

INCH- POUND

MIL-C-24774(SH)

7 July 1992

## MILITARY SPECIFICATION

CHAIN, STUD LINK, ANCHOR,  
FLASH BUTT WELDED, NONMAGNETIC

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers single shots (90-foot lengths) of 3/4, 7/8, 1, 1-1/8, and 1-1/4 inch, nonmagnetic, flash butt welded, stud link, anchor chain for use on mine warfare ships. Only one classification of chain is covered by this specification.

## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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 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-N-286 - Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500).  
TT-V-51 - Varnish, Asphalt.

## MILITARY

- MIL-P-24441 - Paint, Epoxy-Polyamide, General Specification for.  
MIL-P-24441/1 - Paint, Epoxy-Polyamide Green Primer Formula 150, Type I.  
DOD-E-24635 - Enamel, Gray, Silicone Alkyd Copolymer Semigloss (for Exterior Use). (Metric)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, 2531 National Center Bldg 3, Washington, DC 20362-5160 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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MIL-I-17214 - Indicator, Permeability; Low-MU (Go-No Go).

STANDARDS

MILITARY

- MIL-STD-271 - Requirements for Nondestructive Testing Methods.
- DOD-STD-2142 - Magnetic Silencing Characteristics Measurement of.  
(Metric)
- DOD-STD-2143 - Magnetic Silencing Requirements for the Construc-  
tion of Nonmagnetic Ships and Craft. (Metric)
- MIL-STD-45662 - Calibration Systems Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

NAVSHIPS 0900-LP-003-8000 - Metals, Surface Inspection Acceptance Standards.

(Application for copies should be addressed to the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products. (DoD adopted)
- E 381 - Standard Method of Macroetch Testing, Inspection, and Rating Steel Products, Comprising Bars, Billets, Blooms, and Forgings. (DoD adopted)

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

DET NORSKE VERITAS (DnV)

Certification of Offshore Mooring Chain (Certification Notes No. 2.6).

(Application for copies should be addressed to DET Norske Veritas, P.O. Box 300, N-1322 Hovik, Oslo, Norway.)

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(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 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), samples of chain shall be subjected to first article inspection (see 6.4) in accordance with 4.3.

3.2 Material. Form 1 material (unaged, bar, rod, and forging) in the hot finished condition and conforming to QQ-N-286 shall be used in manufacturing the chain links and studs. The material used in normal production shall be the same composition as the material used in the first article sample in chemistry, quality, and properties. The chain material from each mill run shall be identified through the chain fabrication process. Unidentified material shall be considered nonconforming.

3.2.1 Material mechanical properties. Material properties shall be as specified in table I. Column A refers to bar stock material used in making the chain after receiving a heat treatment identical to the chain heat treatment. Column B refers to material specimens taken from a typical chain link.

TABLE I. Mechanical properties after heat treatment.

Property	Column A bar stock (minimum values)	Column B link material (minimum values)
Ultimate tensile strength (ksi)	130	120
Yield strength (ksi)	75	70
Elongation (percent)	20	15
Reduction in area (percent)	32	24

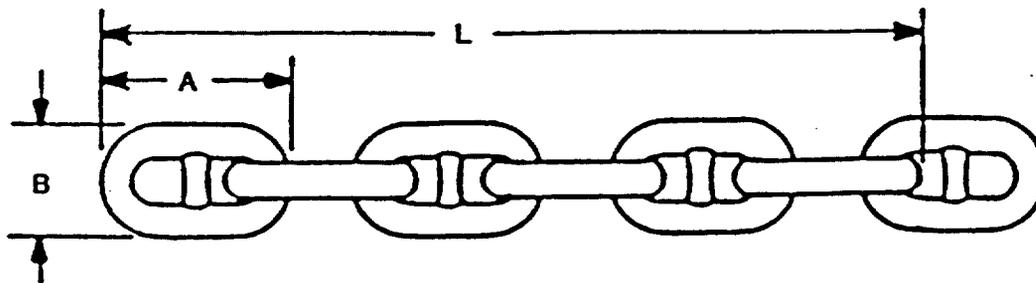
3.2.2 Recovered materials. Unless otherwise specified herein, all materials incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

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3.3 Link dimensions. Link dimensions and properties shall be as specified in table II and on figure 1 (see 6.2). Tolerances shall be as specified in table III and on figure 2. Any flash trim overage existing after the flash butt weld is deburred shall be as specified in table III. The grip radius (G) of each end of the link shall be symmetrical to ensure proper fit and function in the chain handling equipment.

TABLE II. Stud link chain dimensions and properties.

