

MIL-S-21041C

6 January 1975  
Superseding  
MIL-S-21041B  
13 April 1962

## MILITARY SPECIFICATION

### SLOTTED METAL FRAMING, ANGLES AND PANELS

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

#### 1. SCOPE

1.1 Scope. This specification covers slotted metal angle, metal shelving panels, nuts and bolts for assembly.

\*1.2 Classification. Material covered by this specification is designated by the following units and types as specified (see 6.2).

Unit A - Slotted Metal Angle, (dimensions in inches).

Type 1 - Steel, No. 14 gage, Minimum dimensions of 1 1/2 x 1 1/2.

Type 2 - Steel, No. 14 gage, Minimum dimensions of 1 1/2 x 2 1/4.

Type 3 - Steel, No. 12 gage, Minimum dimensions of 1 1/2 x 2 1/4.

Type 4 - Steel, No. 12 gage, Minimum dimensions of 1 1/2 x 3.

Type 5 - Aluminum Alloy, No. 13 gage, Minimum dimensions of 1 1/2 x 2 1/4.

Unit B - Preformed Metal Shelving Panels.

Type 1 - Steel, No. 18 gage, 6 inches wide.

Type 2 - Steel, No. 22 gage, 6 inches wide.

Type 3 - Steel, No. 18 gage, 8 inches wide.

Type 4 - Steel, No. 18 gage, 12 inches wide.

Type 5 - Steel, No. 18 gage, 18 inches wide.

Type 6 - Steel, No. 18 gage, 24 inches wide.

Type 7 - Steel, No. 18 gage, 36 inches wide.

#### 2. APPLICABLE DOCUMENTS

\*2.1 The following documents of the issue in effect on date of invitations for bid or requests for proposal form a part this specification to the extent specified herein.

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SPECIFICATIONS.Federal.

QQ-A-250/8	Aluminum Alloy 5052, Plate and Sheet
QQ-S-698	Steel, Sheet and Strip, Low Carbon
QQ-S-775	Steel, Sheets, Carbon, Zinc-Coated
QQ-Z-325	Zinc Coating, Electrodeposit, Requirement For
PPP-B-601	Boxes, Wood, Cleated
PPP-B-621	Boxes, Wood, Nailed
PPP-C-650	Crates, Wood, Open and Covered

Military.

MIL-P-116	Preservation, Method of
MIL-C-5541	Chemical Films for Aluminum Alloys
MIL-B-26195	Box, Wood, Cleated, Skidded, Load-Bearing Base
MIL-N-45913	Nuts, Self-Locking, Hexagon, Prevailing Torque

STANDARDS.Federal.

FED-STD-595	Colors
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Military.

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

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington D. C. 20402.)

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington DC, Atlanta, Chicago, Kansas City MO, Fort Worth, Denver, San Francisco, Los Angeles and Seattle WA.)

(Federal Government activities may obtain copies of Federal Specifications, Standards and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

(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.)

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

AMERICAN SOCIETY FOR TESTING MATERIAL

A-123 Zinc (Hot-Galvanized) Coating on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips.

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

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Inc., ATTN: Tariff Order Section, 1616 P Street NW, Washington DC 20036).

UNIFORM CLASSIFICATION COMMITTEE, AGENT

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, ATTN: Tariff Publishing Officer, Room 1106, 222 South Riverside Plaza, Chicago IL 60606.)

3. REQUIREMENTS.

3.1 General. Material covered by this specification shall be of good design, new construction, convenient to handle and suitable for the intended purpose. All material and accessories shall be fabricated in accordance with first class commercial practices. Bending, flanging, perforating, forming and similar operations shall be performed in a manner to insure that there are no ruptures, cracks, unsightly wrinkles or other defects in the material. Unless otherwise specified, material will be fabricated to commercial tolerances.

\*3.1.1 Standard Products. The slotted metal angles, the preformed metal shelving panels and nuts and bolts for assembly shall be the manufacturer's commercial product except for any changes necessary to comply with specification requirements. All like items furnished under any one contract, including parts and subassemblies thereof, shall be new and interchangeable. The nominal thicknesses of the angles and panels shall be the manufacturer's standard thickness corresponding to the required gages so long as these thicknesses approximate the current industry standards relating gages and thickness.

