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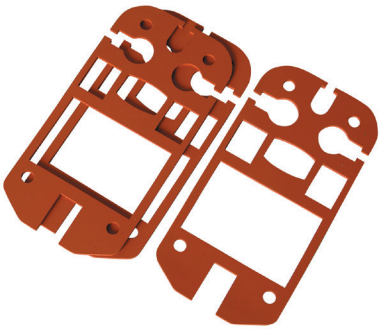
WHITE PAPER

3B CERTIFIED SILICONES WITH HIGH FLEX-FATIGUE RESISTANCE

By: Modus™ Technical Team

 | www.modusadvanced.com | sales@modusadvanced.com | (925) 248-9493



Silicones have many desirable properties. They're chemically inert, resistant to ozone and ultraviolet light, and offer thermal stability over a wide temperature range (typically -55° C to 200° C). Silicones can repel water and form watertight seals, too.

These synthetic elastomers are used in a wide variety of applications, but some silicones have inadequate flex-fatigue resistance – a measure of a material's ability to withstand repeated flexing or bending without cracking.

To overcome this challenge, it's important to use silicones with high flex-fatigue resistance

COMPOUND SELECTION AND PARTS FABRICATION

Specialty Silicone Products (SSP) is an ISO 9001:2008 certified company that supplies silicones with high flex-fatigue resistance. These materials pass the DeMattia Flex Resistance Test and meet the full requirements of the A-A-59588 3B specification – with no exceptions for flexural testing.

Two of SSP's flex-fatigue resistant silicones are certified by an independent testing laboratory. These 50- and 60-durometer elastomers are available in compounds for molding, cured rolls and sheets for cutting, and as uncured and pre-formed materials. Certification for a 70-durometer material is pending.

Modus™ Advanced, Inc. is an AS9100 certified company that converts SSP's flex-fatigue resistance silicone and supplies molded and die cut parts. Using advanced methods, Modus™ molds silicone gaskets to your exact specifications. Modus™ also die cuts flex-fatigue resistant silicones with speed and precision.

THE DEMATTIA FLEXURAL TEST

In some industries, strong flex-fatigue resistance is mission-critical. That's why flex testing is an essential tool for ensuring that aerospace and military silicones can meet the A-A-59588 3B specification from the U.S. General Services Administration (GSA).

The A-A-59588 standard contains six alphanumeric classes or sections: 1A, 1B, 2A, 2B, 3A and 3B. Each A-A-59588 class specifies multiple material properties, but only Classes 3A and 3B include requirements for flex-fatigue resistance.

Within the A-A-59588 standard, each class contains grades that correspond to a silicone's hardness or durometer (Shore A). For example, A-A-59588 Class 3B contains Grades 50, 60, and 70 for 50-, 60-, and 70-durometer silicones, respectively.

PARTIAL COMPLIANCE VS. FULL COMPLIANCE

Some suppliers claim that their silicones are flex-fatigue resistant, but industry-wide compliance has been inconsistent. Other suppliers say that their products meet the A-A-59588 3B standard, but their elastomers are not certified to meet the flexural requirements of 3B.

That's why the 3B silicones that Modus™ Advanced Inc. converts have been independently-tested and certified to the flexural requirements of A-A-59588, Class 3B for Grades 50 and 60 (with Class 70 pending). Today, SSP is the only supplier that certifies materials to this specification with a third-party verification and no exceptions for flex-testing.

As a valued member of the Modus™ supply chain, SSP will flex-text competitive materials at no charge. Both companies encourage product engineers and procurement personnel who need flex-fatigue resistant silicones to choose only certified compounds that pass the DeMattia Flexural Test.

THE DEMATTIA FLEXURAL TEST

Fully-compliant A-A-59588, Class 3B silicones must pass the DeMattia Flex Resistance Test, a dynamic test that measures crack growth in inches over thousands of flexural cycles. The ASTM D813 - 07(2014) Standard Test Method for Rubber Deterioration–Crack Growth defines this testing protocol.

The DeMattia Flexural Test is one of several fatigue tests, but it's a critical one for demanding applications. For engineers, silicone rubber with high flex-fatigue resistance strengthens product designs through longer service life. For example:

- Aerospace engineers need silicones with high flex-fatigue resistance for door seals, window seals, and vibration-isolating mounts used with alternators, compressors, and assembly bolts.
- Automotive engineers need crack-resistant silicones for engine mounts and exhaust hangers.
- Engineers who design industrial machinery need silicones that pass the DeMattia Flexural Test for applications such as high-performance keypads.

The A-A-59588, Class 3B silicones that Modus™ Advanced Inc. converts pass the DeMattia Flex Resistance Test and are Made in the USA at SSP's Ballston Spa, New York facility. Upon request to Modus™, SSP will provide a copy of the original test results from Akron Rubber Development Laboratory (ARDL), an independent test lab, for specimens of SSP-200T, SSP's A-A-59588, Class 3B, Grade 50 silicone.

