CRITICAL ISSUES AFFECTING SILICONE SHEETING

Well known for 30 years, J-Flex presents a guide to issues regarding silicone sheeting

WHITE PAPER

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What are the Critical Issues Affecting Silicone Sheeting?

Demand for silicone sheeting in established and emerging markets worldwide has increased. But quality standards have slipped.

That's the conclusion of a new study by J-Flex. In laboratory tests, J-Flex has discovered that much of the so-called 'competitive' silicone sheeting is sub-standard. Indeed, in many cases, it falls far below the exacting quality standards we should expect.

One of the biggest concerns is that some 'competitive' silicone sheeting is not suitable for gaskets and other components used in the food and beverage industry, and in other critical environments.

In many cases, J-Flex has accumulated evidence that the actual product does not meet the supplier's own material data sheet. This could be construed as deliberately misleading.

Additional concerns:

- Non-compliance to international food standards (despite claims)
- Poor mechanical properties
- Unsafe levels of volatile loss (toxic migration)
- Low thermal stability

Let's examine those concerns in a bit more detail:

Useful Definitions

Extractable Levels
The amount of chemicals that can escape into a liquid from the silicone when it is in prolonged contact with that liquid.

Volatile Loss (Toxic Migration)

The amount of chemicals that escape from the silicone when it is subjected to raised temperatures.

FDA White List

List of permitted ingredients & the manufacturer has a legal obligation to use these white list ingredients.

ALL silicone sheet products supplied by J-Flex comply with these regulations

FDA

BfR
Risiken erkennen – Gesundheit schützen

Food Safety,
EC No.1935:2004

WRAS
Water Regulations Advisory Service

Food Standard Compliance

International food safety standards - FDA/BfR/ EC1935 - state that rubber materials in repeated contact with food shall conform to strict extraction levels and will not change the composition of the food in an unacceptable way or deteriorate the taste or colour of foodstuffs.

These are the pre-requisites for meeting food safety standards:

- Material ingredients shall comply to current REACH regulations
- All material ingredients shall be included on the FDA White List
- No banned substances shall be used
- Products made from these compounds shall be made under "Best Manufacturing Practice" in accordance with EC2023:2006
- Finished sheetings shall be fully post-cured as stipulated by leading raw material suppliers (Bluestar; Wacker; Dow Corning etc.)

Useful Definition of Post Curing

Many silicone rubber parts require a post cure as well as vulcanization. There are two good reasons:

1. To drive off volatile materials. Otherwise, if the part is heated in service, these volatiles might make the inside soft or porous - especially if the part is largely confined.
2. To stabilize the properties of the rubber for high-temperature service. Curing is achieved by heating the parts in a circulating-hot-air oven to the required temperature for the required length of time.

Why are these pre-requisites in place?

TO ENSURE FOOD SAFETY!

In laboratory tests, J-Flex discovered very high levels of volatile loss (or out gassing) in some of the 'competitive' silicone sheetings.

Conclusion:
The products cannot have been post cured.

Result:
They would not meet international food standard extraction levels. In other words, they are not fit for purpose!

Laboratory Testing

Report N°	13-062 SO
Material	*Competitive Silicone*
Date	24-07-2013
Cure conditions	Competitive = 175°C x 5 mins J-Flex's = production conditions
Post cure conditions	Competitive = 200°C x 4 hours J-Flex's = 4 hours at 200°C
Heat age conditions	70hrs @ 150°C *

Test Method	Units	Trans "Competitive" Results	Trans "Competitive" Data Sheet	J-Flex 50 Trans Results	J-Flex 50 Trans Data Sheet	Test Method
Hardness	Shore A	52.5	51	52.5	50+/-5	DIN ISO 7619 -1
SG	g/cm³	1.163	N/A	1.139	N/A	In House
Tensile Strength	MPa	6.21	6.5	8.8	6.5 (Min)	DIN53504 type S1
Elongati on at Break	%	339	320	433	280 (Min)	DIN53504 type S1
Tear Strength	N/mm	11.8	18.8	18.5	10 (Min)	ASTM D624 die B
Comp Set 150°C x 24hours @ 50%	%	27.35	3.2	15	30% (Max)	DIN ISO 815 type B
*Hardness after heat age	Shore A	55	56	54.5	N/A	
Volatile 2hrs @ 200°C	%	2.08	-	0.3	-	In House
*Colour change	Delta b	10.11	-	0.76	-	In House
Thickness	mm	3.35mm	3mm	3.05	3+/-0.3mm	DIN7715 Class 2

But it isn't just food safety applications that can be compromised…

Some traders are offering Red Industrial Grade Silicone. They claim it doesn't need to be such a good grade; they claim there is no need to post cure to food standards.

