MILITARY SPECIFICATION

GLASS, AIRCRAFT INSTRUMENT, LIGHTING WEDGE AND COVER

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope - This specification covers requirements for lighting wedges and cover glasses for use in integrally lighted and unlighted aircraft instruments.

1.2 Classification - Glass covered by this specification shall be of the following types:

Type I - Colorless optical glass having an index of refraction within the range of 1.47 to 1.55.

Type II - Polished plate glass - glass from which surface irregularities have been removed by grinding. For the purpose of this specification, float glass shall be considered equal to polished plate glass.

Type III - Clear sheet glass - transparent, flat, relatively thin glass having a glossy fire-finished apparently plane and smooth surface, but having a characteristic waviness of surface.

2. APPLICABLE DOCUMENTS

2.1 General - The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-P-116	Preservation, Methods of
MIL-C-675	Coating of Glass Optical Elements (Antireflection)
MIL-C-14806	Coating, Reflection Reducing, for Instrument Cover Glasses and Lighting Wedges
MIL-O-16898	Optical Elements, Packaging of
MIL-B-81374	Barrier Material, Greaseproof, Waterproof, Flexible, High Strength

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-1241	Optical Terms and Definitions
MS 28105	Cover Glass, Aircraft Instrument Dial

2.2 Other publications - The following drawing forms a part of this specification to the extent specified herein. Unless otherwise specified, the issue in effect on date of invitation for bid or request for proposal shall apply.

DRAWING

U.S. Army Munitions Command

C 7641866	Surface Quality Standards for Optical Elements

(Copies of specifications, standards, drawings and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General - The glass produced for aircraft instruments under this specification shall be capable of meeting the requirement of tests and inspections specified herein unless specifically excluded by contract or drawing requirements.

3.2 Terms and definitions - Definitions of terms used herein or in the contract shall be in conformance with MIL-STD-1241.

3.3 Material - The material used to produce instrument glass shall conform to the requirements specified herein for glass type, color and surface quality.

3.4 Surface defects - Limiting size of surface defects shall be designated on the drawing by two numbers which refer to two graded sets of surface quality standards (Drawing C 7641866). The first number shall refer to scratches; the second number shall refer to digs. Bubbles and inclusions shall be classed as surface digs. The size of an irregular shaped bubble or inclusion shall be considered one-half the sum of the maximum width and maximum length. Unless otherwise specified, the following defect limitation for scratches and digs shall apply:

Lighting wedges or light piping glass -	40-20
Cover glass for lighted instruments -	60-20
Cover glass for unlighted instruments -	80-50

The combined length of all maximum size scratches shall not exceed one-quarter the diameter of the glass. When a maximum size scratch is present, the maximum combined length of scratches acceptable is calculated as follows:

$$\text{(Scratch Number)} \quad \frac{\text{length of scratch}}{\text{diameter of glass}} = N$$

When scratches over # 20 are evaluated, the product N must be less than 1/2 the maximum size scratch allowed. Scratches less than # 20 are not included in this calculation. When a maximum size scratch is not present, the product N shall not exceed the maximum scratch number.

When polished edges or peripheries are required for internal reflection, the edges may be a fire-finish, mold polish, or equivalent, and shall not be subject to the scratch and dig requirement specified herein.

3.5 Chips - Edge chips .015 inch or smaller shall be allowed. Larger chips which do not encroach on the free aperture shall be allowed, providing the chip shall not be visible and objectionable in the assembled instrument. The chips shall not cause light scattering, create an imbalance in the instrument lighting nor interfere with the

sealing of the instrument. Any chip larger than .020 inch as measured at its largest extremities shall be stoned or sandblasted. The sum of the peripheral length of all chips shall not exceed 10% of the length of the edge on which the chips occur.

3.6 Chamfers - All edges may be chamfered .015 inch maximum at 45 ± 15°. On angles less than 90°, a .020 inch flat normal to the face shall be allowed (Fig. 1) to reduce edge chipping.

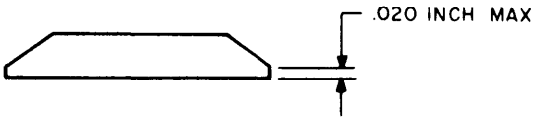


Figure 1.

Edges with included angles exceeding 135° need not be chamfered.

3.7 Striae - Aircraft instrument glass shall have no striae, streaks or cords when inspected in accordance with Section 4 (Test Methods).

3.8 Clarity - The glass shall not be cloudy or turbid.

3.9 Index of refraction - Aircraft instrument glass, including components made from polished plate or sheet glass, shall fall within the index range of 1.47 to 1.55. The value of the refractive index of the glass will be measured at the sodium D line 589.3 nanometers.

