



biw

*When it comes
to silicone*

SILICONE MOLDINGS

QUALITY IN BEST FORM



Expertise. Innovation. Flexibility. These are the three properties which have made BIW a leading company for all aspects of the production of top quality mouldings made of silicone.

Success in the market is a result of a consistent quality policy with continuous improvement as an integral component of the management strategy. This includes both on-going managerial optimisation and regular organizational and technical verification and improvement of all steps in the process chain.

Thanks to its many years of know-how with elastomers together with the necessary flexibility, BIW is in a position to react promptly to new market requirements at all times. The rapid changes and differing demands made by customers present BIW's experts with new challenges every day, which they gladly take up. This guarantees that the company is always up-to-date and that customers are provided with state-of-the-art technology.

Regardless whether standard articles or special products are concerned, BIW provides customers with products and solutions which are tailor-made to their every requirements.

Modern machinery and up-to-date material and production know-how, together with highly motivated and excellently trained staff, are the vital ingredients in BIW's production process. The whole process chain from the raw material through to the finished end product is actually performed "in-house" in order to assure a constantly high standard of quality throughout all stages of the production process. These factors combine to produce a crucial advantage over competitors. BIW's special production expertise has made the company a reliable problem-solving partner for customers who are satisfied in every respect.



LSR – A VERY SPECIAL ELASTOMER

Liquid silicone (LSR – Liquid Silicone Rubber) belongs to the group of hot vulcanising rubbers. As in glass, the basic structure of the polymer is the silicon-oxygen bond. Integration of methyl and vinyl groups produces linear polymer chains (MVO). Liquid silicone, which is usually filled with pyrogenic silicic acid to consolidate the finished vulcanisate, is processed as a two-component system. Whereas the A-component contains a platinum catalyst, the B-component is equipped with a vulcaniser and an inhibitor. After blending the two components, vulcanisation takes place under the influence of heat – platinum catalysed addition curing. Here the Si-H groups of the vulcaniser are added with the aid of the platinum catalyst to the double bond of the vinyl groups in the linear polymer chains.

Compared to the peroxide vulcanisation used for solid rubber mouldings (HTV), the advantage of using addition curing for liquid silicone (LSR) is that no unwanted cleavage products are generated. LSR mouldings contain neither toxic nor aggressive components.

Thanks to the share of vinyl groups, specific blending of fillers and dosing of special additives, the properties profile of LSR can be kept reproducible and special qualities can also be produced. Together with many other outstanding quality characteristics, the prime properties include:

- heat stability to +180°C (stabilised to +280°C)
- cold flexibility to -50°C
- constant mechanical and electrical properties over a broad range of temperatures
- resistant to weathering, aging and UV

- good chemical resistance, particularly in contact with watery solutions of weak acids, lyes and salts
- excellent physiological compatibility
- far higher gas permeability than other elastomers
- very good electrical insulation
- high transparency
- matching colours
- optimum environment compatibility

When handled correctly, LSR mouldings fulfil numerous international standards, regulations and directives (see table).



Conformity of LSR mouldings

Standard	Application	Shore A
BgVV Part A, "Silicone" German Agency for Consumer Health Protection and Veterinary Medicine	Food products and commodities	20-70
FDA Code of Federal Regulation (CFR) 21 §177.2600 Food- & Drug-Association	Food products, sanitation	20-70
USP Class VI US Pharmacopoe, Class VI, Plastics	Medicine, pharmaceutical industry	20-70
European Pharmacopoeia PA/PHExp. 3/T (82) 57 Silicone Elastomers for Closures and Tubing	Medicine, pharmaceutical industry	20-70
ISO 10993 Biocompatibility	Medicine	20-70
British Standard BS 6920 (WRAS) Water Regulations Advisory Scheme	Drinking water	20-70
KTW Recommendation, category C Plastics and drinking water recommendations of the German Environment Agency	Drinking water	30-70
DIN EN 549 DVGW German Association for the Gas and Water Trade e.V.	Gaskets in gas appliances and gas installations	60
Underwriters Laboratories UL 94-HB / UL 94-V0 Fire behaviour	all branches	20-70

