



P L A S T I C S

[ENBI]

S I L I C O N E S

**CO-CREATING YOUR AMBITIONS IN
LIQUID SILICONE RUBBER**

7 Inspiring short stories that help you achieve success in bringing
your products to life using Liquid Silicone Rubber



The possibilities with liquid silicone rubber and silicone moulding are endless.

It might be anything from a rubber O-ring in a household appliance, a weather stripping in a car, parts in manufacturing lines, or an element used in healthcare or aerospace. In any instance, the use of liquid silicone rubber is to accomplish a business goal or help complete a project in a better way. Manufacturers are just now starting to explore the endless possibilities of Liquid Injection Moulding. ENBI Plastics & Silicones is here to help.

Wherever you look, you will find confirmation that plastic, rubber and silicone moulding can be crafted to fit just about any need or application and this brochure gives you inspiration where and how to start.

At ENBI Plastics & Silicones, we are continuously developing Liquid Silicone Rubber injection moulding solutions for companies around the globe. As an expert, we will gladly think along with you even at the early stages of the development process. No matter how small or large the component is, it will always be part of a bigger picture. At ENBI Plastics & Silicones we do not only ask 'what' you want to create, but most especially 'why' and 'how'. By keeping the bigger picture in mind, we are able to truly add value to your organization. Our goal is to remain a co-creator you can rely on to consistently provide the best service and innovative, high quality LSR injection moulded solutions.

Let us introduce you to the world of Liquid Silicone Rubber.



CO-CREATING YOUR LIQUID SILICONE RUBBER AMBITIONS

INDEX

1. WELCOME TO THE WORLD OF LIQUID SILICONE RUBBER	4
2. GETTING STARTED WITH LIQUID SILICONE RUBBER: WHAT YOU NEED TO KNOW	6
3. THE VARIOUS USES OF LSR	8
4. MISCONCEPTIONS ABOUT LIQUID SILICONE RUBBER	10
5. LIQUID INJECTION MOULDING OF LIQUID SILICONE RUBBER	12
6. CHOOSING THE RIGHT LSR LIQUID INJECTION MOULDING PARTNER	14
7. SETTING UP A SUCCESSFUL LSR PROJECT	16

WELCOME TO THE WORLD OF LIQUID SILICONE RUBBER

1.

Liquid Silicone Rubber (LSR) is a liquid silicon material, which is processed with an injection moulding process. Thanks to its special materials and processing properties, LSR offers unique design and production opportunities for ENBI Plastics & Silicones. LSR has numerous uses in different industries, including health care, food, automotive, household appliances, and other sectors.

For the injection moulding of silicon, ENBI Plastics & Silicones uses machines with a closing force between 25 and 110 tons. This way we produce products made of components weighing from less than a single gram to approximately 100 grams, and which vary between <10 Shore A to approximately 80 Shore A in hardness, using both 1K and 2K injection moulding processes.

Would you like to know more about LSR and how it can benefit your products or components?

Our experts at ENBI Plastics & Silicones love to help you with all your questions about LSR. Feel free to contact one of our specialists today.

WHAT ARE THE CHARACTERISTICS OF LSR?

Many businesses opt for LSR for the production of their elastomer parts. Why exactly? Mainly because of the reproducibility of the material. Injection moulding LSR offers ease of processing, a great variety of geometric possibilities, consistent component quality, and improved productivity. Because of its unique properties, LSR is the ideal material for demanding applications:

