WACKER SILICONES

ELASTOSIL®

ELASTOSIL® SILICONE RUBBER FOR THE APPLIANCE INDUSTRY

CREATING TOMORROW'S SOLUTIONS

Where to find what

GOOD TO KNOW: THE DEVELOPMENT POTENTIAL OF ELASTOSIL® SILICONE RUBBER OPENS UP NEW OPPORTUNITIES FOR THE APPLIANCE INDUSTRY

INNOVATIONS THROUGH DIALOG

Innovations are daily business. At least in the domestic appliance industry. The ever higher demands in this sector have resulted in products that meet the highest technical standards. Paradoxically, as quality requirements become stricter, cost pressures become greater. Products have to become even better, and their production processes even more efficient and economical. Production methods today hardly have time to get established before they are superseded by new technologies. The challenges facing product developers, engineers, applications technologists and cost controllers are huge.

With more than 50 years' experience in silicone technology and with its above-average commitment to R&D, WACKER has long been a driving force for progress in this sector.

Here, dialog among experts is essential, because creating a never-ending stream of new and compelling solutions tailored precisely to the needs of the market requires thorough knowledge of production processes and material requirements. We develop many of our solutions in direct collaboration with our customers.

Innovations are daily business. At least at WACKER. Take advantage of the expertise of our service engineers, and ask them about the extensive research facilities in our company. Our pilot plant can develop new products and test prototype series at any time, under realistic conditions and on state-of-the-art production lines.

Let's tackle it together.
Preferably right away.

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

A MATERIAL'S POTENTIAL APPLICATIONS ALWAYS DEPEND ON ITS PROPERTIES

Thanks to its wide variety of outstanding properties, ELASTOSIL® silicone rubber from WACKER offers almost unlimited applications in the domestic appliance industry. The product has become indispensable for the production of state-of-the-art irons, cookers, baking trays and molds, as well as solar collectors.

The following properties make ELASTOSIL® silicone rubber the ideal choice for numerous applications in the appliance industry:

– Excellent high-temperature resistance
– Very good adhesion to many substrates
– Gas and water-vapor permeability
– Very good chemical resistance
– Excellent radiation resistance
– Environmental compatibility
– Low order of toxicity
– Outstanding electrical properties

Irons

ELASTOSIL® silicone rubber has many potential applications in a steam iron. Components exposed to high-temperature water and steam have to be bonded together or sealed at various points:

The entire interface between the die-cast steam chamber and the riveted lid has to be sealed.

High-quality steam irons have a stainless steel or ceramic sole plate which makes ironing much easier. This sole plate is bonded to the steam chamber with a thin layer of silicone adhesive.

The tubular heating elements integrated in the steam chamber are also sealed at their ends and thus protected from moisture with a drop of very low-viscosity silicone.

In all these applications, ELASTOSIL® silicone rubber excels on account of its excellent adhesion, heat resistance and tailored rheological properties.

Cookers

The main use of ELASTOSIL® silicone rubber in cookers is to bond the oven door and the cooktop, since it is here that the materials used must withstand the highest temperatures.

An oven door is basically a composite assembly of different materials, such as glass, steel, enamel and polyurethane and epoxy-based paint. For some of these materials, only an adhesive can provide a secure and cosmetically acceptable bond.

The fabrication of cooktops involves bonding the glass sheet to a frame of steel, aluminum or coated profiles. Besides long-term resistance to heat and cleaning agents, it is important for the adhesive to have finely tuned rheological properties. This allows the cooktop to meet the aesthetic requirements placed on an exposed adhesive joint.

Solar collectors

Highly transparent potting compounds that permit maximum transmission of sunlight are used to embed crystalline silicon wafers behind plates of glass or plastic.

On account of its exceptionally high resistance to weathering and extreme temperatures, ELASTOSIL® silicone rubber is used to bond the metal frame to the plates and to seal the joint.

Baking trays and molds

Outstanding release properties and hot-air resistance make ELASTOSIL® silicone rubber ideal for coating baking trays and molds. You no longer need to grease trays or molds prior to baking. Nothing sticks and nothing burns.

ELASTOSIL® grades for these applications are physiologically compatible and conform to guidelines of the FDA and Germany's Institute for Risk Assessment (BfR).

