

INCH-POUND

MIL-F-62422A(AT)

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SUPERCEDING

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MILITARY SPECIFICATION  
FILTER, LASER HAZARD PROTECTION

This specification is approved for use by the U.S. Army Tank-Automotive Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers laser hazard filters used in unity vision devices.

1.2 Classification. Filters shall be a hybrid filter consisting of laser absorbing glass substrate with a .694 micron blocking multilayer interference filter coating. This specification replaces MIL-F-62543 for filters classified as Category XI only.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issue of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

Military

MIL-G-174 Glass, Optical

MIL-O-13830 Optical Components for Fire Control Instruments;  
General

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Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-Automotive Command, ATTN: AMSTA-GDS, Warren, MI 48397-5000, by using the self-addressed Standardization Document Improvement Proposal Form (DD 1426) appearing at the end of this document.

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THIS DOCUMENT CONTAINS 16 PAGES.

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- MIL-F-13926 Specification Governing the Manufacture, Assembly, & Inspection of Fire Control Parts for Fire Control Instruments: Care of
- MIL-P-14232 Parts, Equipment and Tools for Army Material, Packing of
- MIL-I-45607 Inspection Equipment, Acquisition, Disposition and Maintenance of
- MIL-C-48497 Coating, Single or Multilayer, Interference: Durability Requirements for

## STANDARDS

## Military

- MIL-STD-109 Quality Assurance Terms and Definitions
- MIL-STD-810 Environmental Test Methods and Engineering Guidelines
- MIL-STD-45662 Calibration System Requirements

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect of the date of the solicitation.

- |   |   |
|---|---|
| Dwg. no. 12357797   | Filter  |
| Dwg. no. 12357801   | Filter  |
| Dwg. no. 12357857   | Filter  |
| TB MED 524  | Control of Hazards to Health from Laser Radiation |
| AEHA Nonionizing Radiation Protection Study 25-42-0434-86 |   |

(Copies of specifications, standards, handbooks, drawings, publications, and other Government documents required by the contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DOD adopted shall be the issue listed in the current DODISS and the supplement thereto, if applicable.

## AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

- ASTM E308-85 Computing the Colors of Objects Using the CIE System
- ASTM D-1003 Haze And Luminous Transmittance Of Transparent Plastics

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(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103)

2.3 Order of precedence. In the event of a conflict between this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede application laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

3.1 Qualification. Filters furnished under this specification shall be products which have been tested, and passed the qualification tests listed herein.

3.1.1 First article. When specified in the contract or purchase order (see 6.2), samples shall be submitted for first article inspection in accordance with 4.3.

3.2 Materials. Materials shall be in accordance with applicable drawings and specifications forming a part of this specification.

3.2.1 Glass. Glass used as an absorbing substrate shall be class 2, grade C, tempered glass laser filter, heat-absorbing type, ionically colored, per MIL-G-174 (Hoya LP-15, Isuzu ISK-167, Schott KG-3 or equivalent). Tempered glass shall withstand 3 impacts of a 16 gram ball dropped from a height of 127 centimeters on edge supported glass.

3.3 Construction. The filter shall be manufactured in accordance with drawings 12357797, 12357801 and 12357857.

### 3.4 Environmental.

3.4.1 Weathering. Filters shall evidence no delamination or other physical deterioration when exposed to an irradiance level of  $1120 \text{ W/m}^2$  ( $355 \text{ Btu/ft}^2/\text{h}$ ), per MIL-STD-810, Method 505, Procedure II for five 24-hour cycles and shall subsequently meet the requirements of paragraphs 3.5.1 through 3.5.8 of this document (see 4.5.3).

### 3.5 Optical characteristics.

3.5.1 Optical density. The optical density of the filter shall be equal to or greater than the value specified in Table I for all angles specified and for incident radiation in both "P" and "S" polarization states (see 4.6.2).