Chain size (inches)	Length A (inches)	Length over 6 links L (inches)			Link width B (inches)	Number of links per shot	Proof test load (pounds)	Break test load (pounds)	Minimum weight per 15-fathom shot (pounds)	Maximum weight per 15-fathom shot (pounds)
		Minimum	Nominal	Maximum						
3/4	4-1/2	19-3/8	19-1/2	19-3/16	2-11/16	359	39,600	64,800	520	563
7/8	5-1/4	22-5/8	22-3/4	23-1/16	3-1/8	305	53,900	88,200	705	765
1	6	25-7/8	26	26-3/8	3-5/8	267	70,400	115,200	920	1000
1-1/8	6-3/4	29-1/16	29-1/4	29-5/8	4-1/16	237	89,100	145,800	1165	1270
1-1/4	7-1/2	32-5/16	32-1/2	32-15/16	4-1/2	213	110,000	180,000	1435	1565

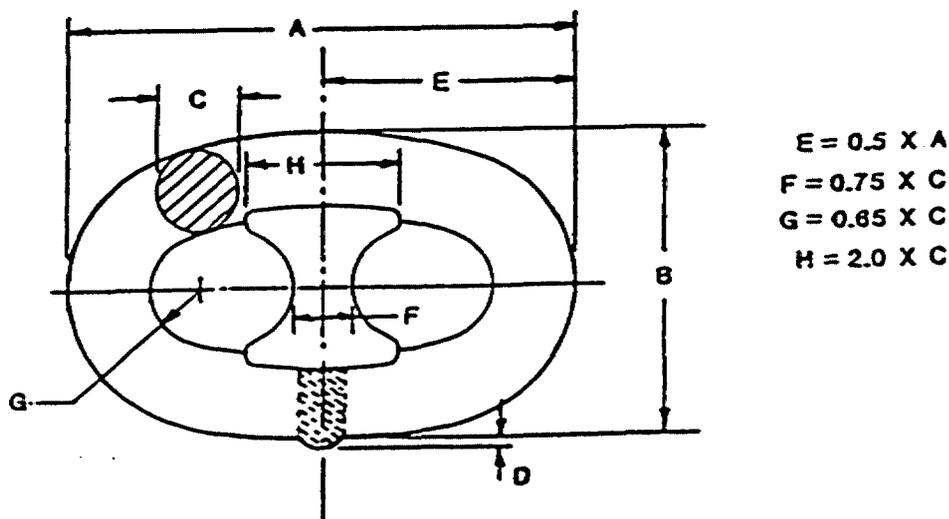
FIGURE 1. Stud link chain dimensions.

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TABLE III. Stud link tolerances.

Nominal chain size (C) (inches)	Permissible tolerances (inch)							
	Link length (A) plus or minus	Link width (B) plus or minus	Wire diameter ovality (maximum) $\frac{1}{16}$	Maximum flash trim overage (D)	Stud centering plus or minus	Stud width		Grip radius (G) plus or minus
						(F) plus	(H) minus	
3/4 to 1-1/4 (inclusive)	1/16	1/16	1/32	1/16	3/16	1/16	1/8	1/16

1/ When the link diameter (dimension C) is checked for ovality (major axis minus minor axis), the area of the elliptical cross section ( $\pi/4 \times$  major axis  $\times$  minor axis) shall be at least equal to the area of a circle of the chain size ( $\pi/4 \times$  link diameter<sup>2</sup>). Dimension C shall be measured at a point generally as specified on figure 2.

FIGURE 2. Basic link and stud dimensions.

3.4 Link and stud surface. Burrs, irregularities, and rough edges shall be contour ground to a fair surface. Links and studs shall also be free of cracks, surface irregularities, dents, and undercutting in excess of 1/16 inch when examined as specified in 4.5.2 and 4.7.3. Special attention shall be given to inspection in the following areas:

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- (a) Grip area while links interface during loading.
- (b) Region gripped by clamping dies during flash welding.
- (c) Flash weld buildup perimeter after trimming.

Any ridge, flashing, or other projection in these areas shall be ground flush or blended with the fair link surface.

### 3.5 Flash butt weld.

3.5.1 Weld surface. The link surfaces at the flash weld shall be free of cracks, lack of fusion, and gross porosity when examined with liquid penetrant as specified in 4.5.3.

3.5.2 Fusion of weld joint. The flash weld shall be free of defects causing ultrasonic (UT) back reflections equal to or greater than those produced from a 0.05-inch surface notch calibration standard, when tested as specified in 4.5.4.

3.5.3 Fusion zone microstructure. The heat-affected zones on each side of the weld joint shall be free of cracks when examined as specified in 4.5.8.

3.6 Stud size and alignment. Stud size and shape, alignment, and centering shall be as specified on figure 2 (see 4.5.7 and 4.7.12) and shall have no gaps visible between the stud and the link body at the ends of the H dimension. Noncontinuous gaps are permissible along the length H.

3.6.1 Stud penetration. Prior to being pressed into the link body, every stud must be free from unwanted protrusions and flash resulting from manufacturing or forging operations. Stud penetration (at midplane) into the link body resulting from the stud pressing process shall be so that a firm stud fit results; that is, no detectable looseness in any direction and shall be no more than 0.05C (C is the nominal chain size) maximum depth on either side of the link. Stud penetration shall be measured as specified in 4.5.5. The perimeter of the stud saddle shall be radiused (sharpness removed) to prevent cutting into the link body.

3.7 Link and stud interior. Links and studs shall be free from harmful defects such as laps, seams, pipes, cracks, fins, porosity, nonmetallic inclusions and segregation when examined as specified in 4.5.5 and 4.7.13.

3.8 Chain length. The chain shall be in 90-foot shots (15 fathoms) and consist of all common links, the quantity of which is specified in table II (see 6.2). The overall length of six consecutive links measured from every third link shall be within the limits specified in table II (see 4.5.1). By this method of measurement, every link, except three links at each end of the chain, shall be measured twice with different combinations of adjacent links totaling six links (see 4.7.1).

