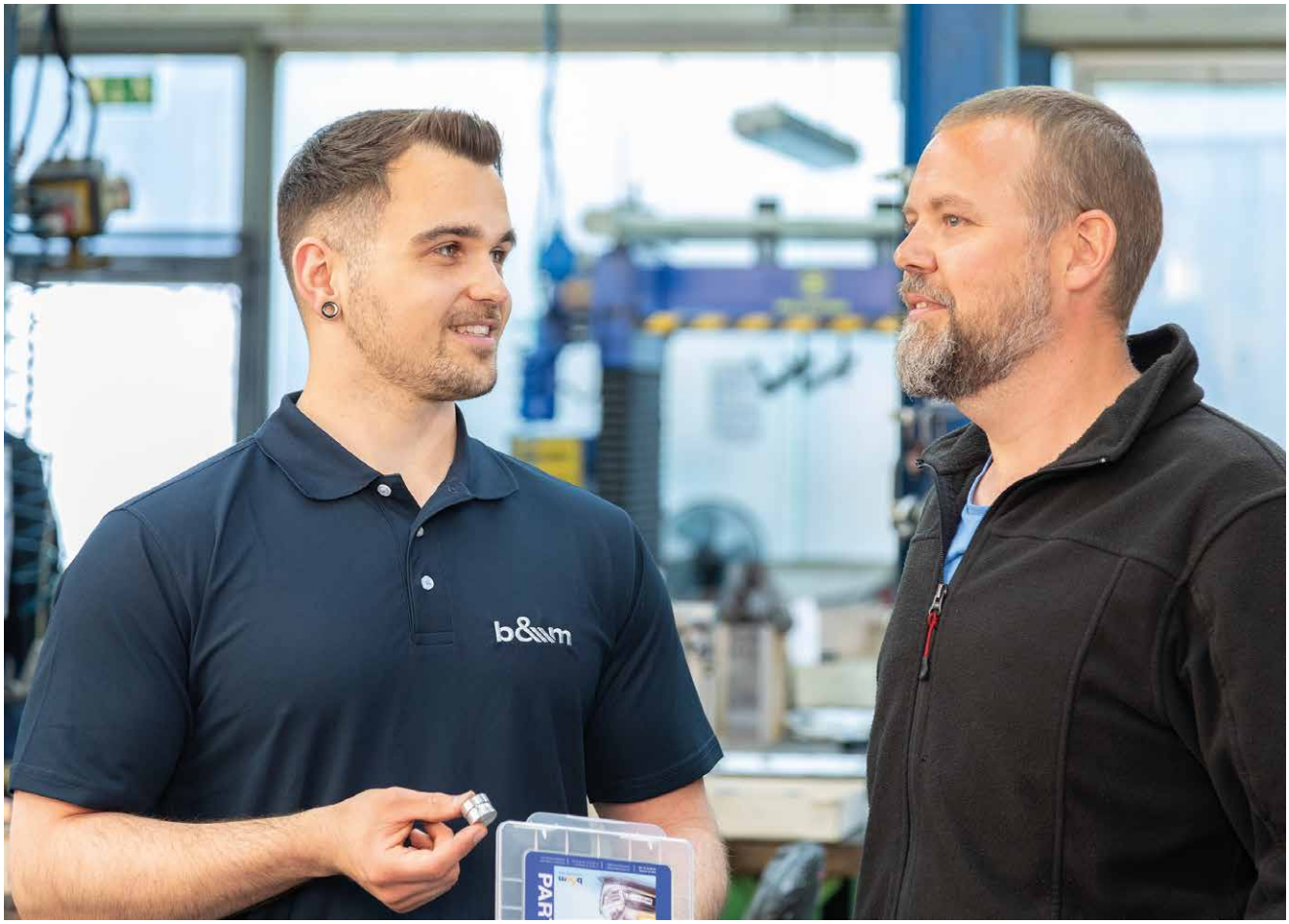


Fig. 4: **Constantin Egold (left) in conversation with Mark Joos, Manager Tool Construction at Haller Kunststofftechnik.**

and a thermowell this new type of plug can also act as a control unit for optimizing tempering processes, for example – whether for the power electronics of e-cars or in injection molding and die casting tools.

## Successful in practical use

One customer that uses the b&m-KL Plug, among others, is Haller Kunststofftechnik GmbH, in Rodgau. The company uses injection molding to produce technical components made of thermoplastic polymers. These are mainly used in the automotive, electrical and energy sectors in brackets for control devices, cable carriers for electrical wires, and parts for refrigeration units. "The b&m-KL Plug not only increases tightness values, but also considerably reduces closing element installation time and costs compared to what we previously used in the tempering channels of the tools that we also manufacture for our customers," says Mark Joos, Manager Tool Construction (Fig. 4)."

