

INCH-POUND

MIL-DTL-8878L
27 March 2014
SUPERSEDING
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w/AMENDMENT 1
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DETAIL SPECIFICATION

TURNBUCKLES, POSITIVE SAFETYING, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers positive safetying turnbuckle component parts.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of the documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 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 these documents are those cited in the solicitation or contract.

Comments, suggestions, or questions on this document should be addressed to DLA Aviation, VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or e-mailed to STDZNMGT@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST database at <https://assist.dla.mil>.

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DEPARTMENT OF DEFENSE SPECIFICATIONS

- | | |
|---------------|--|
| MIL-S-6050 | - Steel, Chrome-Nickel-Molybdenum (8630) Bars and Reforging Stock (Aircraft Quality) |
| MIL-A-8625 | - Anodic Coatings for Aluminum and Aluminum Alloys |
| MIL-PRF-16173 | - Corrosion Preventive Compound, Solvent Cutback, Cold-Application |

(See supplement 1 for list of specification sheets.)

DEPARTMENT OF DEFENSE STANDARDS

- | | |
|-------------|--|
| MIL-STD-130 | - Identification Marking of U.S. Military Property |
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(Copies of these documents are available online at <http://quicksearch.dla.mil>)

2.2.2 Other government documents. The following other government documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

STANDARDIZATION DOCUMENTS

- | | |
|------|--------------------------------------|
| SD-6 | - Provisions Governing Qualification |
|------|--------------------------------------|

(Copies of this document are available online at <http://quicksearch.dla.mil/>)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- | | |
|-----------|---|
| ASME B1.1 | - Unified Inch Screw Threads (UN and UNR Thread Form) |
|-----------|---|

(Copies of this document are available from <http://www.asme.org/> or from American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

- | | |
|----------|---|
| ASQ Z1.4 | - Sampling Procedures and Tables for Inspection by Attributes |
|----------|---|

(Copies of these documents are available from <http://www.asq.org/> or American Society of Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203.)

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ASTM INTERNATIONAL

ASTM A313/A313M	- Standard Specification for Stainless Steel Spring Wire
ASTM A564/A564M	- Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A967/A967M	- Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM B21/B21M	- Standard Specification for Naval Brass Rod, Bar, and Shapes
ASTM B135	- Standard Specification for Seamless Brass Tube
ASTM E8/E8M	- Standard Test Methods for Tension Testing of Metallic Materials
ASTM E140	- Standard Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, and Scleroscope Hardness
ASTM E1417/E1417M	- Standard Practice for Liquid Penetrant Testing

(Copies of these documents are available from <http://www.astm.org/> or ASTM International, 100 Barr Harbor Drive, Conshocken, PA 19428-2959.)

SAE INTERNATIONAL

SAE AMS2430	- Shot Peening, Automatic
SAE AMS2700	- Passivation of Corrosion Resistant Steels
SAE AMS2770	- Heat Treatment of Wrought Aluminum Alloy Parts
SAE AMS5643	- Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings 16Cr - 4.0Ni - 0.30Cb - 4.0Cu Solution Heat Treated, Precipitation Hardenable
SAE AMS6360	- Steel Tubing, Seamless, 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130) Normalized or Stress Relieved
SAE AMS-H-6875	- Heat Treatment of Steel Raw Materials
SAE AMS-QQ-A-225/6	- Aluminum Alloy, 2024, Bar, Rod, and Wire; Rolled, Drawn, or Cold Finished - UNS A92024
SAE AMS-QQ-P-416	- Plating, Cadmuim (Electrodeposited)
SAE AMS-S-6758	- Steel, Chrome-Molybdenum (4130) Bars and Reforging Stock (Aircraft Quality)
SAE AMS-WW-T-700/3	- Tube, Aluminum Alloy, Drawn, Seamless, 2024

(Copies of these documents are available from <http://www.sae.org/> or from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

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2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related associated MS 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 MS sheets. The individual item requirements shall be as specified herein and in accordance with the applicable MS sheet. In the event of any conflict between the requirements of this specification and the MS sheet, the latter shall govern.

