



# Liquid Silicone Rubber Capabilities



# Innovation meeting customer needs

Advanced Liquid Silicone Rubber (LSR) technology is seeing exponential growth, particularly into high-tech fields of applications. In life sciences, it is driven by an increasing trend toward self-treatment of chronic ailments such as autoimmune diseases, blood conditions and hormone deficiencies. While in areas such as food processing and potable water, more stringent environmental, as well as health and safety scrutiny, are the catalysts to the move to LSR. In automotive, the vision of the fully autonomous car means vehicles have more and more electronic features; prompting the demand for super clean and integrated LSR components. The rising demand for LSR is also related to urbanization, demographic and social changes as a growing affluent population has a greater buying power for electronics and other lifestyle products and consumables.



**Cleanroom**  
manufacturing

Concept to serial  
**production**

**Global**  
presence

Pioneer in  
**automation**  
**and tooling**

In the still rather new field of high precision LSR technology, Trelleborg Sealing Solutions is a world leading player. What distinguishes Trelleborg as a leader are:

- Ability to develop and produce components at the highest level of complexity and accuracy
- Swiss precision tooling, process and automation technology
- Global manufacturing presence
- State-of-the-art and unique manufacturing set-up including cleanrooms
- Quality mindset throughout
- Development partner from first concept stage to serial production

**LOCAL PRESENCE, GLOBAL REACH**



Increasingly the world is becoming one and this trend is evident in manufacturing. Products are based on global platforms and manufacturers are demanding that their components are produced in the same way consistently, wherever they are supplied from. Trelleborg Sealing Solutions can help facilitate this through a network of over 50 marketing companies, regional R&D facilities, strategically placed manufacturing sites and centers of excellence globally.

Trelleborg’s LSR processing technology was born in Switzerland and the original manufacturing facility in Stein am Rhein is now the global center of excellence. The same processes and regimes founded there are replicated exactly in worldwide manufacturing facilities located in North America, Europe and Asia, with quality systems including ISO 9001, ISO 13485, ISO 14001 and TS 16949.

# Liquid silicone rubber: solutions through advanced technology

LSR and two-component injection technology can be applied to any industry. The components Trelleborg aims to produce are the result of your and our designers' imagination plus the quest for innovative solutions of our toolmakers and process engineers.



Electrical



Optics &  
lighting

Automotive



Pharmaceutical



Medical



Baby care



Food & beverage



Sanitary & household



Electronics



Lifestyle products



Water management



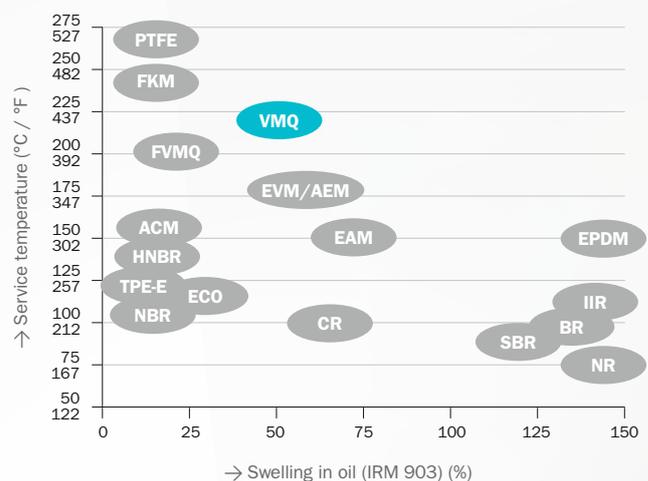
# Silicone – elastomer with unique capabilities

## Benefits of silicone

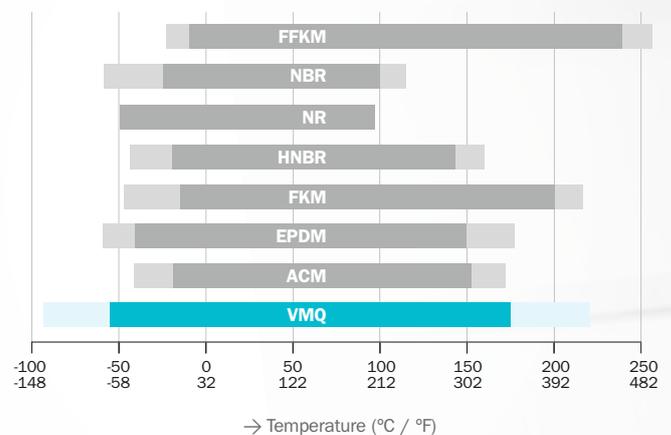
Silicone is an extremely versatile material that lends itself to a broad range of application conditions. As a liquid raw material, silicone offers advantages in processing that render it a premier choice of material for technical components in high volumes.

