



Standard Classification for Specifying Silicone Adhesives and Sealants for Transportation Applications¹

This standard is issued under the fixed designation F2468; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This classification covers silicone adhesives and sealants intended for but not limited to sealing and retaining metallic and nonmetallic component assemblies in transportation applications. The materials cure to an elastomeric state by their specified cure system and mechanism.

NOTE 1—The classification system may serve many of the needs of industries using silicone materials. This classification is subject to revision, as the need requires; therefore, the latest revision should always be used.

1.2 This classification is intended to be a means of classifying silicone materials. It is not intended for engineering design purposes.

1.3 It is not the intent of this classification to include pressure-sensitive or hot-melt adhesives.

1.4 In all cases in which the provisions of this classification system would conflict with the referenced ASTM standard for a particular method, the latter shall take precedence.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 The following safety hazards caveat pertains only to the test methods portion, Section 7, of this classification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

C679 Test Method for Tack-Free Time of Elastomeric Sealants

¹ This classification is under the jurisdiction of ASTM Committee F03 on Gaskets and is the direct responsibility of Subcommittee F03.30 on Classification.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- D149** Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
- D150** Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation
- D257** Test Methods for DC Resistance or Conductance of Insulating Materials
- D412** Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- D471** Test Method for Rubber Property—Effect of Liquids
- D573** Test Method for Rubber—Deterioration in an Air Oven
- D618** Practice for Conditioning Plastics for Testing
- D624** Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
- D792** Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D907** Terminology of Adhesives
- D1002** Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
- D1053** Test Methods for Rubber Property—Stiffening at Low Temperatures: Flexible Polymers and Coated Fabrics
- D1084** Test Methods for Viscosity of Adhesives
- D1349** Practice for Rubber—Standard Temperatures for Testing
- D1415** Test Method for Rubber Property—International Hardness
- D1566** Terminology Relating to Rubber
- D1898** Practice for Sampling of Plastics (Withdrawn 1998)³
- D2240** Test Method for Rubber Property—Durometer Hardness
- D3182** Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets
- D4800** Guide for Classifying and Specifying Adhesives

2.2 SAE Standard:⁴

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

TABLE 1 Minimum Classification Requirements

Selection Order Sequence	Property	Designation								
		1	2	3	4	5	6	7	8	9
1 st Digit	Cure system (Cure by-product)	Addition (no by-product)	Acetoxy (acetic acid)	Alkoxy (methanol, ethanol)	Amine (cyclohexylamine)	Epoxy (acetone)	Oxime (methyl ethyl ketoxime)	Free radical	...	As specified
2 nd Digit	Cure mechanism	One-part moisture cure	Two-part moisture cure	One-part radiation cure ^A	One-part radiation-moisture cure	One-part thermal cure	Two-part thermal cure	Radiation	...	As specified
3 rd Digit	Application rate, g/min	<50	50-99	100-199	200-299	300-499	500-749	750-999	>999	As specified
4 th Digit	Test Method C679 , Tack free time, min	<5	5-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-60	>60	As specified
5 th Digit	Test Methods D412 (Die C) Ultimate elongation, %	<100	100-199	200-299	300-499	500-699	700-999	>999	...	As specified
6 th Digit	Test Methods D412 , Tensile strength, MPa	<0.345	0.345-0.690	0.691-1.035	1.036-1.380	1.381-3.450	3.451-6.899	6.90-14.0	>14	As specified
7 th Digit	Blowout resistance, ^B s	<10	10-20	21-30	31-40	41-50	51-60	>60	...	As specified
8 th Digit	Test Methods D792 , Specific gravity, g/cc	<0.85	0.86-0.95	0.96-1.05	1.06-1.15	1.16-1.25	1.26-1.35	1.36-1.50	>1.5	As specified
9 th Digit	Test Method D1002 , ^C Lap shear bond strength, MPa	<0.345	0.345-0.690	0.691-1.035	1.036-1.380	1.381-3.450	3.451-6.899	6.90-14.0	>14	As specified
10 th Digit	Silicone volatile Content, %	<0.6	0.6-1.0	1.1-1.9	2.0-2.9	3.0-4.9	5.0-6.9	7-10	>10	As specified

^A Ultraviolet light (UV), microwave, or visible light cure.

