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MILITARY SPECIFICATION

COATING OF GLASS OPTICAL ELEMENTS (ANTI-REFLECTION)

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

1. SCOPE

1.1 Scope. This specification establishes the minimum optical and durability requirements for magnesium fluoride interference films used as anti-reflection coatings on optical materials.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Federal

L-T-90	Tape, Pressure-Sensitive Adhesive Cellophane and Cellulose Acetate
CCC-C-440	Cloth, Cheesecloth, Cotton Bleach and Unbleached

Military

MIL-E-12397	Eraser, Rubber-Pumice for Testing Coated Optical Elements
MIL-O-13830	Optical Components for Fire Control Instruments; General Specification Governing the Manufacture, Assembly and Inspection of
MIL-I-45607	Inspection Equipment, Acquisition, Maintenance and Disposition of

Beneficial comments (recommendations, additions, deletions), and any pertinent data which may be of use in improving this document, should be addressed to: Commander, US Army Armament Research and Development Command, ATTN: DRDAR-TST-S, Dover, New Jersey 07801, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426), appearing at the end of this document, or by letter.

STANDARDS

Military

MIL-STD-105 Sampling Procedure and Tables for Inspection by Attributes
MIL-STD-109 Quality Assurance Terms and Definitions
MIL-STD-1241 Optical Terms and Definitions

DRAWINGS

U.S. Army Armament Command

C7641866 Surface Quality Comparison Standards
D7680600 Coating Quality Comparison Standards
D7608606 Coating, Eraser Abrasion Tester

(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.)

2.2 Other publication. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117-73-Standard Method of Salt Spray (fog) Testing

(Applications for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA, 19103. Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.)

3. REQUIREMENTS

3.1 Optical terms and definitions.- Terms and definitions peculiar to the general field of optics as used herein are defined in MIL-STD-1241 and Section 6.3 of this specification.

3.2 Materials.- The material used for coating shall be a pure grade of Magnesium Fluoride adequate to meet all requirements of this specification.

3.3 Coated area.- Optical components shall be coated over their entire clear aperture. In those instances where the clear aperture is not specified on the component drawing or procurement document the following allowable uncoated holding area shall apply:

Diameter or Maximum Diagonal Dimension of Optical Element	Maximum Width of Uncoated Area
Up to 2"	0.040"
Greater than 2"	0.040" plus additional width of 0.015" for each inch in diagonal greater than 2"
OR	OR
Up to 5 CM	1 MM
Greater than 5 CM	1 MM plus additional width increasing at the rate of 0.15 MM for each CM over 5 CM

In those instances where the clear aperture is specified, areas outside the clear aperture may be coated at the discretion of the contractor.

3.4 Coating quality.- The coating shall be uniform in quality and condition and shall conform to the following:

3.4.1 Physical.- The coating shall show no evidence of deterioration such as flaking, peeling, cracking or blistering.

3.4.2 Cosmetic.- No stains, smears, streaks, or cloudiness shall be permitted on optical components lying in a focal plane beyond those permitted by the component drawing. Unless otherwise specified on the component drawing or procurement document, visual discolorations such as stains, smears, streaks, cloudiness, etc. on optical components which lie outside a focal plane in an optical system shall be acceptable when the stained area of the coated component conforms to the following:

a. The transmission and/or reflection requirements of 3.5 and 3.7.

b. The adhesion requirement of 3.8.5.

c. The severe abrasion resistance requirement of 3.8.4.1 for substrates having a Knoop hardness greater than 450 kg/mm^2; or the abrasion resistance requirement of 3.8.4.2 for substrates having a Knoop hardness less than 450 kg/mm^2.

NOTE: For purposes of this specification, should a question arise as to whether an optical component lies at or outside the focal plane, it will be assumed that it lies at the focal plane.

3.4.3 Spatter and holes.- Coating spatter and holes shall be considered as a dig and shall not exceed the allowable dig size and quality stated on the component drawing or procurement document.

3.4.4 Surface defects (scratch and dig).- Coating scratches and digs shall not exceed the values specified for the substrate on the component drawing or procurement document. Coating scratches and digs shall

3.5 Transmission.- The increase in transmission of an element after coating at the wavelength that corresponds to a coating with a quarter wave optical thickness (QWOT) (See 6.3) shall be equal to or greater than the value specified in Figure 1, as applicable to the substrate's refractive index and surface(s) coated.

3.6 Film thickness.- Unless otherwise specified on the component drawing or procurement document, the coating shall have a QWOT between 0.45 um and 0.60 um (See 6.2).