transparent or in various colours; detailed information on request

Properties of LSR mouldings		Standard types	Self- lubricating types, oil level 2-5%	Oil-resistant types	Self- adhesive types	Self- extinguishing types UL 94 V0 >0,9mm LOI 35	Electrically conductive types
Density DIN 53479 A	g/cm ³	1,08-1,19	1,10-1,30	1,29-1,34	1,07-1,16	1,36-1,45	1,07-1,12
Hardness DIN 53505	Shore A	15-75	30-70	50-70	10-60	48-55	40-55
Tensile strength DIN 53504	N/mm ²	3-10	5-10	6-7	1,5-10,5	4-6	4,5-7
Elongation at break DIN 53504	%	300-800	400-900	230-430	600-750	350-450	350-650
Tear strenght ASTM D 624 B	N/mm	15-45	12-35	15-18	5-25	8-15	12-30
Rebound resilience DIN 53512	%	45-65	30-60	55-60	40-60	50	50
Compression set DIN 53517 22h/175°C	%	10-60	15-65	17-25	20-25 ⁽¹⁾	15-40	12-25
Dielectric strength VDE 0303	kV/mm	23	20-30	23	-	25-27	-
Specific dielectric resistance Electrical conductivity VDE 0303	Ohm · cm Ohm · cm	10 ¹⁴ -10 ¹⁶	10 ¹⁵ -10 ¹⁶	10 ¹⁵	-	10 ¹⁵	10
(High) Temperature resistance no significant changes	°C	180 a. c. ⁽²⁾ 280 black	180 a. c. 280 black	180 a. c. 280 black	180 a. c.	180 grey	180 black

⁽¹⁾ 22h/125°C

⁽²⁾ a.c = all colours

The reactivity of platinum catalysed addition vulcanisation depends on the concentration of the catalyst and inhibitor, and on the temperature. As vulcanisation already begins at room temperature, complicated process technology is required for safe, economic series production. The precision of the two-component dosing system is therefore very important for LSR processing. Corresponding attention is paid to the mixing head where both components come together and through which an additional colour component or necessary additives can be dosed.

The injection moulding machine is the central unit integrating the injection machine, the injection nozzles and the closing unit. The machine control guarantees a fully automated process with reproducible injection profile, constant production parameters, optimised cycle time and permanent process monitoring.

The actual moulding procedure takes place with tool systems adjusted individually to the part, constructed with corresponding know-how based on many years of experience and with all due care and attention. The hardened tools are heated up to accelerate vulcanisation. Adapted handling systems de-mould and remove the LSR mouldings in the cycle.

The extremely low viscosity of the compound when injected into the tool not only requires mature tool technology but also maximum precision to prevent flash.

When rated correctly, vulcanised liquid silicone mouldings required minimum after-working and can therefore be produced economically with a high level of automation.

BIW's subsequent post-curing process ensures that the parts produced for the company's customers are not only suitable for use in contact with food products: LSR mouldings can also be used in medical technology.



VERSATILITY IN ITS SPECIFIC FORM



The outstanding properties of liquid silicone, combined with the tool and processing technology as well as the compounding know-how of BIW's experts, offer the ideal basis for solving customised three-dimensional elastomer demands.

BIW produces LSR mouldings in the injection moulding process with many different wall thicknesses.

Part weights vary from 0.15 g to more than 200 g.

The clamping dimensions for the tools extend to max. 415 mm x 615 mm at closing forces of up to 1,500 kN.