- Available in hardnesses from 10 – 80 Shore A
- Platinum curing gives the highest purity material
- Excellent low and high temperature resistance
- Offers excellent resistance to ozone, weather and UV rays
- Water repellent
- Offers excellent mechanical damping properties
- Possesses outstanding electrical properties:
  - Availability of UL94 listed types
- Specific to food contact applications:
  - Compliant with FDA, BfR, NSF
  - Neutral in taste and odor
- Specific to potable water applications:
  - Compliant with WRAS, KTW, ACS, NSF
- Specific to biomedical and pharmaceutical applications:
  - Highest purity
  - Biocompatibility to ISO 10993 and USP Class VI
  - Compliant with European Pharmacopoeia 3.2.9
  - Withstands common sterilization methods such as steam,  $\gamma$ -radiation, EtO

Media resistance of silicone (VMQ) in IRM 903 oil



Working temperature range of silicone (VMQ) against other elastomer types



## TRELLEBORG CALLS IT 2C LSR TECHNOLOGY – THE ULTIMATE LSR PROCESS

One of Trelleborg's most outstanding capabilities is the simultaneous injection of LSR in combination with technical plastics, 2C LSR technology. In what is commonly also referred to as 2K, 2-shot, multi-component injection molding, or co-injection, Trelleborg employs highly advanced and sophisticated tool and process engineering to develop the most innovative solutions, combining two, three or more individual materials into one fully bonded, robust component.

### General advantages of LSR

- Enables production of part geometries and technical solutions not possible otherwise
- Flashless, wasteless product quality
- Provides the highest consistency in product dimensions, precision, and overall quality due to lean manufacturing processes
- Enables highest volume production as a result of short cycle times
- Offers the lowest TCQ (Total Cost of Quality)

### Advantages of 2C LSR technology

- Offers designers much more latitude in design solutions
- Can integrate multiple components into one fully-bonded solution
- Single component is more robust than an assembly of individual parts
- Provides lighter weight components
- Risks and costs associated with secondary assembly can be avoided
- Enables more hygienic design solutions
- Lowers cost by reducing the number of components in the customer's supply chain



# The complete toolbox

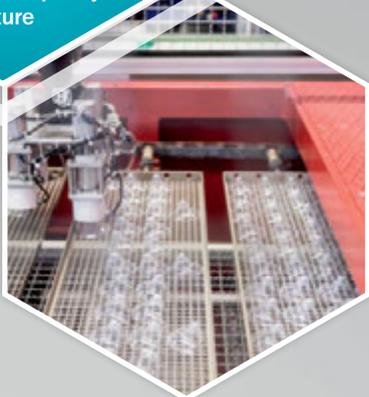
Providing the right solution for an application can be challenging. At Trelleborg Sealing Solutions we employ a complete toolbox of skills and expertise to make sure that the best result is achieved every time.





**PROCESS**

- Lean
- Flashless and wasteless principles
- Robust APQP process
- In-process quality control
- Zero-Defect quality culture



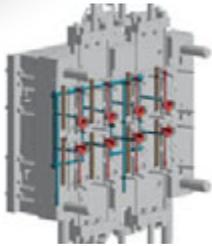
**TOOLING**

- From prototype to complete multi-cavity production tools
- Quick prototyping and sampling service
- Proprietary designs
- Innovation-driven



**ADVANCED LIQUID INJECTION MOLDING**

- Leading edge technology
- Closed loop manufacturing cells including handling, cleaning, inspection and packing



**TECHNICAL SKILLS**

- Our biggest asset
- Tradition of apprenticeship, training and continuous improvement
- Outstanding skill levels based on extensive technical experience



**AUTOMATION**

- State-of-the-art equipment
- Customized, fit-for-purpose solutions for the highest efficiency and quality



# Shoulder-to-shoulder engineering

Fully integrated solutions – from first concept through to serial production, from tens of thousands to many millions of parts, we work alongside our customers as a reliable development partner and dependable manufacturer of high quality, high precision LSR and 2C LSR components.



