



# AEROSPACE MATERIAL SPECIFICATIONS

## AMS 2521

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc.

485 Lexington Ave., New York, N. Y. 10017

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Revised

### REFLECTION-REDUCING COATINGS FOR INSTRUMENT GLASSES

1. **ACKNOWLEDGMENT:** A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.
2. **APPLICATION:** Primarily to reduce the intensity of reflection from the surfaces of instrument glasses and to increase light transmission through the glasses.
3. **TECHNICAL REQUIREMENTS:** The coating shall conform to the following requirements when applied to substrate materials having indices of refraction within the range of 1.47 - 1.55. Tests shall be performed on the coated parts or on coated glass witness samples of the same index of refraction and surface finish. When ASTM methods are specified for determining conformance to the following requirements, tests shall be conducted in accordance with the issue of the ASTM method listed in the latest issue of AMS 2350.
  - 3.1 **Specular Reflectance:** The specular reflectance from each coated surface, as measured with a calibrated spectrophotometer, shall not exceed the following limits for energy incident on the surface at an angle within the range 0 - 15 deg. incl, and at an angle of 30 degrees:

Wavelength Range millimicrons	Reflectance, %, max For Angle of Incidence Shown	
	0 to 15, incl	30
450 to 675, incl	0.6 absolute	
450 to 650, incl		1.0 absolute
500 to 620, incl	0.35 average	0.50 average
425 to 700, incl	0.35 average	0.50 average

- 3.2 **Light Absorption:** Within the wavelength range 425 - 700 millimicrons, light loss in the coating shall not exceed the following limits per surface:

Maximum average absorption	0.5%
Maximum absolute absorption	2.0%
Maximum diffuse reflectance	0.1%

- 3.3 **Durability:** The coating shall exhibit no visible evidence of peeling, flaking, cracking, crazing, or delaminating and shall have no change in reflectance characteristics which result in nonconformance to the requirements of 3.1 and 3.2, when subjected to the following sequence of tests:
  - 3.3.1 **Adhesion of Coating:** A strip of pressure sensitive cellulose tape, 1 in. in width and having a minimum adhesion value of not less than 40 oz per in. of width, shall be pressed firmly in contact across the entire coated surface. The tape shall be removed quickly with a snap action which exerts the greatest possible stripping effect on the surface.
  - 3.3.2 **Salt Spray Resistance:** The coating shall withstand continuous exposure to salt spray for 24 hr when tested in accordance with ASTM B117.
  - 3.3.3 **Humidity Resistance:** The coating shall withstand continuous exposure for 24 hr in an atmosphere controlled at  $120\text{ F} \pm 4$  ( $48.9\text{ C} \pm 2.2$ ) and  $98\% \pm 2$  relative humidity.
  - 3.3.4 **Abrasion Resistance:** The coating shall withstand being subjected to the eraser abrasion resistance test in accordance with 3.3.4.1.

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3.3.4.1 Abrasion Resistance Test:

3.3.4.1.1 Test Procedure: The coating shall be tested by holding a standard abrasion testing device in the hand and rubbing the coated surface with a standard eraser mounted in the holding device. A force of approximately 2.0 - 2.5 lb shall be applied. Strokes of about 1 in. shall be made if the size of the element will permit it; smaller strokes for smaller elements. All strokes shall be made on one path for 20 complete strokes.

3.3.4.1.2 Test Equipment: Assembly details of the Abrasion Tester may be obtained on written request from the Quality Assurance Directorate, Frankford Arsenal, Bridge and Tacony Streets, Philadelphia, Pennsylvania 19147. The only rubber eraser plug which is acceptable for this test is also available from the same source. All requests should make reference to Drawing D7680606 (Tester, Abrasion, Optical Coating).

3.4 Environmental Resistance: The coating shall show no change in spectral characteristics which results in nonconformance to the requirements of 3.1 and 3.2 when exposed to any of the following conditions:

3.4.1 Elevated Temperature: Exposure for a continuous period of 15 min. at  $600\text{ F} \pm 15$  ( $315.6\text{ C} \pm 8.3$ ) and thereafter reduced to room temperature. Heating and cooling rates shall not be greater than 15 F (8.3 C) degrees per minute.