3.9 Chain weight. The weight of each shot of chain shall be in accordance with table II. The required weight limits of six-link samples shall be calculated from the information in table II. Weighing shall be done as specified in 4.5.10.

3.10 Chain breaking load. The chain shall withstand the breaking load specified in table II and shall not crack in the flash butt weld, or the flash butt weld heat-affected zone, when tested as specified in 4.6.2.

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3.11 Chain proof load. The chain shall withstand the proof load specified in table II when tested as specified in 4.6.3.

The actual load applied shall:

- (a) Not cause cracking, fracture, or deformation.
- (b) Not permanently increase chain length more than 1.7 percent or cause the chain to exceed the six-link and individual link dimensions.
- (c) Be used on a full shot or any portion thereof.
- (d) Not be applied more than three times.
- (e) Be recorded on strip charts along with the resulting elongation.

3.11.1 Chain sizing. Chain shall be sized (lengthened) to meet six-link length requirements by applying loads greater than the proof load (see 4.6.3 and 4.7.1) (see 6.3).

3.11.2 Maximum sizing load. Sizing loads greater than 120 percent of the proof test load shall be cause for rejection of the entire shot (where a full shot is sized in one operation) or the affected links (where fractions of a shot are sized in continuous production processes).

3.12 Chain properties. Sample links detached from finished chain shall be sectioned and tested for determination of properties and bending characteristics (see 4.6.4, 4.6.5, 4.6.7, and 4.5.9). Mechanical properties shall be as specified in table I. During bend testing, cracking or fracture shall not occur until the bend angle reaches 120 degrees when tested as specified in 4.6.5. The magnetic permeability ( $\mu$ ) of finished links shall be in accordance with DOD-STD-2143 and shall not exceed 1.2  $\mu$  using the test method P01 of DOD-STD-2142. Each shot shall be tested in accordance with DOD-STD-2142.

3.13 Standards of manufacture. Manufacture of the chain shall be as specified in 3.13.1 through 3.13.5. Equipment and processing parameters used to manufacture the first article inspection samples shall also be used for production chain (see 6.3).

3.13.1 Heating and bending. Bars shall be heated before bending using electric resistance heating. Peak bar temperatures shall not exceed 2100 degrees Fahrenheit ( $^{\circ}$ F). Bending should be performed with bar temperatures above 1600 or below 900 $^{\circ}$ F. Reheating of the bar is permitted, but prolonged soaking at 2100 $^{\circ}$ F is to be avoided.

In order to prevent undue scaling or flaking of the bar due to excessive heat, the heating phase shall be automatically controlled by an optical heat sensor for electric resistance heating. The controller shall be checked for calibration at least once every 8 production hours (see 6.3).

3.13.2 Flash butt welding. The bent bar shall be electrically flash butt welded. Maximum bar end misalignment shall not exceed 5 percent of the bar diameter. The bar ends shall be parallel within 5 degrees. Bar end misalignment shall be checked a minimum of once every 10 links (see 6.3).

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The following welding parameters shall be controlled during welding of each link:

- (a) Platen motion.
- (b) Current as a function of time.
- (c) Hydraulic pressure.
- (d) Flashing voltage.

After removal of excess flash butt weld material, a visual inspection of each link in the area to be covered by the stud shall be made to determine if subsequent rework is required. Potentially harmful indications shall be tagged for later evaluation (see 4.5.2, 4.5.3, and 4.5.4) or removal of the link.

3.13.3 Heat treatment. Heat treatment shall be performed after welding has been completed and prior to testing and inspection. No more than two complete heat treatments (annealing plus age hardening) shall be permitted. A system of identification shall be established to ensure that no shot or portion thereof will be heat treated more than twice. Temperatures and times, or temperatures and chain speed shall be controlled. After exit from the furnace, the links shall be cooled in such a manner that differential cooling does not occur relative to opposite sides of the links.

3.13.3.1 Annealing. Annealing of chain after welding may be used to refine grain size and equalize internal stresses after fabrication and welding on the links. It shall be performed at 1800 to 1875°F (in order to produce a uniform temperature within the links) and followed by a water quench to room temperature.

3.13.3.2 Age hardening. Aging of chain shall be performed to obtain a beneficial combination of strength and other mechanical properties such as ductility.

3.13.4 Markings. The stud of each link shall be permanently marked in raised letters or letters indented with a blunt nose tool. One side shall be marked for the US Navy (for example, "USN"), along with chain size and nonmagnetic material identification (for example, "1-1/4 NM"). The other side shall identify the manufacturer or trade name of the chain. The studs of both end links of 90-foot shot shall be marked with serial numbers assigned by the manufacturer and traceable to production, test inspection, and certification records. Markings shall be a minimum of 5/32 inch in height for 3/4-inch to 1-1/8 inch chain, and 1/4 inch in height for 1-1/4 inch chain. Markings shall be raised or indented a minimum of 1/32 inch. An area for serial number marking may be prepared by grinding.

