INCH-POUND

MIL-DTL-22499D
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31 March 1989

DETAIL SPECIFICATION

SHIM STOCK, LAMINATED

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

1. SCOPE

1.1 Scope. This specification covers the requirements for surface bonded laminated shim stock.

1.2 Classification. Shim stock shall be of the following compositions, types, and classes, as specified in the contract or purchase order (see 6.2):

Compositions:

Composition 1 - Aluminum alloy.
Composition 2 - Brass.
Composition 3 - Corrosion resisting steel.
Composition 4 - Carbon steel.
Composition 5 - Titanium alloy.
Composition 6 - Polyimide plastic.

Types:

Type 1	All laminations.
Type II	One-half solid stock.

Classes:

Class 1	.002 inch laminations.
Class 2	.003 inch laminations.

Beneficial comments (recommendations, additions, deletions and any pertinent data which may be of use in improving this document should be addressed to: The Defense Industrial Supply Center, Code DISC-AESD), 700 Robbins Avenue, Phila., PA 19111-5096, by using the Standardization document Improvement Proposal (DD Form 1426), appearing at the end of this document or by letter.

AMSC N/A FSC 9535
DISTRIBUTION STATEMENT A Approved for public release: distribution is unlimited.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of those 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

FEDERAL:

QQ-S-698 - Steel, Sheet and Strip, Low Carbon

DEPARTMENT OF DEFENSE

MIL-I-24768/13 - Insulation, Plastic, Laminated, Thermosetting, Cotton-Fabric-Base. Phenolic-Resin (FBE)
MIL-I-24768/15 - Insulation, Plastic, Laminated, Thermosetting, Cotton-Fabric-Base Phenolic-Resin (FBI)
MIL-P-46112 - Plastic Sheet and Strip, Polyimide.
MIL-T-9046 - Titanium Alloy, Sheet, Strip, and Plate
MIL-DTL-22499/1 - Shim Stock, Laminated, Aluminum Alloy
MIL-DTL-22499/2 - Shim Stock, Laminated, Brass
MIL-DTL-22499/3 - Shim Stock, Laminated, CRES
MIL-DTL-22499/4 - Shim Stock, Laminated, Carbon Steel

Unless otherwise indicated, copies of specifications, standards and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5096.

2.2 Non-Government publications. The following document forms 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 are the issue of documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI/ASQC Z1.4 - Sampling Procedures and Tables for Inspection by Attributes.

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

AEROSPACE MATERIAL SPECIFICATIONS

AMS QQ-A-250/1	-	Aluminum 1100, Plate and Sheet.
AMS QQ-A-250/5	-	Aluminum Alloy Alclad 2024, Plate and Sheet
AMS QQ-A-250/8	-	Aluminum Alloy, 5052, Plate and Sheet
AMS 5513	-	Steel. Corrosion Resistant, Sheet, Strip and Plate
AMS 5516	-	Steel, Corrosion Resistant, Sheet, Strip and Plate
AMS 5903	-	Steel Sheet, Strip, and Plate, Corrosion Resistant
AMS 5904	-	Steel Sheet and Strip, Corrosion Resistant
AMS 5905	-	Steel Sheet and Strip, Corrosion Resistant
AMS 5906	-	Steel Sheet and Strip, Corrosion Resistant
AMS 5910	-	Steel Sheet, Strip, and Plate, Corrosion Resistant
AMS 5911	-	Steel Sheet and Strip, Corrosion Resistant
AMS 5912	-	Steel Sheet and Strip, Corrosion Resistant
AMS 5913	-	Steel Sheet and Strip, Corrosion Resistant

(Applications for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 36	-	Brass Plate, Sheet, Strip and Rolled Bar
ASTM B 121	-	Leaded Brass Plate, Sheet, Strip and Rolled Bar
ASTM B 601	-	Temper Designations for Copper and Copper Alloys - Wrought and Cast
ASTM D 903	-	Standard Test Method for Peel or Stripping Strength of Adhesive Bonds

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

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications or specification sheets), 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 in the contract or purchase order, preproduction samples of shim stock of the composition, type, class, nominal size and lateral dimensions specified (see 1.2 and 3.2) shall be subjected to first article inspection (see 4.3 and 6.3).

