

MIL-C-48497A
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~~SUPERSEDING~~
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MILITARY SPECIFICATION

COATING, SINGLE OR MULTILAYER, INTERFERENCE: DURABILITY REQUIREMENTS FOR

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

1. SCOPE

1.1 Scope. This specification establishes minimum quality and durability requirements for single layer and multilayer interference coatings that are primarily used within the protective confines of sealed optical systems. (See 6.1).

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)
O-A-51	Acetone, Technical
O-E-760	Ethyl Alcohol (ethanol), Denatured Alcohol, and Proprietary Solvent
O-T-634	Trichloroethylene, Technical
CCC-C-440	Cloth, Cheesecloth, Cotton Bleached and Unbleached

Military

MIL-E-12397	Eraser, Rubber Pumice, for Testing Coated Optical Elements
MIL-E-13830	Optical Components for Fire Control Instruments; General Specification Govern- ing 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.

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STANDARDS

Military

MIL-STD-105	Sampling Procedures 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 Research & Development Command

7641866	Surface Quality Standards for Optical Elements
7680606	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.)

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.

3.2 Coated area. Optical components shall be coated over their entire clear aperture.

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

3.3.1 Physical. The coating shall have no evidence of flaking, peeling, cracking or blistering.

3.3.2 Cosmetic. When specified the coating shall conform to the cosmetic requirements (stains, smears, discolorations, streaks, cloudiness, etc.) stated on the component drawing or other documents.

3.3.3 Environmental and solubility blemishes. The coated surface shall be free of blemishes such as stains, smears, discolorations, streaks, cloudiness, etc., that would cause non-conformance to the coating's spectral requirements as stated on the component drawing or other documents.

3.3.4 Spatter and holes. Coating spatter and holes in the coating shall be considered as a dig and shall not exceed the allowable dig size and quantity stated on the component drawing or other documents.

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3.3.5 Surface defects (scratch and dig). Coating scratches and digs shall not exceed the values specified for the substrate on the component drawing or other documents. Coating scratches and digs shall be considered separate from the substrate scratch and dig requirements.

3.3.5.1 Transparent coated surfaces. Scratch and dig requirements for transparent coated surface shall be specified by two (2) numbers separated by a hyphen (i.e. 60-40) in accordance with MIL-O-13830.

3.3.5.2 Opaque coated surfaces. Scratch and dig requirements for opaque coated surfaces shall be specified by two letters separated by a hyphen (i.e. F-C). The first letter of the pair is the maximum scratch value; the second letter is the maximum dig value.

3.3.5.2.1 Scratches. The scratch letter defines the width of the scratch in accordance with the following table:

<u>SCRATCH LETTER</u>	<u>SCRATCH WIDTH(MICRONS)</u>	<u>SCRATCH WIDTH (INCHES)</u>
A	5	.00020
B	10	.00039
C	20	.00079
D	40	.00157
E	60	.00236
F	80	.00315
G	120	.00472

3.3.5.2.1.1 Density of maximum size scratches. The accumulated length of all maximum size scratches present shall not exceed 1/4 the average diameter of the coated surface.

3.3.5.2.1.2 Density of all scratches. When a maximum size scratch is present, the sum of the products of the widths designated by the scratch letters times the ratio of their length to the diameter of the coated surface shall not exceed one half the width specified by the scratch letter. When a maximum size scratch is not present, the sum of the products of the widths designated by the scratch letters times the ratio of their length to the diameter of the coated surface shall not exceed the width specified by the scratch letter.

3.3.5.2.2 Digs. The dig letter specifies the average diameter of the dig in accordance with the following table:

<u>DIG LETTER</u>	<u>DIAMETER (MM)</u>	<u>DIAMETER (INCHES)</u>
A	0.05	.0020
B	0.10	.0039
C	0.20	.0079
D	0.30	.0118
E	0.40	.0158
F	0.50	.0197
G	0.70	.0276
H	1.00	0.394

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The permissible number of maximum size digs shall not exceed one per each 20 millimeters of (.80 inches) diameter or fraction thereof on any single coated surface. The sum of the diameters of all digs shall not exceed twice the diameter of the maximum size specified by the dig letter per 20 millimeters of diameter.