^B Resistance to blowout refers to the time to failure at a standardized internal pressure using a fixture as agreed upon between producer and user.

^C Standard test conditions: 5 cm (1.97 in.) min cross head speed, 1 mm (0.039 in.) gap, 1.27 cm (0.50 in.) overlap, Q panel 20204T3 Aluminum (as received).

SAE J369 Flammability of Polymeric Interior Materials—Horizontal Test Method

2.3 UL Standard:⁵

UL 94 Flammability

3. Terminology

3.1 *Definitions*—Some terms in this classification are defined in Terminologies **D907** and **D1566**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cure mechanism*—the method of initiating the cure for a silicone material.

3.2.2 *cure system*—the cross-linking mechanism the silicone material uses to transition to the elastomeric state.

3.2.3 *draw-down*—a method of sample preparation of viscous and sag-resistant sealants, in which the sealant is leveled using a knife or tool to a specified thickness.

3.2.4 *formed in place gasket, fig*—a one- or two-component adhesive or sealant applied wet, uncured, to a joint surface where the mating parts are assembled before the curing process is complete. When fully cured it forms a barrier to media migration across the joint.

3.2.5 *sag resistance*—a property of some adhesives and sealants that enables the applied or extruded material to retain its shape before curing or cross-linking.

3.2.6 *thixotropic*—a rheological property of uncured sealants in which the sealant resists sagging or slumping unless disturbed by an external force or pressure.

3.2.7 *transportation*—any transportation venue involving land, sea, or air, civilian or military, stationary and small engines.

3.2.8 *volatiles*—low molecular weight components of an adhesive or sealant that can be extracted by the environment of the application.

4. Significance and Use

4.1 The purpose of this classification system is to provide a method of adequately identifying silicone adhesives and sealants through the use of a line call-out designation.

4.2 This classification system was designed to permit the addition of property values for future silicone adhesives and sealants.

5. Classification

5.1 A ten-digit numbering system is used to classify a silicone adhesive and sealant cure system, cure mechanism, application rate, tack free time; ultimate elongation, tensile strength; blowout resistance, lap shear bond strength, specific gravity, and silicone volatile content as defined in **Table 1**. The first column (left side of the table) indicates the digit number or order sequence required while the designation numbers for each property are indicated on the top of the table. The ten-digit classification number must also be separated with hyphens

⁵ Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

between the fourth and fifth digit, and the sixth and seventh digit as seen in Example 1 (5.1.1).

5.1.1 *Example 1*—To specify a silicone adhesive or sealant with an acetoxy cure system, two-part moisture cure mechanism, application rate of 150 g/min, tack free time of 8 min, 400 % ultimate elongation, 1.2 MPa tensile strength, 15 s blowout resistance, 1.1 specific gravity, 2.0 MPa lap shear bond strength, and 2.5 % silicone volatile, the line call-out would be:

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where:

- 2 = the acetoxy cure system,
- 2 = the two-part moisture cure,
- 3 = application rate between 100 and 199 g/min,
- 2 = tack free time between 5 and 9.9 min,
- 4 = ultimate elongation between 300 and 499 %,
- 4 = tensile strength between 1.036 and 1.380 MPa,
- 2 = blowout resistance between 10 and 20 s,
- 4 = specific gravity between 1.06 and 1.15 g/cc,
- 5 = lap shear strength between 1.381 and 3.45 MPa, and
- 4 = silicone volatile content between 2.0 and 2.9 %.