3.2 Unit A.

\*3.2.1 Unit A, Types 1, 2, 3 and 4 shall be formed slotted steel angle conforming to QQ-S-698 Half-hard Temper, 60,000 psi minimum yield or QQ-S-775, Class d, Cold Rolled Half-hard No. 2 Temper, 60,000 psi minimum yield.

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\*3.2.2. Unit A, Type 5, shall be formed slotted aluminum angle alloy No. 5052H34 (QQ-A-250/8) with a minimum yield of 31,000 psi.

3.2.3 Length. Unit A, all types shall be supplied in lengths of 10, 12, or 15 feet or special lengths when required for a specific design purpose as specified in 6.2.2.

3.2.4 Camber. Camber, if any, of the slotted metal angle shall not exceed 3/16 inch in a length of 10 feet.

3.2.5 Hole Pattern. The hole pattern for the 1 1/2" x 1 1/2" angle shall be of such design as to provide one line of holes and/or slots in each flange; the 1 1/2" x 2 1/4" angle shall have one line of holes and slots in the narrow flange and two lines of holes and slots in the wide flange; the 1 1/2" x 3" angle shall have one line of holes and slots in the narrow flange, and three lines of holes and slots in the wide flange. The hole pattern shall be of continual repetition and shall be visibly indexed at 3" intervals.

### 3.3 Unit B.

\*3.3.1 Unit B, Types 1 and 2. Panels shall be of steel sheet conforming to QQ-S-698 (Minimum Skin-passed Temper) or QQ-S-775, Class d (Minimum Cold Rolled Soft No. 4 Temper) formed with channeled sides and open ends. Slotted bolt holes shall be made in the underneath flange of the channel to receive the bolt specified in 3.4.1.

\*3.3.2 Unit B, Types 3, 4, 5, 6 and 7 shall be sheet steel conforming to QQ-S-698 (Minimum Skin-passed Temper) or QQ-S-775, Class d (Minimum Cold Rolled Soft No. 4 Temper) formed with channeled sides and closed boxed ends. Slotted bolt holes shall be made in the underneath flange of the channel and along each corner portion of the outer edge of the channel for bolts specified in 3.4.1.

3.3.3 Length. Unit B, all types shall be supplied in standard lengths of 6" increments between 30 and 60 inches as specified in 6.2.2.

### 3.4 Accessories.

\*3.4.1 Nuts and bolts. Nuts and bolts shall be of hardened steel. The bolts shall be minimum 5/16" shank diameter, 5/8" length for Unit A, Type 1, 2, 5 and 3/4" length for Type 3 and 4 and 9/16" hexagon head. Bolts shall have an unthreaded load bearing shoulder to prevent shearing action on the threads. The nuts shall be 9/16" across the hexagon flats and shall have a class 2 fit when engaged with the bolts. One mating surface shall be knurled to improve fastness. All nuts and bolts shall be finish treated in accordance with Para 3.5.1, Class 2. When specified (see 6.2) the nuts supplied shall be of the self-locking type, conforming to MIL-N-45913 Type 1, Grade A, to prevent loosening after extended storage/handling and vibration during shipment of assembled slotted angle structures.

3.5 Surface Finish. The surface finish of material furnished under this specification shall be free from grease, oil, scale, rust or other extraneous matter. All exposed edges shall be rounded, beveled, deburred, or fabricated in such a manner to prevent injury to the users hands.

3.5.1 The following classes of finish shall be applicable to material furnished under this specification. Procuring agencies shall specify the class of finish desired (see 6.2.2 and 6.1).

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\*Class 1. Primer or phosphatized base and baked-on synthetic enamel of high grade commercial quality. The method of paint application shall be at the discretion of the supplier provided it assures a strong bond with the base metal. Color shall be DOD Gray, approximating chip 36321, unless otherwise specified (see 6.2.2), in accordance with FED-STD-595.

