

# Silicone processing with SilcoSet

## The tightest bond between technology and know-how

*Engineering Passion*

***Krauss Maffei***

# Facts and figures regarding SilcoSet technology

## Application areas



Medical technology / baby care



Consumer goods



Automotive

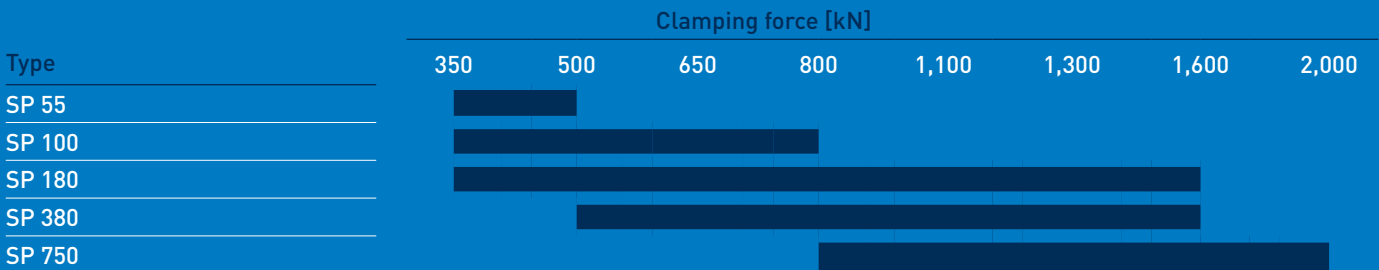


Electrical / electronics

## Technical data: LSR plasticizing unit

		Type				
		SP 55	SP 100	SP 180	SP 380	SP 750
Diameter	[mm]	18	22	30	40	50
Stroke volume	cm <sup>2</sup>	20	38	85	201	393
Injection pressure	bar	2,500	2,500	2,025	1,860	1,892

## Machine configurations



Complete technical data can be found in the catalog of hydraulic and electrical model series.

## Silicone processing with SilcoSet The tightest bond between technology and know-how

Thanks to new, improved material characteristics, silicones are being used in ever more applications in modern plastics processing. Silicones are highly transparent, easy to fit, temper-free and antibacterial. Furthermore, the number of self-adhesive systems is also continuously growing. New industries, such as the consumer goods industry, recognize the added value achieved with the improved look and feel of their products. SilcoSet technology makes KraussMaffei's hydraulic, electric and hybrid machines with clamping forces of 35 to 650 tonnes suitable for silicone processing – even subsequently. Turnkey solutions even provide a complete system, including the injection mold and peripherals.

### **The highlights of SilcoSet technology at a glance:**

- Exact shot weight consistency even with 256 cavities
- Absolute platen parallelism guarantees reliable processing of low-viscosity materials
- Easy changeover from thermoplastic processing to silicone processing

