WACKER SILICONES

ELASTOSIL®

BONDING, SEALING, POTTING / ENCAPSULATION AND COATING WITH RTV SILICONE RUBBER COMPOUNDS

CREATING TOMORROW'S SOLUTIONS

Where to Find What

WHOEVER IS FAMILIAR WITH WACKER RTV SILICONE RUBBER COMPOUNDS KNOWS THEIR STRENGTHS

LOOK FOR A PRODUCT AND FIND IT!

Room-temperature-vulcanizing silicone rubber compounds are a traditional mainstay of WACKER SILICONES' product portfolio. Our range of ready-to-use products for the numerous applications in the fields of bonding, sealing, potting/encapsulation, coating and mold-making is accordingly impressive. Equally impressive, however, is WACKER SILICONES' experience in the processing techniques and material requirements specific to these industries: from DIY-scale right up to industrial production lines.

With more than 50 years' experience in silicone technology and an above-average commitment to R&D, WACKER SILICONES has long since become indispensable to its customers for their technical progress. This would not be possible without ongoing, confidential dialog – without the trading of knowledge, experience and ideas that powers a shared undertaking. Our joint undertaking right here and now is to find the ideal product for your application.

You can always rely on WACKER's technical support service.

BENEFIT FROM QUALITY

Thermal Resistance

Thermal resistance is just one of the outstanding material properties that characterize silicones. For applications involving temperatures above 150 °C, silicones are the only elastomer candidate. Unlike other elastomers, they can withstand temperatures up to 180 °C permanently; special heat-stabilized grades will even withstand brief exposure to temperatures of up to 300 °C. For maximum thermal stability, it is important that the silicone rubber cures, or vulcanizes, completely. Thermal stability can be enhanced still further by subjecting the silicone compound to subsequent, well-ventilated post-curing, during which the temperature is raised slowly.
At the other end of the scale, silicones remain flexible down to -50 °C, with specialty grades resisting temperatures as low as -110 °C.

Expansion

Silicone rubber elastomers have a coefficient of linear expansion that is a direct function of filler loading and hence of specific gravity. The higher the density of a rubber, therefore, the lower is its coefficient of linear expansion. Typical values are in the range of $2 \cdot 10^{-4}$ m/mK and are thus substantially higher than for other potting/encapsulation compounds. Since silicone rubber undergoes relatively pronounced expansion during the curing process, the shrinkage encountered on cooling is likewise pronounced. This "apparent" shrinkage must be taken into account in advance.

Bonding Properties

Silicone rubber grades adjusted to be self-adhesive are suitable for many substrates. The bond quality will depend on the nature of the material to be bonded, the stress, the kind of bond and possibly the surface treatment.
The most superior bonds are obtained on oxidic and siliceous surfaces.
Good adhesive strength is also obtained with a number of plastics.

In other instances, it may be necessary or advisable to prime the substrate or subject it to flame or plasma treatment prior to bonding. Surfaces must always be clean and free of grease. Low-boiling solvents such as acetone[1] or aliphatic hydrocarbons are suitable cleaning agents.

Release Properties

The surfaces of silicone elastomers show a pronounced release effect when used with inorganic and organic materials such as gypsum, concrete, polyester, epoxide, polyurethane, polyamide, polystyrene, PVC, wax and metal alloys. This effect is exploited in the use of silicone rubber compounds to make molded parts and reproductions. WACKER supplies pourable, spreadable and kneadable silicone rubber grades to suit a wide variety of applications.

Mechanical Properties

WACKER supplies RTV silicone rubber compounds to meet a wide range of mechanical requirements. Compounds with a processing viscosity in excess of 10,000 mPa s yield elastomers with excellent tensile strength, elongation at break and tear strength. Low-viscosity products (less than 10,000 mPa s) yield elastomers with mechanical properties that are generally not as strong.

RTV silicone foams constitute a special class of RTV silicones. Although their mechanical properties are less good on account of their porous structure, these foams offer excellent damping and insulation. Their compressibility makes them ideal for use in seals.

Silicone gels are another special class of RTV silicones. These very soft materials (Shore A < 0) have an extremely low elastic modulus, so that even large temperature differences cause only little thermomechanical stress. Silicone gels are thus ideal for protecting delicate electronic components.

[1] Please pay attention to the material's flammability.

Permeability to Gas and Water-Vapor

At room temperature, the gas permeability of silicone rubber is about ten times that of natural rubber. Not until 100–150 °C do the permeability values converge. Under normal conditions, silicone rubber may contain some 15–20 vol % of dissolved air. Reducing or increasing the gas pressure causes a decrease or increase in the quantity of dissolved gas. Consequently, a sudden pressure drop will make dissolved air become visible in the form of bubbles. Special care must be taken when metering equipment is used, as the use of compressed air to convey the compound can also cause bubbling. Similar effects can occur on rapid heating, as the gas solubility decreases with a rise in temperature. The water-vapor permeability, as determined in accordance with DIN 53122 under climatic conditions D and a film thickness of 2 mm, is about 20 g/m^2 d.

Chemical Resistance

Silicone rubber is resistant to aqueous solutions, diluted acids and bases and polar solvents. Solvents such as ketones, esters and hydrocarbons may cause reversible swelling of the silicone rubber but do not destroy its chemical structure. Products with a high filler loading and/or that are very hard tend to swell less than softer compounds. The only way to remove cured silicone rubber from a surface is by destroying the rubber completely with concentrated sulfuric acid, alcoholic alkali solution or the like.

Radiation Resistance

Silicone rubber can be exposed to high doses of electromagnetic radiation – from the microwave to the UV range – without any noticeable effects. In terms of radiation resistance and hot-air resistance, it is superior to all other organic elastomers. This explains the use of silicone rubber in such a wide variety of applications, ranging from microwave cookers to solar generators.

Flame Resistance

The auto-ignition temperature of cured silicone rubber is about 430 °C. The resultant flame burns at 750 °C. In addition to the usual combustion products, namely carbon dioxide and water, silicon dioxide is produced and forms an insulating layer of ash on the surface. Silicones are flame-resistant – even without the addition of halogen compounds, which can generate corrosive and toxic gases in a fire. Generally speaking, their fire performance is better than that of many organic elastomers and casting resins.

Environmental Compatibility

Silicones have the same basic chemical structure as quartz. The cured rubber therefore poses no known ecological or physiological risks.

Thermal Conductivity

The thermal conductivity of most silicone elastomers is in the range from 0.15–0.25 W/(Km) at room temperature. However, values up to 2.5 W/(Km) may be obtained with specialty grades that have a high filler loading.