3.4 Coating durability.

3.4.1 Environmental and pyhsical durability. The coated optical surface shall meet the following service conditions in the order specified:

3.4.1.1 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 the the coated surface.

3.4.1.2 Humidity. After exposure in an atmosphere of $120^{\circ} \pm 4^{\circ}\text{F}$ and 95 to 100% relative humidity, the coated optical surface shall meet the requirements of 3.3.1 and 3.3.3.

3.4.1.3 Moderate abrasion. The coated optical surface shall show no signs of deterioration such as streaks or scratches when abraded with a dry, clean cheesecloth pad.

3.4.2 Thermal and cleaning durability. The coated optical surface shall meet the following conditions:

3.4.2.1 Temperature. The coated optical surface shall be exposed to temperatures of -80°F and $+160^{\circ}\text{F}$ for 2 hours at each temperature. The rate of temperature change shall not exceed 4°F per minute. Subsequent to these exposures, the coated optical surface shall meet the requirements of 3.3.1 and 3.4.1.1.

3.4.2.2 Solubility and cleanability. After immersion in trichloroethylene, acetone and ethyl alcohol and wiping with cheesecloth, the coated optical surface shall show no evidence of coating removal or scratches and shall meet the requirements of 3.3.1 and 3.3.3.

3.4.3 Optical durability requirements. When specified on the component drawing or other documents (See 6.2) the following requirements shall be added or substituted:

3.4.3.1 Severe abrasion. Abrasion by an eraser conforming to MIL-E-12397 shall not cause deterioration such as streaks or scratches on the coated optical surface.

3.4.3.2 Salt solubility. After immersion in a saline solution, the coated optical surafce shall meet the requirements of 3.3.1 and 3.3.3.

3.4.3.3 Water solubility. After immersion in distilled water, the coated surface shall meet the requirements of 3.3.1 and 3.3.3.

3.5 Optical. The coated component shall conform to the pertinent optical requirements specified on the component drawing or other documents (See 6.2).

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, 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 & 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 6.4). The Government reserves the right to test the actual coated component with the same test to which the witness pieces were subjected. Should a component fail, even though the witness pieces pass the test, the lot shall be rejected.

4.1.3 Characteristics of the witness piece. When 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 have the same refractive index and absorption coefficient as the components to be coated.

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

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

d. Where transmission characteristics are required 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.

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4.2 First article (initial production) approval. The requirement for first article approval and the responsibility (government or contractors) 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 consists of five (5) coated components plus ten (10) coated witness pieces (See 4.1.2 and 4.1.3). The 5 coated componets shall be tested, as specified herein, for all the requirements of 3.2, 3.3.1, 3.3.2, 3.3.4 and 3.3.5. Five coated witness pieces shall be tested, as specified herein, for all the requirements of 3.4.1 and 3.5. The other 5 coated witness pieces shall be tested as specified herein for all the requirements of 3.4.2 and 3.5. The government reserves the right to subject the coated components to all the tests specified here. The sample shall be coated in the same manner, using the same materials, equipment, processes, and procedures as used in regular production. All parts and materials including packaging 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 contactor 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 hour or 10 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 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 and subassemblies. All coated componets and sub-assemblies shall be inspected in accordance with this specification and

the inspection provisions contained in Supplementary Quality Assurance Provisions (SQAP) listed in the Technical Data Package (TDP). Examination and tests related to Section 3 herein shall be performed on a class basis in accordance with MIL-STD-105 and the sampling plans specified in Tables I and II herein. The tabulated classification of defects in Tables 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 FOR COMPONENTS