# Transparent technology

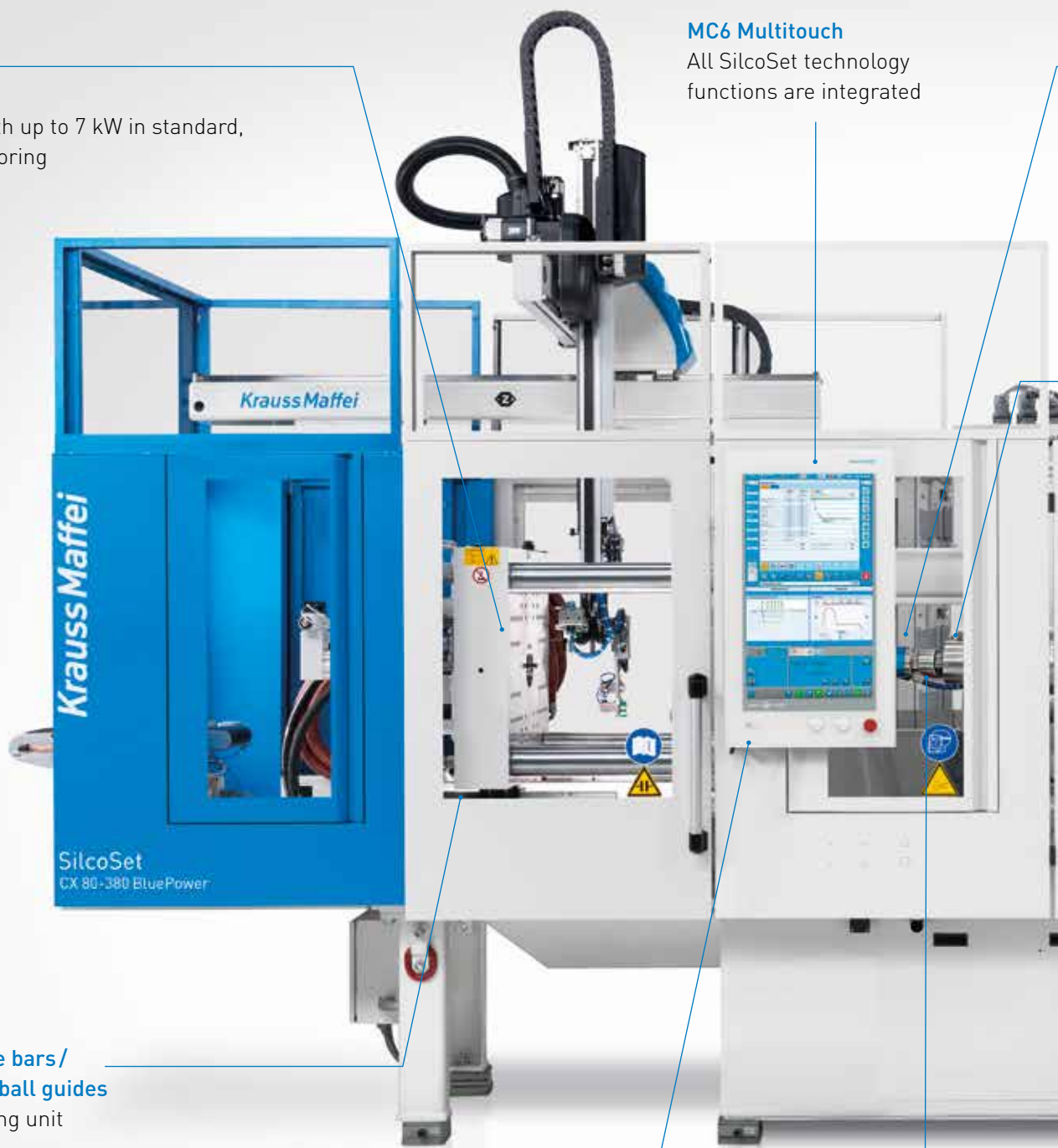
## Fascination SilcoSet technology

### Mold heating

High heat output with up to 7 kW in standard, heater circuit monitoring

### MC6 Multitouch

All SilcoSet technology functions are integrated



### Viton stripper for tie bars / on all recirculating ball guides

Protects the clamping unit against wear

### APC for SilcoSet

Compensates for the relatively large batch fluctuations of silicone products



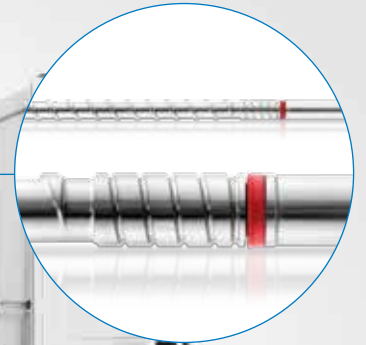
### Water-cooled shut-off diving nozzle

Reliable process up to the mold



### Leading screw technology

Precise and gentle processing of silicones without leakage



### Mixing and metering unit

The right range of peripheral equipment for every requirement



### Barrel with cooling-jacket

Precise temperature control for short cycle times

### Special silicone non-return valve

Very good, reproducible closing characteristics

### Proven in-line injection unit

Direct line of action for high injection precision

## Highly demanding consistency LSR – Liquid Silicone Rubber

The processing of liquid silicones, so-called LSRs, is particularly demanding. The consistency of LSR varies from water to honey, and demands absolute platen parallelism to ensure that the mold closes extremely tightly and an injection molding process that is matured to the finest detail.