Electrical Properties

The electrical properties of silicone rubber remain almost constant over the temperature range from -45 °C to +180 °C. At room temperature they compare well with those of other insulating materials. What makes silicone rubber elastomers far superior to other materials, however, is the fact that elevated temperatures have no appreciable effect on their insulation resistance, dielectric strength or dissipation factor. These properties even remain constant when the compounds are immersed in water.

Normally, silicone elastomers are electrical insulators. However, they can be rendered electrically conductive by adding specialty fillers.

Unlike organic elastomers and casting resins, RTV silicone rubber shows excellent arc and tracking resistance. Specialty grades can attain values > 3.5 kV (IEC 587) for arc resistance and > 300 s for tracking resistance.

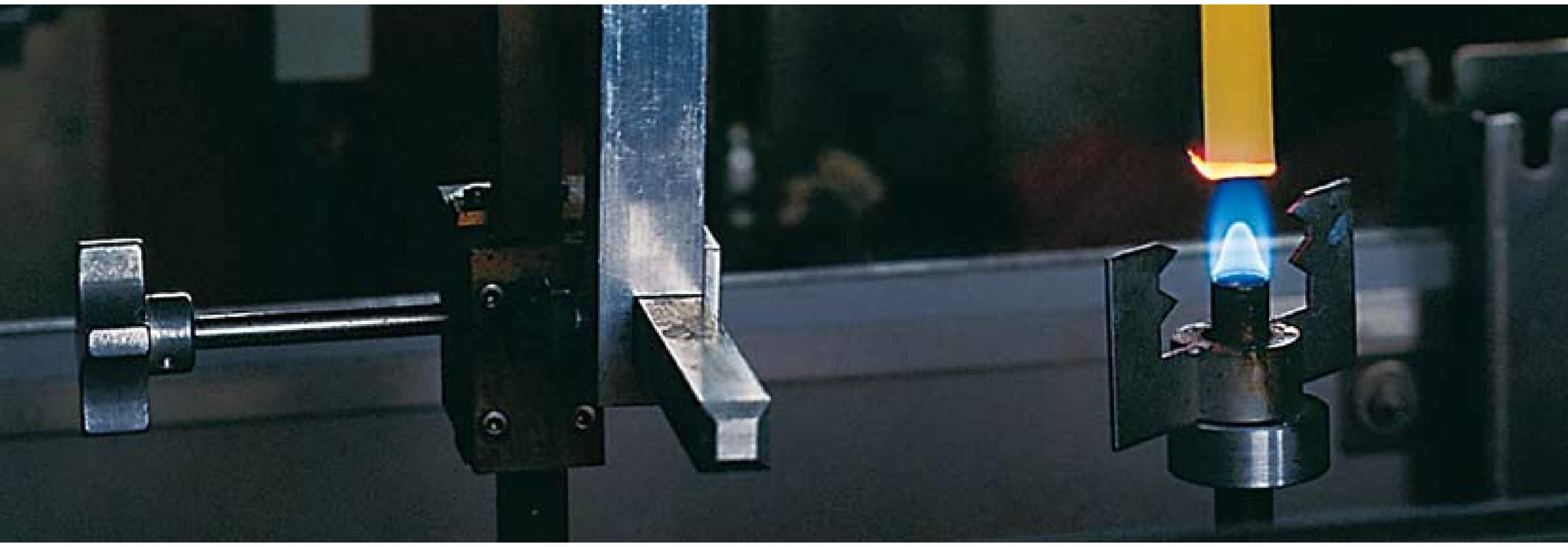
Optical Properties

The color and appearance of silicone rubber is determined by the fillers selected for the compound in question. The light permeability of thin layers of unfilled materials is almost 100 % in the visible range from 400 to 760 nm. These materials only become opaque in the UV range below 200 nm. Their refractive index n_D25 is between 1.410 and 1.404.

Storage Stability

SEMICOSIL®, ELASTOSIL® and WACKER SilGel® silicone rubber grades have a shelf life of up to 24 months (the exact time will depend on the grade in question) when stored in the original, sealed containers at between 5 °C and 30 °C. Storage beyond the date specified does not necessarily mean that the material is unusable, but a quality check should be performed on the most important properties.

DISCOVER DIVERSITY



By virtue of their diverse and excellent properties, RTV silicone rubber compounds from WACKER have a wide variety of bonding, sealing, potting/ encapsulation, coating and mold-making applications[2].

Property Overview

- Outstanding thermal resistance from -50 °C to +180 °C; specialty grades can withstand temperatures up to +250 °C and, at the other end of the scale, down to -100 °C
- Very good bonding to a variety of substrates
- Excellent weathering and radiation resistance
- Very good chemical resistance
- Superlative dielectric properties that remain almost constant over a wide temperature and frequency range
- Excellent environmental compatibility and no known harmful effects
- Water-repellent surface and low moisture uptake
- Low elasticity modulus
- High chemical purity

[2] You will find more on the subject of mold-making in our brochure "ELASTOSIL® M Mold-Making Compounds for Maximum Precision." Please contact your WACKER sales office.

SUPERIOR BONDING

Mechanical assembly techniques such as screwing and bolting, riveting, welding and soldering are being increasingly supplanted by modern adhesive bonding methods. The advantages are convincing:

Advantages of Adhesive Bonding

- More uniform stress distribution, as adhesives distribute stresses over the entire bonding area and thus minimize high localized stress concentrations
- An adhesive bond is simultaneously a seal and thus prevents the corrosion that so frequently occurs with mechanical fasteners
- Thanks to the high flexibility and low elasticity modulus of adhesive bonds, cyclic temperature loading causes only small thermomechanical stresses in bonded substrates with different coefficients of thermal expansion
- Ability to bond dissimilar materials
- Thanks to the good insulating properties of silicones, metals with different electrochemical properties can be bonded without risk of galvanic corrosion. The dimensions of the substrate remain practically unchanged
- An adhesive bond affords good vibration damping, as the silicones have a much lower elasticity modulus than the substrate
- Cost savings at various manufacturing levels: reduced warehousing, reduced labor costs thanks to automated adhesive application, less critical machining tolerances for the parts to be bonded

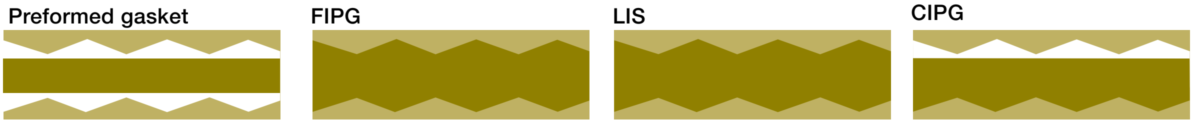
Products for Adhesive Bonding

WACKER offers products with widely differing property profiles for the adhesive bonding of materials:

