

LIM

Liquid silicone rubber and solid silicone injection molding

world of innovation



LIM AND HTV

A material with great potential for many applications

The term "silicone" stands for polymers whose chains, in contrast to hydrocarbon polymers, do not consist of carbon atoms, but instead of silicon and oxygen atoms (siloxane chains). However, hydrocarbon compounds, in the simplest case methane, or the methyl group (-CH₃) derived from it, are bonded to the two unoccupied bonds of the silicon. The material properties can be altered by bonding them with other types of hydrocarbon, such as ethane, propane, hexane, etc..

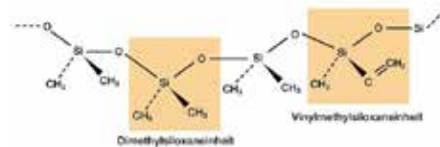


Photo: Wacker Silicones

The combination of an inorganic chain with organic outer molecules gives the silicones a unique range of properties not achieved by any other plastic material.

The advantages

- » Extensive range of application from -50 to +250 °C (special types from -110 to +300 °C)
- » High flashpoint and advantageous fire behavior
- » Good electrical insulation property
- » Excellent resistance to weathering and aging
- » High dimensional stability even under long-term load (sealing)
- » High bio-compatibility, odor and taste neutrality (medical use, baby care, etc.)

Accordingly extensive and diversified are the fields of application and manufacturing options. They range from sealing parts, medical components and baby care products up to crystal-clear optical lenses.

Depending on the chain length and/or molecular weight, the physical states vary from liquid or viscous to solid. Accordingly, silicone polymers are divided into liquid silicone rubber (= short chains) and solid silicone. By adding catalyzers and cross-linking agents, hydrocarbon bridges (cross-linking) between the siloxane chains can be produced and thus permanently elastic polymers (silicone rubber). Both liquid and solid silicone can be injection-molded.



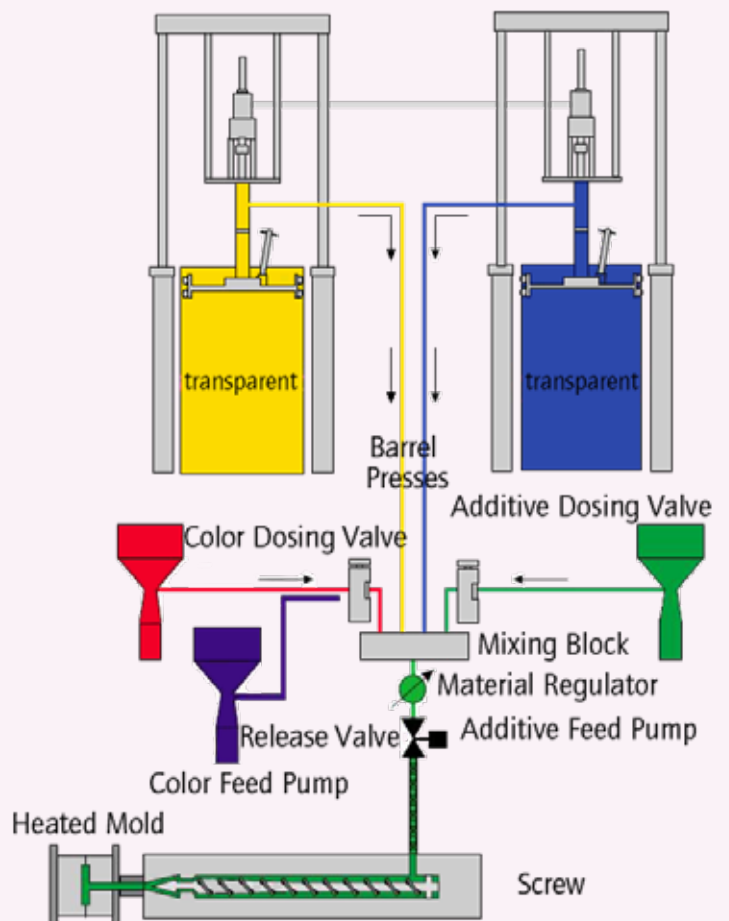
PROCESS TECHNOLOGY

Mixing, injection, cross-linking

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The technology for liquid silicone processing