### Machine technology for state-of-the-art liquid silicone processing

Liquid Silicone Rubber consists of two components which produce a stable network in a platinum-catalyzed additive cross-linking without fission products while retaining its elasticity. With the SilcoSet process developed by KraussMaffei, the screws, cylinders and nozzles on the injection molding machines are configured for the special features of the material LSR and furthermore are optimally suited to production in a cleanroom.

### Typical material characteristics of Liquid Silicone Rubber are:

- Extreme operating temperature range from -50 °C to 290 °C with stable characteristics profile
- Exceptionally high purity without softeners, biologically compatible and therefore ideal for medical technology
- Outstanding mechanical and elastic properties with extremely low compression set

- Highly transparent, but can be colored from translucent to opaque
- Fast cross-linking reaction

The SilcoSet injection molding machines from KraussMaffei let you take advantage of these properties.

### Process features

When LSR is processed, the raw material is made into a homogeneous mixture in a mixing and metering unit and fed to the plasticizing unit. The reactive, shear-sensitive mixture is cooled in the specially configured injection unit and gently transferred to the mold. It is important that the material is now injected very precisely as it reacts and cross-links very quickly during the vulcanization process at mold temperatures over 170 °C. The finished parts can be removed either by automation or by brushing.



### The benefits of LSR:

- Exceptionally high purity without softeners, biologically compatible and therefore ideal for medical technology
- Biologically compatible and hypoallergenic
- Outstanding mechanical and elastic properties

Nasal ventilator unit with  
FDA certification



All-electric machine with mixing and metering unit



## Machine equipment

### Standard package

Interface to mixing and metering unit

Special LSR plasticizing unit with sealed screw shank

Extension nozzle, non-return valve (RSP) and water-cooled cylinder casing

Viton stripper on the clamping unit

Temperature control units

### Add-ons

Hybrid solution for electric drive units

Vacuum preparation and pump, including integrated control system

LSR bolt-on injection unit and other multi-component solutions such as rotary plate and transfer technology

Full automation

Numerous other options

### Application areas:

- Aerospace
- Automotive
- Electrical / electronics
- Medical technology
- Consumer goods

## Maximum dimensional stability HTV – High Temperature Vulcanizing

The more cost-effective HTV is a solid silicone which comes in the form of rectangular blocks before it is processed. The art lies in processing the plasticine-like consistency without forming bubbles, which is guaranteed among other things by the intelligent design of the material feeding unit.

### High-performance materials for maximum dimensional stability

In addition to liquid silicones (LSR), there are also solid silicones (HTV: high-temperature vulcanizing), which come in rectangular blocks before being processed into their final shape. Due to their insulating properties and even higher dimensional stability, they are particularly well suited to applications in the electronics industry or applications involving high mechanical stress.

### Typical material characteristics of solid silicones are:

- Very good insulating properties, but also with variable electrically conductive properties
- Very good dimensional stability, cut resistance and resistance to weathering
- Flame-resistant; decomposes into non-toxic combustion products in the event of fire
- Excellent resistance to aggressive media, especially oil, fuels and coolant
- More cost-effective than liquid silicones

The SilcoSet injection molding machines from KraussMaffei allow you to use precisely these material properties to your advantage.

### Process features

When processing HTV, the bubble-free supply of plasticine-like blocks is especially important. This is guaranteed by adequate ventilation in the supply unit. The shear sensitivity of HTV allows it to be non-compressively plasticized with precise temperature control at temperatures below 45 °C. Afterwards, proper ventilation is decisive for the filling of the cavity and for component quality. The vulcanization process occurs at mold temperatures of 165 – 190 °C.



