

MIL-F-22978A(ASG)

10 JUNE 1963

Superseding
MIL-F-22978(Wep)
20 August 1962

MILITARY SPECIFICATION

FASTENER, ROTARY, QUICK-OPERATING, HIGH-STRENGTH

This specification has been approved by the Department of the Air Force and by the Bureau of Naval Weapons.

1. SCOPE

1.1 Scope.- This specification covers the general requirements for a high-strength, quick-operating, rotary fastener.

1.2 Classification.- Fasteners furnished under this specification shall be of the following types, as specified (see 6.2):

Type I - Flush head

Type II - Protruding head

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

SPECIFICATIONSFederal

QQ-A-287	Aluminum Alloy Plate and Sheet, Alclad 7075
QQ-A-362	Aluminum Alloy Plate and Sheet, Alclad 2024
QQ-P-416	Plating, Cadmium (Electrodeposited)

Military

MIL-H-3982	Hardware (Fasteners and Related Items) Packaging and Packing for Shipment and Storage of
MIL-S-5000	Steel, Chrome-Nickel-Molybdenum (4340 or E-4340) Bars and Reforging Stock
MIL-C-5541	Chemical Films for Aluminum and Aluminum Alloys
MIL-S-6050	Steel, Chrome-Nickel-Molybdenum (8630) Bars, Rods, and Reforging Stock (for Aircraft Applications)
MIL-H-6875	Heat Treatment of Steels, (Aircraft Practice), Process for
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys

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MIL-S-18728	Steel Plate, Sheet, and Strip, Alloy, 8630, Aircraft Quality
MIL-S-18729	Steel Plate, Sheet, and Strip, Alloy, 4130, Aircraft Quality

STANDARDSFederal

FED. STD. NO. 66	Steel: Chemical Composition and Hardenability
FED. STD. TEST METHOD NO. 151	Metals; Test Methods

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of US Military Property
MS9006	Recesses - Cross, Low Torque Drive, Dimensions and Gage Dimensions for
MS17731	Fastener, Rotary, Quick-Operating, Flush Head, Floating Type, 2210 Lbs Min Tensile Strength
MS17732	Fastener, Rotary, Quick-Operating, Protruding Head, Floating Type, 2210 Lbs Min Tensile Strength

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Qualification.- The fastener furnished under this specification shall be a product which has been tested and has passed the qualification tests specified herein, and has been listed on or approved for listing on the applicable Qualified Products List.

3.2 Materials.- Materials shall be carbon or alloy steel selected from one of the following tables titled:

"Standard Nonresulphurized Carbon Steels: Compositions and Forms Available"

"Standard (SAE) Nonresulphurized Carbon Steels for Plates, Sheet, Strip, Structural Shapes, and Welded Tubing"

or

"Standard and Tentative Standard Alloy Steels"

of Federal Standard No. 66. The material shall be sound, of uniform quality and condition, free from pipes, and shall not contain decarburization, carburization, lap, cracks, twists, seams, or other defects detrimental to the fabrication or performance of parts.

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3.2.1 Heat treatment.- Heat treatment of steel shall be in accordance with Specification MIL-H-6875.

3.3 Design and construction.- The fastener shall be of the stud-receptacle design and shall be so constructed that neither the stud assembly nor the receptacle assembly can be inadvertently disassembled during normal operation. The design shall be such that the stud and receptacle can be removed and replaced in service with any other acceptable fastener of the same type without deviation from the dimensions noted herein and without the use of special tools. The fastener shall provide for retention of the stud in the outer sheet when unfastened.

3.3.1 Curved sheet installation.- The fastener shall be adaptable to a rigid, curved sheet installation wherein the radius of curvature is not greater than 12 inches and the included angle between extreme fasteners is 90 degrees when tested in accordance with 4.6.11. The fastener shall also be adaptable when the sheet has a radius of curvature not greater than 24 inches, is hinged at one side, and the included angle between the hinge and any fastener is 45 degrees.

3.3.2 Dimensions.- The stud assembly and receptacle assembly shall fall within the envelope dimensions and shall conform to the detail dimensions shown on Standards MS17731 and MS17732 for the applicable type.

3.3.3 Stud assembly.- The stud assembly configuration may employ a shear bushing, retainer ring, and other components.

3.3.3.1 Recess.- The recess in the head of the stud shall be of the cross-recess type in accordance with the dimensions shown on Standard MS9006.