- **Certified for medical and food sector:** LSR can safely be applied in parts that come into contact with drinking water, food, or drinks. Because LSR is odorless and tasteless, it doesn't affect food and drinks.
- **High Purity:** LSR is odorless and tasteless. Thanks to this high level of purity, LSR can also be used in medical components.
- **Oil resistant:** Because of the material's temperature resistance, LSR can be used in situations where oil is present. This makes LSR especially suitable for the automotive sector.
- **Oil excreting:** Because LSR excretes oil, it is a suitable material for products or components that are used for mounting purposes.
- **Mechanical properties:** LSR is flexible, which means it has a high tear and tensile strength. It also has a low C.S. Value (compression set/permanent deformation). It is available in a variety of hardness, ranging from 10 to 80 Shore A.
- **Electrically insulating or conducting:** Due to its insulating and conducting properties, LSR can be easily applied to electric components
- **Ultra transparent:** LSR has an optical material grouping, which means it is ultra transparent. For this reason, it is regularly applied in lighting systems such as lens or light conductors.
- **Self-bonding:** Thanks to its self-bonding properties, LSR is extremely suitable for 2 component parts, both for LSR + LSR and LSR + plastic and LSR + metal.

WHAT ARE THE BENEFITS OF LSR?

Because of the unique properties of LSR, the use of silicone in products has many benefits. The material is elastic, durable, and resistant to chemicals and high temperatures. Working with LSR also has many benefits for the production process:

- **Production of large quantities:** Advanced LSR materials provide ENBI Plastics & Silicones with the opportunity for injection moulding in a cost efficient way and large-scale production of complex silicon parts.
- **Low risk of contamination:** The LSR production process takes place in a closed system—a so-called 'closed-loop system'. This means the chance of contamination is almost zero. After all, the operator does not come into contact with the material. This way, the material is not exposed to the environment.
- **Higher automation level:** Although injection moulding of LSR is a labor-intensive process, LSR is responsible for completely automating material supply, injection, processing, and demoulding of tools and machines. As a result, labor costs to control and protect the production process are kept as low as possible.
- **Fast cycle time:** the cycle time for LSR components depends on the product thickness and temperature, geometries of the part, general vulcanization properties, and chemistry of the hardening material. LSR's cycle times are significantly shorter than those of rubber and plastic products.

The background of the entire page is a vibrant green. Scattered across this background are several black, cylindrical parts made of Liquid Silicone Rubber (LSR). Some parts are hollow tubes, while others have conical or pointed ends. They are arranged in a way that suggests they are various components or prototypes created using LSR.

GETTING STARTED WITH LIQUID SILICONE RUBBER: WHAT YOU NEED TO KNOW

Liquid Silicone Rubber (LSR) is a material for injection moulding that is being used more and more by ENBI Plastics & Silicones. It is durable, flexible, and extremely versatile. Not to mention, it is also very cost efficient.

By means of this article, ENBI Plastics & Silicones aims to help you make the right decisions in terms of material type and which process composition best suits your project. Within just a few steps it'll quickly become clear which choices are important when starting an LSR project.

2.

IS LSR THE RIGHT MATERIAL FOR YOUR PROJECT?

The first step in product or project development is determining the right material. In terms of the production process at ENBI Plastics & Silicones, LSR comes with many benefits. These benefits are more extensively discussed in the previous article. These unique properties make LSR the best choice for a great variety of complex injection moulding projects.

LSR is a versatile material, which makes it suitable for a great variety of uses. For example, LSR can be used in the injection moulding of household appliances such as food processors. Additionally, thanks to its unique characteristics and benefits, LSR is also applicable in areas such as the automotive, agriculture, food, medical, and infant care sectors.

LSR is an extremely versatile material. In other words, LSR offers an expansive range of design possibilities. It has a high thermal stability and neither the mechanical nor chemical properties will change in (extremely) hot or cold environments. It can be used to produce products or components with a high degree of complexity, combined with an extremely high level of precision and large range of geometric possibilities.

LSR is naturally resistant to degradation through chemicals, environment, or UV. The properties of the material remain stable, even with long-term exposure. LSR is also resistant to mold, mildew and other bacteria. In short, LSR is a versatile material and a smart choice for demanding applications.

WHICH PROCESS SUITS YOUR PROJECT BEST?