### The benefits of HTV:

- More cost-effective than LSR
- Very high dimensional stability with high mechanical load capacity
- Reliable and dependable

High-temperature-resistant  
plug sleeve



For the processing of HTVs, KraussMaffei offers injection molding machines which are specially configured for the properties of the material – even with patents on the AZ automatic supply unit.



## Machine equipment

### Standard package

Mechanical screw rotation blocking device and viton stripper on the clamping unit and linear guides

Water-cooled cylinder and extension nozzle, RSP additionally optimized for HTV with compatible key set

Injection compression molding and venting circuit

Automatic purging program in case of production downtimes

Sufficient temperature control units

### Add-ons

Automatic Polyload feeding unit for bubble-free material preparation, integrated into control system (vessel volume 50 or 100 l)

Polylift for fully automatic feed of the AZ Polyload without interrupting production

Integrated heater circuit monitor for mold heating

Versatile automation solutions

Full equipment catalog for electric and hydraulic model series

### Application areas:

- Aerospace
- Automotive
- Electrical / electronics
- Medical technology

## Meeting the highest demands Adaptive Process Control (APC) and two-platen technology

The demanding material characteristics of silicone mean the clamping unit has to close absolutely tightly and reliably – no problem for two-platen technology from KraussMaffei. The plasticizing unit provides for high-precision injection and thus for optimal component quality, which can be improved even further with the machine function APC (adaptive process control).

### New: APC for SilcoSet

KraussMaffei is the only manufacturer to have managed to integrate the specially developed machine function APC – which compensates for every process fluctuation – in a silicone production process. APC is available for hydraulic, electric and hybrid machines.

### Compensation for batch fluctuations

As is known, silicone primary products are subject to relatively large batch fluctuations which can lead to varying material viscosity and thus variations in the filling behavior of the cavities. As the process progresses, APC monitors the viscosity of the material and corrects the filling volume even in the shot. The process as a whole is made even more precise; the weight of the parts remains

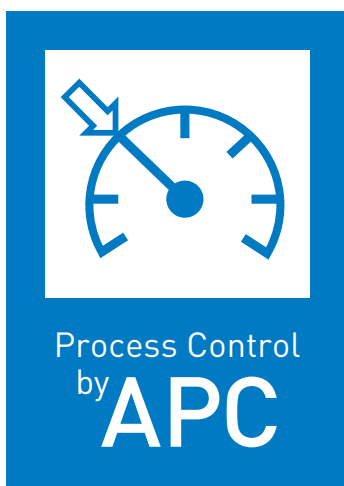
extremely constant. Even any potential preliminary cross-linking of the silicone can also be compensated for with APC.

### Space-saving thanks to proven two-platen technology

KraussMaffei's proprietary two-platen technology impresses with its extreme platen parallelism. The crossbars are guided at three points and form a stable and very compact frame, in part even with a cantilever clamping unit, providing space for peripheral systems.

### Your benefits:

- Constantly high component quality and much lower scrap rates with APC
- Space-saving and absolutely precise closing with two-platen technology



The proven in-line injection unit and innovative APC provide for extremely good shot weight consistency.

## High standards for top quality Plasticizing unit for LSR and HTV

Demanding materials need modern machine technology. To enable liquid and solid silicones to be processed reliably, exact temperature control, perfect closing behavior, reliable material feed and high-precision injection are essential in the process.

### Reliable cooling

To rule out the possibility of premature cross-linking, the uninterrupted cooling provides for stable thermal conditions during plasticizing. The temperature can be precisely controlled from the cylinder to the tip of the nozzle.

### Reliable material feed

The broad range of nozzles means that every mold can be reliably used. In particular the water-cooled, pneumatically driven diving nozzle ensures process-reliable material feed for every shot. In addition, it also acts as a mold seal, preventing material leakage and reducing material consumption.