And more

Other established uses of ELASTOSIL® rubber grades in the domestic appliance industry, which we hope will inspire you to join us in developing new, tailor-made solutions, include:

– Seals for dishwashers and washing machines
– Electric kettles
– Bonding of coffee jugs

WACKER silicone rubber grades provide reliable sealing and bonding. Over periods of several years in the case of solar cells and hot-water collectors.

QUALITY IS THE PROPERTY THAT SUMS UP ALL THE OTHER PROPERTIES

Thanks to their many excellent properties, ELASTOSIL® silicone elastomers are ideal for use in high-quality adhesives and coatings. In the domestic appliance industry, they are used wherever one or more of these properties are essential.

Resistance to extreme temperatures

Among the outstanding properties of silicones is their resistance to extreme temperatures. While no other elastomers can be used at temperatures above 150 °C, silicone rubbers can withstand continuous service at temperatures up to 180 °C. Special grades even retain their elasticity for 1,000 to 2,000 hours at 250 °C, and withstand peak temperatures of up to 300 °C.

Adhesive properties

Silicone rubber adheres without a primer to a wide variety of substrates. This applies especially to the self-adhesive grades. In certain cases, however, it is advisable to prime the substrate. Our G 790 primer is an almost universal problem solver in this respect. It will produce good adhesion to siliceous and oxidic surfaces. With plastics and painted surfaces, adhesion should be tested on a case-to-case basis.

Gas and water-vapor permeability

At room temperature, the gas permeability of silicone rubber is about ten times higher than that of natural rubber; at 100–150 °C, however, it is approximately the same as that of natural rubber. Under normal conditions, silicone rubber can contain about 15–20 % by volume of dissolved air.

Chemical resistance

Silicone rubber is resistant to aqueous solutions, dilute acids and bases, and solvents. It may swell in organic solvents such as ketones, esters and hydrocarbons, but it will not break down. Cured silicone rubber can only be removed by complete degradation with an agent such as concentrated sulfuric acid or alcoholic lye.

Radiation resistance

Silicone rubber withstands high doses of electromagnetic radiation in the microwave-to-UV range. This explains the wide variety of applications it enjoys, from microwave ovens to solar collectors.

Environmental compatibility

The basic structure of silicone polymers is similar to that of quartz. Cured silicone rubber is therefore ecologically compatible and has a low order of toxicity. It can be disposed of along with household garbage.

Thermal conductivity

The thermal conductivity of most silicone elastomers is of the order of 0.15–0.25 W K^{-1} m^{-1} at room temperature. Special, highly filled grades can reach values up to 2.5 W K^{-1} m^{-1}.

Electrical properties

The electrical properties of silicone rubber are comparable to those of other insulating materials at room temperature. However, silicone rubber has the advantage that these properties remain virtually constant over a temperature range from –45 to +180 °C. The fact that their insulation resistance, dielectric strength and loss factor are practically unaltered by high temperatures is important in many applications. They are also virtually unchanged after immersion in water, which is an important advantage for applications such as steam irons.

Optical properties

The color and appearance of silicone rubber is determined by the fillers used in the respective compound. In the visible spectral range (400–760 nm), thin layers of unfilled materials are almost 100 % transparent. They only become

opaque in the UV range below 200 nm. Their refractive index n_D^{25} is between 1.410 and 1.404.

Storage stability

Depending on the grade, ELASTOSIL® silicone rubber from WACKER has a shelf life of up to 12 months if stored in the tightly closed original containers at 5 to 30 °C. If the material is kept beyond the recommended shelf life, it is not necessarily unusable, but a quality check should be performed on the properties relevant to the application.