The next step in starting with an LSR project is to determine the right process. ENBI Plastics & Silicones has multiple possibilities for injection moulding with LSR, including:

- **1K Injection Moulding (LIM):** *The use of silicon products in projects offers many benefits. For injection moulding of silicon, we can use machines with a closing force between 25 and 110 tons. This allows us to create products ranging from less than a gram up to approximately 100 grams in weight, and varying from < 10 Shore A up to 80 Shore A in hardness.*
- **2K Injection Moulding:** *Combining LSR with a different type of material? This is also possible at ENBI Plastics & Silicones, with the help of two-component (2K) injection moulding. In 2K injection moulding, both a plastic and liquid silicon part are injected in a single cycle and chemically bonded. The same is possible by bonding two silicon products—for example with two different hardnesses. It is even possible to bond LSR with a metal, for example stainless steel. We use 2K injection moulding in producing complex compositions of parts, for which the design can often be simplified so that no further assembly is necessary. The closing force of our 2K machines varies from 65 up to 220 tons.*

GET STARTED WITH LSR!

Our experts are here to help you out and are happy to advise you on your LSR project. Contact one of ENBI Plastics & Silicones' experts and discover how we can turn your projects into reality!



THE VARIOUS USES OF LIQUID SILICONE RUBBER

3.

The differentiating properties of Liquid Silicone Rubber make LSR more widely and easily applicable than conventional silicones with high consistency and thermoplastic elastomers.

Since its introduction in the 70's, Liquid Silicone Rubber has grown into a material with a great variation of types and properties. In addition to the original use in niche applications, ENBI Plastics & Silicones now uses the material in a wide range of industrial applications. Extensive developments in the making of new compounds, injection systems in combination with mould construction, and automating and guarding both production process and product quality, make LSR an appealing option for medical and food, industries, household appliances, automotive, industrial and agricultural sectors.

POTENTIAL USES PER SECTOR

Medical

In the medical world, it is a must to warrant absolute product safety. LSR has a soft feel, which makes it an obvious choice for machines that come into close contact with the body. Strict regulations apply to producing medical products made from plastic and/or medical silicon. ENBI Plastics & Silicones is ISO13485 certified and guarantees a working method in which delivering top quality is paramount!

Food

Similar to the medical sector, product safety is equally important in the food sector. LSR is free of smell and taste and does not affect food or drinks. This makes LSR the ideal choice for machines parts that come into direct contact with food or drinks. Today, LSR is often used in both sealing and dosing systems.

Household appliances

The many properties of LSR ensure the diversity of materials that are needed to produce a wide range of household appliances. These products vary from vacuum cleaner parts to food processors.

Automotive

From essential necessities for automobile production, to both visible and invisible parts and components. ENBI Plastics & Silicones has extensive experience in developing and producing solutions for the automotive sector, using LSR as a base material. LSR is durable, flexible, and has a high thermal stability. In addition, LSR has a low compression set value, which prevents permanent distortion. This makes it an excellent

choice for components under the hood, such as oil seals, membranes for cooling-water systems, O-rings, and cable harness components. LSR can also be directly bonded to plastic or metal components.

Industry

Industrial uses of liquid silicone are endless. ENBI Plastics & Silicones produces, among others, paper transport, air treatment, water heating, and lighting system components. If desired, these components can be completely assembled and packaged.

Agricultural sector

Using LSR in the agricultural sector, we're always looking for the most optimal, efficient, and environmentally friendly solution. ENBI Plastics & Silicones produces a wide variety of products for the agricultural sector.

Overmoulding

Without the need for primers, LSR is able to both chemically and mechanically bond to thermoplastics, metals, and other LSR. As a result, overmoulding with LSR is an increasingly frequent process. ENBI Plastics & Silicones can take care of any overmoulding of plastics, electronics, metal axles, and inserts.

CUSTOM MADE COMPONENTS FOR YOUR BUSINESS

ENBI Plastics & Silicones produces custom, high-quality LSR components for markets ranging from the automotive and industrial sectors, to health care and household appliances. Please contact our specialists today and discover the possibilities of LSR for your business!



