ADVANCED TECHNOLOGIES –
AVIATION AND DEFENSE SILICONES
PRODUCT GUIDE

avantor™ | NuSil™

Aviation and defense silicones

Silicones for mission-critical demands

SUPERIOR PERFORMANCE SHAPED BY A RICH FLIGHT HERITAGE

With a flight heritage that spans more than four decades, NuSil® has delivered ultra-high-purity silicones to the world's leading aviation manufacturers and major defense contractors. Our expertise in formulating ultra-high purity silicones and fabricating silicone components allows us to develop innovative technologies that serve vital and demanding requirements.

SILICONES FOR AVIATION AND DEFENSE

From interior applications like digital avionics displays to exterior aircraft coatings and silicone gaskets, our cutting-edge solutions answer the demanding requirements set by today's aviation and defense industries.

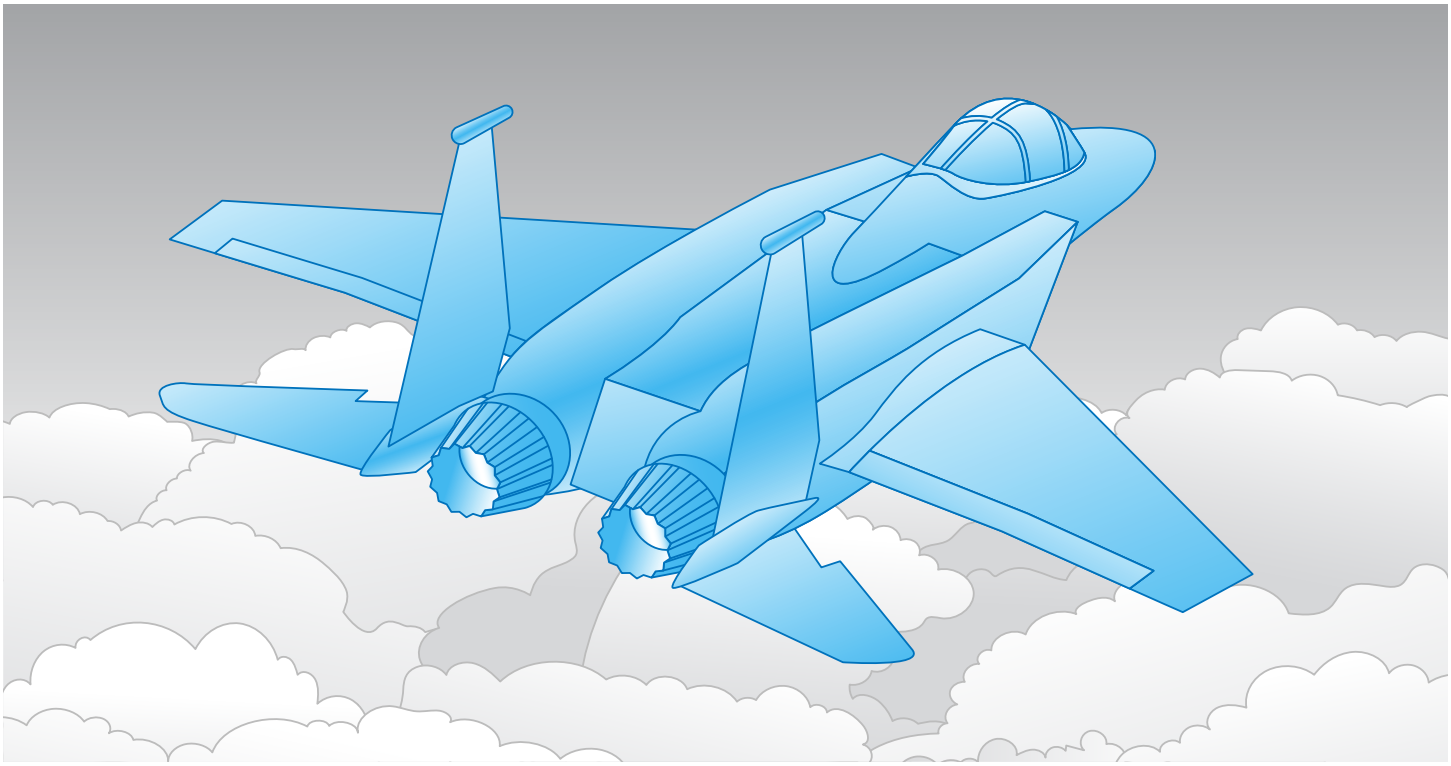
Our experience equips us to formulate for applications with specific requirements, all while providing exceptional customer care. For example, we provide customized fabricated components for defense applications. Our solutions also meet the aviation industry's need for fuel efficiencies while considering ever-present safety concerns. NuSil® offers both off-the-shelf and customized materials to meet our customers' specific needs.

