

SILICONE RUBBER: WHAT'S THE STORY

WHITE
PAPER

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Executive Summary

J-Flex has created this comprehensive Guide to Silicone Rubber to be used as a valuable resource for all those working in the industrial rubber industry.

This guide comprises of:

- What is Silicone Rubber?
- The three forms of Silicone Rubber
- Where would you find Silicone Rubber?
- The properties of Silicone Rubber
- Why would you choose Silicone Rubber?
- Applications that use Silicone Rubber Products
- Life expectancy of Silicone Rubbers
- Is Silicone Rubber expensive?
- The market size and market share

What is Silicone Rubber?

Silicone rubbers were originally developed for commercial use during World War II to meet the military applications that required extreme temperature resistance. Over the years numerous advances have been made and now, silicone rubbers provide maximum reliability amongst state-of-art elastomers. Whether exposed to adverse environments, stored for prolonged periods or performing under extreme operating conditions, these engineered elastomers outlive traditional organic rubbers.

Silicon Metal



Silicone (with 'e') represents a group of polymer products derived from silicon (without 'e') which after oxygen is the most abundant chemical element on the surface of the earth. In fact silicon can be found in over 27% of the earth's crust by mass. Silicon Metal is found in the form of Silica Rock, Quartz or Sand.

Extracted from the earth's surface, silicon is then chemically synthesized with other elements such as carbon, hydrogen and oxygen to convert it into types of silicone (with 'e') Polymer. There are few materials in the world today with the combined versatility and utility of silicones.

Chemically, silicones are quite different from all other materials. It is this difference which gives them their unique combination of properties – properties which permit silicones to perform in many applications where no other elastomer can be used.

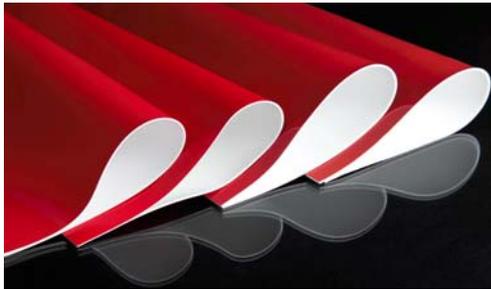
The silica based elastomers are capable of withstanding temperatures ranging from -80°C to +315°C and having excellent resistance to electrical power, ozone and moisture.



The three forms of Silicone Rubber

Silicone rubber is available in three main forms:

- HTV (High Temperature Vulcanised) – 60% of the market
- LR/LSR (Liquid Silicone Rubber) – 15%
- RTV (Room Temperature Vulcanising) – 20%
- Other – 5%



LSR is also cured at high temperatures and is mainly used for injection moulding high volume parts. It offers a very quick cycle time.

RTV is generally used to manufacture sealants and adhesives.

Where would you find Silicone Rubber?

The specific chemistry of silicones endows them with unique working characteristics and performance capabilities. Silicone materials manifest in a variety of forms – as adhesives, sealants and elastomers; as coatings, oils, lubricants and resins which can be tailored to specific performance requirements.

The Properties of Silicone Rubber

Products made of silicone rubber are:

- Extremely resilient
- Heat resistant to dry heat up to approx. +200°C; up to +315°C with special additives
- Flexible at low temperatures down to approx. 80°C
- Elastic at high and low temperatures
- Resistant to ageing
- Resistant to weathering, irrespective of colour formulation
- Resistant to ozone and ultra-violet light
- Water repellent
- Electrically insulating
- Low flammability
- High tear strength
- Thermally conductive
- Resistant to oils, solvents and fuels (fluoro silicone rubber)
- Dielectrical and Insulating properties
- Gas Permeable
- Bio-compatible



Why would you choose Silicone Rubber?

