



<b>AEROSPACE INFORMATION REPORT</b>	<b>AIR5689™</b>	<b>REV. B</b>
	Issued 2000-03 Revised 2016-03 Reaffirmed 2021-05	
Superseding AIR5689A		
(R) Light Transmitting Glass Covers for Exterior Aircraft Lighting		

## RATIONALE

This document is being updated to add definitions for surface quality defects, redefine glass “part” or “lens” as a “glass cover,” and to add additional information to the publication and coating sections.

### 1. SCOPE

This SAE Aerospace Information Report (AIR) provides definitions of and inspection criteria for defects commonly encountered in molded glass covers for exterior aircraft lighting.

#### 1.1 Purpose

This document covers, but is not limited to, visual inspection and evaluation recommendations for molded glass covers used in exterior aircraft lighting applications. The included definitions are for those defects most commonly encountered. The goal is to provide specific evaluation criteria in the following areas:

- a. Color
- b. Internal Quality
- c. Surface Quality
- d. Dimension
- e. Coatings

Inspection of glass covers shall be made at a typical reading distance with normal or corrected 20-20 vision under adequate lighting (refer to ASTM C1036 for reference/guidance). Glass covers shall be free from defects that will prevent the cover from meeting intensity and beam distribution, strength, thermal shock resistance, and other physical requirements. All glass covers shall meet drawing specifications.

### 2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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## 2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AS25050 Colors, Aeronautical Lights and Lighting Equipment, General Requirements For

## 2.2 U.S. Government Publications

Copies of these documents are available online at <http://quicksearch.dla.mil>.

MIL-DTL-7989C Covers, Light-Transmitting for Aeronautical Lights, General Specification For (This is an inactive document. However, it is still generally used as a reference source.)

MIL-G-174 Glass, Optical

MIL-PRF-13830 General specification governing the manufacturing, assembly, and inspection of Optical Components for Fire Control Instruments

## 3. RECOMMENDATIONS

### 3.1 Color

3.1.1 The color shall meet the specifications defined in the detailed item drawing. The drawing shall indicate the desired chromaticity in CIE 1931 coordinates, the applicable light source, and the operating temperature of the glass cover. In the event that no color specifications are indicated, the glass cover shall be produced to meet the requirement of specification AS25050 using a standard CIE Illuminant A (2854 K) source with a glass cover temperature between 20 °C and 25 °C.

3.1.2 The color shall be homogeneous throughout the glass cover.

3.1.3 It should be noted that colored glassware has the tendency to change with operating temperature. This property is most apparent with sharp-cut yellow and sharp-cut red filter glass. The operating temperature of the glass cover should be specified on the detailed drawing for all applications where chromaticity and photometric output are critical. The glass composition shall then be chosen to meet the desired requirements of the glass cover.

3.1.4 Detectable or noticeable color shall not be seen through the optically effective area of clear, uncoated glass covers.

### 3.2 Internal Quality

3.2.1 A "check" is a crack or fracture usually starting from an edge of the glass cover. A "crizzle" is a series of fine checks occurring in one area near the glass cover surface. Cracks, checks, and crizzles are actual fractures in the glass cover and shall not be accepted.

3.2.2 An "inclusion," or "stone," is an opaque, non-glassy material located within the bulk of the glass cover. A fractured inclusion has small cracks surrounding the area of the stone and leading into the glass cover. Fractured stones shall not be accepted. The maximum acceptable inclusion size is related to the overall dimension of the item and the magnitude of thermally induced stress in the glass cover during operation.

3.2.3 "Knots" are semi-transparent areas of incompletely melted glass. The inspection criteria for knots are the same as those for inclusions in 3.2.2.

3.2.4 "Striae," or "cords," appear as lines or threads within the glass cover, and are caused by slight variations of the refractive index in the bulk of the glass. Cords that are not visible to the unaided eye and that do not affect the light output of a cover shall not be a cause for rejection. Striae, which are light and scattered when viewed perpendicular to the optically effective surface, are acceptable so long as the output of the glass cover is not affected. Heavy cords which appear on the surface of the glass cover or degrade the physical integrity or photometric output of the glass cover are unacceptable.

3.2.5 "Bubbles" are pockets of gas trapped within the bulk of the glass cover. The specifications for bubble criteria were adapted from MIL-DTL-7989C. It should be noted that MIL-DTL-7989C is now an inactive document. However, it is still generally used as a reference source.

3.2.5.1 Bubbles should not be so large in size or number that they affect the transmittance of the glass cover. The percentage of the optically effective area of the glass cover obstructed by bubbles should not exceed one. The total number of bubbles shall not exceed the number shown in Table 1.

**TABLE 1**

Effective Diameter of Bubbles in Inches	Number of Bubbles per Square Inch of Optically Effective Area of the Glass Cover
0.050 - 0.060	3
0.040 - 0.050	4
0.030 - 0.040	6
0.020 - 0.030	11
0.015 - 0.020	25
0.010 - 0.015	44
0.005 - 0.010	100

3.2.5.2 Diffusing covers shall not be required to meet any bubble requirements.

3.2.5.3 "Blisters" are bubbles which exceed 0.060 inch in diameter. The size and thickness of a glass cover shall be considered when determining the maximum allowable size of a blister.

