INCH-POUND
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SUPERSEDING
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DETAIL SPECIFICATION

SHACKLE: CABLE, AIRCRAFT

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

1. SCOPE

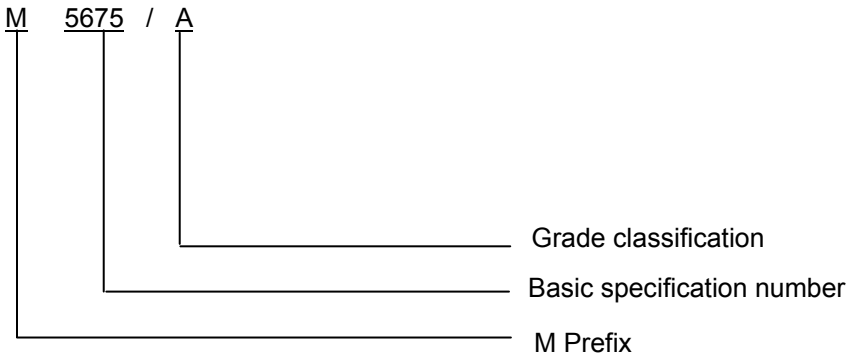
1.1 Scope. This specification establishes the requirements for aircraft cable shackles to be furnished in the grades identified herein.

1.2 Classification. Shackles are of the following grades, as specified by the acquisition requirement document (see 6.2).

1.2.1 Grade. The grades of shackles are as follows:

Grade A steel - cadmium or zinc plated
Grade B steel - corrosion resistant
Grade C nickel - copper - aluminum alloy

1.3 Part or Identifying Number (PIN). The PIN consists of the letter M, the basic specification number, a forward slash, and a letter.



Comments, suggestions, or questions on this document should be addressed to: Defense Supply Center, Columbus, DSCC-VAI, 3990 East Broad Street, Columbus, OH 43218-3990, or emailed to, construction@dscc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online at http://assist.daps.dla.mil/.

AMSC N/A FSC 4030

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this standard. 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 documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government Documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks 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

QQ-N-286	Nickel – Copper – Aluminum Alloy, Wrought (UNS N05500)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-889	Dissimilar Metals
MS20115	Shackle – Wire Rope

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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.

ASTM INTERNATIOINAL (ASTM)

ASTM-A376	Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
ASTM-B117	Salt Spray (Fog) Apparatus, Operating
ASTM-G47	Aluminum Alloy Products, Determining Susceptibility To Stress Corrosion Cracking Of 2xxx And 7xxx
ASTM B633	Zinc On Iron And Steel, Electrodeposited Coatings Of

(Copies of these documents are available from http://www.astm.org or ASTM International, P.O. Box C700, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

ASME INTERNATIONAL (ASME)

ASME Y-14.5M	Dimensioning and Tolerancing

(Copies of these documents are available from http://www.asme.org or ASME International, Three Park Avenue, New York, NY 10016-5990, Phone: 800-843-2763 (U.S/Canada)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE-AMS-6448	Steel Bars, Forgings, And Tubing 0.95cr - 0.22v (0.48 - 0.53c) (SAE 6150)
SAE-AMS-2700	Passivation of Corrosion Resistant Steels
SAE-AMS-QQ-P-416	Plating: Cadmium (Electrodeposited)
SAE-AMS-S-6758	Steel, Chrome-Molybdenum (4130) Bars And Reforging Stock (Aircraft Quality)

(Copies of these documents are available online from http://www.sae.org or from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrandale, PA 15096-001.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, 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 (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Quality.

3.2.1 Statistical process control (SPC). The contractor shall implement and use statistical process control (SPC) techniques, when possible, in the manufacturing of parts covered by this specification. The SPC program shall be developed and maintained in accordance with EIA-557. Where SPC cannot be utilized because of non-continuous production, a lot sampling plan for inspection with C = 0 (accept on zero defects) may be utilized. The SPC and C = 0 programs shall be documented and maintained as part of the overall reliability assurance program as specified in EIA-557 or equivalent. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification, effective 24 months after the date of this document. Dimensioning and tolerancing shall be in accordance with ASME Y-14.5M.

3.3 Materials. Shackles shall be forged from materials specified herein. (see table I).

TABLE I. Materials.

Grade Classification	Materials	Required document
Grade A shackles	Steel – Cadmium or Zinc plated	SAE-AMS-6448, SAE-AMS-S-6758, SAE-AMS-QQ-P-416, ASTM-B633
Grade B shackles	Steel – Corrosion resistant	SAE-AMS-7720
Grade C shackles	Nickel - Copper - Aluminum alloy	QQ-N-286

3.3.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle cost.

3.3.2 Hazardous substances. The use of hazardous substances, toxic chemicals, or ozone depleting chemicals (ODC's) shall be avoided, whenever feasible.

