INCH-POUND
MIL-C-24633A
24 April 1990
SUPERSEDING
MIL-C-24633
10 April 1984
(See 6.7)

MILITARY SPECIFICATION

CHAIN, STUD LINK, ANCHOR, LOW ALLOY STEEL, FLASH BUTT WELDED

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

1. SCOPE

1.1 Scope. This specification covers 3/4-inch through 4-3/4 inch, low alloy steel, flash butt welded, stud link anchor chain for use on ships.

1.2 Length. Chain shall be furnished as single shots, nominally 90 feet (15 fathoms) long (see 3.11).

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).

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 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 4010

SPECIFICATIONS

MILITARY

MIL-P-24380 - Paint, Anchor Chain, Solvent Type, Gloss Black. (Metric)

STANDARDS

MILITARY

MIL-STD-271 - Requirements for Nondestructive Testing Methods.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 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.

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

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

(Application for copies should be addressed to the Standardization Documents Order Desk, Bldg. 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 112 - Standard Test Methods for Determining Average Grain Size. (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.)

AMERICAN WELDING SOCIETY (AWS)

A5.1 - Specification for Covered Carbon Steel Arc Welding Electrodes. (DoD adopted)

A5.5 - Specification for Low Alloy Steel Covered Arc Welding Electrodes. (DoD adopted)

A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding. (DoD adopted)

AWS (Continued)

A5.26 - Specification for Consumables Used for Electrogas Welding of Carbon and High Strength Low Alloy Steels. (DoD adopted)

A5.28 - Specification for Low Alloy Steel Filler Metals for Gas Shielded Arc Welding. (DoD adopted)

A5.29 - Specification for Low Alloy Steel Electrodes for Flux Cored Arc Welding. (DoD adopted)

B2.1 - Standard for Welding Procedure and Performance Qualification.

(Application for copies should be addressed to the American Welding Society, Inc., 550 NW LeJeune Road, P.O. Box 351040, Miami, FL 33125.)

DET NORSKE VERITAS

Certification Notes No. 2.6 - Certification of Offshore Mooring Chain.

(Application for copies should be addressed to Det Norske Veritas, Post Office Box 300, N-1322 Hovik, Oslo, Norway.)

(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), a sample shall be subjected to first article inspection (see 6.4) in accordance with 4.3.

3.2 Material. Steel used in the manufacture of chain links and studs shall be ingot-cast process or continuous-cast process with a minimum reduction in area of 12:1, fully killed, and made to fine-grain practice. Sufficient croppage shall be taken from the top and bottom of each ingot or beginning and end of each continuously cast strand to ensure removal of harmful defects or segregation that would adversely affect the chain quality. Bar stock made from material at the top of the ingot or end of the continuously cast strand after cropping shall be identified for testing. The bar stock for each heat of steel used in the manufacture of the links shall have an austenite grain size of 5 or finer in accordance with ASTM E 112. Studs shall be made of steel of the same composition used in the links. Studs shall be forgings. Material used in normal production shall be the same composition of material used in the first article sample in chemistry, quality and properties. The chain material shall be identified from steel mill to chain fabrication. Unidentified material shall be considered nonconforming. Bar stock for links may be selected greater than the nominal chain size (link diameter) according to table I, provided that the finished chain meets the dimensions and tolerances specified (see 3.3 and 4.5.7). Ovality of the bar stock shall be not greater than 0.75 times the bar stock tolerance.

TABLE I. Bar stock tolerances.

Chain size, inclusive (inches)	Permissible bar stock tolerance (inch)
3/4 to 1-1/4	Plus 3/64
1-3/8 to 2-1/2	Plus 1/16
2-5/8 to 3-1/2	Plus 3/32
3-5/8 to 4-3/4	Plus 1/8

3.2.1 Material chemical composition. The chemical composition of the steel shall be determined at the steel mill for each heat of steel and shall conform to table II (see 4.6.1). Alloying elements to achieve required strength and grain refinement shall be included, as necessary. The material shall be analyzed for alloying elements added or limited by the manufacturer and the material chemical composition shall be reported in the mill certification.

TABLE II. Chemical composition ladle analysis.

Element	Weight percent (maximum)
Carbon, C	0.33
Silicon, Si	0.37
Manganese, Mn	1.94
Phosphorus, P	0.030
Sulphur, S	0.030

3.2.2 Material mechanical properties. The bar stock used in the manufacture of the chain links, after receiving identical heat treatment as the chain (see 3.15.4), shall possess the mechanical properties specified in table III when tested (see 4.6.7 and 4.6.8).

TABLE III. Bar stock mechanical properties.

Property	Value (minimum)
Yield strength (0.2 percent offset)	68,000 lb/in^2
Ultimate tensile strength	99,600 lb/in^2
Elongation specimen gauge length - 4X specimen diameter	18 percent
Reduction in area	45 percent
Specimen impact, Charpy V-notch, average for three specimens at 32°F	43 ft-lb

3.2.3 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.

3.3 Link weight and dimensions. Link weight and dimensions shall be in accordance with table IV, figure 1, and figure 2 (see 3.2). Link tolerances shall be in accordance with figure 2 and table V. Length over six links shall be measured from every third link (see 3.11, 4.5.1, and 4.7.1). A maximum flash trim overage permitted after the flash butt weld is deburred shall be as specified in table V (see 3.15.2.1). 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 IV. Stud link chain dimensions and properties.