Applications

Whether it's helping to ensure commercial aircrafts safely reach their destinations or collaborating with defense contractors to develop the next military flight innovation, our expertise, products and solutions have repeatedly proven themselves.

Our silicones are used in a wide range of applications, from commercial and defense aircraft to unmanned aerial vehicles (UAVs). The aviation and defense industries incorporate NuSil® silicones into:

- Aircraft exteriors
- Engines
- Control surfaces and structures
- Electrical, hydraulic and pneumatic systems
- Cockpits



Aviation and defense silicones

HIGH-PURITY SILICONES THAT HELP AVIATION AND DEFENSE AIRCRAFT TAKE FLIGHT

Backed by our extensive history, NuSil® has developed silicones with a broad operating temperature range that are optimized to remain flexible at extremely low temperatures and resist breakdown at elevated temperatures. We can formulate silicones and engineer fabricated parts for sophisticated systems such as engines and electrical and pneumatic systems.

To meet increasing demands for fuel and solvent resistance, NuSil® formulates fluorosilicones for long-lasting stability in harsh environments. These silicones resist degradation, which makes them highly suitable for the most demanding aircraft applications.

With a diverse range of off-the-shelf and customized products, NuSil® offers one of the most extensive solutions for the aviation and defense industries.

FLUOROSILICONES

NuSil®'s fluorosilicone portfolio, one of the most diverse available, resists degradation to protect the aircraft's outer mold line and seals from damaging fuels and solvents. These silicones are formulated to perform in a wide range of operating temperatures — reliability proven through decades of flight service.

ADHESIVES AND SEALANTS

NuSil® silicone adhesives range from traditional liquid adhesives to novel peel-and-stick films and pressure-sensitive adhesives. Primers are also available to improve adhesion.

POTTING AND ENCAPSULATING MATERIALS

NuSil® potting and encapsulating silicones provide excellent protection against thermal cycling, shock and contaminants such as moisture and debris.

COATINGS

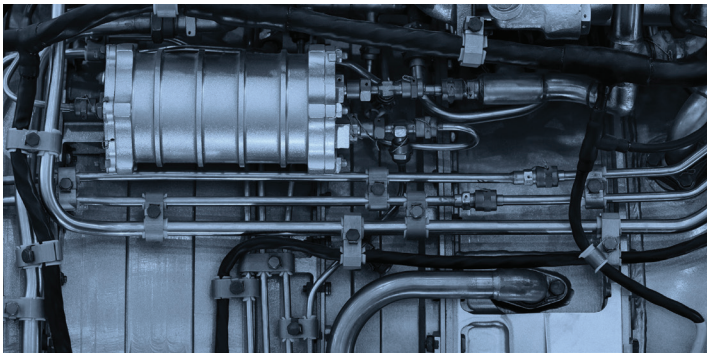
Primarily used on aircraft exteriors, silicone coatings provide UV protection and can operate under a wide range of temperatures. They can be used on a variety of aircraft and control surfaces.

THERMALLY AND ELECTRICALLY CONDUCTIVE MATERIALS

NuSil® thermally conductive silicones facilitate heat transfer from electronic devices without adding stress to systems. Our electrically conductive silicones can carry a current, while our dissipative silicones enable static to dissipate continuously rather than accumulate and discharge, thus causing damage.

CUSTOMIZATION MASTERED

Off-the-shelf solutions don't always meet the needs of aviation and defense manufacturers. That's why we meet our customers' highly specialized needs with customization from formulation to packaging. With more than 3000 products and over 40 years of expertise, we can take customization to a mass scale.



NUSIL® SUPPORT

With a documented quality management system certified to AS9100, we ensure that our silicones meet the reliability and consistency needs of our customers. Our comprehensive quality systems also include the standard ISO 9001 certification.