- From flowable to non-sag
- Hardness levels from Shore A 10 to Shore A 80
- From transparent to black
- Electrically insulating or electrically conductive
- Thermally conductive up to W/(Km) (on request), but electrically insulating

FULLY AUTOMATED SEALING

Sealing technologies



	Preformed gasket	FIPG	LIS	CIPG
Application	Injection molded separately	Pasty to flowable, fully automated application	Pasty to flowable, fully automated injection	Pasty to flowable, fully automated application
Adhesion	None	Two-sided	None	One-sided
Assembly	After curing	Prior to curing	Prior to injection and curing	After curing
Disassembly	Possible	Impossible	Possible	Possible
Sealing function		Due to adhesive bonding	Due to expansion	Due to compression
Silicone sealants	ELASTOSIL® R or LR	ELASTOSIL® RTV-1 and RTV-2	ELASTOSIL® silicone sealant LIS (RTV-2)	ELASTOSIL® RTV-1, RTV-2 and ELASTOSIL® SC[3]

Fig. 1

Seals are frequently exposed to extreme conditions. As the interface between inside and outside, hot and cold or wet and dry, they have to be able to withstand all of these opposites.

Silicone seals are either manufactured in a separate injection-molding process and subsequently incorporated into the multi-component part, or else they are cured "in place". Curing can take place before or after the components have been assembled:

In wet assembly (FIPG), the parts to be sealed are assembled before the silicone rubber cures; accordingly, the accuracy of the part geometry is less critical. The adhesion of the silicone rubber to the components enhances the reliability of the seal.

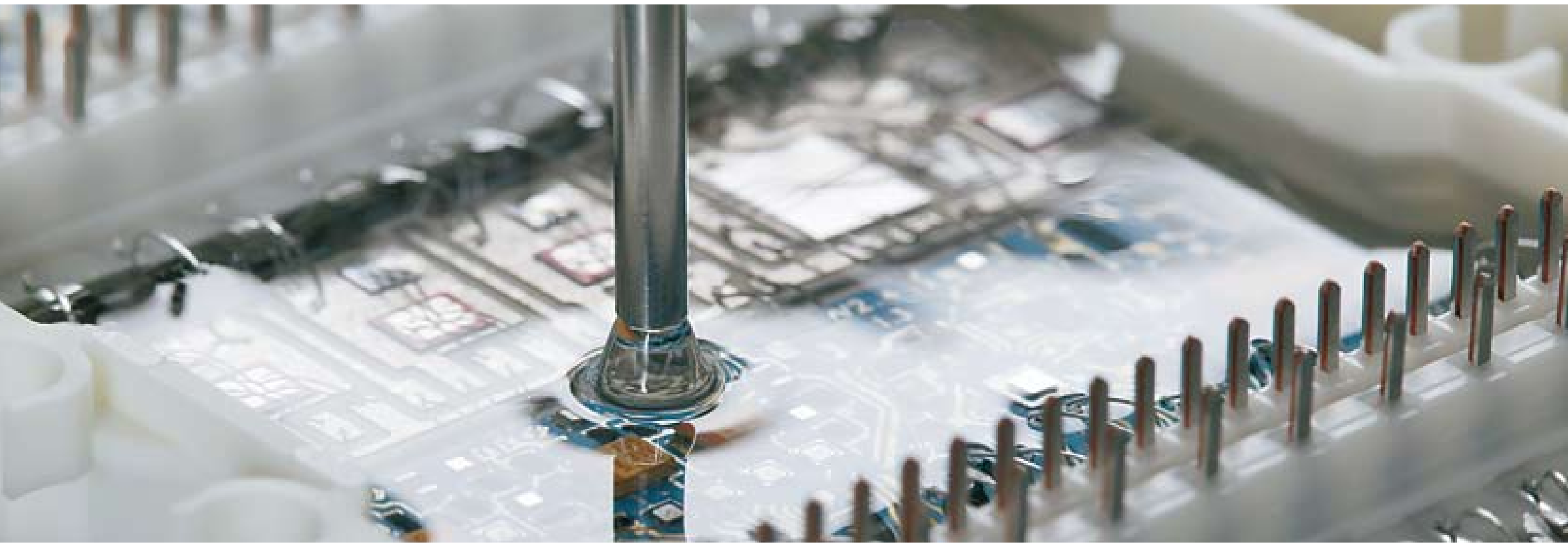
In dry assembly (CIPG), the seal adheres to the part to be applied and thus stays in place without being secured in any way. The seal can be dimensioned such that the joined components are mutually noise and vibration-damped.

This fully automated process using WACKER silicones offers a number of benefits:

- Less material input
- Simplified warehousing
- Fully automated application
- Flange surface needs no special post operations
- Simple groove design
- Seals stay in place until time of assembly

[3] Foams as dust and splash protection; large tolerances and low contact pressure

