Technical Data Sheet

DOWSIL™ 702 Diffusion Pump Fluid
DOWSIL™ 704 Diffusion Pump Fluid
DOWSIL™ 705 Diffusion Pump Fluid

Diffusion pump fluids for high vacuum, fast pumping of gas/vapor

Features & Benefits

- Thermal stability
- Resists oxidation
- Chemically inert

Composition

- Silicone (DOWSIL™ 702 Fluid)
- Single-component silicone material (DOWSIL™ 704 Fluid and DOWSIL™ 705 Fluid)

Applications

- Fast pumping of large volumes of gas or vapor in production operations
- (DOWSIL 702 Diffusion Pump Fluid);
- Producing vacuums of 10^{-5} to 10^{-8} torr, untrapped, and 10^{-10} to 10^{-11} torr, trapped (DOWSIL 704 Diffusion Pump Fluid);
- Producing ultrahigh and ultraclean vacuum (DOWSIL 705 Diffusion Pump Fluid).

Typical Properties

Specification Writers: These values are not intended for use in preparing specifications.

Property	Unit	DOWSIL 702 Diffusion Pump Fluid	DOWSIL 704 Diffusion Pump Fluid	DOWSIL 705 Diffusion Pump Fluid
Ultimate Vacuum, torr				
untrapped	torr	10^{-6}	10^{-7} to 10^{-8}	10^{-9} to 10^{-10}
trapped	torr	—	to 10^{-11}	10^{-11}
Extrapolated Vapor Pressure 25 (77°)	torr	1×10^{-6}	2×10^{-8}	3×10^{-10}
Specific Gravity at 25°C (77°F)	°C (F)	1.07	1.07	1.09
Viscosity at 25°C (77°F)	cSt	45	39	175
Flash Point, open cup	°C (F)	193 (380)	221 (430)	243 (469)
Boiling Point, at 0.5 torr	°C (F)	180 (356)	215 (419)	245 (473)
Typical Boiler Temperature	°C (F)	190 (374)	220 (428)	250 to 270 (482 to 518)

T = absolute temperature, K.

Typical Properties (Cont.)

Property	Unit	DOWSIL 702 Diffusion Pump Fluid	DOWSIL 704 Diffusion Pump Fluid	DOWSIL 705 Diffusion Pump Fluid
Surface Tension	dynes/cm	30	37.3	36.5
Heat of Vaporization	kcal/g mole	21.7/190°C (374°F)	25.5/200°C (392°F)	28.2/250°C (482°F)
Molecular Description		Mixed phenyl-methyldimethyl cyclosiloxane	Tetramethyl-tetraphenyl-trisiloxane	Penta phenyl-trimethyltri-siloxane
Molecular Weight		—	484	546
Vapor Pressure Equation[1],		A = 10.3	A = 11.025	A = 12.31
log10 P = A - B/T		B = 4820	B = 5570	B = 6490

1. P = vapor pressure, torr

Description

DOWSIL 702, 704 and 705 Diffusion Pump Fluids are designed for high vacuum and for fast pumping of large volumes of gas or vapor in production operations.

DOWSIL 702 Diffusion Pump Fluid is a general-purpose fluid designed for fast pumping of large volumes of gas. It is used to produce vacuums in the range of 10^{-5} to 10^{-7} torr. It is also used in vapor ejector pumps that attain vacuums of 10^{-4} to 10^{-5} torr.

DOWSIL 704 Diffusion Pump Fluid is a single-component fluid for high vacuums of 10^{-6} to 10^{-8} torr (untrapped) and 10^{-10} to 10^{-11} torr (trapped). It performs well in tough, rugged applications and offers quick pumpdown, even after exposure to air at operating temperatures.

DOWSIL 705 Diffusion Pump Fluid is a colorless to straw-colored, single-component fluid designed for ultrahigh vacuum applications in the range of 10^{-9} to 10^{-10} torr (untrapped) and 10^{-11} torr (trapped). The vapor pressure and backstreaming rate of DOWSIL 705 Diffusion Pump Fluid are so low that use of traps or refrigeration is unnecessary for some ultrahigh and ultraclean vacuum applications. It has the highest phenyl content of all silicone diffusion pump fluids and the best resistance to radiation.

Benefits

Dow diffusion pump fluids offer the following benefits:

- Shorter conditioning runs: Single-component silicone fluids reach maximum potential in far less time than that required for multi-component organic fluids.
- Faster pumping: Diffusion pumps using silicone fluids can operate against 20–300 percent higher fore pressures than those using organic fluids. For higher gas through-put at the high-pressure end of the pump's operating range, heater input can be increased 20–30 percent.
- Minimal backstreaming: The vapor pressure of single-component silicone fluids from Dow is so low that the use of traps – or refrigeration of existing traps – is unnecessary for many applications.
- Longer service life: Thermal and chemical stability of silicone fluids allows exceptionally long runs without deterioration or contamination.