What this means in practice can be seen when one observes the production of a cable bracket ordered by a carmaker. The tool consists of two mold halves – a cube weighing a total of 900 kg with dimensions of 1000 x 500 x 500 mm³ (length x width x depth) (Fig. 5). "It is principally made of tool steel," explains Mark Joos. "Whereby the shape-forming area, in particular, that comes into contact with the polymer, is made of hardened tool steel. And because we also process glass-fiber reinforced plastics, the mold contours must be hardened, and even partly coated – soft steels would wear too quickly."

In the past, the Heller team regularly used expander solutions to close and seal the cooling circuit in the tool, but also used plugs or screw fittings made of brass, frequently wrapped in Teflon tape to improve the sealing effect (Fig. 6). "Such systems are effective, but require comparatively complicated preparation of the drilled hole," says Mark Joos. "This involved several steps, for example changing the drill and countersinking, but also cutting and cleaning the thread and, in the case of sealing screws, milling of the heads is also important."

One must also take into account that many closing and sealing elements, such as expanders, generate a waste product (mandrel) on setting that must be removed from the assembly plant separately. And with the b&m-KL Plug? "It allows us to act without dirt or waste, and we save about five minutes per drilled hole," confirms Mark Joos.

### BAIER & MICHELS

Founded in 1932 as a local dealer of screws and fittings, the company now has a global orientation as a member of the Würth Group and employs about 500 personnel. baier & michels (b&m), based in Ober-Ramstadt, supplies the production industry with connection, closing and sealing solutions for cold forming – developed and produced in-house. Customers include OEMs and suppliers to the automotive, electrical and medical technology industries, as well as tool and plant constructors. In addition to application-related technical consulting, the company also offers training courses and, with its b&m-PORT, an online portal that supports industrial companies in the standardization of their C-parts.

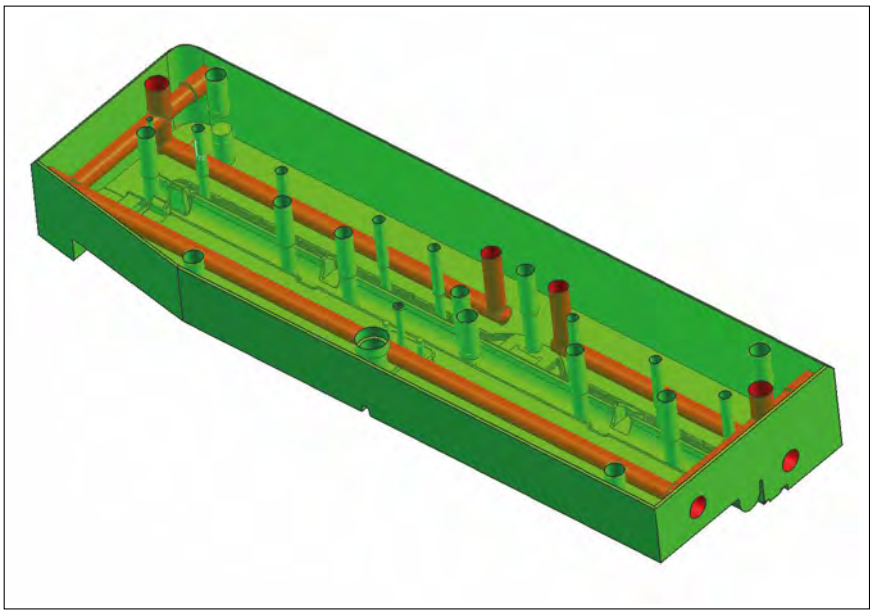

Fig. 5: **3D view: The cooling channels, including the drilled holes in which b&m-KL Plugs are installed, are in red. In a concrete case, there are a total of eight contour inserts in the tool, which weighs 900 kg.**