Chain size (inches)	Link length A (inches)	L Length over 6 links (inches)			Link width B (inches)	Number of links per 15-fathom shot	Proof test load (lb)	Break test load (lb)	Min Wt per 15-fathom shot (lb)	Max Wt per 15-fathom shot (lb)
		Minimum	Nominal	Maximum						
0-3/4	4-1/2	19-3/8	19-1/2	19-13/16	2-11/16	359	48,000	75,000	465	525
0-7/8	5-1/4	22-5/8	22-3/4	23-1/16	3-1/8	305	64,400	98,000	640	713
1	6	25-7/8	26	26-3/8	3-5/8	267	84,000	129,000	840	925
1-1/8	6-3/4	29-1/16	29-1/4	29-5/8	4-1/16	237	106,000	161,000	1,050	1,150
1-1/4	7-1/2	32-5/16	32-1/2	32-15/16	4-1/2	213	130,000	198,000	1,310	1,430
1-3/8	8-1/4	35-9/16	35-3/4	36-1/4	4-15/16	193	157,000	235,000	1,590	1,760
1-1/2	9	38-13/16	39	39-1/2	5-3/8	177	185,000	280,000	1,890	2,080
1-5/8	9-3/4	42	42-1/4	42-7/8	5-7/8	165	216,000	325,000	2,180	2,390
1-3/4	10-1/2	45-1/4	45-1/2	46-1/8	6-5/16	153	249,000	380,000	2,520	2,750
1-7/8	11-1/4	48-1/2	48-3/4	49-1/2	6-3/4	143	285,000	432,000	2,900	3,150
2	12	51-11/16	52	52-3/4	7-3/16	135	318,000	454,000	3,270	3,540
2-1/8	12-3/4	54-15/16	55-1/4	56-1/8	7-5/8	125	357,000	510,000	3,690	3,980
2-1/4	13-1/2	58-3/16	58-1/2	59-3/8	8-1/8	119	396,000	570,000	4,150	4,450
2-3/8	14-1/4	61-7/16	61-3/4	62-5/8	8-9/16	113	440,000	628,000	4,640	4,960
2-1/2	15	64-11/16	65	66	9	107	484,000	692,000	5,150	5,490
2-5/8	15-3/4	67-7/8	68-1/4	69-1/4	9-7/16	101	530,000	758,000	5,670	6,280
2-3/4	16-1/2	71-1/8	71-1/2	72-9/16	9-7/8	97	578,000	826,000	6,240	6,890
2-7/8	17-1/4	74-3/8	74-3/4	75-7/8	10-3/8	93	628,000	897,000	6,840	7,520
3	18	77-5/8	78	79-3/16	10-13/16	89	679,000	970,000	7,460	8,180
3-1/8	18-3/4	80-13/16	81-1/4	82-1/2	11-1/4	87	732,000	1,046,000	8,090	8,890
3-1/4	19-1/2	84-1/16	84-1/2	85-3/4	11-11/16	83	787,000	1,124,000	8,760	9,600
3-3/8	20-1/4	87-5/16	87-3/4	89	12-1/8	79	843,000	1,204,000	9,470	10,350
3-1/2	21	90-9/16	91	92-5/16	12-5/8	77	900,000	1,285,000	10,220	11,140
3-5/8	21-3/4	93-13/16	94-1/4	95-5/8	12-15/16	73	958,000	1,369,000	10,990	12,190
3-3/4	22-1/2	97-1/16	97-1/2	98-7/8	13-1/2	71	1,019,000	1,455,000	11,660	12,920
3-7/8	23-1/4	100-1/4	100-3/4	102-3/16	14	69	1,080,000	1,543,000	12,540	13,850
4	24	103-1/2	104	105-1/2	14-3/8	67	1,143,000	1,632,000	13,330	14,680
4-1/8	24-3/4	106-3/4	107-1/4	108-13/16	14-7/8	65	1,207,000	1,724,000	14,080	15,520
4-1/4	25-1/2	110	110-1/2	112-1/8	15-5/16	63	1,272,000	1,817,000	14,830	16,360
4-3/8	26-1/4	113-3/16	113-3/4	115-3/8	15-3/4	61	1,338,000	1,911,000	15,570	17,200
4-1/2	27	116-7/16	117	118-11/16	16-3/16	59	1,405,000	2,008,000	16,300	18,030
4-5/8	27-3/4	119-11/16	120-1/4	122	16-5/8	57	1,474,000	2,105,000	17,010	18,840
4-3/4	28-1/2	122-15/16	123-1/2	125-5/16	17-1/8	57	1,700,000	2,550,000	18,370	20,300

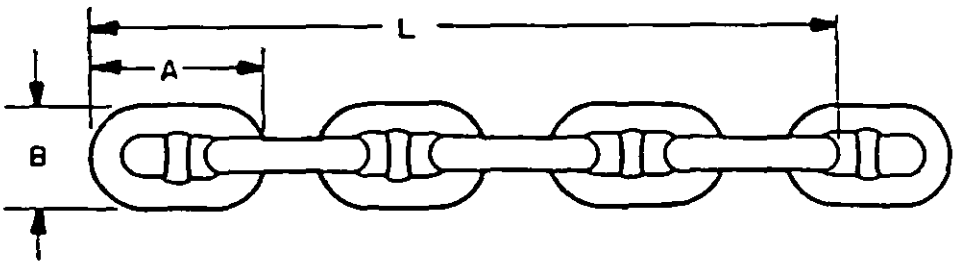


FIGURE 1. Stud link chain dimensions.

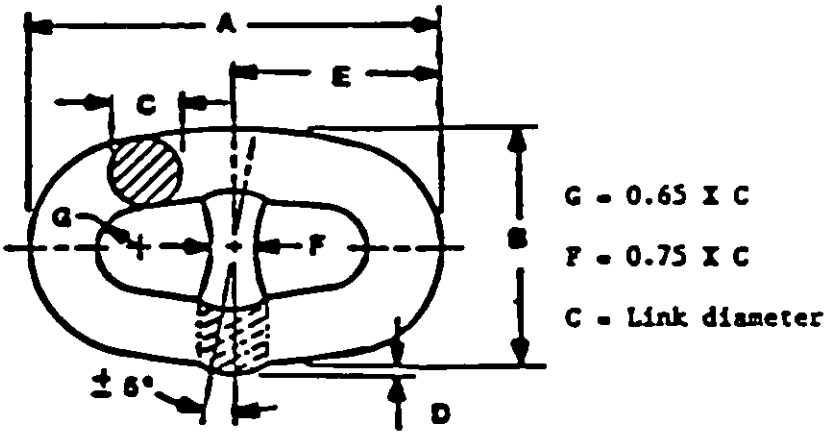


FIGURE 2. Basic link and stud dimensions.

TABLE V. Basic link and stud tolerances.