3.3.3.2 Head flushness.- In designs utilizing a shear bushing-type component, the stud shall be flush with the top of the shear bushing within ± 0.005 inch.

3.3.4 Receptacle assembly.- The receptacle assembly shall be of a floating type and have a minimum float of 0.020 in any direction from the centered position.

3.3.5 Locking and unlocking.- When the stud assembly is mated with its receptacle assembly, the installed fastener shall be capable of being fully locked (see 6.4.2) within two complete rotations in the clockwise direction as viewed from the outer sheet. After rotation in the counterclockwise direction to the point of disengagement, and when the inner and outer sheets are then separated by an amount equal to the applicable minimum sheet pull-up value, the fastener shall be capable of relocking without additional counterclockwise rotation. The fastener shall be considered to be fully locked when tightened to a torque conforming to the sheet separation requirement specified in 3.5.5 but which does not exceed the applicable maximum locking torque value listed in table I. The fully locked fastener shall unlock to the point of complete disengagement within two complete rotations in the counterclockwise direction as viewed from the outer sheet.

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3.4 Finish.- Parts of carbon or alloy steel shall be cadmium plated in accordance with type II, class 3 of Specification QQ-P-416.

TABLE I. Room temperature mechanical properties

Requirement	Torque value
Locking torque	30 inch-pounds (max)
Unlocking torque	35 inch-pounds (max)
Torque out	75 inch-pounds (min)
Ultimate shear load	4,650 pounds (min)
Rated shear load	3,580 pounds (min)
Ultimate tensile load	2,210 pounds (min)
Rated tensile load	1,700 pounds (min)
Sheet separation (test condition)	Not to exceed 0.015 inch at rated tensile load
Sheet pull-up	1/16 inch (min)
Stud push-out	150 pounds (min)
Receptacle push-out	125 pounds (min)

3.5 Performance.-

3.5.1 Locking and unlocking torque.- The maximum locking torque value specified in table I shall not be exceeded while operating the fastener through the entire range of sheet pull-up from initial engagement to the fully locked condition when tested in accordance with 4.6.2. The unlocking torque value specified shall not be exceeded while rotating the fastener from the fully locked condition to the point of complete disengagement.

3.5.2 Torque-out.- When the installed fastener is subjected to the torque-out values specified in table I in accordance with 4.6.3, there shall be no failure (see 6.4) or permanent deformation to any of the fastener components.

3.5.3 Shear.- The fastener shall not develop permanent deformation when subjected to the rated shear load and shall withstand the ultimate shear load specified in table I without failure when tested in accordance with 4.6.9.

3.5.4 Tension.- The fasteners shall not develop permanent deformation when subjected to the rated tensile load and shall withstand the ultimate tensile load specified in table I without failure when tested in accordance with 4.6.5.

3.5.5 Sheet separation.- The sheet separation determined in accordance with 4.6.6 shall not exceed the value specified in table I when the installed fastener assembly in the fully locked condition is subjected to the rated tensile load specified in table I.

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3.5.6 Sheet pull-up.- The installed fastener shall be capable of initial engagement when a sheet separation condition exists at the fastener of not less than the values specified for "Sheet pull-up" in table I. The fastener shall then be capable of drawing the sheets together at the fastener to the fully locked condition when tested in accordance with 4.6.2.

3.5.7 Stud push-out.- The stud assembly of the installed fastener shall withstand the push-out values specified in table I without permanent deformation to any components or separation from the sheet when tested in accordance with 4.6.12.

3.5.8 Receptacle push-out.- The push-out test load shall be applied axially to the receptacle body through a stud of the type fastener being tested and sufficiently long to transmit the entire test load to the receptacle components. The receptacle assembly shall be mounted in the same fixture as used for the tension test specified in 4.6.13.

3.5.9 Vibration.- The fastener assembly shall be capable of withstanding the vibration test specified in 4.6.8 without fastener failure and with no more than a 10-percent reduction in the torque required to lock the fastener assembly.

3.5.10 Shear fatigue.- There shall be no single fastener failure of the fastener assemblies when fatigue tested in accordance with 4.6.7.

3.5.11 Corrosion resistance.- The fastener assembly shall be capable of withstanding the salt spray test specified in 4.6.10 without becoming inoperable within the locking and unlocking torque specified in 3.3.5.

