Cable harnesses hold tight thanks to polyurethane

Yazaki relies on system expertise from KraussMaffei when manufacturing polyurethane grommets for vehicle cable sets

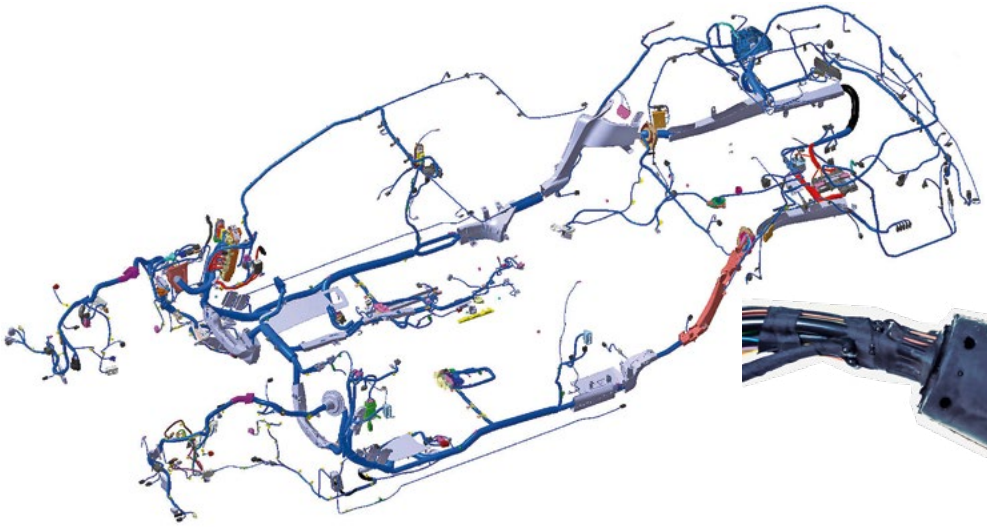

Figure 1: A car cable set can hold over 2,000 meters of cable.
Source: Yazaki

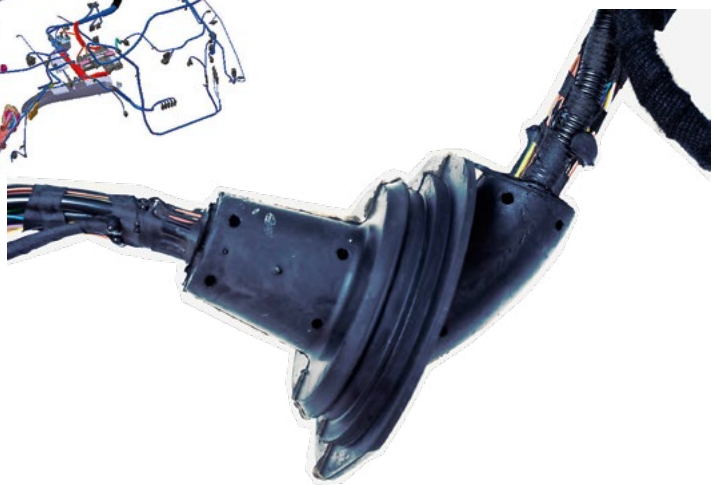

Figure 2: The polyurethane foam reliably fills the intermediate spaces in the cable harness, which means that no moisture can ingress into the vehicle's interior. Furthermore, the elastic polyurethane material also ensures secure assembly in the grommet fitting.
Source: Yazaki/Werner Bauer

Automotive Cable or wiring bundles in vehicles ensure fast energy and signal transfer. It gets interesting when transitioning from the moisture compartment into the interior. Moisture may not get into the passenger compartment. Grommets made from foamed polyurethane are much more reliable than other seal systems.

