

Product Information

Silicones for Aerospace

DOW CORNING

Dow Corning® Space-Grade Silicone Sealants

FEATURES

- Supplied in flowable and thixotropic grades
- Cure to flexible rubber elastomers
- Meet NASA requirements for low thermal vacuum outgassing
- Good physical and electrical stability over a wide temperature range

COMPOSITION

- One- and two-part silicone elastomers

One- and two-part silicone elastomers for aerospace applications

HOW TO USE

Surface Preparation

All surfaces should be thoroughly cleaned and/or degreased with *Dow Corning*® brand OS Fluids, naphtha, mineral spirits, methyl ethyl ketone (MEK) or other suitable solvent.¹ Solvents such as acetone or isopropyl alcohol (IPA) do not tend to remove oils well, and any oils remaining on the surface may interfere with adhesion. Light surface abrasion is recommended whenever possible, because it promotes good cleaning and increases the surface area for bonding. A final surface wipe with acetone or IPA is also useful. Different cleaning techniques may give better results than others. Users should determine the best techniques for their applications.

In most cases, substantially stronger and more uniform adhesion is obtained by preparing the surface to be treated with *Dow Corning*® 1200 Prime Coat or *Dow Corning*® P5200 Adhesion Promoter, which should be applied by dipping, brushing or spraying. Best results are often obtained by wiping the primer on with a clean cloth and then immediately wiping off any excess with a fresh, clean cloth. Typically, a very thin coating of primer will provide the best adhesion. If cracks appear in the chalked film, too much primer was applied.

Under typical room temperature and humidity conditions, the primer should be allowed to air-dry for 1 to 2 hours. Because the prime coat is moisture sensitive, low humidity will necessitate a longer drying time.

Adhesion

Good adhesion cannot be expected on nonreactive metal substrates or nonreactive plastic surfaces such as *Teflon*®², polyethylene or polypropylene. Special surface treatments such as chemical etching or plasma treatment can sometimes provide a reactive surface and promote adhesion to these types of substrates.

Poor adhesion may be experienced on plastic or rubber substrates that are highly plasticized, because the mobile plasticizers act as release agents. Small-scale laboratory evaluation of all substrates is recommended before production trials are made.

In general, increasing the cure temperature and/or cure time will improve the ultimate adhesion.

Substrate Testing

Due to the wide variety of substrate types and differences in substrate surface conditions, general statements on adhesion and bond strength are

¹Follow solvent manufacturer's recommended safe handling instructions and applicable federal, state and local regulations.

²*Teflon* is a registered trademark of E.I. du Pont de Nemours Co.

PRODUCT INFORMATION

| Dow Corning® brand Product | Description | Features |
|--|--|---|
| Space-Grade Silicone Sealants | | |
| 6-1104 Controlled Volatility Sealant | One-part RTV silicone sealant; translucent | Extrudable, nonslump materials cure at room temperature; no corrosive cure byproducts; meet NASA requirements for low outgassing; wide operating temperature range; easy repairability; good physical and electrical stability over a range of frequencies, temperatures and humidities; ensure protection of components from temperature extremes, high humidity, radiation, thermal shock, atomic oxygen and mechanical vibration |
| 6-1125 Controlled Volatility Sealant | One-part RTV silicone sealant; white | |
| 93-500 Space Grade Encapsulant | Two-part silicone elastomer | Exceed requirements of NASA SP-R-0022A for thermal vacuum low outgassing; wide operating temperature range from -115 to 200°C (-149 to 392°F) |
| 93-500 Thixotropic Space Grade Encapsulant | | |

impossible. To ensure maximum bond strength on a particular substrate, a 100 percent cohesive failure of the adhesive in a lap shear or similar adhesive strength test is desired. This ensures compatibility of the adhesive with the substrate being considered. Also, this test can be used to determine minimum cure time or can detect the presence of surface contaminants such as mold release agents, oils, greases and oxide films.

One-Part Sealants

Dow Corning® 6-1104 and 6-1125 Controlled Volatility Sealants are caulk-like materials and may be applied directly from the collapsible tube. They are generally cured at room temperature in a range of 30 to 80 percent relative humidity. Greater than 90 percent of their full physical properties should be attained within 3 to 5 days. Materials and parts can be handled in

much shorter times of about 2 hours depending on the amount of material used per part. These materials are not typically used for highly confined or deep section cures. Materials will generally cure about 0.25 inch per seven days from any exposed surface. Cure progresses from the outer surface and is dependent on the moisture in the air. Working time is generally a few minutes to an hour for these products until a surface skin begins to form. Mild heat acceleration of the cure rate may be possible but temperatures above 60°C (140°F) are not recommended.

