

MIL-A-7021C
16 December 1974
SUPERSEDING
MIL-A-7021B
13 December 1963

MILITARY SPECIFICATION

ASBESTOS SHEET, COMPRESSED, FOR FUEL, LUBRICANT, COOLANT, WATER, AND HIGH TEMPERATURE RESISTANT GASKETS

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

1. SCOPE

1.1 Scope . This specification covers compressed asbestos sheet for gaskets for use where high temperature resistance to hydrocarbon fuels, petroleum-based lubricants, coolants, and water is required (see 6.1).

1.2 Classification. The asbestos sheet shall be supplied in classes and forms as described below:

1.2.1 Classes.

Class 1 - Fuel, lubricant, coolant, and high temperature resistant

Class 2 - Water Resistant

1.2.2 Forms .

Sheet form - thickness greater than 1/16 inch (see 5.1.1.2)

Roll form - thickness 1/16 inch and less (see 5.1.1.1)

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

FSC 5330

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SPECIFICATIONS

Federal

O-M-232	Methanol (Methyl Alcohol)
NN-P-530	Plywood, Flat Panel
QQ-A-250/4	Aluminum Alloy 2024, Plate and Sheet
QQ-B-613	Brass, Leaded and Nonleaded, Flat Products (Plate, Bar, Sheet and Strip)
QQ-B-750	Bronze Phosphor, Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections
QQ-M-44	Magnesium Alloy Plate and Sheet (AZ31)
TT-W-572	Wood Preservative; Water Repellent
UU-P-268	Paper, Kraft, Untreated, Wrapping
PPP-B-576	Box, Wood, Cleated, Veneer, Paper Overlaid
PPP-B-585	Box, Wood, Wirebound
PPP-B-591	Box, Fiberboard, Wood-Cleated
PPP-B-601	Box, Wood, Cleated-Plywood
PPP-B-621	Box, Wood, Nailed and Lock-Corner
PPP-B-636	Box, Fiberboard
PPP-B-1055	Barrier Material, Waterproofed, Flexible
PPP-D-723	Drum, Fiber
PPP-T-45	Tape, Gummed, Paper Reinforced, Plain, For Sealing, Securing
PPP-T-97	Tape; Pressure Sensitive Adhesive, Filament Reinforced

Military

MIL-H-5559	Hydraulic Fluid, Arresting Gear
MIL-L-10547	Liners, Case and Sheet, Overwrap, Water- Vaporproof or Waterproof, Flexible
MIL-B-13239	Barrier Material, Waterproofed, Flexible, All Temperatures, Heat Sealable
MIL-S-18729	Steel Plate, Sheet, and Strip, Alloy, 4130, Aircraft Quality

STANDARDS

Federal

FED Test Method Standard No. 601	Rubber: Sampling and Testing
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Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking For Shipment and Storage

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(Copies of specifications, standards, drawings, and publications, required by suppliers in connection with specific procurement function should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIAL STANDARDS (ASTM)

ASTM F36-66 Compressibility and Recovery of Gasket Materials

ASTM F152-72 Tension Testing of Non-Metallic Gasket Materials

(ASTM Standards are published by the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103).

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using agencies.

3. REQUIREMENTS

3.1 Material. The compressed asbestos sheet shall be made from asbestos fiber bonded under pressure with a rubber compound and processed to form a pliable, resilient sheet capable of meeting the requirements of this specification. The component material shall be uniformly dispersed throughout the sheet. The composition shall be such that it will not cause weak spots or wicking.

3.2 Dimensions and tolerances.

3.2.1 Dimensions. Dimensions of the asbestos material shall be as specified by the procuring activity (see 6.2).

3.2.2 Tolerances.

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3.2.2.1 Thickness. Unless otherwise specified in the contract, the thickness of compressed asbestos material, when determined as specified in 4.5.2.1, shall not vary more than the amount shown in Table I.