Chain size, inclusive (link diameter) C (inches)	Permissible tolerance (inch)						Maximum flash trim overage D (inch)
	Link length A plus or minus	Link width B plus or minus	Link diameter ovality, maximum 1/	Stud centering (E = A/2) plus or minus	Stud width F plus	Grip radius G plus or minus	
3/4 to 1-1/4	1/16	1/16	1/32	3/16	1/16	1/16	1/16
1-3/8 to 2-1/2	3/32	1/8	3/64	5/16	3/32	3/32	1/16
2-5/8 to 3	3/16	3/16	3/32	7/16	1/8	1/8	3/32
3-1/8 to 3-1/2	1/4	1/4	1/8	9/16	3/16	3/16	3/32
3-5/8 to 4-1/8	5/16	5/16	3/16	11/16	1/4	1/4	1/8
4-1/4 to 4-3/4	3/8	5/16	1/4	3/4	1/4	1/4	5/32

1/ When the link diameter (dimension C) is checked for ovality (major axis minus minor axis), the area of the elliptical cross section ($\pi/4$ x major axis x minor axis) shall be at least equal to the area of a circle of the chain size ($\pi/4$ x link diameter^2). Dimension C shall be measured at a point generally in accordance with figure 2.

3.4 Link and stud surface. The link surface shall be free of cracks when examined in accordance with 4.5.2 and 4.7.3. Burrs, irregularities and rough edges shall be contour ground to a fair surface. Links and studs shall also be free of surface irregularities, dents and undercutting in excess of the amounts shown in table VI when examined in accordance with 4.5.2 and 4.7.3.1. Care shall be given to inspection in the vicinity where the link is gripped by clamping dies during flash welding. The inside surface of the grip area of the chain shall be free of ridges, flashings or other projections above the fair surface of the chain. Any ridges, flashings or other projections in the grip area shall be ground flush with the fair surface of the chain link.

TABLE VI. Allowable surface defects.

Chain size, inclusive (inches)	Allowable surface defect (inch)
3/4 to 2-1/2	1/32
2-5/8 to 3-1/2	3/32
3-5/8 to 4-1/8	1/8
4-1/4 to 4-3/4	5/32

3.5 Flash butt weld surface. Link surface at the flash butt weld shall be free of cracks, lack of fusion, or gross porosity when examined in accordance with 4.5.3.

3.6 Stud size, placement and alignment. Stud size and shape, alignment and centering shall be in accordance with figure 2 (see 4.7.13).

3.6.1 Studs. The stud shall not have protrusions on either end of the saddle. The stud shall be pressed into the link body and shall have no protruding flash from the stud forging process. Stud penetration into the link body resulting from the stud pressing process shall be within the limits specified in table VII. Stud insertion shall be measured in accordance with 4.5.5. The perimeter of the stud saddle shall be radiused to prevent sharp entry into the link body.

TABLE VII. Stud penetration.

Stud penetration at midplane		
Location	Minimum 1/ (inch)	Maximum 1/ (inch)
Unwelded side	0.01C	0.05C
Flash welded side	0.03C	0.07C

1/ C = Link diameter (see figure 2).

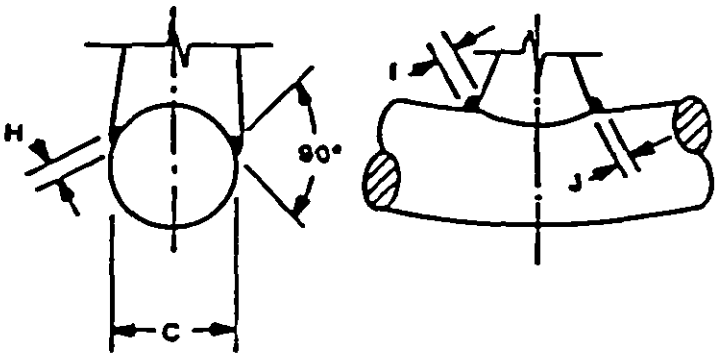
3.7 Flash butt weld fusion. The flash butt weld shall be free of defects causing ultrasonic (UT) back reflections equal to or greater than the standard when measured in accordance with 4.5.4.

3.8 Link and stud interior. Links and studs shall be free from harmful defects such as laps, seams, pipes, cracks, fins, porosity, bursts, flakes, slivers, scabs, forged in scale, nonmetallic inclusions and undue segregation when examined in accordance with 4.5.5 and 4.7.14.

3.9 Fusion zone microstructure. The fusion zone of the flash butt weld and stud weld areas shall have fine grain structure (grain size 7 or finer in accordance with ASTM E 112) and be free from Widmanstatten (needle-like) structure of any form when examined in accordance with 4.5.9 and 4.5.10 (see 3.15.4) after heat

treating. The heat-affected zones on each side of the flash butt weld shall be examined in accordance with 4.5.9 for signs of overheating. The heat-affected zones shall be free of grain boundaries with intergranular fissuring and hot cracking. The stud weld fusion zones shall be free of cracks and fissures when examined in accordance with 4.5.10.

3.10 Stud weld. Magnetic particle inspection shall be performed on the stud weld (see 4.5.6), and the stud weld shall be free of cracks and fissures as specified in 4.7.12. Stud weld size shall be in accordance with figure 3.



Dimension designation	Minimum 1/ dimension (inches)
H	0.1C
I	0.2C
J	0.09C

1/ C = Link diameter (see figure 2).

FIGURE 3. Stud weld dimensions.

3.11 Chain length. The chain shall be in 90-foot shots (15 fathoms) (see 1.2 and 6.2). A chain containing the number of links specified in table IV shall constitute a 90-foot shot. The overall length of six consecutive links measured from every third link shall be within the limits specified in table IV (see 3.3 and 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).

3.11.1 Chain weight. Each shot of chain shall be weighed in accordance with 4.5.12.

3.12 Chain breaking load. The chain shall withstand the breaking load specified (see table IV and 4.6.2). There shall be no cracking in the flash butt weld, flash butt weld heat-affected zone, or in the area of the toe of the stud weld (see figure 3).

3.13 Chain proof load. The chain shall withstand the proof load specified (see table IV) without fracture (see 4.6.3). There shall be no cracking in the flash butt weld, flash butt weld heat-affected zone, or in the area of the toe of the stud weld (see figure 3). Strip chart recordings of the applied load shall be taken of all proof load tests during both first article and nominal production tests.