- » In its original state, liquid silicone consists of liquid and transparent silicone in equal quantities. The silicone component A contains an additional platinum catalyzer, the silicone component B a cross-linking agent. Normally fillers for reinforcement, such as silicic acid or quartz, are added to both components as well.
- » Both material components are delivered in 20-liter or 200-liter metal drums. These are connected with a metering system, and the lids of the drums are subsequently replaced by the disk pistons of the material loading devices coupled with hydraulic or electric feed units. When the pistons advance, they apply pressure to the contents of the drum. Both material components are fed into a static mixer through tube connections simultaneously and in equal quantities. The mixing process starts the additive cross-linking reaction. In the mixer, colorants and/or other additives can be blended into the transparent silicone as well.
- » From the mixing block, the activated material blend is conveyed under pressure through a tube connection to the feed zone of the injection molding machine's LSR barrel. The barrel is cooled to between 20 and 25 °C by liquid circuit zones, to slow down the cross-linking process. As soon as a set volume of the reactive blend has been dosed, it is injected into a mold heated up to between 170 and 220 °C. Accelerated by the heat input, the completion of LSR cross-linking takes no more than a few seconds.
- » Control of the dosing and mixing system is synchronized via an interface with the injection molding machine.



LIM MACHINE TECHNOLOGY

Complete equipment package ex factory

The basic machines for LIM injection molding are the standard machines from the MicroPower, SmartPower and EcoPower series. The LIM machines from WITTMANN BATTENFELD are characterized by injection units specially adapted to the material attributes of liquid silicone and other LSR-specific equipment options.

The LIM equipment package follows a modular concept like the standard machines. It covers a wide range of injection volumes and mold sizes.

The LIM equipment options:

- » Injection unit with pneumatic shut-off nozzle for 2-component liquid silicone processing
- » Spring-activated check valve
- » Interface for 2-component material blending, dosing and feeding system
- » Cooling circuit drillings in the mold platens
- » Vacuum package
- » Cooling water monitor
- » Backwash filter

Moreover, an extensive range of equipment package options is available to adapt the machine individually to the relevant application.



THE LIM MACHINE EQUIPMENT PACKAGE

Matured by many years of practice

Wittmann



LIM

The highlights

- » **The injection unit**
Thanks to their open design, all injection units of the MicroPower, SmartPower and EcoPower series offer easy access for cleaning and maintenance. For 2-component liquid silicone processing a liquid-cooled barrel and a liquid-cooled needle shut-off nozzle are used.
- » **LIM check valve**
A spring-activated disk check valve version, which allows active closing and prevents the low-viscosity material from flowing back during injection
- » **Mold-media interfaces**
Molds for LIM injection molding require a vacuum connection for operation interfaces and/or connections for electrical mold heating, and optional compressed air and power connections.
- » **Vacuum, water monitor, backwash filter**
The vacuum pump is mounted at an easily accessible place on the machine frame. Parameter and monitoring settings are entered directly in the machine's control system. Features such as a cooling water monitor with backwash filter (cold runner cooling) can be used as an option.
- » **Differential pressure measurement and filter adapter for LSR**
The WITTMANN BATTENFELD feed pressure measurement is equipped with a filter adapter and pressure sensors. The measurement takes place as a differential pressure measurement and is evaluated in the quality table. The measured values can be used to check the function of the non-return valve and the process parameters, and contamination of the screen by already cross-linked material can also be detected.
- » **Demolding equipment**
Options available for demolding the often very soft and unstable LSR parts are either demolding devices (brushing devices) or parts removal robots with electric or pneumatic drives.