MISCONCEPTIONS ABOUT LIQUID SILICONE RUBBER

4.

Silicone is a synthetic material made from quartz sand. There are a wide variety of molecular structures, which means that this material is available in multiple forms, such as oils and fats (basic raw material for the chip / Waver industry) and LSR. This explains the rich variety of properties and range of products.

ENBI Plastics & Silicones specializes in LSR processing using the liquid injection moulding process. This allows ENBI Plastics & Silicones to realize the production of, for instance, car parts, medical equipment, and household appliances.

However, there are still many misconceptions about the material and product quality of LSR. This keeps companies from discovering and applying the benefits of LSR. In this article, ENBI Plastics & Silicones walks you through the misconceptions about LSR known to us. In addition, we explain why LSR can be a smart choice for applications in your organization.

Misconception 1: LSR injection moulding has limited possibilities

The injection moulding process of LSR is based on a fully automated process. The products roll out of the machine without a need for post-processing. Despite the flexibility of the material, it is definitely possible to selectively package products, to carry out sub-assembly, and to check products with vision systems. Due to its flow behavior and the flexibility of the material, extreme undercuts, multiple and large differences in wall thickness combinations, and very thin wall thickness (from 0.08 mm) with long flow paths are possible.

Misconception 2: LSR injection moulding is unaffordable

Injection moulding of LSR is actually very cost effective. Thanks to the development of advanced mould technologies, LSR tools are also attractive for small-scale batches. By using developed energy transfer systems, in which moulds are pre-heated, ENBI Plastics & Silicones can provide attractive offers. In addition, the LSR process has been developed to prevent material waste and save costs on secondary operations, such as membrane removal.

Misconception 3: LSR can only be produced using high mould temperatures

LSR can be adjusted so that it can be injection moulded and vulcanized at low mould temperatures. This process is mainly used when overmoulding moisture-proof electrical and electronic components (printed circuit boards, LEDs). At ENBI Plastics & Silicones this process is applied both 1K and 2K.

Misconception 4: LSR is sticky

The base component of LSR is liquid. Because of this, it is thought that LSR is, and will remain, a sticky material. However, after the vulcanization process, all forms of stickiness will have disappeared. The base material is rough, though this effect can be converted to a smooth and low-friction surface by special treatments during the production process. For applications such as cable insulation or medical products, the surface must meet these low-friction requirements.

Misconception 5: LSR causes allergies, irritation, and illness

Multiple LSR types have been developed and certified

for use in projects for both the food and medical industry. Naturally, the processing requirements are well documented by the different suppliers, and raw materials are certified per delivered batch. Various studies have shown that liquid silicone rubber - unlike natural rubber and chemical rubber types - does not cause allergic reactions or irritation of the skin.