3.5.12 Elevated temperature.- The installed fastener assembly shall withstand a temperature limit of 450° F, when tested in accordance with 4.5.1 and shall be capable of passing the performance tests specified in 4.3.3.

3.5.13 Endurance.- The fastener shall withstand 1,500 cycles of locking and unlocking without failure when tested in accordance with 4.6.4.

3.6 Marking.- Marking shall be in accordance with Standard MIL-STD-130 and the applicable MS standard.

3.7 Workmanship.- Workmanship shall be in accordance with high-grade manufacturing practices. Fastener parts shall be free from burrs, tool marks, cracks, and other defects which may affect the serviceability or performance of the fastener as defined herein.

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4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection.- Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any other commercial laboratory acceptable to 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.

4.2 Classification of tests.- Inspection and testing of fasteners shall be classified as follows:

- (a) Qualification tests (4.3)
- (b) Quality conformance tests (4.4)

4.3 Qualification tests.-

4.3.1 Sampling instructions.- The qualification test samples shall consist of 14 type I flush head fasteners in the following sizes. Seven of the -2 size, two of the -5 size, and five of the -9 size. Samples shall be plainly identified by securely attached durable tags containing the following information and shall be forwarded to the activity responsible for qualification (see 6.3).

Sample for qualification tests
FASTENER, ROTARY, QUICK-OPERATING, HIGH-STRENGTH
MS Part No.
Manufacturer's Part No.
Name of manufacturer
Submitted by (name) (date) for qualification tests in
accordance with Specification MIL-F-22978A(ASG) under
authorization (reference letter of authorization).

4.3.2 Samples submitted for qualification testing shall be accompanied by a complete set of engineering drawings of the fasteners for which qualification is desired.

4.3.3 Qualification.- The following samples, of the sizes indicated, shall be subjected to qualification tests as specified:

- (a) Three samples of the -9 size shall be subjected to the following tests in the order listed:
 - (1) Elevated temperature (4.6.1).
 - (2) Stud and receptacle push-out (4.6.12 and 4.6.13).
 - (3) Sheet separation (4.6.6)-
 - (4) Tension (4.6.5).

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- (b) Three samples of the -2 size shall be subjected to the following tests in the order listed:
- (1) Elevated temperature (4.6.1).
 - (2) Shear fatigue (4.6.7).
 - (3) Shear (4.6.9).
- (c) Two samples each of the -2, -5, and -9 sizes shall be subjected to the following tests in the order listed:
- (1) Elevated temperature (4.6.1).
 - (2) Torque-out (4.6.3).
 - (3) Endurance (4.6.4).
 - (4) Vibration (4.6.8).
- (d) Two samples of the -2 size shall be subjected to the following tests in the order listed:
- (1) Elevated temperature (4.6.1).
 - (2) Sheet pull-up, locking and unlocking torque (4.6.2).
 - (3) Curved sheet installation (4.6.11).
 - (4) Corrosion resistance (4.6.10).

4.3.4 Tests.- Qualification tests shall consist of examinations and all tests of this specification (see 4.5 and 4.6 and subparagraphs thereto).

4.4 Quality conformance tests.- Quality conformance tests shall consist of examinations and the following tests as specified under 4.6.

- (1) Sheet pull-up, locking and unlocking torque (4.6.2).
- (2) Torque-out (4.6.3).
- (3) Shear (4.6.9).
- (4) Corrosion resistance (4.6.10).

4.4.1 Inspection lot.- An inspection lot shall consist of complete fasteners of the same type and size manufactured under essentially the same conditions and submitted for inspection at the same time.

4.4.2 Sampling.-

4.4.2.1 Sampling for examination.- A random sample of fasteners shall be selected from each inspection lot in accordance with Standard MIL-STD-105, Inspection level II, Acceptable Quality Level (AQL) 1.0 percent defective.

4.4.2.2 Sampling for quality conformance tests.- A random sample of fasteners shall be selected in accordance with Standard MIL-STD-105, Inspection level L6, AQL 1.0 percent defective.

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4.4.3 Rejection and retest.- The instructions on reworking or re-submitting rejected items shall be as specified in the general provisions of the contract.

4.5 Examinations.-

4.5.1 Examination of product.- Each of the sample fasteners selected in accordance with 4.4.2.1 shall be examined for conformance to materials, design, dimensions, head flushness, receptacle float, and workmanship as specified herein and on the applicable MS standard.

