INCH-POUND

MIL-DTL-781J
10 March 2014
SUPERSEDING
MIL-DTL-781H
1 April 2005
MIL-DTL-781H
w/AMENDMENT 3
17 February 2009

DETAIL SPECIFICATION

TERMINAL, WIRE ROPE SWAGING, 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 wire rope terminals designed for attachment to wire rope by swaging.

1.2 Classification. The terminals will be of the following types, as specified (see 6.2).

1.2.1 Types. The types of terminals are as follows:

Type I - Straight shank terminals
Type II - Ball-end terminals
Other - Eye and fork end strap terminals

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.

Comments, suggestions, or questions on this document should be addressed to Defense Logistics Agency - Aviation, ATTN: DLAA-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or emailed 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/.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standard 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.

FEDERAL SPECIFICATIONS

RR-W-410	-	Wire Rope and Strand

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-6117	-	Wire Rope Assemblies, Aviation, Swaged Type
MIL-DTL-83420	-	Wire Rope, Flexible, for Aircraft Control, General Specification for

(See supplement 1 for list of specification sheets.)

(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 these documents 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.

AEROSPACE INDUSTRIES ASSOCIATION

NAS494	-	Terminal - Ball Type Cable
NAS1435	-	Terminal - Strap, Cable Eye End and Fork End

(Copies of these documents are available online at http://www.aia-aerospace.org/ or from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3901.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	-	Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B46.1	-	Surface Texture (Surface Roughness, Waviness, and Lay)

(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 this document are available from http://www.asq.org/ or from American Society of Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203.)

ASTM INTERNATIONAL

ASTM A967/A967M	-	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM E18	-	Standard Test Methods for Rockwell Hardness of Metallic Material

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

SAE INTERNATIONAL

SAE AMS2430	-	Shot Peening, Automatic
SAE AMS2700	-	Passivation of Corrosion Resistant Steels

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

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

3.2 Qualification. Steel wire rope terminals furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3). Qualification requirements do not apply to NAS494 and NAS1435 terminals.

3.3 Material. Unless otherwise specified, all terminals, except NAS1435, shall be made of corrosion resistant steel, 303Se (UNS S30323) or 304 (UNS S30400). NAS1435 terminals shall be made of 301(UNS S30100), 302 (UNS S30200), 304 (UNS S30400) or 304L (UNS S30403). All terminals shall be suitable for swaging onto wire ropes in accordance with the requirements of 3.3.1.

3.3.1 Tensile strength. Except for NAS494 and NAS1435 terminals, the maximum tensile strength shall not exceed 125,000 pounds per square inch for sizes under 1/4 inch in thickness and 115,000 pounds per square inch for sizes 1/4 inch and larger in thickness. Where applicable, tensile strengths for parts that will be subjected to finish annealing may be higher than those specified, but must meet the hardness requirements delineated in 3.8.3, after annealing.

3.4 Threads. Threads shall be in accordance with ASME B1.1.

3.5 Design and dimensions.

3.5.1 Type I shank terminals. The design and dimensions of type I terminals shall be in accordance with MS20658, MS20667, MS20668, MS21259, or MS21260, as specified in the contract or order (see 6.2).

3.5.2 Type II ball-end terminals. The design and dimensions of type II terminals shall be in accordance with MS20663, MS20664, or NAS494, as specified in the contract or order (see 6.2).

3.5.3 Strap, cable eye end and fork end terminals. The design and dimensions of strap, cable eye end and fork end terminals shall be in accordance with NAS1435, as specified in the contract or order (see 6.2).

3.6 Protective treatment.

3.6.1 Surface treatment methods. 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).

3.6.2 Washing. Upon completion of any treatment specified in 3.6.1except (d), the terminals shall be thoroughly rinsed in water and dried.

3.6.3 Retreatment. Retreatment of terminals after swaging is not required.

3.7 Surface roughness. The surface roughness of the machined surface, except in the threaded area, shall not exceed 125 root mean square (RMS) in accordance with ASME B46.1.

3.8 Performance.

3.8.1 Distortion. Except for NAS494 and NAS1435 terminals, elongation shall not exceed 0.001 inch per inch in the direction of load application (see 4.6.1) for any measured dimension resulting after the application of a proof load. The proof load shall be applied for 5 seconds and shall be 60 percent of the minimum breaking strength (MBS) as specified in the related MS sheet for terminal sizes up to 3/8. Sizes 7/16 and larger shall be tested at a proof load of 40 percent MBS.

3.8.1.1 Marks from NAS1435 fittings. Marks on MS20663, MS20664, or AIA NAS494 ball end fittings caused by AIA NAS1435 fittings during proof loading are not considered distortion and shall not be considered as failures of the ball fittings.

3.8.2 Breaking strength. Terminals shall be capable of withstanding a tension load equal to the MBS specified on the applicable MS or NAS sheet when tested in accordance with 4.6.2.

3.8.3 Hardness. When tested in accordance with paragraph 4.6.3, terminal hardness readings shall not exceed a Rockwell A-scale value of 62.5 or Rockwell B-scale value of 100.