HIGH-VOLUME POTTING AND ENCAPSULATION



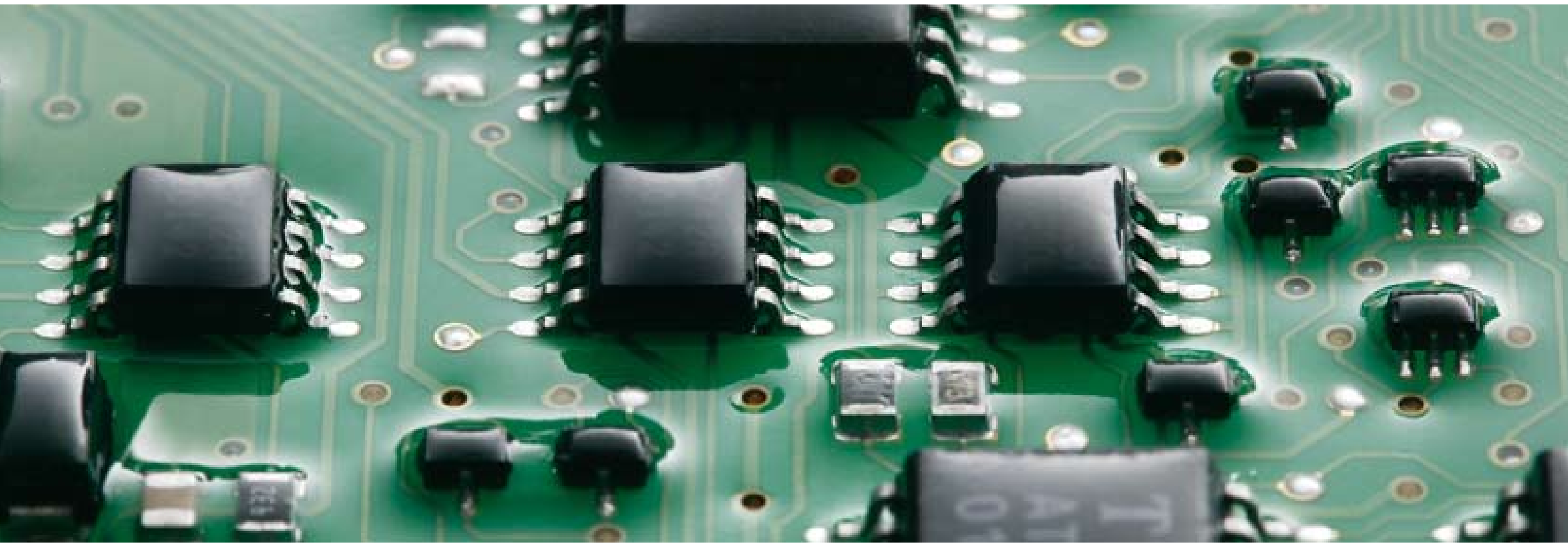
Potting and encapsulation – as methods of partially or completely covering microchips, hybrid circuits and semiconductor power modules – have proved extremely successful: they are particularly effective ways of protecting such components from external influences.

WACKER offers a wide range of one and two-part products for potting/encapsulation applications. Extra-soft gels are available for sensitive electronic devices such as bonded ICs. These gels ensure that the device will work properly even under conditions of extreme temperature fluctuations or strong vibration. For sensor applications, gels characterized by particularly low volatility and low bleed are becoming increasingly important. With its unique process for manufacturing polydimethylsiloxane, WACKER SILICONES is excellently positioned for this market.

Material Property Options

- Low viscosity or shear diluting
- Variable processing and curing times
- Soft to hard
- Transparent to opaque
- High flame resistance
- High thermal conductivity
- Fuel resistance, e.g. fluorosilicones
- Remarkable low-temperature flexibility (down to -100 °C)
- High thermal shock resistance
- Low shrinkage
- Good adhesion to polymer housings
- Low outgassing
- Low uncured-silicone bleed
- Pronounced damping property
- Specified low ion content

EFFICIENT COATING



Coatings or protective lacquers for PCBs or hybrid devices are also known as “conformal coatings.” They afford protection against external influences such as dust, light, aggressive media, temperature fluctuations and mechanical stresses. They insulate electronic circuits from the surrounding environment or enhance the dielectric strength of highly complex modules.

Various methods are available for applying conformal coatings in volume production:

- Spray application
- Dip coating
- Flow coating
- Selective coating (partial cover)

Each of these techniques puts different demands on the protective lacquer in terms of its rheological, pot-life and curing characteristics. WACKER SILICONES offers customized products for each technique: both solvent-based and solvent-free. SEMICOSIL® and ELASTOSIL® silicone rubber grades meet the challenging functional, quality, reliability and cost-efficiency requirements of conformal coating production.

SYSTEMATIC SELECTION

WACKER offers different silicone rubber systems marketed under the brand names SEMICOSIL®, ELASTOSIL® and WACKER SilGel®. The processing properties differ too, sometimes substantially. It is therefore essential to select the silicone system that is best suited to your individual production requirements. Discuss the issue with your WACKER technical service manager. He will be glad to assist you.

Set Priorities

The end result is often the same. The various silicone rubber systems offered by WACKER merely constitute different ways of getting there (see Fig. 3).

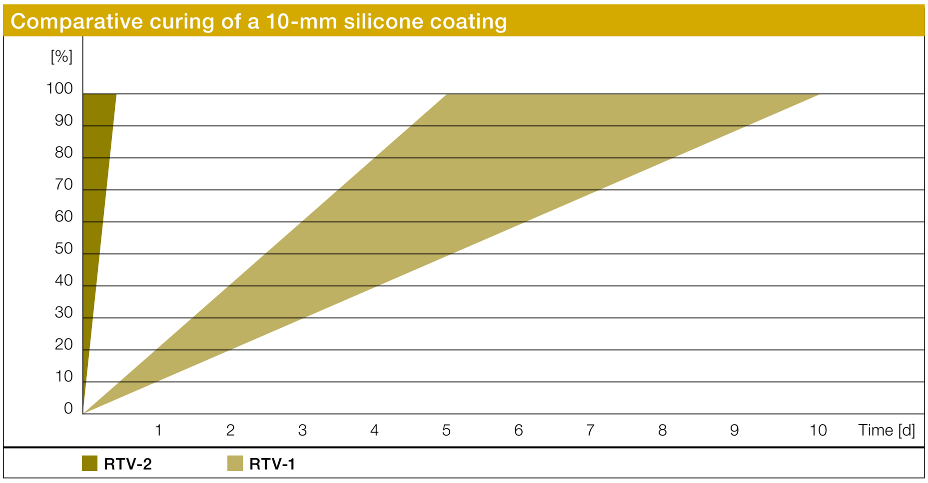


Fig. 2

ELASTOSIL®, SEMICOSIL® and WACKER SilGel® are registered trademarks of Wacker Chemie AG.

Silicone systems and product requirements

Fast curing >>

RTV-2 Silicones

- Addition-curing and condensation-curing 2-part systems that vulcanize at room temperature
- Dual-component metering equipment is needed to process them
- Rapid curing in the order of minutes is achieved by working at elevated temperatures or selecting a suitable curing agent

One-Part Systems

- One-part systems that cure exclusively at high temperatures
- Simple metering equipment suffices to process them
- Curing is fast, sometimes taking only minutes

RTV-1 Silicones

- One-part systems that cure at room temperature
- Simple metering equipment suffices to process them; these rubber grades can even be applied manually
- Atmospheric moisture is needed for curing

Easy processing >>

Fig. 3

APPRECIATING ONE-PART SYSTEMS

Condensation-curing RTV-1 silicones are ready-to-use, free-flowing to pasty 1-part products that cure at room temperature. Their popularity is explained by the ease with which they are processed (and the minimum of investment that is required) and by the outstanding properties of the cured products. By virtue of the wide variety of properties they offer, they are ideal for numerous bonding, sealing and coating applications.