4.5.2 Preservation, packaging, packing, and marking.- Preparation for delivery shall be examined for conformance to section 5.

4.6 Test methods.- For all tests specified herein, the sheet preparation for mounting fasteners shall conform to figure 1. Specimens shall be remounted, as necessary, to perform the tests in the sequence specified in 4.3.3.

4.6.1 Elevated temperature.- The installed fastener assembly shall be baked for 4 hours at the specified temperature limit and then cooled slowly in air to room temperature before performing additional tests. There shall be no evidence of failure or permanent deformation of any of the fastener parts. A drop of oil may be added to the receptacle locking elements after completion of the baking operation.

4.6.2 Sheet pull-up, locking and unlocking torque.- Conformance to the sheet pull-up requirements shall be established by installing the fastener in flat plates of aluminum alloy (2024-T4, 2024-T3, 2024-T6, or 7075-T6) in accordance with Specification QQ-A-362 or QQ-A-287. The plate size shall be 3 inches by 5 inches by 0.125 inch. The stud and receptacle shall engage when a feeler gage 1/16 inch thick is inserted between the inner and outer plates, allowing a 1-1/2 inch space between the shear bushing and the feeler gage on opposite sides of the fastener. The torque tests shall begin with the fastener engaged to provide the maximum pull-up. Torque shall then be applied not to exceed the values specified in table I and the fastener shall be rotated to the fully locked position. In the fully locked position, both mounting plates shall be touching each other in the immediate vicinity of the shear bushing. Torque required to unlock the fastener shall not exceed the values specified in table I. Rotation of the stud to lock and unlock the fastener shall not exceed that specified in 3.3.5.

4.6.3 Torque-out.- The test load shall be applied by means of a torque-measuring device with a hexagon bit adapter by rotating the stud of the installed fastener in a clockwise direction. The fastener components shall be so adjusted that stud rotation is resisted at the extremity of its travel when there is no axial load on the stud due to locking of the fastener. This test shall be repeated in the counterclockwise direction when torquing in that direction is possible because of fastener design.

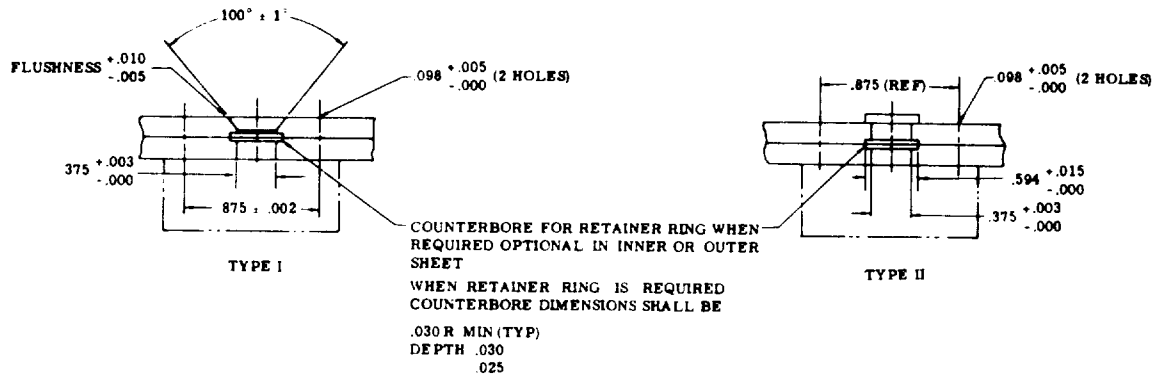


FIGURE 1. Sheet preparation

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4.6.4 Endurance.- The fastener shall be subjected to 1,500 cycles of operation, each cycle consisting of rotation from the completely disengaged position to the fully locked condition. The fastener shall be visually examined at the completion of this test to determine any detrimental effects or excessive wear to the components thereof. Failure or wear which prevents the fastener from conforming to the performance requirements of this specification as specified in 4.3.3 shall be cause for rejection. A drop of oil may be added at the beginning of this test.

4.6.5 Tension.- When the installed fastener is tightened to not more than the maximum locking torque specified in table I, the rated tensile load specified in table I shall be applied in a direction to the sheeting tending to pull the fastener apart. The test load shall be applied and released five consecutive times. The fastener shall then be subjected again to the locking and unlocking torque tests specified in 3.3.5. The torque readings shall not exceed the maximum values specified in table I and there shall not be any evidence of permanent deformation. The fastener shall then be loaded to the ultimate tensile load specified in table I and examined for evidence of failure. A typical fastener mounting and tension test jig are shown on figure 2.