6. Line Call-Outs

6.1 A “line call-out,” which is a specification, shall contain the ASTM classification number F2468, a ten-digit prefix specifying the cure system, cure mechanism, application rate, tack free time, ultimate elongation, tensile strength, blowout resistance, specific gravity, lap shear bond strength, and silicone volatile content. This shall be followed by appropriate suffixes per Section 12 as agreed upon between producer and user.

7. General Requirements

7.1 General requirements are properties that are inherent in every lot of silicone produced but may be tested in accordance with the line call-out at a frequency agreed on by the producer and user to verify specification conformance.

7.2 *Suffixes*—When using the line call-out for materials covered by this classification, the suffixes found in Table 2 shall be used to detail specific requirements needed for the application intended and as agreed upon between producer and user. In general, the suffix letter gives the test condition and the second digit gives the specific requirement.

TABLE 2 Suffix Symbols and Requirements

Symbol	Characteristic
A	HEAT RESISTANCE—Test Method D573 First digit—See Table 3 for time designation. Second digit—See Table 3 for temperature designation. Third digit—See Table 4 for hardness change designation. Fourth digit—See Table 4 for tensile change designation. Fifth digit—See Table 4 for elongation change designation. Sixth digit—See Table 4 for volume change designation.
C	CORROSIVITY Second letter A = Copper B = Steel C = Aluminum Three-digit number 001 = 0 = test method to be specified by user.

TABLE 2 Continued

Symbol	Characteristic
	1 = no permanent discoloration of the metals that does not buff off with a nonabrasive cloth.
D	ELECTRICAL (dielectric/resistance properties) Second letter A = dielectric strength (short time), Test Method D149 Three-digit number x factor of 0.1 = kV/mm, min B = dielectric strength (step by step), Test Method D149 Three-digit number x factor of 0.1 = kV/mm, min C = insulation resistance, Test Methods D257 Three-digit number x factor of 10 ⁶ = Ω, min D = dielectric constant at 1 MHz, Test Methods D150, max Three-digit number x factor of 0.1 = value E = dissipation factor at 1 MHz, Test Methods D150, max Three-digit number x factor of 0.0001 = value
E	FLUID RESISTANCE—Test Method D471 Second letter A = ASTM #1 Oil B = IRM 902 Oil C = IRM 903 Oil D = ASTM SF105 E = ASTM B Fuel F = ASTM C Fuel Q = as specified First digit—See Table 3 for time designation. Second digit—See Table 3 for temperature designation. Third digit—See Table 4 for hardness change designation. Fourth digit—See Table 4 for tensile change designation. Fifth digit—See Table 4 for elongation change designation. Sixth digit—See Table 4 for volume change designation.
F	LOW TEMPERATURE—Test Methods D1053
G	TEAR STRENGTH—Test Method D624 Second letter B = Die “B” C = Die “C” First digit—See Table 3 for time designation. Second digit—See Table 3 for temperature designation.
H	HARDNESS Second letter A = Test Method D2240 B = Test Method D1415 First digit—See Table 3 for time designation. Second digit—See Table 3 for temperature designation.
L	COLOR Second letter A = does not have to match a standard B = as agreed upon between producer and user
M	FLAME RETARDANT Second letter A = UL 94 First digit indicated minimum specimen thickness, mm 0 to be specified 1 0.25 2 0.40 3 0.80 4 1.60 5 2.50 6 3.00 7 6.00 8 12.70 9 >12.70 Second digit indicates type of flame test 1 = vertical (94 V) 2 = horizontal (94 H) 3 = 125-mm flame (94 to 95 V) 4 = vertical thin materials (94 VTM) Third digit indicates the flame rating 0 = (94 V/94 VTM) 0 – refer to UL 94 1 = (94 V/94 VTM) 1 – refer to UL 94 2 = (94 V/94 VTM) 2 – refer to UL 94 3 = (94HB) 1 – burn rate, <40 mm/min 4 = (94HB) 2 – burn rate, <75 mm/min 5 = UL94-5VA 6 = UL94-5VB

