Pros and Cons of

Designing with Silicone Rubber

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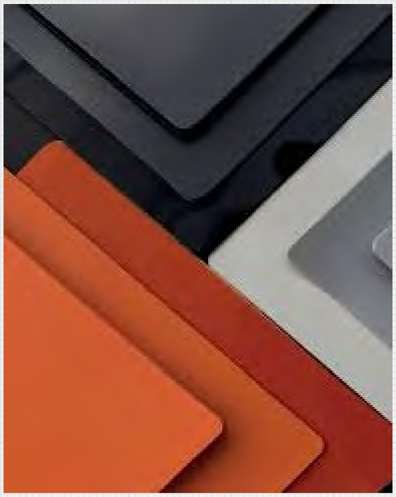
INTRODUCTION

Why design with silicone rubber?



In this eBook we are going to talk about silicone, that is, silicone rubber. However, before we begin let's get a few things straight: First of all, our primary discussion will focus on silicone rubber materials as dense rubber compounds and foam or sponge materials that are intended for use as silicone gaskets and seals, vibration dampers, shock absorbers, and reducers of NVH (noise, vibration and harshness).

Secondly, we will discuss silicone in general terms. There are MANY manufacturers of silicone materials and each offers a wide variety of silicone products with varying strengths and weaknesses. We'll try to pull the discussion back to some specific silicone products where possible and practical.

Thirdly, this is NOT a scientific treatise on the make-up and magic of silicone elastomers, or as they are sometimes called, siloxane, or poly-dimethyl siloxane compounds. We promise not to get too technical. For example, we are not going to explain the silicone chemical formula (R2SiO)x. Shoot, we couldn't if we tried. We convert silicone materials. We do not mix them.

However, we may have to dive into some details about the make-up of silicone rubber in order to explain some of the benefits, but we'll talk about that later.

First, let's have some fun trashing silicone. Let's consider...

Why NOT design with Silicone Rubber?

WHY NOT DESIGN WITH SILICONE RUBBER?

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Why NOT Design with Silicone Rubber?

Silicone is not a cure-all, do-all rubber type. There are certainly some negative characteristics about silicone. We can think of at least 4 good reasons to avoid silicone in your design. Let's count them down…

#4 Silicone is not as tough as many other elastomers. It typically exhibits poor abrasion resistance, poor tensile strength, and poor tear strength.

Compared to some other rubber compounds – such as polyisoprene (aka pure gum), SBR, neoprene, and nitrile – silicone abrades more quickly, and will have lower tensile and tear strength. Of course, manufacturers combat these weaknesses by combining the silicone rubber with other materials. For example, a cloth (usually woven fiberglass) inserted into silicone rubber, such as: Saint Gobain Norseal® 3320, Rogers BISCO ® HT-1500 or Rogers DSP-1564-7038. These materials have significantly higher tensile and tear strength.

#3 Silicone has poor resistance to petroleum based chemicals and fluids such as toluene, mineral spirits, gasoline and carbon tetrachloride.

Other elastomers such as nitrile and even neoprene will perform better with these types of hydrocarbon solvents. On the other hand, there is fluorosilicone rubber which has been formulated to enhance it's resistance to oils, fuels (including aviation fuel) acids and alkaline chemicals.

Why NOT Design with Silicone Rubber?

#2 Silicone is a "low surface energy" material, which translates: it is difficult to bond to a silicone surface.

Okay, this might be an advantage if that is what you are trying to achieve. For example, release liners used with pressure sensitive adhesives are most often coated with silicone. Also, silicones will stick to each other but have a hard time bonding to dissimilar surfaces. If you want to bond an acrylic PSA on a silicone rubber, you must first treat the silicone surface to increase the surface energy. This can be done through corona treating, for example.

Unless the surface is thoroughly cleaned to remove the silicone prior to painting, silicone particles can contaminate an unpainted surface by transference or outgassing. If either occur, they can cause the paint to fail to bond securely to that surface.

#1 Of course, the number one reason to avoid silicone in your design: The stuff is darned expensive.

In solid form of 50 or 60 durometer (Shore A), a commercial grade silicone may be double the cost of neoprene, nitrile or EPDM. If considering a specification grade of silicone rubber, the difference will be even greater. When comparing cellular materials (sponge or foam) of the same base compounds, the difference in cost is significantly more. Silicone foam is as much as 3 to 5 times more expensive than a closed cell rubber blend foam.