3.3.3 Other materials. Materials not otherwise specified shall conform to applicable specifications and to the requirements specified herein. All materials that are not specifically described shall be of the highest quality and suitable for the purpose intended. There shall be no presence of cadmium, titanium, magnesium, mercury, or beryllium (see 6.4)

3.3.4 Grade A shackles. Grade A shackle, shall be made from steel in accordance with SAE-AMS-6448 or SAE-AMS-S-6758.

3.3.5 Grade B shackles. Grade B shackles shall be made from corrosion-resistant steel conforming to SAE-AMS-S-7720.

3.3.6 Grade C shackles. Grade C shackle, shall be made from nickel-copper-aluminum alloy conforming to QQ-N-286.

3.3.7 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and galvanic corrosion shall be provided. Dissimilar metals such as brass, copper or steel (except corrosion-resisting steel passivated in accordance with SAE-AMS2700) shall not be used in intimate contact with aluminum or aluminum alloy. Protective measures for dissimilar metals shall be in accordance with MIL-STD-889.

3.4 Form and dimensions. The form and dimensions shall be as specified on MS20115.

3.5 Bend and tension. The shackle shall withstand the applicable load specified on MS20115 without cracks or failure when the shackle is bent as specified herein (see 4.8.3) and then returned to its original shape.

3.6 Finish. Shackles shall be free from cracks, seams, flaws or other imperfections when viewed as specified.

3.6.1 Grade A shackles. Grade A shackles shall be cadmium plated in conformance with SAE AMS-QQ-P-416 Type II, or zinc plated in accordance with ASTM-B633, Type II. This requirement gives a minimum protection of 96 hours against salt spray in accordance with ASTM-B117.

3.6.2 Grade B and C shackles. Grades B and C shackles shall be polished on all surfaces. Grades B and C shackles shall withstand exposure to salt spray as specified in 4.8.4.2 without showing any signs of corrosion. Superficial tarnish removable with a damp cloth shall not be cause for rejection, unless accomplished by pitting.

3.6.2.1 Salt spray exposure. Salt-spray testing of grade B shackles shall be in accordance with SAE AMS 2700.

3.7 Workmanship. The workmanship shall conform to high grade manufacturing practice for aircraft parts. Flashes or fins shall be trimmed off, even with, but not below, the surface. Shackles shall be free from pipes laps, cracks, cold shuts, scale pits, and other injurious defects. Scales shall be removed by sand blasting or tumbling.

4. VERIFICATION

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

a. First article inspection (see 4.5).

b. Conformance inspection (see 4.3).

4.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the applicable test procedures.

4.3 Conformance inspection. All finished shackles shall be carefully examined to determine conformance problems with the specification with respect to workmanship, form, and dimensions.

4.4 Responsibility for compliance. All items shall meet all requirements of sections 3, 4, and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.4.1 Lot records. Manufacturers shall keep lot records for 3 years minimum. Manufacturers shall monitor for compliance to the prescribed procedures, and observe that satisfactory manufacturing conditions and records on lots are maintained for these thimbles. The records, including as a minimum, an attributes summary of all quality conformance inspections conducted on each lot, shall be available to review by customers at all times.

4.5 First article inspection. First article inspection, if not done by the manufacturer, shall be performed at a laboratory acceptable to the procuring activity on sample units produced with equipment and procedures used in production.

4.6 Samples for first article. Samples for first article shall be representative of the products proposed to be furnished to this specification. Sampling shall be in accordance with 4.8.2.1.

4.7. First article inspection routine. All samples shall be subjected to first article testing in accordance with table II. Sequence is manufacturing’s discretion.

TABLE II. First article inspection.

Inspection	Requirement	Test method
Visual and mechanical inspections	3.7	4.9.1
Salt spray testing	3.6.2.1	4.9
Finish	3.6	4.8.4
Grade A shackles plating	3.6.1	4.8.4.1
Grade B & C shackles corrosion	3.6.2	4.8.4.2

4.7.1 Acceptance of first article inspection. Required first article tests may be eliminated if documented approval has been obtained from the procuring activity. A first article test cannot be waived by DLA unless the contractor has delivered the same item within the last three years, has no unfavorable quality history, and has not proposed changes to the processes or changed any subcontractors. DLA will not accept first article test results outside the stated requirements. All waivers or deviations shall be approved by the procuring activity.

4.7.2 Failures. All samples must meet all of the contract requirements. Failure of a sample unit to pass any test shall be cause for rejection of the entire lot and to grant first article approval.

4.7.3 First article samples. Samples shall be representative of the construction workmanship, components, and materials to be used during production. When a manufacturer is in continuous production of the shackles from one contract to another, submission of additional first article samples for a new contract may be waived at the discretion of the acquiring activity (see 6.2).