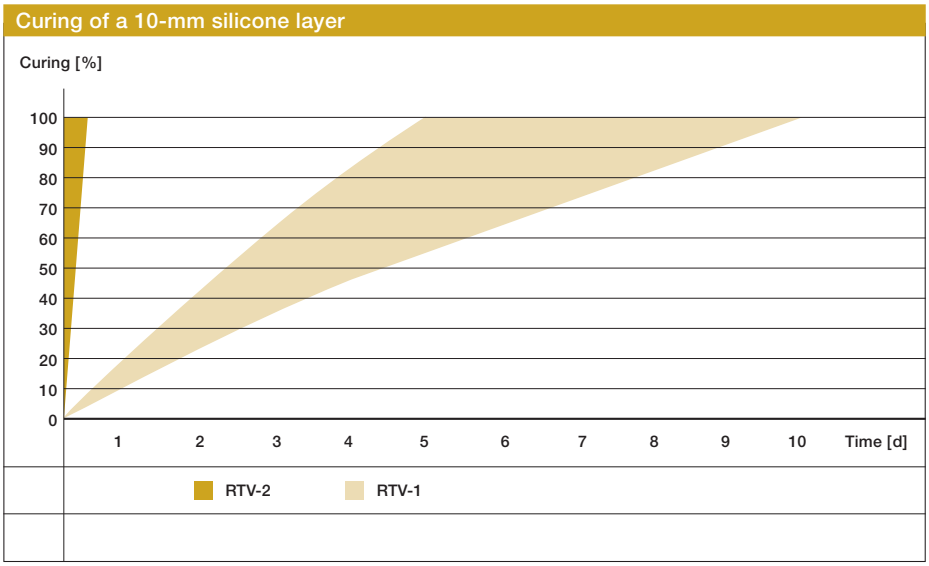
Practical tests are performed on all products in the applications technology lab.

THE RIGHT SILICONE SYSTEM FOR YOUR PRODUCTION PROCESS

WACKER offers various ELASTOSIL® silicone rubber systems for the appliance industry. The processing properties of these silicones often differ considerably, which makes it important to set the right priorities when choosing the system best suited to your individual production requirements. Discuss the options with your WACKER technical support consultant.

Every application defines a range of material properties that limits the choice of suitable silicone rubber. In the appliance industry, resistance to extremely high temperatures and good adhesion of the elastomer are often essential properties.

Which product is best suited to your application will depend on the technicalities of your production process. A fully automated mass production process with short cycle times places different requirements on the silicone rubber than a short-run batch process does. WACKER offers various silicone systems, the processing parameters of which may differ significantly irrespective of the properties of the cured rubber. These parameters are especially the pot life, processing technology, curing rate and temperature, whether the silicone system is a one or two-part system, and whether it is available in the desired quantity.



A 10-mm test specimen of RTV-1 rubber takes about a week to cure. An identical test specimen of RTV-2 rubber takes only a few minutes.

The goal is often the same. The various WACKER rubber systems only point to different ways of reaching it.

In the past, RTV-1 silicones were preferred, because they are particularly easy to process.

In some circumstances, this is still the case: for example, with a discontinuous production process and if relatively long curing times are tolerated. If these conditions do not apply, WACKER also offers faster curing alternatives: RTV-2 silicones and heat-curing one-part systems.

Products and their production requirements

Fast curing ^^

RTV-2 silicones

- Two-part systems that cure at room temperature. Special metering and mixing equipment is needed to process them.
- Fast curing in the order of minutes is possible if elevated temperatures or a suitable catalyst are used.