3.13.1 Chain sizing. Chain may be sized (lengthened) to meet six-link length requirements by applying a load in excess of the proof load (see 4.6.3 and 4.7.1). However, such sizing shall not be done without the concurrence of the designated classification society surveyor. Sizing loads applied shall be recorded on strip charts.

3.13.2 Maximum sizing load. The sizing load shall not exceed 110 percent of the proof test load. Exceeding 110 percent of the proof test load will cause 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).

3.14 Chain mechanical properties. Links of samples detached from finished, heat-treated chain shall be sectioned for determination of mechanical properties (see 4.6.4, 4.6.5, and 4.6.6). Mechanical properties shall be as specified in table VIII. In addition, the angle of bend shall be not less than 120 degrees before cracking or fracture (see 4.6.6).

TABLE VIII. Chain link mechanical properties.

Test	Value (minimum)
Yield strength (0.2 percent offset)	68,000 lb/in^2
Ultimate tensile strength	99,600 lb/in^2
Elongation (specimen gauge length = 4X diameter)	16 percent
Reduction in area	40 percent
Charpy V-notch impact energy, unwelded portion of link, average for three specimens at 32°F	43 ft-lb
Charpy V-notch impact energy, flash weld heat-affected zone (immediately adjacent to fusion line), average for three specimens at 32°F	36 ft-lb

3.14.1 Link hardness. The link hardness, Brinell or Rockwell scale, shall be established for a first article sample of chain in accordance with 4.6.9.

3.15 Standards of construction. Construction of the chain shall include the processes and equipments specified in 3.15.1 through 3.15.6. The material specification, process parameters, and equipment used to construct the first article inspection sample to this specification shall also be used in construction of production chain.

3.15.1 Heating and bending. Bars shall be heated before bending using electric resistance heating. Peak bar temperatures shall not exceed 2100 degrees Fahrenheit (°F), and bending shall be performed at a bar temperature of 1450°F or greater. Reheating of the bar shall be permitted should production sequence be delayed or interrupted. Alternate bar heating methods will be considered if acceptable documentation is presented for Government approval prior to contract or purchase order award.

3.15.1.1 Heating control. In order to prevent undue scaling or flaking of the bar stock due to excessive heat, the heating phase shall be automatically controlled by an optical heat sensor. The controller shall be checked for calibration at least once every 8 hours. Bar temperature and controller calibration records shall be available for inspection (see 4.4.2).

3.15.2 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 and the bars shall be parallel within 5 degrees. Bar end misalignment shall be checked a minimum of once every 10 links after welding and systematically recorded.

3.15.2.1 Flash butt welding parameters. The following welding parameters shall be controlled during the welding of each link:

(a) Platen motion.
(b) Current as a function of time.
(c) Hydraulic pressures.

These parameters, both in first article and normal production, shall be automatically recorded on strip charts. Excess flash butt weld material shall be removed to a uniform surface consistency over the entire link to the dimensional requirements of the link (see 3.3). Excess flash butt weld material shall be removed to a smooth contour with no depressions below the surface of the link body adjacent to the weld.

3.15.2.2 Flash removal inspection. A clean fusion zone free of all foreign material such as scale, dirt and slag shall be maintained. A visual inspection of each link in the area to be covered by the stud shall be made after excess flash butt weld metal removal. 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.

3.15.3 Stud welding. For chain sizes 1-1/2 inches and larger, the stud shall be completely welded, circumferentially, on the end opposite the flash butt weld using hydrogen controlled electrodes (EXX18) in accordance with AWS A5.1 or A5.5, or by MIG or TIG processes in accordance with AWS A5.26 and A5.28, or by flux-cored wire feed arc welding in accordance with AWS A5.20 or A5.29. The weld shall be of the size shown on figure 3. Welding shall be performed using a welding preheat of 200°F minimum to 300°F maximum. Welding shall be performed prior to normalizing. The welding process and welders shall be qualified in accordance with AWS B2.1. For chain sizes smaller than 1-1/2 inches, the studs shall be welded along the outside edges, parallel to the longitudinal direction of the link, on the end opposite the flash butt weld in accordance with the requirements previously stated in this paragraph.

3.15.4 Heat treatment. Chain shall be heat treated above the upper transformation temperature, at a combination of temperatures and times to produce a fine-grain structure throughout the link body, flash and stud welds, and fusion zones of those welds (see 3.2.2, 3.9, 4.5.9 and 4.5.10). Heat treatment shall be performed after all welding has been completed and prior to testing and inspection. Chain shall not be heat treated more than twice. 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. Each link shall be maintained at a temperature between 1500°F minimum and 1750°F maximum for a period determined as a result of first article production. After exit from the furnace, the links shall be air-cooled, or quenched and tempered in such a manner that differential cooling does not occur relative to opposite sides of the links. A continuous-type furnace shall be used for normal production. Chain shall be removed from the furnace exit to prevent accummulating chain in areas with elevated temperatures that may affect the air-cooling.

3.15.5 Markings. The stud of each link shall be permanently marked, in raised letters or letters indented with a blunt nose tool, with "USN" and the chain size in fractional inches on one side, and with the brand name or trade name of the manufacturer on the other side. The studs of both end links of each 90-foot shot shall be marked with serial numbers assigned by the manufacturer and traceable to production, test inspection and certification records (see 4.5.12). Markings shall be a minimum of 5/32 inch in height for 3/4 to 1-1/8 inch chain, and 1/4 inch in height for 1-1/4 inch chain and above. Markings shall be raised or indented a minimum of 1/32 inch. An area for serial number marking may be prepared by grinding.

3.15.6 Finishing. Chain shall be thoroughly cleaned by shot-blasting, grit-blasting, or other approved mechanical cleaning method to remove loose scale and welding slag. After satisfactory completion of all tests and inspections, the chain shall be coated with an application of anchor chain paint, in accordance with MIL-P-24380. The minimum application thickness shall be at least 3 mils (see 4.5.12). Coating shall be dry to the touch (70°F) after 24 hours. Heat used in finishing shall not exceed 150°F.