3.2 Qualification. The turnbuckle component parts furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see [4.3](#) and [6.3](#)).

3.3 Material. The material used in the manufacture of turnbuckle parts and locking clips shall be as specified herein.

3.3.1 Turnbuckle bodies. The turnbuckle bodies shall be made of one of the following materials.

3.3.1.1 Brass bodies. Brass turnbuckle bodies shall be made from UNS C48200 or UNS C46400, hard tempered (H04), per ASTM B21/B21M or UNS C33000, seamless brass tubing, per ASTM B135. The 15 percent minimum elongation value in table II of ASTM B135 is changed to 9 percent minimum. Marking by impression stamping, if used, shall be done before stress relieving. Brass turnbuckle bodies shall be stress relieved at 450 °F for two hours after fabrication.

3.3.1.1.1 Hardness. Finished brass turnbuckle bodies shall have a minimum hardness of R15T-70.

3.3.1.2 Steel bodies. Steel turnbuckle bodies shall be made from UNS G86300 steel bar per MIL-S-6070 or UNS G41300 steel bar per SAE AMS-S-6758 or UNS G41300 seamless steel tubing per SAE AMS6360, except that the tensile strength shall be 75,000 pounds per square inch (psi) minimum.

3.3.1.3 Aluminum bodies. Aluminum turnbuckle bodies shall be made from UNS A92024 aluminum alloy temper T4 or T851 per SAE AMS-QQ-A-225/6 or UNS A96061 aluminum tubing material per SAE AMS-WW-T-700/3, except that heat treatment shall be T81 or T851 per SAE AMS2770.

3.3.2 Clevis and eye turnbuckle ends. Clevis and eye turnbuckle ends shall be made of either corrosion resistant steel or carbon or alloy steel as specified. Carbon or alloy steel is inactive for new design. Corrosion resistant steel should be used in current applications whenever possible. The finished parts shall conform to applicable requirements of this specification.

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3.3.2.1 Corrosion resistant ends. Corrosion resistant steel clevis and eye turnbuckle ends shall be forged or machined from UNS S17400 in the H1150 condition per SAE AMS5643 or in the H1150 or H1150M condition per ASTM A564/A564A.

3.3.2.2 Carbon or alloy steel ends. Carbon or alloy steel turnbuckle ends are inactive for new design and not preferred. Corrosion resistant steel should be used when possible. Carbon or alloy steel clevis and eye turnbuckle ends shall be made of UNS G41300 steel per SAE AMS-S-6758. Ends not fabricated from heat treated material shall be heat treated per SAE AMS-H-6875 to conform to this specification and the applicable MS sheet.

3.3.3 Locking clip. The locking clip shall be made of corrosion-resisting steel wire, composition UNS S30200 or UNS S30400 per ASTM A313/A313M.

3.4 Construction. The construction of turnbuckle components shall be as specified herein and on MS21251, MS21252, MS21253, MS21254, MS21255, and MS21256.

3.4.1 Turnbuckle body and ends. Turnbuckle body and ends shall contain facilities for employing a locking clip that will provide positive safetying of mating parts in assembly.

3.4.1.1 Positive safetying. Positive safetying, for purpose of this specification, is defined as preventing rotational movement between turnbuckle body and end within the requirements of this specification without structural failure of the components or locking clip.

3.4.2 Locking clip. The locking clip shall be constructed as specified herein and on MS21256. It shall be capable of being installed manually without the use of tools and shall be self-retaining in assembly.

3.5 Protective treatment. Steel and aluminum parts shall be treated for corrosion protection as specified.

3.5.1 Steel parts.

3.5.1.1 Carbon and alloy steel. Carbon and alloy steel turnbuckle parts shall be cadmium plated per type II, class 2, of SAE AMS-QQ-P-416.

3.5.1.1.1 Bore of carbon and alloy steel parts. The bore of carbon and alloy steel parts shall be coated with corrosion preventive compound conforming to grade 1 of MIL-PRF-16173.