Tool technology developed in the company's own specialist departments is based on modular structures with fully hardened or plasma-nitrided precision moulds equipped with quick-action chuck systems. This means that in many cases the tool costs for the customers are reduced to just the actual shaping contour plates. The basic structures with tool heating and runner systems based on BIW's own cold channel technology are attributed to the injection moulding machine. Individual, optimised tool concepts are elaborated in close cooperation with the customer, taking account of general commercial aspects. The ideal runner technology and number of cavities are then defined in accordance with annual quantity, target price, lead time and tool cost budget, together with deadlines and quality requirements. On the basis of this structured concept, up to

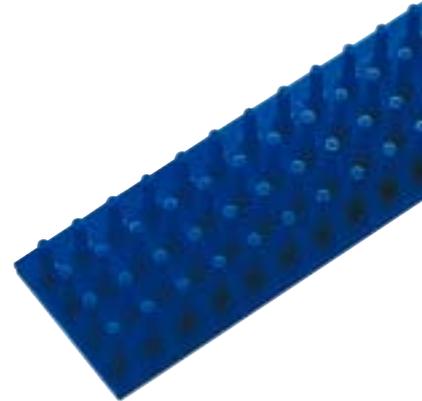


now a comprehensive range of widely differing LSR moulded parts has been produced with classical tunnel or film sprue, as well as runner rest free direct injection in multi-cavity tools. Thanks to the integrated control, the whole production process with dosing plant, injection moulding machine, tool system and handling operates in automatic mode with permanent monitoring to safeguard a constantly high level of quality. LSR injection moulding thus allows for a high level of automation, producing finished parts which are essentially free of burrs and bubbles. In this way, BIW offers sensible value for money for small, medium and large series, taking account of the tool costs.

When stipulated by the subsequent requirements for use, the LSR mouldings then undergo post-curing at BIW in special turbo ovens with constantly high air circulation and permanent fresh air supply.

A separate post-curing process for platinum catalysed addition vulcanised LSR mouldings at BIW, which is kept apart from the other production zones, also precludes the risk of potential contamination from other vulcanisation systems.

The parts not only attain the best possible vulcanisation density but also satisfy the very toughest requirements made of migration behaviour by the food product industry, medical technology, electrical engineering and the automotive industry.



LIQUID SILICONE INJECTION MOULDING PARTS



The automotive industry is a major sector for LSR applications: here BIW produces connector seals for cable sets and vehicle networks in line with the automotive and OEM specifications such as SAEJ-200xxx, DBLxxx, VW 2.8.1xxx or Bosch N2580-x.

Many different special materials are used, such as oil transpiring LSR types for self-lubricating gaskets. Multiple sealing systems for headlamps with adjustable luminosity range, anti-vibration pads for connector strips, O-rings, housing seals and battery end caps are just some of the available product variations for the automotive industry. When it comes to lamp seals, BIW has developed special compounds and processing technology to prevent "fogging" effects.

Another broad range of applications is the domestic appliance and small electrical appliance industry. Typical applications here are rising pipe connectors

for beverage machines, seals for hot plates or thermos flasks and iron seals. BIW is capable of providing samples for stoppers and bumpers, valves or housing seals for new generations of appliances in no time at all, and offers customers valuable advice during the development phase.

The company's compounding know-how is in great demand particularly in the heating appliance industry for development of the gasket design. DVGW-registered compounds designed for gaskets in combustion gas conveying systems and MPA-tested materials for exhaust systems cover the whole spectrum of sealing technology for condensing boiler systems. BIW offers its customers a full range of gaskets, starting with gaskets for the gas supply system, via combustion chamber and condensate pan gaskets, through to exhaust gaskets for the chimney.

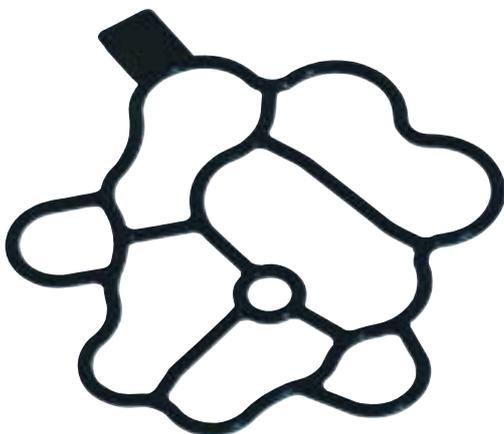


In terms of sanitary applications, the significance of LSR mouldings is constantly on the increase. One main reason for this is that the compound is free of halogens, together with its excellent residual compressive strength, high transparency and aging resistance. BIW uses recipes tested by KTW and WRAS for seals in water conveying systems and mixing tap systems.