## 01

### CONCEPT DEVELOPMENT

- 'Black box' development
- Value-engineering of customer concept or existing product
- Creating ideas
- DFM (Design for Manufacture)

## Quality by Design



## 02

### PRODUCT SPECIFICATION

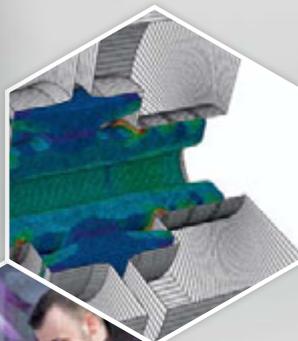
- Drawings
- 3D models
- Critical criteria
- Cleanliness
- Special surface finish or treatments
- Special packaging
- Product testing



## 03

### FEASIBILITY ANALYSIS

- FEA simulation
- Manufacturing feasibility
- Tool design models
- Supply chain considerations
- Feed-to-line concepts



## 04

### CONCEPT VALIDATION

- Flow simulation
- Quick prototyping (additive manufacturing)
- Quick sampling
- Material evaluation



# 05

## TESTING AND VALIDATION

- Dimensions
- Material properties
- Functional product testing
- Surface cleanliness
- Special testing, e.g. bioburden



# 06

## PRODUCT OPTIMIZATION AND DESIGN FREEZE

- Pre-serial trials
- DOE (Design of Experiment)



# 07

## INDUSTRIALIZATION

- Construction of molding and demolding tools and automated handling units
- Closed loop fully automated cells for high volumes
- Finalization of serial process in suitable environment: Cleanroom, White room, Gray room, Food safe cells





# 08

## SERIAL VALIDATION

- Part and material validation package to suit customer requirements
- Run@Rate studies
- Dimensional capability
- In-line inspection
- Process audit



# 09

## SCALE-UP PRODUCTION

- Scaled-up tools
- Scaled-up production cells
- Advanced automation techniques
- Direct Line Feed (DLF) programs
- Ready-to-use product packaging and supply systems



# LSR multi-component solutions

**Trelleborg offers countless options to develop solutions integrating two, three or even more components with LSR. This can provide a wealth of benefits:**

- Eliminates need for secondary seal/gasket assembly
- Removes the risk and cost associated with secondary assemblies
- Much greater design latitude for the developer
- Robust and cost-effective design solutions
- Eradicates potential leak paths
- Lowest total cost of ownership (TCO) for the customer

## **SUBSTRATES AVAILABLE**

Depending on application, product design and process requirements, we draw from a broad range of substrates that we combine with LSR into a fully bonded component:

- Dissimilar LSR types
- Technical thermoplastics
- Metals
- Other types of hard or soft substrates

### SIMULTANEOUS 2C LSR PROCESS

- Our most outstanding capability otherwise referred to as 2K, 2shot, co-injection or rubber-to-plastic bonding
- Available in many hard-soft and soft-soft combinations including multi-color and multi-hardness options
- Robust and most efficient way of providing fully fit to purpose product in high volumes



### LSR OVERMOLDING

- Combination of LSR with mostly plastic or metallic substrates
- Robust and most efficient manufacturing process for lower to medium volumes
- Fully-bonded custom solutions produced in two steps
- Available in a variety of hard-soft combinations



### MULTI-COMPONENT OPTIONS

- LSR in combination with other substrates, completed in a combination of injection molding, assembly and other process steps
- Customized systems and ready-to-use solutions



# LSR special capabilities

Using our advanced LSR design and production capabilities, Trelleborg Sealing Solutions offers a wealth of custom solutions.