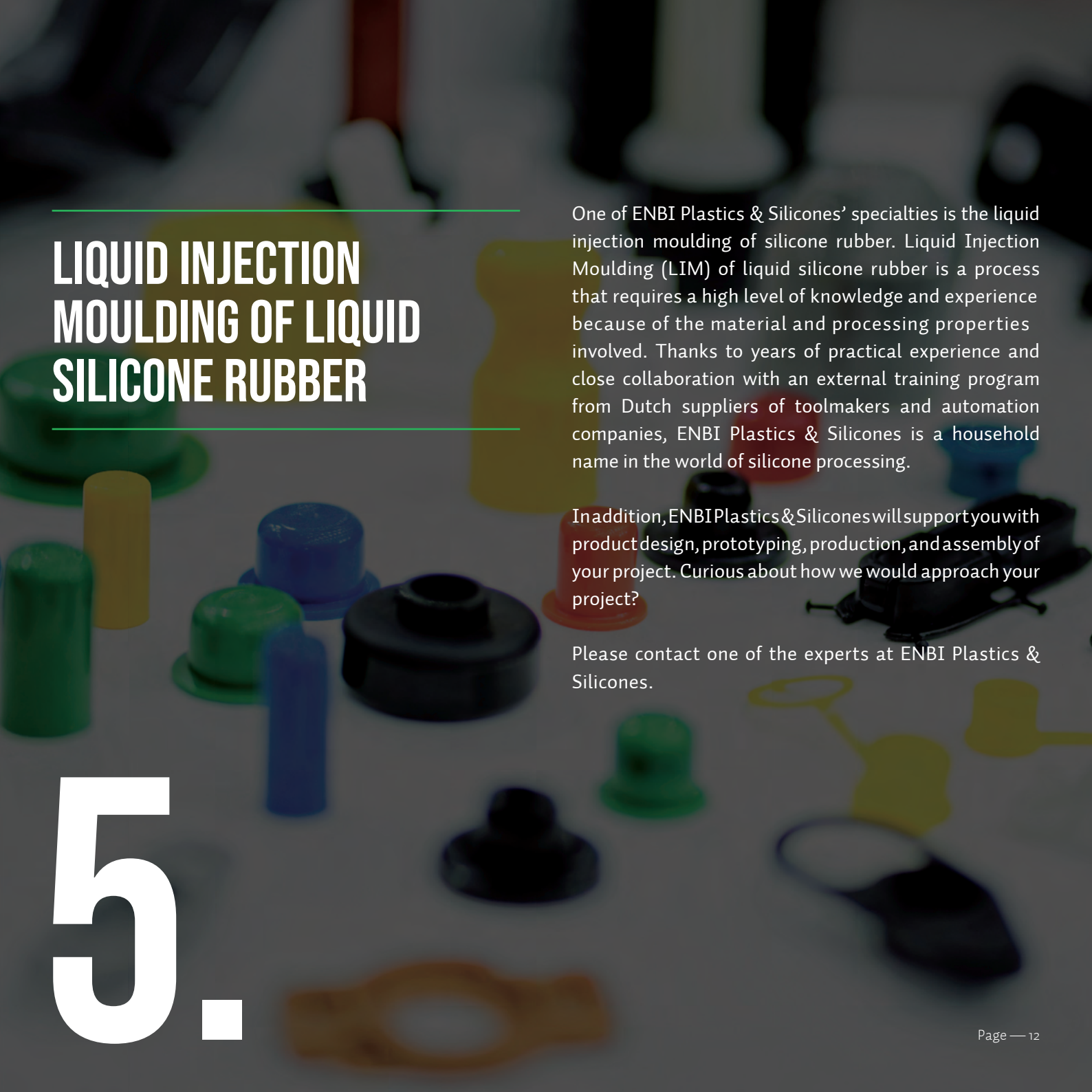
Misconception 6: LSR contributes to environmental pollution

The chemicals that cause environmental pollution and have an effect on the ozone layer are volatile organic compounds (VOCs), such as acetones, alcohols, methacrylate, and chlorofluorocarbon compounds (CFCs). LSR is non-organic in nature. This means that LSR does not contain the chemicals that contribute to environmental pollution or damage to the ozone layer. Waste products are processed by incineration, with quartz sand as a residue.

DISCOVER THE MANY BENEFITS OF LSR

Using LSR in your products or projects has many benefits. That is why it is crucial to work with an experienced liquid injection-moulding specialist. ENBI Plastics & Silicones has broad and in-depth expertise when it comes to LSR and its applications. From product (re)design in collaboration with the customer, mould development to prototyping, and from production to assembly. ENBI Plastics & Silicones takes your needs and wishes into account in every step of the process!





LIQUID INJECTION MOULDING OF LIQUID SILICONE RUBBER

One of ENBI Plastics & Silicones' specialties is the liquid injection moulding of silicone rubber. Liquid Injection Moulding (LIM) of liquid silicone rubber is a process that requires a high level of knowledge and experience because of the material and processing properties involved. Thanks to years of practical experience and close collaboration with an external training program from Dutch suppliers of toolmakers and automation companies, ENBI Plastics & Silicones is a household name in the world of silicone processing.