3.4.2 Sand and Dust: Exposure for 12 hr to the conditions of 3.4.2.1.

3.4.2.1 Sand and Dust Test:

3.4.2.1.1 Test Chamber: The chamber shall consist of a dusttight cabinet with the floor designed to permit the dust to fall into hoppers for recirculation. The facility shall be time-cycle-controlled to accomplish the exposure and shutdown required. A blower and dusting shall be provided to circulate the dust throughout the test chamber with the velocity and concentration as outlined.

3.4.2.1.2 Test Procedure: The test samples shall be placed in the test chamber and the sand and dust density raised to, and maintained at, 0.1 - 0.5 g per cu ft within the test space. The test chamber shall be vented to the atmosphere. The relative humidity shall not exceed 30% at any time during the test. Sand and dust used in the test shall be of angular structure and have characteristics as follows:

- a. 100% of the sand and dust shall pass through a 100 mesh screen, U.S. Standard Sieve Series.
- b.  $98\% \pm 2$  of the sand and dust shall pass through a 140 mesh screen, U.S. Standard Sieve Series.
- c.  $98\% \pm 2$  of the sand and dust shall pass through a 200 mesh screen, U.S. Standard Sieve Series.
- d.  $75\% \pm 2$  of the sand and dust shall pass through a 325 mesh screen, U.S. Standard Sieve Series.
- e. Chemical analysis of the dust shall be as follows:

Substance	% by Weight	
	min	max
SiO <sub>2</sub>	97	99
Fe <sub>2</sub> O <sub>3</sub>	--	2
Al <sub>2</sub> O <sub>3</sub>	--	1
TiO <sub>2</sub>	--	2
MgO	--	1
Ignition	--	2

The sand and dust specified is commercially known as "140 mesh silica flour." Sand and dust (140 mesh silica flour) produced by the Fenton Foundry Supply Company, Dayton, Ohio, and Ottawa Silica Company, Ottawa, Illinois, or equivalent is satisfactory for use in the performance of these tests.

Part I: The internal temperature of the test chamber shall be maintained at  $77\text{ F} \pm 8$  ( $25\text{ C} \pm 1.7$ ) for a period of 6 hr, with sand and dust velocity through the test chamber between 100 and 500 ft per minute.

Part II: After 6 hr at the above conditions, the temperature shall be raised to, and maintained at,  $160\text{ F} \pm 8$  ( $71.1\text{ C} \pm 1.7$ ). These conditions shall be maintained for 6 hours. At the end of this exposure period, the sample shall be removed and allowed to cool to room temperature. Accumulated dust shall be removed by brushing, wiping, or shaking.

3.4.3 Fungus Resistance: There shall be no observed growth of spores when subjected for 14 days to the conditions of 3.4.3.1.

3.4.3.1 Fungus Resistance Test: Testing shall be conducted in accordance with ASTM D1924. The following test fungi shall be used in preparing the culturer. One species of fungus from each of the following groups shall be used:

Group	Organism	American Type Culture Collection No. (See Note 1)	Quartermaster No. (See Note 2)
I	Chateomium globosum	6205	459
	Myrothecium verrucaria	9095	460
II	Memnieniella echinata	9597	1225
	Aspergillus niger	6275	458
III	Aspergillus flavus	10836	1223
	Aspergillus terreus	10690	82j
IV	Penicillium citrinum	9849	1226
	Penicillium ochrochloron	9112	477

Note 1. Source. American Type Culture Collection  
2112 M Street, N. W.  
Washington, D. C. 20037

Note 2. Source. Mycology Laboratory, PRD  
Quartermaster Research and Engineering Center  
Natick, Massachusetts 01760

3.4.4 Thermal Shock: Exposure for a continuous period of at least 1 hr at  $158\text{ F} \pm 4$  ( $70\text{ C} \pm 2.2$ ) and thereafter placed in direct contact with an ice cube for a period of 2 minutes.

3.4.5 Salt Spray Resistance: The coating shall withstand 50 hr continuous exposure to salt spray when tested in accordance with ASTM B117.

4. QUALITY: The coating shall be uniform in quality and condition, clean, smooth, and free from foreign materials, and from physical imperfections and optical imperfections detrimental to the performance of parts when tested in accordance with the latest issue of ARP 924.