TABLE I. Thickness tolerances

Thickness (inch)	Tolerance (inch)	
	Plus	Minus
1/64 and less	0.005	0.002
Over 1/64 and less than 1/16	0.005	0.005
1/16 and over	0.008	0.008

3.2.2.2 Linear dimensions. Unless otherwise specified in the contract, linear tolerances on sheet form material shall be $\pm .25$ inch. Roll form shall be $\pm .25$ inch for width and ± 0.5 percent for length.

3.3 Physical properties. The physical properties of the compressed asbestos sheet shall be in accordance with the requirements of Table II.

3.4 Identification of products.

3.4.1 Sheets and rolls. Unless otherwise specified each square foot of a sheet shall be legibly marked with a fuel and oil resistant lacquer, ink or dye to show the specification number, class, manufacturer's name and product identification. In addition the asbestos shall also be marked once with the date of manufacture (quarter and year), for example January 1974 would be marked 1-74; June 1974 - 2-74, etc. The marking fluid shall not affect material performance. The color of the markings shall be red for Class 1 and blue for Class 2.

3.4.2 Small parts (cut from sheet or roll). When the shape and size of the material does not permit marking in accordance with the above, a red dot or a blue dot may be used to indicate the class. This dot shall appear on the face of the piece, if the piece has a minimum of 1-inch surface dimension in each of two directions. In the event that the dimensions of the material are such that dot marking cannot be made in accordance with the above, the individual pieces shall be stacked for marking purposes and a painted identification stripe applied to the stacked edges.

3.5 Workmanship. All details of workmanship shall be in accordance with highgrade manufacturing practices covering these classes of materials. The compressed asbestos shall be uniform in quality and condition, clean, sound, smooth, and free from foreign materials and from defects detrimental to fabrication, appearance, or performance of parts.

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TABLE II. Physical properties

PROPERTY	REQUIREMENT ^{1/}		TEST PARA.
	CLASS 1	CLASS 2	
Thickness			
As received	As determined		4.5.2.1
% Change after immersion in: Aromatic fuel			4.5.2.2
Temporary	+20, -0	-	
Permanent	<u>+3</u>	-	
Distilled water (temporary)	-	+10, -0	4.5.2.3
Compressibility			
As received, percent	12 <u>+5</u>	12 <u>+5</u>	4.5.3.1
Recovery, as rec'd, % min.	45	45	
Compressibility after immersion in aromatic fuel, %, max.	30, No rupture	-	4.5.3.2
Bend Test			
As received	No cracking		4.5.4.1
After oven aging	No cracking		4.5.4.2
Tensile Strength, PSI, Min.			
As received	2000	1500	4.5.5.1
After immersion in:			
Distilled water	-	825	4.5.5.2
Water-alcohol	1100	-	
Ethylene Glycol	1100	-	
Petroleum base oil	1600	-	
Aromatic fuel	800	-	
Corrosion	No corrosion		4.5.6
Chloride content, %, max.	0.35	-	4.5.7

^{1/} "-" in the requirement column indicates a property not applicable to that class.

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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 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 inspections and testing of the asbestos sheet shall be classified as follows:

(a) Quality conformance inspection (see 4.3)

4.3 Quality conformance.

4.3.1 Lot formation. Unless otherwise specified, a lot shall consist of all the asbestos material of the same class, manufactured under essentially the same conditions and submitted for inspection at one time.

4.3.2 Sampling.

4.3.2.1 For physical testing. The sample unit shall consist of a 2 square foot section of material cut from a sheet or roll. The sample shall not be taken within 3 inches of any edge. The sample size shall be selected in accordance with Inspection Level S-1 of MIL-STD-105. When irregular shaped items are supplied that cannot be used for test samples, the manufacturer shall furnish 2 square feet of 0.063 +0.016 inch thick material identical to that offered for inspection. Testing shall be as specified in 4.3.3.1.