This durable, highly resistant elastomer is perfect:

- For appliances in excess of 100°C (the limit of most other rubbers)
- Where food quality is required, silicone rubber is non-toxic
- For excellent colour matching and durability
- Where translucent rubber is required
- For seals and gaskets that need to be steam sterilized
- For excellent electrical resistance



Applications that use Silicone Rubber Products

Application	What	Why
Peristaltic pumps (roller pumps)	High strength translucent tubings	Resistance to wide range of media being pumped. Silicone production ensures close accuracy so correct metered quantities are pumped. Good recovery qualities.
Drinks vending machines	Silicone rubber feed	Food safe and non-toxic. Also high strength to ensure coffee does not percolate into the tea and other drinks.
Lamps, illumination and floodlighting	Silicone sealing profiles; cords and gaskets	Chosen for continuous heat resistance and compression/sealing properties. Weather-proof.
Refrigeration Plants and Freeze Driers	Silicone seal and gaskets	Chosen for low temperatures resistance and flexibility retention.
Food Processing/ packaging equipment	Gaskets, tubings, strips and seals	Food safe and non-toxic. Resistance to cooking fats and sterilizing fluids used to clean food plant.
Electrical Insulation of wire and cables	Electrical Insulation Sleeving	Made to BS 2858. Available in a wide range of colours for identification & insulating purposes.
Underwater lighting (used in North Sea)	Silicone seals	Replaces latex due to severe weathering and salt water degradation. Good compression set requirements. UV resistant.
Electrical distribution/power generation	High voltage insulators - moulded and die cut gaskets	Silicone has excellent ageing properties and high temperature resistance
Furnace and boiler production	Gaskets and Seals	Chosen for excellent sealing properties at elevated temperatures.

Heat sealing and packaging machines	Silicone strips	Used on heat platens for sealing plastic bags. Good release properties - long life at high temperature.
Vacuum forming	Profiles and sections	Give long life at high temperatures under vacuum on glass lamination & glass fibre/composite production.
Steel plant furnaces	U' section seals on furnace observation window	Chosen for safety and high temperature resistance.
Ice Cream making equipment	JFR' Silicone Hoses textile or wire reinforced	Chosen for non-toxicity, 'FDA' approved compound and resistance to repeated sterilisation.
Mass transportation food services	Insulation for heater elements in food dispensing	Replaced other solvent based foam because of better insulation properties; and odours from other foam were detrimental to food taste and quality.
Automotive	Gasket seal for car engine microprocessors	New application - had not been able to find suitable material for temperature extremes and compression set requirements
Microwave equipment	Flexible dielectric material for high frequency guides	Replaces urethane foam because of temperature requirements
Printing Plants	Silicone tubings	Used as insulation tubing in production of printed polypropylene. Silicone being resistant to high voltage 'Corona' discharges.
Electronics	Insulation in thermal test chambers for evaluating electronic components used in automobiles	New application - chosen for temperature resistance
Photocopying Equipment	High temperature fuse roller used in copying machines	Replaced urethane foam because of temperatures involved
Test equipment supplier	Insulation in thermal test chamber for P.C board + electronics	Replaced polyimide foam because of better abrasion resistance
Food processing equipment	Door seal on oven/dryer for potato processing	Replaces rubber seal because of better temperature resistance and because of the odour of the rubber
Gasket manufactures	High temperature industrial gaskets - many uses	Replaces other synthetic rubber and foams because of better temperature range
Laundry equipment	Door seal for dry cleaning equipment	Replaces Neoprene Sponge due to temperature requirements and compressing set properties
Process industries	Pipe insulation tubing	Replaces P.V.C foam because of superior thermal and sound insulation properties

