Technical Data Sheet

ACC F111 DIMETHYL FLUIDS

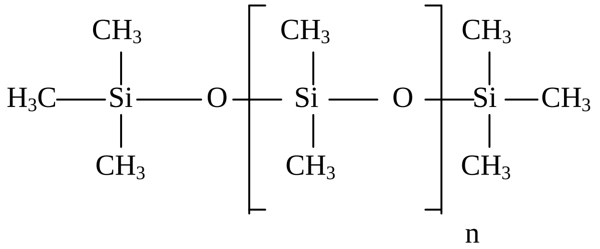
INTRODUCTION

ACC F111 series of fluids are water-white liquids which are available in a range of viscosities from 20 to 60,000 $mm^2\,s^{-1}$ [(a)] . They are characterised 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 surfaces the fluids are believed to adopt a characteristics ‘spread chain’ conformation.

ACC F111 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.

The chemical structure of the F111 fluids can be illustrated by the following generic formula.



Viscosity Data

The viscosity of ACC F111 fluids is related to the value of ‘n’. Some typical fluid viscosities in relation to ‘n’ and the average molecular weight are shown in table A

Table A : Relationship between viscosity, molecular weight and the value of ‘n’

Viscosity mm^2s^{-1}	Approx value of ‘n’	Average molecular
20	23	1,900
50	48	3,700
100	90	6,800
300	180	13,500
1,000	330	28,000
10,000	810	60,000
60,000	1,215	90,000

The actual viscosities of ACC F111/20 and F111/50 are controlled within the limits 18-22 mm^2s^{-1} and 47 – 53 mm^2s^{-1} respectively. The remaining fluids in the ACC F111 series have their viscosities controlled within ± 5 of the nominal values up to 1000 mm^2s^{-1} and ± 10 for those of higher viscosity as shown in Table 2

Typical Physical Properties

The physical properties of ACC F111 Fluids show very small changes across the wide range of viscosities. Some of the important properties are summarised in Table 1.

Table 1

Characteristics	F111.20	F111/50	F111/100	F111/300	F111/350	F111/500	F111/1000	F111/10,000 to 60,000
	Grade of F111 Fluid							
Viscosity at 25°c $mm^2 s^{-1}$	20	50	100	300	350	500	1,000	10,000- 60,000
Specific gravity at 25°C/25°C	0.953	0.963	0.968	0.972	0.972	0.973	0.974	0.975 – 0.978
Flash point °C (approx) (2)	230	280	>315	>315	>315	>315	>315	>315
Freezing Point °C (approx)	-73	-55	-55	-50	-50	-50	-50	-45
Refractive index at 25°C (approx)	1.402	1.402	1.403	1.403	1.403	1.403	1.403	1.404
Surface tension at 25°C – dynes/cm (approx) - Newton/m (approx)	20.6 $2.06x10^{-2}$	20.7 $2.07x10^{-2}$	20.9 $2.09x10^{-2}$	21.1 $2.11x10^{-2}$	21.1 $2.11x10^{-2}$	21.1 $2.11x10^{-2}$	21.1 $2.11x10^{-2}$	21.1 $2.11x10^{-2}$
Vapour pressure at 200°C -mm Hg (approx - Pascals (approx)	1.10^{-2} 1.33	1.10^{-2} 1.33	1.10^{-2} 1.33	1.10^{-2} 1.33	1.10^{-2} 1.33	1.10^{-2} 1.33	1.10^{-2} 1.33	1.10^{-2} 1.33
Volume expansion coefficient between 25°C and 100°C $cm^3/cm^{3\ °C}$ (approx)	$1.07x10^{-3}$	$1.05x10^{-3}$	$9.25x10^{-4}$	$9.25x10^{-4}$	$9.25x10^{-4}$	$9.25x10^{-4}$	$9.25x10^{-4}$	$9.25x10^{-4}$
Specific heat -cal/g.°C (approx) - joules/g.°C (approx)	0.39 1.63	0.35 1.46	0.35 1.46	0.35 1.46	0.35 1.46	0.35 1.46	0.35 1.46	0.36 1.50
Thermal conductivity -cal. $Cm/sec.cm^2$. °c (approx) - watts/m.°C (approx)	$3.4x10^{-4}$ 0.14	$3.8x10^{-4}$ 0.16	$3.8x10^{-4}$ 0.16	$3.8x10^{-4}$ 0.16	$3.8x10^{-4}$ 0.16	$3.8x10^{-4}$ 0.16	$3.8x10^{-4}$ 0.16	$3.8x10^{-4}$ 0.16
Viscosity/temperature coefficient (3) (approx)	0.59	0.60	0.62	0.62	0.62	0.62	0.62	0.62
Dielectric constant at 25°C between 0.5 and 100kHz (approx)	2.68	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Dielectric Strength at 25°C kV/mm (approx)	15	16	16	16	16	16	16	18
Power factor at 25°C - 0.5kHz (approx) - 100kHz (approx)	$4x10^{-5}$ $1x10^{-5}$	$2x10^{-4}$ $1x10^{-4}$	$2x10^{-4}$ $1x10^{-4}$	$2x10^{-4}$ $1x10^{-4}$	$2x10^{-4}$ $1x10^{-4}$	$2x10^{-4}$ $1x10^{-4}$	$2x10^{-4}$ $1x10^{-4}$	$2x10^{-4}$ $1x10^{-4}$
Volume Resistivity at 25°c ohm. cm	$1x10^{14}$	$1x10^{14}$	$1x10^{15}$	$1x10^{15}$	$1x10^{15}$	$1x10^{15}$	$1x10^{15}$	$1x10^{15}$