Two-Part Sealants

Compatibility

Certain materials, chemicals, curing agents and plasticizers can inhibit the cure of addition-cure silicones such as *Dow Corning®* 93-500 Space Grade Encapsulant and 93-500 Thixotropic

Space Grade Encapsulant. Most notable of these include:

- Organotin and other organometallic compounds
- Silicone rubber containing organotin catalyst
- Sulfur, polysulfides, polysulfones or other sulfur-containing materials
- Amines, urethanes or amine-containing materials
- Unsaturated hydrocarbon plasticizers
- Some solder flux residues

If a substrate or material is questionable with respect to potentially causing inhibition of cure, it is recommended that a small scale compatibility test be run to ascertain suitability in a given application. The presence of liquid or uncured product at the interface between the questionable substrate and the cured gel indicates incompatibility and inhibition of cure.

| Dow Corning® brand Product | Typical Applications |
|--|--|
| Space-Grade Silicone Sealants | |
| 6-1104 Controlled Volatility Sealant | Sealing and adhering components in space environments; used on space systems, electronics and optical applications where low outgassing is essential; bonding, sealant and encapsulating electrical/electronic wires and terminals; mounting optics, resistors, connectors and other components on a variety of terrestrial and space systems, electrical, electronic and optical assemblies |
| 6-1125 Controlled Volatility Sealant | |
| 93-500 Space Grade Encapsulant | Adhering/bonding applications such as solar cells to substrates, cover glasses to solar cells, OSR mirrors to substrates, electronic subcomponents and sub-assemblies, optical and other sensors; encapsulating/potting applications such as electronic components, circuit boards and assemblies, modules, relays and connectors, thermal extremes, shock and cycling protection, vibration shock dampening; sealing/coating applications such as atomic oxygen protection, fay or fillet seals, formed-in-place gaskets and seals, binders for thermal control paints, seals for optical sensors |
| 93-500 Thixotropic Space Grade Encapsulant | |

Mixing and Deairing

Dow Corning 93-500 Space Grade Encapsulant and 93-500 Thixotropic Space Grade Encapsulant are supplied as two-part elastomers that require mixing of the base and curing agent to cure. Just prior to use, the two components should be thoroughly blended in a ratio of 10 parts by weight base to one part curing agent. Avoid entrapment of air during mixing. Vacuum deairing is recommended to remove all entrapped air to ensure void-free applications. For best results, deair in containers that are no more than one-third full to avoid foaming material overflowing the container. Continue deairing for 3 to 5 minutes after the bubbles have collapsed.

Variations of up to 10 percent in the concentration of curing agent have little effect upon the working time or on the cured properties. Lowering the curing agent level by more than 10 percent will result in a softer, weaker material, while increasing the level by more than 10 percent will result in a harder, more brittle material. Both conditions can cause higher vacuum weight loss characteristics.

Applying and Curing

When applying the silicone, avoid air entrapment.

All four silicone products can be handled after 24 hours or less of room temperature cure, but full mechanical, electrical and weight loss properties

are not achieved for seven days. When using *Dow Corning* 93-500 and 93-500 Thixotropic Space Grade Encapsulants for thin sections (10 mills or less), the silicone surface should be covered with polyethylene during cure or the application should be heat cured to avoid potential surface tackiness that can be caused by airborne contaminants. Curing times can be appreciably decreased with the application of heat. Suggested quick cure cycles are as follows:

- 2 hours at 65°C (150°F)
- 30 minutes at 100°C (212°F)
- 10 minutes at 150°C (300°F)

Relatively massive parts require additional time to bring them up to the required temperature.

TYPICAL PROPERTIES

Specification Writers: Please contact your local Dow Corning sales office or your Global Dow Corning Connection before writing specifications on this product.

| Dow Corning® brand Product | As Supplied | | | | | | | Physical Properties As Cured – 7 days at 25°C (77°F) and 50% RH | | | | | | |
|--|-------------|-------------------------------------|--|------------------|-----------------|-----------------------|---------------------------------|---|----------------------------|-----------------------|---------------------|---------------------------|----------------------------------|-----------------------------------|
| | Color | Specific Gravity, g/cm ³ | Extrusion Rate, 1/8" nozzle at 90 psi, g/min | Viscosity, poise | Pot Life, hours | Tack-Free Time, hours | Full Cure, 1/8" Thickness, days | Refractive Index | Durometer, Shore A, points | Tensile Strength, psi | Elongation, percent | Tear Strength, Die B, ppi | Lap Shear, primed aluminium, psi | 180° Peel, primed aluminium, ppiw |
| Space-Grade Silicone Sealants | | | | | | | | | | | | | | |
| 6-1104 Controlled Volatility Sealant | Translucent | 1.10 | 165 | Non-slump | — | 0.9 | 5-7 | 1.41 | 40 | 925 | 600 | 180 | 500 | 100 |
| 6-1125 Controlled Volatility Sealant | White | 1.10 | 95 | Non-slump | — | 0.8 | 5-7 | — | 45 | 1025 | 650 | 190 | 400 | 85 |
| 93-500 Space Grade Encapsulant | Transparent | 1.03 | — | 80 | 2.5 | <16 | 1 | 1.41 | 40 | 975 | 170 | 15 | 475 | — |
| 93-500 Thixotropic Space Grade Encapsulant | Translucent | 1.08 | 1065 | Non-slump | 0.9 | <16 | 1 | 1.44 | 60 | 1225 | 125 | 30 | 475 | — |