3.16 Chain. Chain shall consist of all common links.

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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall 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 ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the 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.

4.2 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 IX.

TABLE IX. First article inspection.

Inspection	Requirement	Examinations and tests	Sample	Rejection and retest
Chain proof load	3.13	4.6.3	4.3.1(a)	4.7.6 and 4.7.7
Chain length	3.11	4.5.1	4.3.1(a)	4.7.1 and 4.7.2
Chain weight	3.11.1	4.5.12.1	4.3.1(a)	4.7.16
Link dimensions	3.3	4.5.7	4.3.1(c)	4.7.13
Stud size and alignment	3.6	4.5.8	4.3.1(c)	4.7.13
Stud penetration	3.6.1	4.5.5	4.3.1(b)	4.7.14
Chain breaking load	3.12	4.6.2	4.3.1(c)	4.7.5 and 4.7.6
Link surface	3.4	4.5.2	4.3.1(a)	4.7.3
Flash butt weld surface	3.5	4.5.3	4.3.1(a)	4.7.4
Flash butt weld fusion	3.7	4.5.4	4.3.1(a)	4.7.11
Stud weld	3.10	4.5.6	4.3.1(a)	4.7.12
Link interior (macrostructure)	3.8	4.5.5	4.3.1(b)	4.7.14
Flash butt weld fusion zone microstructure	3.9	4.5.9	4.3.1(b)	4.7.14
Stud weld fusion zone microstructure	3.9	4.5.10	4.3.1(b)	4.7.14
Chemical composition	3.2.1	4.6.1	4.3.1(b)	4.7.15
Chain specimen tensile test	3.14	4.6.4	4.3.1(b)	4.7.8
Chain specimen impact test	3.14	4.6.5	4.3.1(b)	4.7.9
Chain specimen bend test	3.14	4.6.6	4.3.1(b)	4.7.10
Chain specimen hardness test	3.14.1	4.6.9	4.3.1(b)	------
Bar stock tensile test	3.2.2	4.6.7	4.3.1(d)	4.7.8
Bar stock impact test	3.2.2	4.6.8	4.3.1(d)	4.7.9
Bar stock microstructure	3.2	4.5.11	4.3.1(d)	4.7.14

4.3.1 First article inspection samples. The following samples shall be prepared for the first article inspection examinations and tests specified in table IX (see 4.3 and 6.2). Chain links shall be cleaned on all surfaces to remove scale. Chain samples shall consist, as a minimum, of:

(a) One six-link section for examination of chain length (see 4.5.1), link surface examination (see 4.5.2), examination of flash butt weld surface (see 4.5.3), examination of flash butt weld fusion (see 4.5.4), examination of stud weld (see 4.5.6), chain proof load test (see 4.6.3), and chain weight (see 4.5.12.1).

(b) Finished links, after heat treating as necessary, for verification of chemical composition (see 4.6.1), chain specimen tensile test (see 4.6.4), chain specimen impact test (see 4.6.5), chain specimen bend test (see 4.6.6), interior examination of flash weld (see 4.5.5), microstructure examination (see 4.5.9 and 4.5.10), and hardness test (see 4.6.9).

(c) One triplet, minimum, for breaking load test (see 4.6.2) from (a) above with examination of link and stud dimensions (see 4.5.7) and stud alignment and centering and size (see 4.5.8).

(d) One (8- to 12-inch) section of bar stock. The material shall be selected from bar stock of the same heat or melt of steel as the chain links used for first article inspection. The section of bar stock shall be used for bar stock mechanical properties tests (see 4.6.7 and 4.6.8), and bar stock microstructure (see 4.5.11).

4.4 Quality conformance inspection. Bar stock and chain samples shall be selected in accordance with 4.4.1 and shall be inspected in accordance with table X (see 6.3 and appendix A). In addition, a detailed inspection of the chain by the authorized agent of the contracting activity shall be performed following cleaning of all surfaces to remove scale and after proof testing. The chain shall be arranged to permit careful inspection from all sides. The chain shall be free of paint or other coating which would tend to conceal defects during the testing and inspection (see 6.3 and appendix A).

TABLE X. Quality conformance inspection.

Inspection	Requirement	Examination and tests	Sample	Rejection and retest
Chain proof load	3.13	4.6.3	4.4.1.3	4.7.6 and 4.7.7
Chain length	3.11	4.5.1	4.4.1.3	4.7.1 and 4.7.2
Link surface	3.4	4.5.2	4.4.1.3	4.7.3
Flash butt weld surface	3.5	4.5.3	4.4.1.3	4.7.4
Flash butt weld fusion	3.7	4.5.4	4.4.1.3	4.7.11
Stud penetration	3.6.1	4.5.5	4.4.1.5	4.7.14
Stud weld	3.10	4.5.6	4.4.1.3	4.7.12
Chain weight	3.11.1	4.5.12	4.4.1.3	4.7.16
Link dimensions	3.3	4.5.7	4.4.1.4	4.7.13
Stud size and alignment	3.6	4.5.8	4.4.1.4	4.7.13
Chain breaking load test	3.12	4.6.2	4.4.1.4	4.7.5 and 4.7.6
Chain specimen tensile test	3.14	4.6.4	4.4.1.5	4.7.8
Chain specimen impact test	3.14	4.6.5	4.4.1.5	4.7.9
Flash butt weld fusion zone microstructure	3.9	4.5.9	4.4.1.5	4.7.14
Stud weld fusion zone microstructure	3.9	4.5.10	4.4.1.5	4.7.14
Bar stock tensile test	3.2.2	4.6.7	4.4.1.1	4.7.8
Bar stock impact test	3.2.2	4.6.8	4.4.1.1	4.7.9

4.4.1 Sampling for quality conformance.

4.4.1.1 Bar stock material. For the purpose of sampling bar stock material for use in construction of chain, one 8- to 12-inch long section shall be selected from each heat or melt of steel. The section shall be removed from either end of any bar in the heat or melt. Bar stock mechanical properties tests (see 4.6.7 and 4.6.8) shall be conducted for each heat or melt of steel.