3.7 Reflectance (at the minimum point).- The magnitude of the specular reflectance for each coated surface at the minimum point on the spectral reflectance curve shall not exceed the values shown in Figure 2, according to the refractive index of the substrate.

3.8 Durability.

3.8.1 Salt solubility.- After immersion in a saline solution for a period of 24 hours, the coated surface shall meet the requirement of 3.4.1 and the applicable abrasion resistance requirement of 3.8.4.

3.8.2 Humidity.- After exposure to an atmosphere of $120^{o} \pm 4^{o}F$ ($48.9^{o} \pm 2.2^{o}C$) and 95 to 100% relative humidity, the coated surface shall meet the requirements of 3.4.1 and the applicable abrasion resistance requirement of 3.8.4.

3.8.3 Salt spray fog.- After exposure to a salt spray fog for a continuous period of 24 hours, the coated surface shall meet the requirements of 3.4.1 and the applicable abrasion resistance requirements of 3.8.4.

3.8.4 Abrasion resistance.

3.8.4.1 Severe abrasion.- There shall be no visible damage, such as evidence of abrasion or coating removal, to the coated surface when abraded by an eraser conforming to MIL-E-12397. The requirement shall be performed on substrate materials that have Knoop hardness greater than 450 kg/mm^2.

3.8.4.2 Moderate abrasion.- There shall be no visible damage, such as evidence of abrasion or coating removal, to the coated surface when abraded by a dry, clean, cheesecloth pad. The requirement shall be performed on substrate materials that have a Knoop hardness less than 450 kg/mm^2.

3.8.5 Adhesion.- The coated optical surface shall show no evidence of coating removal when cellophane tape is pressed firmly against the coated surface and quickly removed at an angle normal to the coated surface.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection.- Unless otherwise specified in