HANDLING PRECAUTIONS

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED IN THIS DOCUMENT. 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 CALLING YOUR GLOBAL DOW CORNING CONNECTION.

USABLE LIFE AND STORAGE

Shelf life is indicated by the “Use Before” date found on the product label.

For best results, *Dow Corning* space-grade silicone sealants should be stored below 32°C (90°F). Containers should be kept tightly closed.

PACKAGING

Dow Corning 6-1104 and 6-1125 Controlled Volatility Sealants are supplied in 5-oz (142-g) collapsible tubes.

Dow Corning 93-500 and 93-500 Thixotropic Space Grade Encapsulants are supplied in packages that contain the base and curing agent in separate containers. Complete packages (base and curing agent) are available as 3.9-oz (110-g) and 1.1-lb (0.5-kg) kits, net weight.

LIMITATIONS

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

| <i>Dow Corning</i> [®] brand Product | Physical Properties As Cured – 7 days at 25°C (77°F) and 50% RH | | | | Electrical Properties As Cured – 7 days at 25°C (77°F) and 50% RH | | | | | |
|---|---|---|---|-----------------------------|---|----------------------------|--------------------------------|---------------------------------|-------------------------------|--------------------------------|
| | Thermal Vacuum Weight Loss ¹ , percent | Volatile Condensable Materials ² , percent | Linear Coefficient of Thermal Expansion, micron/m°C | Thermal Conductivity, W/m°C | Dielectric Strength, volts/mil | Volume Resistivity, ohm-cm | Dielectric Constant, at 100 Hz | Dielectric Constant, at 100 kHz | Dissipation Factor, at 100 Hz | Dissipation Factor, at 100 kHz |
| Space-Grade Silicone Sealants | | | | | | | | | | |
| 6-1104 Controlled Volatility Sealant | 0.20 | 0.03 | 350 | 0.23 | 540 | 1.0 x10 ¹⁵ | 2.6 | 2.6 | 0.0004 | 0.0002 |
| 6-1125 Controlled Volatility Sealant | 0.20 | 0.01 | 350 | 0.23 | 550 | 1.0 x10 ¹⁵ | 2.6 | 2.6 | 0.0016 | 0.0002 |
| 93-500 Space Grade Encapsulant | 0.20 | 0.01 | 300 | 0.20 | 480 | 1.0 x10 ¹⁵ | 2.6 | 2.6 | 0.0011 | 0.0002 |
| 93-500 Thixotropic Space Grade Encapsulant | 0.20 | 0.01 | 295 | 0.20 | 460 | 6.2 x10 ¹⁴ | 2.8 | 2.8 | 0.0011 | 0.0002 |

¹24 hours at 125°C (257°F) and <1 x 10⁻⁶ torr.

²Percent collected at 25°C (77°F) during vacuum weight loss test.

SHIPPING LIMITATIONS

None.

HEALTH AND ENVIRONMENTAL INFORMATION

To support customers in their product safety needs, Dow Corning has an extensive Product Stewardship organization and a team of Health, Environment and Regulatory Affairs specialists available in each area. For further information, please consult your local Dow Corning representative.

WARRANTY INFORMATION

The information contained herein is offered in good faith and is believed to be accurate. However, because conditions and methods of use of our products are beyond our control, this information should not be used in substitution for customer's tests to ensure that Dow Corning's products are safe, effective, and fully satisfactory for the intended end use. Dow Corning's sole warranty is that the product will meet the Dow Corning sales specifications in effect at the time of shipment. Your

exclusive remedy for breach of such warranty is limited to refund of purchase price or replacement of any product shown to be other than as warranted. Dow Corning specifically disclaims any other express or implied warranty of fitness for a particular purpose or merchantability, unless Dow Corning provides you with a specific, duly signed endorsement of fitness for use. Dow Corning disclaims liability for any incidental or consequential damages. Suggestions of use shall not be taken as inducements to infringe any patent.