ELASTOSIL® RTV-1 Silicone Rubber

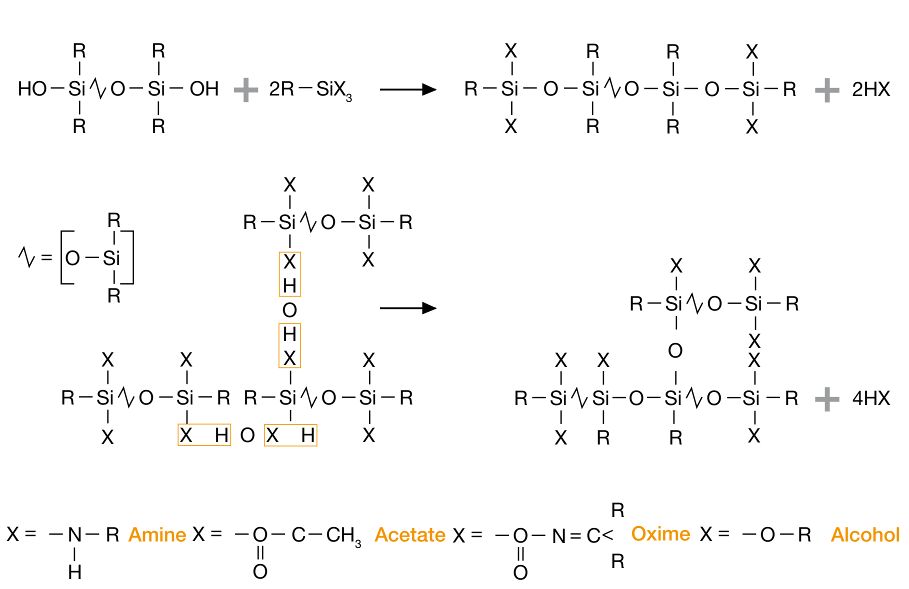


Fig. 4

The Advantages at a Glance

- Extremely easy processing
- Low capital investment for equipment
- Very good bonding to a variety of substrates

Chemistry

RTV-1 silicone rubber compounds from WACKER consist of polydimethylsiloxanes, curing agents, fillers and, in some cases, solvents and additives. During the compounding process, terminal OH groups on the polysiloxane react with the crosslinking agent to form curable products. The various systems available differ in the type of curing agent employed:

Alkaline systems release small amounts of amine while curing (ELASTOSIL® A grades).

Acidic systems release small amounts of acetic acid while curing (ELASTOSIL® E grades).

Neutral systems release small amounts either of an oxime or of an alcohol while curing (ELASTOSIL® N grades).

The crosslinking, i.e. curing or vulcanization, of RTV-1 silicone rubber grades takes place on exposure to atmospheric moisture. It starts with the formation of a skin on the surface of the silicone rubber and gradually works its way into the compound. The higher the relative humidity, the faster is the curing rate. Curing is not possible in closed systems without air access. In such cases, we recommend the use of RTV-2 silicone rubber grades.

Film thickness[4]

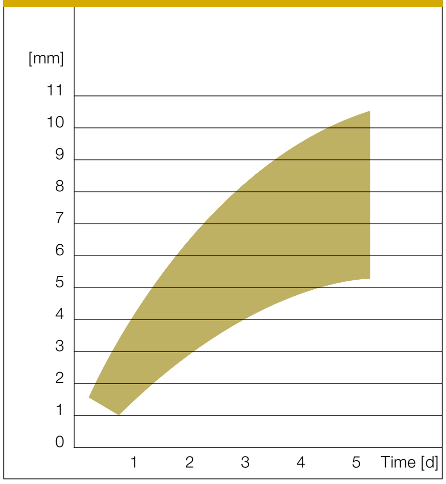


Fig. 5

If air access is from one side only, a film thickness of 10 mm should not be exceeded. Curing times can be greatly reduced by the application of heat, especially if the relative humidity is high and the rubber has been applied thinly. The temperature should be raised slowly in order to allow any solvents or hydrolysis products to evaporate. Final temperatures may be as high as 200 °C provided that the films are thin (less than 0.5 mm thick). If the films are any thicker, blistering is likely to occur. Curing is still possible at temperatures down to approx. -15 °C.

Vulcanized film thickness[5]

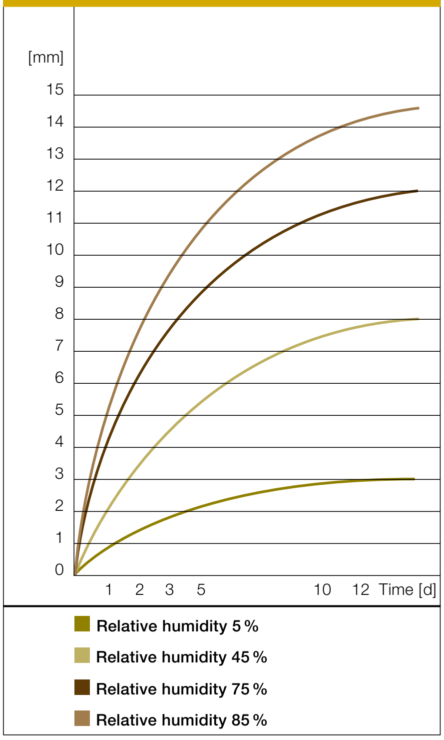


Fig. 6

Processing Guidelines

RTV-1 silicone rubber compounds may be applied manually or by machine. In the case of cartridges, either hand-operated or pneumatic guns are used. Automatic discharge or dispensing equipment is generally adopted for the larger containers. After dilution with anhydrous solvents, RTV-1 compounds can also be applied by airless spray guns. Optimum adhesion is achieved by pressing RTV-1 silicone rubber firmly onto the substrate surfaces. Parts to be bonded must be assembled immediately after the rubber has been applied, i.e. before a skin can form, and may need to be clamped.

Uncured RTV-1 silicone rubber may be removed with a spatula, paper or a rag, and any residues washed off with a solvent such as petroleum ether, toluene or trichloroethylene. All tools and processing equipment should likewise be cleaned immediately before the rubber has a chance to vulcanize. Once it has vulcanized, silicone rubber can only be removed mechanically, if necessary after using the previously mentioned solvents to make it swell.

Safety Precautions

The vapors comprising volatile by-products released during vulcanization and possibly also evaporated solvents should not be inhaled for any length of time or in high concentrations. The workplace should therefore be well ventilated. Uncured silicone rubber must not be allowed to get into contact with the eyes or mucous membranes, as it can cause irritation and acid burns.