Benefits (Cont.)

- Cleaner systems, less maintenance required: Low vapor pressure of silicone fluids at baffle temperatures results in low migration rates. Jets and boiler surfaces stay clean; silicone fluids exhibit virtually no breakdown or decomposition under operational conditions.
- Faster cycling, reduced downtime, less frequent fluid replacement: The recovery rate of silicone fluids after exposure to air at operating temperatures is many times faster than that of organic fluids. Time is saved between cycles because the outstanding resistance of silicone fluids from Dow to oxidation and hydrolysis allows release of the vacuum without cooling the pump.

Uses

Dow diffusion pump fluids can be used in a variety of applications including:

Electronics

- Evacuating television and cathode-ray tubes
- Evacuating power and microwave tubes
- Vapor deposition of thin films by sputtering or evaporation in devices and microcircuits

Metallurgy

- Electron-beam operations; high-vacuum furnaces
- Melting, degassing and sintering refractory metals; thick-film deposition

Vacuum Coatings

- Aluminizing television tubes
- Optical coatings
- Decorative coatings for novelties and automobile parts
- Coating architectural glass, plastic and metal sheet

Research

- Ultrahigh vacuum and ultraclean vacuum for thin-film, surface-emissivity, lubrication and metal-fatigue studies

Performance Data

Radiation Resistance

Dow diffusion pump fluids exhibit good resistance to gamma radiation because of their high phenyl content. Fluid, with the highest phenyl content of all silicone diffusion pump fluids, has the best resistance to radiation. (See Table 1.) DOWSIL 704 Diffusion Pump Fluid, for example, requires approximately 1800 mega-rads of irradiation to double the origina viscosity. The phenyl content of DOWSIL 702 Diffusion Pump Fluid is slightly lower. And DOWSIL 705 Diffusion Pump Fluid, with the highest phenyl content of all silicone diffusion pump fluids, has the best resistance to radiation. (See Table 1.)

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Performance Data (Cont.)

Seal Compatibility

Immersion Tests at 70°C (158°F) have shown that butyl and Viton® rubbers, as well as others, are suitable for sealing pumps using DOWSIL 705 Diffusion Pump Fluid.

Oxidation Resistance

Silicone fluids are not oxidized by air at operating temperatures and are not subject to hydrolysis by water vapor. Their chemical resistance gives them long life and eliminates frequent replacement. Also, the silicone fluids, being inert, do not react with metal parts, elastomer seals and gasses such as hydrogen and carbon monoxide.

Rapid Cycling

The results of cycling tests show that the capability of silicone fluids was practically unchanged after 1000 cycles. In comparison, the vacuum obtainable with an organic ester deteriorated by a factor of about 100 after 400 cycles. In the test, a single-stage glass diffusion pump and a Knudsen vacuum gauge were used.

During each cycle, the pump was exposed to atmosphere for three operated for 12 minutes and then minutes. The heater was off during exposure, but the fluid remained close to the operating temperature. Test results were:

DOWSIL™ 702 Fluid	
Number of Cycles	Pressure, torr
0	3.3×10^{-6}
492	3.8×10^{-6}
1016	3.8×10^{-6}

DOWSIL™ 704 Fluid	
Number of Cycles	Pressure, torr
0	2.3×10^{-6}
994	3.0×10^{-6}
2072	3.3×10^{-6}

DOWSIL™ 705 Fluid	
Number of Cycles	Pressure, torr
0	2.4×10^{-6}
101	2.4×10^{-6}
1082	3.0×10^{-6}

Tests under the same conditions with the organic ester fluid, di (2 ethylexyl) phthalate, gave the following results:

Number of Cycles	Pressure, torr
0	2.0×10^{-6}
107	3.5×10^{-5}
220	6.0×10^{-5}
412	1.6×10^{-4}

Performance Data (Cont.)

Explosion Resistance

Silicone diffusion pump fluids, in the absence of less stable contaminants or high-temperature ignition sources, pump air and oxygen with little danger of fire or explosion. This conclusion, drawn from Dow test data, is supported by service experience both in continuous pumping of pure oxygen and in repeated venting of hot pumps to atmospheric pressure.

DOWSIL 704 Diffusion Pump Fluid has excellent resistance to explosion, as shown by tests conducted in a pure oxygen atmosphere. (See Table 2.) Oxygen was mixed with vapors of the pump fluids at known pressures and temperatures to determine the temperature at which various mixtures would explode. The total pressure of the mixture was one atmosphere. Ignition temperatures are shown in Table 3.

Spontaneous ignition temperatures of DOWSIL 705 Diffusion Pump Fluid were found in this test to be approximately 200°C (392°F) above the normal operating temperature in a diffusion pump.