4.3.2.2 For visual examination. The lot size for purposes of this inspection shall be expressed in units of packages of sheets or rolls of material. The sample unit shall be one sheet or one roll of asbestos (1 yard of the roll shall be inspected). The sample size shall be selected in accordance with Inspection Level II of MIL-STD-105. The samples shall be examined as specified in 4.3.3.2.

4.3.2.3 For preparation for delivery. The lot size for purposes of this inspection shall be the number of shipping containers. The sample unit shall be one shipping container. The sample size shall be determined using Inspection Level S-2 of MIL-STD-105. Inspection as specified in 4.3.3.3.

4.3.3 Inspections.

4.3.3.1 Physical testing. Test specimens for each property specified in Table II shall be prepared from each sample unit selected. If one or more of the specimens fail to meet a requirement of Table II, the lot represented by the specimen shall be rejected.

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4.3.3.2 Visual examination. The samples selected in accordance with 4.3.2.2 shall be visually examined for defects in appearance and dimensional defects as specified in Table III. The Acceptable Quality Level (AQL) shall be 1.5 percent defective.

TABLE III. Visual examination defects

EXAMINATION	DEFECT
Appearance	Any hole, tear, fold, or crease
Workmanship	Nonuniform surface, smoothness or texture Rough surfaces, uneven edges Not pliable
Markings	Identification markings missing, incorrect, illegible or not in accordance with specification or contract requirements
Dimensions	
Thickness	Not in accordance with contract or order. Tolerance not in accordance with 3.3.2.1
Sheets	
Length & width	Sheet dimensions shall not vary more than $\pm 1/4$ inch from those specified in the contract or order
Rolls	
Length	Unless otherwise specified in the contract or order, shall not vary ± 0.5 percent of the nominal length
Width	Shall not vary $\pm 1/4$ inch from the width specified

4.3.3.3 Preparation for delivery. The containers selected in 4.3.2.3 shall be visually examined to the requirements of Table IV and all other applicable requirements to determine conformance to Section 5 of this specification. The Acceptable Quality Level (AQL) for this examination shall be 4.0 percent defective. In addition, shipping containers fully prepared for delivery shall be examined for closure defects.

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TABLE IV. Preparation for delivery examination

EXAMINATION	DEFECT
Packaging (as applicable)	<p>Not level specified; not in accordance with contract requirements.</p> <p>Sheets or rolls not interleaved over full area.</p> <p>Rolls not wound on substantial core, not restrained.</p> <p>Interleaving material not as specified.</p> <p>Outer wrapper not adequately sealed.</p> <p>Stacked sheets exceed height specified; less than specified or indicated number of sheets per package.</p>
Packing (as applicable)	<p>Not level specified; not in accordance with contract requirements.</p> <p>Container not as specified; closures not made by specified methods or materials.</p> <p>Any nonconforming component, component missing, damaged or otherwise defective affecting serviceability.</p> <p>Inadequate application of components, such as: incomplete closure of case liners, container flaps, loose or inadequate strapping, bulged or distorted containers.</p>
Count	Less than specified or indicated quantity of rolls or packages of sheets.
Weight Markings	<p>Gross weight exceeds specified requirements.</p> <p>Interior or exterior markings (as applicable) omitted, illegible, incorrect, incomplete or not in accordance with contract requirements.</p>

4.4 Test conditions.

4.4.1 Temperature and time tolerance. Unless otherwise specified, tolerances for the test temperatures shall be $+2^{\circ}\text{C}$ or $+3.6^{\circ}\text{F}$, and for exposure time, shall be as follows: 30 and 60 minutes $+5$ minutes, 5 $+1/4$ hour, 22 $+1/4$ hour, and 70 $+1$ hour.

