

MIL-F-21424A(OS)  
31 July 1975  
SUPERSEDING  
MIL-F-21424(NOrd)  
13 June 1958

**MILITARY SPECIFICATION**  
**FILTERS, POLARIZING (FOR OPTICAL INSTRUMENTS)**

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

**1. SCOPE**

1.1 This specification covers polarizing filters for use in optical instruments.

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**\* 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**

**Military**

MIL-B-131

Barrier Materials, Water Vaporproof,  
Flexible, Heat-Sealable

MIL-G-174

Glass, Optical

MIL-O-13830

Optical Components for Fire Control  
Instruments; General Specification  
Governing the Manufacture, Assembly, and  
Inspection of

MIL-P-16898

Optical Elements; Packaging of

MIL-A-3920

Adhesive, Optical, Thermosetting

FSC 1240

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## STANDARDS

Federal

FED-STD-406                      Plastics: Methods of Testing

MilitaryMIL-STD-105                      Sampling Procedures and Tables for  
Inspection by Attributes

MIL-STD-129                      Marking for Shipment and Storage

(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 First Article.

\* 3.1.1 Preproduction sample. Unless otherwise specified (see 6.2) the contractor shall furnish a preproduction sample for inspection in accordance with 4.3.1. Preproduction sample filters shall be manufactured using the same procedures, materials, and plant facilities scheduled to produce the filters fulfilling the terms of the contract. Further production of items prior to procuring activity approval of the preproduction sample shall be at the contractor's risk. Preproduction filters shall become property of the procuring activity and shall not be included in the quantity of filters called for in the contract or order.

\* 3.2 Material. The filters shall consist of a sheet of polarizing material bonded between two homogeneous plates of stable, non-hygroscopic, substantially colorless glass. Glass meeting the requirements of MIL-C-174, Grade C, is satisfactory provided the other requirements of this specification are met.

\* 3.2.1 Bonding adhesive. Unless otherwise specified in the contract or order (see 6.2), optical cement shall be in accordance with MIL-A-3920.

3.3 Shape and dimensions. The shape and dimensions of the filters shall be as specified on the applicable drawings. (See 6.2)

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**3.4 Transmittance and polarizing performance.** The transmittance and polarizing performance of the filters shall be such that the following luminous transmittance values will be met:

Single filters	Not less than 30 percent
Two like filters with axes parallel	Not less than 18 percent
Two like filters with axes perpendicular	Not over 0.05 percent

**3.5 Uniformity of transmittance and degree of polarization.** The transmittance and degree of polarization of a pair of filters shall be uniform over the entire area with the axes crossed or partially crossed.

**3.6 Image clarity.** The image definition of a target seen through a pair of filters shall not materially deteriorate as extinction is approached, nor shall any diffused or scattered light be visible.

\* **3.7 Optical quality.**

**3.7.1 Surface and internal defects.** Requirements related to surface and internal defects for each filter shall be in accordance with MIL-O-13830 with the appropriate "scratch and dig" designation specified on applicable drawings.

**3.7.2 Surface accuracy.** Fabrication tolerances for spherical power and irregularity of each surface of each filter shall be sufficient for each filter to meet the resolution requirements below.

**3.7.3 Resolution.** The limit of resolution of each filter shall not exceed that specified on the applicable drawings when each filter is tested as described in 4.6.6.

**3.7.4 Deviation.** The deviation at normal incidence shall not exceed that specified on applicable drawings.

**3.8 Edges.** Filters shall be entirely free from edge separation when examined with the unaided eye. The periphery of each filter shall be smooth ground to conform to the requirements of the applicable drawing.

**3.9 Temperature stability.** Filters shall be capable of withstanding the temperature test specified in 4.6.1 without displaying discoloration, bubbles, or separation.

**3.10 Weathering stability.** Filters shall be capable of withstanding the weathering test specified in 4.6.2 without displaying discoloration, bubbles, or separation extending in from the edge more than two millimetres.