3.13.5 Finishing. Chain shall be thoroughly cleaned by shot-blasting, grit-blasting, or other approved mechanical cleaning method to remove loose scale and welding slag. Pickling of the chain to remove scale is prohibited. After completion of all tests and inspections, the chain shall be painted with two coats epoxy-polyamide, green primer, formula 150 in accordance with MIL-P-24441 and MIL-P-24441/1, 3 mils thick each coat; and two coats of silicone alkyd enamel, black, 3 mils dry film thickness each coat in accordance with DOD-E-24635, color 27038. As an alternative, TT-V-51, black asphalt varnish, 3 mils dry film thickness each coat may be used in lieu of DOD-E-24635. Coating shall be dry to the touch 70°F (21.1°C) after 24 hours. Heat used in finishing shall not exceed 150°F (65.6°C).

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## 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements, examinations and tests as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by 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 supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program (see 6.3). The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

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

- (a) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall consist of the examinations and tests specified in table IV.

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TABLE IV. First article inspection.

Inspection	Requirement	Examinations and tests	Sample	Rejection and retest
Chain proof load	3.11	4.6.3	4.3.1(a)	4.7.7
Chain length	3.8 and 3.11.1	4.5.1	4.3.1(a)	4.7.1 and 4.7.2
Chain weight	3.9	4.5.10.1	4.3.1(a)	4.7.5
Link dimensions	3.3	4.5.6	4.3.1(c)	4.7.12
Stud size and alignment	3.6	4.5.7	4.3.1(c)	4.7.12
Stud penetration	3.6.1	4.5.5	4.3.1(b)	4.7.13
Chain breaking load	3.10	4.6.2	4.3.1(c)	4.7.6
Link and stud surface	3.4	4.5.2	4.3.1(a)	4.7.3
Flash weld surface	3.5.1	4.5.3	4.3.1(a)	4.7.4
Flash weld fusion	3.5.2	4.5.4	4.3.1(a)	4.7.10
Flash weld microstructure	3.5.3	4.5.8	4.3.1(b)	4.7.13
Link interior (macrostructure)	3.7	4.5.5	4.3.1(b)	4.7.13
Chemical composition	3.2	4.6.1	4.3.1(b)	4.7.14
Chain specimen tensile test	3.12	4.6.4	4.3.1(b)	4.7.8
Chain specimen bend test	3.12	4.6.5	4.3.1(b)	4.7.9
*Chain specimen hardness	3.12	4.6.7	4.3.1(b)	-----
Chain magnetic permeability	3.12	4.5.9	4.3.1(c)	4.7.11
Bar stock tensile test	3.2.1	4.6.6	4.3.1(d)	4.7.8

\*For information only (see 6.3).

4.3.1 First article inspection samples. The following samples shall be prepared for the first article inspection. All samples shall be thoroughly cleaned of loose scale and welding slag and proof tested prior to doing the following examinations and tests:

- (a) One six-link section for nondestructive testing (see table IV).
- (b) Single links for destructive testing (quantity as required in table IV).
- (c) One triplet, minimum, (from (a) above) for breaking load test (see 4.6.2), for examination of link and stud dimensions (see 4.5.6), for stud alignment and size (see 4.5.7), and magnetic permeability (see 4.5.9).
- (d) One (8- to 12-inch) length of bar stock processed through annealing and age hardening as though it were a length of chain. The material shall have been selected from bar stock of the same heat or melt of material as that used for making first article inspection samples.

4.4 Quality conformance inspection. Bar stock and chain samples shall be selected in accordance with 4.4.1 and shall be inspected by the contractor as specified in table V (see 6.3). In addition, a detailed inspection of the chain shall be performed by the contractor following cleaning of all surfaces to remove

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scale and after proof testing. The chain shall be arranged to permit careful inspection from all sides. The chain shall be bright, free of paint or other coating which would tend to conceal defects during the testing and inspection (see 6.3).

TABLE V. Quality conformance inspection (for production chain).

Inspection	Requirement	Examinations and tests	Sample	Rejection and retest
Chain proof load	3.11	4.6.3	4.4.1.3	4.7.7
Chain length	3.8 and 3.11.1	4.5.1	4.4.1.3	4.7.1 and 4.7.2
Link and stud surface	3.4	4.5.2	4.4.1.3	4.7.3
Flash weld surface	3.5.1	4.5.3	4.4.1.3	4.7.4
Flash weld fusion	3.5.2	4.5.4	4.4.1.5	4.7.10
Stud penetration	3.6.1	4.5.5	4.4.1.5	4.7.13
Chain weight	3.9	4.5.10	4.4.1.3	4.7.5
Link dimensions	3.3	4.5.6	4.4.1.4	4.7.12
Stud size and alignment	3.6	4.5.7	4.4.1.4	4.7.12
Chain breaking load	3.10	4.6.2	4.4.1.4	4.7.6
Chain specimen tensile test	3.12	4.6.4	4.4.1.5	4.7.8
Flash weld microstructure	3.5.3	4.5.8	4.4.1.5	4.7.13
Chain magnetic permeability	3.12	4.5.9	4.4.1.4	4.7.11
Bar stock tensile test	3.2.1	4.6.6	4.4.1.1	4.7.8

4.4.1 Sampling for quality conformance.

4.4.1.1 Bar stock material samples. For sampling bar stock material to be used in construction of chain, one 8- to 12-inch long section shall be selected from each heat or melt of material. The section shall be removed from either end of any bar in the heat or melt and subjected to the annealing and age hardening treatments to be used for production chain. Bar stock mechanical properties tests (see 4.6.6) shall be conducted for each heat or melt of material.