4.4.2 Conditioning of material. "As received" test specimens for compressibility and recovery (4.5.3), bending (4.5.4), and tensile strength (4.5.5) shall be cut from material which has been conditioned in a circulating air oven for 60 minutes at 100°C (212°F), then cooled and stored in a desiccator. Each "cut" specimen shall be stored in a desiccator until immediately before test.

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4.4.3 Immersion fluids. Unless otherwise specified all immersion fluids shall be 12 to 20 times the volume of, and shall completely cover the test specimen. Table V identifies the immersion fluids and exposure conditions for testing.

TABLE V. Immersion media

Fluid	Specification or method	Test Conditions	
		Temperature	Exposure hours
Water-alcohol	50 percent Distilled water - 50 percent O-M-232 Grade A methanol (by wt)	66°C	22
Hydraulic fluid (Ethylene glycol base)	MIL-H-5559	149°C	5
Petroleum-base oil.... Medium No. 1	Fed. Test Method Std. No. 601 - Method 6001	149°C	5
Aromatic fuel Medium.. No. 6	Fed. Test Method Std. No. 601 - Method 6001	23°C	22
Distilled water..... Medium No. 10	Fed. Test Method Std. No. 601 - Method 6001	100°C	70

4.5 Test methods.

4.5.1 Examination of product. Compressed as tos shall be examined to determine conformance with this specificati. with respect to material, identification, workmanship, dimensions, and toler. ces.

4.5.2 Thickness.

4.5.2.1 As received. Thickness of the specimen shall be determined in accordance with Method 2011 of Federal Test Method Standard No. 601, except that a total force of 9 +0.1 ounce shall be exerted by the dial micrometer on the specimen.

4.5.2.2 After fluid immersion, class 1. Class 1 specimens shall be immersed in Medium 6 of Table V. Temperature and exposure time shall be as specified in that table. Immediately after exposure, the temporary change in thickness shall be determined in accordance with method 6231 of Fed. Test Mthd Std. No. 601. The same specimens shall then be conditioned 22 hours at room temperature before determining the permanent change in thickness using the method described above.

4.5.2.3 After fluid immersion, class 2. Class 2 specimens shall be immersed in medium 10 of Table V. Temperature and exposure time shall be as specified in that table. Immediately after exposure, temporary change in thickness shall be determined as specified in 4.5.2.2.

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4.5.3 Compressibility and recovery.

4.5.3.1 As received. Compressibility and recovery shall be determined in accordance with ASTM F 36, compressed asbestos sheet.

4.5.3.2 Compressibility after fluid immersion. Compressibility after fluid immersion shall be determined on new specimens after immersion in medium 6 of Table V. Temperature and exposure time shall be as specified in 4.4.3 and that table. The specimens shall be blotted lightly with filter paper and tested within 15 seconds after removal from the fluid. The test method shall be ASTM F 36.

4.5.4 Bending. 12 - 1 by 6 inch specimens, 6 cut with the grain and 6 across the grain shall be prepared and tested as specified below:

4.5.4.1 As received. 3 specimens with the grain and 3 across the grain shall be conditioned as specified in 4.4.2, then subjected to a 180 degree bend around a mandrel whose diameter is equal to 12 times the least measured thickness of the material.

4.5.4.2 After oven aging. 3 specimens with the grain and 3 across the grain shall be conditioned in a circulating air oven for 70 hours at 100°C (212°F). After conditioning, the specimens shall be cooled for 30 minutes in a desiccator, then subjected to a 180 degree bend around a mandrel whose diameter is equal to 16 times the least measured thickness of the material.

4.5.5 Tensile strength. Tensile strength shall be determined in accordance with ASTM F152 using Die "A" and a jaw separation of 12 inches per minute. Specimens shall be cut as specified below.

4.5.5.1 As received. 3 specimens with the grain and 3 across the grain shall be cut from material conditioned in 4.4.2. The weaker grain shall be determined by test and reported as the average of 3 specimens.