4.7.3.1 First article information. Upon completion of first article inspection, the Government activity responsible for conducting the inspection program (see 6.2), shall report the results of the inspection, with appropriate recommendation, to the contracting officer. Approval of the first article samples or the waiving of first article inspection does not preclude the requirements for performing conformance inspection.

4.7.3.2 Disposition of samples. First article samples shall be furnished to the Government as directed by the contracting officer (see 6.2).

4.8. Group A inspection. For manufacturers that have successfully passed first article inspections and are continuously producing shackles to this specification, on going inspections shall consist of individual inspections (see table III) and sampling and periodic inspections (see table IV). If first article is waived due to prior successful first article inspection the individual inspections and sampling and periodic inspections shall be the manufactures in house inspection procedures.

TABLE III. Group A inspections.

Inspections	Requirement paragraph	Inspection paragraph	Number of samples
Visual and mechanical	3.7	4.9.1	100%

4.8.1 Group B inspection. Sampling and periodic inspections shall consist of the inspections specified in table IV. Individual inspections shall be implemented on a continual basis throughout the production of thimbles.

TABLE IV. Group B inspections. 1/

Inspections	Requirement paragraph	Inspection paragraph	Number of samples
Salt Spray	3.6.2	4.9	4.8.2.1
Bend & Tension	3.5	4.8.3	4.8.2.1

1/ If the manufacturer can demonstrate that the periodic tests have been performed for two consecutive years with zero failures, then the frequency of the periodic test, with the approval of the qualifying activity, can be performed every fourth year.

4.8.2 Inspection lot.

4.8.2.1 Lot and sample. The inspection lot shall be product selected at random from the production lot without regard to quality and shall be the sample size specified in table V.

TABLE V. Lot and sample size.

Production lot size	Sample size
1 to 90	8
91 to 150	12
151 to 280	19
281 to 500	21
501 to 1200	27
1201 to 3200	35
3201 to 10,000	38
10,001 to 35,000	46

4.8.3 Bend and tension test. The shackles being tested shall be opened by means of a wedge under gradual pressure, or otherwise, until the minimum opening is at least equal to the specified inside diameter of the shackle, without cracking. The shackle shall then be returned to its original shape end the required load shall be applied through a shackle or a U-bolt similar in shape and size to the thimble-normally used with the shackle under test.

4.8.4 Finish. The surface condition of the entire sample shall be examined under a five-time magnification for imperfections as listed in 3.6

4.8.4.1 Grade A shackles. Plating thickness shall be tested in accordance with the applicable plating specification, ASTM E376

4.8.4.2 Grades B and C shackles. Grades B and C shackles shall be tested for corrosion resistance for a period of 200 hours in accordance with ASTM B117.

4.9 Salt spray testing. Fittings when subjected to corrosion resistance testing in accordance with ASTM B633 and ASTM B117, shall meet the requirements of 3.6.1. The following details shall apply:

4.9.1 Visual and mechanical inspection. Shackles shall be examined to ensure conformance with this specification and associated specification sheets. Continuous examination shall be performed to assure compliance with the following requirements:

a. First article (see 3.1).
b. Materials (see 3.3, 3.3.1).
c. Design, construction and physical dimensions (see 3.4).
d. Workmanship (see 3.7).

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 materiel 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.

6.0 NOTES

6.1. Intended use. Shackles are intended for use with wire thimbles in assembling spliced cable terminals.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. PIN and grade required (see 1.2, 1.3).
c. First article required (see 3.1).
d. Packaging requirements (see 5.1).

6.3 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

6.4 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet or exceed the operational and maintenance requirements, and promotes economically advantageous life cycle costs. Table VI lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. If any of these hazardous materials are required, it is recommended that they be used only when other materials cannot meet performance requirements.

TABLE VI. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and compounds	Lead and compounds	Toluene
Carbon Tetrachloride	Mercury and compounds	1,1,1 - Trichloroethane
Chloroform	Methyl Ethyl compounds	Trichloroethylene
Chromium and compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and compounds	Nickel and compounds	

6.5 Guidance on use of alternative parts with less hazardous or non-hazardous materials. This specification provides for a number of alternative plating materials via the PIN. Users should select the PIN with the least hazardous material that meets the form, fit, and function requirements of their application.

6.6 Subject term (key word) listing.

96 Hour corrosion protection
Nickel
Stainless steel
Copper-aluminum alloy
Spliced terminals
Wire thimbles

CONCLUDING MATERIAL

Custodians;
Army - AV
Navy - AS
Air Force – 99
DLA - CC

Preparing Activity:
DLA - CC

Review Activities:
Army -MI
Navy – SA, MC
Air Force – 11, 50, 70

Project 4030-2005-003

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 Online database at http://assist.daps.dla.mil.