Technical Application Report

AS1810 Diesel Resistant Silicone RTV

Application Challenges

Modern diesel engines require gaskets to seal a variety of components including fuel systems and control units. RTV silicones have bean used with in and around the engine for many years, being chosen for their flexibility and ability to with stand high temperatures. For use within a diesel engine the gasket material must be able to withstand the temperatures generated from the engine but most importantly, must be able to withstand the continual contact with diesel fuel.

In general silicone RTV sealants are prone to attack from mineral oils. To overcome this problem silicone RTV's can be formulated using fluorosilicone polymers, however the dramatic increase in costs usually prohibits their commercial use.

One of the patented acetone cure RTV silicone sealants was chosen and extensive testing was carried out to prove its suitability for applications involving contact with both conventional and bio-diesel fuels.

AS1810

Technical Data*

Cure type:	Acetone
Colour:	Black
Tack free:	4 min
SG:	1.05
Extrusion rate:	169 g/m
Temp range:	-50°C to +220°C
Hardness (Duro):	35 shore A
Tensile:	1.81 MPa
Elongation:	353%
Tear:	6.00 kN/m

*for full product data refer to technical data sheet

Additional testing would be required to establish the fuel resistance of the Acetone cure silicone. In addition to testing with standard grade diesel, tests would be carried out using RME (Rapeseed Methyl Ester) Bio-grade diesel.

Testing

As a supplier to the aerospace industry for well over 25 years we are well qualified to carry out an extensive rage of material testing within their own facilities. In addition to the standard tests carried out under their own stringent quality control and development procedures, a specialist outside testing house was commissioned.

MERL (Materials Engineering Research Laboratories) was commissioned to carry out the following tests using Liquid F diesel (ISO1817) and RME diesel (DIN EN 14214).

MEARL Additional Testing:

Fuel immersion testing to establish effect on:
Hardness, SG, Elongation, Tensile, Tear, Modulus, Compression Set, Heat Capacity.

Exposure Conditions
72 hours @ 23ºC
72 hours @ 100ºC
504 hours @ 100ºC
1008 hours @ 100ºC

Testing regime

Property	Standard	No of Samples
Micro IRDH hardness	Din 53519-2	17 off
Shore A hardness	DIN 54505	17 off
Tensile strength	DIN 53504	17 x 5 off
Tear strength	DIN 35307B	17 x 5 off
Density	DIN 53479A	17 off
Compression set 22hrs @ 150ºC	VDA 675216B	2 off
DMA analysis -45ºC to +60ºC in 1ºC steps		1 off
DSC cold orientation value	TR DBL5555 Part II section 4.3 also ISO 4663	1 off

Conclusions of testing

1. **Liquid F Diesel ISO1817 reduces the physical strength of AS1810 by a greater degree in comparison to Winter Bio-diesel RME (Rapeseed Methyl Ester) DIN EN 14214.**

2. The modulus/hardness of the AS1810 drops very rapidly after 3 days of exposure to Liquid F diesel at 100°C and slowly decreases in hardness over the next 928 hours. The elongation remains relatively constant after an initial drop after 3 days exposure. The density initially drops after 3 days exposure at 100°C then remains constant over the next 928 hours. This indicates that the AS1810 has become saturated with the Liquid F diesel and can't physically absorb any more. The liquid F diesel is trapped in the AS1810 and is very difficult to remove, even after drying at 100°C for 22 hours. **The AS1810 though weak in physical strength, (tensile and trouser tear) and low in hardness, still has sufficient strength and elastic properties to remain useful as a sealant in a low stress environment when immersed in Liquid F diesel for 1000 hours at 100°C.**

3. The modulus/hardness of the AS1810 drops very rapidly after 3 days of exposure to Winter Bio-diesel at 100° and slowly decreases in hardness over the next 928 hours. The drop in properties is not as great as those seen with Liquid F diesel. The elongation remains relatively constant over the 100 hour test period at 100°C. The density initially drops after 3 days exposure at 100°C then remains constant over the next 928 hours. This indicates that the AS1810 has become saturated with the Winter Bio-diesel and can't physically absorb any more. The Winter Bio-diesel is trapped in the AS1810 and is very difficult to remove even after drying at 100°C for 22 hours. **The AS1810, though weak in physical strength and low on hardness, still has sufficient strength and elastic properties to remain useful as a sealant in a low stress environment when immersed in Winter Bio-diesel for 1000 hours at 100°C**

4. Compression set results indicate the ability of the AS1810 to return to its original shape and size after a compression force gas been applied for a given time period. In this case AS1810 gave a value of 74.4% after 22 hours compression at 150°C. When left for a further 30 minutes the AS1810 does improve to 60% compression set. The lower the % compression set the better the ability of the material to recover from stress compression. **These values indicate that the AS1810 can be compressed beyond its point of recovery. There is a slow improvement but AS1810 is not expected to return to the original size and shape.**

5. DMA (Dynamic Mechanical Analysis) is the change in modulus of a material over a temperature range. Modulus is the ability of a material to stretch with applied force, the lower the modulus value, the softer/more elastic the material. The modulus of AS1810 shows a small increase with a decrease in temperature but then achieves a stable value (see Table Fig 7). **The DMA results show that the AS1810 shows very little change in elastic properties over the temperature range of -45°C to 60°C.**

6. DSC (Differential Scanning Calorimetry) analysis determines the specific heat capacity of the AS1810. This is the amount of energy/heat required to raise the temperature of 1 gram of AS1810 by 1°C (1 Kelvin). AS1810 has a specific heat capacity of 1.57 joules/gram.Kelvin (J/g.K). The lower the specific heat capacity the less energy/heat is required to raise the temperature of the material. Some comparisons are given below:

Material	Specific Heat Capacity (j/g.K)
AS1810	1.57
Iron	0.46
Aluminium	0.90
Polypropylene	1.93
Nitrile rubber	1.99

This shows that AS1810 requires a substantial amount of energy to raise the temperature by 1°C in comparison to metallic materials like aluminium and iron, so would take a longer period of time to reach a maximum operating temperature and also, take a longer period of time to lose this heat (thermal insulator).

A full copy of the MERL testing results can be made available from Technical Services

Summary

Extensive testing proved AS1810 suitable for use with conventional and Bio-diesel when used as a gasket material in conjunction with mechanical fixings.