To ensure complete confidentiality, NuSil® is compliant with National Institute of Standards and Technology (NIST) 800-171 and Defense Federal Acquisition Regulation Supplement (DFARS) clause 282.204-7012, allowing us to handle controlled unclassified information (CUI). Additionally, NuSil® is registered with the DDTC and has a robust export compliance program.

We collaborate with customers to ensure that our silicone solutions meet their individual needs, from developing revision-controlled material specifications to supporting the inclusion of specified part numbers and fulfilling unique labeling requirements.

Fluorosilicones

Description

Fuel- and solvent-resistant, our fluorosilicones offer reliable protection, even during prolonged exposure. They are precisely optimized for a wide range of operating temperatures, remaining flexible at extremely low temperatures and resisting breakdown at very high temperatures. As versatile materials, fluorosilicones can be formulated into various product types depending on the application, from coatings to potting and encapsulating materials.

Applications

Fluorosilicones protect against degradation from hydrocarbons, including jet fuel, de-icing fluids or crude oil, making these silicones ideal solutions for applications like O-rings, gaskets, seals and other precision-molded parts.

FLUOROSILICONES

COATINGS

PRODUCT NUMBER	VISCOSITY (cP/mPa·s)	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	COLOR	SPECIAL FEATURES
R-3930	735	30	750 (5.2)	400	Translucent	Available in federal color standards 36118, 36622, 36375 and 36099
R-3975	1625	25	425 (2.9)	400	Translucent	Broad operating temperature

All materials are acetoxy cured

ADHESIVES AND SEALANTS - ONE-PART

PRODUCT NUMBER	EXTRUSION RATE (g/min)	ADHESION LAP SHEAR psi (mPa)	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	TACK-FREE TIME	OPACITY	SPECIAL FEATURES
FS-3730	180	380 (2.6)	33	900 (6.2)	440	25 min	White	Also available in gray and black
FS3-3730	230	200 (1.4)	35	820 (5.7)	400	15 min	Translucent	-
FS-3775	250	-	30	450 (3.1)	400	8 min	Translucent	Broad operating temperature

All materials are acetoxy cured

ADHESIVES AND SEALANTS - TWO-PART

PRODUCT NUMBER	VISCOSITY (cP/mPa·s) EXTRUSION RATE (g/min)	ADHESION LAP SHEAR psi (mPa)	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	WORK TIME	OPACITY	SPECIAL FEATURES
CF1-3510	70000	-	20	210 (1.5)	135	4 h	Red	High-temperature resistant
FS9-3521	50 g/minute	280 (1.9)	29	750 (5.2)	300	3 h	Brown	High-temperature resistant and available in dual-cartridge packaging

All materials are acetoxy cured

MOLDING ELASTOMERS

PRODUCT NUMBER	EXTRUSION RATE (g/min)	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	WORK TIME	COLOR	SPECIAL FEATURES
FS-3511	40	30	1150 (7.9)	335	> 8 h	Translucent	100% fluoro for hydrocarbon resistance

THERMALLY CONDUCTIVE

PRODUCT NUMBER	THERMAL CONDUCTIVITY w/(mK)	VISCOSITY (cP/mPa·s)	CURE SYSTEM	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	WORK TIME
CF1-3800	1.25	Thixotropic	Platinum	50	125 (0.9)	50	90 min

GELS

PRODUCT NUMBER	VISCOSITY (cP/mPa·s)	DUROMETER TYPE 00	WORK TIME	OPACITY
LS-3238	1500	15	11 h	Clear
GEL-3500	11250	50	12 h	Translucent

Coatings

Description
Protective coatings work in a variety of ways to ensure that aviation and defense platforms function safely and to specifications. Solvent-based coatings are well suited for processes in which the silicone is applied as a thin film coating. Solventless coatings can cure more quickly than solvent-based coatings and are ideal for applications requiring a nonflammable solution.

Applications
Our silicone coatings protect parts and surfaces in critical defense technologies, including missiles, rockets, launch equipment and unmanned aerial vehicles. Manufacturers and contractors use NuSil® ice-release coatings to minimize ice adhesion in order to increase lift and decrease drag.