\*Class 2. Protective zinc coat per QQ-Z-325, Type 1, Class 3, electrodeposition, applied after perforating, or by Hot Dipping process, per ASTM A-123 applied before or after perforating as specified (see 6.2). Nuts and bolts shall be coated after machining is completed. Items manufactured from QQ-S-775, Class d material will not require further coating to comply with this paragraph.

\*Class 3. Same as Class 2 finish with the exception that a coating thickness of not less than 0.001" is to be applied after perforating. The surface finish shall conform to Type 1, Class 1 of QQ-Z-325. The nuts and bolts shall be coated after machining per QQ-Z-325, Type I, Class 3.

Class 4. Surface treatment in accordance with MIL-C-5541 (for aluminum alloy angle).

3.6 Handbook of Instructions. The contractor shall furnish one copy of instructions with each unit package (see 6.2.1) of material under this specification. The instructions will cover assembly, illustrations, and technical data concerning specified rating capacity using a safety factor of two for the horizontal and vertical length according to the application and dimensions. (Deflection occurring at manufacturers' rated loads will also be shown for the normal applications in the horizontal plane.) Additional copies may be ordered as required.

3.7 Workmanship. The finished material shall be first class in quality and appearance; free of defects, blemishes, burrs, ragged or sharp edges, or breaks in coating or plating which would detract from appearance or impair serviceability.

#### 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, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 that supplies and services conform to prescribed requirements.

\*4.1.1. Component and Material Inspection. In accordance with 4.1 above, components and materials shall be inspected and tested in accordance with all the requirements of reference specifications, drawings, and standards unless otherwise excluded, amended, modified, or qualified in this specification or applicable purchase document.

#### 4.2 Sampling for lot acceptance.

4.2.1 Inspection lot. All similar material of one kind offered for delivery at one time shall be considered a lot for purposes of inspection.

4.2.2 Sampling for examination. A random sample of units shall be selected from each lot offered to the Government in accordance with MIL-STD-105 at inspection level II. The acceptable quality level shall be 2.5 percent defective for major defects and 6.5 percent defective for minor defects.

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4.3 Examination. Each sample of the sample units selected in accordance with 4.2.2 shall be examined to verify compliance with the specification. Examination shall be conducted as specified in Table 1. Any units in the sample containing one or more defects shall be rejected and if the number of defective units in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

Table 1. Classification of defects in accordance with MIL-STD-105

Categories	Defects
Critical	None.
Major:	Defects 2.5 AQL.
101	Units not new, evidence of reclaimed, used or salvaged material.
102	Camber in excess of 3/16" in a 10 foot length of the metal angle.
103	Accessories not as specified or missing.
104	Hole and slot pattern not as specified.
105	Dimensions not as specified.
106	Gage not as specified.
107	Surfaces or finish not as specified, void of coating, breaks, incomplete finishes, or plating coats below the required thickness.
Minor:	Defects 6.5 AQL
201	Burrs, ragged edges, impassible or incomplete slots.
202	Handbook of Instructions not as specified.

4.4 Inspection of preparation for delivery. The preservation, packing, packaging and marking of the units shall be examined and tested to determine conformance with the requirements of section 5 of the specification, and as required by specifications referenced therein. Inspection lots and sampling shall be in accordance with MIL-STD-105 with inspection level S-4 with an AQL of 6.5 percent defective.

## 5. PREPARATION FOR DELIVERY.

\*5.1 Packaging. Packaging shall be level A, B, or C as specified (see 6.2).

5.1.1 Levels A and B. Cleaning, drying, preservation and packaging shall be in accordance with MIL-P-116, Method III.

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\*5.1.2 Level C (Commercial Packaging). Slotted angles and panels shall be packaged to afford adequate protection against physical damage during shipment from the supplier to the first receiving activity. The package and the quantity per package shall be the same as that normally used by the supplier for retail distribution.

\*5.2 Packing. Packing shall be level A, B, or C as specified (see 6.2).

5.2.1 Level A. Slotted angles, panels and accessories when required, segregated for form and size, as applicable, shall be packaged in cleated plywood boxes, nailed wood boxes, skid cleated load bearing base wood boxes, or unsheathed crates conforming to PPP-B-601 (overseas type), PPP-B-621 (Class 2), MIL-B-26195 and PPP-C-650 respectively. The gross weight of the boxes shall not exceed 1000 pounds. The gross weight of the crates shall be subject to the weight limitations of the specification. The boxes and crates shall be closed and strapped in accordance with the appendix of the applicable specification.