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Following the test, a pair of weathered filters shall be capable of meeting the requirements for uniformity of transmittance and degree of polarization specified in 3.5 and the luminous transmittance at extinction shall be not more than 0.3 percent.

3.11 Marking. The filter shall be scribed with the short, permanent lines to indicate, within one degree, the diameter that is vertical when the filter is oriented to reduce to a minimum the intensity of the light reflected from a horizontal specular surface at the polarizing angle. These scribed lines shall extend in from the edge of the filter two millimetres or less. On unbeveled filters the marking shall be provided on the side facing the polarized light when the requirements relative to depolarizing and birefringent inclusions are met. On beveled filters they shall be provided on the unbeveled side.

3.12 Workmanship. Workmanship shall be of such quality as to assure conformance with all requirements of the applicable drawings and of this specification.

#### 4. QUALITY ASSURANCE PROVISIONS

- \* 4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.
- \* 4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:
  1. First Article Inspection (see 4.3)
  2. Quality Conformance Inspection (see 4.4)
- 4.3 First Article Inspection.
  - \* 4.3.1 Preproduction inspection. Three preproduction sample filters of each size being purchased shall be submitted for inspection at an activity designated in the contract or order (see 6.2) to determine that the supplier's production methods are capable of yielding items that comply with the technical requirements of this specification. Preproduction inspection shall consist of the examinations in 4.5 and all tests in 4.6. Failure of any filter to pass the inspections or one or more tests shall be cause for rejection of the preproduction sample.

\* **4.4 Quality conformance inspection.** The quality conformance inspection shall consist of the examinations in 4.5 and all tests in 4.6.

4.4.1 **Lot.** For sampling purposes a lot shall consist of not more than 100 filters of the same size made from one pressing or batch as applicable.

\* 4.4.2 **Sampling.** Unless otherwise specified the sampling plans and procedures shall be in accordance with MIL-STD-105, Special Inspection level S-3, for temperature and weather stability tests (4.6.1 and 4.6.2), and General Inspection level II for all other tests and examinations. The classification of defects and acceptable quality levels (AQL's) shall be specified by the procuring activity (see 6.2).

#### 4.5 Inspections.

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.

#### 4.6 Test methods.

\* 4.6.1 **Temperature stability.** Expose the filters to  $-29 \pm 3^{\circ}\text{C}$  ( $-20 \pm 5^{\circ}\text{F}$ ) for at least sixteen hours. After permitting them to return to room temperature, expose them to  $68.5 \pm 3^{\circ}\text{C}$  ( $155 \pm 5^{\circ}\text{F}$ ) for at least five hours. After they have returned to room temperature, examine them for discoloration, bubbles, and separation.

\* 4.6.2 **Weathering stability.** Measure transmittance and polarizing performance and uniformity of performance. Expose the filters to accelerated weathering in accordance with method 6022 of FED-STD-406. Test specimens shall consist of entire filters. Other means of accelerated weathering may be permitted subject to the approval of the procuring activity. Upon completion of the test, examine the filters for discoloration, bubbles, and separation. Recheck uniformity of transmittance and degree of polarization and measure luminous transmittance at extinction.

4.6.3 **Transmittance and polarizing performance.** Filters shall be tested for transmittance and polarizing performance to determine compliance to 3.4. The equipment for luminous transmittance measurements shall include a non-polarizing light source of at least 150 watts, such as a projection lamp or other type of incandescent source having an equivalent

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color temperature, operated from batteries or a voltage-regulated power supply; a photo-electric cell, self generating or vacuum tube type and with appropriate spectral response connected to a calibrated measuring device of adequate sensitivity; a correction filter having a spectral transmittance such that the curve of spectral response of the photo cell to light from the incandescent source passed through the filter will correspond approximately to the standard luminosity curve for the normal eye and transmit a negligible amount of the spectrum outside the visible region. All measurements shall be made with the polarizing filter or filters placed between the correction filter and the photo cell. Other methods may be used subject to prior approval of the procuring agency.