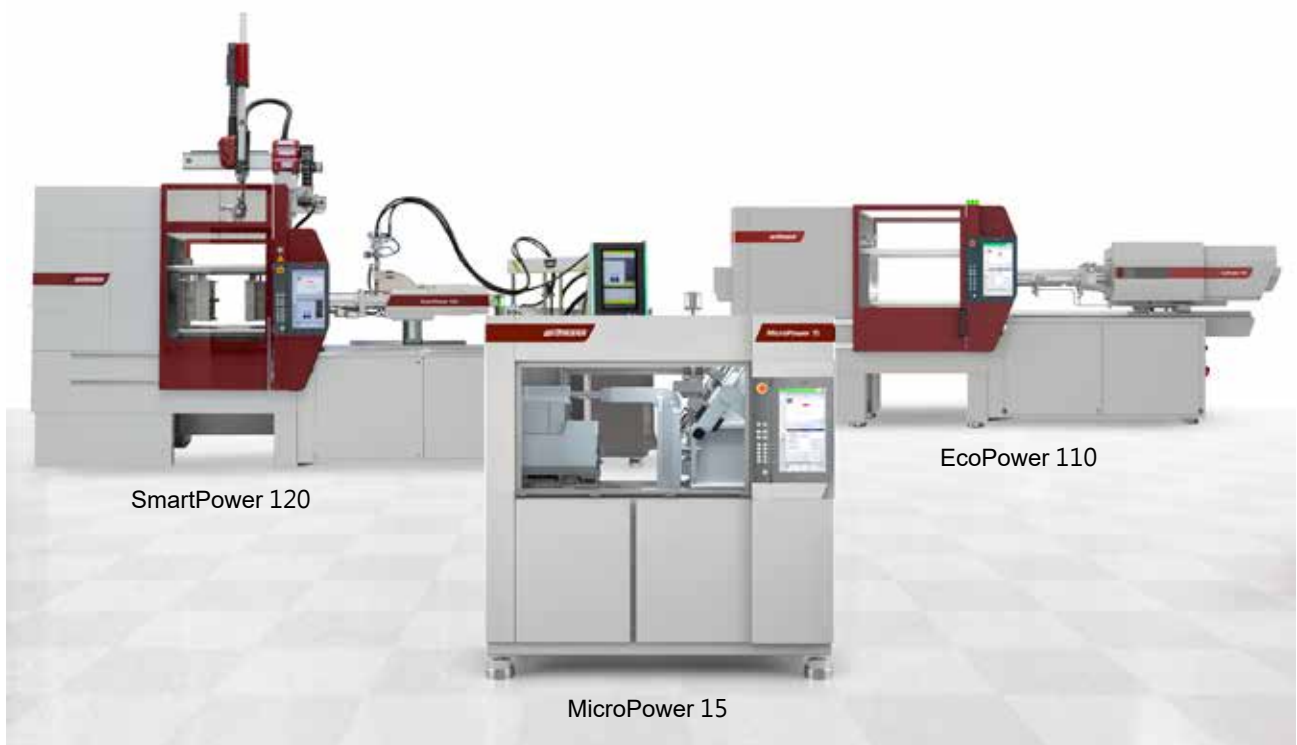
ALWAYS THE RIGHT MACHINE

Micro-, Smart- and EcoPower in LIM trim

The LSR equipment packages are available for the MicroPower, SmartPower and EcoPower machine series. Without exception, all LIM injection molding machines can be combined with all brands of material loading, metering and mixing equipment.

- » **MicroPower**
All-electric micro injection molding machine in clamping force size of 15 t
- » **SmartPower**
Servo-hydraulic all-round injection molding machine in clamping force sizes ranging from 25 to 400 t
- » **EcoPower**
All-electric, high-precision injection molding machine in clamping force sizes from 55 to 550 t
- » **Combimould**
By combining at least two injection units, the machines from all three series can be realized as multi-component models. These can be laid out for processing two types of silicone, as well as for producing combinations of thermoplastics with 2-component silicone.
- » **Medical**
All LIM injection molding machines can also be delivered in a Medical version for clean room production (see special brochure WITTMANN BATTENFELD "Medical").

(* theoretical shot volume)



MicroPower LIM

High precision for smallest parts

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Silicone micro parts are used in large quantities in medicine (e.g. implants and sealing elements for hearing aids) or technical appliances (such as optical parts, membrane, micro plug seals and damping elements). WITTMANN BATTENFELD has developed the LIM version of the MicroPower machines for such purposes.

