UNITED STATES COAST GUARD

OCEAN ENGINEERING DIVISION

WASHINGTON, D.C.

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SPECIFICATION FOR FABRICATION OF SHACKLES, MODEER SHACKLES, AND SWIVELS

SPECIFICATION NO. 417

REVISION D

1. SCOPE

1.1 Purpose. This specification describes the requirements for shackle assemblies, shackle pins, swivels, and split keys used as mooring fittings on aids to navigation buoys. Also included herein are the requirements for Modeer shackle assemblies used for handling stud link chain.

1.2 Classification. Items covered by this specification are described by class, type, and style as defined below.

1.2.1 Class. Shackle assemblies, shackle pins, Modeer shackle assemblies, and swivels are of the classes listed below. The class of an item is based on the item's size, which is defined as the nominal diameter of the bar stock used in the manufacture of the item. In addition, a split key is considered to be of the same class as the shackle pin with which it mates.

Class	Shackle Size (in.)	Swivel Size (in.)	Modeer Shackle Size (in.)
1st	2	2	1-3/4
2nd	1-3/4	1-3/4	1-5/8
3rd	1-1/2	1-1/2	-
4th	1	1-1/4	-
Special	2-1/2	-	-

1.2.2 Type. The term "type" refers to shackle pins. Two types of shackle pin are covered by this specification: rivet pin and split key pin.

1.2.3 Style. The term "style" refers to swivels. Two styles of swivel are covered by this specification: upset head and threaded nut.

1.3 Definitions.

1.3.1 Batch. A batch consists of all items of the same class, type, and style, made from the same heat of steel, and submitted for inspection at the same time.

2. APPLICABLE DOCUMENTS

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

2.2 Industry Publications. The following documents of the issues specified form a part of this specification to the extent referenced herein. Suffixes denoting the specific issue of each document will be omitted from future references to the document in this specification.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 666 10 Mar 2000	Austenitic Stainless Steel Sheet, Strips, Plate and Flat Bar for Structural Applications
ASTM D 5168 10 Oct 1998	Standard practice for fabrication and closure of triple-wall Corrugated fiberboard containers

AMERICAN SOCIETY FOR QUALITY CONTROL (ASQC)

ANSI/ASQC Q9002-1994	Quality Systems - Model for Quality Assurance in Production, Inspection, and Servicing

2.3 Drawings. The latest revision of the following United States Coast Guard Ocean Engineering drawings form a part of this specification to the extent referenced herein, and shall be referred to as "the drawings" throughout this specification:

Number	**Title**
121079D	Shackles
121080C	Modeer Shackles
121081C	Swivels

2.4 Source of Documents. The documents may be obtained from the following sources:

Industry Publications.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1916 Race Street
Philadelphia, PA 19103-1187

AMERICAN SOCIETY FOR QUALITY CONTROL (ASQC)
310 West Wisconsin Avenue
Milwaukee, Wisconsin 53203

2.5 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 General. Shackle bodies and pins, Modeer shackle bodies and pins, and swivels shall be manufactured of carbon steel, and shall be either forged or cast. Split keys shall be manufactured of corrosion resistant steel. The slot in the split key pin shall have a uniform rectangular shape. The design of these items shall be in accordance with the drawings.

3.1.1 Batch number. The Contractor shall assign a unique sequential number to each batch submitted under this specification.

3.1.2 Assemblies. Swivels shall be furnished assembled, as shown on the drawings. Shackle assemblies shall consist of shackle components furnished assembled as described below, in the manner shown on the drawings.

3.1.2.1 Rivet pin shackle assembly. A rivet pin shackle assembly shall consist of the specified class of shackle body and the identical class of rivet pin, assembled. In addition, a retaining wire shall be inserted through the 3/16-inch hole in the rivet pin, so that the pin will remain with the shackle body during shipment.

3.1.2.2 Split key shackle assembly. A split key shackle assembly shall consist of the specified class of shackle body, the identical class of split key pin, and the identical class of split key, assembled. The legs of the split key shall not be spread more than 5 degrees after the split key has been inserted in the pin.

3.1.2.3 Modeer shackle assembly. A Modeer shackle assembly shall consist of the specified class of Modeer shackle body and the identical class of Modeer shackle pin, assembled.