[4] Curing rates of various RTV-1 silicone rubbers at 50 % relative humidity and 23 °C in aluminum pans measuring 24 mm in diameter and 18 mm in depth

[5] Curing rate of ELASTOSIL® A 33 as a function of relative humidity at room temperature

UNDERSTANDING TWO-PART SYSTEMS

There are two essentially different curing systems for RTV-2 silicone rubber:

Condensation-Curing Systems

Condensation-curing silicone rubber compounds consist of a primary component and a curing agent that contains the crosslinker (a catalyst). The primary component and the curing agent are typically mixed in a ratio of 8:1 to 12:1. After mixing, curing takes place with the elimination of alcohol.

Typical processing times for condensation-curing RTV-2 silicone rubber grades are about 10 min pot life and 70 min until the onset of curing (see Fig. 8).

Ultimate mechanical strength is reached after about 6 hours. These times can be varied within limits by adjusting the ratio of main component to curing agent. To ensure reliable processing, however, the pot life must not be less than 2 min. It is not advisable to speed up the reaction by increasing the temperature. The temperature must not exceed 90 °C before curing is complete, otherwise the silicone rubber could be destroyed.

Structural formulae illustrating condensation curing

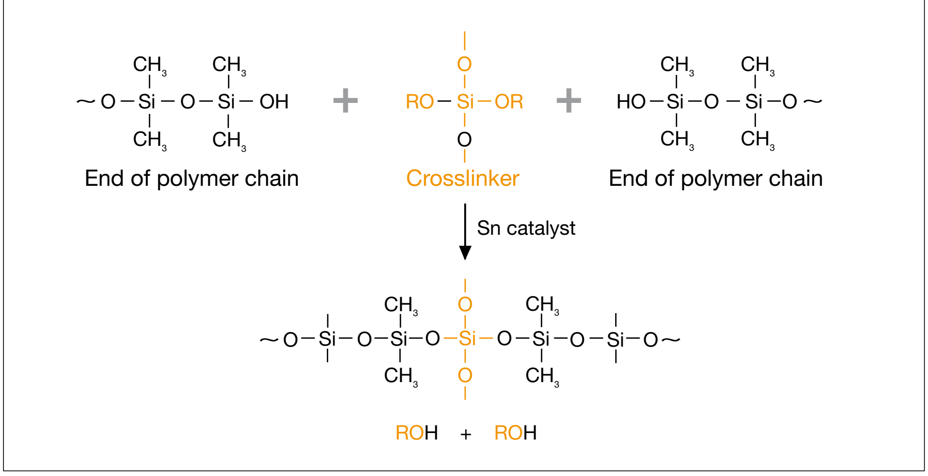


Fig. 7

Typical pot lives as a function of mixing ratio

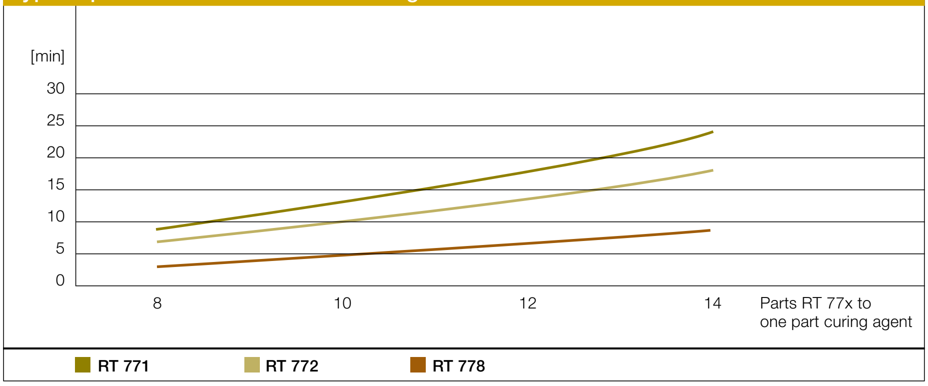


Fig. 8

The Advantages at a Glance

- Fast curing at room temperature, even of thick sections
- Very good thermal resistance
- No inhibition-related curing problems
- Curing rates can be adjusted within given limits by selecting “slow” or “fast” curing agents and by varying the quantities in which these are added
- The curing rate may be boosted by heating to a maximum of 80 °C; heating above 90 °C is apt to cause depolymerization (reversion)
- Only minor weight loss and shrinkage (0.2–2 % linear) occur on curing

Addition-Curing Systems

Addition-curing silicone rubber compounds consist of two components, one of which contains polymer and crosslinker, the other, polymer and a platinum catalyst. When the two components are mixed, they cure to form the elastomer product. During this reaction, the polymer chains are linked through hydrosilylation of the vinyl groups by means of the hydrogen-containing crosslinker. The curing rate is controlled here by the temperature, and not by the mixing ratio as in the case of condensation-curing RTV-2 silicone rubber grades. No by-products are formed on curing (see Fig. 9).

In addition to the 2-part systems, we also offer 1-part, addition-type, heat-curing silicone rubber grades. These are preferred whenever the procurement of a 2-part metering system is not practicable for technical or economic reasons.

The Advantages at a Glance

- Short curing times possible, even for grades with a long pot life
- Pot life can be adjusted with additives
- Curing can be accelerated by heating
- Irreversible cross-linking
- No weight loss on curing, and practically no shrinkage (< 0.1 %)
- No by-products
- Self-adhesive grades show excellent adhesion to a wide variety of substrates

Structural formulae illustrating addition curing

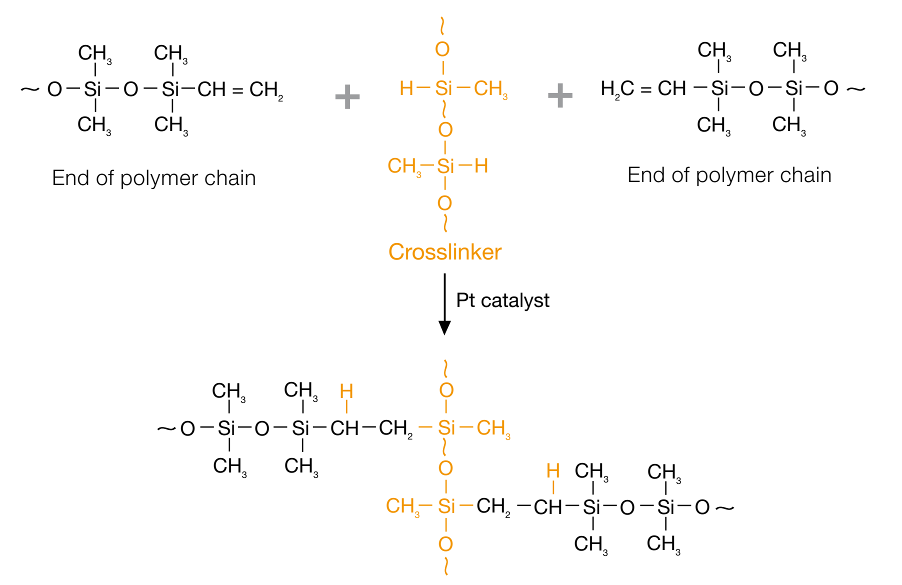


Fig. 9

ACCOMPLISHED PROCESSING

You will find detailed processing instructions for WACKER RTV-2 silicone rubber compounds in the supplementary sheet that accompanies this brochure (Room-Temperature-Vulcanizing Silicone Rubber Compounds). Please ask your WACKER sales office.