LIM equipment options for MicroPower machines:

- » Liquid medium temperature-controlled injection unit to process liquid silicone
- » 2-component material loading, mixing and metering system for small volumes in compact, modular design
- » Control of the LSR material loading and metering system integrated in the machine's B8 control system and visualized on the control system's screen
- » Vacuum package
- » Media interfaces adapted to the specific mold technology
- » Easily convertible from an LSR into an elastomer unit

All equipment options for the standard MicroPower machine series are available as well - see our special "MicroPower" brochure.



LIM SmartPower AND EcoPower

Safe production of high-quality medical and electronic parts

The high bio-compatibility, radiation resistance and excellent electrical properties of liquid silicone, as well as its high transparency, open up many fields of application in medical technology, the production of baby care articles and items for the electrical and electronic industries, where the parts must generally be produced under clean room conditions. WITTMANN BATTENFELD supplies the appropriate machine models.

(Please see our product brochure "Medical" for details.)



LIM COMBIMOULD

Open for every configuration

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WITTMANN BATTENFELD injection molding machines from all machine series can be transformed into multi-component injection molding cells by adding further aggregates to the standard injection unit. In all aggregate configurations, every aggregate can be equipped for liquid silicone rubber injection molding, and combinations of aggregates for thermoplastics with LIM aggregates are also possible. The main field of application is mounting sealing components on housings, etc. by sequential combination of thermoplastics injection molding with silicone injection molding. For this purpose, Combimould machines are fitted with rotary or sliding tables in the clamping unit.

» V-configuration

Injection from above, also into the mold parting line

- Generous adjustment range
- Slide unit on linear guides
- Simple horizontal adjustment
- V aggregate can be moved back completely for an absolutely free mold space
- Path measurement for nozzle position incl. display in control system

» S-configuration

Slanted position above horizontal injection unit

- Compact machine design
- Small footprint
- S and H aggregates can move independently
- Separate adjustment for moment-free nozzle contact pressure
- Excellent access to the nozzle

» L-configuration

Injection from the non-operator side, also into the mold parting line

- Slide unit free on the rear of the fixed platen
- Injection unit supported on linear guides
- Large adjustment path
- Access to the nozzles and the mold from the rear via large operator safety gate
- Fixed platen free for standard linear robot
- Path measurement for nozzle position incl. display in control system

» H-H-configuration

Two parallel horizontal aggregates

- Both aggregates can move independently
- Good thermal separation of the aggregates
- Compact design
- Easy barrel change
- Short material testing



SOLID SILICONE INJECTION MOLDING

HTV processing

When solid silicone is to be processed instead of liquid silicone, the injection unit must be combined with suitable equipment to feed and liquefy the HTV, which is generally delivered in the form of blocks. This equipment module, known as a feeder device, consists of a material chamber and a pressure piston unit to make the inserted material flowable and to meter it into the plasticizing barrel. The feeding process is synchronized with the injection molding process and runs automatically. The pre-compression of the material displaces virtually all of the air from it and thus facilitates the production of parts free of bubbles and shrink holes.



SOLID SILICONE INJECTION MOLDING

Equipment in detail

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The HTV equipment options:

- » Compression-free screw conveyor with check valve adapted to the material
- » Water-cooled plasticizing barrel with diving nozzle
- » Evacuating program combined with a vacuum pump and connection points close to the mold area
- » Feeder in the appropriate size
- » Additional temperature control points for the mold
- » Automation equipment for parts removal
- » Automatic material loader for the feeder

An extensive range of additional equipment options is available for individual adjustment of the machines to specific applications.



UNILOG B8

Control system and process monitoring

The Unilog B8 machine control system is the WITTMANN BATTENFELD solution to simplify the operation of complex processes. To this end, the integrated industrial PC has been equipped with an enlarged intuitive touch screen operating terminal. The visualization is the interface to the new Windows® 10 IoT operating system, which offers extensive capacity for process control. In addition to the pivotable monitor screen, an integrated panel/manual operating terminal unit is installed in the machine's central console.



For parameter setting and regulation, monitoring and documentation of the LIM injection molding process, an optional program module is available to complement the standard machine control system.