3.2 Material.

3.2.1 Shackle bodies. shackle pins, swivels. Shackle bodies and pins, Modeer shackle bodies and pins, and swivels shall be made of carbon steel of uniform quality. The chemical composition of the steel shall be determined at the steel mill for each heat of steel, and shall conform to the values listed in Table I.

Table I
Chemical Composition of Steel

Element	**Wt. Percent**
Carbon	0.28 - 0.55
Manganese	0.60 - 1.00
Silicon	0.80 max.
Phosphorus	0.05 max.
Sulphur	0.05 max.

3.2.1.1 Alloying elements. Additional alloying elements may be added to the steel as necessary to meet the proof load and breaking load requirements specified herein. If alloying elements are added, they shall not exceed the values listed in Table II.

Table II
Alloying Elements

Element	**Wt. Percent**
Chromium	0.6 max.
Nickel	0.7 max.
Molybdenum	0.25 max.

3.2.2 Split keys. Split keys shall be class 316 or class 316L plate or strip corrosion resistant steel conforming to ASTM A 666.

3.2.4 Traceability. The Contractor shall maintain the traceability of steel and corrosion resistant steel throughout the production, inspection, and testing processes. Each item offered under this specification shall be traceable by batch number to the heat of steel or corrosion resistant steel from which it was made.

3.3 Design. Items covered by this specification shall conform to the configurations, dimensions, and tolerances shown on the drawings. Swivels shall rotate freely. Shackles shall be easily assembled and disassembled. When rivet pins are furnished alone, and not as part of rivet pin shackle assemblies, the 3/16-inch hole shown on the drawings may be omitted.

3.4 Proof load. Each shackle assembly, shackle pin, Modeer shackle assembly, and swivel offered for acceptance shall have been subjected to the applicable proof load specified in Table III without rupture or deformation.

3.5 Breaking load. Shackle assemblies, shackle pins, Modeer shackle assemblies, and swivels shall be capable of withstanding the applicable breaking load specified in Table III for a minimum of 15 seconds without rupture.

3.6 Heat treatment. Items submitted under this specification shall be heat treated by a suitable process as required to meet the proof load and breaking load requirements specified herein.

3.7 Welding. Welding is required in the design of the threaded nut style swivel, as shown on the drawings. This welding shall be performed by an electric welding method. The welds shall not contain cracks, craters, undercutting, overlap, porosity, or lack of fusion.

3.8 Finish. All items shall be submitted in natural color and finish. Varnish or other coatings shall not be used.

Table III
Proof and Breaking Loads

Item	**Proof Load (lb.)**	**Breaking Load (lb.)**
Shackle Assemblies and Shackle Pins		
1st Class	115,000	230,000
2nd Class	90,000	180,000
3rd Class	65,000	130,000
4th Class	30,000	60,000
Special Class	180,000	360,000
Modeer Shackle Assemblies		
1st Class	90,000	180,000
2nd Class	65,000	130,000
Swivels		
1st Class	82,000	164,000
2nd Class	60,000	120,000
3rd Class	45,000	90,000
4th Class	30,000	60,000

3.9 Surfaces. All items offered shall be free from cracks, mill defects, burrs, flaws, rough surfaces, or other defects which might adversely affect their serviceability and handling.

3.10 Identification Marking. For tracking purposes, each item offered under this specification (with the exception of split keys) shall be identified by an identification marking. The marking shall be stamped, engraved, or otherwise permanently affixed to each item, and shall include the manufacturer's name or trademark, the batch number, and the year code and last three digits of the contract number (for example, a contract numbered "DTCG23-01-D-TCB004" would be marked as ("01-004"). Shackle assemblies and Modeer shackle assemblies shall be marked on the bodies and on the pins.

3.11 Documentation.

3.11.1 Quality Assurance Inspection Form. The Contractor shall develop and provide a Quality Assurance Inspection Form (QAIF). The QAIF shall be used to document the inspections and tests performed during the fabrication process. The form shall be printed on standard (i.e., 8½ x 11 inch) white paper. Inspection results may be handwritten on the form. The form shall be prepared in the Contractor's format and shall be legible, in English, and suitable for reproduction. The form shall be made available to the Contracting Officer's Technical Representative (COTR) for review.