This is not strictly true. First, note the definition: "post curing fully stabilises the properties of the silicone for those high temperature applications."

Next consider this:

Poor Mechanical Properties/ Low Thermal Stability

In laboratory studies, J-Flex heat aged 'competitive' silicone sheetings for 70 hours at 150° C - a perfectly acceptable temperature for normal silicones.

But look what happened:

First, the translucence was affected - the material took a very cloudy appearance. That's due to the use of cheap filled base materials.

It was noted that the elongation and tensile properties reduced slightly.

However, the tear strength was reduced by almost 40% and the compression set worsened after heating from 15% to 28%.

This poor thermal stability caused the test pieces to shrink by 3 - 4%.

Therefore, it is reasonable to suggest that if the silicone sheet is converted into a gasket in a static seal application, the poor compression set and shrinkage factor would cause a critical leak path.

Compression Set Definition

A cylindrical button of rubber of known thickness is compressed to a fixed height (typically 70% or 75% of its original height) at a defined temperature for a specific period of time.

The button is then released, allowed to recover (typically for 30 minutes) and the thickness is measured.

Compression Set is the height that is not recovered, expressed as a percentage of the amount by which it was compressed.

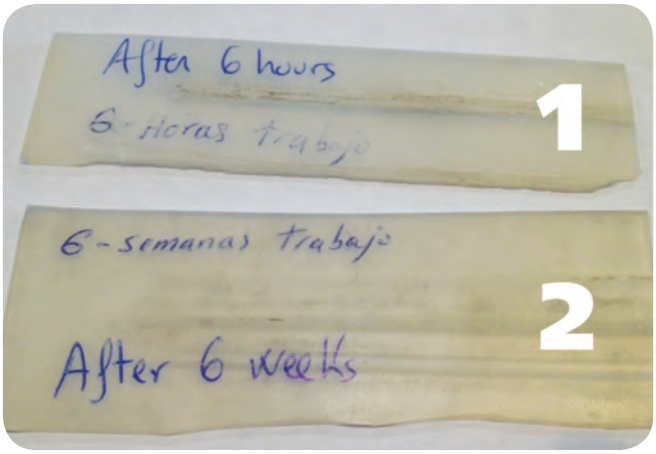
$$\% \text{ Comp. Set} = \frac{\text{original height - recovered height}}{\text{original height - compressed height}} \times 100$$

Specific Application

One leading European producer of P.P. bags for the food industry uses silicone pressure pads in a continuous heat welding application. The working temperature is 210^{O} C for 1 second on a 24/7 basis.

So how do these 'competitive' silicone materials cope in an application like that?

This image shows you... First the materials shrank; then they totally disintegrated in less than 6 working hours.



1. Competitive Silicone 2. 'Normal' Silicone

Shows the difference!

Normal Silicone materials last for over six weeks in this continuous application. That equates to over 160 times more working life at just an additional €3 per square metre!

How Can You Identify These 'Competitive' Silicone Sheetings?

Despite efforts to disguise the odour, some of these 'competitive' silicones have a distinctive, pungent smell.

That's because the materials are made from precipitated silicones, not fumed silicones as is the norm in Europe.

The benefits of fumed silicone

- Better transparency
- Better electrical properties
- Better mechanical properties - tear; tensile and elongation

Are There Any Positives For Precipitated Silicone?

It's cheaper - but for most customers, that's not nearly a good enough reason to compromise.

Warning! Volatile Loss (Toxic Migration)

The German Food Standard (BfR) expressly states that volatile loss (toxic migration) shall not exceed 0.5%. But when the 'competitive' materials were tested for two hours at 200° C, they gave off levels of 1.7% to 2.6%.

The inhalation of carcinogenic fumes from these emissions can cause serious long term health problems for everybody involved - warehouse / store people, gasket cutting operatives / gasket installers and process plant maintenance staff.

This is not an isolated fault or a one-off problem. As you'll see from the graph, J-Flex has been testing 'competitive' materials over several years.

High levels of toxic migration are also potential breeding sites for bacteria. It's almost unthinkable that this could even be an issue for silicone sheeting customers in 21st Century Europe. But with so many sub-standard materials being sold into the European market, it really is.