<u>CLASS</u>	<u>CHARACTERISTIC</u>	<u>REQUIREMENT</u>	<u>TEST PROCEDURE</u>
<u>CRITICAL:</u>	<u>NONE DEFINED</u>		
<u>MAJOR:</u>	<u>AQL 1.0%</u>		
101.	Coated area	3.2	4.5.1
102.	Coating quality, physical	3.3.1	4.5.2.1
103.	Coating quality, cosmetic	3.3.2	4.5.2.2
104.	Coating quality, spatter & holes	3.3.4	4.5.2.4
105.	Coating quality, scratch & dig	3.3.5	4.5.2.5
<u>MINOR:</u>	<u>NONE DEFINED</u>		

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

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

4.3.2.3 Special sampling.

4.3.2.3.1 Environmental and physical durability. A minimum of one (1) coated witness piece (or one (1) coated component, when required) shall be selected from each evaporation lot to form a minimum of five (5) samples for each inspection lot. The samples shall meet the requirements and tests in Table II.

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TABLE II - ENVIRONMENTAL & PHYSICAL DURABILITY

<u>NO.</u>	<u>CHARACTERISTIC</u>	<u>REQUIREMENT</u>	<u>TEST PROCEDURE</u>
301.	Adhesion	3.4.11	4.5.3.1
302.	Coating quality, physical (post humidity)	3.4.1.2, 3.3.1	4.5.3.2, 4.5.2.1
303.	Coating quality, blemishes (post humidity)	3.4.1.2, 3.3.3	4.5.3.2, 4.5.2.3
304.	Moderate abrasion	3.4.1.3	4.5.3.3
305.	Optical	3.5	4.5.6

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

4.3.2.3.2 Failure of sample. Should any one item of a special sampling fail to meet the specified test requirements, acceptance of the represented inspection lot shall be suspended by the Government until necessary corrections have been made by the contractor and the resubmitted items have 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 equipment 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 non-conforming. Construction shall be such as to facilitate routine calibration of test equipment.

4.5 Test methods and procedures.

4.5.1 Coated area. The coated area of the component or subassembly shall be examined with standard measuring equipment (See 6.4). The coated area shall conform to the requirements of 3.2.

4.5.2 Coating quality.

4.5.2.1 Physical. The coating 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. The coated surface shall be viewed against a black matte background. The only illumination in the test area shall be from the light source used for testing. This method of examination is as depicted in Figure 1. The coating shall conform to the requirements of 3.3.1.

4.5.2.2 Cosmetic. The coated component shall be examined using the test method specified in 4.5.2.1 for evidence of discoloration, stains, smears, streaks, cloudiness, etc. The coating shall conform to the requirements of 3.3.2.

4.5.2.3 Environmental and solubility blemishes. The coated witness samples (or coated components, when required) shall be examined using the test method specified in 4.5.2.1 for evidence of discoloration, stains, smears, streaks, cloudiness, etc. The coating shall conform to the requirements of 3.3.3. When evidence of blemishes is found, the blemished area shall be examined (See 4.5.6) for compliance to the spectral requirements specified on the component drawing.