TABLE I		Optical Density	
.	Wavelength	O.D. with Angle	unity device
.	(nm)	(0 to 80)+/-1.5 DEG	w/filter
. A	. 694	. 3.4	. 3.5
. B	. 1048-1068	. 3.4	. 3.5
. C	. 1064	. 3.4	. 3.5

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3.5.1.1 Ruby coating characterization. The ruby blocking coating shall be spectrally characterized from 680 nm to 880nm and shall have an optical density equal to or greater than 2 from 680 nm to 880 nm (see 4.6.3).

3.5.2 Photopic transmission. The photopic transmission of the filter shall be at least 65 percent at an angle of incidence of  $0 \pm 1.5$  degrees and at least 40 percent at angles of incidence up to  $50 \pm 1.5$  degrees (see 4.6.4).

3.5.3 Chromaticity. The transmission spectrum of the filter at  $0 \pm 1.5$  degrees shall have chromaticity coordinates (x,y) that fall within the chromaticity curve, defined in ASTM E308-85, and the region bounded by the rectangle whose coordinates shall be: x,  $0.423 \pm 0.030$ ; and y,  $0.433 \pm 0.030$  (see 4.6.5).

3.5.4 Resolution. The resolution of the test pattern, described and constructed per para. 4.2.5 of MIL-O-13830, through the filter shall be less than one minute of arc (see 4.6.6).

3.5.5 Filter coating durability. The coating shall pass all the requirements herein after testing per MIL-C-48497 for adhesion, humidity, severe abrasion and paragraphs 3.3.1 and 3.3.3 of MIL-C-48497 for coating quality (see 4.6.7).

#### 3.5.6 Surface quality.

3.5.6.1 Substrate. The filter substrate shall not exceed a surface quality of 80 - 50 per table I of MIL-O-13830, paragraphs 3.5.2 and 3.5.3, except that the maximum bubble/inclusion diameter shall be 1 mm, and the minimum bubble/inclusion separation shall be 20 mm (see 4.6.8).

3.5.6.2 Coating. Coating scratches and digs shall not exceed the values specified for the substrate. Coating scratches and digs shall be considered separate from the substrate scratch and dig requirements (see 4.6.8).

3.5.7 Laser damage resistance. Filters shall exhibit no delamination or other physical deterioration when exposed to laser radiation (see 4.6.9).

3.5.8 Temperature stability. Filters shall meet the requirements of row A in Table I when exposed to  $-40 \pm 5$  degrees F to  $+140 \pm 5$  degrees F (see 4.6.10).

#### 4. QUALITY ASSURANCE PROVISIONS AND TEST REQUIREMENTS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order (see 6.2), the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order (see 6.2), 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 necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspections set forth in this specification shall become

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a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

4.1.3 Classification of tests - The inspection requirements specified herein are classified as follows:

- a. Certification tests (see 4.2).
- b. First Article tests (see 4.3).
- c. Quality conformance inspection (see 4.4.1).
- d. Control tests (see 4.4.2)
- e. Inspection of packaging (see 4.5.2).

4.2 Certification Test. The contractor shall submit six (6) samples for certification tests. Certification tests shall consist of tests for all the requirements of this specification. All items delivered to the government shall be accompanied by:

- a. A certification that the construction, materials and workmanship used in fabrication of the six items are representative of the production items to be offered under contract.
- b. The results obtained for the test performed along with a list of all test equipment utilized to perform the required inspections and tests.
- c. A written description of the Quality Assurance system used in the manufacturer's normal operations.
- d. A summary of operations and tests performed on subcontract, and identification of the subcontractor.

4.2.1 Certification Approval. Potential suppliers who have submitted the required items for certification testing will be approved as sources for this specification at such time as the specimens have successfully passed all the required tests in a Government laboratory or at contractor facilities, and witnessed by Government representatives. Failure to meet all of these requirements will result in failure to obtain certification approval. Certification items will be accepted for retest upon presentation of satisfactory evidence that deficiencies have been corrected. The Government reserves the right to conduct such on-site inspections on the potential suppliers premises as may be deemed necessary to insure that the manufacturing processes and quality control measures used in fabrication of the specimens are indicative of the quality of the item expected in production.

