

Information About

***Dow Corning*® 702 Diffusion Pump Fluid**

***Dow Corning*® 704 Diffusion Pump Fluid**

***Dow Corning*® 705 Diffusion Pump Fluid**

Type

Silicone (702 Fluid); single-component silicone material (704, 705 Fluid)

Physical Form

Fluid

Special Properties

Thermal stability; resists oxidation; chemically inert

Primary Uses

Fast pumping of large volumes of gas or vapor in production operations (702 Fluid); producing vacuums of 10-5 to 10-8 torr, untrapped, and 10-10 to 10-11 torr, trapped (704 Fluid); producing ultrahigh and ultraclean vacuum (705 Fluid)

DESCRIPTION

Dow Corning® 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.

***Dow Corning* 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.

***Dow Corning* 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.

***Dow Corning* 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 *Dow Corning* 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. High spontaneous ignition temperature makes this fluid ideal for use in human-rated space simulation chambers.

BENEFITS

Dow Corning 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 to 300 percent higher forepressures 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 to 30 percent.

- Minimal backstreaming: The vapor pressure of single-component silicone fluids from *Dow Corning* 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.
- 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 Corning* to oxidation and hydrolysis allows release of the vacuum without cooling the pump.

USES

Dow Corning Diffusion Pump Fluids can be used in a variety of applications including:

Aerospace

- Space simulation chambers

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

TYPICAL PROPERTIES

These values are not intended for use in preparing specifications.

	<i>Dow Corning 702</i> <u>Diffusion Pump Fluid</u>	<i>Dow Corning 704</i> <u>Diffusion Pump Fluid</u>	<i>Dow Corning 705</i> <u>Diffusion Pump Fluid</u>
Ultimate Vacuum, torr,			
untrapped	10-6	10-7 to 10-8	10-9 to 10-10
trapped	—	to 10-11	10-11
Extrapolated Vapor Pressure, torr,			
25°C (77°F)	1 x 10-6	2 x 10-8	3 x 10-10
Specific Gravity at 25°C (77°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)
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 phenylmethyl- dimethyl cyclosiloxane	Tetramethyltetra- phenyltrisiloxane	Penta phenyltri- methyltrisiloxane
Molecular Weight	—	484	546
Vapor Pressure Equation,	A = 10.3	A = 11.025	A = 12.31
log ₁₀ P = A - B/T	B = 4820	B = 5570	B = 6490
<small>(P = vapor pressure, torr; T = absolute temperature, °K)</small>			

Specification Writers: Please obtain copies of the *Dow Corning Sales Specification* for these products and use them as a basis for your specifications. They may be obtained from any *Dow Corning Sales Office*, or from *Dow Corning Customer Service* in Midland, MI. Call (517) 496-6000.

Vacuum Coatings

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

Atomic Energy

- Processing metals and fuels
- Accelerators

Research

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

LIMITATIONS

Because *Dow Corning 704* Diffusion Pump Fluid has been known to crystallize under rare and undefined conditions below 21°C (70°F), *Dow Corning* considers *Dow Corning 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.

PERFORMANCE DATA

Radiation Resistance

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

Seal Compatibility

Immersion Tests at 70°C (158°F) have shown that butyl and Viton®1 rubbers, as well as others, are suitable for sealing pumps using *Dow Corning 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.

1 Viton is a registered trademark of E.I. du Pont de Nemours and Company.

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

Dow Corning 702 Fluid

Number of Cycles	Pressure, torr
0	3.3 x 10-6
492	3.8 x 10-6
1016	3.8 x 10-6

Dow Corning 704 Fluid

Number of Cycles	Pressure, torr
0	2.3 x 10-6
994	3.0 x 10-6
2072	3.3 x 10-6

Dow Corning 705 Fluid

Number of Cycles	Pressure, torr
0	2.4 x 10-6
101	2.4 x 10-6
1082	3.0 x 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 x 10-6
107	3.5 x 10-5
220	6.0 x 10-5
412	1.6 x 10-4

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 Corning test data, is supported by service experience both in continuous pumping of pure oxygen and in repeated venting of hot pumps to atmospheric pressure.

Dow Corning 704 Diffusion Pump Fluid has excellent resistance to explosion, as shown by tests conducted in a pure oxygen atmosphere. (See Table II.)

Table I: Radiation Resistance After Exposure to Cobalt 60 Source¹

Fluid	Dosage, megarads	Pressure, torr	
		Before Exposure	After Exposure
Organic	100	2 x 10-6	1.1 x 10-5
<i>Dow Corning 704</i> Diffusion Pump Fluid	280	2 x 10-6	3 x 10-6

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

Table II: Explosion Resistance in Pure Oxygen Atmosphere¹

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

¹Journal of Vacuum Science and Technology, Vol. II, Number 5, Sept.-Oct. 1965.

Table III: Ignition Temperatures of *Dow Corning 705* Diffusion Pump Fluid vs. Hydrocarbon Diffusion Pump Fluid

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

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 III.

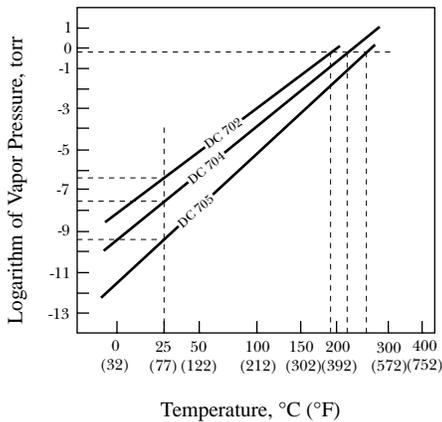
Spontaneous ignition temperatures of *Dow Corning 705* Diffusion Pump Fluid were found in this test to be approximately 200°C (392°F) above the normal

operating temperature in a diffusion pump.

Vapor Pressure

As Figure 1 shows, *Dow Corning 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. Because of its low vapor pressure, contamination rates with *Dow Corning* 705 Diffusion Pump Fluid in water-baffled systems can be up to 100 times lower than with *Dow Corning* 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 *Dow Corning* 705 Diffusion Pump Fluid is so low that ultrahigh vacuum can be obtained with a water-cooled baffle only. *Dow Corning* 705 Diffusion Pump Fluid

also makes ultraclean operation possible without trapping for moderate periods of time.

SHIPPING LIMITATIONS

None.

STORAGE AND SHELF LIFE

When stored in the original, sealed container, at or below 25°C (77°F), *Dow Corning* Diffusion Pump Fluids have a shelf life of 60 months from date of manufacture, although no inherent limitations on the useful life of this product are known to exist.

PACKAGING

Dow Corning Diffusion Pump Fluids are available in 16.9-fl oz (500-mL) bottles, 8.5-lb (3.9-kg), 42.5-lb (19.3-kg) pails and 425-lb (192.8-kg) drums. All weights net.

SAFE HANDLING INFORMATION

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED. BEFORE HANDLING, READ PRODUCT AND MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE MATERIAL SAFETY DATA SHEET IS AVAILABLE FROM YOUR *DOW CORNING* REPRESENTATIVE, OR DISTRIBUTOR, OR BY WRITING TO *DOW CORNING* CUSTOMER SERVICE, OR BY CALLING (517) 496-6000.

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