3.1.1. Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheets, the latter shall govern.

3.2 Materials.

3.2.1 Laminations and solid stock.

3.2.1.1 Composition 1. The laminations shall be manufactured from aluminum 1100, conforming to AMS QQ-A-250/1 (processed to temper H19, with a minimum tensile strength of 24.0 ksi) or from aluminum alloy 5052, conforming to AMS QQ-A-250/8 (processed to temper H19 or H39, with a minimum tensile strength of 42.0 ksi).

3.2.1.1.1 Solid stock. The solid stock shall be manufactured from aluminum alloys conforming to AMS QQ-A-250/5 (alclad 2024) tempers T3, T4, T81 or T861 for use with AMS QQ-A-250/1 laminates; AMS QQ-A-250/8 (5052) tempers H32 or H34 for use with AMS QQ-A-250/8 laminates.

3.2.1.2 Composition 2. The laminations and solid stock shall be manufactured from brass conforming to UNS C26000 of ASTM B 36 or UNS C33500 of ASTM B 121, H01 temper or harder (ASTM B 601).

3.2.1.3 Composition 3. Unless otherwise specified, the laminations and solid stock shall be manufactured from corrosion resisting steel conforming to AMS 5516, AMS 5903, AMS 5904, AMS 5905, or AMS 5906, Type 302, annealed condition or harder.

3.2.1.3.1 Type 304. If Type 302 material cannot be procured to meet all of the requirements of this specification, then Type 304 material may be substituted for Type 302 material, conforming to AMS 5513, AMS 5910, AMS 5911, AMS 5912, or AMS 5913, annealed condition or harder.

3.2.1.4 Composition 4. The laminations shall be manufactured from carbon steel conforming to QQ-S-698, temper annealed or harder.

3.2.1.5 Composition 5. The lamination shall be manufactured from titanium alloy conforming to MIL-T-9046, (CP-1 annealed condition or harder).

3.2.1.5.1 Solid stock The solid stock shall be manufactured from titanium alloy sheet conforming to MIL-T-9046 (AB-1 annealed condition).

3.2.1.6 Composition 6. The lamination shall be manufactured from the polyimide film conforming to MIL-P-46112. (Type "H" condition).

3.2.1.6.1 The solid stock shall be manufactured from phenolic resin cotton fabric base conforming to MIL-I-24768/13 or MIL-I-24768/15 (Type FBE or FBI condition).

3.2.2 Peel strength. Each individual lamination for composition 1 through 5 shall have a peel strength no less than 1 pound per inch of width and no more than 5 pounds per inch of width, except at the solid/laminate bond line which may be higher. For composition 6, each individual lamination shall have a peel strength no less than 1/2 pound per inch of width and no more than 2 1/2 pounds per inch of width, except at the solid/ laminate bond line which may be higher.

3.3 Construction and dimensions. The shim stock shall be fabricated from the materials specified herein. The applicable type, class and nominal size of the shim stock shall be as specified in Table I, the applicable specification sheet, or as otherwise required. The lateral dimensions shall be as specified in the contract or purchase order for compositions 5 and 6 (See 6.2 and 6.). Unless otherwise specified, for compositions 1, 2, 3, and 4 the lateral dimensions shall be as specified in the applicable specification sheet, or as otherwise required. Unless otherwise specified the tolerance of the specification width and length shall be ±1/8 inch.

3.3.1 Construction details. The laminations and solid stock shall be bonded together throughout the whole surface area in a manner which will permit peeling of the laminations for adjustment of the shim thickness without separation of the remaining laminations and solid parts. The shim stock shall be capable of being cut, using suitable tools, without separation and shall remain intact with normal handling.

3.3.2 Tolerance on nominal shim stock size. The tolerance on nominal shim stock size shall be in accordance with Table II.

3.3.3 Tolerance on lamination thickness. The thickness of Class 1 and 2 laminations (see 1.2) shall be within ±.0002 inch and ±.0003 inch, respectively, of the values specified.