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4.2.2 Retention of Certification. Two (2) years from the date of last notification of certification approval, unless otherwise directed by the certifying activity, suppliers shall submit six (6) representative samples (see 4.2 herein) for recertification. Failure of the samples to meet all the required tests shall be cause for removal of certification. Manufacturers producing hazard filters within two years of the last certification are not required to be recertified.

4.3 First Article Tests (pre-production) - Unless otherwise specified in the Contract or purchase order (see 6.2), the contractor is responsible for conducting first article tests as specified in Table II. Failure of any filter to pass any of the inspections or tests shall be cause for rejection. Three filters of each type shall be inspected and tested to determine that the supplier's production methods are capable of yielding items that comply with the technical requirements of this specification. The samples and records of the inspections and tests, including certificates of conformance for materials, shall be submitted to the Government for approval. The Government reserves the right to witness all the contractor's inspections and tests.

4.3.1 First article inspection failure. Deficiencies found during, or as a result of, the first article inspection shall be cause for rejection of the first article sample until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiency. Any deficiency found during, or as a result of, first article inspection shall be evidence that all items already produced prior to completion of the first article test are similarly deficient unless contrary evidence satisfactory to the contracting officer is furnished by the contractor. The Government will not accept products until first article inspection is completed to the satisfaction of the Government.

#### 4.4 Examinations and tests

4.4.1 Quality conformance inspection - The quality conformance inspection (QCI) shall consist of the examinations of 4.4.1.4 and the tests of 4.4.1.5. Noncompliance with any of the specified requirements in sections 3 and 5 shall be cause for rejection.

4.4.1.1 Sampling inspection - Unless otherwise specified (see 6.2), the sampling plan specified herein shall be used.

4.4.1.2 Lot formation - An inspection lot shall consist of all filters of the same category made from the same production batch (manufactured under essentially the same conditions and at essentially the same time), submitted at the same time for acceptance.

4.4.1.3 Sample - The sample for QCI examinations and tests shall be randomly selected from the inspection lot in accordance with Table IV.

4.4.1.4 QCI examinations - Filters shall be examined for the characteristics specified in Tables II and III. Unless otherwise specified (see 6.2), sample in accordance with Table IV. The acceptance number in all cases is zero.

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4.4.1.4.1 QCI failure - Any item that fails to conform to any specified requirement shall be rejected; any failure (one or more) of the selected sample in either the Major/Minor categories or test for the appropriate inspection lot size shall constitute a failure of the entire lot. The rejected item(s) may be repaired or corrected and resubmitted for inspection. If the contractor utilizes sampling inspection as an element of his inspection system, rejected inspected lots may be resubmitted for acceptance if the contractor performs 100 percent inspection on the lot for those characteristics which were defective and resulted in rejection of the lot and removes all defective units or obtains procuring activity approval to resample the lot due to the insignificance of the defects. Resubmitted lots shall be kept separate from new lots and shall be clearly identified as resubmitted lots.

4.4.1.5 QCI tests (100%) - Each filter shall be subjected to the QCI tests specified in Table II.

4.4.1.5.1 Test failure - Failure of the item to pass the QCI tests shall be cause for the Government to refuse acceptance of the item. Any item containing one or more defects either shall not be submitted for Government acceptance or shall be corrected and re-examined or retested and resubmitted without defects for Government acceptance. Resubmitted items shall be kept separate from new items, and shall be clearly identified as resubmitted items.

4.4.2 Control tests - Control tests shall be conducted on one filter per chamber load unless otherwise specified. The filter(s) shall be subjected to the control tests specified in Table II.