- \* 4.6.4 Uniformity of transmittance and degree of polarization. The filters shall be examined for uniformity of transmittance and degree of polarization to determine conformance to 3.5. Examination shall be made with the unaided eye, with the filters held normal to the line of sight at a distance of 18 inches from the eye.

4.6.5 Image clarity. Filters shall be tested for image clarity to determine conformance to 3.6. A natural target containing highlights, such as reflections of the sun, is viewed through a pair of filters held at the unaided eye, as the filters are rotated through all orientations of the axes.

#### 4.6.6 Optical quality.

a. Area included. Except as otherwise specified, not less than 95 percent of the total filter area shall be included in the tests.

- \* b. Examination for surface and internal defects. Filters shall be examined for surface and internal defects in accordance with MIL-O-13830 to determine conformance to the requirements specified on the applicable drawing(s).

- \* c. Resolution. The resolution test shall be made by holding the filter in front of the objective of a telescope that has been accurately focused on the resolution target before insertion of the filter and is not refocused during the test. The aperture of the testing telescope shall be sufficiently large to accommodate the entire clear aperture of the filter and the magnification shall be greater than 60 divided by the limit of resolution of the filter as specified on the applicable drawing(s). The resolution target shall be collimated to infinity focus by means of a corrected collimator objective and shall be of the Foucault resolving-power pattern containing horizontal and vertical black bars upon a white field. The target shall be brightly illuminated by tungsten light without filters. Variation of the target illumination to obtain optimum visual resolution is permitted.

- \* d. Deviation. Filters shall be tested for deviation by means of a goniometer, spectrometer or other standard measuring instruments of adequate accuracy and sensitivity.

## 5. PREPARATION FOR DELIVERY

- \* 5.1 Cleaning, wrapping, and packaging. Filters shall be cleaned, wrapped, and packaged in accordance with MIL-P-16898, level A or C as specified in the contract or order (see 6.2). Unit bags for level A packaging shall be constructed from material conforming to MIL-B-131, class 1.
- \* 5.2 Packing. Filters shall be packed in accordance with MIL-P-16898, level A or C as specified in the contract or order (see 6.2).
- \* 5.3 Identification marking. Filter containers shall be identified by the title, number, date of this specification, and by drawing number.
- 5.4 Other markings. In addition to any special marking required by the contract or order (see 6.2), shipping containers shall be marked in accordance with MIL-STD-129.

## 6. NOTES

- \* 6.1 Intended use. Optical polarizing filters may be used singly, in an optical instrument or with the unaided eye, to reduce the intensity of light reflected from a specular surface or due to haze. They may also be used in pairs as a light attenuator (variable-density filter) by rotating one filter with respect to the other so that the light intensity may be varied from maximum to virtual extinction.
- 6.2 Ordering data. Procurement documents should specify the following:
  - a. Title, number, and date of this specification.
  - b. Drawing numbers of filters required.
  - \* c. Whether preproduction samples are required (see 3.1.1).
  - \* d. Optical cement other than as specified (see 3.2.1).
  - \* e. Testing activity for preproduction samples (see 4.3.1).
  - f. Classification of defects and AQL's applicable (see 4.4.2)
  - g. Levels of packaging and packing required (see 5.1, 5.2 and 6.3).
  - h. Special marking when required (see 5.4).
  - i. Number of unit packages per intermediate container.
  - j. Number of intermediate containers per pack.

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6.3 Packaging and packing. Level C, packaging and packing shall not be selected unless it is definitely known that the filters will be used immediately upon receipt.

6.4 Preproduction and production-control samples. Preproduction samples shall be cleaned, wrapped, and packaged in accordance with the requirements for Level C (see 5.1). The package shall be addressed as directed by the procuring activity and shall be plainly marked as follows:

Title, number, and date of this specification  
Drawing number  
"Samples for preproduction tests"  
Manufacturer's name and code  
Manufacturer's designation of the product  
Date of shipment  
Reference (authorizing or forwarding letter)

6.5 Marginal identification. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and suppliers are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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Preparing activity:  
Navy - OS  
Project Number 1240-N659



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