### Perfect closing characteristics

Depending on the material requirements, special non-return valves have been developed for the SilcoSet procedure.

The special feature of these valves is that they close perfectly, even at extremely low viscosity, thus ensuring absolute reproducibility.

### Maximum shot weight consistency

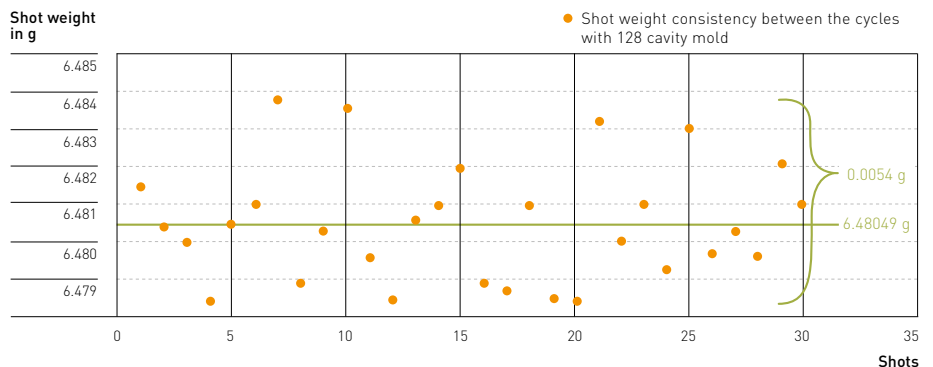
The minimal holding pressure means that high-precision injection is a major challenge when processing silicone in particular. The unique in-line design of the plasticizing unit means the force is transmitted directly and centrally from the injection pistons to the screw. This produces maximum shot weight consistency and optimal reproducibility.

### Your benefits:

- Optimal reproducibility and reliable production
- Reduced material costs
- Stable component quality
- Flexible use of your molds



### Shot weight consistency



With 12,800 parts produced, the fluctuation in shot weight is just 0.01%.

The RSPs developed by KraussMaffei guarantee reliable production.

# Unbeatable characteristics for every application

## Familiar and new application possibilities with silicone

The material characteristics of silicones are as varied as the industries in which they are used. KraussMaffei knows these characteristics very well and can support you with process know-how and machine technology from decades of experience.

### Electronics

The versatile characteristics of silicone are especially interesting for the electrical / electronics industry. Properties ranging from electrically conductive to insulating are possible.

#### Wire-end ferrules:

- Machine: all-electric, clamping force 800 kN
- Number of cavities: 256
- Shot weight: 13 g
- Cycle time: 16 sec.
- Special features: High-torque direct drive with high-precision injection unit and complex component removal with simple core-pulling programming
- Material: LSR

### Automotive

The automotive industry is also becoming increasingly interested in the extreme temperature range in which silicones can be employed. Self-adhesive types are suitable as seals on covers made of polyamide (including with glass fiber element) or other thermoplastics. Ignition cables for electric motors with high mechanical properties can also be easily realized with HTV.

#### Cover housing with LSR seal in the engine bay:

- Machine: CX 2K with rotary plate, clamping force 1600 kN
- Number of cavities: 1+1
- Shot weight: 170 g
- Cycle time, including automation: < 1 minute
- Special features: rotary plate with hose bushing; piggy-back combination of thermoplastic and LSR

#### Your benefits:

- Production reliability for precision parts with maximum number of cavities
- Automation solution for maximum flexibility
- Perfect machine design for minimal cycle times
- Precise temperature control despite opposing processing temperatures
- Complex production cell including automation in a very tight space
- Scrap rates reduced further thanks to APC



Wire-end ferrules: 265 parts in one shot



Cover housing with LSR seal



Cleanroom-compatible processing of liquid silicones: KraussMaffei injection molding machines are equipped for simple cleanliness, with antistatic and high-gloss paint finishes.



The modern and flexible material for all applications in the field of baby care.