4.4.2.1 Control test failure - Failure of any filter to pass any of the specified control tests shall be cause for the Government to refuse acceptance of the production quantity represented, until action taken by the contractor to correct defects and prevent recurrence has been approved by the Government. If a sample fails to pass Group B inspection, the contractor shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, and on all units of product which can be corrected and which are manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity has been taken. After the corrective action has been taken, Group B inspection (all tests and examinations, or the test which the original sample failed, at the option of the qualifying activity) shall be repeated on additional sample units (the number of samples shall be approved by the qualifying activity). Final acceptance and shipment shall be withheld until the Group B inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

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4.4.3 Table II - Classification of Inspections

<u>Title</u>	<u>Requirements</u>	<u>Inspection</u>	<u>First Article</u>	<u>OCT Exam Tests</u>	<u>Control Tests</u>
<u>Group A</u>					
Materials, Design, Construction	3.2, 3.3	4.5.1	X	X	
<u>Group B</u> (Performance)					
Optical Density FAT	3.5.1	4.6.2.1	X		
Optical Density	3.5.1	4.6.2.2	X	X	
Optical Density Scan	3.5.1	4.6.2.3	X		X
Ruby Coating Characterization	3.5.1.1	4.6.3	X		X
Photopic Transmission	3.5.2	4.6.4	X	X	
Chromaticity	3.5.3	4.6.5	X	X	
Resolution	3.5.4	4.6.6	X	X	
Filter Coating Durability	3.5.5	4.6.7	X		X
Surface Quality	3.5.6	4.6.8	X	X	
Laser Damage Resistance	3.5.7	4.6.9	X		
Temperature Stability	3.5.8	4.6.10	X		X
<u>Group C</u> (Environmental)					
Weathering	3.4.1	4.5.3	X		
<u>Group D</u> (Packaging)					
	5.2	4.5.2	X	X	

4.4.3.1 Table III - Classification of Defects  
(note: SIE - Standard Inspection Equipment)

<u>Category</u>	<u>Defect</u>	<u>Method of Inspection</u>
<u>Critical</u>		
001	Optical density not as specified (see 3.5.1)	SIE
<u>Major</u>		
101	Materials not as specified (see 3.2).	Visual
102	Dimensions and tolerances, cleanliness, and workmanship not as specified (see 3.3).	Visual and SIE
103	Photopic Transmission not as specified (see 3.5.2).	Visual and SIE
104	Chromaticity not as specified (see 3.5.3).	Visual and SIE
105	Resolution not as specified (see 3.5.4).	Visual and SIE
106	Surface Quality not as specified (see 3.5.6).	Visual and SIE
<u>Minor</u>		
201	Packaging not as specified (see 5.2).	Visual

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4.4.3.2 Table IV - Sampling plan for OCI.  
(NON-MAJOR ITEM)

OCI sampling plan			
Inspection lot size	Sample size		
	Examination		Test (100%)
	Major	Minor	Critical
2 to 8	*	5	*
9 to 15	13	5	*
16 to 25	13	5	*
26 to 50	13	5	*
51 to 90	13	7	*
91 to 150	13	11	*
151 to 280	20	13	*
281 to 500	29	16	*
501 to 1200	34	19	*
1201 to 3200	42	23	*
3201 to 10000	50	29	*
10001 to 35000	60	35	*
35001 to 150000	74	40	*
150001 to 500000	90	40	*
500001 and over	102	40	*

\* Indicates entire lot must be inspected (100% inspection)

4.4.4 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.

4.4.5 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.

4.4.6 Contractor furnished inspection equipment

4.4.6.1 Government design - All inspection equipment specified by drawing number, specification or Quality Assurance Provision forming a part of the contract shall be supplied by the contractor.

4.4.6.2 Contractor equipment - The contractor shall supply inspection equipment compatible with the "Test Methods and Procedures" specified in 4.6 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,

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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 Examinations

4.5.1 Visual and dimensional examination - Filters shall be visually and dimensionally examined for completeness of manufacture, freedom from defects other than optical quality defects, proper item identification conformance to applicable drawings and specifications, and workmanship.

4.5.2 Cleaning, wrapping, packaging, packing and marking examination - Sample filter containers shall be examined to determine whether or not cleaning, wrapping, packaging, packing and marking are in accordance with Section 5.

#### 4.5.3 Environmental

4.5.3.1 Weathering - This test is to be conducted on the First Article samples only. Upon completion of the examinations in 4.5 and the tests in 4.6, the filters shall be subjected to the environmental conditions specified in 3.4.1. A testing cycle in accordance with 3.4.1 shall be submitted to the procuring activity for approval prior to test initiation. After environmental testing, the filters shall show no evidence of physical damage and shall again meet the optical requirements specified in 3.5.