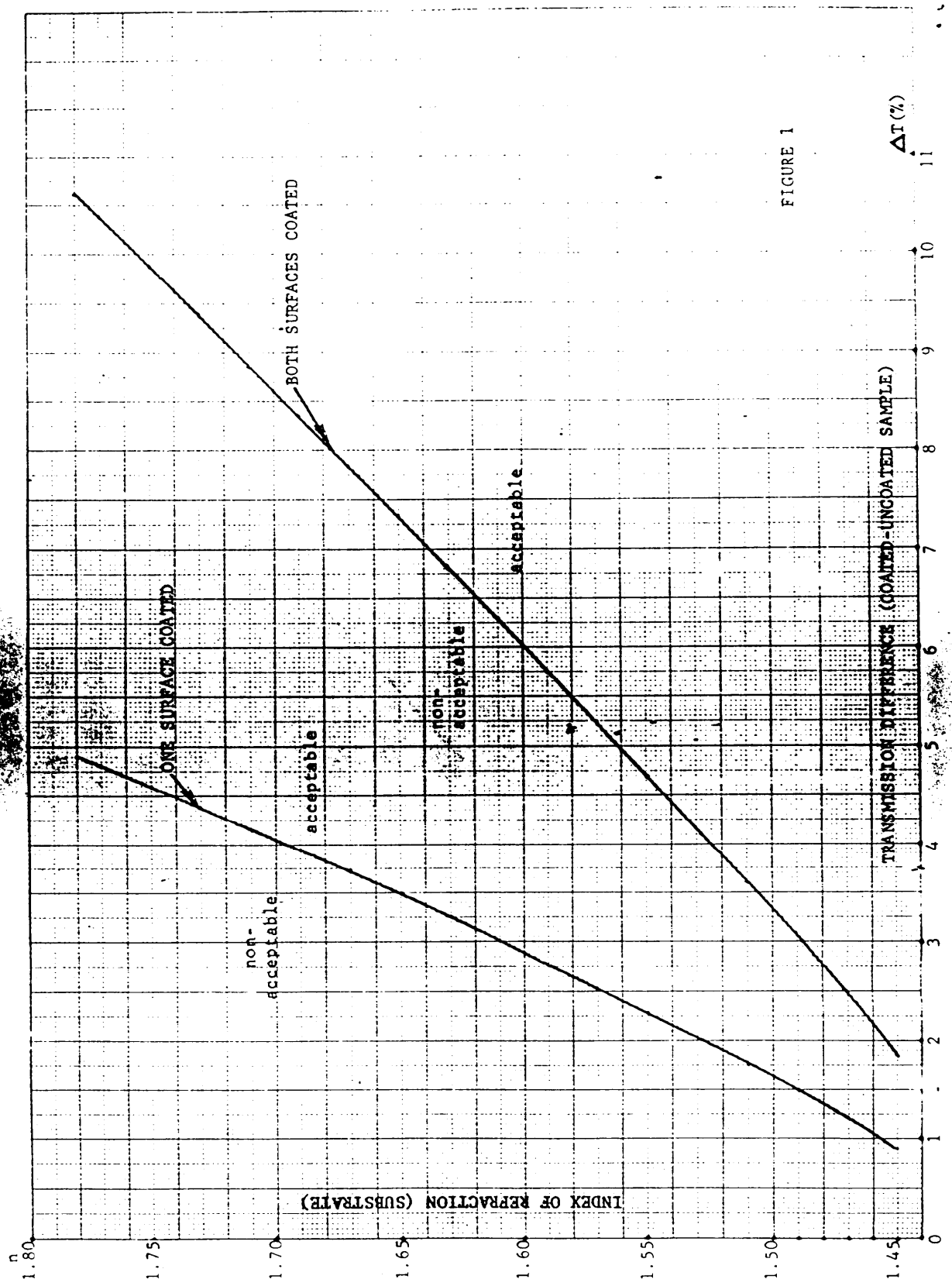


FIGURE 1

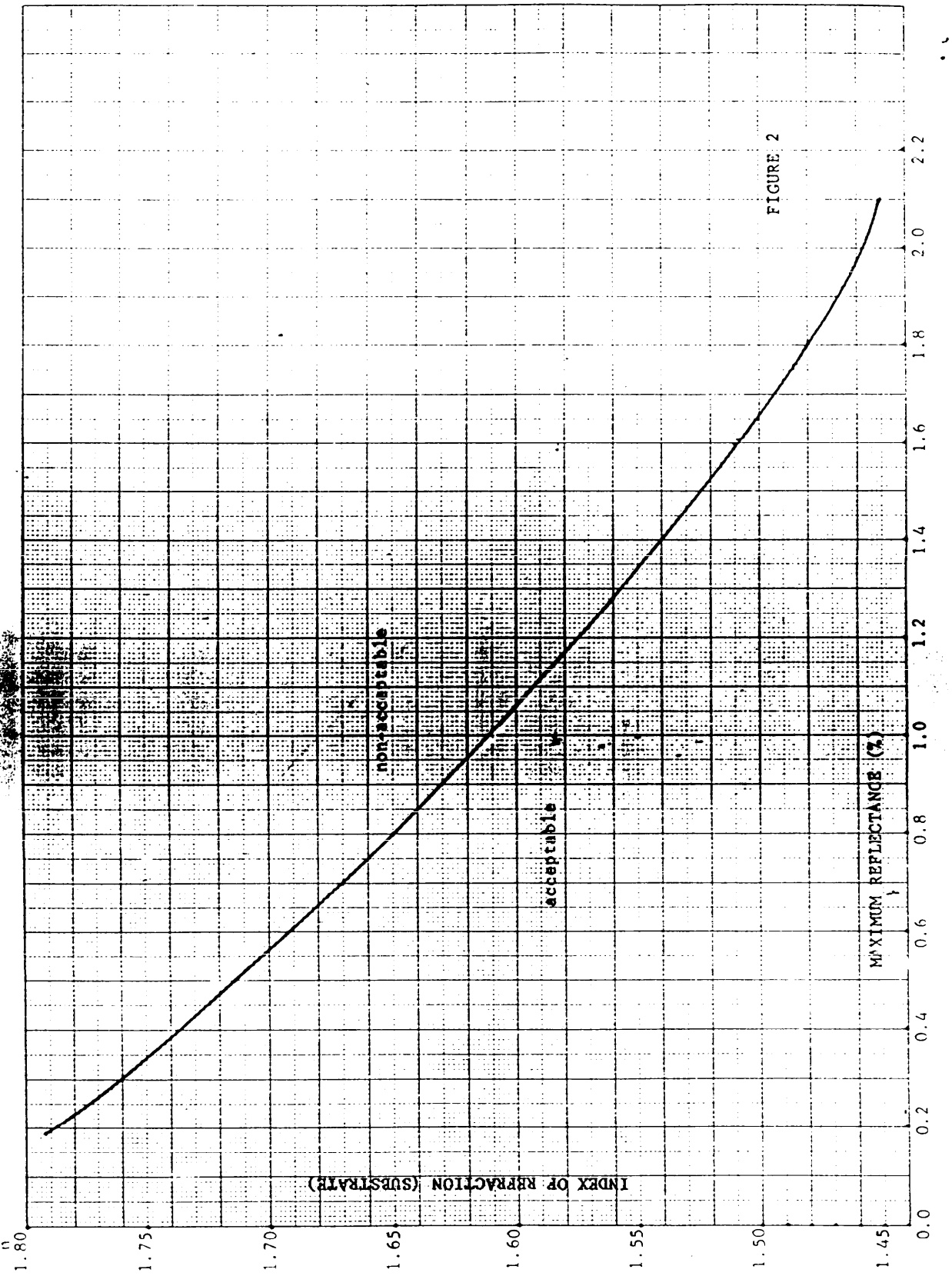


FIGURE 2

the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities 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 that supplies and services conform to prescribed requirements (See 6.2).