3.3.4 Thickness of bond. The thickness of the bond between laminates shall not exceed .0003 inch.

3.4 Water immersion. The shim stock shall be capable of withstanding total immersion in water at a temperature of 120°F ± 5°F for a period of 3 hours without separation of laminations.

3.5 Workmanship. The shim stock shall be uniform in quality, clean, and free of defects detrimental to functional performance of the material.

4. VERIFICATION

4.1 Classification of inspections. The inspection of the shim stock shall be classified as:

a. First article inspections (see 4.2).

b. Quality conformance inspections (see 4.4).

4.2 First article inspection. The first article inspection shall consist of the inspection specified in 4.4 and the additional tests in 4.3. The contractor shall be responsible for the performance of the first article inspection (see 6.3).

4.2.1 First article sample. Unless otherwise specified in the contract or purchase order, the first article sample shall consist of two 1 inch by 12 inch strips of shim stock (see 6.3.).

4.3 First article testing.

4.3.1 Separation of laminations. Representative strips of the sample shim stock specified in 4.2.1 shall be allowed to stand for a minimum period of 8 hours following manufacture or until complete cure, whichever comes first, before being tested for peel strength. The laminations shall peel without separation of the remaining portion.

4.3.1.1 Laminations and bond thickness. In the process of performing the test specified in 3.1, the shim stock shall be dimensionally examined to determine compliance with the requirements of 3.3.3 and 3.3.4.

4.3.2 Peel strength. Peel strength shall be tested in accordance with ASTM D 903 (see 3.2.2). The number of peels per sample shall be in accordance with Table III.

4.3.3 Water immersion. Representative strips of the sample shim stock specified in 4.3.1 shall be immersed in water at 120°F ± 5°F for a period of 3 hours. At the end of the test period, the shim stock shall be examined to determine compliance with the requirements of 3.4.

4.4 Quality conformance inspection

4.4.1 Lot. A lot shall consist of all of the shim stock of the same composition, type, class, nominal size and lateral dimensions, manufactured under essentially the same conditions, and submitted for acceptance at the same time.

4.4.2 Samples. Statistical sampling and inspection shall be in accordance with the general requirements of ANSI/ASQC Z1.4. Lot acceptance criteria shall be based on a single sampling plan with a zero acceptance number.

4.4.3 Examination. The sample shim stock, selected in accordance with 4.4.2, shall be visually and dimensionally examined to determine compliance with the requirements of this specification.
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4.4.4 Inspection of material. The material used in the manufacture of the laminated shim stock furnished under this inspection shall have been inspected and accepted in accordance with the respective specifications specified herein. The contractor shall furnish certification that the above requirements have been met.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or purchase order (see 6.2). When actual packaging of material 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

6.1 Intended use. The surface laminated shim stock covered by this specification is intended for use in the manufacturing of laminated shims. Note: Edge bonded shims shall comply to composition, type and class only. Surface laminated construction does not apply to edge bonded shims.

6.2 Acquisition Requirements. Acquisition documents shall specify the following:

a. Title, number and date of this specification and specification sheets as applicable.
b. Composition/specification of laminate, temper or condition of material and either: type, class and nominal size (see 1.2, 3.2.1, and 3.3); or part number selected from the applicable specification sheet.
c. Dimensions of shim stock (see 3.3).
d. Quantity.
e. Packaging requirements (see 5.1).
f. Whether first article is required (see 3.1 and 6.3).
g. Sampling plan (see 4.4.1 and 4.4.2).

6.3 First article. When a first article inspection is required, the items should be a first article sample. The first article should consist of two 1 inch by 12 inch strips of shim stock or as otherwise specified in the contract or purchase order. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Lateral dimensions available. Some of the typical lateral dimensions of shim stock available from commercial stocks are shown in Table IV.

6.5 Subject Term (Keyword) Listing.

Shim
Shim Stock
Laminated

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 extensiveness of the changes.