4.6 Test methods and procedures - The calibration of measurement and testing equipment shall be in accordance with MIL-STD-45662. Detector responsivity calibrations (see section 4.6.1.2 of this document) shall be used in all measurements.

#### 4.6.1 Test equipment required

4.6.1.1 Monochromator. The monochromator shall have a nominal half-bandwidth of 5.8 nm or less.

4.6.1.2 Detectors. The spectral responsivity of the detectors shall be known. The detector responsivity versus incident light intensity shall be known for the light ranges appropriate for each measurement.

#### 4.6.2 Optical density measurements

##### 4.6.2.1 Optical density measurement using a laser (First Article) (see 3.5.1)

4.6.2.1.1 Apparatus - National Institute of Standards and Technology (NIST) filters shall be used to calibrate the measurement system for optical densities 2 through 3.5. The detector configuration shall be such that each pulse, in its entirety, is monitored prior to passing through the filter (for example, see Figure 1). Optical density shall be measured for all angles specified and at least 0.50 inches away from any edge. The sample detector will have a signal to noise ratio of 10 or more and will be located at least 200mm from the laser. NOTE: If the system is calibrated for optical densities 2 through 3.5, the optical density of the filter can be inferred by comparing the sample

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detector reading for the calibrated filter to the reading achieved for the filter.

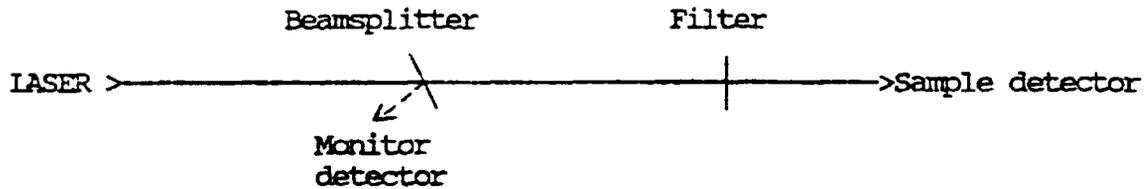


FIGURE 1

4.6.2.1.2 Measurement - This test shall be conducted on the First Article samples. Detector responsivity calibrations are the same as those in Section 4.6.1.2. Each filter shall then be tested at a wavelength of 694 nm (see paragraph 3.5.1) using a linearly polarized laser with a collimated beam diameter of no less than 3 mm. The energy distribution over the area of the laser pulse shall be a gaussian shape. Measurements of the noise level (flash tube pulse but no laser light to the detectors) without the filter in the optical train, shall be a reading recorded as an average of at least 100 pulses. Similarly, readings of the laser pulse energy without the filter in the optical system, and with the filter in the optical system, shall be values recorded as an average of at least 100 pulses. (The value of 100 pulses is used assuming that the minimum value achieved with the filter in the optical train is 1.5 orders of magnitude above the noise level; the contractor shall demonstrate that there is less than 5% drift.) All readings 4.6.2.1.2.2 through 4.6.2.1.2.4 shall be laser energy transmitted through different areas of the filter as shown in paragraph 4.6.6, Figure 2, except that only one center point shall be used. The laser energy incident on the filter shall be "P" polarized (minimum 100:1 ratio of "P" to "S"). The measurements shall be made such that the beam incident energy spreads in the fashion depicted by the rectangles in Figure 2.

4.6.2.1.2.1 Reading 1. The laser energy incident on the filter is measured and must not drift by more than 5% (This can be performed directly or using a calibrated beamsplitter as in Figure 1 and then calculating the energy incident on the filter).

4.6.2.1.2.2 Reading 2. The filter is placed in the beam at two degrees incidence, and the beam energy transmitted through the filter is measured at one center point only and each edge as shown in Figure 2.

4.6.2.1.2.3 Reading 3. The filter is placed at 60 degrees incidence with the polarization vector parallel to the plane of incidence, and the transmitted beam energy is measured at one center point only and each edge as shown in Figure 2.