4.1.1 General provisions.- Definitions of inspection terms shall be as listed in MIL-STD-109.

4.1.2 Witness piece.- Unless otherwise specified, witness pieces as defined in 4.1.3 or coated components may be used to test the optical and durability requirements of the coated component (See 4.2, 4.3 and 6.2). The witness pieces shall be positioned in the coating chamber such that they represent the optical and durability characteristics of the whole evaporated lot (See 6.3). The Government reserves the right to test the actual coated component with the same test to which the witness pieces were subjected, except in the case where the known Knoop hardness of the coated component is less than 450 kg/mm^2, the moderate abrasion test of 4.5.11 shall be utilized. Should a component fail, even through the representative witness pieces pass the test, the lot shall be rejected.

4.1.3 Characteristics of the witness piece.- When the witness pieces are used to test the optical and durability requirements of the coated component they shall exhibit the following characteristics:

a. The witness piece shall be such that it presents no difficulty in measuring and testing the optical and durability requirements of the coating.

b. The witness piece shall have a surface finish similar to that of the component to be coated.

c. The witness piece shall simulate the axial thickness of the component by either computational methods or using a witness piece that has the same thickness as the coated component for the measurement of transmission characteristics.

d. The witness piece shall have a Knoop hardness greater than 450 kg/mm^2 and be a low staining material.

NOTE: When the refractive index and absorption coefficient of the witness piece differs from that of the component, the transmission difference between the coated and uncoated witness piece shall conform to Figure 1; the reflectance of the quarter wave optical thickness (QWOT) coating on the witness piece shall be equal to or less than the value specified in Figure 2.

4.2 First article (initial production) approval.- The requirement for first article approval and the responsibility (government or contractor) for first article testing shall be as specified in the contract (See 6.2). Unless otherwise specified, the sample for first article approval tests shall consist of five (5) coated components, plus fifteen (15) coated witness pieces (See 4.1.2 and 4.1.3). The five (5) coated components shall be tested as specified herein, for all the requirements of 3.3, 3.4.1, 3.4.2, 3.4.3 and 3.4.4. The fifteen (15) coated witness pieces shall be divided into three (3) groups. Each group shall consist of five (5) each coated witness pieces. One group of five (5) coated witness pieces shall be tested, as specified herein, for all the requiements of 3.5, 3.6, 3.7, 3.8.1, and 3.8.4.1. The second group of five (5) coated witness pieces shall be tested, as specified herein, for all the requirements of 3.5, 3.6, 3.7, 3.8.2 and 3.8.4.1. The third group of five (5) coated witness pieces shall be tested, as specified herein, for all the requirements of 3.5, 3.6, 3.7, 3.8.3 and 3.8.4.1. Except as noted herein, the government reserves the right to subject the coated components to all the tests specified. The sample shall be coated in the same manner using the same materials, equipment, processes and procedures as used in regular production. All materials shall be obtained from the same source of supply as used in regular production.

4.2.1 Government testing.- When the government is responsible for conducting first article approval tests, the contractor, prior to submitting the sample to the Government, shall inspect the sample to insure that it conforms to all the requirements of the contract and submit a record of this inspection with the sample, including certificates of conformance for materials, as applicable.

4.2.2 Contractor testing.- When the contractor is responsible for conducting first article approval tests, the sample shall be inspected by the contractor for all the requirements of the contract. The sample and a record of this inspection, including certificates of conformance for materials, shall be submitted to the Government for approval. The Government reserves the right to witness the contractor's inspection.

4.3 Inspection provisions.-

4.3.1 Submission of product.

4.3.1.1 Inspection lot size.- The inspection lot size shall consist of all components or subassemblies (unit of product) coated within one (8 through 12 hour) work shift.

4.3.1.2 Lot formation and presentation of lots.- the unit of product shall be submitted for inspection on a moving inspection lot basis where the components or subassemblies are continuously offered for inspection in the order produced.

NOTE: Each evaporation lot (coated components and witness pieces) forming a part of a moving inspection lot shall be identified for subsequent evaluation, if required.