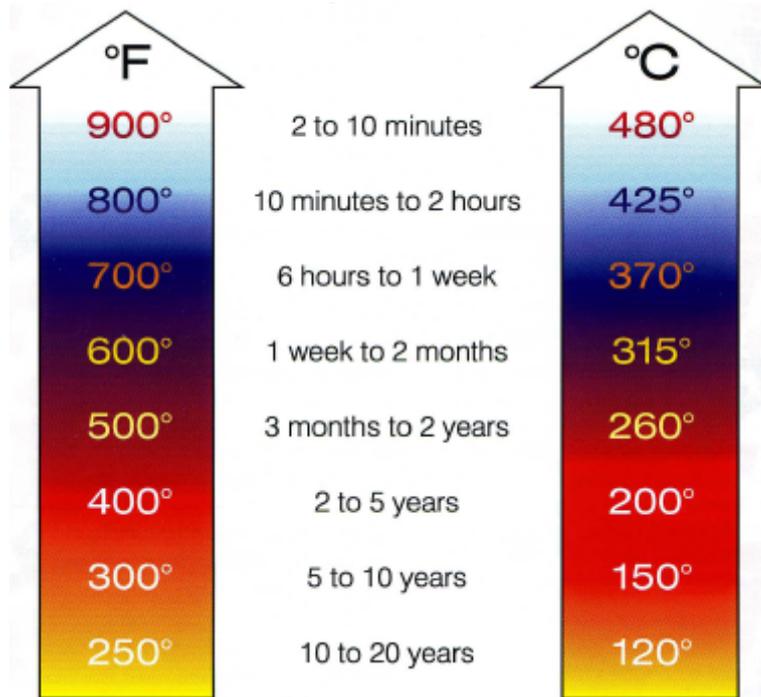
Environmental control	Dust and dirt seals on filtration equipment processing	Replaced Neoprene Sponge because of temperature and sealing requirements.
T- Shirt transfers printing machines	J-Flex 'Hi-Recovery' silicone sponge	Chosen for ability to recover fully at high temperature
Solar P.V. (Renewable Energy)	Vacuum Lamination Membranes	<ul style="list-style-type: none"> • Temperature Resistant • Good flexibility allows great draw-down over module composite

Life Expectancy of Silicone Rubbers

Thermal Stability

General purpose silicone's physical properties are not adversely affected by prolonged exposure to temperatures from -80°C to +315°C. It can withstand intermittent exposure to even higher temperatures.

Silicone beats other elastomers for resistance to thermal degradation and outperforms other elastomers in general service life; compression set resistance, electrical strength and non-stick properties. Silicone also has good chemical and fluid resistance.



Warning

For every 10 degrees higher than the recommended working temperature your product works at you will reduce its life expectancy by 50%. For example, a 200°C rated material has a life of two years, but if it is seeing 210°C and another process at 230°C, the life at 210°C is now one year and at 230°C is now three months.

Is Silicone Rubber Expensive?

When a silicone rubber is chosen to replace a natural or neoprene rubber, the natural or neoprene rubber has usually been found to be more expensive because they have failed to perform their job satisfactorily.



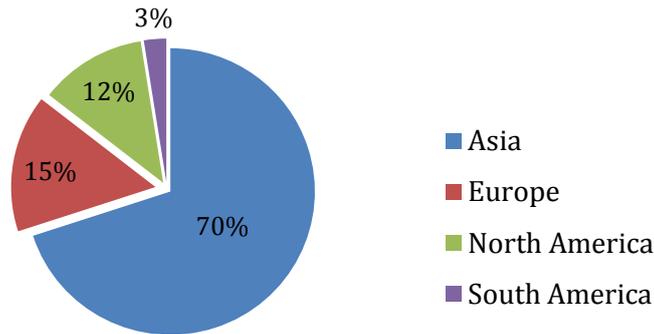
The base silicone rubber polymers are more costly to buy, but when used for the correct application, they are less expensive in the long run and require less maintenance.