### 3.3 Surface Quality

3.3.1 Elongated blisters which catch a fingernail on the glass cover shall not be accepted. Open surface blisters or blisters which can be punched open with a fingernail or pencil point shall be rejected.

3.3.1.1 Open and elongated bubbles which can catch a fingernail on the glass cover are acceptable providing they are less than 0.015 inch deep.

3.3.2 "Wrinkles," or "chill marks," are slight wavy areas on the surface of the glass cover caused by variations in mold temperature and glass cooling. Wrinkles should be acceptable as long as light output is not reduced below desired levels.

3.3.3 "Shear marks" are caused by the slicing and cooling action of the shears used in cutting an individual gob of glass for manufacturing the glass cover. Typically, the glass gob is hot enough to smooth any roughness which may have been caused by the shearing action. After molding, the shear mark should appear as a smooth, possibly irregularly shaped line on the surface. The glass within the shear mark should be well fused and not act as a concentration point for residual stress. Rough shear marks, characterized by a raised mark or abraded edges, shall be rejected. Although generally cosmetic in nature, shear marks should be in locations which have minimal impact on the light output of the glass cover.

### 3.3.4 Chips and Flakes

3.3.4.1 "Flakes" are small voids along an abraded or sliced edge of the glass cover. There shall be no cracked or residual glass remaining in the region of the flake. Flakes shall be acceptable so long as no cracks emanate from the flake into the bulk of the glass cover.

3.3.4.2 "Chips" are larger voids along a sharp edge which are caused by contact of the glass with a hard surface under sufficient force to break off a piece of the glass. There shall be no cracked or residual glass remaining in the region of the chip. Chips are acceptable if no crack protrudes from the site of the chip into the bulk of the glass cover.

- 3.3.4.3 The acceptable size of chips and flakes depends on the dimension of the part. Chips or flakes shall not be larger than 1/4 of the width of the bottom mounting flange of the part. Chips and flakes should not extend into the main body of the glass cover on either the inside or the outside. Chips and flakes should not extend for more than 0.060 inch for glass covers less than or equal to 4 inches maximum dimension, or more than 0.125 inch for glass covers greater than 4 inches in maximum dimension.
- 3.3.5 "Scratches" are rough grooves on the glass cover surface caused by abrasive materials or contact with sharp metal or ceramic objects. Scratches can usually be seen in reflected or off-axis lighting or can be felt by rubbing a fingernail over the surface of the glass cover. Coarse or deep scratches that exceed 160 as defined by MIL-PRF-13830, will affect the physical integrity of the glass cover and are unacceptable. The combined length of a light scratch should not exceed 25% of the largest dimension of the glass cover.
- 3.3.6 "Laps," or "folds," are smooth ridges on the glass cover surface. Laps are caused by two regions of glass meeting at an interface but not being sufficiently hot enough to blend together. Laps are acceptable so long as they are cosmetically acceptable and do not reduce the light output below desired levels.
- 3.3.7 "Scale" is iron oxide appearing as a reddish brown discoloration on the surface of the glass cover. It can usually be removed by buffing without causing permanent damage to the glass cover surface.
- 3.3.8 A "scuff" is an abrasion of the glass cover surface creating a cloudy or hazy appearance. Scuffs are acceptable so long as they do not reduce light output below desired levels.
- 3.3.9 "Pits" are small surface holes caused by bits of glass or dirt on the mold surface during forming. Pits are acceptable unless they are numerous, unsightly, reduce light output below desired levels, or are in regions of known high thermal stress.
- 3.3.10 Sharp edges remaining from molding or finishing operations can be sources of mechanical strength problems due to thermal shock or thermal stress. All sharp edges should be removed.
- 3.3.11 "Haze/Diffusion" is a dull or hazy appearance on the inside or outside surface of the glass cover. Haze/Diffusion that does not reduce light output below desired levels will be acceptable.
- 3.3.12 "Orange Peel" is a surface condition that appears rough, much like the skin of an orange, on the surface of the glass cover. Orange Peel that does not reduce light output below desired levels will be acceptable.
- 3.3.13 "Fire Checks" are irregular, raised areas on the surface of the glass cover created during the manufacturing process by glass flowing into the cracks of the glass cover tooling. Fire Checks that do not reduce light output below desired levels will be acceptable.
- 3.3.14 "Tooling Marks" is a line or lines in the glass cover that represent unwanted marks or scores in tooling (the mold, ring, and plunger) or marks remaining from the tooling machining process. Tooling marks that do not reduce light output below desired levels will be acceptable.

### 3.4 Dimensions

- 3.4.1 All lenses shall meet the dimensions and contour specified in the detailed drawing.

### 3.5 Coatings

#### 3.5.1 Conductive Coatings

- 3.5.1.1 The intent of conductive coatings is to limit the amount of electromagnetic energy transferred into or out of a light source. It is important to understand that a conductive coating will reduce the amount of light transmitted through a glass cover. The coating should not decrease the output of the coated glass cover below desired photometric levels.