4.3.2 Examination and tests.

4.3.2.1 Components, subassemblies and witness pieces.- The magnesium fluoride film coatings on components, subassemblies and witness pieces shall be inspected in accordance with this specification and the inspection provisions contained in Supplementary Quality Assurance Provisions (SQAP) or other procurement document listed in the Technical Data Package (TDP). Examination accordance with MIL-STD-105 and the sampling plans specified in Tables I and II herein. The tabulated classification of defects in Table I and II shall constitute the minimum inspection to be performed by the supplier after first article approval and prior to Government acceptance or rejection by item or lot.

TABLE I - CLASSIFICATION OF DEFECTS

CLASS	CHARACTERISTIC	REQUIREMENT	TEST PROCEDURE
CRITICAL:	NON-DEFINED		
MAJOR:	AQL 0.65% DEFECTIVE		
101.	Coated area	3.3	4.5.2
102.	Coating quality, physical	3.4.1	4.5.3.1
103.	Coating quality, cosemtic	3.4.2	4.5.3.2
104.	Coating quality, spatter and holes	3.4.3	4.5.3.3
105.	Coating quality, scratch and dig	3.4.4	4.5.3.4
MINOR:	NONE DEFINED		

NOTE: The inspection for the characteristics in Table I shall be conducted at a temperature between +60°F and +90°F (15.6°C and 32.2°C).

4.3.2.2 Acceptance and rejection.- Rejected lots shall be screened for all defective characteristics. Removal of defective units and resubmittal of rejected lots shall be in accordance with "Acceptance and Rejection" procedures specified in MIL-STD-105.

4.3.2.3 Special sampling.

4.3.2.3.1 Optical and abrasive resistance.- A minimum of three coated witness pieces, or coated components (when required), shall be selected from each evaporation lot as a special sample. The samples shall meet the requirements and tests in Table II.

TABLE II- CLASSIFICATION OF DEFECTS

NO.	CHARACTERISTIC	REQUIREMENT	TEST PROCEDURE
301.	Transmission	3.5	4.5.4
302.	Film thickness	3.6	4.5.5
303.	Reflectance at minimum point	3.7	4.5.6
304.	Severe abrasion	3.8.4.1	4.5.10

NOTE: The inspection for the characteristics in Table II shall be conducted at a temperature between +60°F and +90°F (15.6°C and 32.2°C).

4.3.2.3.2 Failure of special sample.- Should any one item of a special sampling fail to meet the specified test requirements, acceptance of the represented evaporation lot shall be suspended by the Government until necessary corrections have been made by the contractor and the resubmitted item has been approved (See 4.3.2.2).

4.4 Inspection equipment.- Except as otherwise provided for by the contract, the contractor shall supply and maintain inspection equipment in accordance with the applicable requirements of MIL-I-45607.

4.4.1 Government furnished inspection equipment.- Where the contract provides for Government furnished test equipment, supply and maintenance of test equipment shall be in accordance with applicable requirements specified in MIL-I-45607.

4.4.2 Contractor furnished inspection equipment.

4.4.2.1 Government design.- All inspection equipment specified by drawing number in specifications or SQAP forming a part of the contract shall be supplied by the contractor in accordance with technical data included in the contract.

4.4.2.2 Contractor equipment.- The contractor shall supply inspection equipment compatible with the "Test Methods and Procedures" specified in 4.5 of this specification. Since tolerance of test equipment is normally considered to be within 10% of the product tolerance for which it is intended, this inherent error in the test equipment must be considered as part of the prescribed product tolerance limit. Thus, concept, construction, materials, dimensions and tolerances used in the test shall be so selected and controlled as to insure that the test equipment will reliably indicate acceptability of a product which does not exceed 90% of the prescribed tolerance limit, and permit positive rejection when nonconforming. Construction shall be such as to facilitate routine calibration of test equipment.

4.5 Test methods and procedure.

4.5.1 Cleaning.-Before and after subjecting a coated sample (component or witness piece) to any inspection or test, the coated sample shall be thoroughly and carefully cleaned to remove dirt, finger marks, smears, etc. The cleaning solution shall be acetone, ethyl alcohol, isopropyl alcohol, or mixtures thereof. Following the cleaning, the coated sample shall be carefully dried with lens tissue or a soft clean cloth. The temperature of the cleaning solution shall not exceed 80°F (26.7°C).

4.5.2 Coated area.- The coated area of the component or subassembly

shall be examined with standard measuring equipment (See 6.3). The coated area shall conform to the requirements of 3.3.