3.11.1.1 QAIF Content. At a minimum the QAIF shall include:

a) Item
b) Batch number (paragraph 3.1.1)
c) Serial numbers of items inspected
d) Date of test or inspection
e) Test or inspection to be performed (list every test and inspection required by paragraph 4.5)
f) Result of test or inspection
g) Accept/Reject criteria for each test or inspection
h) Corrective action taken (if any)
i) Notes
j) Initials or signatures of Contractor's test personnel

3.11.2 Mill reports. The Contractor shall furnish a mill report from the steel mill for each heat of steel. The report shall indicate the heat number, steel designation, chemical composition (including any added alloying elements), and quantity of steel represented by the report. Mill reports containing the above information shall also be furnished for each heat of corrosion resistant steel used in split keys.

3.11.3 Material Inspection and Receiving Report (DD Form 250). A form DD-250 shall be used as a certification of product quality assurance, as a packing list, and as a certification of acceptance. The Contractor shall prepare a separate DD-250 for each shipping lot. Prior to shipment, the DD-250 must be signed by the COTR.

4. VERIFICATION

4.1 General. The Contractor's quality assurance program shall meet the requirements of ANSI/ASQC Q9002. However, the Contractor does not have to be Q9002 certified.

4.1.1 Contractor's calibration system. The Contractor shall maintain a calibration and maintenance system to control the accuracy of measurement and test equipment used in the fulfillment of the requirements of this specification. The system shall include, as a minimum, prescribed calibration intervals, source of calibration, and a monitoring system to ensure adherence to calibration schedules. All testing equipment shall have been calibrated traceable to the National Standards within 12 months prior to the testing. At the time of Coast Guard inspection, documentation in support of this requirement shall be made available to the COTR.

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

a. Contractor production inspection (paragraph 4.2.1)
b. Coast Guard inspection (paragraph 4.2.2)

4.2.1 Contractor Production Inspection. The tests and inspections required by this specification are not intended to supplant any controls, examinations, inspections, or tests normally employed by the Contractor to assure product quality. The Contractor shall perform the tests and inspections specified in paragraph 4.5 to ensure conformance to this specification. The Contractor shall provide space, personnel, and test equipment to conduct all inspection and test requirements.

4.2.2 Coast Guard Inspection. The Coast Guard reserves the right to observe, verify, or perform the tests and inspections outlined in paragraph 4.5. During the Coast Guard inspection, the COTR will use the defect categories, rejection criteria, and sampling plans outlined in paragraphs 4.3 and 4.4 (and all associated sub-paragraphs).

4.3 Defect categories. The defect categories listed below will be used during the Coast Guard inspection.

4.3.1 Major. Failure to comply with the requirements of the following paragraphs will constitute major defects:

3.2 Material (and all associated subparagraphs)
3.4 Proof load
3.5 Breaking load

4.3.1.1 Rejection for major defects. If a major defect is found in any batch, the entire batch will be rejected. A batch thus rejected shall not be reworked or resubmitted.

4.3.2 Minor. Failure to comply with the requirements of the following paragraphs will constitute minor defects:

3.3 Design
3.7 Welding
3.8 Finish
3.9 Surfaces
3.10 Marking

4.3.2.1 Rejection for minor defects. Batches rejected for minor defects may be reworked and resubmitted for inspection when they are in compliance with the requirements of this specification. Resubmitted batches shall be clearly identified as such, and shall be kept separate from new batches.

4.4 Sampling. Samples for inspections and tests performed during the Coast Guard inspection will be randomly selected from batches by the COTR, according to the sampling plans described below.

4.4.1 Sampling plan for inspection of minor defects. The unit of inspection will be one shackle assembly, one shackle pin, one Modeer shackle assembly, one swivel, or one split key. The number of samples and accept/reject values will be in accordance with Table IV.

Table IV
Sampling for Minor Defects

No. Items In Batch	No. of Samples	Minor Defects	
		Accept	Reject
2 to 15	2	0	1
16 to 50	5	1	2
51 to 90	8	2	3
91 to 150	13	3	4
151 to 280	20	5	6
281 to 500	32	7	8
501 to 1200	50	10	11
1201 to 3200	80	14	15
3201 and above	125	21	22

4.4.2 Sampling plan for proof load and breaking load tests. The unit of inspection will be one shackle assembly, one shackle pin, one Modeer shackle assembly, or one swivel. The number of samples and accept/reject values will be in accordance with Table V. In addition to the deliverables required by the solicitation, additional units shall be manufactured and processed with each batch in the quantities required by Table V for the breaking load tests.