Viscosity

WACKER RTV-2 silicone rubber compounds lend themselves to a large number of processing techniques, including spraying, dipping, potting/encapsulating, silk-screen printing and automated application. The suitability of a compound for a particular processing method is dictated by its rheological properties, for example, its viscosity. This is measured in mPa s. RTV-2 silicone rubber compounds usually have a viscosity between 500 and 2,000,000 mPa s. Many RTV-2 silicone rubbers show non-Newtonian behavior, and so it is always necessary to quote the shear rate at which the viscosity was measured. The viscosity, for its part, depends on the preliminary treatment (e.g. stirring) and on the temperature. Precise temperature control is therefore essential, as also the fulfillment of certain requirements (stirrer speed and time) during preliminary treatment.

[6] Please ask us for the addresses of manufacturers.

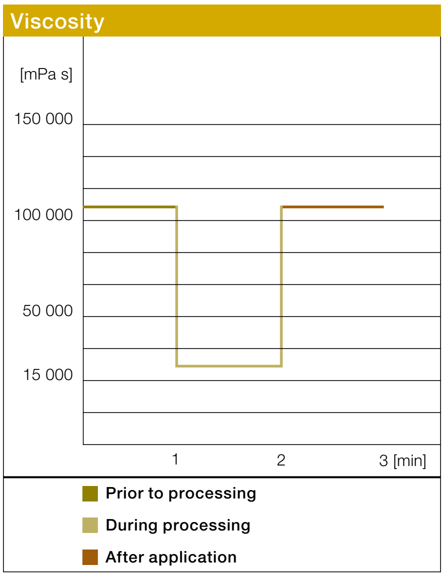


Fig. 10

Mixing and Applying

Flowable RTV-2 silicone rubber compounds are noted for their ease of processing in both small-scale and large-scale use. The two components are first mixed in the prescribed ratio to form a homogeneous compound. This may be done manually or by machine. The equipment employed must always be scrupulously clean. If the components have different colors, they should be mixed until the compound is totally streak-free. For economical, large-scale processing, especially of pasty/thixotropic grades, we recommend the use of metering equipment[6]. Air entrained during mixing must be removed from flowable products by evacuation at approx. 20 mbar before they are processed further.

The container should be four times the volume of the product, as the silicone rubber will foam extensively when the vacuum is applied. Metering equipment involving the use of compressed air may be problematic due to possible bubble formation. The reason for this is the high gas solubility of silicones. In the case of pasty/thixotropic RTV-2 grades, any dissolved air will have already been removed during filling in the plant. In such cases, metering equipment fitted with follower plates is used to dispense the product directly from the original containers. As for silicone foams, selective admixing of gases into the components can serve to enhance the structure of the foam.

Curing

The pot life and curing time of condensation-curing silicone rubber compounds may be influenced, for one, by selection of an appropriate curing agent (slow or fast curing agent) and, for the other, by the amount of curing agent used.

While heat is not necessary for the vulcanization of condensation-curing silicone rubber grades, it will substantially shorten the time needed for addition-curing silicones to vulcanize. Exactly how much time is required will depend on the grade in question and on the heat transfer rate. Suitable heat sources include heated metal molds, circulating-air ovens and IR tunnels. Several addition-curing silicones have been developed that have extended pot lives ranging from one day to several months. Curing is effected in this case at high temperatures of up to 200 °C. Please consult the respective product leaflets for details.

Vulcanization of addition-curing silicone rubber compounds may be substantially impaired by contact with substances containing amino, sulfur or tin compounds. This is usually indicated by tackiness, and can be avoided by appropriate preliminary tests.

Pot Life

The pot life of RTV-2 silicones is heavily temperature-dependent, especially that of addition-curing products: a rise or fall in the temperature shortens or prolongs the pot life accordingly. The average pot life of RTV-2 silicone rubber compounds varies between 30 minutes and 6 hours, while for some grades it is of the order of a few minutes. It can also be adjusted over a wide range – in the case of condensation-curing systems by means of special curing agents and in the case of addition-curing systems by means of additives – to suit the application in question (see Fig. 11).

A number of addition-curing grades offer a pot life of up to several days at room temperature, and certain compounds are even supplied as one-part products with an appropriately long shelf life. These specialty products do not allow the fine adjustments (see graphs) with Inhibitor PT 88 (longer pot life) or Catalyst EP (shorter pot life).