3.10 Physical measurement - Physical size and tolerances shall conform when practicable to MS 28105 or shall be as specified in the contract.

3.11 Color - Type II and Type III glass shall be no darker than the green color of an optical cell as outlined in Section 4 (Test Methods).

3.12 Coatings - Where an antireflection coating is required, instrument glasses shall be coated on all glass-to-air surfaces as specified in the contract with magnesium fluoride conforming to MIL-C-675 or multiple-layer, low-reflection coating conforming to MIL-C-14806.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Inspection provisions -

4.2.1 Submission of product - Unless otherwise specified by the contracting officer, inspection lot size, lot formation and presentation of lots shall be in accordance with "Submission of Product" provisions in MIL-STD-105.

4.2.2 Examination and tests -

4.2.2.1 Final acceptance inspection - The classification of defects in Table I constitute the minimum inspection to be performed by the supplier prior to government acceptance or rejection by item or lot.

Table I - Classification of Defects

Level II of Table I, Sampling Plan IIA of MIL-STD-105

Major: A.Q.L. 1.0% defective

	Requirements	Test Procedures
Surface Defects	3.4	4.4.1
Chips	3.5	4.4.2
Chamfers	3.6	4.4.3
Striae	3.7	4.4.4
Clarity	3.8	4.4.5
Physical measurements	3.9	4.4.6
Color	3.10	4.4.7

4.2.2.2 Material certification - Unless actual performance tests are specified in the contract, the supplier shall certify that the material meets the requirements of 3.8.

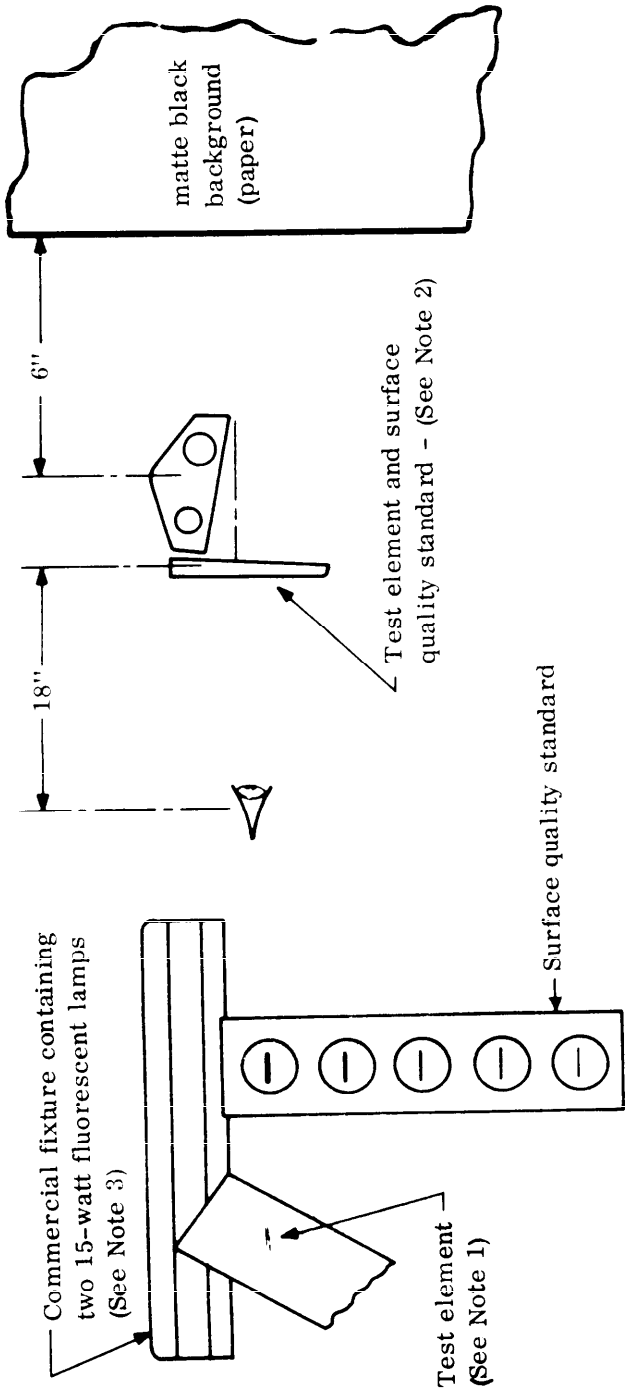
4.2.3 Acceptance and rejection - Rejected lots shall be screened for all defective characteristics. Removal or correction of defective units and resubmission of rejected lots shall be in accordance with "Acceptance and Rejection" as specified in MIL-STD-105.