Table V
Sampling for Proof Load and Breaking Load

No. Items in Batch	Proof Load			Breaking Load		
	No. Samples	Accept	Reject	No. Samples	Accept	Reject
2 to 15	2	0	1	2	0	1
16 to 50	5	0	1	2	0	1
51 to 90	8	0	1	2	0	1
9l to l50	13	0	1	3	0	1
151 to 280	20	0	1	3	0	1
281 to 500	32	0	1	3	0	1
501 to 1200	50	0	1	4	0	1
1201 to 3200	80	0	1	4	0	1
3201 and above	125	0	1	4	0	1

4.5 Inspections and tests.

4.5.1 General. The following inspections and tests shall be performed to comply with the requirements of this specification. They are not intended to limit or supplant any inspections and

tests normally performed by the Contractor.

4.5.2 Documentation Review. The documentation required by paragraph 3.11 shall be reviewed for conformance with this specification and provided to the COTR upon request.

4.5.3 Visual inspection. Each item shall be visually inspected to verify conformance with paragraphs 3.3, 3.7, 3.8, 3.9, and 3.10. Items failing to comply with the requirements of this specification shall be rejected.

4.5.3.1 Proof load test. The Contractor shall proof test each shackle assembly, shackle pin, Modeer shackle assembly, and swivel manufactured under this specification. Items which fail this proof testing prior to being offered for Coast Guard inspection may be reworked, or screened for defectives, and re-tested. This process shall be recorded on the QAIF (3.11.1) At the time of Coast Guard inspection, every shackle assembly, shackle pin, Modeer shackle assembly, and swivel offered shall have successfully passed the proof load test as specified in paragraph 3.4. The Contractor shall certify this by submitting a Certificate of Performance (Appendix A) for each batch offered. In addition, at the time of Coast Guard inspection, the Contractor shall proof test the samples chosen in accordance with paragraph 4.4.2 in the presence of the COTR. If any item fails the proof test at this time, it shall be considered a major defect.

4.5.3.2 Method of proof load testing. Shackle assemblies, Modeer shackle assemblies, and swivels shall be proof tested assembled. These items may be proof tested individually or in a series. When shackle pins are to be furnished alone, they may be proof tested individually, or by inserting them into shackle bodies of the appropriate class and tested as assemblies. Application of the proof load shall be at the centerline of the sample. The diameter of the attachments used in the proof tests shall not be greater than the size of the sample being tested.

4.5.3.3 Breaking load test. The Contractor shall perform breaking load tests in the presence of the COTR, using samples chosen in accordance with paragraph 4.4.2. Shackle assemblies, Modeer shackle assemblies, and swivels shall be break tested assembled. When shackle pins are to be furnished alone, they may be break tested individually, or by inserting them into shackle bodies of the appropriate class and tested as assemblies. Application of the breaking load shall be at the centerline of the sample. The diameter of the attachments used in the breaking load tests shall not be greater than the size of the sample being tested.

4.6 Inspection of packaging and marking. The Coast Guard inspection to determine compliance with the requirements of paragraph 5.1 will be performed at the point of destination. Items received at the point of destination which are not packaged and marked in accordance with the requirements of paragraphs 5.1 will be rejected.

5. PACKAGING AND MARKING

5.1 Packaging requirements are specified in Section D, Part 1, and Contract Schedule.

APPENDIX A

CERTIFICATE OF PERFORMANCE

Contract No. _____

Item _____ Batch No._____

I hereby certify that all items in the above numbered batch submitted for the above numbered contract have successfully passed the proof load test as specified in paragraph 3.4 of U.S. Coast Guard Specification No. 417D.

Signed_____ Date_____

Title _____

SPECIFICATION FOR FABRICATION OF SHACKLES, MODEER SHACKLES, AND SWIVELS

SPECIFICATION NO. 417

Revision D

NOVEMBER 2000

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