Cable sets for vehicles rank among the most important products for the automotive supplier, Yazaki (see the company portrait box). The cable set—often called a "cable harness"—is the nervous system of the vehicle in a certain sense. It handles the task of transferring signals or energy among the numerous electrical and electronic components (Figure 1). In a car, the cable harness consists of approximately 700 cables with an average length of around three meters.The entire length of all the cables contained in an automobile cable set extends over 2000 meters. This means that the total weight of an entirely prefabricated cable set can amount to between 25 and 30 kg. Because practically every vehicle in the auto-

Figure 3: Yazaki has been operating ten polyurethane foaming systems from KraussMaffei at multiple locations in Eastern Europe. Source: Krauss Maffei

maker's series production has individualized equipment, the cable set must also be specially fit to each individual vehicle. In other words: nearly every cable set manufactured by Yazaki is unique. Due to the many different assembly steps, the cable sets are usually prefabricated manually.

Numerous intermediate spaces make sealing difficult

When the cable set is installed in the vehicle, the wiring bundles are fed from the outside into the interior from multiple places. Two of these feed-throughs are normally found on the front wall bulkhead that separates the engine bay from the passenger compartment. Additional feed-throughs are positioned in the rear or floor area of the vehicle, depending on the equipment.

Throughout the service life of the vehicle, no moisture is allowed to ingress into these areas of the passenger compartment. However, a reliable seal is not all that easy to achieve due to the numerous small spaces between the individual lines that make up the bundle. Until 2005, these seals had still been applied at Yazaki in a manual process. To do this, the wiring bundles had to first be spread apart with special tools. Subsequently, suitable rubber compounds (known as cold melts) were manually installed between the individual cables to seal the intermediate spaces. Finally, a shrink tube had to be applied so that the wiring bundle is as round as possible and can later be fastened in the grommet fitting without problems. These manual processes for seal application were not able to sufficiently fulfill quality requirements.

Therefore, Yazaki and KraussMaffei began a collaborative project in 2005 with the goal of replacing the hand-made grommets with foamed polyurethane components. The advantage offered by polyurethane material is that it has a very low viscosity at the beginning of the foaming process. In this state, the material flows very well, allowing it to fill in all the spaces between the individual cables. The polyurethane then foams up inside the mold to ensure a reliable sealing effect. The grommet's Shore hardness can be configured by selecting the appropriate formulation in a way that allows the grommet to be easily inserted into the fitting and ensures that it is sealed (Figure 2). In 2006 a pilot system for grommets made from polyurethane was put into operation and the technology has been used in series production since 2008. In the meantime, Yazaki has been operating ten polyurethane foaming systems from KraussMaffei at multiple locations in Eastern Europe (Figure 3).

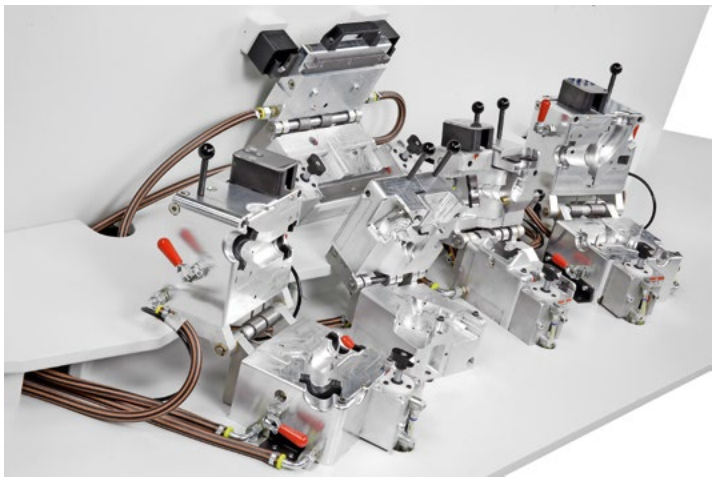

Figure 4: Equipping a cable set with polyurethane grommets normally requires multiple tools. Source: Krauss Maffei

