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DETAIL SPECIFICATION

FILTER, LASER HAZARD PROTECTION

This specification is approved for use by the U.S. Army Tank-automotive and Armaments 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 protection filters used in unity vision devices.

1.2 Classification. Filters described in this specification are hybrid filters consisting of a laser absorbing glass substrate with a 0.694 micron blocking multilayer interference filter coating.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirement documents cited in sections 3 and 4 of this specification, whether or not they are listed.

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 and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A FSC 6650

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-G-174	- Glass, Optical.
MIL-PRF-13830	- Optical Components for Fire Control Instruments; General Specification Government the Manufacture, Assembly and Inspection of.
MIL-C-48497	- Coating, Single or Multilayer, Interference: Durability Requirements for.

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-810	- Environmental Test Methods and Engineering Guidelines.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWINGS

7641866	- Surface Quality Standards for Optical Elements.
12357797	- Filter.
12357801	- Filter.
12357857	- Filter.
12370300	- Filter.
12370324	- Filter.

(Copies of the above drawings are available from the U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/NCSL Z540-1	- General Requirements for Calibration Laboratories and Measuring and Test Equipment.

(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D1003	- Plastics, Transparent, Haze and Luminous Transmittance of (DoD Adopted).
ASTM E308	- System, CIE, Computing the Colors of Objects by Using the (DoD Adopted).

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Materials. Materials shall be in accordance with applicable drawings and specifications forming a part of this specification (see 4.4.2).

3.2.1 Glass. Glass used as an absorbing substrate shall be class 2, grade C, tempered glass filter, heat-absorbing type, ionically colored, in accordance with 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 (see 4.4.2).

3.3 Construction. The filter shall be manufactured in accordance with the interface dimensions and tolerances shown on Drawing 12357797, 12357801, 12357857, 12370300, or 12370324 as specified in the contract (see 4.4.2 and 6.2).

3.4 Environmental weathering. Filters shall evidence no detonation or other physical deterioration when exposed to an irradiance level of 1120 Watt per square meter (W/m^2) (355 British thermal units per square foot per hour ($Btu/ft^2/h$)) and shall subsequently meet the requirements of 3.5.1 through 3.5.8 (see 4.5.2).

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 4.5.3).

TABLE I. Optical density (O.D.).

	Wavelength, (nm) 1/	O.D. with angle (0 to 80) +/-1.5 degrees	Unity device w/filter
A	694	3.4	3.5
B	1048-1068	3.4	3.5
C	1064	3.4	3.5

1/ Nanometers (nm).

3.5.1.1 Ruby coating characterization. The ruby blocking coating shall be spectrally characterized from 680 nm to 880 nm and shall have an optical density equal to or greater than 2 from 680 nm to 880 nm (see 4.5.4).

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 4.5.5).

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 as specified in ASTM E308 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 4.5.6).

3.5.4 Resolution. The resolution through the filter shall be less than one minute of arc (see 4.5.7).

3.5.5 Filter coating durability. The coating shall be capable of operation under adverse environmental conditions without any evidence of flaking, peeling, cracking, or blistering (see 4.5.8). The coated surface shall be free of blemishes such as stains, smears, discolorations, streaks, and cloudiness.

3.5.6 Surface quality.

3.5.6.1 Substrate. The filter substrate shall conform to the scratch and dig requirements of MIL-PRF-13830. The filter substrate shall not exceed a surface quality of 80-50 in accordance with table I of MIL-PRF-13830, except that the maximum bubble/inclusion diameter shall be 1 millimeter (mm) and the minimum bubble/inclusion separation shall be 20 mm (see 4.5.9).

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 4.5.9).

3.5.6.3 Cosmetic. Filters shall show no characteristics which are imperative or distractive to a clear, uniform field of view, that is, blemishes or color variations which are discernible/distinguishable when viewed from the normal parameters of the field of view (see 4.4.3).

3.5.7 Laser damage resistance. Filters shall exhibit no delamination or other physical deterioration when exposed to laser radiation (see 4.5.10).

3.5.8 Temperature stability. Filters shall meet the requirements of row A in table I when exposed to -40 ±5 degrees Fahrenheit (°F) to +140 ±5°F (see 4.5.11).

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified here in are classified as follows:

a. First article inspection (see 4.2).
b. Conformance inspection (CI) (see 4.3).

4.2 First article inspection. Three filters of each type shall be examined for the defects specified in table II and shall be subjected to the inspections specified in table III. Failure of any filter to pass any of the inspections shall be cause for rejection. The Government reserves the right to witness all the contractor's inspections.