4.4.1.2 Finished chain. For the purpose of sampling finished chain, extra chain links shall be provided in each lot. A lot shall be defined as four shots plus additional links as described below, all from the same heat or melt of steel. Extra links shall be provided and processed with the shots of chain. All four shots in a lot shall be constructed with four extra links. The fourth link shall be cut to remove sample triplets.

4.4.1.3 Shots. Chain proof load test (see 4.6.3) and examination of chain length (see 4.5.1 and 4.5.7) shall be conducted on each shot of chain. Examination of link surface (see 4.5.2), examination of flash butt weld surface (see 4.5.3), examination of flash butt weld fusion (see 4.5.4), and stud weld examination (see 4.5.6) shall be conducted on each shot. The weight of finished shots shall be determined (see 4.5.12).

4.4.1.4 Detached triplets. A minimum of a triplet for each lot 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 4.5.7), grip radius, and stud alignment and size (see 4.5.8) prior to the breaking load test.

4.4.1.5 Links. Extra links for each lot shall be removed in a manner that allows specimens to be taken for the chain specimen tensile test (see 4.6.4), chain specimen impact test (see 4.6.5), flash butt weld fusion zone microstructure (see 4.5.9), stud weld fusion zone microstructure (see 4.5.10), 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 shipped with the finished chain, retained at the manufacturing facility, or scrapped. If retention or shipping is desired, 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 with the chain links under a tension of 10 percent of proof load, and in a position to ensure that links are aligned and in full contact. The overall length of six links shall be measured from every third link of each shot for conformance to table IV (see 3.3, 3.11, and 4.7.1).

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

4.5.3 Examination of flash butt weld surface. Magnetic particle or liquid penetrant inspection means shall be employed to examine the flash butt weld surface of the link. Procedures for magnetic particle examination and 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 and before painting. Frequency of examination shall be in accordance with table XI. Flash butt welds shall meet the requirements specified in 3.5.

4.5.4 Examination of flash butt weld fusion. Ultrasonic examination (in accordance with Det Norske Veritas Certification Note No. 2.6, except that frequency of examination shall be in accordance with table XI), shall be employed to examine the flash butt welded fusion area of links. Links shall be examined for conformance to 3.7 and 3.15.2.2 (see 4.7.11).

TABLE XI. Frequency of examination of flash butt weld surface, flash butt weld fusion, and stud weld.

Chain size, inclusive (inches)	Frequency of examinations
3/4 to 1	End links and every tenth link
1-1/8 to 1-3/8	End links and every eighth link
1-1/2 to 1-7/8	End links and every sixth link
2 to 2-3/4	End links and every fourth link
2-7/8 to 4-5/8	End links and every second link
4-3/4	All links

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 4.7.14). The sample shall be one piece or in three pieces from the same link, approximately equal in size, cut transverse to the long axis, and consisting of the weld and stud section, and both bend sections. ASTM E 381 shall be used to rate the significance of indications observed in the macrostructure. The insertion 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, 3.8 and table VII.

4.5.6 Examination of stud welds. Stud welds shall be completely magnetic particle inspected about the entire circumferential weld for conformance to 3.10. This examination shall be done after cleaning all surfaces to remove scale and after proof testing, and before painting. Magnetic particle inspection procedures and equipment shall be in accordance with MIL-STD-271 and acceptance criteria in accordance with NAVSHIPS 0900-LP-003-8000. Frequency of examination shall be in accordance with table XI. All stud welds of first article sample chain shall be inspected.

4.5.7 Link dimensions. The dimensions of each link, including grip radii, of each detached triplet (see 4.4.1.4) shall be measured. Dimensions in table IV 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 4.7.13). Link dimensions shall meet the requirements specified in 3.3.

4.5.8 Stud alignment and size. The stud alignment and centering, and size of each circumferential stud weld shall be measured on the stud of each link of each detached triplet (see 4.7.13). Stud alignment and size shall meet the requirements specified in 3.6.

4.5.9 Examination of flash butt weld fusion zone microstructure. A sample of material shall be taken parallel with the length of the link, traversing the flash butt weld fusion zone, and extending inward from the outside surface to the center of the bar (see 4.4.1.5). A 1-inch square area is considered the minimum size for a microstructure inspection for chain 1-1/2 inches and over. For smaller sizes, the largest practicable sample shall be used. The flash butt weld zone shall be polished and acid etched. A microstructural inspection shall be performed using 100X magnification for conformance to 3.9 and 3.15.4.

4.5.10 Examination of stud weld fusion zone microstructure. A sample of material shall be taken parallel with the length of the link, which includes the stud weld fusion zone including the region where stud and link body intersect (see 4.4.1.5). A 1-inch square area is the minimum size for a microstructure inspection for chain 1-1/2 inches and over. For smaller sizes, the largest practicable sample shall be used. The fusion zone shall be polished and acid etched and a microstructural inspection shall be performed using 100X magnification for conformance to 3.9 and 3.15.4.

4.5.11 Examination of bar stock microstructure. A sample of material shall be taken parallel to the bar long axis for examination of the microstructure with respect to the longitudinal axis of the bar (see 4.3.1(d)). A 1/2-inch square area is the minimum size required for the bar stock microstructural inspection and shall be taken from the center of the bar. The sample shall be polished and acid etched and a microstructural inspection shall be performed using 100X magnification (see 3.2).

4.5.12 Chain weight. Finished chain shall be weighed on completion of marking (see 3.15.5) and finishing (see 3.15.6). Chain weight shall meet the requirements specified in table IV.

4.5.12.1 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 6 to establish the minimum and maximum weights for the six-link section.

4.6 Tests.

4.6.1 Chemical composition. The material sample shall be selected in accordance with 4.3.1(b) and shall be analyzed to determine the chemical composition. The chemical analysis shall include alloying elements added or limited by the contractor. The chemical composition (see 3.2.1) of the steel used in the manufacture of links and studs for first article testing shall be verified by a chemical or spectrographic analysis conducted by the contractor independent of the steel supplier.