- » **Integration of the cold runner needle shut-off nozzle control directly in the machine control system**
Setting of the needle shut-off nozzle can be effected directly via the machine's control system.
- » **Remote access to the mixing and metering system**
Depending on the model of the 2-component mixing and metering system, it can be integrated in the machine's control system. This makes it possible for the machine operator to enter the process parameters directly into the control system of the injection molding machine.
- » **Evacuation program**
Due to the high viscosity and the high injection pressures, molds must be produced with extremely low tolerances. Too high tolerances cause the formation of burrs and webs. With narrow tolerances, the mold seals very tightly under high pressure, which is why evacuation is necessary prior to injection. Air pockets would cause burnt spots, surface defects and filling problems.

General facts and figures about the WITTMANN BATTENFELD machine control system can be found in the special brochure "Unilog B8 control system".

WITTMANN 4.0

Barrier-free communication



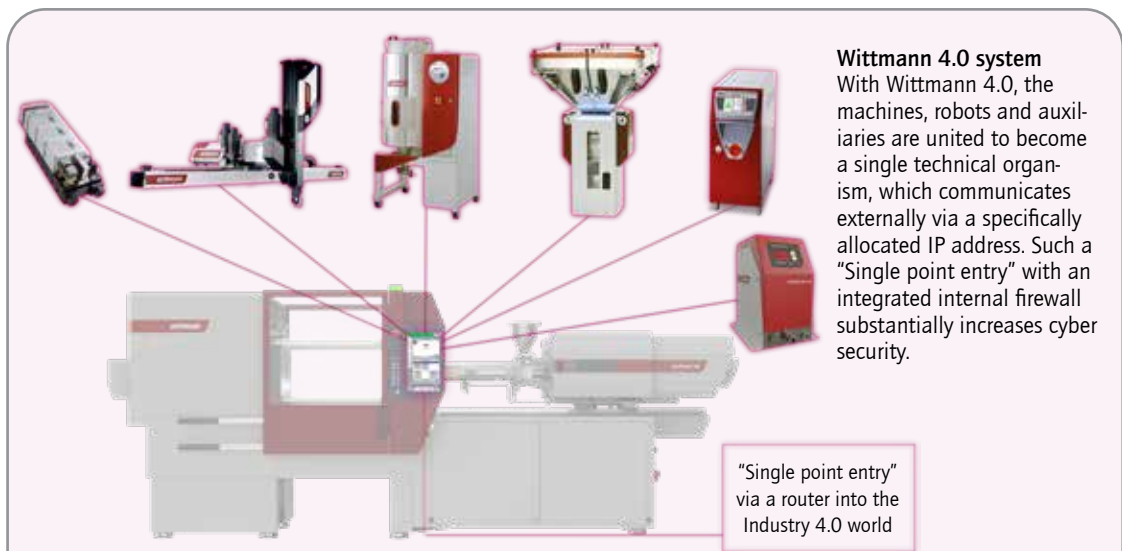
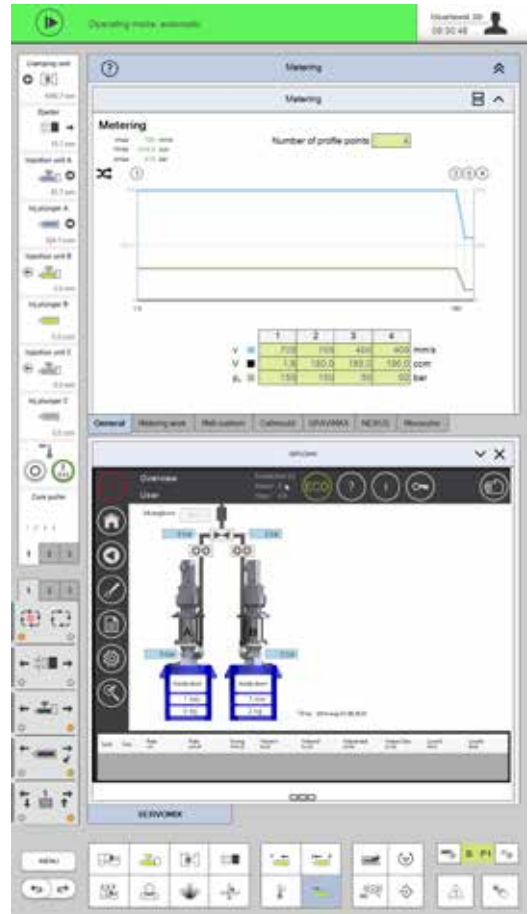
With the Wittmann 4.0 communication standard, the WITTMANN Group has established a uniform data transfer platform between the injection molding machine and the auxiliaries from WITTMANN. In case of an appliance change, the corresponding visualizations and settings are loaded automatically via an update function, following the principle of "Plug & Produce".