4.2.1 First article samples. First articles samples shall be three randomly selected filters of each type to be manufactured. The filters shall be selected from a full chamber run.

4.2.2 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 finished by the contractor. The Government shall not accept products until first article inspection is completed to the satisfaction of the Government.

TABLE II. Classification of defects.

Category	Defect	Method of inspection
Critical:		
001	Optical density not as specified (see 3.5.1).	SIE 1/
Major:		
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	Chromatically 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 3.5.6.3).	Visual and SIE

1/ SIE = Standard Inspection Equipment.

TABLE III. Classification of inspections.

Title	Requirement	Inspection	First article	Conformance	
				Examin-ations	Tests
Optical density, first article	3.5.1	4.5.3.1	X		
Optical density	3.5.1	4.5.3.2	X		X
Optical density scan	3.5.1	4.5.3.3	X	X	
Ruby coating characterization	3.5.1.1	4.5.4	X	X	
Photopic transmission	3.5.2	4.5.5	X	X	
Chromaticity	3.5.3	4.5.6	X	X	
Resolution	3.5.4	4.5.7	X	X	
Filter coating durability	3.5.5	4.5.8	X	X	
Surface quality	3.5.6	4.5.9	X	X	
Laser damage resistance	3.5.7	4.5.10	X		
Temperature stability	3.5.8	4.5.11	X	X	
Environmental weathering	3.4	4.5.2	X		

4.3 Conformance inspection. Conformance inspection shall consist of the examinations of 4.3.4 and the tests (100%) of 4.3.5. Noncompliance with any of the specified requirements in section 3 shall be cause for rejection.

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

4.3.2 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, and submitted at the same time for acceptance.

4.3.3 Sample. Unless otherwise specified (see 6.2), the sample for CI examinations and tests shall be randomly selected from the inspection lot in accordance with table IV.

4.3.4 CI examinations. The sample selected in accordance with 4.3.3 shall be examined for the defects specified in table II.

TABLE IV. Sampling plan for CI.

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 10 000	50	29	*
10 001 to 35 000	60	35	*
35 001 to 150 000	74	40	*
150 001 to 500 000	90	40	*
500 001 and over	102	40	*

* Indicates entire lot shall be inspected (100% inspection).

4.3.5 CI tests (100%). Each filter shall be subjected to the CI tests specified in table III.

4.3.6 CI 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 Examinations.

4.4.1 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.

4.4.2 Materials and construction. Conformance to 3.2, 3.2.1, and 3.3 shall be determined by inspection of contractor records providing proof or certification that design, construction, processing, and materials conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data.

4.4.3 Defects. Conformance to 3.2, 3.3, 3.5.1, 3.5.2, 3.5.3, 3.5.4, and 3.5.6.3 shall be determined by examination for the defects listed in table II. Examination shall be visual, tactile, or by measurement with standard inspection equipment.

4.5 Test methods and procedures. The calibration of measurement and testing equipment shall be in accordance with ANSL/NCSL Z540-1. Detector responsivity calibrations (see 4.5.1.2) shall be used in all measurements.

4.5.1 Test equipment requirements. The following test equipment shall be used.

4.5.1.1 Monochromater. The monochromater shall have a nominal half-bandwidth of 2 nm or less.

4.5.1.2 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.

4.5.2 Environmental weathering (first article only). To determine conformance to 3.4, upon completion of the examinations in 4.4 and the tests in 4.5.3 through 4.5.11, the filters shall be subjected to the environmental conditions as specified in MIL-STD-810, method 505, procedure II for five 24-hour cycles. After environmental testing, the filters shall show no evidence of physical damage and shall again meet the optical requirements as specified in 3.5.

4.5.3 Optical density measurement. To determine conformance to 3.5.1, filters shall be subjected to the measurements as specified in 4.5.3.1, 4.5.3.2, and 4.5.3.3.

4.5.3.1 Optical density measurement using a laser (first article).

4.5.3.1.1 Apparatus. National Institute of Standards and Technology (NIST) filters shall be used to calibrate the measurement system for optical densities 3 through 4. The detector configuration shall be such that each pulse, in its entirety, shall be monitored prior to passing through the filter (for example, see figure 2). Optical density shall be measured for all angles as specified and at least 0.50 inches away from any edge. The sample detector shall have a signal-to-noise ratio of 10 or more and shall be located at least 200 mm from the laser. If the system is calibrated for optical densities 3 through 4, the optical density of the filter can be inferred by comparing the sample detector reading for the calibrated filter to the reading achieved for the filter.