4.5.3 Coating quality.

4.5.3.1 Physical.- The film coating on the component shall be visually examined by reflection, with the unaided eye, for evidence of flaking, peeling, cracking or blistering. The examination shall be performed using two 15 watt cool white fluorescent light tubes as the light source. The viewing distance from the coated surface to the eye shall not exceed 18 inches (45.7CM). The coated surface shall be viewed against a black matte background. The only illumination in the inspection area shall be from the light source used for examination. This method of examination is as depicted in Figure 3. The coating shall conform to the requirements of 3.4.1.

4.5.3.2 Cosmetic.- The film coating on the component shall be examined using the test method specified in 4.5.3.1 for evidence of discoloration, stains, smears, streaks, cloudiness, etc. Coatings exhibiting any visual discoloration shall be subjected to the applicable tests (See note) specified in 4.5.4, 4.5.6, 4.5.10, 4.5.11 and 4.5.12. The coating shall conform to the requirements of 3.4.2.

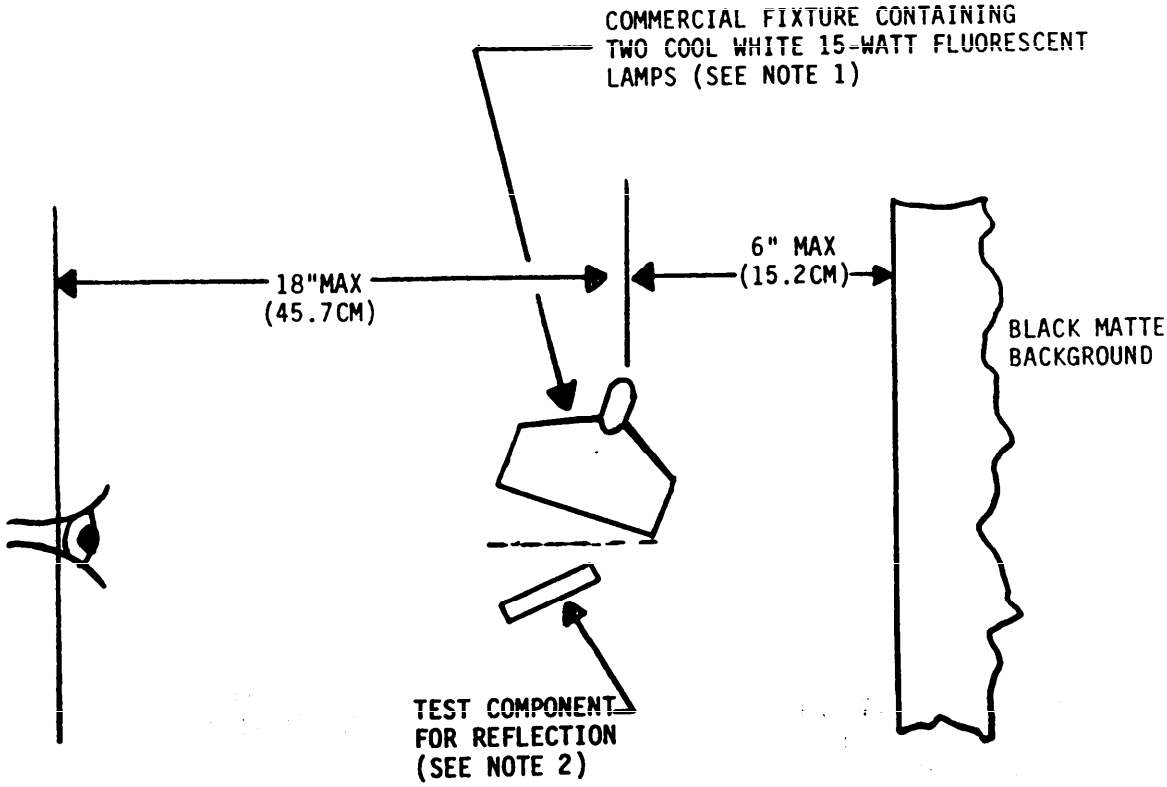
NOTE: The test procedures selected for discolored coatings shall be compatible with component drawing requirements (4.5.4 or 4.5.6) and the Knoop hardness of the component substrate (4.5.10 or 4.5.11).

4.5.3.3 Spatter and holes.- The film coating shall be examined for coating spatter and holes in the film coating using the applicable test method specified in 4.5.3.4. The film coating shall conform to the requirements of 3.4.3.

4.5.3.4 Surface defects (scratch and dig).- The film coating of the component shall be examined utilizing the technique specified in 4.5.3.1 except that magnification will be used where needed. The size of the scratch and dig (hole) in the coating shall be evaluated by comparison with the Surface Quality Standards for Optical Elements (scratch and dig) Drawing C7641866. The size of the scratch, and the diameter of the digs in the coating shall conform to the requirements of 3.4.4. The lengths and density of all scratches, and the diameters and density of all digs shall conform to the requirements of MIL-O-13830.