4.4.1.2 Finished chain. For sampling finished chain (cleaned, proof tested, and inspected), four or more extra links shall be provided with each shot for destructive and non-destructive testing. The extra links and shots must be processed together and then cut apart to provide proof-tested shots for delivery and detached triplets and links for testing.

4.4.1.3 Shots. Chain proof load testing (see 4.6.3) and examination of chain length (see 4.5.1 and 4.5.6) shall be conducted on each shot of chain. The surface examination of links (see 4.5.2) and flash butt welds (see 4.5.3) shall be conducted after proof load testing. The weight of finished shots shall be determined (see 4.5.10).

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4.4.1.4 Detached triplets. A minimum of one triplet from each shot shall be removed for the chain breaking load test (see 4.6.2). Dimensions of each link of the triplet shall be measured for conformance to link dimensions (see 4.5.6); grip radius, stud size and alignment (see 4.5.7); and magnetic permeability (see 4.5.9) prior to the breaking load test.

4.4.1.5 Links. Extra links for each shot shall be removed in a manner that allows specimens to be taken for the chain specimen tensile test (see 4.6.4), flash butt weld fusion zone microstructure (see 4.5.8), interior examination of flash butt weld fusion (see 4.5.4), and stud penetration (see 4.5.5).

4.4.1.6 Disposition of chain samples. Unless otherwise specified (see 6.2), all chain test samples and unused samples shall be scrapped. If retained or shipped, each sample shall be identified according to the shot from which it was taken.

#### 4.5 Examinations.

4.5.1 Chain length. Chain length measurements shall be made after proof testing. The chain shall be free of twist and under a tension of 10 percent of proof load. The overall length of six links shall be measured from every third link of each shot for conformance to 3.8.

4.5.2 Surface examination of link and stud. After cleaning all surfaces to remove scale and after proof testing, all surfaces of each link and stud shall be visually examined for conformance to 3.4.

4.5.3 Surface examination of flash butt weld. Liquid penetrant inspection shall be employed to examine the flash butt weld area of links. Procedures for liquid penetrant inspection shall be in accordance with MIL-STD-271. Acceptance criteria shall be in accordance with NAVSHIPS 0900-LP-003-8000. This examination shall be done after cleaning all surfaces to remove scale and after proof testing but before any painting. Every link shall be examined. Flash butt welds shall meet the requirements specified in 3.5 (see 4.7.3 and 4.7.4).

4.5.4 Examination of flash weld fusion. Ultrasonic examination shall be employed to examine the flash butt weld area of links in accordance with DnV Certification Note No. 2.6, except that the frequency of examination shall be every link. Links shall be examined for conformance to 3.5 (see 4.7.10). For first article examination, all links of the sample are to be examined.

4.5.5 Examination of link and stud interior (macrostructure). A single link shall be cut in half on a plane parallel with both the long and short axes, etched, and examined (see 4.7.13). The sample shall be one piece or in three pieces from the same link, approximately equal in size, showing (1) bend section, (2) weld and stud penetration section, and (3) the other stud penetration section. ASTM E 381 shall be used to rate the significance of indications observed in the macrostructure. Penetration of the stud into the link body as a consequence of the stud pressing operation shall be determined and conform to 3.6.1 and 3.7.

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4.5.6 Link dimensions. The dimensions of each link, including grip radii, of each detached triplet (see 4.4.1.4) shall be measured for conformance to 3.3. Dimensions in table II shall be checked when dimensional discrepancies are observed in visual examination of each shot (see 4.4), and as required for links of triplets detached from finished chain (see 4.7.12).

4.5.7 Stud size and alignment. The size, alignment, and centering of each stud shall be measured on each link of each detached triplet (see 4.7.12) to determine if the requirements of 3.6 are satisfied.

4.5.8 Examination of flash butt weld fusion zone microstructure. A sample of material shall be taken from the link, to show the microstructure on a plane cutting the fusion zone perpendicular to the weld joint. The specimen shall be about 1.0 square inch in area and shall be polished and etched for microstructural inspection at 100X magnification for conformance to 3.5.3.

4.5.9 Examination of link magnetic permeability. Triplets removed from the chain breaking load test shall be examined for magnetic permeability prior to other testing. Each sample shall be visually examined with particular attention to the weld area and stud, using a permeability indicator in accordance with MIL-I-17214, and with an appropriate insert calibrated in accordance with MIL-STD-45662 (see 3.12).

4.5.10 Chain weight. Finished chain shall be weighed on completion of marking (see 3.13.4) and finishing operations (see 3.13.5), and after removal of any extra links needed for destructive testing.

4.5.10.1 First article sample weight. For the first article inspection, the sample six-link section shall be weighed (see 4.3.1(a)). The minimum and maximum weight of the six-link section shall be calculated from the information listed in table IV. The minimum and maximum shot weights shall be divided by the number of links per shot and the results multiplied by six to establish the minimum and maximum weights for the six-link section.