Stringent requirements for mold technology

"Collaboration made it possible for both sides to continue broadening their knowledge and to gain valuable experience," says Hans-Joachim Linke, Yazaki Systems Technologies GmbH. "KraussMaffei is very well positioned as a system supplier. This suits us very well in terms of planning and system integration." "This configuration provides both sides with a substantial time savings advantage because all necessary components come from a single source and consequently, can be coordinated more efficiently." KraussMaffei has developed specific solutions for Yazaki that are tailored to specific applications. Foaming the cable set grommets places very specific requirements on process technology. The grommets are only foamed onto the cable set once it is completely prefabricated. Storage of the cable set's individual parts must be precisely defined in advance so that the areas that are to be encapsulated can be inserted into the individual molds without complications. Furthermore, the advantage that the polyurethane mixture initially flows very easily imposes high standards on the mold technology (Figure 4). "The mold must be vacuum sealed at the wiring loom's input and outputs so that the polyurethane does not flow into the

adjacent areas of the cable set," Linke explains.
Usually, cable sets are fit with multiple polyurethane grommets. This depends on how many transitions from the moisture compartment to the dry compartment are required (Figure 5). As soon as the polyurethane mixture is brought into the mold, the chemical reaction begins. After a few minutes, the cable set with the grommets can be removed from the molds. At some locations, Yazaki also inserts rotary table systems with multiple toolkits, ensuring the ability to produce greater quantities.
According to Linke, "KraussMaffei did a wonderful job of helping us to coordinate the individual system parts to each other, such as the mixing and metering systems, mixing heads, tools, additional purchased parts and software, in a way that satisfied the requirements." In close collaboration with the material and component suppliers, the optimal parameters were defined and implemented for each application and each location.

Well-prepared training and instructional management

Employee training is an important topic for Yazaki. Mastering the chemical reaction during the foaming process requires production employees and the process owners to have proven knowledge of polyurethane technology. "The training and instructional management at KraussMaffei is set up magnificently," according to Linke. "The training can be planned in advance so that trained personnel is available at production start."
Just-in-sequence production for cable sets requires that the systems for foaming the polyurethane sealed grommets can reliably be operated around the clock. It is an advantage for Yazaki that KraussMaffei can service the entire system. "If problems arise, KraussMaffei's easy accessibility and quick response times are critical; no matter whether it be replacement part delivery or sending a service technician to the site." Polyurethane grommet foaming has successfully established itself as standard procedure at Yazaki due to its high reproducibility in producing cable sets. Further investments are planned and the process is under permanent continuous development, especially in the area of mold technology. "From the standpoint of highly automated driving in particular, process reliability requirements will continue to increase in the future," explains Linke. PL