One-part silicones

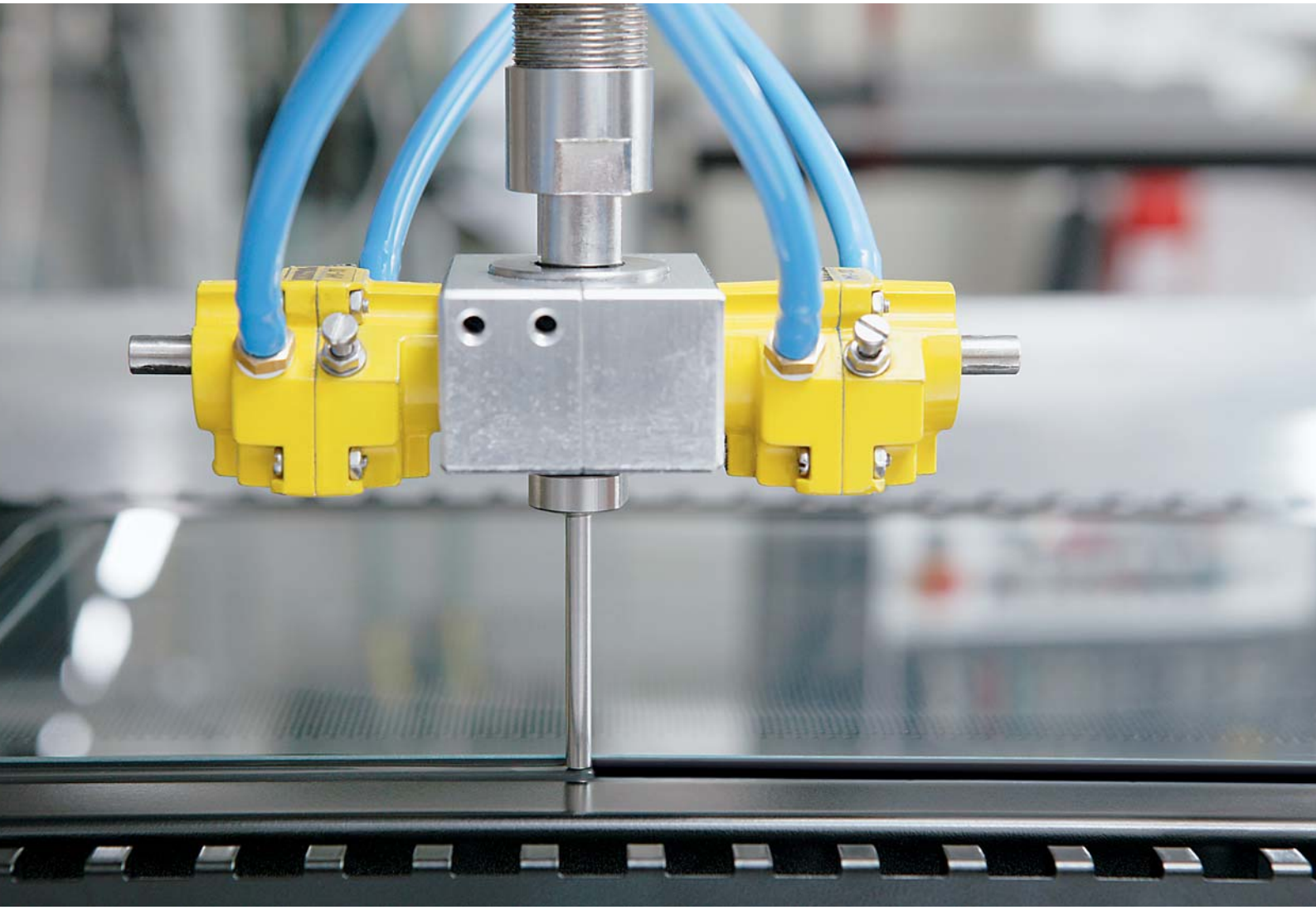
- Heat-curing one-part systems that only cure at high temperatures. They can be processed with simple metering equipment.
- Fast vulcanization within a few minutes

RTV-1 silicones

- One-part systems that cure at room temperature. They can be processed with simple metering equipment, and can even be applied manually.
- Since they need atmospheric moisture to cure, they harden slowly from the outside inwards.

Easy processing >>

WE OFFER ONE OR TWO-PART, CONDENSATION OR ADDITION-CURING SYSTEMS



The key to successful visible gaskets is a perfectly adjusted material flow from beginning to end.

ELASTOSIL® silicone elastomers for the domestic appliance industry are grouped under four different curing systems: condensation-curing one and two-part systems and addition-curing one and two-part systems. The various systems offer different processing advantages.

Condensation-curing RTV-1 silicone elastomers

ELASTOSIL® RTV-1 silicone elastomers are one-part systems that cure at room temperature. They owe their popularity to the outstanding properties of the cured products and their ease of processing, requiring minimum investment.

To cure, RTV-1 silicone elastomers need moisture. The rate of curing of these silicones is limited by the rate of diffusion, typically about 1–2 mm per day.

RTV-1 silicone rubber grades are classified according to the by-products that split off during curing: acetic acid, amine, oxime or alcohol-curing systems.

Thanks to their ease of processing, ELASTOSIL® RTV-1 silicone elastomers are popular for applications involving only thin layers and tolerable curing times. However, these silicones sometimes require lengthy postcuring, which is not reconcilable with the short cycle times required of modern mass production. In such cases, fast-curing systems are needed.

The advantages at a glance

– Very easy processing
– Low capital investment
– Very good adhesion to a large variety of substrates

Condensation-curing RTV-2 silicone elastomers

The two components of the self-adhesive, condensation-curing ELASTOSIL® RTV-2 silicone elastomers are typically mixed in a ratio of 8 : 1 to 12 : 1. As the system cures, alcohol is eliminated [Fig. 1].

The following silicone rubber grades were developed for mass production, in which interruptions to production must be kept to an absolute minimum: ELASTOSIL® RT 771, ELASTOSIL® RT 772 and ELASTOSIL® RT 778 [Fig. 2].