#### 4.6 Testing methods

4.6.1 Chemical composition. The material sample shall be selected in accordance with 4.3.1(b) and be analyzed for chemical composition (see 3.2) by using chemical or spectrographic analysis techniques. The analysis shall be done independently from the material supplier for verification purposes.

4.6.2 Chain breaking load test. While completely free from twist, first article and production samples of finished chain shall be subjected to the appropriate tensile load of table II for 15 seconds (minimum) and examined for cracking after the load is removed. The loading arrangement on the end links must duplicate the arrangement between any other two links. After inspection, the samples for first article testing shall be loaded to destruction to determine ultimate chain strength (for information only). The test triplets shall be disposed of as specified in 4.4.1.6. The break testing machine shall have been calibrated within the 12 months preceding the chain breaking load test (see 4.7.6).

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4.6.3 Chain proof load test. While completely free from twist, each chain sample shall be loaded in tension to the value specified in table II. The loading arrangement on the end links must duplicate the arrangement between any other two links. The proof load testing machine shall have been calibrated in accordance with MIL-STD-45662 within the 12 months preceding the chain proof load test. Applied loads shall not exceed 120 percent of proof test load value nor produce a permanent length increase greater than 1.7 percent.

4.6.4 Chain specimen tensile test. Two tensile specimens shall be taken longitudinally from a test link, one from each side and midway between the ends of the link as shown on figure 3 (see 4.3.1(b) and 4.4.1.5). Tensile tests shall be conducted with procedures and using standard specimens machined in accordance with ASTM A 370 (see 3.12 and 4.7.8).

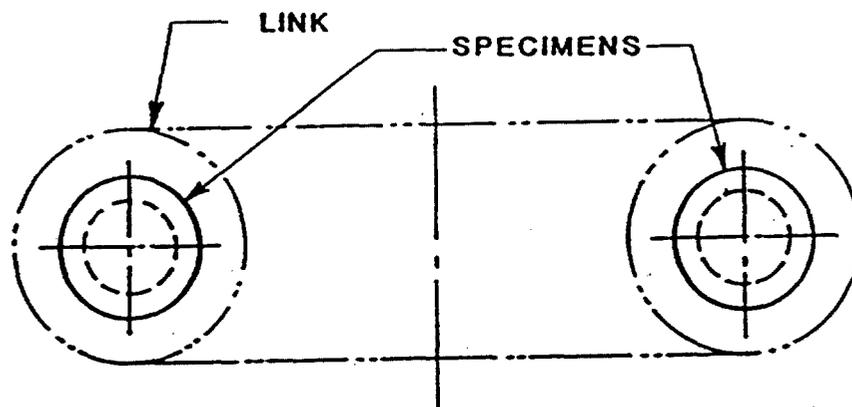


FIGURE 3. Orientation of tensile test specimen.

4.6.5 Chain specimen bend test. Orientation of the flash butt weld bend test specimen shall be as shown on figure 4. The sample shall be taken from an area of the link below the stud (see 4.3.1(b)). The test piece shall be prepared with the maximum area of original bar surface retained and with a maximum thickness of 0.45 inch. The test shall be conducted with the bar surface in tension using a mandrel having a diameter of  $4.4 \times T$ . The specimen shall be precisely positioned over the mandrel such that the weld area is parallel to and in contact with the mandrel.

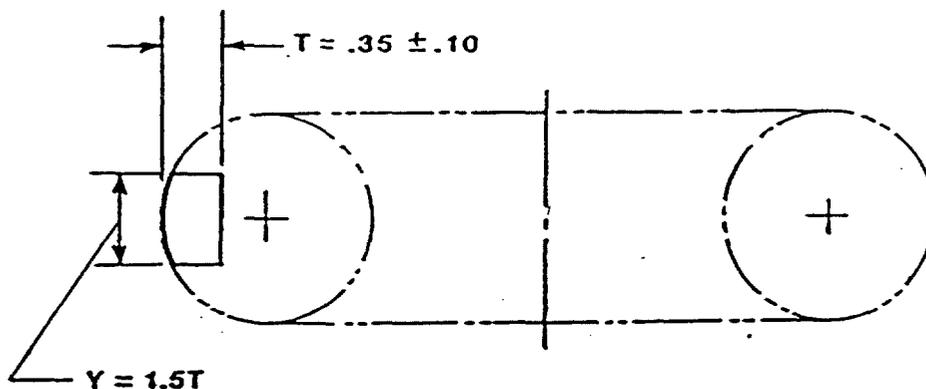


FIGURE 4. Orientation of bend test specimen.

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4.6.6 Bar stock tensile test. The specimen shall be taken from the bar stock sample (see 4.3.1(d) and 4.4.1.1) and tested as specified (see 4.6.4) in accordance with ASTM A 370 (see 4.7.8).

4.6.7 Brinell hardness test. The Brinell or Rockwell C scale hardness of a test link (see 4.3.1(b)) shall be established on the outside of the link on the side opposite the flash butt weld in accordance with ASTM A 370 (see 6.3).

4.7 Retest and rejection criteria.

4.7.1 Length. If the length of six consecutive links is short after proof testing, the chain may be stretched by applying loads up to 120 percent of the proof test load specified in table II, provided that the requirements of 3.11 are met. If the chain length over six links exceeds the tolerances shown in table II, the overlength chain links shall be cut out and 4.7.2 shall apply (see 4.5.1), except first article sample chain which shall conform to the dimensions shown in table II.