TABLE 2 Continued

Symbol	Characteristic
	7 = UL94VTM-0 8 = UL94VTM-1 9 = UL94VTM-2
	Second letter
	B = SAE J369
	First digit indicates minimum specimen thickness, mm
	0 = to be specified 1 = as supplied
	Second digit indicates width of specimen test area
	0 = to be specified
	Third digit indicates flame rating
	0 = DNI (does not ignite) 1 = SE (self extinguishing) 2 = SE/NBR (self extinguishing/no burn rate) 3 = SE/B (self extinguishing/burn rate) 4 = B (burn rate), burn rate of <2 in./min 5 = B, burn rate of <3 in./min 6 = B, burn rate maximum to be specified 7 = RB (rapid burn)
T	TENSILE MODULUS, at 100 %, kPa—Test Methods D412 (Die C)
	First digit
	0 = Not specified 1 = <200 2 = 200-399 3 = 400-599 4 = 600-799 5 = 800-999 6 = 1000-1199 7 = 1200-1500 8 = >1500 9 = As specified
V	VISCOSITY
	Second letter
	A = Test Methods D1084 , Method B, using an RVT viscometer B = Test Methods D1084 , Method B, using an LVT viscometer
	First digit indicates spindle number
	For RVT(A) For LVT(B)
	0 = As specified 0 = As specified 1 = RV spindle #1 1 = LV spindle #1 2 = RV spindle #2 2 = LV spindle #2 3 = RV spindle #3 3 = LV spindle #3 4 = RV spindle #4 4 = LV spindle #4 5 = RV spindle #5 6 = RV spindle #6 7 = RV spindle #7
	Second digit indicates spindle speed
	For RVT(A) For LVT(B)
	0 = As specified 0 = As specified 1 = RV 0.5 RPM 1 = LV 0.3 RPM 2 = RV 1.0 RPM 2 = LV 0.6 RPM 3 = RV 2.0 RPM 3 = LV 1.5 RPM 4 = RV 4.0 RPM 4 = LV 3.0 RPM 5 = RV 5.0 RPM 5 = LV 6.0 RPM 6 = RV 10 RPM 6 = LV 12 RPM 7 = RV 20 RPM 7 = LV 30 RPM 8 = RV 50 RPM 8 = LV 60 RPM 9 = RV 100 RPM
	Third digit indicates viscosity in centipoise (cP)
	0 = As specified 1 = ≥50 but <500 2 = ≥500 but <2500 3 = ≥2500 but <5000 4 = ≥5000 but <10 000 5 = ≥10 000 but <15 000 6 = ≥15 000 but <55 000 7 = ≥55 000 but <100 000 8 = ≥100 000 but <150 000 9 = ≥150 000 but <200 000
Z	OTHER SPECIAL REQUIREMENTS

TABLE 2 Continued

Symbol	Characteristic
	These characteristics will be spelled out in detail and identified in sequence, that is, 01, 02, 03, and so forth (see Guide D4800 for example).

7.3 Additional suffixes will be added to this classification as test methods and requirements are developed. A further list of suffixes can be found in Guide **D4800** and may be used for additional requirements as appropriate.

8. Test Methods

8.1 Determine the properties enumerated in this classification by means of ASTM International test methods as they apply, unless otherwise stated in this classification or unless test methods are agreed upon between the producer and user.

9. Sampling

9.1 Unless otherwise agreed upon between the producer and user, the material shall be sampled in accordance with the sampling procedure prescribed in Practice **D1898**. Adequate statistical sampling shall be considered an acceptable alternative. A lot of material shall be considered as a unit of manufacture as prepared for shipment.

10. Specimen Preparation

10.1 Silicone adhesives involve a number of curing mechanisms, each requiring special consideration when preparing samples.

10.1.1 *Type I*—Compression molded.