COATINGS

PRODUCT NUMBER	CURE SYSTEM	VISCOSITY (cP/mPa·s)	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	OPACITY	SPECIAL FEATURES
GENERAL PURPOSE							
R-1182	Acetoxy	10	-	-	-	Translucent	Low-friction coating
R-1082	Acetoxy	700	25	1425	950	Translucent	Excellent adhesion to a variety of substrates
R-1008-0	Oxime	1300	23	235 (1.6)	223	Translucent	-
R-1009	Oxime	6150	45	1150 (7.9)	650	Translucent	-
CF19-2615	Platinum	1050	30	120 (0.9)	100	Clear	Solventless
R-2180	Platinum	3075	40	1700 (11.7)	1050	Translucent	High-strength coating, available in black, and requires heat to cure
ABLATIVE							
R-2588	Alkoxy	825000	65	750 (5.2)	95	Red	Available in 100:3.8 and 10:1 (base: catalyst) mix ratios (R10-2588)

Processing tips
Homogeneously premix before drawing from the container. De-airing may be required to ensure a bubble-free product. It is recommended to increase the cure temperature slowly or utilize a multistep curing process, which allows the solvent to evaporate prior to the silicone curing.

Adhesives and sealants

Description

Our adhesives provide excellent bonding to a wide range of substrates, including metals, plastics and glass. NuSil® silicone adhesives range from liquid to film. We also offer primers to improve adhesion.

Applications

Many NuSil® adhesives can be heat accelerated to speed up processing time or can be cured at room temperature faster than traditional adhesives.

ADHESIVES AND SEALANTS

ONE-PART

PRODUCT NUMBER	CURE SYSTEM	EXTRUSION (g/min)	ADHESION LAP SHEAR psi (mPa)	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	WORK TIME (TACK-FREE TIME)	OPACITY	BROAD OPERATING TEMPERATURE	SPECIAL FEATURES
R-1140	Acetoxy	Thixotropic	625 (4.3)	30	700 (4.8)	350	7 min	Translucent		Available in black
R4-1140	Acetoxy	93	-	25	1400 (9.7)	750	10 min	Translucent		Recommended for applications in which some flow is required and for adhering to plastics
R-1130	Oxime	Thixotropic	485 (3.3)	35	850 (5.9)	325	25 min	Translucent		Recommended for adhering to plastics
R-1600	Oxime	Thixotropic	205 (1.4)	45	650 (4.5)	300	30 min	Translucent	•	Recommended for adhering to plastics

TWO-PART

PRODUCT NUMBER	MIX RATIO	VISCOSITY (cP/mPa·s) EXTRUSION RATE (g/min)	ADHESION LAP SHEAR psi (mPa)	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	WORK TIME	OPACITY	PRIMERLESS ADHESION	SPECIAL FEATURES
R32-2186	1:1	80000	130 (0.9)	15	850 (5.9)	800	15 h	Translucent	•	Long pot life and minimum 80 °C to cure
R31-2186	1:1	82000	110 (0.8)	20	1000 (6.9)	775	15 min	Translucent	•	RTV or cures rapidly with heat
R33-2186	1:1	83000	100 (0.7)	20	1015 (7.0)	740	2 h	Translucent	•	RTV or cures rapidly with heat, available in white
R-2141	1:1	90000	350 (2.4)	40	650 (4.5)	250	1.5 h	Translucent	•	Non-slump and tack free in ~5 h
R34-2186	1:1	520	150 (1.0)	45	800 (5.5)	400	>8 h	Translucent	•	Minimum 60 °C cure, adheres to plastic films such as PET, tested per UL 94 and passed V-1 at 4.7 mm
R-2145	1:1	295	560 (3.9)	45	1050 (7.2)	400	15 min	Dark gray	•	Fast cure
R1-2145	1:1	285	540 (3.7)	45	1000 (6.9)	400	1 h	Dark gray	•	Tough. RTV or cures rapidly with heat, tested per UL 94 and passed V-1 at 4.6 mm
R-2187	10:1	23000	-	42	790 (5.4)	175	6 h	Translucent		Broad operating temperature
R-2160	10:1	250000	-	20	750 (5.2)	625	50 min	Red		Recommend for high-temperature applications

All platinum cure system

FILM ADHESIVES

PRODUCT NUMBER	ADHESION LAP SHEAR psi (mPa)	THICKNESS	CURE SYSTEM	SPECIAL FEATURES
R1-2680-4	-	0.004 in (0.1 mm)	Platinum	Compatible with a variety of activators
R-2682-12	100	0.012 in (0.12 mm)	Platinum	Contains reinforcing mesh