4.6.2.1.2.4 Reading 4. The filter is placed at 80 degrees incidence with the polarization vector parallel to the plane of incidence, and the transmitted beam energy is measured at one center point only and each edge as shown in Figure 2.

4.6.2.1.3 Calculations

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4.6.2.1.3.1 Optical density at two degrees. For each position and orientation, the value of reading 2 is divided into the value of reading 1. The log (base 10) of this quotient is the optical density of the filter at two degrees.

4.6.2.1.3.2 Optical density at 60 degrees. For each position and orientation, the value of reading 3 is divided into the value of reading 1. The log (base 10) of this quotient is the optical density of the filter at 60 degrees.

4.6.2.1.3.3 Optical density at 80 degrees. For each position and orientation, the value of reading 4 is divided into the value of reading 1. The log (base 10) of this quotient is the optical density of the filter at 80 degrees.

4.6.2.2 Optical density measurement (production) - All filters shall be tested for compliance with row A of Table I (see 3.5.1). Optical density shall be measured at the center of the filter with light incidence angles of  $0 \pm 1.5$  degrees and  $80 \pm 1.5$  degrees. The energy incident on the filter shall be "P" polarized (minimum 100:1 ratio of "P" to "S"). Filters shall be measured using a laser setup as in section 4.6.2.1.1 or a spectroradiometer setup as in section 4.6.4.1. Either system must be calibrated over the optical density range of 2 through 3.5 using NIST calibrated neutral density filters. Variations from either of the two test setups mentioned above must be submitted in a test plan and approved by the Contracting Officer.

#### 4.6.2.2.1 Calculation

4.6.2.2.1.1 Transmission at each wavelength and angle is:

$$T = \frac{\text{Radiance with the filter in the optical train}}{\text{Radiance without filter in optical train}}$$

4.6.2.2.1.2 The optical density is defined as:

$$\text{O.D.} = \log (1/T)$$

4.6.2.3 Optical density scan - A minimum of one sample per manufacturing lot shall be tested for compliance with row A of Table I (see 3.5.1). Optical density shall be measured in 0.5 degree increments (or less) with light incidence angles from  $0 \pm 1.5$  degrees to  $80 \pm 1.5$  degrees. The optical density scan shall be performed at the center of the filter. The energy incident on the filter shall be "P" polarized (minimum 100:1 ratio of "P" to "S"). The optical density shall be measured in 0.5 degree increments (or less) and shall be recorded as either pass or fail. If a failure is detected the optical density shall be recorded for all angles that fail row A of Table I. Filters shall be measured using a laser setup as in section 4.6.2.1.1 or a spectroradiometer setup as in section 4.6.4.1. Either system must be calibrated over the optical density range of 2 through 3.5 using NIST calibrated neutral density filters. Variations from either of the two test setups mentioned above must be submitted in a test plan and approved by the Contracting Officer.

4.6.2.4 Melt certification - The contractor shall validate substrate performance to rows B and C of Table I (see 3.5.1).

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4.6.3 Ruby coating characterization - The spectral transmission from 680 nm to 880 nm shall be measured in 1 nm increments and recorded for a minimum of one sample per lot to verify compliance to 3.5.1.1. See section 4.6.4.1 for apparatus. The system shall be calibrated for optical density of 2 using a NIST calibrated neutral density filter(s).

4.6.4 Photopic transmission (PT) measurement - (see 3.5.2)

4.6.4.1 Apparatus - One of the following systems shall be utilized:

- a. A constant current tungsten lamp  
A monochromator  
A detector
- b. A double beam spectrophotometer
- c. A Pritchard type photometer

The system shall be traceable to the National Institute of Standards and Technology through a calibrated neutral density filter(s).

4.6.4.2 Measurement - The preferred wavelength range for this measurement is 380 nm to 760 nm; any range that includes the range 400 nm to 700 nm is acceptable. The filter is to be illuminated with a tungsten lamp with color temperature 2,854 degrees K (Illuminant A). Photopic transmission shall be derived from multiplying measured spectral transmission data, taken every 10 nm or less, by the photopic luminous efficiency values that make up the standard human eye curve established by the Commission Internationale del'Eclair (CIE) (see ASTM D-1003).