### MICRO AND NANO TECHNOLOGY

- Components below 10 milligrams in weight
- Flashless production made possible with Trelleborg's needlepoint injection technology and fully automated parts handling



### THIN SECTIONS

- 0.10 mm / 0.004 inch or less
- Ideal for thin membranes
- Perfect consistency in thickness and quality
- No pin holes



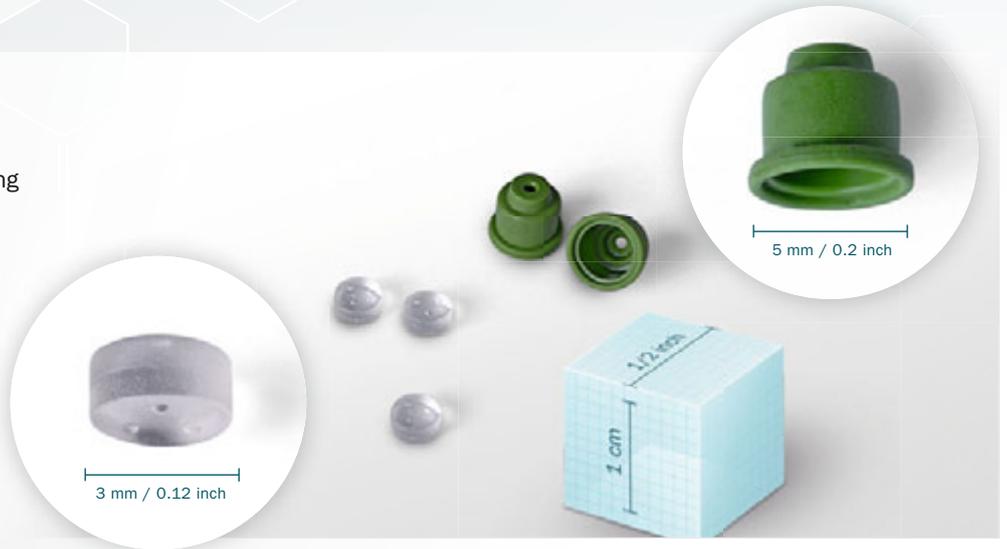
### DELICATE PARTS

- Formed reliably every time
- Flashless production made possible with special tool construction and automation



### VIRTUALLY FLASH-FREE

- No need for secondary deflashing
- High dimensional stability directly from mold
- Flashless, wasteless design principles
- Highest efficiency



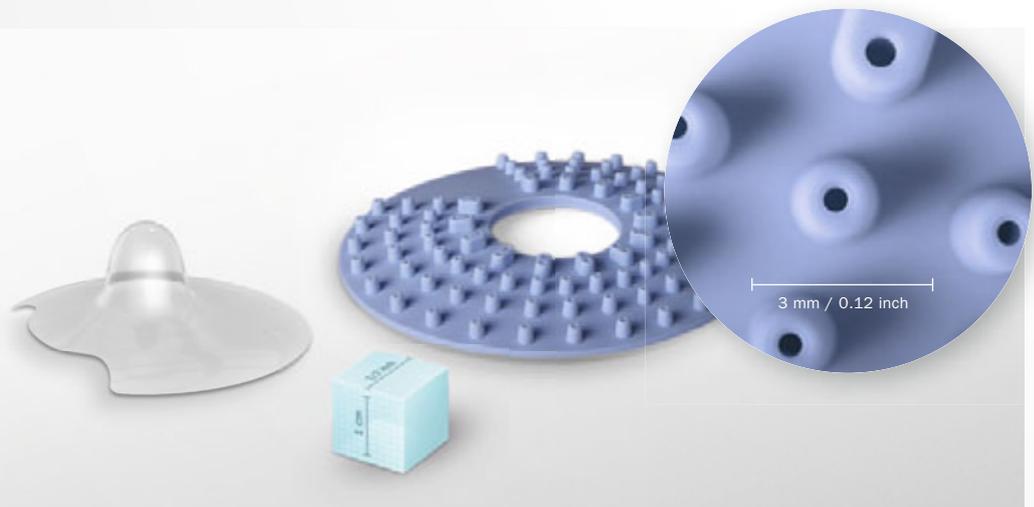
### BLIND SECTIONS

- Through holes perfectly formed every time
- Long tube sections reliably formed
- Made possible with special tool construction



### HIGHEST PRECISION

- Surfaces from high polish to textured
- Consistent manufacturing over millions of parts



**UNDER CUTS**

- Common feature in bellows, for example
- Made possible with LSR and special tool construction for molding and de-molding