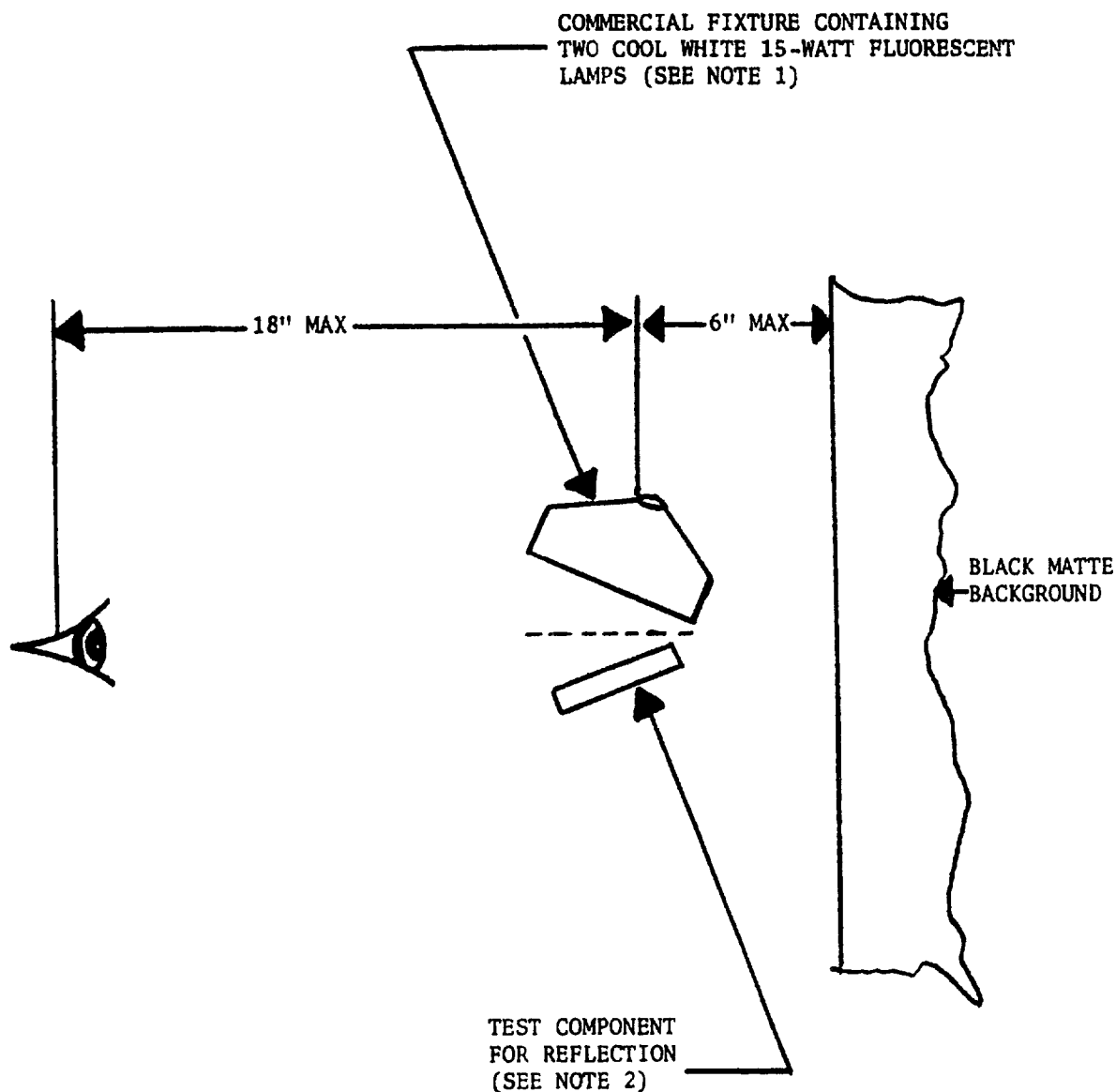
4.5.2.4 Spatter and holes. The coated components shall be examined for dig size and quantity using the applicable test method specified in 4.5.2.5. The coating shall conform to the requirements of 3.3.4.

4.5.2.5 Surface defects (scratch and dig).

4.5.2.5.1 Transparent coated surfaces. Transparent coated surfaces shall be examined utilizing the technique specified in 4.5.2.1, except that (hole) in the coating shall be evaluated by comparison with the Surface Quality Standards for Optical Elements (scratch & dig) Drawing 7641866. The visual appearance of the scratch, and the diameter of the digs in the coating shall conform to the requirements of 3.3.5.1. The lengths and density of all scratches, and the diameters and density of all digs shall conform to the requirements of MIL-O-13830.