3.5.1.2 UNS S17400 steel. After removal of all oil and grease, terminals shall be treated by one of the following methods:

- a. Nitric passivation per ASTM A967/A967M, Nitric 3 method or SAE AMS2700, Method 1, type 7.
- b. Nitric passivation per ASTM A967/A967M, Nitric 1 method or SAE AMS2700, Method 1, type 2
- c. Citric passivation per ASTM A967/A967M, Citric 1, 2 or 3 method or SAE AMS2700, Method 2.
- d. Glass bead peening per SAE AMS2430.

The method of treatment is at the manufacturer's option unless specified in the contract (See [6.2.e](#)).

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3.5.2 Aluminum parts. Aluminum alloy shall be anodized per MIL-A-8625, type II, class 1.

3.6 Dimensions. The dimensions of turnbuckle bodies, turnbuckle ends, and the locking clip shall conform to those specified on the applicable MS sheet.

3.6.1 Threads. The internal threads in the turnbuckle bodies shall conform to ASME B1.1 UNF-3B. Concentricity between tap hole and threads shall be such that the locking clips can be installed with the terminals engaged to the cross hole for all locking slots (see [4.6.5.1](#)).

3.7 Physical properties.

3.7.1 Rotational movement. The total angular clockwise and counterclockwise rotational movement between turnbuckle body and turnbuckle end with locking clip installed shall not exceed that specified in [table I](#) when subjected to 10 percent of the specified torsion load (see [4.6.1](#)).

TABLE I. Torsion test loads and rotational movement.

MS sheet dash number	Minimum torque (in-lbs)	10% of torsion load (in-lbs)	Rotation movement (maximum degrees)
2	8	0.8	15
3	26	2.6	11
4	82	8.2	8
5	82	8.2	8
6	163	16.3	7
7	318	31.8	6
8	318	31.8	6
9	523	52.3	5
10	750	75.0	4

3.7.2 Torsion. Turnbuckle bodies and ends shall be capable of withstanding the torsional loads specified in [table I](#), applied clockwise and counterclockwise direction without permanent deformation when tested per [4.6.2](#).

3.7.3 Tensile fatigue. Turnbuckle bodies and ends shall be capable of withstanding a load equal to 60 percent of the minimum breaking strength (MBS) specified on the applicable MS sheet, applied repeatedly in tension at a rate of approximately one cycle per second for 300 applications without failure, deformation, or permanent increase in overall length of any component part in excess of 0.001 inch per inch in the direction of the application of load (see [4.6.3](#)).

3.7.4 Breaking strength. The MBS of turnbuckle parts shall not be less than the values specified on the applicable MS sheet (see [4.6.4](#)).

3.7.5 Bending. Turnbuckle ends shall withstand bending through an angle of 90 degrees without cracking or fracture. Locking clip formed radii shall withstand straightening so that the test sample becomes approximately a straight length of wire (see [4.6.6](#)).

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3.7.6 Locking clip retention. Locking clips when installed in the turnbuckle assembly shall withstand a removal or disengagement force of 15 pounds (lbs.) when tested per [4.6.5](#).

3.8 Identification. Turnbuckle bodies and ends shall be marked with the manufacturer's name or trademark and the applicable MS part number per MIL-STD-130. All turnbuckle bodies shall be dated showing the year of manufacture by any permanent means available in MIL-STD-130. Location of the marking shall be as indicated on the applicable MS sheet. Where space will not permit all marking to be located in a single area, the information shall be divided appropriately and conspicuously located in two adjacent areas. The maximum depth of marking will be in accordance with the applicable MS sheets. On certain curved surfaces, this depth may be exceeded to assure adequate legibility.

3.8.1 Marking. Each clip shall be coated with light blue Dykem code DMF (staining color shall be obtained from the Dykem Company, 8501 Delport Drive, St. Louis, MO 63114), or equal. Incomplete coverage shall not be cause for rejection. (Equivalent processes shall be evaluated, when requested through the qualification activity.)