4.5.4 Transmission.

4.5.4.1 Witness pieces and components with plano surfaces.- Coated witness pieces, and components with plano surfaces shall be tested for increase in transmission by use of a spectrophotometer. The transmission values of identical coated and uncoated witness pieces, or components, shall be obtained by spectrophotometric measurements. The increase in transmission after coating shall conform to the requirements of 3.5.



NOTES

1. THE ONLY ILLUMINATION IN THE TEST AREA SHALL BE FROM THE LIGHT SOURCE USED FOR TEST.

2. TILT AT AN APPROPRIATE ANGLE TO SEE THE COATED SURFACE.

FIGURE 3

4.5.4.2 Lenses or components with curved surfaces.- A coated lens or component with curved surface(s) shall be tested for increase in transmission by use of a photometer system (Pritchard Model No. 1980 or equi - valent) that is capable of making a measured comparison between a coated and uncoated component. The increase in transmission after coating shall conform to the requirements of 3.5.

NOTE: The spectrophotometric inspection methods specified in 4.5.4.2 will only be used for acceptance inspection when it is necessary to evaluate a coated lens or component with curved surface(s) that has a visual discoloration since the values obtained are relative, not absolute.

4.5.5 Film thickness.- Perform this test in a witness piece, coated on one side, utilizing a spectrophotometer. A specular reflectance curve shall be obtained and used to determine the QWOT. The QWOT is the wavelength associated with the minimum point on the reflectance curve. The QWOT shall conform to the requirements of 3.6 (See 6.4).

4.5.6 Reflectance at the minimum (witness pieces and plano surfaces).- Perform this test concurrent with the test for optical film thickness. The percentage of reflectance at the minimum point on the spectral reflectance curve shall conform to the requirements of 3.7.

NOTE: This test is not applicable to components with curved surfaces.

4.5.7 Salt solubility.- The coated witness piece shall be immersed for a period of 24 hours in a solution of water and sodium chloride (salt). The mixture shall be 6 ounces (170 grams) of salt per gallon (3.8 liters) of water at room temperature (16° to 32°C). Subsequent to this immersion the coated witness piece shall be removed from the solution and gently washed, or dipped in clean running water not warmer than 100°F (38°C) to remove salt deposits. The witness piece shall then be cleaned (See 4.5.1), dried, and then subjected to the examination specified in 4.5.3.1. Subsequent to the visual examination for physical defects the witness piece shall be subjected to the test in 4.5.10. The film coating on the witness piece shall meet the requirements of 3.8.1 and 3.8.4.1.

4.5.8 Humidity.- The coated witness piece shall be placed into an environmentally controlled test chamber and exposed to a temperature of 120° ± 4°F (48° ± 3°C) and 95% to 100% relative humidity for a minimum of 24 hours. Subsequent to this exposure the coated witness piece shall be removed from the test chamber, cleaned (See 4.5.1), dried, and then subjected to the examination specified in 4.5.3.1. Subsequent to the visual examination for physical defects, the witness piece shall be subjected to the test in 4.5.10. The film coating on the witness piece shall meet the requirements of 3.8.2 and 3.8.4.1.

4.5.9 Salt spray (fog).- The coated components, or witness piece shall be subjected to a salt spray fog test in accordance with ASTM B117-73, for a continuous period of 24 hours. Subsequent to the slat spray fog exposure the witness piece shall be washed and dried as specified. The witness piece shall then be cleaned (See 4.5.1), dried, and then subjected to the examination specified in 4.5.3.1. Subsequent to the visual examination for physical defects the witness piece shall be subjected to the test in 4.5.10. The film coating on the witness piece shall meet the requirements of 3.8.3 and 3.8.4.1.

4.5.10 Severe abrasion- The coated components, or witness piece, shall be subjected to a severe abrasion by rubbing the coated surface with a standard eraser conforming to MIL-E-12397 mounted in an eraser abrasion coating tester that conforms to the requirements of Drawing D7680606. The eraser shall be rubbed across the surface of the component, or witness piece, from one point to another over the same path for 20 complete cycles (40 strokes) with a force of 2.0 to 2.5 pounds continuously applied. The length of the stroke shall be approximately equal to 3 diameters of the eraser when the diameter or area of the component, or witness piece, permits. The eraser abrasion tester shall be held approximately normal to the surface under test during the rubbing operation. Subsequent to the rubbing operation the component or witness piece, shall be cleaned (See 4.5.1), dried and then subjected to the examination specified in 4.5.3.1 for evidence of physical damage to the coating. The film coating on the component, or witness, shall meet the requirements of 3.8.4.1.