4.5.2.5.2 Opaque coated surfaces. Opaque coated surfaces shall be examined utilizing the lumination, reflection and viewing background technique specified in 4.5.2.1. The length and width of scratches, and the dig (hole) diameters shall be determined by use of interferometry, microscopic measuring

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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 1

devices, calibrated precision comparators, or similar applicable precision measuring devices. The width, length and density of all scratches in the coating shall conform to the requirements of 3.3.5.2. The diameter and density of all digs (holes) in the coating shall conform to the requirements of 3.3.5.2.

4.5.3 Environmental physical durability tests. The coated components or witness samples shall withstand exposure to the following test conditions:

4.5.3.1 Adhesion. The coated component or witness samples shall be subjected to an adhesion test using 1/2" wide cellophane tape conforming to Type I of L-T-90. Press the adhesive surface of the cellophane tape firmly against the coated surface and quickly remove at an angle normal to the coated surface. A visual inspection shall be made for conformance to 3.4.1.1. Subsequent to this test, the coated component or witness sample shall be subjected to the test of 4.5.3.2.

4.5.3.2 Humidity. The coated components or witness samples shall be placed into an environmentally controlled test chamber and exposed to a temperature of 120°F and 95% to 100% relative humidity. The coating shall be exposed for a minimum of 24 hours. Subsequent to this exposure, the coating shall be cleaned and evaluated for conformance to 3.3.1 and 3.3.3. The coated component or witness sample shall then be subjected to the test specified in 4.5.3.3.

4.5.3.3 Moderate abrasion. Within one hour after the humidity test of 4.5.3.2, the coated component or witness sample shall be subjected to a moderate abrasion test. It shall consist of rubbing a minimum of 50 strokes across the surface in straight lines. The abrader shall be a 1/4" thick by 3/8" wide pad of clean dry, laundered cheesecloth conforming to CCC-C-440. The bearing force shall be a minimum of 1 pound and shall be applied approximately normal to the coated surface. The actual test apparatus shall be the Eraser Abrasion Coating Tester of Drawing 7680606 except that the eraser portion shall be completely covered with cheesecloth and the cheesecloth shall be secured to the shaft of the tester with an elastic band. Subsequent to this test, the coating shall be evaluated for conformance to 3.4.1.3. Following the tests of 4.5.3.1, 4.5.3.2 and 4.5.3.3 the coated component or witness sample shall be evaluated for conformance to the provisions of 4.5.6.

4.5.4 Thermal and cleaning durability. The witness samples shall withstand exposure to the following test conditions:

4.5.4.1 Temperature. The witness samples shall be subjected to temperatures of $-80^{\circ}\text{F} \pm 2^{\circ}\text{F}$ and $+160^{\circ}\text{F} \pm 2^{\circ}\text{F}$ for a period of 2 hours at each temperature. After each exposure the coated components or witness samples shall be stabilized at an ambient temperature between $+60^{\circ}$ and $+90^{\circ}\text{F}$ and subjected to the test specified in 4.5.3.1. Subsequent to this test, the coating shall be evaluated for conformance to 3.4.1.3 and 3.3.1. The rate of temperature change between any two temperature levels shall not exceed 4°F per minute.

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4.5.4.2 Solubility and cleanability. The witness samples shall be immersed, in sequence, in the following solutions maintained at room temperature (+60° to +90°F): trichloroethylene conforming to O-T-634; acetone conforming to O-A-51; and ethyl alcohol conforming to O-E-760. The immersion time in each solution shall be a minimum of ten minutes. Upon removal from each solution, the solvent shall be allowed to evaporate to dryness without wiping or forced drying before proceeding to the next solution. Upon removal from the alcohol solution, and after drying any resultant stains on the coated surface shall be removed by wiping the coating to a clean, stain-free condition with an ethyl-alcohol-mositened cheesecloth. Subsequent to this cleaning, the coating shall be evaluated for conformance to 3.4.2.2, 3.3.1, 3.3.3 and 3.5.

