

INCH-POUND

MIL-G-47033A(MI)

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Superseding

MIL-G-47033(MI)

19 April 1974

## MILITARY SPECIFICATION

## GLASS, BOROSILICATE

This specification is approved for use within the U.S. Army Missile 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 one type of borosilicate glass intended for use where a low coefficient of thermal expansion is desired.

## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues 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
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MIL-O-16898	Optical Elements, Packaging of
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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: Commander, U.S. Army Missile Command, ATTN: AMSMI-RD-SE-TD-ST, Redstone Arsenal, AL 35898-5270, by using the self-addressed Standardization Document Improvement Proposal (DD Form 11426 appearing at the end of this document or by letter.

AMSC N/A

FSC 9340

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## STANDARDS

## FEDERAL

FED-STD-406

Plastics, Methods of Testing

## MILITARY

MIL-STD-129

Marking for Shipment and Storage

(Copies of specifications, standards and other Government documents required by 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. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 336

Annealing Point and Strain Point by Fiber Elongation, Standard Test Method for

ASTM E 111

Youngs Modulus, Tangent Modulus and Chord Modulus, Standard Test Method for

ASTM E 228

Linear thermal Expansion of Solid Materials with a Vitreous Silica Dilatometer, Standard Test Method for

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

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets, or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 First article. when required in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3 and 6.2)

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3.2 Material. The material shall be fine annealed, clear, borosilicate glass formulated from silica, boric oxide, soda, and alumina oxides, having an approximate refractive index of 1.474.

3.3 Mechanical properties.

3.3.1 Coefficient of expansion. The maximum coefficient of expansion shall be 0.000033 inch per inch per degree Celsius (C) (1.8 degrees Fahrenheit (F)) in the range of zero degrees C to 300 degrees C (32 degrees F to 572 degrees F).

3.3.2 Modulus of elasticity. the modulus of elasticity shall be 9.5 times  $10^6$  pounds per square inch, minimum.

3.4 Physical properties.

3.4.1 Specific gravity. The specific gravity shall be 2.230 plus or minus 0.004.

3.4.2 Strain point. The strain point shall be 520 degrees C (968 degrees F), maximum.

3.4.3 Annealing point. The annealing point shall be 565 degrees C (1049 degrees F), maximum.

3.4.4 Inclusions. The allowable maximum and minimum size inclusions shall be as specified in Table I. The permissible number of maximum size inclusions shall be 1 per each cubic centimeter (cc) of glass. The sum of the diameter of all inclusions larger than the minimum size per cc of glass shall not exceed the diameter of the allowable maximum size. Inclusions smaller than the minimum size shall be disregarded.

Table I.

Inclusion Criteria

Maximum Size (Millimeters)	Minimum Size (Millimeters)
0.50	0.10

3.5 Workmanship. The workmanship shall be such as to insure a high quality product which is uniform, and in conformance with this specification. The borosilicate glass shall be free of dirt, foreign materials, cracks or contaminants.

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## 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall be come 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 assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.3).
- b. Quality conformance inspection (see 4.4).

4.3 First article inspection. A first article sample shall be prepared using the same methods proposed for the preparation of subsequent lots of material. First article inspections shall be conducted on the first article sample and shall consist of all the examinations and tests specified herein. Unless otherwise specified (see 6.2) the Government will perform the first article inspection at the contractor's plant. Samples which do not meet all the requirements of this specification shall be rejected and returned to the contractor. Subsequent quantities will not be considered for acceptance until approval of the first article sample has been obtained.

4.4 Quality conformance tests. Quality conformance tests for acceptance of material shall consist of the following examinations and tests:

- a. Coefficient of expansion (4.5.1.1).
- b. Specific gravity (4.5.2.1).
- c. Inclusions (4.5.2.4).

4.4.1 Lot size. Lot size shall consist of all the material submitted for acceptance at the same time, which has been prepared by the same company without change in materials or processes in one continuous period of operation.

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4.5 Test methods.4.5.1 Mechanical property tests.

4.5.1.1 Coefficient of expansion. The coefficient of expansion specified in 3.3.1 shall be determined in accordance with ASTM E 228.

4.5.1.2 Modulus of elasticity. The modulus of elasticity specified in 3.3.2 shall be determined in accordance with ASTM E 111.

4.5.2 Physical property tests.

4.5.2.1 Specific gravity. The specific gravity specified in 3.4.1 shall be determined in accordance with FED-STD-406, Method 5011.

4.5.2.2 Strain point. The strain point specified in 3.4.2 shall be determined in accordance with ASTM C 336.

4.5.2.3 Annealing point. The annealing point specified in 3.4.3 shall be determined in accordance with ASTM C 336.

4.5.2.4 Inclusions. The examination for inclusions shall be in accordance with MIL-G-174, for compliance with 3.4.4.

4.6 Inspection of packaging. Packaging shall be inspected for conformance to section 5.

## 5. PACKAGING

5.1 Preservation, packaging, and packing. Preservation, packaging, and packing shall be Level A, B, or C as specified (see 6.2) in accordance with MIL-O-16898.

5.2 Marking. In addition to any special marking required by the contractor or order, unit packages, intermediate packages, and shipping containers shall be marked in accordance with the requirements of MIL-STD-129.

5.2.1 Special marking. Shipping containers shall be marked with the words "GLASS HANDLE WITH CARE". The appropriate side of the container shall be clearly marked to indicate "TOP" or "OPEN THIS SIDE".

## 6. NOTES

6.1 Intended use. The borosilicate glass covered by this specification is intended for the fabrication of first surface glass substrate mirrors.

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6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Whether first article inspection is required (see 3.1).
- c. Where first article inspection shall be performed (see 4.3).
- d. Any special marking requirements.
- e. Packaging limitations (see 5.1).
- f. Selection of applicable levels of reservation, packaging, and packing.

6.3 Metrication. Metric equivalents in accordance with FED-STD-376 are acceptable for use in this specification.

6.4 Subject term (key word) listing.

Glass, Borosilicate

6.5 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:  
Army - MI

Preparing Activity:  
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