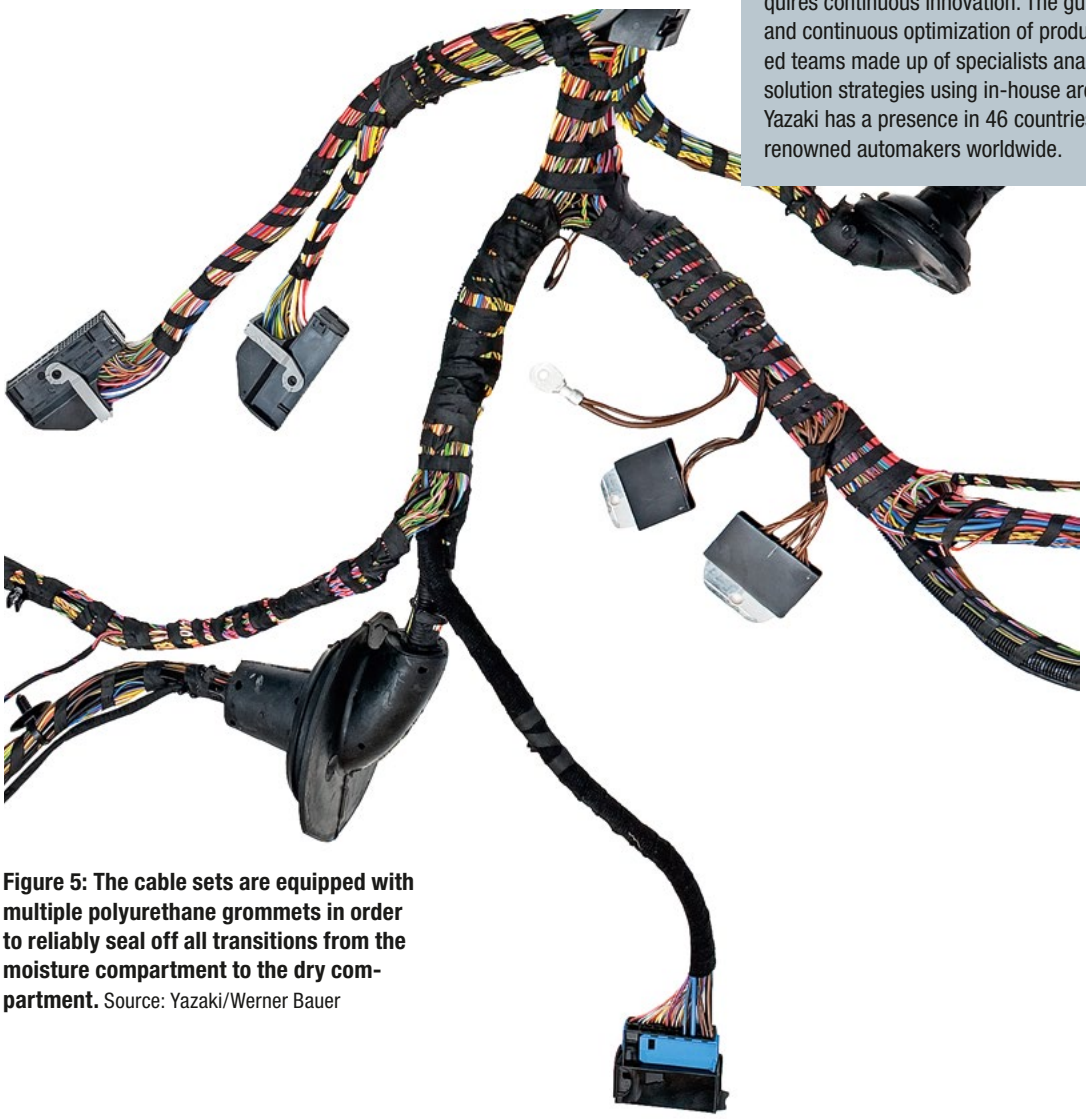

Figure 5: The cable sets are equipped with multiple polyurethane grommets in order to reliably seal off all transitions from the moisture compartment to the dry compartment. Source: Yazaki/Werner Bauer

Yazaki company portrait

Yazaki was founded in 1941 and currently employs more than 285,000 workers. The company is headquartered in Tokyo and it is among the 20 largest automotive suppliers in the world. Yazaki is a Japanese, family-owned company and is the market leader in on-board power supply systems for the automotive industry.
Yazaki brings all key technologies together under the general heading of EEDDS (Electrical/Electronic Distribution and Display Systems), offering its customers modern and customized solutions in the areas of on-board power supply, components, electronics, instrumentation and high voltage. This requires continuous innovation. The guiding idea here is vertical integration and continuous optimization of products, processes and services. Dedicated teams made up of specialists analyze customer requests and develop solution strategies using in-house architecture software.
Yazaki has a presence in 46 countries with 619 locations and serves all renowned automakers worldwide.

"The collaboration made it possible for both sides to broaden their knowledge continuously and gain valuable experience." Hans-Joachim Linke, Yazaki Systems Technologies GmbH Source: Yazaki

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