Custodians:
Army - MR
Navy - AS

Review activities:
Army - AR, EA, CR4, MI,
Navy - MC
DLA - CC

Preparing Activity:
DLA-IS

(Project 9535-0623)

TABLE I

Construction and Dimensions

	Class 1(.002)		Class 2 (.003)	
Nominal Thickness	Type I	Type II	Type I	Type II
Inch	Applicable Compositions	Applicable Compositions	Applicable Compositions	Applicable Compositions
.006	1,2,3,4		1,2,3,4	
.008	1,2,3,4,6			
.010	1,2,3,4,6			
.012	1,2,3,4,6		1,2,3,4,6	
.015	1,2,3,4,5,6		1,2,3,4,5,6	
.016	1,2,3,4,5,6		1,2,3,4,5,6	
.020	1,2,3,4,5,6		1,2,3,4,5,6	
.021	1,2,3,4,5,6		1,2,3,4,5,6	
.032	1,2,3,4,5,6		1,2,3,4,5,6	
.033	1,2,3,4,5,6		1,2,3,4,5,6	
.048	1,2,3,4,5,6		1,2,3,4,5,6	
.062	1,2,3,4,5,6	1,2	1,2,3,4,5,6	1,2
.063	1,2,3,4,5,6	1,2	1,2,3,4,5,6	1,2
.078	1,2,3,4,5,6	3	1,2,3,4,5,6	
.080	1,2,3,4,5,6	3	1,2,3,4,5,6	
.093	1,2,3,4,5,6	1,2	1,2,3,4,5,6	1,2
.094	1,2,3,4,5,6	1,2	1,2,3,4,5,6	1,2
.109	5,6		5,6	1
.121	5,6	1	5,6	1
.125	1,2,3,4,5,6	1,2,3,4	1,2,3,4,5,6	1,2,3,4
.156	1,2,3,4		1,2,3,4	
.186	1,2,3,4	1,2	1,2,3,4	1,2
.187	1,2,3,4	1,2	1,2,3,4	1,2
.190	1,2,3,4	1,2	1,2,3,4	1
.250	1,2,3,4		1,2,3,4	
.251	1,2,3,4		1,2,3,4	
.375	1,2,3,4		1,2,3,4	
.376	1,2,3,4		1,2,3,4	

TABLE II

Tolerances (thickness) on Composition 1, 2, 3, 4, 5 and 6.

Thickness (Inch)	Tolerance (plus)	Tolerance (minus)
.006	.001	.0005
.008	.001	.0005
.010	.0015	.0005
.012	.0015	.001
.015	.0015	.001
.016	.0015	.001
.020	.002	.001
.021	.002	.001
.032	.003	.002
.033	.003	.002
.048	.005	.002
.062	.006	.002
.063	.006	.002
.078	.007	.002
.080	.007	.002
.093	.009	.003
.094	.009	.003
.109	.010	.003
.120	.012	.003
.121	.012	.003
.125	.012	.003
.156	.015	.003
.186	.018	.003
.187	.018	.003
.190	.018	.005
.233	.020	.005
.250	.025	.005
.251	.025	.005
.375	.030	.005
.376	.030	.005

TABLE III

Peel Determination

SAMPLE	MINIMUM NUMBER OF PEELS
8 or more foil layers	5
7 layers	4
6 layers	3
5 layers	2
4 layers	1
3 or less foil layers	0

TABLE IV

Lateral Dimensions

Dimensions (inches) ± 1/8”		Applicable compositions
Width	Length	
8	24	2
8	48	2
12	48	2,5,6
20	48	1,2,3,4
24	48	1,2,3,4,6

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, 6, 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** MIL-DTL-22499D	**2. DOCUMENT DATE (YYMMDD)** 980227

3. DOCUMENT TITLE **SHIM STOCK, LAMINATED**

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 Emelia Altomari	b. TELEPHONE *Include Area Code)* (1) Commercial ((215) 697-6827 (2) AUTOVON 442-6827
c. ADDRESS *(Include Zip Code)* Defense Industrial Supply Center 700 Robbins Avenue, Bldg. 3 Code DISC-AESD) Philadelphia, PA 19111-5096	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** DEFENSE QUALITY AND STANDARDIZATION OFFICE 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22401-3466 Telephone (703) 756-2340 AUTOVON 289-2340