#### Medical technology

One of the most frequently encountered fields of application is the health sector. Machines with cleanroom capability are used to produce, for example, cannulas, pacifiers or breastfeeding aids. Access to medical care is increasing in many countries around the world, and demand along with it. In the booming market in China, growth is also influenced by two other trends. First, the population in China is aging at a rate similar to Europe. Second, the number of very young users of silicone products is increasing due to the rising birth rate.

#### Pacifiers/bottle teats

- Machine: all-electric with cleanroom equipment
- Number of cavities: 8 with 21 g shot weight
- Cycle time: 25.5 sec. – including 20 sec. heating time
- Special features: encapsulated drive units and closed lubrication systems for a lubricant-free mold chamber
- Full automation for maximum cleanliness

#### Your benefits:

- Produced in cleanroom class 5
- Servo-electric drive unit for high-precision shot weight
- Unbroken documentation due to data records in the machine control



## Benefit from our SilcoSet expertise Advantages that speak for themselves



Their special characteristics make silicones suitable for a huge range of applications, including sport and leisure.

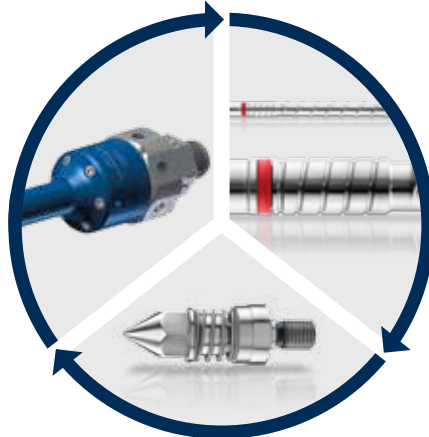
Only the concentration of competence will produce success in the long run, especially in demanding applications such as silicone processing. As one of the first processors, KraussMaffei has gathered well-founded experience in processing silicons. Experience, which we are constantly developing to enable us to offer you the best possible solution.

**100% process reliability thanks to the best components**

Thoroughly thought through from the material feed to the removal of the part, the SilcoSet process comes up trumps with specially developed components. For example, cylinders with cooling jackets, non-return valves and the needle shut-off nozzle provide for a smooth process which is not wasteful with the difficult material silicone. All important peripheral systems such as the automatic feed system and the vacuum pump are integrated into the MC6 control system, making the system much easier to operate.

**Perfect component quality**

KraussMaffei fine-tunes many aspects of the production process to ensure that optimal component quality is achieved. The screw is an especially gentle and efficient way of feeding the material. The in-line design of the plasticizing unit guarantees excellent shot weight consistency thanks to optimum force transmission. The integration of the machine function APC eliminates all fluctuations (e.g. batch fluctuations) and keeps the process absolutely stable.



Everything in perfect coordination

**Powerful network**

Demanding applications such as silicone processing require the pooling of expertise. KraussMaffei gives you the most powerful network in the industry, consisting of application technology, project and technology management and a modern TechCenter for sampling. This allows ever more new, individual customer solutions to be found, while the exchange of know-how and information with suppliers and universities also enables us – and you – to retain a competitive edge.

**Your benefits:**

- Reduced machine downtimes
- Very high user-friendliness
- Far fewer rejects for reduced costs
- Complete processing of turnkey projects
- Automation solutions from a single source
- Broad network of partners in the silicone industry



Comprehensive expertise

# Silicone processing with SilcoSet

## The tightest bond between technology and know-how

As one of the first processors, KraussMaffei has gathered well-founded experience in processing silicones – experience which we are constantly developing to enable us to offer you the best possible solution. SilcoSet technology makes KraussMaffei's hydraulic, electric and hybrid machines fit for silicone processing – even subsequently. Turnkey solutions even provide a complete system, including the injection mold and peripherals. Thoroughly thought through from the material feed to the removal of the part, the SilcoSet process comes up trumps with specially developed components. Plastics processors considering the idea of entering the silicone field are in good hands with KraussMaffei.