Vapor Pressure

As Figure 1 shows, DOWSIL 705 Diffusion Pump Fluid has extremely low vapor pressure. The broken line at 25°C (77°F) marks the vapor pressures with a baffle at that temperature. Broken lines at right indicate operating temperatures in modern commercial pumps producing 0.8 torr boiler pressure.

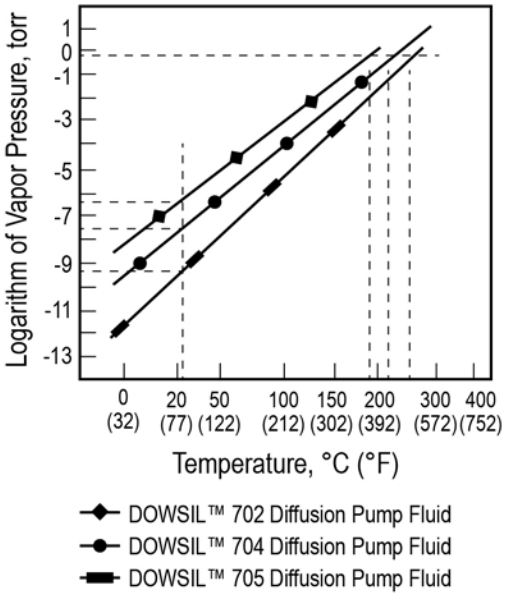

Figure 1:
Vapor Pressure

Backstreaming

Contamination rates at surfaces in a vacuum chamber are controlled by the vapor pressure of the condensed fluid film on the baffle.

Performance Data (Cont.)

Because of its low vapor pressure, contamination rates with DOWSIL 705 Diffusion Pump Fluid in water-baffled systems can be up to 100 times lower than with DOWSIL 704 Diffusion Pump Fluid. The difference is even greater in comparison with most organic fluids.

Contamination can be stopped by trapping; however the rate for DOWSIL 705 Diffusion Pump Fluid is so low that ultrahigh vacuum can be obtained with a water-cooled baffle only. DOWSIL 705 Diffusion Pump Fluid also makes ultraclean operation possible without trapping for moderate periods of time.

Table 1: Radiation Resistance After Exposure To Cobalt 60 Source[1]

		Pressure, torr	
Fluid	Dosage, megarads	Before Exposure	After Exposure
Organic	100	2×10^{-6}	1.1×10^{-5}
DOWSIL 704 Diffusion Pump Fluid	280	2×10^{-6}	3×10^{-6}

1. Samples tested in single-stage glass diffusion pump. Pressure measured with Knudsen gauge.

Table 2: Explosion Resistance in Pure Oxygen Atmosphere[2]

				Explosions at	
Fluid	Cell Pressure Range, ton	Cell Temp. Range, °C (°F)	Cell Pressure, torr	Cell Temp., °C (°F)	Reservoir Temp.,°C (°F)
DOWSIL 704 Diffusion Pump Fluid	40 to 734	304 to 483 (580 to 901)	300	478 (893)	269 (516)
			455	430 (806)	267 (513)
			633	429 (804)	267 (513)

2. Journal of Vacuum Science and Technology, Vol. II, Number 5, Sept.-Oct. 1965.

Table 3: Ignition Temperatures of DOWSIL 705 Diffusion Pump Fluid vs. Hydrocarbon Diffusion Pump Fluid

Fluid	Partial Fluid Pressure, torr	Volume Fluid Vapor, percent	Spontaneous Ignition Temperature, °C (°F)
DOWSIL 705 Diffusion Pump Fluid	23	3	475 (890)
	37	4.9	464 (870)
	72	9.5	440 (824)
Hydrocarbon diffusion pump fluid	8.1	1.1	300 (572)
	21	2.7	325 (617)
	30	4.0	340 (644)

Handling Precautions

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED IN THIS DOCUMENT. BEFORE HANDLING, READ PRODUCT AND SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE SAFETY DATA SHEET IS AVAILABLE ON THE DOW WEBSITE AT WWW.CONSUMER.DOW.COM, OR FROM YOUR DOW SALES APPLICATION ENGINEER, OR DISTRIBUTOR, OR BY CALLING DOW CUSTOMER SERVICE.

Usable Life And Storage

When stored at or below 25°C (77°F) in the original unopened container, these products have a usable life of 60 months from the date of production.

Avoid Freezing.

Limitations

Because DOWSIL 704 Diffusion Pump Fluid has been known to crystallize under rare and undefined conditions below 21°C (70°F), Dow considers DOWSIL 702 Diffusion Pump Fluid the preferred choice for sealed transducers that will encounter low temperature.

This product is neither tested nor represented as suitable for medical or pharmaceutical uses.

Shipping Limitations

None.

Health And Environmental Information

To support customers in their product safety needs, Dow has an extensive Product Stewardship organization and a team of product safety and regulatory compliance specialists available in each area.

For further information, please see our website, www.consumer.dow.com or consult your local Dow representative.

http://www.consumer.dow.com