4.5.5.2 After fluid immersion. 12 weaker grain specimens shall be cut from Class 1 material and 3 weaker grain specimens from Class 2 material. Cross sectional areas shall be determined prior to immersion. All Class 2 specimens shall be immersed in medium 10 of Table V. Class 1 specimens shall be immersed, 3 in each of the remaining fluids of Table V. Exposure times and temperatures shall be as specified in 4.4.3 and Table V. Upon completion of the exposure times, the specimens at elevated temperatures shall be transferred to fresh fluid at room temperature for 30 minutes. The specimens shall then be individually removed from the fluids blotted lightly with filter paper and tested within 3 minutes of removal from the fluid. Note: The oil immersed specimens may be wiped with a clean dry cloth, dipped in acetone and blotted with filter paper before test. Tensile strength shall be determined as specified in 4.5.5.

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4.5.6 Corrosion. Test specimens 1 by 2 inches shall be cut from the compressed asbestos material and placed between alternate metal plates, which have been washed in toluene and dried to form a stack consisting of the following, in the order indicated:

Aluminum alloy	QQ-A-250/4
Brass	QQ-B-613 (Composition 2, Temper Quarter Hard)
Bronze	QQ-B-750 (Composition A)
Steel	MIL-S-18729
Magnesium alloy	QQ-M-44 (Condition A)

The metal plates shall be 1 by 2 by .062 inches, polished to 5-15 microinch rms finish. The stack shall be held together in a sandwich jig consisting of four corner bolts and wing nuts. Thirty pounds pressure shall be applied to the stack, and the corner wing nuts shall be finger tightened. A control sandwich consisting of metal plates with filter paper (No. 2 Whatman or equivalent) shall be prepared. The test sandwich, along with control sandwich, shall then be placed in a circulating air oven maintained at 70°C (158°) for a period of 7 days. At the end of this period, the metal surfaces shall be examined for evidence of progressive pitting or corrosion. The material shall not adhere to the metal. Discoloration is not considered or defined as corrosion.

4.5.7 Chloride determination. A 5 gram sample shall be cut in 1/8 inch squares, weighed and transferred to an erlenmeyer flask of suitable size. The sample shall be diluted with 150 ml. of distilled water, refluxed for 1 hour, and filtered. The flask and sample shall be washed with distilled water. The filtrate and washings shall be cooled to room temperature, diluted to 200 ml., and titrated with 0.1N silver nitrate solution, using potassium chromate as the indicator. A blank determination shall be run on distilled water, and the value for the blank subtracted from that for the sample. The percent chlorine in the sample shall be calculated.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be Level "A" or "C" as specified.

5.1.1 Level A.

5.1.1.1 Rolls. Compressed sheets of a thickness 1/16 inch or less shall be furnished in rolls wound on a substantial core and suitably restrained from unwinding. The roll shall be interleaved, over the full

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area of contact between sheets, with Kraft paper conforming to UU-P-268. When "anti-stick" finish is procured (sec 6.2), the interleaving may be omitted. No further packaging is required for shipment involving PPP-D-723 drums. Rolls intended for shipment in containers other than drums shall be further packaged by applying Kraft paper headers to each end of the rolls and secured with a suitable adhesive, then wrapped with Kraft paper and the wrap sealed with tape conforming to PPP-T-45. Basis weight of the Kraft paper for interleaving shall be 20-30 pounds and for wraps and headers 50-60 pounds.

5.1.1.2 Flat sheets. Compressed sheets of a thickness over 1/16 inch shall be furnished in flat sheets. Flat sheets shall be interleaved, wrapped and taped as specified for rolls. Stacked sheets shall not exceed 10 inches in height.