3.9 Workmanship. Turnbuckle parts shall be 125 root mean square (RMS) or better and free from burrs, sharp edges, cracks, flaws, pronounced tool marks, or other discontinuities that would prevent proper functioning or performance. Slight burrs in the thread locking area that do not prevent gauging or interfere with installation of the terminal and locking clip are acceptable. Discoloration resulting from heat treatment of UNS S17400 will be removed.

3.10 Penetrant inspection. Brass and aluminum turnbuckle bodies shall be fluorescent penetrant inspected per ASTM E1417/E1417M. Any crack visible with the unaided eye shall be cause for rejection.

4. VERIFICATION

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

- a. Qualification inspection (see [4.3](#)).
- b. Conformance inspection (see [4.4](#)).

4.2 Qualification test facilities. Due to the critical nature of these products and the urgent and ongoing requirement for quality control, qualification test facilities must be readily accessible to government personnel.

4.3 Qualification inspection.

4.3.1 Sampling instructions. Qualification test samples shall consist of four turnbuckle assemblies containing the component part of the type and size upon which qualification is desired. The four turnbuckle assemblies are to be distributed as specified in [table II](#).

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TABLE II. Qualification test sample distribution.

Test	Quantity
Rotational movement	1
Torsion	Use rotational movement sample
Hardness	Use rotational movement sample
Tensile fatigue	1
Breaking strength	1
Locking clip retention	1
Bending	Use breaking strength sample

4.3.2 Tests. The qualification tests of turnbuckle component parts shall consist of all the tests specified under [4.5](#) and [4.6](#).

4.3.3 Maintenance of qualification. At specified intervals determined by the qualifying activity, the manufacturer must be able to demonstrate that the company still has the capabilities and facilities necessary to produce the QPL items in accordance with this specification and in accordance with the provisions governing qualification specified in SD-6.

4.4 Conformance inspection. Conformance tests shall consist of examinations and tests specified under [4.5](#), [4.6.4](#), [4.6.5](#), [4.6.6](#), and [4.6.7](#).

4.4.1 Inspection lot. An inspection lot shall consist of turnbuckle component parts of the same type, size, and material produced under the same manufacturing conditions. The unit of inspection shall be one turnbuckle component part except for hardness and examination of product.

4.4.2 Hardness sampling. The unit of inspection shall be one brass turnbuckle body per stress relief batch.

4.5 Examinations.

4.5.1 Examination of product. Each sample part shall be examined for conformance to the material, design, dimensional, protective treatment, marking, workmanship, and penetrant inspection requirements of this specification and the applicable MS sheet.

4.5.2 Sampling. ASQ Z1.4 shall be used as a guide in the development of contractor's statistical techniques to assure the components meet all requirements specified herein.

4.6 Tests.

4.6.1 Rotational movement. A turnbuckle assembly containing the sample component part with a locking clip installed, shall be subjected to 10 percent of the applicable torque load specified in [table I](#), applied in a clockwise and counterclockwise direction. The total relative angular rotation between the turnbuckle end and turnbuckle body (less the free play) from the extreme of one direction (clockwise) to the extreme of the other (counterclockwise) shall be measured for conformance to [3.7.1](#).

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4.6.2 Torsion. A turnbuckle assembly containing the sample component part with a locking clip installed shall be subjected to the applicable torque load specified in [table I](#), applied in a clockwise and counterclockwise direction for five complete cycles. The turnbuckle shall then be disassembled and the sample shall be inspected for evidence of failure per [3.7.2](#). There shall be no evidence of cracks in the sample turnbuckle part of locking clip. Deformation of the turnbuckle or locking clip is acceptable if parts can be disassembled by hand.

4.6.3 Tensile fatigue. A turnbuckle assembly containing the sample component part shall be subjected to a tension load equal to 60 percent of the MBS specified on the applicable MS sheet for the sample, applied repeatedly in tension at a rate of approximately one cycle per second for 300 applications. The turnbuckle assembly shall be disassembled and the sample parts shall be inspected for conformance to [3.7.3](#). Elongation of the sample turnbuckle part(s) shall be determined per ASTM E8/E8M.