4.6.4.3 Calculation

The photopic transmission (PT) is derived from:

$$X = \int_{380}^{760} E T(w) S(w) V(w) dw \qquad Y = \int_{380}^{760} E S(w) V(w) dw$$

$$P.T. = X/Y$$

where,

E = the mathematical summation symbol  
w = wavelength  
T(w) = Filter transmission characteristics  
S(w) = CIE source A characteristics (1931)  
V(w) = Photopic visibility function (1931)  
dw = 10nm or less Intervals

4.6.5 Color chromaticity measurement - (see 3.5.3)

4.6.5.1 Apparatus - Same as 4.6.4.1.

4.6.5.2 Measurement - The filter is to be illumined with a tungsten lamp with color temperature 2,854 degrees K (Illuminant A). The transmission of the

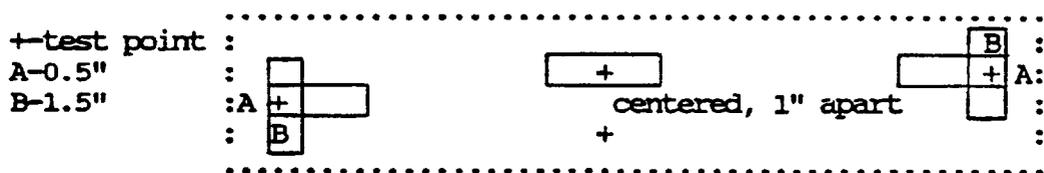
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filter (see section 4.6.4.3) shall have chromaticity coordinates (x,y), as calculated using the 1931 C.I.E. (Commission Internationale del'Eclair) system for color chromaticity coordinates, that meet the requirement given in 3.5.3.

4.6.6 Resolution measurement - (see 3.5.4)4.6.6.1 Apparatus

- a. A dioptometer with at least 3x
- b. A resolving power chart
- c. A holding fixture for the test set

4.6.6.2 Measurement - Using the dioptometer, the target as seen at the exit aperture shall be resolved in each of the four meridians. The test shall be repeated in four regions of the test unit; see Figure 2. The resolution of the test pattern shall be less than one minute of arc.



Note: A & B are distances from the edge

FIGURE 2

4.6.7 Durability measurement - Two filters per chamber load shall be tested for coating durability per MIL-C-48497 in the order specified below. One filter shall be chosen from the upper (or inner) area of the coating zone and one filter shall be chosen from the bottom (or outer) area of the coating zone. Within one hour after performing the humidity test, the optical density of the filters shall be determined in accordance with paragraph 4.6.2.2 herein, except that the optical density shall be measured at one center point and each edge point shown in Figure 2 for light incidence  $0 \pm 1.5$  degrees (see 3.5.5).

Adhesion (Fast tape pull) para 3.4.1.1 of MIL-C-48497

Humidity (24 hours) para 3.4.1.2 of MIL-C-48497

Optical Density para 4.6.2.2

Severe Abrasion para 3.4.3.1 of MIL-C-48497

4.6.8 Surface quality measurement. Filters shall be tested for surface quality per MIL-O-13830, paragraphs 4.2.2.1 or 4.2.2.2, for digs and scratches as defined in paragraphs 3.5.2 and 3.5.3 of MIL-O-13830. Filters shall not exceed a surface quality of 80-50 per table I of MIL-O-13830 (see 3.5.6).

4.6.9 Laser damage resistance. This test is to be conducted on the First Article samples only. Filters shall be tested at each wavelength, energy density, and repetition rate specified in Table V using the corresponding lasers. The energy distribution over the area of the laser pulse shall be a gaussian shape and have a FWHM pulse width of 5-30 nanoseconds. Each test point shown in Figure 2 shall receive a minimum of ten laser pulses. After exposing all test points, the filter shall be illuminated and examined with a 3X minimum magnifier. Any visual damage constitutes failure (see 3.5.7).