Our condensation-curing RTV-2 silicone elastomers typically have a pot life of about 10 minutes and take 70 minutes to set. The ultimate mechanical strength is reached after about 6 hours. These times can be varied within limits by varying the ratio of main component to catalyst. To ensure reliable processing, however, the pot life should not be less than 2 minutes.

It is not usual to accelerate curing by increasing the temperature. On the contrary, the temperature should not exceed 90 °C until the product has cured completely, as the silicone rubber could otherwise be destroyed.

The advantages at a glance

– Rapid curing at room temperature, even of thick layers
– Very good adhesion to a large variety of substrates
– Outstanding heat resistance

Structural formula of condensation curing

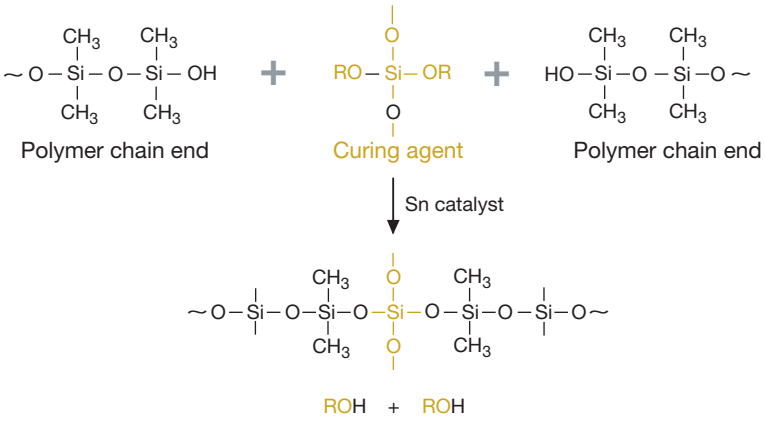


Fig. 1

Typical pot lives as a function of mixing ratios

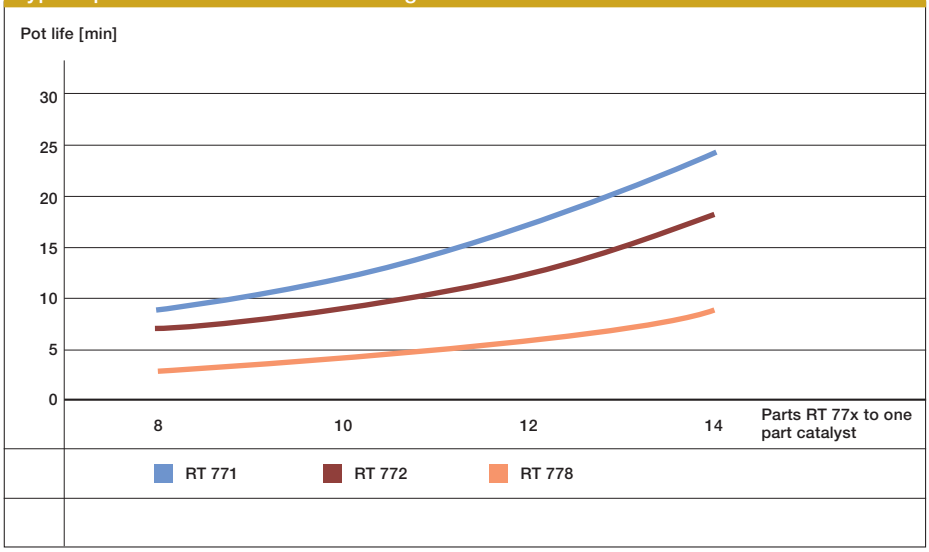


Fig. 2

Addition-curing RTV-2 silicone elastomers

Addition-curing ELASTOSIL® RTV-2 silicone elastomers cure via a completely different mechanism from that of condensation-curing systems: when the two components are mixed, the polymer, a platinum catalyst and the curing agent are brought into contact with each other. Unlike the condensation-curing RTV-2 silicone elastomers, the curing rate is controlled by the temperature and not the mixing ratio. No by-products are formed during curing [Fig. 3].

Our transparent, crystal-clear, addition-curing RTV-2 silicone elastomers ELASTOSIL® RT 601 and SilGel® 612 are used in many potting applications.