4.5.3.1.2 Optical density (first article). Detector responsivity calibrations shall be as specified in 4.5.1.2. Each filter shall then be tested at a wavelength of 694 nm using a linearly polarized laser with a collimated beam diameter of 4.8 $\pm$1.7 mm ($1\backslash e^2$). 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 determined as an average of at least 100 pulses. The value of 100 pulses shall be used assuming that the minimum value achieved with the filter in the optical train is 1.5 orders of magnitude above the noise level. Similarly, readings 1 through 3 shall be values determined as an average of at least 100 pulses (see 4.5.3.5 for exemption to 100 pulse requirement). All readings specified in 4.5.3.1.4 and 4.5.3.1.5 shall be laser energy transmitted through different areas of the filter as shown on figure 1, except that only one center point shall be used. The laser energy incident on the filter shall be “P” polarized with a 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 on figure 1.

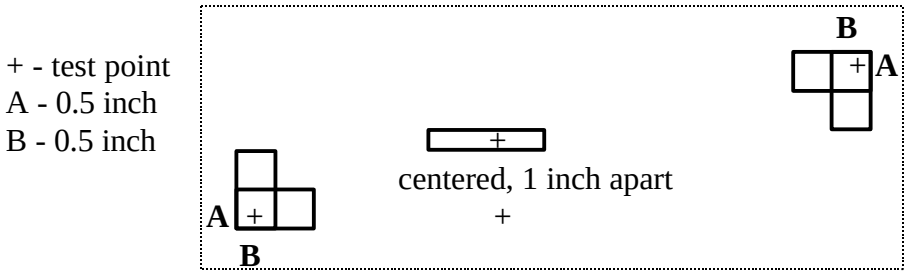
4.5.3.1.3 Reading 1. The laser energy incident on the filter shall be measured. This measurement can be performed directly or by using a calibrated beamsplitter as on figure 2 and then determining the energy incident on the filter. If the reading is performed directly, the laser energy incident on the filter shall not drift by more than 5 percent. If a calibrated beamsplitter is used, reading 1 shall be performed simultaneously with reading 2 or reading 3 as required.

4.5.3.1.4 Reading 2. The filter shall be placed in the beam at 2 ±1.5 degrees incidence and the beam energy transmitted-fitted through the filter shall be measured at one center point only and each edge as shown on figure 1.

4.5.3.1.5 Reading 3. The filter shall be placed at 80 ±1.5 degrees incidence with the polarization vector parallel to the plane of incidence and the transmitted beam energy shall be measured at one center point only and each edge as shown on figure 1.

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

4.5.3.1.7 Optical density at 80 degrees. For each position and orientation, the value of reading 3 shall be divided into the value of reading 1. The log (base 10) of this quotient shall be the optical density of the filter at 80 degrees.



NOTE: A & B are the distances from the edge.

FIGURE 1. Optical density measurement points.

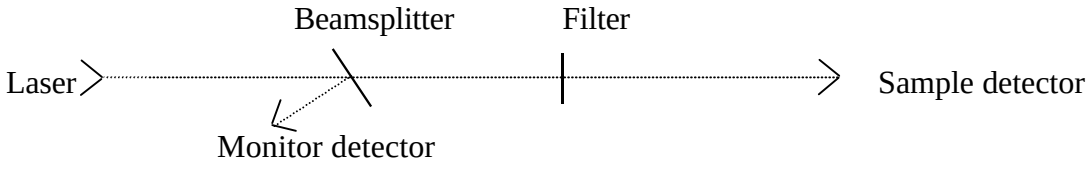


FIGURE 2. Beamsplitter setup.

4.5.3.2 Optical density (production). All filters shall be tested for compliance with row A of table 1. Optical density shall be measured at the center of the filter with light incidence angles of 0 ±1.5 degrees and 80 ±1.5 degrees. The energy incident on the filter shall be “P” polarized with a minimum 100:1 ratio of “P” to “S”. The incident light shall have a collimated beam diameter of 10 ±3 mm (l\e^2). Filters shall be measured using a laser setup as specified in 4.5.3.1.1 or a spectroradiometer setup as specified in 4.5.5. Either system shall be calibrated over the optical density range of 3 through 4 using NIST calibrated neutral density filters. Variations from either of the two test setups mentioned above shall be approved by the contracting officer. If a laser is used for optical density measurements, see 4.5.3.5.