5.2.2 Level B. Slotted angles, panels and accessories when required, shall be packed as specified in 5.2.1 except that the cleated plywood box shall conform to PPP-B-601 (domestic type) and the nailed wood box to PPP-B-621 (Class 1).

\*5.2.3 Level C (Commercial Packaging). Slotted angles and panels, packaged as specified in 5.1, shall be packed in a manner to insure carrier acceptance and safe delivery to destination at the lowest transportation rate for such supplies. The quantity per shipping container shall be the same as that normally used by the supplier for retail distribution. Containers shall comply with Uniform Freight Classification Rules, National Motor Freight Classification Rules, or the regulations of other carriers as applicable to the mode of transportation.

5.3 Marking. In addition to any special marking required by the contract or order, shipping containers shall be marked in accordance with Standard MIL-STD-129.

## 6. NOTES

\*6.1 Intended use. Material described herein is intended for the construction and erection of frame type units of warehouse shelving, racks, stands, etc. It is also intended for the framework of small buildings, sheds, walkways, and crating. When the material is intended for outdoor use, a class 3 finish shall be required.

## 6.2 Procurement instructions.

6.2.1 Unit package. A unit package of Unit A (par. 1.2) material shall be 10 pieces of the same dimensions of slotted metal angle supplied with not less than 75 each bolts and nuts as specified in 3.4.1. A unit package of Unit B material shall be 12 pieces of the same dimensions of panels supplied with not less than 48 each bolts and nuts as specified in 3.4.1.

\*6.2.2 Ordering Data. Procurement documents should specify the following:

- (a) Title, number and date of this specification.
- (b) Number of unit packages (see 6.2.1) of Unit A and Unit B by types and dimensions required. (See 3.2.3 and 3.3.3)
- (c) Additional copies of instructions or quantities of bolts and nuts required (3.6 and 3.4.1).
- (d) If self-locking nuts are required (3.4.1).

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- (e) Class of finish required (3.5.1 and 6.1).
- (f) Color of Class 1 finish required if other than DOD Gray (3.5.1).
- (g) Level of packing and packaging required (5.1 and 5.2).
- (h) Special inspection or testing required.

\*6.3 Note 1. The gage of metal used in the fabrication of angles and panels covered by this specification shall be dimensionally defined by the thicknesses specified in the "Manufacturers' Standard" of the American Iron and Steel Institute. As these are only approximate thicknesses, they are listed only for guidance and are not for inspection purposes. The acceptability of the thickness of metal furnished shall be determined per paragraph 3.1.1.

GAGE NO.	12	13	14	18	22
APPROX. THICKNESS	0.1046"	0.0897"	0.0747"	0.0478"	0.0299"

6.4 Note 2. The margins of this specification are marked with an asterisk to indicate where changes (additions, modification, 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 contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the previous issue.

## CUSTODIANS:

Air Force - 84  
 Army - GL  
 Navy - YD

## PREPARING ACTIVITY:

Air Force - 84

## PROJECT NUMBER:

7125-0093

## 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 waiver any portion of the referenced document(s) or to amend contractual requirements.

**I RECOMMEND A CHANGE:**

 1. DOCUMENT NUMBER  
MIL-S-21041C

 2. DOCUMENT DATE (YYMMDD)  
75/01/06

## 3. DOCUMENT TITLE

SLOTTED METAL FRAMING, ANGLES AND PANELS

 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)*

 e. DATE SUBMITTED  
*(YYMMDD)*

 (1) Commercial  
(2) AUTOVON  
*(If applicable)*
**8. PREPARING ACTIVITY**

a. NAME

WR-ALC/LKJE

 b. TELEPHONE *(Include Area Code)*

 (1) Commercial (912) 926-2864  
(2) AUTOVON 468-2864

 c. ADDRESS *(Include Zip Code)*

 225 OCMULGEE COURT  
ROBBINS AFB, GA 31098-1647

**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:**

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