Optical and Physical Properties of Dow Corning® MS-1003 Moldable Silicone and Changes with High Temperature Aging

Dow Corning MS-1003 Moldable Silicone is a colorless, two-part addition cure, injection moldable material. In addition to its optical clarity and stability in heat, the flexibility, moldability and durability of optical silicones like Dow Corning MS-1003 Moldable Silicone make them suitable for secondary lenses, light pipes, light guides and many other components.

This guide can assist you in understanding the specific optical and physical properties of Dow Corning MS-1003 Moldable Silicone before and after thermal aging.

Testing Methodology

ASTM conforming, tensile bar samples of Dow Corning MS-1003 Moldable Silicone (Figure 1) were injection-molded in an LSR-style injection molding machine.

The mold was highly polished to an approximately SPI A-1 finish which lends to a clear sample with a flat, mirror-finish surface. This allowed the samples to be used for both physical and optical testing. Following molding, the samples were post-cured at 150° C for one hour to ensure that all parts were fully cured prior to beginning the testing. The results shown in the following graphs include un-aged samples as well as samples that were thermally aged in an air-circulating oven at 150° C for up to 10,000 hours.

Optical Properties

Several optical properties were measured as the material was aged. Some of the most commonly requested properties are shown in this bulletin. Note that this testing occurred as the samples were pulled from the oven over a 14-month (10,000 hour) period. Slight variations in measured values over such a long period of time are expected. Measurements were made using a Varian Cary 5000 UV-Vis-NIR spectrophotometer with an internal integrating sphere attachment. It can measure properties between 250 nm and 2,500 nm, but typically, narrower scans are utilized. Some of the properties are measured directly while others are calculated.

Further details on how these optical properties are measured can be found in the “Measurement of Optical Properties” bulletin.
**Total transmission** is the measurement of all light that passes through a medium, in both a direct and diffuse fashion. As can be seen in the graph below, there is little change in the transmission with time at an elevated temperature.

![Graph of Dow Corning MS-1003 Silicone Thermally Aged Transmission @ 150° C](image)

If one looks only at the visible region and magnifies the axis, it becomes apparent that the changes seen are more related to data measurement than actual material changes.

![Graph of Dow Corning MS-1003 Silicone Thermally Aged Transmission @ 150° C](image)

Note that the transmission decreases, then increases over time. This lends to changes in data measurement rather than material changes. This can be expected when measuring properties over a 14-month time span.

**Reflection** is the portion of light that changes direction at the interface of two different media (air and material) so that the light returns into the media from which it originated. Similar to transmission, there is little change seen in the reflection with time at an elevated temperature.

![Graph of Dow Corning MS-1003 Silicone Thermally Aged Reflection @ 150° C](image)
Absorption is the amount of light that is “captured” by and dissipated within the material as it passes through. The shape of the curve is much different here due to the use of the log scale for the percent-absorption values.

Haze is the degree of a material’s diffuse transmission, or the amount of light that is scattered. It should be noted that haze can be greatly effected by surface imperfections or dirt, such as fingerprints or dust particles.

Refractive index is a material-specific index which defines the speed of light in a sample. Refractive index is dependent on the details of the material composition and structure.

Similar heat aging even at higher temperatures has shown that the optical properties of Dow Corning MS-1003 Moldable Silicone are stable and show very little change, up to 200°C. Some physical properties however, begin to show significant decreases at temperatures above 150°C.

Physical Properties

Mass loss, the amount of material that is lost from a sample after curing, is typical for other silicone products used in the electronics industry. At 150°C, Dow Corning MS-1003 Moldable Silicone loses approximately three percent by weight in the first 1,000 hours. After that, little additional loss is seen— about one percent over the next 9,000 hours.

The hardness of Dow Corning MS-1003 Moldable Silicone changes very little over 10,000 hours. A gain of approximately three points in hardness on the Shore A scale is seen over the full time period.

Tensile strength and elongation follow a somewhat different curve. Tensile strength decreased to about one-half of the original value as the material aged to 10,000 hours at 150°C. Further loss was seen in the elongation of Dow Corning MS-1003 Moldable Silicone with it decreasing to about one-third of the original value over 10,000 hours at 150°C. Even with this loss in properties, Dow Corning MS-1003 Moldable Silicone maintains flexibility and shows no evidence of cracking or discoloration.
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