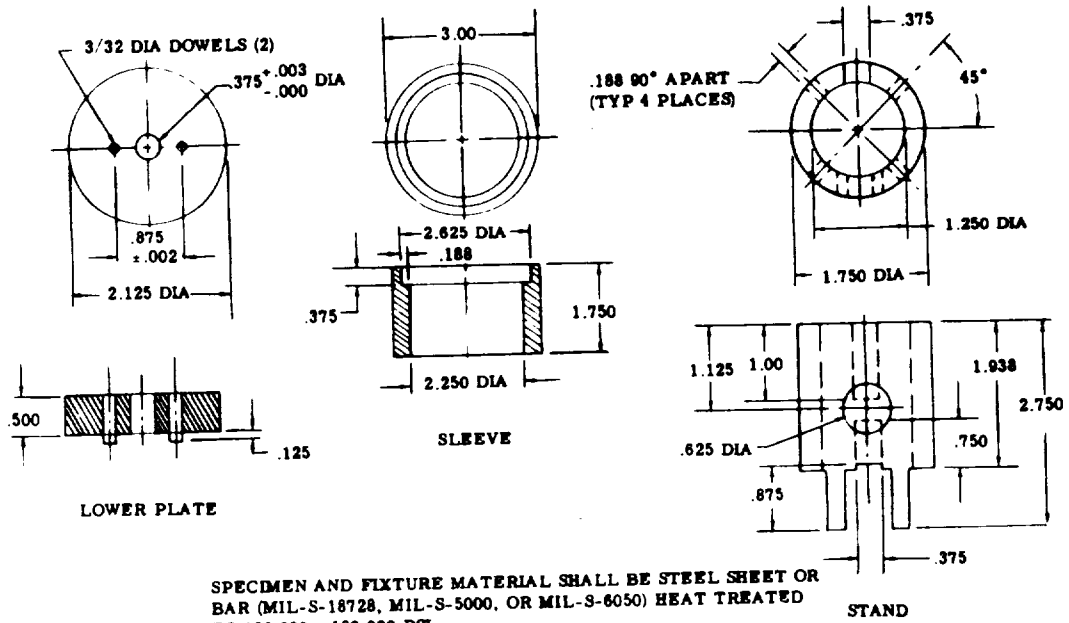
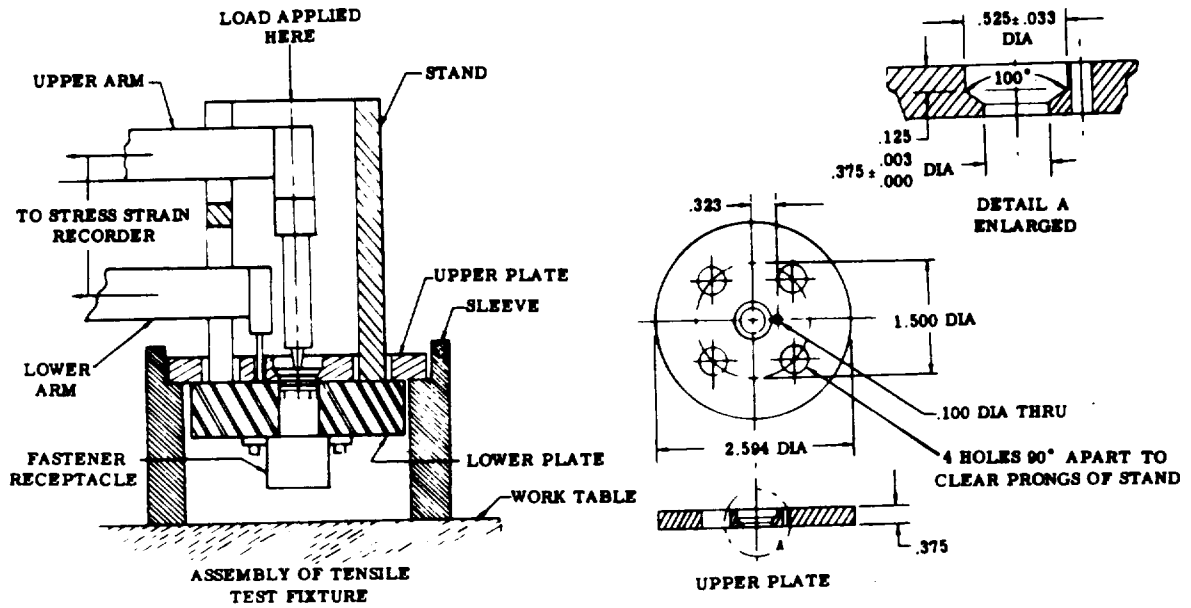
4.6.6 Sheet separation.- The installed fastener shall be fully locked to the torque value specified in table I and loaded to its rated tensile load as specified in table I. The amount of separation between the inner and outer sheets shall then be measured by the stress strain recorder as shown on figure 2 in the area immediately around the shear bushing.