5.1.2 Level C. Rolls and flat sheets shall be packaged in accordance with the manufacturer's commercial practice.

5.2 Packing. Packing shall be Level A, B or C, as specified.

5.2.1 Level A.

5.2.1.1 Rolls. Unless otherwise specified, rolls without headers and wrapping shall be packed in lined fiber drums conforming to PPP-D-723, Type III, Grade A. Drum closures shall be reinforced by means of a 3-inch wide tape conforming to PPP-T-97. Rolls, with headers and over-wrap as specified in 5.1.1.1, shall be packed in overseas type exterior containers that conform to PPP-B-576, PPP-B-585, PPP-B-591, PPP-B-621, PPP-B-636. Case liners of materials conforming to PPP-B-1055 or MIL-B-13239, and fabricated in accordance with MIL-L-10547 shall be provided. Plywood, when used, shall conform to NN-P-530, Group A, Type I or II Grade 4. Plywood shall be surface treated in accordance with TT-W-572. The gross weight of the shipping container, when packed for shipment, shall not exceed 200 pounds.

5.2.1.2 Flat sheets. Flat sheets packaged as specified in 5.1.1.2 shall be packed in overseas type exterior containers conforming to PPP-B-576, PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-621, or PPP-B-636. Case liners and plywood shall be as required for rolls. The gross weight of the shipping container, when packed for shipment, shall not exceed 200 pounds.

5.2.2 Level B.

5.2.2.1 Rolls. Rolls packaged as specified in 5.1.1.1, without headers and overwrap, shall be packed in fiber drums conforming to PPP-D-723, Type I, Grade A. Drum closures shall be taped to the side walls with 3-inch wide tape conforming to PPP-T-97. Rolls packaged as specified in 5.1.1.1, with headers and overwrap, shall be packed in domestic type exterior containers conforming to PPP-B-576, PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-621 or PPP-B-636.

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5.2.2.2 Flat sheets. Flat sheets packaged as specified in 5.1.1.2 shall be packed in domestic type exterior containers conforming to PPP-B-576, PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-621, or PPP-B-636. The gross weight of the shipping container, when packed for shipment, shall not exceed 200 pounds. The gross weight of fiberboard containers shall not exceed the weight limitations indicated in PPP-B-636.

5.2.3 Level C. Rolls and flat sheets shall be packed to insure that shipment arrives in satisfactory condition at destination. Shipment shall conform to the applicable carriers rules and regulations in effect at the time of shipment.

5.3 Marking of shipments. In addition to any special marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with Standard MIL-STD-129 and shall include the following information:

ASBESTOS SHEET, COMPRESSED, FOR FUEL, LUBRICANT,
COOLANT, WATER, AND HIGH TEMPERATURE RESISTANT
GASKETS

Stock Number

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Class

Manufacturer's designation

Manufacturer

Contract Number

6. NOTES

6.1 Intended use.

6.1.1 Class 1. This material is intended for use as gaskets to prevent leakage of fuel, lubricating oil, ethylene glycol, and water-alcohol mixture, especially throughout the powerplant system. This class is recommended for use in flanges of heavy construction with close bolt spacing, where high-bolt torque may be applied.

6.1.2 Class 2. This material is intended for use as gaskets to prevent leakage of water.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of specification
- (b) Class, dimensions, and thickness
- (c) Part number (when applicable)

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- (d) Stock number
- (e) Total quantity desired
- (f) Selection of applicable levels of preservation and packaging, and packing
- (g) Whether interleaving is required (see 5.1.1.1)
- (h) Special markings (when applicable)

6.3 ASTM designations - The materials described in this specification may be generally classified in accordance with ASTM F 104-71 as follows:

- Class 1 - ASTM F 104 (F112000D11M6Z)
- Class 2 - ASTM F 104 (F112000D11M5Z)

The above designations are for information and are not intended to be used in lieu of the requirements in MIL-A-7021.

Custodians:
Army - AV
Navy - AS
Air Force - 11

Preparing Activity:
Navy - AS
(Project No. 5330-0448)

Review Activities:
Army - AT, EL, GL
Navy - SA
Air Force - 82
DSA - IS

User Activities
Navy - SH, MC