4.7.2 Single links. If single links are found to be defective or not to meet other applicable requirements, defective links shall be cut out and a connecting link inserted in their place. After the entire shot has successfully completed all manufacturing and inspection, the connecting link shall be removed and the two resulting lengths may be used to start new shots of chain. No shot or portion thereof shall be heat treated more than twice.

4.7.3 Cracks. If a crack is found visually or by the liquid penetrant test of 4.5.3, it shall be eliminated by grinding to a maximum depth of 1/16 inch and streamlining the surface to eliminate any abrupt discontinuities. The repaired area shall then be examined using the dye penetrant inspection technique in accordance with MIL-STD-271. The area shall be free of cracks. If the defect is still present, 4.7.2 shall apply.

4.7.3.1 Surface irregularities. If a surface irregularity, dent or undercut, exceeding the criteria of 3.4 in depth is found, this shall be cause for rejection of the link and 4.7.2 shall apply.

4.7.4 Flash butt weld. Linear indications found in the flash butt weld by dye penetrant inspection that are greater than 1/8 inch shall be cause for link rejection and 4.7.2 shall apply. Indications of 1/8 inch or less shall be treated as cracks (see 4.7.3).

4.7.5 Weight. Chain that is not within the weight limits as specified in 3.9 shall be rejected.

4.7.6 Break. If a chain triplet breaks anywhere or cracks in a welded area (see 3.10) below the break test load value specified in table II, the associated shot shall be rejected.

4.7.7 Proof test failure. If the chain fails to satisfy the requirements of 3.11 during the proof test, 4.7.2 shall apply (see 4.6.3).

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4.7.8 Tensile test failure. If the results from tensile testing chain and bar stock specimens fail to meet the requirements in table I but are within 2000 pounds per square inch (lb/in<sup>2</sup>) of the required tensile strength or within 2 percent of the required elongation, a retest of another specimen selected from the same sample will be permitted. If the second test fails to meet the requirements of table I, the shot shall be rejected (see 4.6.4 and 4.6.6).

4.7.9 Bend test failure. If there is cracking or fracture associated with the flash butt weld or in the heat-affected zone of the bend specimen before 120 degrees of bend is made, the first article samples shall be rejected (see 4.6.5).

4.7.10 Ultrasonic inspection failure. If indications of interior flash butt weld defects exceed the standards of 3.5.2 during ultrasonic examination of the flash weld zone, 4.7.2 shall apply (see 4.5.4).

4.7.11 Magnetic permeability. Chain exceeding the permeability limits of 3.12 shall be rejected.

4.7.12 Dimensions. If link diameter, length, width, grip radii, stud, stud alignment, and centering dimensions do not conform to the required dimensions, these shall be compared to the dimensions of other links in the triplet and links of all sample chain representing the shot. If a single particular dimension fails to meet the required dimensional tolerance in more than one-half of the sample links, all links in each shot shall be examined for link dimensions, grip radii, stud, stud alignment, and size. If a single particular dimension fails to meet the required dimensions in five of the links in a shot, the shot shall be rejected and 4.7.2 shall apply (see 3.3, 3.6, 4.5.6, and 4.5.7).

4.7.13 Macrostructure and microstructure. Rejection in macrostructural and microstructural examinations shall be for defects, cracks, or discrepancies in regard to microstructure requirements (see 3.5.3, 3.7, 4.5.5, and 4.5.8). If stud penetration exceeds the limits specified in 3.6.1, the two detached links in the shot shall be checked. If one other link shows unacceptable stud penetration, the shot shall be rejected.

4.7.14 Material composition. Material not within the composition tolerances shall be rejected (see 3.2 and 4.6.1).

4.8 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

## 5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 Preservation. Preservation shall be as specified (see 6.2).

5.1.1 Levels A, B, C, and commercial. Chain shall be doubled and redoubled to form a bundle. A nonreturnable wire rope or chain pendant shall be reeved through the bundle and secured with clamps to form a loop for handling.

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5.2 Packing. Packing shall be as specified (see 6.2).

5.2.1 Level A, B, C, and commercial. The size and weight of the bundles shall be adjusted to ensure carrier acceptance for shipment and transshipment as may be required for delivery to the required destination as named in the acquisition document.

5.3 Marking.

5.3.1 Levels, A, B, C, and commercial. In addition to any special marking required (see 6.2), to each shot of chain there shall be securely wired to each end link (both ends of length) a corrosion-resistant metal tag plainly and permanently marked with the following information:

Serial no. \_\_\_\_\_  
 Size \_\_\_\_\_  
 Length \_\_\_\_\_  
 Weight (pounds) \_\_\_\_\_  
 Contract number \_\_\_\_\_  
 Contractor \_\_\_\_\_

## 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 chain covered by this specification is intended to be used for anchoring mine warfare ships.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of this specification.
- (b) Issue of DoDISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
- (c) Requirement for first article inspection (see 3.1).
- (d) Chain size (link diameter) (see 3.3).
- (e) Number of shots of chain required (see 3.8).
- (f) Disposition of first article and other samples (see 4.4.1.6).
- (g) Levels of preservation and packing (see 5.1 and 5.2).
- (h) Special marking required (see 5.3.1).