3.9 Identification of product. Terminals shall be marked for identification in accordance with the applicable MS or NAS sheet. The maximum depth of marking shall be in accordance with the applicable MS or NAS sheet, however, on certain curved surfaces, the maximum depth specified may be exceeded to assure adequate legibility. Unless otherwise specified, the position of the marking is optional.

3.9.1 Method of marking. Indention as specified on the applicable MS sheets may be done by stamping, chemical or laser etching, or any other method that will provide a permanent mark. Method of marking is at the manufacturer's option.

3.10 Workmanship. Terminals shall be uniform in quality and free from pits, voids, burrs, sharp edges, rust, laps, cracks, seams and other detrimental defects that would prevent proper functioning or performance. Slight burrs in the thread-locking slot area that do not prevent gauging or interfere with installation of the barrel and locking clip are acceptable.

4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 Qualification inspections. The qualification inspections shall consist of all the tests and examinations of this specification.

4.2.1 Sampling instructions. Qualification test samples shall consist of a minimum of four terminals of the type and size upon which qualification is desired. Either the left-hand or right-hand threaded fitting may be submitted for qualification approval, wherein qualification of one would automatically mean approval of the other without additional tests

4.2.2 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.

4.3 Conformance inspection. The conformance inspection shall consist of:

a. Examination of product (see 4.5.1).
b. Hardness (see 4.6.3).
c. Breaking strength (see 4.6.2).

4.3.1 Lot. A lot shall consist of finished terminals of the same material, size, and part number produced consecutively by the same machine or series of progressive processing machines submitted for inspection at the same time under one contract or order. Lots shall be segregated and marked to identify them with their respective random samples designated for testing.

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

4.4 Test preparations. Sample terminals to be tested for distortion and breaking strength shall be swaged, in accordance with MIL-DTL-6117, to 2-foot lengths (minimum) of the appropriate size wire rope conforming to MIL-DTL-83420 for sizes of wire rope up to and including 3/8-inch diameter or to RR-W-410 for 6 x 19 independent wire rope core (IWRC) construction, 7/16-inch diameter and larger as applicable. The swaged terminals shall be examined for cracks and splits and dimensions accurately measured and noted.

4.5 Examinations.

4.5.1 Examination of product. Each sample terminal shall be examined to determine conformance to dimensions, workmanship, and all other requirements of this specification not covered by tests.

4.6 Tests.

4.6.1 Distortion. A proof load of 60 percent of the MBS specified on the applicable MS sheet shall be applied to the terminal-wire rope assembly for sizes up to and including 3/8-inch diameter. The proof load shall be 40 percent of MBS for sizes 7/16-inch diameter and larger. After holding for 5 seconds, the load shall be released and the terminal measured for distortion. Permanent increase of the overall dimensions measured in the direction of application of load shall not exceed 0.001 inch per inch.

4.6.2 Breaking strength. The wire rope-terminal assembly shall be subjected to the specified MBS on a tension testing machine. The load shall be applied to the fitting end of the terminal in a manner similar to that for which it was designed. Prior to application of the load, the wire rope shall be marked at the point where it enters the swaging end of the terminal. Any slippage of the wire rope in the fitting, or signs of failure in the terminal shall be cause for rejection. The test wire rope must not break below the minimum required breaking strength of the terminal. In order to achieve breaking strength required for terminal, a carbon steel wire rope should be used.

4.6.3 Hardness. Terminals and ball ends shall be tested in accordance with ASTM E18 to determine compliance with 3.8.3. Hardness values will be obtained from the area reserved for swaging. Correction for convex surfaces shall be made when appropriate. Because of variations caused by surface work hardening, sectionalized hardness testing is permitted to ascertain conformance when values exceed the allowable limit. The sectioned hardness test must be performed on a cross-section of the area reserved for swaging.

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. The corrosion-resistant steel terminals covered by this specification are intended for swaging to corrosion-resistant steel and galvanized wire rope conforming to MIL-DTL-83420 or RR-W-410 as applicable. These terminals can also be used in applications involving corrosive conditions or where non-magnetic properties are essential.

6.1.1 Type I terminals. Type I terminals are the regular terminals in general use on aircraft wire rope assemblies.

6.1.2 Type II terminals. Type II terminals are designed for use in ordnance and glider control installations, secondary control systems such as switch or mechanism actuation, trim tab control, etc., and in attaching wire ropes to quadrants, drums, etc., in the wire rope control systems of powered aircraft.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Type of terminal required (see 1.2).
c. MS or NAS sheet, assembly numbers, or other drawing numbers required (see 3.5.1, 3.5.2, and 3.5.3).
d. Packaging requirements (see 5.1).
e. Specific surface treatment method if required (see 3.6.1).

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-781 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 orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Logistics Agency - Aviation, ATTN: DLAA-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or STDZNMGT@dla.mil.

6.4 Subject term (key word) listing.

Ball end
Eye
Fork
Shank ball end
Straight shank terminal
Strap eye
Strap fork

6.5 Amendment notations. The margins of this specification are marked with vertical lines to indicate where modifications from this amendment 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:
Army - CR
Navy - AS
Air Force - 99
DLA - GS

Review Activities:
Army - AR, GL, MI
Navy - MC
Air Force - 71

Preparing Activity:
DLA - GS5

(Project 1640-2013-001)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST database at https://assist.dla.mil/.