PRESSURE-SENSITIVE ADHESIVES

PRODUCT NUMBER	180° PEEL STRENGTH ppi (kN/m)	VISCOSITY cP (mPa·s)	SOLIDS CONTENT %	SOLVENT	SPECIAL FEATURES
PSA-1170	3.75 (0.7)	300	50	Ethyl acetate	-
PSA-1270	3.5 (0.6)	1700	50	Naphtha	1.43 RI
PSA-1180	5.0 (0.9)	3500	70	Ethyl acetate	For applications requiring higher cohesive strength, 2.8 lb (12 N) tack

Next-generation adhesives

An alternative to traditional liquid adhesives, NuSil® curable silicone film adhesives offer reliable bond line control in a simple-to-use peel-and-stick format that doesn't require mixing.

Customization

NuSil® offers an extensive array of film adhesive options. We can formulate solutions that meet aviation or defense application requirements, such as parameters for size, thickness and adhesion to specific substrates. Mesh or carriers can also be used for structural support, improving the integrity of the adhesive.

PRIMERS

PRODUCT NUMBER	% SOLIDS	ADHESIVE CURE SYSTEM	SPECIAL FEATURES
SP-120	4	Naphtha	General all-purpose primer, recommended for polyphthalamide (PPA), use with platinum- or tin-catalyzed silicones
SP-121	3	Naphtha	SP-120 with red pigment to identify where primer has been applied
SP-142	15	Naphtha	Recommended for increasing adhesion to plastics, such as polycarbonate (PC) and polyurethane (PU)
CF1-135	4	Naphtha	Recommended for platinum cure silicones where there is slight cure inhibition
CF6-135	9	Naphtha	Increased adhesion to polysulfone (PSU) and substrates where severe platinum inhibition is of concern
CF1-136	4	Naphtha	Contains red pigment to identify where primer has been applied, designed for use where slight platinum inhibition is of concern
CF2-137	7	Naphtha	CF1-135 with UV-light-detectable dye for inspections
CF1-141	6	IPA	SP-126 with red pigment to identify where primer has been applied
SP-270	15	Naphtha	Improved adhesion to polyimide (PI) and composite materials, compatible with platinum cure fluorosilicones
SP-272	9	Tert-butyl acetate	Contains red pigment to identify where primer has been applied, improved adhesion to polyimide (PI) and composite materials, compatible with fluorosilicones
SP-273	9	Naphtha	Designed for platinum cure fluorosilicones to reduce risk of cure inhibition

Processing tips

For the best bond, ensure the substrate is thoroughly clean. Activating and/or priming the surface can also improve adhesion. When working with silicone adhesives, it is important to consider the solvents, chemicals and substrates that they may contact in their uncured state. Certain chemical elements and compounds can retard or inhibit the adhesive's curing.

Thermally and electrically conductive materials

Description

We formulate silicones that help protect critical aviation and defense components. Thermally conductive silicones conform to complex geometries to aid in heat transfer, while our electrically conductive materials allow static to dissipate continuously rather than build up to a rapid, damaging discharge.

Applications

Thermally conductive materials from NuSil®, available with flowable and non-flowable options, are used in a variety of applications, such as sealing grooves or adhering openings in sensors, modules and housings. Our electrically conductive silicones can be found in RFI and EMI shielding for vital components like control panels, sensors and gaskets that require continuity across the seal.

ELECTRICALLY CONDUCTIVE/STATIC DISSIPATIVE

PRODUCT NUMBER	VOLUME RESISTIVITY (ohm-cm)	VISCOSITY (cP/mPa·s) EXTRUSION RATE (g/min)	CURE SYSTEM	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	WORK TIME	COLOR	SPECIAL FEATURES
R-2634	0.001	160 g/min	Alkoxy	80	250 (1.7)	90	3 h	Gray-green	Broad operating temperature
R-2637	0.006	Thixotropic	Platinum	60	210 (2.1)	275	4 h	Tan	-
R-2630	6	11700	Platinum	60	690 (4.7)	95	15 h	Black	Self-leveling
R-1505	8	Thixotropic	Oxime	75	525 (3.6)	25	-	Black	One-part, broad operating temperature
R-2631	23	150 g/minute	Platinum	40	600 (4.2)	300	20 min	Black	Moldable