4.6.4 Breaking strength. A turnbuckle assembly containing the sample component part shall be tested for MBS by an appropriate means per ASTM E8/E8M. The MBS value is that specified on the applicable MS sheet. There shall be no evidence of failure in the sample part. It may be necessary to fabricate special high strength fixtures for attaching to the parts to be tested in order to develop the required loads.

4.6.5 Locking clip retention. A locking clip shall be installed in a turnbuckle per the instructions specified on MS33736. A direct pull of 15 lbs. shall be applied to the locking clip as shown on [figure 1](#). The locking clip shall not break nor shall the retention feature become disengaged.

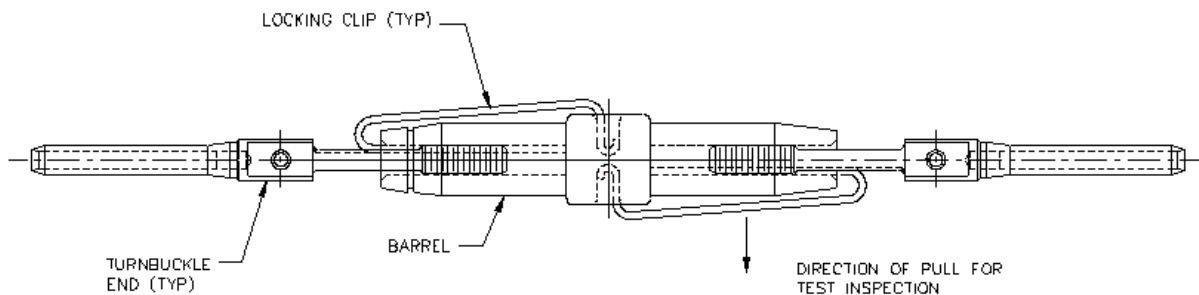


FIGURE 1. Locking clip retention.

4.6.5.1 Functional acceptability. The turnbuckle body and mating terminals must be assembled and the locking clip inserted in each end of the turnbuckle body. After removing clips, except for -2, the terminals are rotated one half turn and the locking clip inserted once again. This functional assembly requirement tests every combination of the locking capability of the assembly.

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4.6.6 Bending. Turnbuckle parts shall be tested for bending as follows:

4.6.6.1 Turnbuckle ends. Sample turnbuckle ends that pass the breaking strength test (see [4.6.4](#)) shall be held in a square-nosed vise and the shank bent through an angle of 90 degrees. There shall be no evidence of failure or cracking when inspected.

4.6.6.2 Locking clip. Locking clip must withstand straightening with the use of pliers. The various formed radii shall be straightened so that the sample becomes approximately a straight length of wire. This is to insure that brittleness has not been induced in the formed areas of the clip. There shall be no evidence of failure (break) or cracking.

4.6.7 Hardness. Hardness testing shall be performed on the outer surface of the brass turnbuckle body in accordance with ASTM E140.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see [6.2](#)). When packaging of material is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. 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

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Turnbuckles and component parts are intended for use in the construction of aircraft and aircraft accessories.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Name of part.
- c. Part number.
- d. Packaging requirements (see [5.1](#)).
- e. Passivation method, if specific method required (see [3.5.1.2](#))

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6.3 Qualification. With respect to products requiring qualification, awards will be made only for products that are, at the time of award of contract, qualified for inclusion in QPL-8878 whether or not such products have actually been so listed by that date. The attention of contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DLA Aviation, VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or STDZNMGT@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

6.4 Subject term (key word) listing.

Cadmium
Chrome
Chrome nickel
Citric acid
Connectors
Fittings
Nitric acid
Wire rope assemblies

6.5 Revision notations. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue, except editorial corrections, 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.

Custodians:
Navy – AS
Air Force – 99
DLA – GS

Preparing Activity:
DLA – GS5

(Project 1640-2014-001)

Review Activity:
Air Force – 71

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