Market Size and Market Share

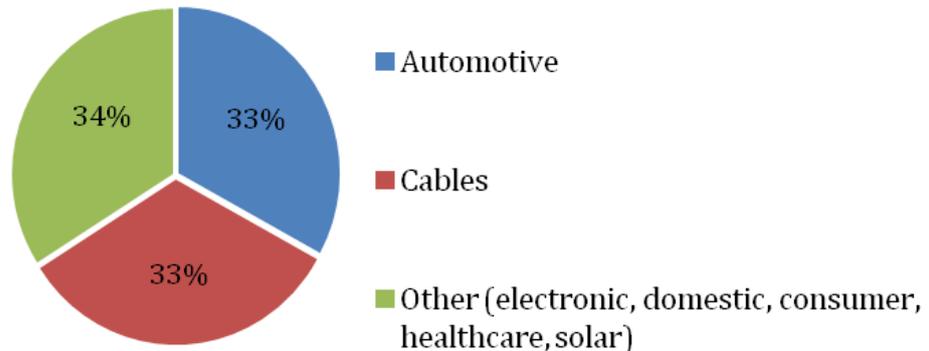
To give you some idea of market size, the total world market in silicone rubber is around 800,000 tonnes per annum. The split by region for silicone rubber consumption is shown below.



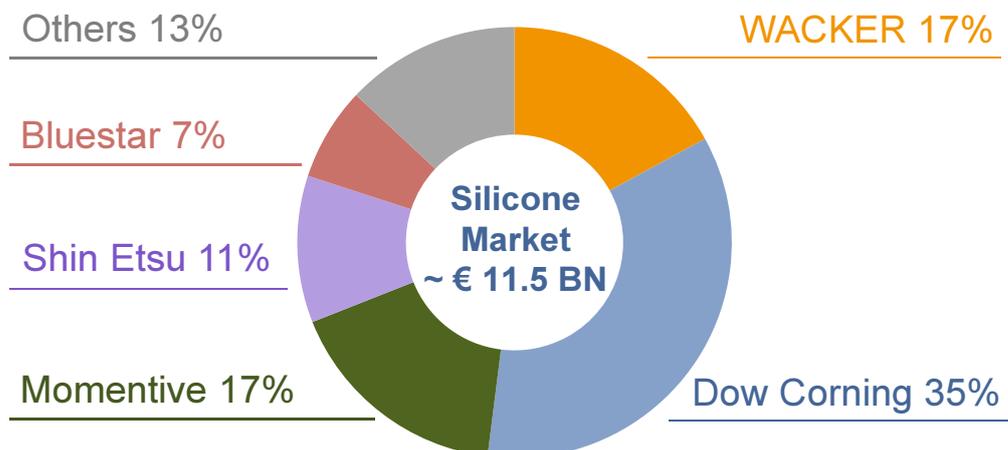
Worldwide Rubber Consumption



Main Markets for Silicone Rubber



Main Raw Material Suppliers – Market Share



About J-Flex

Established in 1984, and with over 30 years in the industry, J-Flex offers expertise in industrial rubber product manufacture and supply. Our mission is to help our customers by providing the right industrial rubber product, at the right time, in perfect condition.

We pride ourselves in good, old-fashioned customer service. Our customers are looking for product availability, reliability and a quick and efficient response to their requests. We deliver every time.



We are already helping over 2,000 customers and we export to over 50 countries.

We are accredited to BS: EN: ISO 9001: 2015 and are Registered Licensees under the The Chemours Company - Viton™ Licensing Scheme. We also ensure where appropriate our products are tested and approved by the relevant authorities, and will provide relevant certifications on request.

We manufacture silicone and components made for silicone and other quality products. An idea of the components we make is shown in the diagram below.

For you today J-Flex supply the following Components:



If you are struggling to specify the right solution for your particular circumstances, please contact us and we'll do our very best to help you make the right decision.

Check out the download area of our website www.j-flex.co.uk for product information, data sheets and more.

About The Author

John Kirk set up J-Flex in 1984 and is the Managing Director of the company.



As an industry veteran, with over 45 years' experience in the rubber industry, John relishes the opportunity to help customers with solutions to their industrial rubber engineering challenges.

Travelling worldwide on a regular basis, John is able to tap into his extensive network of contacts to drive the J-Flex business forward to the benefit of customers. With a strong customer focus, John is also keen to develop new products to meet customer requirements.

John is eager to ensure the rubber industry as a whole meets the quality standard customers expect which is one of the reasons for writing this White Paper.

John is a past President of European Seals and Gaskets Association (eusga).

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