4.5.3.2.1 Results. Transmission at each wavelength and angle shall be determined by:

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

4.5.3.2.2 Optical density. The optical density shall be defined as:

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

4.5.3.3 Optical density scan. Two filters per chamber load shall be tested for compliance with row A of table I (see 3.5.1). 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. Optical density shall be measured in 0.5 degree increments (or less) with light incidence angles from 0 ±1.5 degrees to 80 ±1.5 degrees. The optical density scan shall be performed at the center of the filters. The energy incident on the filters shall be "P" polarized with a minimum 100:1 ratio of “P” to “S”. The incident light shall have a collimated beam diameter of 4.8 ±1.7 mm (1\e^2) and a full angle beam divergence less than or equal to 1 millirad (1\e^2). Filters shall be measured using a ruby laser setup as in 4.5.3.1.1. The system shall be calibrated over the optical density range of 3 through 5. The optical density shall be measured for at least one pulse per angle.

4.5.3.3.1 Inflection point. Optical density for each angle shall be measured in accordance with 4.5.3.3. The contractor shall determine the optical density verses angle of incidence from 0 to 80 degrees. For any region of a valley where the optical density decreases by more than 0.7 and increases by more than 0.7 in 2 degrees or less and the minimum optical density is less than 4.4, the contractor shall locate the inflection point (angle) and the minimum optical density within that region by remeasuring the optical density within that region in 0.1 degree increments or less.

4.5.3.4 Melt verification. The contractor shall verify substrate performance to rows B and C of table I (see 3.2.1 and 3.5.1).

4.5.3.5 Laser optical density measurements. Unless otherwise specified (see 6.2), all readings shall be determined as an average of at least 100 pulses. The contractor may reduce the minimum number of pulses averaged from 100 to 10 if it is shown that all 10 single pulse optical density readings are within ±5 percent of the 10 pulse average optical density reading.

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

4.5.5 Photopic transmission (PT). To determine conformance to 3.5.2, one of the following systems shall be utilized:

a. A constant current tungsten lamp, a monochromater, and a detector.
b. A double beam spectrophotometer.
c. A photometer.

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

4.5.5.1 Photopic transmission 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 shall be illuminated with a tungsten lamp with color temperature of 2854 degrees Kelvin (Illuminant A). Photopic transmission shall be derived from multiplying measured spectral transmission readings taken every 10 nm or less by the photopic luminous efficiency values that make up the standard human eye curve established by the Commission Intemationale del'Eclair (CIE) (see ASTM D1003).

4.5.5.2 Photopic transmission derivation. To determine conformance to 3.5.2, the photopic transmission (PT) shall be derived from:

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

$$PT = X/Y$$

where,

w = wavelength
T(w) = Filter transmission characteristics
S(w) = CIE source A characteristics
V(w) = Photopic visibility function
dw = 10 nm or less intervals

4.5.6 Chromaticity. To determine conformance to 3.5.3, the chromaticity of the filter shall be measured as specified in 4.5.6.2 using the apparatus specified in 4.5.6.1.

4.5.6.1 Chromaticity apparatus. The apparatus for measuring the chromaticity shall be as specified in 4.5.5.

4.5.6.2 Chromaticity measurement. The filter shall be illuminated with a tungsten lamp with a color temperature of 2854 degrees Kelvin (Illuminant A). The transmission of the filter shall have chromaticity coordinates (x, y) as specified in 3.5.3 when determined using the CIE system for color chromaticity coordinates.

4.5.7 Resolution. To determine conformance to 3.5.4, a test pattern shall be constructed as specified in the resolution test of MIL-PRF-13830. The filter resolution shall be measured as specified in 4.5.7.2 using the apparatus as specified in 4.5.7.1.

4.5.7.1 Resolution apparatus. The following apparatus shall be used to measure the filter resolution:

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

4.5.7.2 Resolution 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 1). The resolution of the test pattern shall conform to 3.5.4.

4.5.8 Filter coating durability measurement. To determine conformance to 3.5.5, two filters per chamber load shall be tested for coating durability in accordance with 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 15 minutes after performing the humidity test, the optical density of the filters shall be determined in accordance with 4.5.3.2, except that the optical density shall be measured at one center point and each edge point as shown on figure 1 for light incidence at 0 $\pm$1.5 degrees.

a. Adhesion (fast tape pull).
b. Humidity (24 hours).
c. Optical density.
d. Severe abrasion.

4.5.9 Surface quality measurement. To determine conformance to 3.5.6.1 and 3.5.6.2, filters shall be tested for surface quality in accordance with MIL-PRF-13830 for digs and scratches. Filters shall be evaluated using the surface quality standards for optical components as specified on Drawing 7641866.

4.5.10 Laser damage resistance. This test shall be conducted on the first article samples only. To determine conformance to 3.5.7, 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 on figure I 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. The energy density values specified in table V are maximum energy density values. For gaussian energy distribution, the maximum energy density is twice the average energy density. The average and maximum energy density shall be determined as specified in 4.5.10.1 and 4.5.10.2, respectively.