The advantages at a glance

– Rapid curing, even in combination with long pot life
– Reaction accelerated by raising the temperature
– Flowable and non-sag grades available

One-part, heat-curing silicone elastomers

One-part, heat-curing ELASTOSIL® silicone elastomers comprise the same components as the addition-curing RTV-2 silicone elastomers. Consequently, they cure by the same chemical reaction. They are preferable to the two-part addition-curing silicones if the purchase of two-part metering equipment is not possible for technical or financial reasons. Their principal advantage is that they can be processed without the need for complicated mixing equipment, making them suitable for both long-run mass production and for short-run production.

We have developed special grades, such as ELASTOSIL® RT 705, for adhesive bonding applications.

The curing reaction can be accelerated as required by increasing the temperature. Even with pot lives as long as 6 months, curing times can be as short as 30 min at 140 °C or 2 min at 200 °C. The only limit on curing temperature is the heat resistance of the substrate to be bonded [Fig. 4].

The curing temperature should be at least 120 °C.

The advantages at a glance

– Low capital investment
– Suitable for short production runs
– Long pot lives and short curing times
– Reaction accelerated by increasing the temperature
– Flowable, non-sag grades available

Structural formula of addition curing

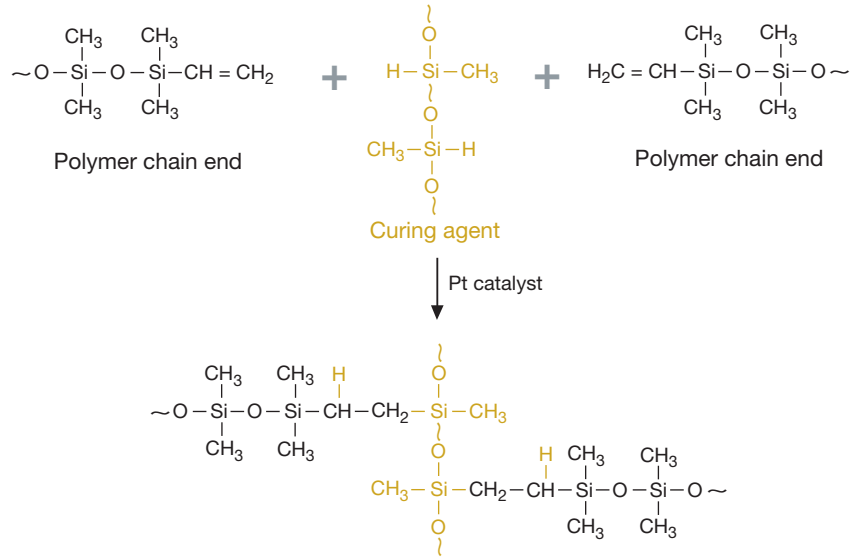


Fig. 3

The influence of temperature on the curing time of ELASTOSIL® RT 705

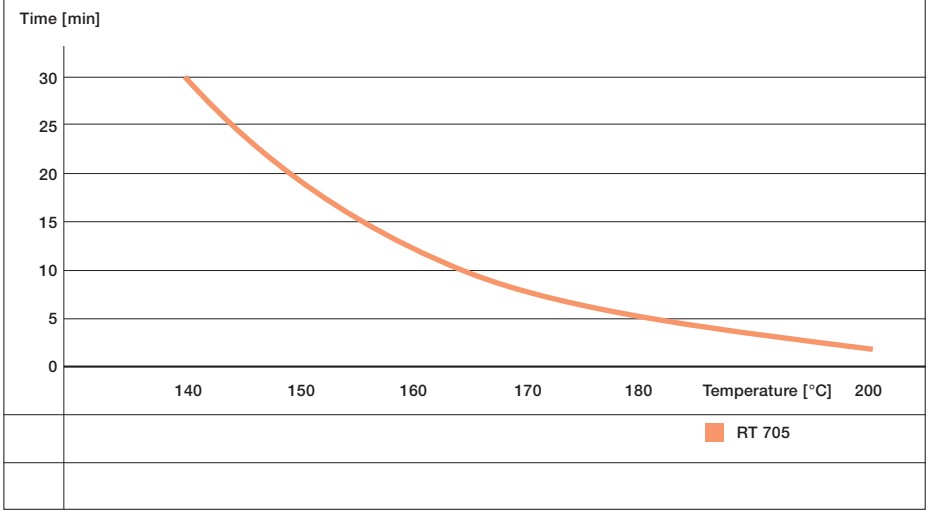


Fig. 4

ATTRACTIVE AND PRACTICAL: COMBINATIONS OF RUBBER AND PLASTICS

The ELASTOSIL® LR family of self-adhesive liquid silicone elastomers is one of the latest accomplishments of WACKER product research. These silicones can be molded in a single operation together with plastics to produce multicomponent articles. The resulting time and cost savings are huge.