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6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DIDs) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DIDs are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirements for a DD Form 1423.

<u>Reference paragraph</u>	<u>DID number</u>	<u>DID title</u>	<u>Suggested tailoring</u>
3.3	DI-DRPR-80651	Engineering drawings	----
3.11.1, 3.13, 4.3, 4.4, 6.5 and appendix B	DI-MISC-80678	Certification/data report	----
4.4, 4.6.7 and appendix A	DI-MISC-80653	Test reports	10.2.a does not apply

The above DIDs were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DIDs are cited on DD Form 1423.

6.3.1 Language and units. Data submitted as required by this specification should be prepared using the English language and English physical units or a true and certified translation shall be provided.

6.3.2 Certification. To be considered a qualified producer of anchor chain and eligible to bid on solicitations to this specification, a contractor should currently be qualified by the American Bureau of Shipping (ABS) to produce extra-high strength, grade 3a, flash butt welded, stud link anchor chain, and authorized to use the American Petroleum Institute (API) monogram on chain manufactured in accordance with API Specification 2F. A contractor bidding on solicitations to this specification shall identify the place of manufacture of the chain, the source of rolled bars and the source of forged studs to be used in fulfilling any resulting contract.

6.3.3 Retention of records. Agencies using this specification to acquisition anchor chain for use on U.S. Navy ships should forward a copy of all data to Naval Sea Systems Command, Deck and Replenishment Systems Machinery Division (SEA 56W2), Department of the Navy, Washington, DC 20362-5101, for retention.

6.4 First article. When a first article inspection is required, the items should be a first article sample. The first article should consist of the number of units specified. 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.

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6.5 Classification society inspection. Unless otherwise specified in the contract or purchase order, the contractor should provide the services of a surveyor from a member society of the International Association of Classification societies during the manufacture and testing of chain made to this specification. The qualifications and experience of the particular surveyor (by name) should be submitted to and approved by the Government before the first article construction begins. The contractor should maintain an inspection and record-keeping system satisfactory to the surveying society. The surveyor should witness the measurement and testing of all chain (see 6.3 and appendix B).

6.6 Standards of manufacture. Any exceptions for paragraph 3.13 that are considered acceptable or needed to obtain acceptable chain shall be identified and submitted for information.

6.7 Conditions for use of level B preservation. When level B preservation is specified (see 5.1), this level of protection should be reserved for the acquisition of chain for resupply worldwide under known favorable handling, transportation, and storage conditions.

6.8 Subject term (key word) listing.

Brinell hardness  
Chain proof load  
Magnetic permeability  
Nonmagnetic  
Studs

Preparing activity:  
Navy - SH  
(Project 4010-N049)

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APPENDIX A

TEST REPORTS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers information that shall be included in the test reports when specified in the contract or order. This appendix is mandatory only when data item description DI-MISC-80653 is cited on DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TEST REPORTS

30.1 Reports. When required by the contract or order, test reports shall contain the following information:

- (a) Quality conformance test results.
- (b) Serial number assigned by the manufacturer.
- (c) Material chemical composition (see 3.2.1).
- (d) Statement: "Records are available covering heating, heat-treating, flash welding parameters Brinell hardness and magnetic permeability" (see 3.13.2, 3.13.3, and 4.6.7).
- (e) Bar temperature and controller calibration (see 3.13.1).
- (f) Exceptions to paragraph 3.13 considered acceptable or needed to obtain acceptable chain shall be identified and submitted for information (see 3.13).
- (g) Bar end misalignment shall be checked a minimum of once every 10 links and systematically recorded (see 3.13.2).
- (h) Welding parameters, in first article and production, shall be automatically recorded on strip charts (see 3.13.2).
- (i) Brinell hardness test shall have a minimum of three readings recorded (see 4.6.7).

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APPENDIX B

CERTIFICATION/DATA REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers information that shall be included in the certification/data report when specified in the contract or order. This appendix is mandatory only when data item description DI-MISC-80678 is cited on DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. CERTIFICATION CONTENT

30.1 Quality conformance inspection. A certification/data report shall provide the results of the detailed inspection of the chain following cleaning and proof testing (see 4.4).

30.2 Classification society inspection. The surveyor from the classification society member (see 6.5) shall verify and provide a certificate of compliance to this specification for all material used. The surveyor shall witness the measurement and testing of all chain and provide certificates of compliance to this specification, identified by chain serial numbers, for all chain delivered.

# 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.

<b>I RECOMMEND A CHANGE:</b>		1. DOCUMENT NUMBER MIL-C-24774(SB)	2. DOCUMENT DATE (YYMMDD) 92-07-07
3. DOCUMENT TITLE CHAIN, STUD LINK, ANCHOR, FLASH BUTT WELDED, NONMAGNETIC			
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 (Technical Point of Contact) Mr. Bartoszyk SEA 56W23		b. TELEPHONE (Include Area Code) (1) Commercial (703) 602-1937	(2) AUTOVON 332-1937
c. ADDRESS (Include Zip Code) Commander Naval Sea Systems Command Washington, DC 20362-5101		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	