TABLE V. Laser damage test parameters.

Wavelength (nm)	Energy density (mJ/cm^2) 1/	Repetition rate (Hz) 2/
694	$\geq$ 500	0.2 + 10%
1064	$\geq$ 650	2.5 + 10%

1/ Millijoules per square centimeter (mJ/cm^2)
2/ Hertz (Hz)

4.5.10.1 Average energy density. The average energy density shall be given by:

$$H_{avg} = \frac{Q}{A_2}$$

where Q is the total pulse energy and A_2 is the area bounded by the $1/e^2$ intensity points.

4.5.10.2 Maximum energy density. The maximum energy density shall be given by:

$$H_{max} = \frac{Q}{A_1} = 2H_{avg}$$

where Q is the total pulse energy and A_1 is the area bounded by the 1/e intensity points.

4.5.11 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 ±5°F for a minimum of six hours and then the optical density shall be measured at the center of the filter for light incidence of 80 ±1.5 degrees as specified in 4.5.3.2, except that the collimated beam diameter incident on the filter shall be 4.8 ±1.7 mm ($1/e^2$). The filter shall than be returned to room temperature (70 +10°F) for a minimum of six hours and then allowed to stabilize at 140 ±5°F at a maximum relative humidity of 10 percent for at least six hours and then the optical density shall be measured at the center of the filter for light incidence at 80 ±1.5 degrees as specified in 4.5.3.2.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. Filters covered by this specification are intended for use in unity vision devices in combat type vehicles. As there are no commercial applications or alternatives, these laser filters are considered military unique.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of the specification.
b. Model periscope/vision block for which the filter is being procured (see 1.1).
c. Issue of the DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
d. If first article is required (see 3.1).
e. Applicable drawing number and title (see 3.3).
f. If the sampling plan should be other than as specified (see 4.3.1).
g. If the sample for CI examinations and tests should be other than as specified (see 4.3.3).
h. If readings should be determined other than as specified (see 4.5.3.5).

i. Packaging requirements (see 5.1).
j. If certification is required (see 6.3).

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 drawing. The attention of suppliers is called to this requirement, and manufacturers are urged to arrange to have the products they propose to offer to the Government tested for certification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Certification tests should be in accordance with 6.4. The activity responsible for certification is the U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-R (MS #263), Warren, MI 48397-5000, and information pertaining to certification of products may be obtained from that activity.

6.3.1 Filter certification. The filters submitted in accordance with 6.4 should be as specified herein and should be considered as certified for all filters specified upon successful completion of certification testing. The dimensions of these filters should be as specified by the certifying authority.

6.4 Certification tests. The filter manufacturer is responsible for conducting certification tests. The manufacturer should submit six (6) samples for certification tests. Certification tests should consist of tests for all the requirements of this specification. All items delivered to the Government should be accompanied by the following:

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 from the tests performed along with a list of all test equipment utilized to perform the required inspections and tests.
c. A written description of the verification system used in the manufacturer's normal operations.
d. A summary of operations and tests performed on subcontract and identification of the subcontractor.

6.4.1 Certification approval. Potential suppliers who have submitted the required items for certification will be approved as sources for tills specification at such time as the specimens have successfully passed all the required tests in a Government laboratory or at contractor facilities. Failure to meet all of the 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 on-site inspections on the potential suppliers premises as may be deemed necessary to ensure 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.

6.4.2 Retention of certification. Two (2) years from the date of last notification of certification approval, unless otherwise directed by the certifying activity, suppliers should submit six (6) representative samples (see 6.4) for recertification. Failure of the samples to meet all of the required tests will be cause for removal of certification.

6.5 Subject term (key word) listing.

Coating
Combat vehicles
Glass substrate
Hybrid
Interference
Multilayer
Unity vision devices

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodian:
Army - AT

Preparing Activity:
Army - AT

(Project 6650-0024)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE *(YYMMDD)*
	MIL-DTL-62422C(AT)	980930

3. DOCUMENT TITLE

FILTER, LASER HAZARD PROTECTION

4. NATURE OF CHANGE ***(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)***

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(If applicable)*	7. DATE SUBMITTED *(YYMMDD)*

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE *(Include Area Code)*	
	(1) Commercial (810) 574-8745	(2) AUTOVON 786-8745
c. ADDRESS *(Include Zip Code)* Commander U.S. Army Tank-automotive and Armaments Command ATTN: AMSTA-TR-E/BLUE Warren, MI 48397-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403 Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	