Mass-produced injection-molded products, such as gaskets and valves, are used in a wide variety of products by the domestic appliance industry.

The self-adhesive ELASTOSIL® LR liquid silicone rubber grades can be combined with polymers such as polyamide or polyester in a single operation to produce multicomponent articles.

Our self-adhesive ELASTOSIL® LR 3070 and ELASTOSIL® LR 3071 liquid silicones were developed specifically for the mass production of molded multicomponent articles.

There are two technologies available for processing these silicones, the one-shot process and the two-shot process:

In the one-shot process, the article is molded in a single operation in a two-component injection-molding machine with two cores. In the two-shot process, the thermoplastic part is molded first in a thermoplastics injection-molding machine. While still hot, the part is transferred by gantry robot to the silicone mold of an LSR injection-molding machine, where it is overmolded.

The advantages at a glance

- Fast and economic production of high-volume parts
- Similar cycle times for processing thermoplastics and liquid silicone rubber
- Consistently good mechanical properties displayed by the composite
- Scrap-free and flash-free production of liquid silicone rubber

Silicone rubber is readily processed by injection molding, resulting in high productivity.

WE OFFER MORE

As one of the world's major silicone producers, WACKER supplies silicones in all their forms. We can only give a brief outline of other product groups here, with selected examples. For more detailed information, please ask us for the appropriate special brochure. Or discuss your product requirements with your WACKER technical consultant, who will be glad to assist you in finding the best solution to your specific problem.

Silicone foams

ELASTOSIL® SC 870 is a two-part, addition-curing silicone foam. The product is ideal for applications that require a low-density, highly compressible sealing or filling material, especially where organic foams cannot be used because of high temperatures.

ELASTOSIL® SC 870 silicone foam forms a predominantly closed cell structure that confers excellent mechanical properties on the foam.

Process parameters such as air content and type of mixer have a significant effect on the quality of the foam. In our pilot metering plant, we can perform tests to find out the right processing conditions for a particular case.

The advantages at a glance

- Silicone foam has the high heat resistance and chemical resistance of silicone rubber
- Rapid curing when heated
- Foaming without ozone-depleting blowing agents
- High compressibility
- Low compression set
- Quickly becomes tack-free, even at room temperature

Heat-curing ELASTOSIL® R und LR silicone elastomers

Heat-curing silicone rubber is processed efficiently by injection molding and extrusion to manufacture valves, gaskets, cables and the like for use in many domestic appliances. Aside from the wide range of standard grades, we also offer special grades with exceptional steam resistance for use in cookers, etc.

Silicone fluids

Silicone fluids are used as heat transfer media and in temperature sensors, where they are able to withstand temperatures from –60 °C to +350 °C.

Silicone resins

Silicone resins are used together with metal oxides as heat-resistant filling materials in tubular heating elements.

Microporous insulation material

Thanks to its good radiation absorption, WDS® microporous insulation material from WACKER is superior to all other thermal insulation materials at high temperatures. Thus relatively thin insulation layers suffice for high-temperature insulation of radiant heaters.

Special grades for electronic applications

Modern electrical appliances almost always incorporate electronics. WACKER offers a special range of high-purity silicones that effectively screen electronic components against external influences throughout their service life.

RTV-2 silicone rubber grades are preferred for sealing glass ceramic cooktops. Foams made of other materials cannot withstand the high temperatures in the long term.

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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CREATING TOMORROW'S SOLUTIONS

The data presented in this brochure are in accordance with the present state of our knowledge, but do not absolve the user from carefully checking all supplies immediately upon receipt. We reserve the right to alter product constants within the scope of technical progress or new developments. The information given in this brochure should be checked by preliminary trials because of conditions during processing over which we have no control, especially where other companies' raw materials are also being used. The information provided by us does not absolve the user from the obligation of investigating the possibility of infringement of third parties' rights and, if necessary, clarifying the position. Recommendations for use do not constitute a warranty, either express or implied, of the fitness or suitability of the product for a particular purpose.

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