In addition, ENBI Plastics & Silicones will support you with product design, prototyping, production, and assembly of your project. Curious about how we would approach your project?

Please contact one of the experts at ENBI Plastics & Silicones.

5.

WHAT IS LIM?

Liquid Injection Moulding (LIM) is a process in which two components of silicone rubber are processed into a semi-finished product or end product. Both components are fed into the liquid injection-moulding machine in a 1-to-1 ratio by a pump system. Both components are then mixed within the system of pipes, together with a colorant or other additive if desired.

This mixture is permanently cooled throughout the process, after which the desired amount of material is injected into a heated mould via a (controlled) cold-channel system. This can be a single instance, prototyping, and/or small batch sizes, or multiple instances. In addition, it is possible to manually create a few samples with a simple test mould. The 3D printing of samples is also an option.

The versatility of LIM is a result of the material properties of LSR. Silicone can maintain a high degree of heat and flame resistance, tensile strength, flexibility, hardness, and compression set. Depending on the chemical composition, these materials can also serve as insulators or conductors. LIM makes it possible to manufacture very advanced products and components!

INCREASED PRODUCTIVITY AND MORE DESIGN OPTIONS

LIM is a fully automated process. This offers a high degree of process reliability and product quality. A typical property of LSR is the rapid vulcanization. This shortens cycle times, heightens productivity, and can result in significantly lower prices per unit compared to traditional processing techniques for HTV, also known as solid

silicone rubber. Thanks to LSR's viscous behavior and very high wall thickness, flow path ratios can be achieved. This facilitates both the production of very small and accurate precision components, as well as membrane-like products with very thin walls.

2-COMPONENT (2K) INJECTION MOULDING

LIM, based on the 2K liquid injection moulding technique, is another option that ENBI Plastics & Silicones offers to its customers. 2K LIM produces multiple consecutive combinations in one cycle, by one machine. For example, connecting a plastic component to a silicone component. It is also possible to connect two silicone components (two colors and/or levels of hardness). In addition, you can choose to overmould metal parts, printed circuit boards, or other customer-specific components.

With the 2K technique, we strive to achieve a chemical bond, which is already possible for a very wide variety of types of plastic (PC-ABS, polypropylene and polyethylene are recent additions to our list). LSR-types and metals are connected chemically. Mechanical bonding will always remain an option as well.





CHOOSING THE RIGHT LSR LIQUID INJECTION MOULDING PARTNER

6.

Few producers have the right background required for the development and liquid injection moulding of LSR products. This knowledge gap forms a challenge when making a well-considered decision to choose the right LSR liquid injection moulding company. For three decades, ENBI Plastics & Silicones has been a leading company in the development of LSR products, tools, and production processes. We have had the pleasure of unburdening many customers in the field of LSR projects.

ENBI Plastics & Silicones will take care of the entire process, from product development to a reproducible production process including assembly. Naturally, we inform our customers during each project step. This allows you to make informed decisions for all coordinated stages of the process.

In this article ENBI Plastics & Silicones explains more about important considerations when selecting the right partner for your LSR projects. Would you like to learn more about Enbi's approach or LSR material type? Please contact one of our specialists.

LEVEL OF EXPERTISE

The success of your project largely depends on the level of expertise of the injection moulding company that is responsible for the required developments. In ENBI Plastics & Silicones you will find a reliable partner with ample knowledge and years of broad experience. Thanks to a wide range of partnerships with suppliers, colleges, and universities, we can offer our customers many different levels of expertise. Although design specifications and budget certainly play a role in determining your project's possibilities, ENBI Plastics & Silicones can offer you expert advice with regard to product design, material selection, prototyping, mould development, and more.

We recommend finding a partner with extensive experience setting up similar projects. A partner that takes you through all stages of the development and production process, and who will fully guide you through the world of Liquid Silicone Rubber.

QUALITY ASSURANCE

LSR products or components often come into contact with food, liquids, or human beings. As a result, your injection moulding partner must ensure strict compliance with quality and safety guidelines.