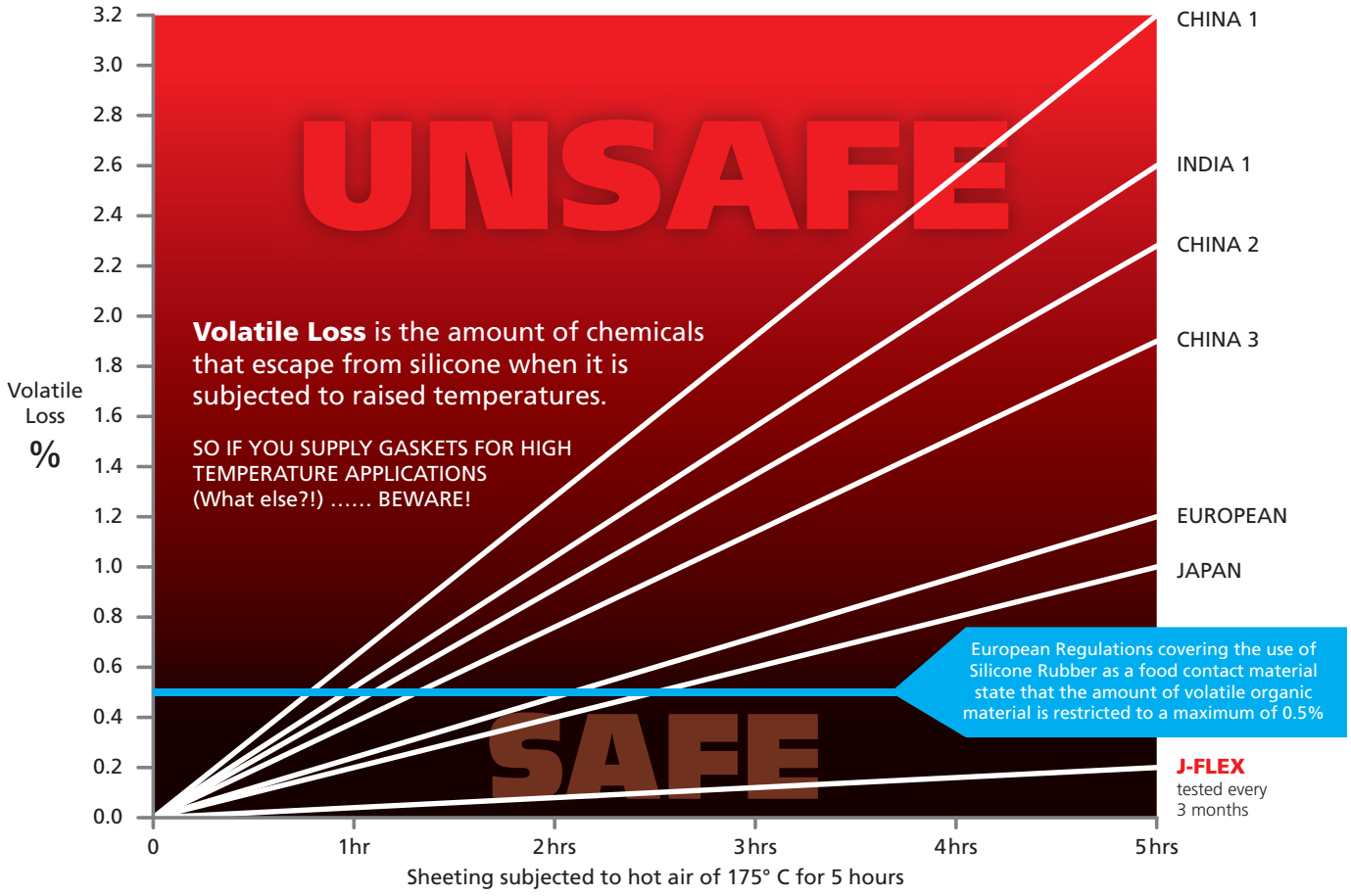
Do you know where your silicone sheets are produced?

Do you know if they've been independently tested to verify the results?

We should know. We all have a duty of care to our colleagues and clients (and even to our clients' customers).

So if you have any doubts about your silicone sheet materials, send us a small sample and we'll put it to the test in the laboratory, free of charge.

COMPARISON OF VOLATILE LOSS OF SILICONE SHEET PRODUCTS
CURRENTLY AVAILABLE ON WORLD MARKETS.



About J-Flex

J-Flex Safe Silicone Sheetings are made in Europe, under Best Manufacturing Practices, from FDA white listed ingredients. Everything we make is independently tested by organisations including Intertek, RAPRA, Labo Richter and SGS.

All our production material is laboratory controlled, tested and approved before it is released to the factory.

J-Flex welcomes even stricter European Food Standards - we all deserve them. That's why our safe silicone products meet all expectations of quality, safety and legislative compliance.

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 currently President of European Seals and Gaskets Association (eusga).

J-FLEX RUBBER PRODUCTS

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