Adjusting the pot life by varying the mixing ratio

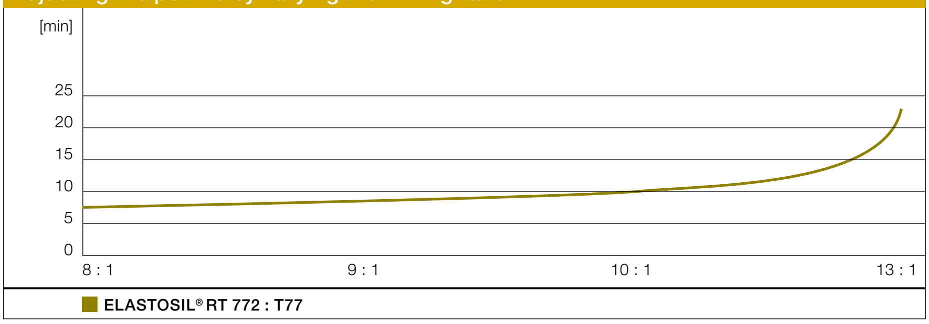


Fig.11

Shortening the pot life by adding Catalyst EP

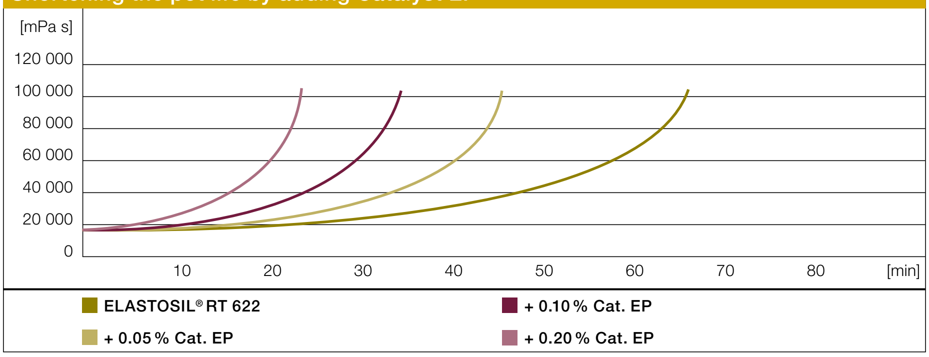


Fig.12

Extending the pot life by adding Inhibitor PT 88

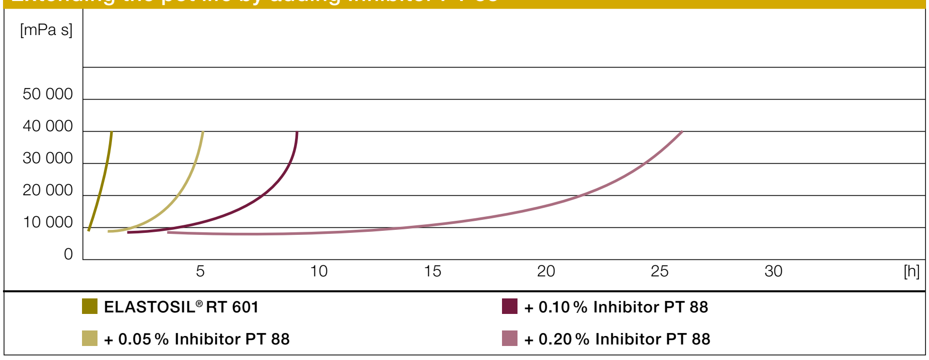
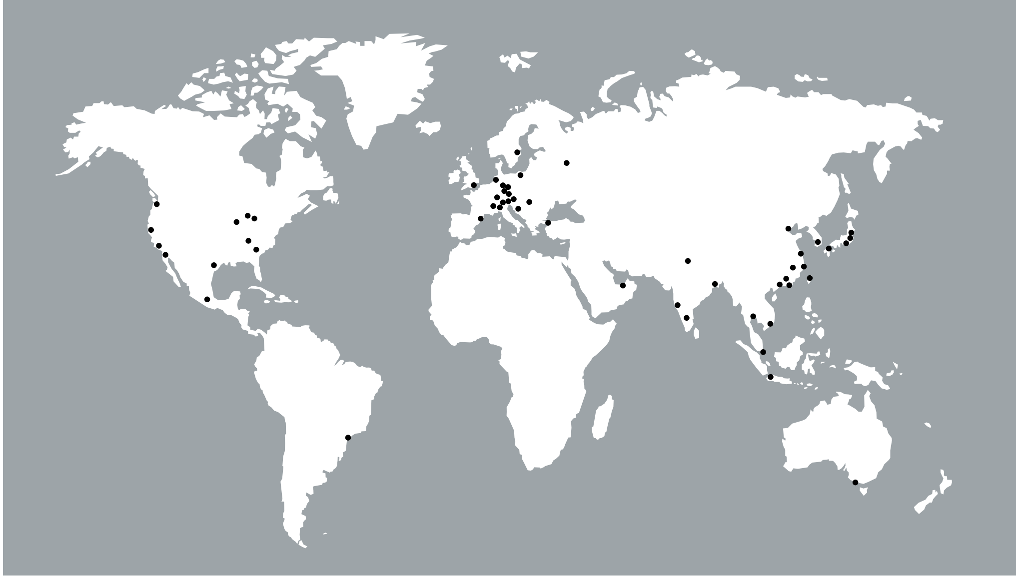


Fig.13

WACKER AT A GLANCE



WACKER
is a technological leader in the chemical and electrochemical industries and a worldwide innovation partner to customers in many key global sectors. With around 14,400 employees, WACKER generated sales of EUR 2.76 billion in 2005. Germany accounted for 21% of sales, Europe (excluding Germany) for 31%, the Americas for 22% and Asia-Pacific, including the rest of the world, for 26%. Headquartered in Munich, Germany, WACKER has some 20 production sites worldwide and a global network of over 100 sales offices. With R&D spending at 5.3% of sales in 2005, WACKER is among the world's most research-intensive chemical companies.

WACKER SILICONES
is a leading supplier of complete silicone-based solutions that comprise products, services and conceptual approaches. As a provider of solutions, the business division helps customers press ahead with innovations, exploit global markets fully, and optimize business processes to reduce overall costs and boost productivity. Silicones are the basis for products offering highly diverse properties for virtually unlimited fields of application, ranging from the automotive, construction, chemical, electrical engineering and electronics industries, through pulp and paper, cosmetics, consumer care and textiles, to mechanical engineering and metal processing.

WACKER POLYMERS
is the global leader for high-quality binders and polymer additives. This business division's activities encompass construction chemicals and functional polymers for lacquers, surface coatings and other industrial applications, as well as basic chemicals, i.e. acetyls. Products such as dispersible polymer powders, dispersions, solid resins, powder binders and surface coating resins from WACKER POLYMERS are used in the construction, automotive, paper and adhesives industries, as well as by manufacturers of printing inks and industrial coatings.

WACKER FINE CHEMICALS
is an expert in organic synthesis, silane chemistry and biotechnology, providing tailored solutions for its customers in the life sciences and consumer care industries. The range of innovative products includes complex organic intermediates, organosilanes, chiral products, cyclodextrins and amino acids. With its comprehensive expertise, WACKER FINE CHEMICALS is a preferred partner for highly challenging custom-manufacturing projects in the fields of chemistry and biotechnology.

WACKER POLYSILICON
has been producing hyperpure silicon for the semiconductor and photovoltaics industries for over 50 years. As one of the largest global manufacturers of polycrystalline silicon, WACKER POLYSILICON supplies leading wafer and solar-cell manufacturers.

Siltronic
is one of the world's leading producers of hyperpure silicon wafers, supplying many major chip manufacturers. Siltronic develops and produces wafers up to 300 mm in diameter at facilities in Europe, the USA, Asia and Japan. Silicon wafers form the basis of state-of-the-art micro and nanoelectronics used, for example, in computers, telecommunications, motor vehicles, medical technology, consumer electronics and control systems.

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