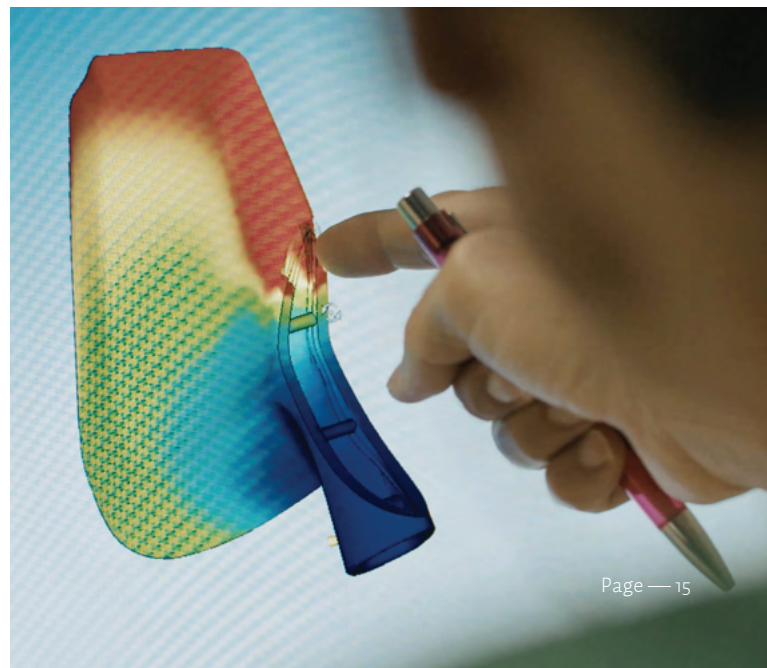
Quality assurance is especially important for medical and food production! Naturally, quality and safety assurance is of paramount importance at ENBI Plastics & Silicones. is therefore ISO13485 (medical), ISO14001 (environment), and ISO9001 (quality management) certified!

CLOSE INVOLVEMENT WITH THE CUSTOMER

Liquid Injection Moulding (LIM) of liquid silicone is an advanced process. It is therefore of great importance that you are advised, informed, and supported throughout this entire process. From prototyping to mass production, the right injection moulding partner will inform the customer towards achieving the desired result at all times. Naturally, if desired, ENBI Plastics & Silicones will sign an NDA (Non-Disclosure Agreement) with its customers. In fact, all our suppliers and collaborating experts have already signed such a confidentiality agreement.

WHY ENBI PLASTICS & SILICONES?

You can count on ENBI Plastics & Silicones for both long and short-term production, product development/prototyping, and secondary services such as assembly, finishing, and packaging.



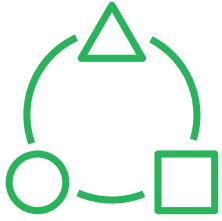
SETTING UP A SUCCESSFUL LSR PROJECT

Determining the correct product geometry, LSR type, and injection system are some of the most crucial steps in setting up an LSR project. Moreover, order sizes, lead times, budgets, and design functions are several examples of reasons for deploying a test phase. They also determine the design of both the injection system and associated tools. For an increasing number of fields, LSR is the preferred material over traditional silicone rubber. The excellent physiological properties of LSR, the fully automatic reproducible production process without post-processing, and the extremely high level of accuracy in dimensional tolerances underlie this.

In this article, ENBI Plastics & Silicones would like to introduce you to the fundamentals of successfully setting up an LSR project. Are you planning to start your LSR project as soon as possible, or would you prefer some additional information first? You are always free to contact one of ENBI Plastics & Silicones' specialists.

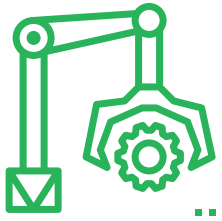


7.