Integration of auxiliaries through Wittmann 4.0

- » **WITTMANN Flowcon plus flow controllers, Gravimax blenders and Aton dryers**
 - Direct activation and control of the auxiliaries via the machine's control system
 - Joint data storage in the production cell, the machine and, via MES, in the corporate network
- » **WITTMANN robots with R9 control system**
 - Robot control via the machine's monitor
 - High-speed communication between the machine and the robot to synchronize their movements
 - Important movements of the machine can be set via the robot's R9 control system
- » **WITTMANN Tempro plus D temperature controllers**
 - Temperatures can be set and controlled via the machine's control system
 - All functions can be operated on the appliance as well as via the machine's control system.

Integration into an MES system

The integration of the machines and complete production cells into an MES system is the prerequisite for an efficient, transparent production plant according to the Industry 4.0 standard. Depending on customers' requirements, small and medium-sized companies as well as global players are offered a compact MES solution based on TEMI+. With the Windows® 10 IoT operating system, selected status information from all connected machines can also be displayed as SmartMonitoring on the control system screen of every machine in the plant.



Wittmann 4.0 system
 With Wittmann 4.0, the machines, robots and auxiliaries are united to become a single technical organism, which communicates externally via a specifically allocated IP address. Such a "Single point entry" with an integrated internal firewall substantially increases cyber security.

"Single point entry" via a router into the Industry 4.0 world

APPLICATION TECHNOLOGY

Above-standard competence



» Automotive

Parts made of silicone elastomers are used in automobiles in large quantities and many varieties, primarily as cable support sleeves for all cable conduits through bodywork panels, but also as folding bellows and damping elements.



» Household/lifestyle

Thanks to its olfactory and taste neutrality, LSR is ideal for making consumer goods such as baking dishes and closures for drinking bottles. Due to their variable properties in many areas, e.g. electrically conductive or insulating, high heat resistance without loss of stability, silicone elastomer parts are an excellent solution for combined loads and functions.



» Medical components

Silicone is flexible and bio-compatible, therefore suitable for many applications in medical technology and bio science. The portfolio includes respiratory masks, sealing elements for blood filters, as well as prosthetic components and even artificial hearts. Thanks to their high heat resistance, silicone components can be sterilized.



» Optical parts

Thanks to their excellent optical attributes and heat resistance, silicones are used in lens production and lighting technology.



» **Sealing elements**

Silicone rubber is superior to rubber elastomers due to good mechanical properties across a wide temperature range (from -50 °C to +250 °C, special types from -110 °C to +300 °C). This is an important prerequisite for long-term preservation of the sealing function.



» **Baby care**

Because of its excellent flexibility and biocompatibility, silicone is ideal for all kinds of baby pacifiers, teething rings and toys.



» **Combimould**

A prominent application of an additive multi-component injection molding system is the production of self-cleaning shower heads, which consist of a thermoplastic housing and an elastic jet area made of LSR. Similar applications are housings with directly overmolded seals.



» **LIM + Airmould®**

Similar to injection molding of thermoplastics, the gas injection process can be used for thick-walled silicone parts to compensate shrinkage. It can also be used for targeted formation of hollow spaces to reduce the consumption of expensive materials.

The Wittmann logo is located in the bottom right corner of the page. It consists of the word "Wittmann" in a white, italicized, sans-serif font, set against a dark red, rounded rectangular background.

WITTMANN BATTENFELD GmbH

Wiener Neustädter Strasse 81

2542 Kottlingbrunn | Austria

Tel.: +43 2252 404-0

info@wittmann-group.com

www.wittmann-group.com