Silicone Fluid Range

1. DESCRIPTION

A series of fluids are water-white liquids which are available in a range of viscosities from 20 to 60,000 mm2 s-1(a). They are characterized by high-temperature stability, oxidation resistance and only a small change in viscosity with temperature. In addition, the fluids are chemically very inert, have good electrical properties, high compressibility and good resistance to shear breakdown.

This unusual combination of properties results from their molecular structure for which a helical conformation is the favoured structure in the absence of solvents, diluents or surfaces on which to spread. When spread in monomolecular layers on polar surface the fluids are believed to adopt a characteristics 'spread chain' conformation.

Fluids are linear dimethyl polysiloxanes consisting of alternate silicone and oxygen atoms, their free valences being saturated by methyl groups. Their unique surface properties and chemical inertness are due to the methyl groups and their protective influence on the Si-O-Si bonds.

2. TYPICAL PHYSICAL PROPERTIES

The physical properties of the Silicone fluids show very small changes across the wide range of viscosities.

	20cs	**50cs**	**100cs**	**350cs**	**500cs**
Viscosity @ 25ºC $mm^2 s^{-1}$ (1)	20	50	100	350	500
Specific gravity @ 25ºC/25ºC	0.953	0.963	0.968	0.972	0.973
Flash point ºC (approx) (2)	230	280	>315	>315	>315
Freezing point ºC (approx)	-73	-55	-55	-50	-50
Refractive index @ 25ºC (approx)	1.402	1.402	1.403	1.403	1.403
Surface tension @ 25ºC					
- **dynes/cm (approx)**	20.6	20.7	20.9	21.1	21.1
- **newtons/m (approx)**	$2.06.10^{-2}$	$2.07.10^{-2}$	$2.09.10^{-2}$	$2.11.10^{-2}$	$2.11.10^{-2}$
Thermal conductivity					
- **cal. cm/sec.cm^2 ºC**	$3.4.10^{-4}$	$3.8.10^{-4}$	$3.8.10^{-4}$	$3.8.10^{-4}$	$3.8.10^{-4}$
- **watts/m.ºC (approx)**	0.14	0.16	0.16	0.16	0.16
Dielectric strength @ 25ºC kV/mm (approx)		15	16	16	16
Dielectric constant @ 25ºC between 0.5 & 100 kHz (approx)	2.68	2.8	2.8	2.8	2.8

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3. COMPRESSIBILITY

Silicone fluids show greater volume reduction under extreme pressure than petroleum and other organic liquids. This high compressibility is used to advantage in liquid springs but does not interfere with the normal operation of damping or hydraulic systems. Typical values are given in the table below.

Pressure		Volume reduction (%) Silicon Fluid	
$1b/in^2$	Kg/cm^2	100cs	1000cs
10,000	703	5.6	5.0
20,000	1,406	9.2	8.5
30,000	2,110	11.6	11.0
50,000	3,51	15.2	14.5

The bulk modulus of the silicone fluids is 10,550 kg/cm2 at 25ºC and 351 kg/cm2 pressure. Bulk modulus is a measure of volume elasticity or compressibility and it is calculated by dividing the applied pressure by the volume change per unit volume.

Bulk modulus increases with pressure and decreases with temperature.

4. SHEAR STABILITY

Low-molecular-weight and hence low-molecular-viscosity silicone fluids are essentially Newtonian, that is their measured viscosity does not change even after vigorous and prolonged shearing action. The higher viscosity fluids show a non-Newtonian character and at high shear rates; the effect increasing with viscosity. The apparent change in viscosity of a non-Newtonian fluid is not permanent an the original viscosity returns at lower shear rates (some organic fluids show a permanent drop in viscosity under shear, this resulting from the fluid molecules being torn apart by the mechanical action).

5. GAS SOLUBILITY

The solubility of gases in the fluids depends on the viscosity, the temperature and the pressure applied. At room temperature and 1 atmosphere pressure, the volumes of gas that have been found to be soluble in one gram of silicone fluid, depending on the viscosity, are given below:

Gas	Volume, cm3
Air	0.175 - 0.190
Nitrogen	0.163 - 0.175
Carbon dioxide	1.00 – 1.02

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6. CHEMICAL RESISTANCE

Dimethyl fluids are chemically inert and are unaffected by most materials.

Water and dilute solutions of inorganic acids and bases will not react with the fluids at room temperature. However, at concentrations above 30%and at elevated temperatures, acids and bases cause rearrangement of the silicone molecular structure, resulting in viscosity increases and, in some instances, gelation of the fluids.

Most metals do not affect dimethyl fluids even in the pressure of oxygen at temperatures up to 200ºC. Lead, Tin, Selenium and Tellurium, however, adversely affect the stability of fluids at high temperatures under oxidizing conditions, causing viscosity increases and possibly gelation.

7. EFFECT ON MATERIALS

Dimethyl fluids have no deleterious effect on most common materials of construction.

Surface coatings of the fluids have a lubricating effect on natural and synthetic rubbers. Immersion in silicone fluid, particularly at elevated temperatures, may cause decreases in weight and volume and increases in hardness of many rubbers. This effect, caused by partial leaching out of plasticisers, is less marked with the higher-viscosity fluids. Special rubber formulations are supplied by major fabricators for the production of gaskets and seals for systems containing silicone fluids.

Plastics, in general, are unaffected by silicone fluids. When they are used as mould release agents for polyethylene or polyactal resins there is some evidence that the fluids contribute to stress cracking in the finished product. Dimethyl fluids, therefore, should not be used for plastics in fabrication processes which induce stress in the finished product or where the product will be stressed in service. Polyethylenes of low melt flow index are less susceptible to stress cracking in the pressure of silicone fluids.

8. PRODUCTS OF COMBUSTION

When burned with excess oxygen, fluids form silicone dioxide, carbon dioxide and water. If combustion is incomplete the products may also include short-chain polymers, methane, formaldehyde and formic acid.

9. PACKING

Silicone fluids in the Dimethyl fluids series are supplied in non-returnable packs containing the following net quantities of product.

1kg, 5kg, 25kg and 200kg

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10. HEALTH & SAFETY

(Refer to Health & Safety Data Sheet)

Health and handling advice on these products is given in the individual product safety data sheets, available on request.

11. SUITABILITY FOR USE OF DIMETHYL FLUIDS

Dimethyl fluids have been developed for use in industrial applications. NO guarantee can be given that they can be used safely in medical/cosmetic applications.

12. COMMON SOLVENTS AND OTHER PRODUCTS

Customers are advised to obtain data sheets for any common solvents or other products referred to from the manufacturers and to satisfy themselves as to the hazards which they may present in handling and use for the purposes described.

In addition, care should be taken to comply with any government legislation currently in force in the country in which the solvents are to be used.