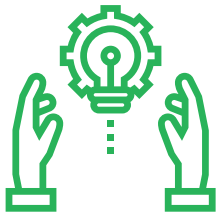
CHOICE OF MATERIAL

One of the first steps in setting up a successful project is to determine the right material. The liquid silicone injection moulding process uses a two-component material, consisting of an A-component (catalyst) and B-component (cross-linker). By cross-linking (vulcanizing) the still liquid mixed components, the compound is subjected to pressure and temperature and converted into a dimensionally stable product. After cooling, products will have the desired hardness and specific electrical, thermal, and mechanical properties. If requested, both dyes and function-dependent components can be added to the base material during the process. ENBI Plastics & Silicones also ensures the compounding of certified mixtures, for which additives have been pre-mixed in the basic material. Just as with thermoplastics, product developers may choose from different types of LSR. For instance, a project may require a silicone material that is self-adhesive, self-bleeding, or oil-resistant. In fact, a combination of multiple properties is also possible. In addition, you can choose from a range of hardness values per type, ranging from 3 to 80 Shore A.



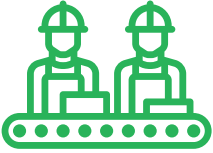
LSR PRODUCT GEOMETRY

During the development of an LSR product, one must take into account the various material and processing properties. These determine both the product geometry and manufacturability in a machine to a significant extent. Our engineers have a high level of knowledge about material processing properties as well as the development of silicone tools. On the basis of standardized mould conditions, ENBI Plastics & Silicones creates structures for both injection systems and moulds. We subsequently outsource execution to specialized companies, who are able to work within tolerance ranges of thousandths of millimeters.



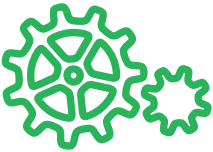
PROTOTYPING

Prototyping is one of the most important development stages in your project. With Liquid Injection Moulding prototyping can save both time and money. In this phase, you can evaluate product geometry, fit, and functionality before considering batch production. Prototyping is possible by means of 3D printing (several samples), manual production in a single mould (several samples from any type of material and hardness possible), and fully automatic liquid injection moulding in a single and/or multiple set of inserts (samples, o batch, and low production quantities)



PRODUCTION

Following the design, production, testing, and approval of your product-specific injection system and mould, the production process will commence. Advanced LSR injection moulding machines are operated by experienced specialists. With their knowledge, experience, and our internal quality control systems, we guarantee the delivery of high-quality products. If desired, ENBI Plastics & Silicones is able to implement 100% production inspection in terms of both dimensions and unwanted visual discrepancies using vision systems.



FINISHING AND ASSEMBLY

Looking to receive a complete end product, packaged and all? Why not opt for turnkey supplier ENBI Plastics & Silicones? ENBI Plastics & Silicones processes the produced plastic, LSR, and 2-K components into semi-finished and end products both manually and automatically. ENBI Plastics & Silicones can also print the products (plastic), melt inserts afterwards (plastic), and provide in-line marking using a laser (plastic and LSR). Moreover, ENBI Plastics & Silicones uses advanced processes and techniques for assembly, including high-frequency welding, laser welding, ultrasonic welding, and bonding. LSR products can be treated in-line or after production. To make certain surfaces of the product low-friction, for example. Here too, the assembled products can be inspected using vision systems if desired.



YOUR PARTNER MAKES THE DIFFERENCE!

Many companies interested in a LSR process for their product have difficulty finding an experienced partner for their project. Working with an experienced partner such as ENBI Plastics & Silicones will be invaluable in every phase of the project. From design, to prototyping, and from production to assembly and follow-up processing, ENBI Plastics & Silicones has numerous options available to make your LSR project a success. Please contact one of the ENBI Plastics & Silicones specialists and take the first step towards setting up your LSR project!

**COLLABORATE.
CO-CREATE.
INNOVATE.**

**WHAT'S YOUR
AMBITION?**





Ampèreweg 15
6101 XE Echt
The Netherlands

T +31(0)475 38 71 11
E info@enbi-plastics.com

enbi-plastics.com