The following section describes ARDL's test procedure and contains the crack-growth results.

ARDL TEST RESULTS

SSP submitted test specimens of SSP-200T, a 50-durometer silicone with strong flex-resistance, to ARDL, an A2LA accredited testing lab and an ISO 9001:2008 company. Using servo-hydraulic testing equipment made by MTS Systems Corporation (MTS), ARDL tested three specimens of SSP-200T from a batch (GK013) that was black in color.

To measure DeMattia flexibility, ARDL followed the ASTM D813 - 07(2014) test standard, which specifies that a 50-durometer elastomer shall not exhibit cracking greater than 0.500 inches prior to 140,000 flex cycles. ASTM D813 also defines the flex-testing requirements for silicones that meet A-A-59588, Class 3B requirements.

A-A-59588, Class 3B is divided into numbered grades that correspond to the hardness or durometer (Shore A) of the material under test. As the following table shows, SSP-200T meets A-A-59588, Class 3B, Grade 50 requirements for flexural resistance. Even at 140,000 flex cycles, SSP's specimens did not exceed the 0.500-in. standard in the DeMatia Flex Resistance Test.

SSP-200T: CRACK GROWTH (INCHES) PER FLEX CYCLES FOR THREE SPECIMENS

0	1	1000	3000	5000	10,000	20,000
0.080	0.080	0.100	0.110	0.110	0.130	0.140
0.080	0.080	0.100	0.110	0.110	0.130	0.140
0.080	0.080	0.090	0.100	0.100	0.120	0.140

30,000	40,000	50,000	60,000	70,000	80,000	90,000
0.060	0.070	0.190	0.220	0.260	0.290	0.310
0.060	0.070	0.240	0.270	0.300	0.310	0.320
0.060	0.190	0.240	0.260	0.260	0.270	0.300

10,000	110,000	120,000	130,000	140,000		
0.320	0.350	0.360	0.370	0.380		
0.340	0.350	0.360	0.380	0.380		
0.320	0.340	0.340	0.350	0.370		

A-A-59588, 3B, GRADE 50 COMPLIANCE

As a fully-compliant 3B material, SSP-200T meets all Grade 50 physical and mechanical requirements. This includes durometer (Shore A), tensile strength, elongation, tear B, compression set, specific gravity, and low temperature brittle point.

The following table contains test data generated with a DCLBP peroxide catalyst system at SSP's quality laboratory in Ballston Spa, New York.

Test	Requirements	Typical Values
Shore A	45 – 55	50
Tensile Strength (psi)	1200 min.	1280
Elongation (%)	500 min.	660
Tear B (ppi)	150 min.	240
Compression Set (%)	20 max.	15
Specific Gravity	1.12 – 1.20	1.15
Flex Resistance (140,000 cycles/inch)	0.5 max.	0.42
Low Temperature Brittle Point @ -70° C	Pass 5 of 5	Pass

A-A-59588, 3B, GRADE 60 COMPLIANCE

Modus™ Advanced Inc. also converts SSP-392, a 60-durometer SSP silicone with strong flex-fatigue resistance that meets the requirements of A-A-59588, 3B, Grade 60.

The following table compares typical values for SSP-392 to the A-A-59588, 3B, Grade 60. All test data generated is certified only for the DCLBP catalyst.

Test	Requirements	Typical Values
Shore A	55 – 65	60
Tensile Strength (psi)	1200 min.	1280
Elongation (%)	400 min.	650
Tear B (ppi)	150 min.	240
Compression Set (%)	25 max.	19.8
Specific Gravity	1.16 – 1.22	1.19
Flex Resistance (50,000 cycles/inch)	0.5 max.	0.45
Low Temperature Brittle Point @ -70° C	Pass 5 of 5	Pass

CONCLUSION

Some fabricators claim that they work with suppliers whose silicones meet the A-A-59588 3B standard; however, these materials only meet 3B's non-flexural requirements. For engineers and procurement personnel in demanding industries, the distinction between full and partial 3B compliance can be critical.

Modus™ Advanced Inc. converts silicones with high flex-fatigue resistance that have been independently-tested and certified to the flexural requirements of A-A-59588, Class 3B for Grades 50 and 60 (with Class 70 pending). These materials are supplied by Specialty Silicone Products (SSP), a trusted member of the Modus™ supply chain.

Both Modus™ and SSP encourage product engineers and procurement personnel who are sourcing A-A-59588 3B silicones to check the certifications for these materials regarding flexural testing. Update your vendor list to include SSP materials, and choose Modus™ for die cutting and molding.