LSR mouldings have a special role to play in medical technology. Here BIW uses materials which correspond to the requirements of USP class VI. Seals, surgical instrument trays and dialysis caps, together with all products for medical applications, are supplied practically migration-free, thanks to special post-curing processes.

LSR mouldings have extraordinary electrical properties which come to the fore in lamp production, in the electrical industry and in energy installations. Together with the high dielectric strength in the range of 18 to 278 kV/mm as per VDE 0303, other positive properties of the LSR mouldings include good creep resistance and arc resistance.

Applications for LSR mouldings can be found in practically all areas of industry, where BIW advises its customers with expert know-how both in terms of material selection and when it comes to the design and rating of parts and moulds.



SPECIAL PRODUCTS



BIW elaborates customised product solutions for the many differing tasks, utilising the company's expertise in the different elastomer and textile processing technologies.

This results in sophisticated combination products for the final user.

One example here consists of respiratory hoses for emergency medical services, which correspond to the special requirements of this sector. The hoses can be heated, and the smooth inner hose is reinforced by a helix as buckling protection. The appliance connection sleeves are also heated and can be equipped with temperature sensors; they are moulded directly to the hoses. These hose systems supply the patient with air adjusted to the required temperature and prevent any condensation in the hose.

Another example of special BIW mouldings refers to filter elements with integrated sealing function, in which

the silicone is injected in or through the filter fabric in the precision tool. Within one manufacturing cycle, these filter elements are injected, cut and separated in a fully automatic series process.

These filter/gasket hybrid parts are used in dialysis treatment; they are physiologically harmless and thus ideal for medical applications.

Combination parts of self-adhesive silicone and thermoplastics already perform important functions in many different areas of industry. The forerunners here are to be found in the automotive and domestic appliance industry, office communications technology and heating appliance construction. BIW projects scenarios for the technical and economic solutions to special problems, develops 2-component parts on the basis of integrated tool systems and then proceeds with demand-oriented series production either in semi-automatic insert procedures or in highly efficient fully automatic production. Individual customer requirements are always the benchmark within a thermoplastic silicone 2-component project.



When bonding silicone parts to metallic surfaces, alternatives to self-adhesive silicone types include bonding agents and special primers to produce a permanent bond.

BIW's experts create special surfaces by using coating dispersions or lubricant coatings to achieve exactly the technical or sensory effect required by the customer. In this way it is possible to give the finished part a dry grip or improved wear resistance.

As in 2-component technology, combined metal/LSR mouldings are produced in practice and in series production on the basis of structured process management, incorporating experience and commitment to each individual customer's specific needs. Gaskets moulded in place on metallic or thermoplastic materials relieve the final user of the need to finish the parts himself.

Mouldings whose functional cavities have baffles and different diameters can only be produced with LSR dispensing with cores and slides by means of gas injection technology

(GIT). This young technology in elastomer injection moulding consists of one process step in which the tool is filled and the part is hollowed. It can be used among others to produce complicated structures for pipes and systems conveying media for numerous applications (e.g. infusion tubes for medical engineering, or multi-angled hose manifolds for the domestic appliance industry). Connection elements can be directly integrated.

Silicone foam mouldings frequently required in gasket technology with simple three-dimensional contours need special production technology. In contrast to chemical foaming with corresponding blowing agents used in pressureless vulcanisation in extrusion, BIW uses physical foaming with specially modified injection nozzles for silicone foam mouldings.

This means that there are practically no limits to further developments in terms of top quality elastomer applications when using LSR, the material of tomorrow. Just ask for the know-how and competence of the BIW experts.





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