## LOCAL CONTACTS

### EUROPE

**Austria – Vienna** (Slovenia)

+43 (0) 1 406 47 33

**Belgium – Dion-Valmont** (Luxembourg)

+32 (0) 10 22 57 50

**Bulgaria – Sofia** (Albania, Azerbaijan, Belarus, Bosnia and Herzegovina, Greece, Kosovo, Macedonia, Montenegro, Romania, Serbia, Ukraine)

+359 (0) 2 969 95 99

**Croatia – Zagreb**

+385 (0) 1 24 56 387

**Czech Republic – Rakovník** (Slovakia)

+420 313 529 111

**Denmark – Copenhagen**

+45 48 22 80 80

**Finland – Vantaa** (Estonia, Latvia)

+358 (0) 207 12 13 50

**France – Maisons-Laffitte**

+33 (0) 1 30 86 56 00

**Germany – Stuttgart**

+49 (0) 711 7864 0

**Hungary – Budaörs**

+36 (06) 23 50 21 21

**Italy – Livorno**

+39 0586 22 6111

**The Netherlands – Rotterdam**

+31 (0) 10 29 22 111

**Norway – Oslo**

+47 22 64 60 80

**Poland – Warsaw** (Lithuania)

+48 (0) 22 863 30 11

**Russia – Moscow**

+7 495 627 57 22

**Spain – Madrid** (Portugal)

+34 (0) 91 71057 30

**Sweden – Jönköping**

+46 (0) 36 34 15 00

**Switzerland – Crissier**

+41 (0) 21 631 41 11

**Turkey – Istanbul**

+90 216 569 73 00

**United Kingdom – Solihull** (Eire)

+44 (0) 121 744 1221

**Aerospace Hub Europe, North**

(UK and Nordic Countries)

+44 (0) 121 744 1221

**Aerospace Hub Europe, South & West**

(Continental Europe and Middle East)

+33 (0) 1 30 86 56 00

**Automotive Hub Europe**

+49 (0) 711 7864 0

### AMERICAS

**Americas Regional**

+1 260 749 9631

**Brazil – São José dos Campos**

+55 12 3932 7600

**Canada Central – Etobicoke, ON**

+1 416 213 9444

**Canada East – Montreal, QC**

+1 514 284 1114

**Canada West – Langley, BC**

+1 604 539 0098

**Mexico – Mexico City**

+52 55 57 19 50 05

**USA, Great Lakes – Fort Wayne, IN**

+1 260 482 4050

**USA, East – Mt. Juliet, TN**

+1 615 800 8340

**USA, Midwest – Schaumburg, IL**

+1 630 539 5500

**USA, Northern California – Fresno, CA**

+1 559 449 6070

**USA, Northwest – Portland, OR**

+1 503 595 6565

**USA, Southwest – Houston, TX**

+1 713 461 3495

**Aerospace Hub Airframe**

+1 303 469 1357

**Aerospace Hub Distribution & Engineering**

+1 260 749 9631

**Aerospace Hub East**

+1 610 828 3209

**Aerospace Hub West**

+1 310 371 1025

**Automotive Hub North America**

+1 734 354 1250

**Automotive Hub South America**

+55 12 3932 7600

### ASIA PACIFIC

**Asia Pacific Regional**

+65 6 577 1778

**China – Hong Kong**

+852 2366 9165

**China – Shanghai**

+86 (0) 21 6145 1830

**India – Bangalore**

+91 (0) 80 3372 9000

**Japan – Tokyo**

+81 (0) 3 5633 8008

**Korea – Seoul**

+82 (0) 2 761 3471

**Malaysia – Kuala Lumpur**

+60 (0) 3 90549266

**Taiwan – Taichung**

+886 4 2382 8886

**Vietnam – Ho Chi Minh City**

+84 8 6288 6407

**Singapore and all other countries in South and East Asia, Australasia**

+65 6 577 1778

**Aerospace Hub China**

+86 (0) 21 6145 1830

**Aerospace Hub Singapore**

+65 6 577 1778

**Automotive Hub China**

+86 (0) 21 6145 1830

**Automotive Hub India**

+91 (0) 80 3372 9200

### AFRICA, CENTRAL ASIA AND MIDDLE EAST

Details available at [www.tss.trelleborg.com](http://www.tss.trelleborg.com)



Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative engineered solutions accelerate performance for customers in a sustainable way. The Trelleborg Group has local presence in over 40 countries around the world.

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