4.6.2 Chain breaking load test. Samples for break tests shall be tested by securing them in a testing machine in such a manner that the chain shall be free from twist; and the holding arrangement shall be such that all stresses bearing on the end links of the section under test shall be the same as those applied to every link tested. If, in normal production only, it is considered that the test equipment would be endangered by a sudden break, it will be considered acceptable if the triplet is loaded to the required breaking strength and maintained at the load for 15 seconds. Samples in first article testing shall be tested to destruction. The test triplets shall be disposed of in accordance with 4.4.1.6. The break testing machine shall have been calibrated within the 12 months previous to the chain breaking load test (see 4.7.5 and 4.7.6). The chain shall meet the requirements specified in 3.12.

4.6.3 Chain proof load test. Shots and first article sample chain shall be tested by securing them in a testing machine in such a manner that the chain shall be free from twist; and the holding arrangement shall be such that all stresses bearing on the end links of the section under test are the same as those applied to every link tested. The proof load testing machine shall have been calibrated within the 12 months previous to the chain proof load test. Chain to be sized shall not be loaded in excess of 110 percent of the proof load (see 3.13.1). The chain shall meet the requirements specified in 3.13.

4.6.4 Chain specimen tensile test. The tensile specimen shall be taken from the link in the side opposite the flash butt weld (see 4.3.1(b) and 4.4.1.5). Orientation of the specimen shall be as shown on figure 4. Tensile tests shall be conducted with procedures and using standard specimens machined in accordance with ASTM A 370 and shall meet the requirements specified in 3.14.

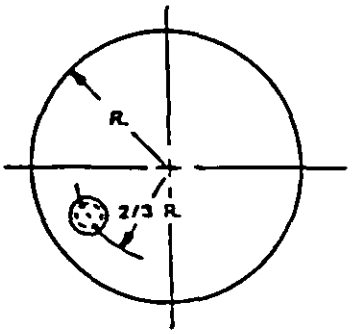


FIGURE 4. Orientation of tensile test specimen.

4.6.5 Chain specimen impact test. Six impact test specimens shall be taken from one of the extra sample links (see 4.4.1.5). Three impact test specimens shall be taken across the weld and three impact test specimens shall be taken across the unwelded side of the links. Orientation of the specimens shall be as shown on figure 5. The notch shall be centered in the flash butt weld heat-affected zone, 1/8-inch from the flash butt weld centerline, for the three specimens taken from that side of the link. Impact tests shall be conducted in accordance with ASTM A 370 (see 3.14, 4.6.8 and 4.7.9). For chain sizes smaller than 1-1/2 inches, the required impact test specimens may be taken from more than one link. When the impact test specimens are taken from more than one link, the notch orientation shall be maintained for the corresponding impact test specimens taken from the welded and unwelded sides of the same link.

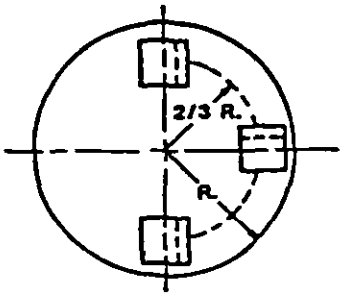
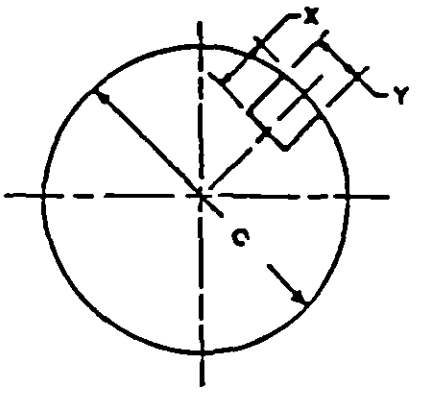


FIGURE 5. Orientation of Charpy V-notch impact test specimens.

4.6.6 Chain specimen bend test. Orientation of the flash butt weld bend test specimen shall be as shown on figure 6. 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 0.75 inch. The test shall be conducted with the bar surface in tension using a mandrel of the maximum radius shown in table XII for the specimen thickness being tested. The sample shall meet the requirements specified in 3.14. The specimen shall be precisely positioned over the mandrel such that the weld area is parallel to and in contact with the mandrel.

TABLE XII. Bend test mandrel radius.

Bend test specimen thickness (inch)	Mandrel maximum radius (inches)
1/4	11/16
5/16	7/8
3/8	1-1/16
7/16	1-1/4
1/2	1-1/2
9/16	1-5/8
5/8	1-13/16
11/16	2
3/4	2-1/4



X = 1/4-inch minimum to 3/4-inch maximum

Y = 1.5X OR C

C = Link diameter (see figure 2)

FIGURE 6. Orientation of bend test specimen.

4.6.7 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. The specimen shall meet the requirements specified in 3.2.2.

4.6.8 Bar stock impact test. Three specimens shall be taken from the bar stock sample (see 4.3.1(d) and 4.4.1.1) and tested as specified (see 4.6.5) in accordance with ASTM A 370. The specimens shall meet the requirements specified in 3.2.2.

4.6.9 Hardness test. The Brinell or Rockwell 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. A minimum of three readings is required.

4.7 Retest and rejection criteria.

4.7.1 Length. If the length of six consecutive links is short, the chain may be stretched by loading above the proof test load specified in table IV, providing this load does not exceed the proof load by more than 10 percent (see 3.13.1 and 4.6.3). If the chain length over six links exceeds the tolerances shown on figure 2, 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 IV.

4.7.2 Single links. If single links are found to be defective or to not meet other applicable requirements, defective links may be cut out and a connecting link inserted in their place (see 4.7.1, 4.7.3, 4.7.4, 4.7.7, 4.7.11, and 4.7.13). 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, it shall be ground down not more than 1/16 inch and streamlined to provide no sharp contours. The link shall then be rechecked for conformance to 3.4; otherwise, 4.7.2 shall apply. If flashings are found in the grip area, they shall be ground down in accordance with 3.4 and rechecked; otherwise, 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 surface. In flash butt weld surface examination by dye penetrant or magnetic particle inspection, the area shall be free of linear indications greater than 1/16 inch. If a defect in the flash butt weld is found, the area shall be ground down not more than 1/16 inch, and streamlined to provide no sharp contours. The repaired area shall be examined by dye penetrant or magnetic particle inspection and if a defect is still present, 4.7.2 shall apply.