4.3 Test conditions -

4.3.1 Visual - Unless otherwise specified, all visual tests shall be restricted to the unaided eye within a 60° cone of visibility at a distance of 18 ± 2 inches.

4.4 Test methods -

4.4.1 Surface Defects - Inspection for surface defects shall be performed in accordance with the method outlined in Figure 2, and using scratch and dig comparison



NOTES:
1. The scratches on the test element shall be aligned parallel to those of the comparison surface quality standard.
2. For transmitting elements, both the standard and the element surface are viewed using the transmitted light.
3. Illumination in the testing area should be from the two 15-watt fluorescent lamps only.
4. For evaluation of striae, elements shall be checked without the use of scratch and dig standards.

Figure 2. Scratch and Dig Test Method

standards (Drawing C 7641866). Standards for use in testing for scratches and digs shall be furnished by the procuring agency, which shall procure them from the Frankford Arsenal, Bridge and Tacony Streets, Philadelphia, Pennsylvania 19137. Instrument glass rejected for visual defects may be reinspected in a fixture where the illumination of the part is identical to that in the instrument. If the defect, when illuminated, falls within acceptable scratch or dig standards, the part will then be considered acceptable.

4.4.2 Chips - Glass shall be examined by transmission or reflection to determine acceptance against requirement 3.5.

4.4.3 Chamfers - Unless otherwise specified, the chamfer dimension shall be measured along the length of the part, not along the slope of the chamfer.

4.4.4 Striae - There shall be no visible striae, streaks or cords when viewed in the direction of maximum visibility, as shown in Figure 2.

4.4.5 Clarity - Glass which is cloudy or turbid shall be rejected.

4.4.6 Physical measurements - Components shall be checked for compliance with the mechanical dimensions on the drawings using standard measuring equipment. Caution should be exercised to preclude the possibility of scratching either glass or coating during measurement.

4.4.7 Color - When viewed perpendicular to the parallel surfaces of the test cell against a white background, the glass color shall be no darker than the green of the test cell indicated below.

Standard Solution

3.890 gm of copper chloride ($CU\ Cl_2 - 2\ H_2O$)
2.644 gm of nickel chloride ($Ni\ Cl_2 - 6\ H_2O$)
1.330 gm of cobolt chloride ($Co\ Cl_2 - 6\ H_2O$)
20 ml of 1-N hydrochloric acid
980 ml of distilled water

Optical Cell

Optical Absorption Cell #5-987
(Pyrex body and windows, Class 1)
American Instrument Co., Inc., Silver Spring, Md.

5. PREPARATION FOR DELIVERY

5.1 Packaging, packing and marking - Packaging, packing and marking of aircraft instrument glass lighting wedges and covers shall be in accordance with MIL-O-16898 except where otherwise specified herein.

5.1.1 Levels A and B - Wrapping of individual wedges or covers shall be as specified in MIL-O-16898, except that the wrapper shall be 10# Kraft Nontarnishing Paper or equivalent and shall be closed with a double fold and undertuck without tape. The unit packaging shall be in accordance with Method 1C-3 of MIL-P-116, except that the fibre-board stiffener may be omitted. The bag utilized for this method shall be fabricated of heat-sealable polyethylene or equivalent and shall be heat-sealed.

5.1.2 Intermediate packing - The intermediate packing shall be as specified in MIL-O-16898 except that the box shall be of fibre-board conforming to the construction requirements of the National Motor Freight Classification. Box closure shall also be in accordance with the National Motor Freight Classification.

5.1.3 Outer packing - The outer packing shall be in accordance with MIL-O-16898, Level "C".

5.1.4 Marking - Marking shall be in accordance with sound commercial practices.

5.2 Inspection - Packaging and packing defects and tests listed in MIL-O-16898 which are not applicable due to the exceptions in 5.1.1 through 5.1.4 shall be deleted from the inspection procedure.

6. NOTES

6.1 Intended use - The glass covered by this specification is intended for use as aircraft instrument cover glass and lighting wedges.

6.2 Ordering data - Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Type of glass desired.
(c) Type of antireflection coating desired.
(d) Selection of applicable levels of packaging and packing.

Custodians:
Navy - AS
Air Force - 11
Army - GL

Preparing Activity:
Navy - AS
(Project No. 9340-0020)

Review Activites:
Navy - AS
Air Force - 11, 84, 85
Army - GL, AV, MD

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SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION
MIL-G-81704

ORGANIZATION *(Of submitter)*

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT
$

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)*

DATE

DD FORM 1426 1 APR 68

REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE

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Philadelphia, Pennsylvania 19112

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