4.5.11 Moderate abrasion- The coated component shall be subjected to a moderate abrasion by rubbing the coated surface with a 1/4 inch (6.4MM) thick by 3/8 inch (9.5MM) wide pad of clean dry, laundered cheesecloth conforming the CCC-C-440 affixed to the tester specified in 4.5.10. The cheesecloth pad shall completely cover the eraser portion of the tester and be secured to the shaft with an elastic band. The cheesecloth pad shall be rubbed across the surface component from one point to another over the same path for 25 complete cycles (50 strokes) with a minimum force o 1.0 (0.45kg) pound continuously applied). The length of the stroke shall be approximately equal to two diameters of the cheesecloth pad when the diameter or area of the component permits. The abrasion tester shall be held approximately normal to the surface under test during the dubbing operation. Subsequent to the rubbing operation the component shall be cleaned (See 4.5.1), dried and then subjected to the examination specified in 4.5.3.1 for evidence of physical damage to the coating. The film coating on the component shall meet the requirements of 3.8.4.2.

NOTE: Where the Knoop hardness of the component is unknown it shall be subjected to the abrasion test of 4.5.10.

4.5.12 Adhesion.- The coated component shall be subjected to an adhesion test using 1/2" (12.7MM) wide cellophane tape conforming to Type I of L-T-90. Press the adhesive surface of the cellophane tape firmly against the coated surface so as to cover the stained area, then quickly remove it at an angle which is normal to the coated surface. Immediately following the removal of the adhesive tape, the coated surface of the component shall be evaluated as specified in 4.5.3.1 for evidence of coating removal. The film coating on the component shall meet the requirements of 3.8.5.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

6.1 Intended use.- The magnesium fluoride coating covered by this specification is applied to the surface of optical elements to increase light transmission and reduce reflections. The requirements defined by Figures 1 and 2 for transmission difference and maxium reflectance respectively, apply to coatings employed in the visible spectrum. Optical requirements for magnesium fluoride coatings used in ultraviolet or infrared spectral applications must be independently determined and specified.

The durability requirements established in this specification insure a level of quality consistent with military requirements. Additional durability requirements to confirm the suitability of a magnesium fluoride coating in a particular application should be considered when it is established that a coated optical element (coating and substrate) will exhibit the capability to satisfy the additional requirements.

This specification permits certain cosmetic defects, such as stains, on coated optical elements. This requirement is established to permit the acceptance of coated elements where the defect is strictly aesthetic and the optical and durability properties of the coating are not impaired. The attention of optical designers is directed to this requirement for non-focal plane optical as it may be necessary to rescind this requirement on an individual basis when cosmetic defects cannot be tolerated on the optical elements.

6.2 Ordering data.- Purchasers should exercise any desired options offered herein, and procurement documents should specify the following:

a. Title, number and date of this specification.
b. Film thickness requirement (See 3.6).
c. Responsibility for performance of inspection requirements (See 4.1).
d. Mandatory use of coated components for tests (See 4.1.2).
e. Requirement for first article approval (See 4.2, 4.2.1 and 4.2.2).

6.3 Definitions.-

6.3.1 QWOT.- QWOT is the quarter-wave optical thickness defined as

$$QWOT = 4\ nt$$

where n is the refractive index of the coating
t is the physical thickness of the coating

The QWOT has the dimension of length and is usually expressed as micrometers (um) and nanometers (nm). Thus if a layer has a QWOT of 550 um, this means that one-quarter wavelength of light at 550 um has the same length as the optical thickness of the layer.

6.3.2 Standard measuring equipment (SME).- Standard measuring equipment is defined as the common measuring devices which are usually stocked by commercial supply houses for ready supply (shaft items) and which are normally used by an inspector to perform dimensional inspection of items under procurement. This category also includes commercial testing equipment such as meters, optical comparators, etc.

6.4 Coating quality comparison standard, optical element, Drawing No D7680600.- When component inspection documents identify the comparison standard for use in the inspection of coating quality, it will be utilized as an auxiliary inspection aid to evaluate film coating thickness on lenses and components with curved surfaces. Its use shall be restricted to evaluating QWOT magnesium coatings (single layer) on components having refractive indicies compatible to the coating standard. The evaluation consists of making a color comparison of the coated component to the applicable comparision standard by reflecting an image of a standard white fluourescent lamp off the standard and component. The coating comparison standard is a visual inspection aid for coated lenses, and as such is not to be used as a substitute for the film thickness test specified in 4.5.5.

Custodians:
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Project No. 6650-0103

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3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.