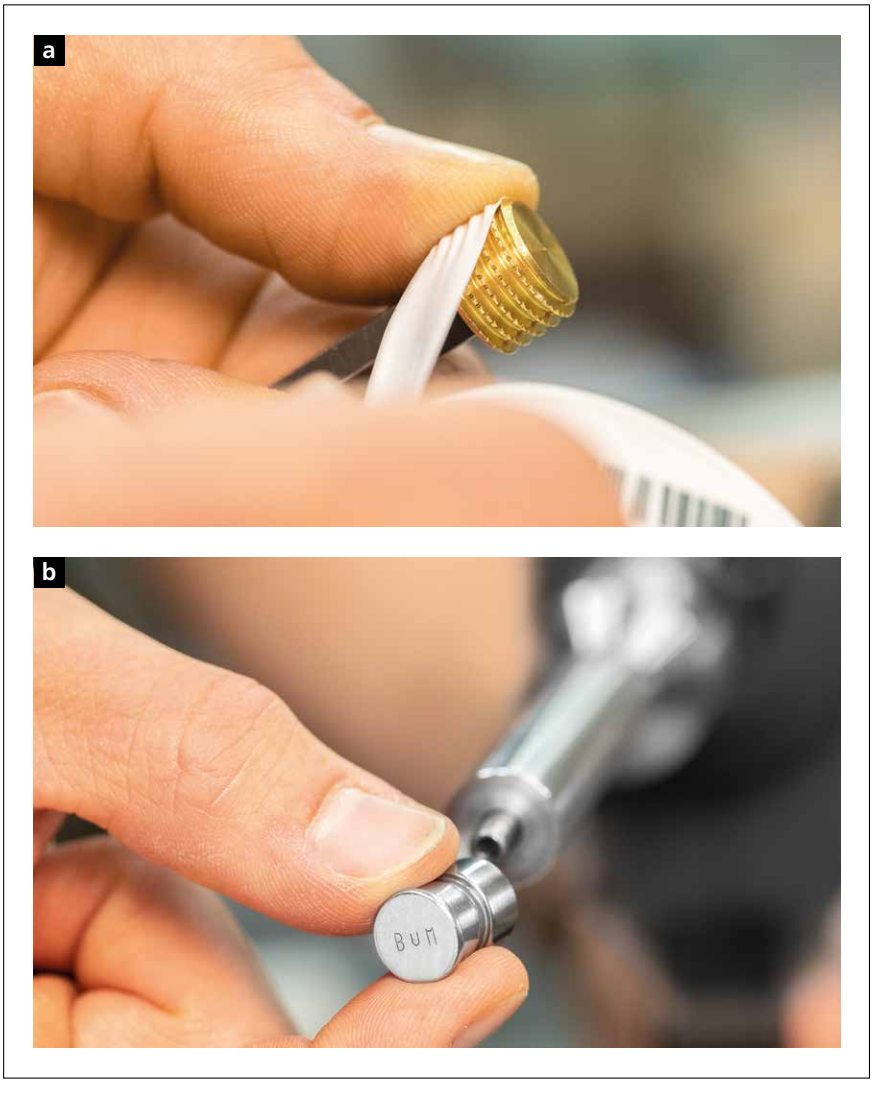


Fig. 6: **Fewer work steps: Unlike the setting of a conventional closing plug, which requires several actions, sometimes including wrapping with Teflon tape (a), the b&m-KL Plug (b) is rapidly installed.**

"We generally work with diameters of from 10 to 14 mm." According to Joos, the channels of the two tool molds in which the cable brackets are made contain a total of about 80 b&m-KL Plugs, "which overall makes us considerably more efficient."

Efficiency is also essential when designing tempering circuits. Depending on whether the flowing medium is, for example, a water/glycol mix or oil, many years' use of the tool, which sometimes involves lengthy storage periods, cause the gradual formation of rust or even contaminants. So Constantin Egold recommends keeping the volume of medium in the channels to the minimum necessary. The b&m-KL Plug can help reduce the so-called dead space: "With a lengthened mouthpiece it can be rapidly placed in the desired depth of the drilled hole – and unlike other closing and sealing solutions, if necessary the drilled hole can be re-used without renewed preparation."

## Use in die casting

The topic of non-destructive disassembly is especially relevant in the field of die casting, more precisely in cold-chamber processes. During each casting cycle, the required quantity of melt is newly fed into a receptacle, the so-called shot chamber, and transported into the intended mold via a movable piston at high speed. "To ensure that the liquid hot metal (at about 700°C) does not change its physical state while in the shot chamber, it is heated by the tempering circuit (mostly filled with oil) from outside the chamber walls," explains Constantin Egold.

When it is necessary to remove closing and sealing elements, for example for maintenance work, conventional closing screws must generally be removed (which is cost-intensive) or, if other solutions are used, there may be metal shavings. Then the borehole must be drilled out to the next-largest diameter required for the new element – which often poses problems for personnel due to lack of space. "The b&m-KL Plug is disassembled without destruction and thus helps save time," says Constantin Egold and adds: "By making complex things seem easy, this somewhat different sealing plug supports our customers in their desire for process stability and a high level of automation."

**www.baier-michels.com**

*Andreas Wollny, Manager Product Communication, baier & michels GmbH & Co. KG*