4.5.5 Optional durability tests. The coated componets or witness samples shall withstand exposure to the following test conditions when specified in the contract, purchase order or on the componet drawing. (See 6.2).

4.5.5.1 Severe abrasion. The coated componets or witness samples shall be subjected to a severe abrasion, rubbing the coated surface with a standard eraser conforming to MIL-E-12397 mounted in the Eraser Abrasion Coating Tester of Drawing 7680606. The bearing force shall be between 2 and 2 1/2 lbs. Applied approximately normal to the coated surface. A total of 20 strokes shall be made along a straight line path. Subsequent to this test the coating shall be evaluated for conformance to 3.4.3.1 and then subjected to the test specified in 4.5.3.

4.5.5.2 Salt solubility. The coated components or witness samples shall be immersed for a period of 24 hours in a solution of water and sodium chloride (salt). The mixture shall be 6 ounces of salt per gallon of water at room temperature (+60 to +90°F). Subsequent to this immersion, the coated componets or witness samples shall be removed from the solution, dried with clean, laundered, cheesecloth, and then evaluated for conformance to 3.3.1 and 3.3.3.

4.5.5.3 Water solubility. The coated componets or witness samples shall be immersed for a period of 24 hours in distilled water at room temperature (+60°F to +90°F). Subsequent to this immersion, the coated componets or witness samples shall be removed from the solution, dried with clean laundered cheesecloth, and then evaluated for conformance to 3.3.1 and 3.3.3.

4.5.6 Optical. Appropriate optical instruments such as spectrophotometers, radiometers, etc. shall be used to test conformance to the optical requirements of 3.5.

5. PACKAGING

This section is not applicable to this specification.

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6. NOTES

6.1 Intended use. This specification establishes minimum quality and durability requirements for single or multi-layer interference coatings applied to components in optical systems. It is applicable to coatings utilized on a wide variety of substrate materials for such items as lenses, prisms, mirrors, beam splitters, reticles, laser elements, windows, filters, etc.

Coatings produced to the requirements of this specification may be exposed without damage to those handling and cleaning procedures associated with optical instrument assembly practice and will generally be employed within the protective confines of a sealed instrument.

Certain applications may necessitate the use of additional or expanded quality and durability requirements, some of which are included within the optical durability section of this specification. (See 3.4.3). Other quality and durability requirements with the appropriate test methods must be defined when they are applicable. All additional requirements must be specified on the applicable drawing or other documents. Examples of coating applications where additional requirements must be specified include laser systems where resistance to laser energy damage is necessary; also when coatings are used outside the confines of a sealed instrument, resistance to such environments as salt fog, fungus, extended humidity, etc. may be necessary.

This specification is not intended as a substitute for other coating specifications, e.g., MIL-C-675, MIL-C-14806, etc. It is intended that this specification provide the durability requirements for coating applications not covered by other documents and in some cases to serve as a supplement, by reference, in other coating specifications.

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. Optional abrasion, salt solubility, and water solubility requirements (see 3.4.3 and 4.5.5)
- c. Optical requirements of coating (See 3.5)
- d. Responsibility for performance of inspection requirements (See 4.1)
- e. Mandatory use of coated components for tests (See 4.1.2)
- f. Requirement for first article approval (See 4.2, 4.2.1 and 4.2.2)

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6.3 First article sample. When the government is responsible for conducting first article approval tests the required article sample specified in 4.2 shall be forwarded to:

Commander
US Army Armament Research & Development Command
ATTN: DRDAR-QAF
Dover, NJ 07801

6.4 Definitions.

6.4.1 Evaporation lot. An evaporation lot is defined as the group of parts which has the coating applied at the same time and in the same chamber.

6.4.2 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 (shelf 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.

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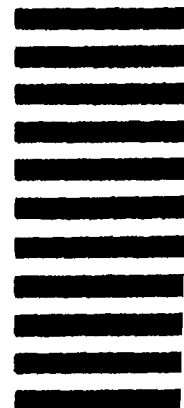
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