So why pay more? As a good design decision maker, you need a reason. Now let's discuss**... Why you SHOULD design with Silicone Rubber.**

WHY YOU SHOULD DESIGN WITH SILICONE RUBBER

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Why You Should Design with Silicone Rubber

#1 Temperature range

Silicone elastomers will function within the largest temperature range of any elastomer. Commonly, silicones are thermally stable from -100° F (-73° C) to 500° F (260° C). No other elastomeric material comes close. A commercial grade EPDM is rated for -40° F to 220° F. You can find a specification grade of EPDM that is rated up to 300° F. However, if your application involves very cold or very hot conditions, silicone is your best choice.

#2 UV and sunlight resistance

Many rubber materials like neoprene, SBR, polyisoprene, and nitrile will degrade relatively quickly when exposed to ultraviolet or ozone. Within a short time, these compounds will harden, crack, and begin scaling leading to failure as a gasket or energy absorber. EPDM has good UV resistance, but silicone is even better.

#3 Silicone is odorless, stain resistant, and hypoallergenic

(Here comes some of the technical jargon we warned you about.) Silicones differ from other elastomers in that its molecular makeup does not include carbon. This essentially makes silicone an inorganic, non-toxic compound. What this means in nutshell is that silicone rubber materials can be FDA grade for use with food processing, pharmaceuticals, and similar demanding environments. Silicone gaskets and seals will function for longer periods of time in food or medical applications without contamination or degradation.

Why You Should Design with Silicone Rubber

#4 Silicone can be made thermally conductive or electrically conductive and flame retardant.

Once again, due to its molecular structure, thermally conductive or electrically conductive fillers can be reliably mixed with the silicone elastomer prior to vulcanization. Those fillers blend predictably and more easily with silicone than is possible with other elastomeric choices.
The silicone elastomer, by its nature, is flame retardant. With fillers, silicone materials can achieve a flame rating as high as UL 94 V-0.

#5 Resistance to compression set

Compression set may be the most common cause of failure in a gasket. As a seal under compression takes a set, it loses compression force deflection. So when pressures rise and fall, and when thermal expansion or contraction occur, the gasket that has taken a set may no longer provide an adequate seal. There are some very good urethane gasket materials like Rogers PORON® that offer very good resistance to compression set. However, silicone elastomeric choices like Rogers BISCO® HT-800 will outlast all other choices when it comes to C-set.

Conclusion

Silicone is a high performance elastomer that outlasts and out-performs most other elastomeric choices on key performance scales.

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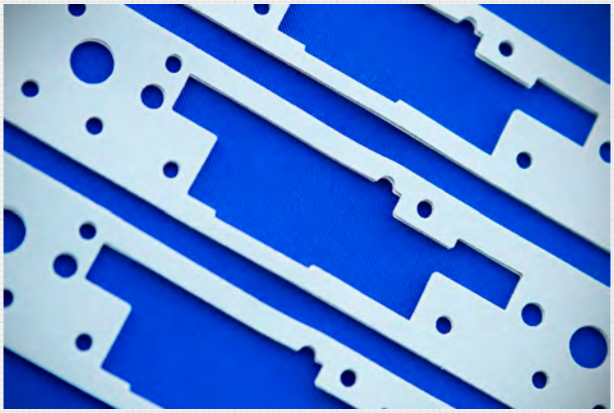
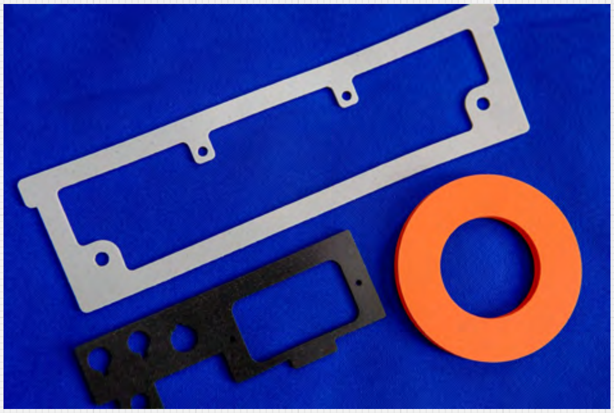
At Marian we manufacture high temperature silicone rubber gaskets as well as gaskets made from closed cell foam rubber, high density urethane foam (Rogers PORON®), EPDM, nitrile and many more materials. Each has their place and purpose. It is our sincere intent to help our customers make the best and most cost effective choice for the design and intent of their products.





Keep Learning! Check out some of our other resources related to silicone rubber

- **Success Story: Silicone Gasket for Motorcycle Infotainment/ Navigation Screen**

READ HERE

- **Ebook: Selecting Foam Materials for Static Sealing Gaskets**

READ HERE

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Contact us for advice, samples, data, even CAD produced prototypes without tooling.

We are anxious to help.

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