10.1.2 *Type II*—Draw-down.

10.1.3 *Type III*—Agreed upon between user and supplier.

10.2 *Specimen Size*—The test sheet thickness shall be 1.90 ± 0.2 mm in accordance with Practice **D3182**.

10.3 *Specimen Cure*—Unless otherwise specified, moisture-cure specimens shall be cured for 168 ± 4 h at 50 ± 5 % relative humidity at 23 ± 2°C.

11. Conditioning

11.1 Condition the uncured material at 23 ± 2°C and 50 ± 5 % relative humidity for not less than 24 h before testing in

TABLE 3 Aging at Temperature Suffix Designations

1 st Digit	Time (hours)	2 nd Digit	Temperature (°C) ^A
1	22	1	0
2	70	2	23
3	168	3	70
4	504	4	100
5	1008	5	125
9	As specified	6	150
		7	175
		8	200
		9	As specified

^A Ranges as specified in Practice **D1349**.

TABLE 4 Property Change Table^A

Digit	Property	0	1	2	3	4	5	6	9
3 rd	Hardness change, points max Type A or IRHD	Unspecified	5	10	20	10 to 35	25 to 50	30 to 60	As specified
4 th	Tensile change, % max	Unspecified	<5	10	20	30	50	100	As specified
5 th	Elongation change, % max	Unspecified	<5	10	20	30	50	100	As specified
6 th	Volume change, % max	Unspecified	<5	10	20	50	100	>100	As specified

^A Table 4 indicates a maximum change from an original test value and is not an absolute value. As such, when a “% maximum change” is indicated, this is the plus/minus range of variation the user would anticipate from the initial value after timed exposure to the temperature or the fluid indicated, or both.

accordance with Procedure A of Practice D618 for those tests in which conditioning is specified.

11.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ relative humidity unless otherwise specified.

11.3 For UV-sensitive materials, special preparations for conditioning and test conditions should be adhered to, as agreed upon between producer and user, or as provided in the referenced standard for the material. Typical temperature is $23 \pm 2^\circ\text{C}$.

12. Suffixes

12.1 Silicone materials within this system may also be specified using suffix requirements detailed in Table 2. Unless a range of values is specified in Table 2, any specific target value must be given a \pm tolerance consistent with the precision and bias of the test standard referenced. It is recommended that each individual suffix be separated with a space and that they be applied in the sequence detailed in Table 2.

12.1.1 *Example 2*—The designation ASTM F2468 6133-25-3672 MA410 VB152 indicates:

6133-25-3672 = oxime cure system, one part moisture cure mechanism, application rate between 100 and 199 g/min, tack free time between 10 and 19.9 min; ultimate elongation

between 100 and 199 %, tensile strength between 1.381 and 3.45 MPa; blowout resistance between 21 and 30 s, specific gravity between 1.26 and 1.35 g/cc, lap shear bond strength between 6 and 13.8 MPa, silicone volatile content between 0.5 and 1.0 %,

MA410 = flame retardant, UL 94, 1.6 mm minimum thickness, vertical flame test, (94 V/94 VTM)0 refer to UL 94, and

VB152 = viscosity, Test Methods D1084 (Method B)—LVT, LV Spindle #1, LV 6 RPM, 500 to 2500 centipoise (cP).

12.2 ASTM test methods involving aging at elevated temperature as identified in Table 2 shall be followed by two digits as defined in Table 3. The first digit shall specify the aging period, and the second shall specify the test temperature. In both cases when listed “as specified,” the variance from the values listed in Table 3 must be defined, and shall be done so in parenthesis per Example 3 below (12.2.1).

12.2.1 *Example 3*—“A39(140)” = Heat resistance after 168 h at 140°C .

12.3 ASTM test methods involving changes in hardness, tensile strength, elongation, or volume after heat aging as referenced in 12.2 are further specified in the third, fourth, fifth, and sixth digits as indicated in Table 4.

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