(1) F111/20 to F111/1000 measured using Test method IP71/87 (ASTM D445-60) using Ostwald U-tube viscometers to BS188 - 1977 “Methods for determination of viscosity” F111/10,000 and above are tested on Brookfield RV viscometer.
(2) Test method is Pensky-Martens, Closed Cup Method, IP 34/88 (BS.2000 Part 34:1990)
(3)Viscosity/temperature coefficient = 1 - (visc. at 99°C/visc. at 38°C).

Some other Properties of ACC F111 Dimethyl Fluids

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 Table 2.

Table 2. Compressibility of ACC F111 Fluids

Pressure		Volume reduction (%) Silicone Fluid	
1b/in^2	kg/cm^2	F111/100	F111/1000
10000	703	5.6	5.0
20000	1406	9.2	8.5
30000	2110	11.6	11.0
50000	3515	15.2	14.5

The bulk modulus of the F111 series of silicone fluids is 10,550 kg/cm^2 at 25°C and 351 kg/cm^2 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.

Shear Stability

Low-molecular-weight- and hence low-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 (30,000+) show a non Newtonian character at high shear rates; the effect increasing with viscosity. The apparent change in viscosity of a non-Newtonian fluid is not permanent and the original viscosity returns at lower share 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).

Gas Solubility

The solubility of gases in ACC F111 diethyl 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 in Table 3.

Table 3. Solubility of gases in ACC F111 Dimethyl Fluids(+)

Gas	**Volume, cm^3**
Air	0.175-0.190
Nitrogen	0.163-0.175
Carbon dioxide	1.00-1.02

[f] At room temperature and 1 atmosphere pressure.

Chemical Resistance

ACC F111 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 ACC F111 dimethyl fluids even in presence of oxygen at temperatures up to 200°C. Lead, tin, selenium and tellurium, however, adversely affect the stability of the fluids at high temperatures under oxidizing conditions, causing viscosity increases and possibly gelation.

Effect on Materials

ACC F111 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 polyacetal resins there is some evidence that the fluids contribute to stress cracking in the finished product. ACC F111 dimethyl fluids, therefore, should not be used for these 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 presence of silicone fluids.

Thermal Stability

The F111 fluids are exceptionally stable when exposed to high temperatures. At 315ºC, thermal rearrangement of the silicone molecular structure begins and, as the temperature rises still further, low-molecular weight siloxane volatiles are formed.

Products of Combustion

When burned with excess oxygen, the F111 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.

Pour Point*

The pour point of a fluid is the temperature at which it loses its ability to flow.
For F111/50 the pour point is –50ºC to –54ºC and for F111/20 it is approx –73ºC

Packages

Silicone fluids in the ACC F111 Dimethyl fluids series are supplied in non-returnable packs containing the following net quantities of product.

1 kg; 5 kg; 25 kg and 200 kg

Health and Safety

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

Suitability for use of ACC F111 Dimethyl Fluids

ACC F111 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.

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.