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TABLE V Laser Damage Test Parameters

<u>wavelength (nm)</u>	<u>energy density (mJ/cm<sup>2</sup>)</u>	<u>repetition rate (Hz)</u>
694	≥ 500	0.2 ± 10%
1064	≥ 650	2.5 ± 10%

4.6.10 Temperature stability. At least one filter per manufacturing lot shall be tested for compliance to 3.5.8. The filter shall be allowed to stabilize at  $-40 \pm 5$  degrees F for a minimum of six hours and then the optical density shall be measured at the center of the filter for light incidence  $80 \pm 1.5$  degrees as prescribed in section 4.6.2.2. The filter shall then be returned to room temperature ( $70 \pm 10$  degrees F) for a minimum of six hours and then allowed to stabilize at  $+140 \pm 5$  degrees F at a maximum relative humidity of 10% for at least six hours and then the optical density shall be measured at the center of the filter for light incidence  $80 \pm 1.5$  degrees as prescribed in section 4.6.2.2.

## 5. PREPARATION FOR DELIVERY.

5.1 Preservation, packaging, packing and marking. Preservation, packaging, packing and marking for the desired level shall be in accordance with the applicable packaging specified by the contracting authority (see 6.2).

### 5.2 Requirements.

5.2.1 Preservation, Packaging, and Packing. Unless otherwise specified, the method and materials used in preservation, packaging, and packing of the filter shall be specified by the contracting authority.

## 6. NOTES

6.1 Intended use. Filters covered by this specification are intended for use in unity vision devices in combat type vehicles.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number and date of this specification.
- b. The model periscope/vision block for which the filter is being procured (see 1.1).
- c. Applicable stock number.
- d. Selection of applicable level of preservation, packaging, packing and marking (see 5.1).
- e. First article instructions (see 4.3 and 6.4).
- f. If responsibility for inspection and the place of inspection is other than as specified (see 4.1).

6.3 Certification. With respect to products requiring certification, awards will be made only for products which are at the time set for opening of bids, certified for inclusion whether or not such products have actually been so listed on the applicable drawing. Recertification shall also be considered in accordance with 4.2.2. The attention of suppliers is called to this requirement, and manufacturers are urged to arrange to have the products they

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propose to offer to the Federal Government tested for certification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for certification is the U.S. Army Tank-Automotive Command, ATIN: AMSTA-RSC, Warren, MI, 48397-5000, and information pertaining to certification of products may be obtained from that activity.

6.3.1 The filters submitted in accordance with 4.2 shall be as specified herein and shall be considered as certified for all filters specified upon successful completion of certification testing. The dimensions of these filters shall be as specified by the certifying authority.

6.4 First article. When first article inspection is required, it shall be tested and approved under the appropriate provisions of 52.209-3 of the Federal Acquisition Regulation (FAR). The contracting officer shall include specific instructions in all procurement instruments regarding arrangements for examination, tests and approval of the first article (see 3.1.1 and 6.2).

6.5 Guidance for the contracting officer on applying OCI sampling/acceptance criteria.

6.5.1 OCI.

6.5.1.1 Examination and tests. All components and subassemblies should be inspected with the inspection provisions contained in the QAPs, drawings, and associated military and/or industrial material specifications and Quality Assurance Provisions of MIL-F-13926 should apply. Examinations and tests related to section 3 herein should be performed on a single defect (individual characteristic) basis in accordance with the sampling plan specified in Table IV. Examination and tests for packaging, packing and marking should be in accordance with MIL-P-14232 and section 5 herein. The tabulated classification of defects in Table III should 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.

6.6 Subject Term (key word) listing.

Filter  
Filter, Laser  
Filter, Coating  
Filter, Hazard

6.7 Supersession data. This specification supersedes ATPD-2155, dated, 5 AUG 89.

6.8 AMC policy on AQLs/LTPDs. This specification is certified to be in compliance with current Army Material Command (AMC) policy for the elimination of AQLs/LTPDs (Acceptable Quality Levels/Lot Tolerance Percent Defectives) from military specifications.

Custodian:

Army - AT

Preparing Activity:

Army - AT

Project No. - 6650-A189