THERMALLY CONDUCTIVE

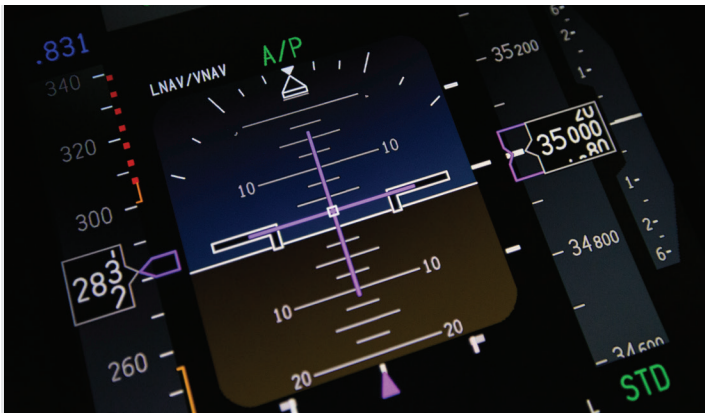
PRODUCT NUMBER	THERMAL CONDUCTIVITY w/(mK)	VISCOSITY (cP/mPa·s)	DUROMETER TYPE A	TENSILE psi (mPa)	ELONGATION %	WORK TIME	COLOR	SPECIAL FEATURES
R-2930	1.46	Thixotropic	80	260 (1.7)	20	3 h	White	-
R-2940	1.00	Thixotropic	90	740 (5.1)	28	4 h	Gray	For bond line applications ≥175 microns
R-2949	0.75	75000	75	270 (1.8)	50	3.5 h	White	Broad operating temperature
R-2939	0.75	70000	70	300 (2.1)	70	4 h	White	For bond line applications ≥50 microns
R-2165	0.50	4000	60	500 (3.4)	100	10 min	Gray	Self-leveling, available in white
R-2175	0.40	3000	50	525 (3.5)	130	1 h minimum	Black	Self-leveling

All materials are platinum cure

Processing tips

To ensure a homogenous blend, individually mix parts A and B prior to combining. De-airing may be required to assure a bubble-free product. For thermally conductive materials, thinner bond lines will result in lower thermal resistance.

For optimum adhesion, it is recommended to use NuSil® primers prior to applying these conductive coatings.



Potting and encapsulating materials

Description

Our potting and encapsulating silicones provide excellent protection against thermal cycling, shock, vibration and outside contaminants. NuSil® low-modulus gels offer the flexibility to prevent shearing in delicate wire bonds and warping in components with complex geometries. Elastomers offer a resilient, more rigid solution for stability and surface protection, while foams are ideal for shock and vibration dampening in applications requiring lightweight and flexible material.

Applications

NuSil® potting and encapsulating compounds are used in power electronics that operate or assist in aircraft functionality.

GELS

PRODUCT NUMBER	VISCOSITY (cP/mPa·s)	PENETRATION (mm)	WORK TIME	SPECIAL FEATURES
GEL-8136	450	13	2 h	RTV or cures rapidly with heat, high tack.
GEL-8150	500	5	4 h	Cures with heat
GEL8-8150	500	5	1.5 h	RTV in 48 h or cures rapidly with heat
GEL-8100	535	9	>24 h	Very soft, flows when cured
GEL-8111	535	10	>24 h	Low volatility, very soft
GEL-8170	600	8	6 h	-
LS1-3443	650	8	2 h	RTV or cures rapidly with heat, high-tack gel with broad operating temperature
GEL1-8155	14500	0.4	24 h	Very firm

FOAMS

PRODUCT NUMBER	FOAM DENSITY lb/ft³ (g/cm³)	VISCOSITY (cP/mPa·s)	WORK TIME	COLOR	SPECIAL FEATURES
R-2360	12 (0.2)	40000	2 min	White	Tough
SFM5-2350	25 (0.4)	52500	20 min	Gray	Tested per UL 94 and passes V-0 at 4.8 mm
CF3-2350	25 (0.4)	90000	20 min	Black	–

All materials are platinum cured

Processing tips

Blend both components of the material into a homogenous mixture and de-air, if necessary, to remove bubbles. Foams do not require a de-airing process. Gels may need to be mixed longer and more aggressively compared to other silicone systems due to their low viscosity. Note: Heat can easily be generated during the mixing process, which can have an adverse effect on pot life.

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