4.7.5 Fracture in flash butt weld. If a crack or fracture occurs in the flash butt weld or flash butt weld heat-affected zone, the connected shot shall be rejected. In addition, another chain breaking load test triplet representative of the remaining three shots constructed in the same lot shall be subjected to the breaking load test. If the triplet fractures in the flash butt weld or flash weld heat-affected zone, the lot shall be rejected (see 4.6.2).

4.7.6 Break. If the chain breaks below the level specified in table IV, by any mode, the connected shot shall be rejected. In addition, another chain breaking load test triplet representative of the remaining three shots constructed in the same lot shall be subjected to the breaking load test. If this triplet breaks below the level specified in table IV by any mode, the lot shall be rejected (see 4.6.2).

4.7.7 Proof test failure. If there is sign of fracture, including breaking or cracking, during the proof test, 4.7.2 shall apply (see 4.6.3).

4.7.8 Tensile test failure. If the tensile test fails to meet the requirements in table III or table VIII, but is within 2000 pounds per square inch (lb/in^2) 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 permissible. If the second test fails to meet the requirements of table III or table VIII, the lot of four shots or bar stock (as applicable) shall be rejected (see 4.6.4 and 4.6.7).

4.7.9 Impact test failures. The average results of the three impact tests shall meet or exceed the minimum requirements specified in table III or table VIII. If the average fails to meet the minimum requirement by an amount not exceeding 5 foot-pounds or the value for more than one specimen fails to meet the requirement, or when the value for only one specimen is below 70 percent of the requirement, three additional specimens from the same samples may be tested and the results added to those previously obtained to form a new average. If the new average fails to meet the requirements of table III or table VIII or if more than two individual results are lower than the requirements of table III or table VIII or more than one result is below 70 percent of the requirements, the lot of four shots or bar stock (as applicable) shall be rejected (see 4.6.5 and 4.6.8).

4.7.10 Bend test failure. If there is cracking or fracture associated with the flash butt weld or in the heat-affected zone in the bend specimen before 120 degrees of bend is made, the lot shall be rejected (see 4.6.6).

4.7.11 Ultrasonic inspection failure. If indications of interior flash butt weld fusion defects in reference to the accepted calibration standards are detected during ultrasonic examination of the flash weld zone, 4.7.2 shall apply (see 4.5.4).

4.7.12 Magnetic particle inspection failure. In stud weld examination by magnetic particle inspection (see 3.10, 4.5.6, and 4.5.10), all welds and at least 1/2 inch of adjacent link body shall be free of linear indications greater than 1/16 inch. If a crack or indication is found, the area shall be ground down not more than 1/16 inch and streamlined to ensure no sharp contours and retested. If the crack or indication is still present, all the studs in the shot shall be

inspected and rewelded (if necessary). The shot shall be normalized if repair welding has occurred and the stud inspection performed a second time. Failure of any stud welds during the second inspection shall be cause for rejection of that shot. No shot, or portion thereof, shall be normalized more than twice.

4.7.13 Dimensions. If link diameter, length, width, grip radii and stud alignment and centering, and stud or stud weld 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 lot. 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 of the lot shall be examined for link dimensions, grip radii, stud alignment, and size. If a single particular dimension fails to meet required dimensions in five of the links in a shot, the shot shall be rejected and 4.7.2 shall apply (see 3.6, 4.5.7 and 4.5.8).

4.7.14 Macrostructure and microstructure. Rejection in macrostructural and microstructural examinations shall be for defects, cracks or discrepancies in regard to grain size or microstructure requirements (see 3.8, 3.9, 4.5.5, 4.5.9, and 4.5.10). If stud penetration exceeds the amount specified in table VII, the other two detached links in the shot shall be checked. If one other link shows excessive stud penetration, the lot shall be rejected.

4.7.15 Material composition. Material not within the composition limits shall be rejected (see 4.6.1).

4.7.16 Chain weight. Shots of chain not within the weight limits of table IV shall be rejected.

4.8 Inspection of packaging. Unless otherwise specified (see 6.2), sample packs (bundles), and the inspection of the preservation, packing, and marking for shipment and storage shall be in accordance with the manufacturer's practice to ensure compliance with the requirements of section 5.

5. PACKAGING

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

5.1 Preservation.

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.

5.2 Packing.

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 acquisitioning 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 maximum (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 ship anchoring.

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) When first article inspection is required (see 3.1).
(d) Chain size (link diameter) (see 3.3).
(e) Number of shots of chain required (see 3.11).
(f) Samples used in the first article inspection to be made available to the Government (see 4.3.1).
(g) Disposition of chain samples (see 4.4.1.6).
(h) Packaging inspection if other than specified (see 4.8).
(i) Special marking required (see 5.3.1).

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 (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's 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 requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.1.1		Inspection system program plan	----
4.4, 6.5, and appendix B	DI-MISC-80678	Certification/data report	----
4.4 and appendix A	DI-MISC-80653	Test reports	10.2.b

The above DID's 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 DID's are cited on the 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 should 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 must 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 acquire 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 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.

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 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.

6.7 Subject term (key word) listing.

Brinell hardness
Chain proof load
Flash butt welding
Studs
Stud welding

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

Custodians:
Navy - SH
Air Force - 99

Review activities:
Air Force - 82
DLA - IS

User activities:
Navy - CG, YD

Preparing activity:
Navy - SH
(Project 4010-0182)

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 the 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) Stud weld process and welding electrode or wire.
(e) Statement: "Records are available covering heating, heat-treating, and flash welding parameters" (see 3.15.1.1, 3.15.2.1 and 3.15.4).

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 the 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 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.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-C-24633A	24 April 1990

3. DOCUMENT TITLE
CHAIN, STUD LINK, AMCHOR, LOW ALLOY STEEL, FLASH BUTT WELDED

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	b. TELEPHONE (Include Area Code) (1) Commercial	(2) AUTOVON
NAVAL SEA SYSTEMS COMMAND	(703) 602-9137	332-9137
c. ADDRESS (Include Zip Code) Attn: 55Z33 WASHINGTON, D.C. 20360-5101	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	