4.6.7 Shear fatigue.- The fastener assembly shall be mounted as shown on figure 3 and tightened to not more than the maximum locking torque specified in table I. The frequency shall be 1,800 \pm 100 cycles per minute (cps) and the number of cycles shall be 50,000 for each of the following loading conditions, which shall vary during each cycle:

- (a) From 0 to 40 percent of the ultimate shear load specified in table I and,
- (b) From -10 percent to +10 percent of the ultimate shear load specified in table I.

NOTE: Parts (a) and (b) shall be conducted consecutively and in the order listed.

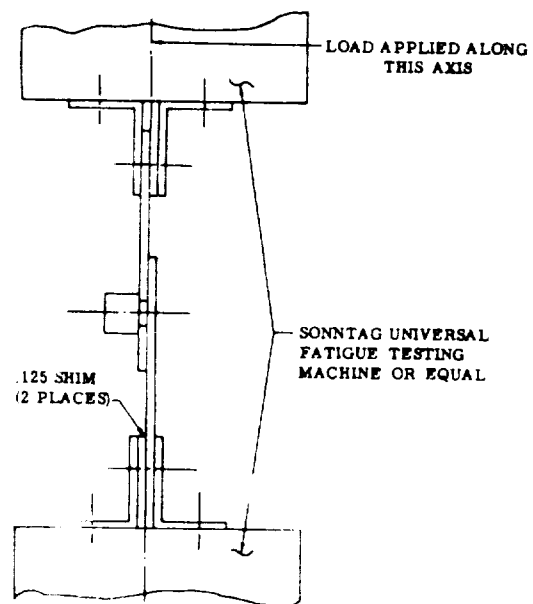
4.6.8 Vibration.- The fastener assembly shall be mounted as shown on figure 4 and tightened to not more than the maximum locking torque indicated in table I. The fastener shall be vibrated at a frequency of from 10 to 2,000 cps at a double amplitude of 0.03 inch or \pm 5 g, whichever is the limiting factor. The rate frequency variation shall be logarithmic and shall require 30 minutes to proceed from 10 to 2,000 to 10 cps. After testing in the "X" direction as shown on figure 4, the test fixture shall be rotated 90 degrees and subjected to the same frequency cycling in the "Y" direction as shown on figure 4.



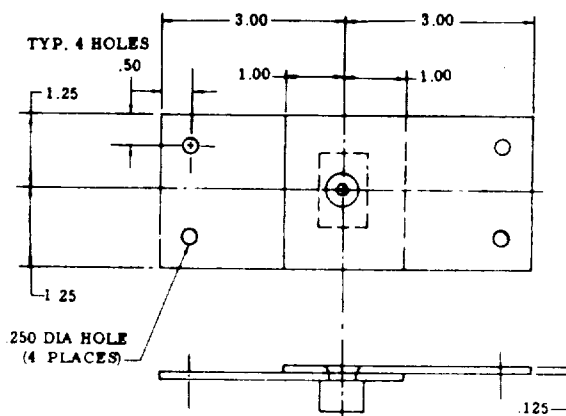
SPECIMEN AND FIXTURE MATERIAL SHALL BE STEEL SHEET OR BAR (MIL-S-18728, MIL-S-5000, OR MIL-S-6050) HEAT TREATED TO 160,000 - 180,000 PSI

FIGURE 2. Fastener mounting and tension test jig

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SPECIMEN MOUNTED IN TESTING MACHINE
 SPECIMEN AND FIXTURE MATERIAL SHALL
 BE STEEL SHEET (MIL-S-18728 OR MIL-S-18729)
 HEAT TREATED TO 160,000 - 180,000 PSI

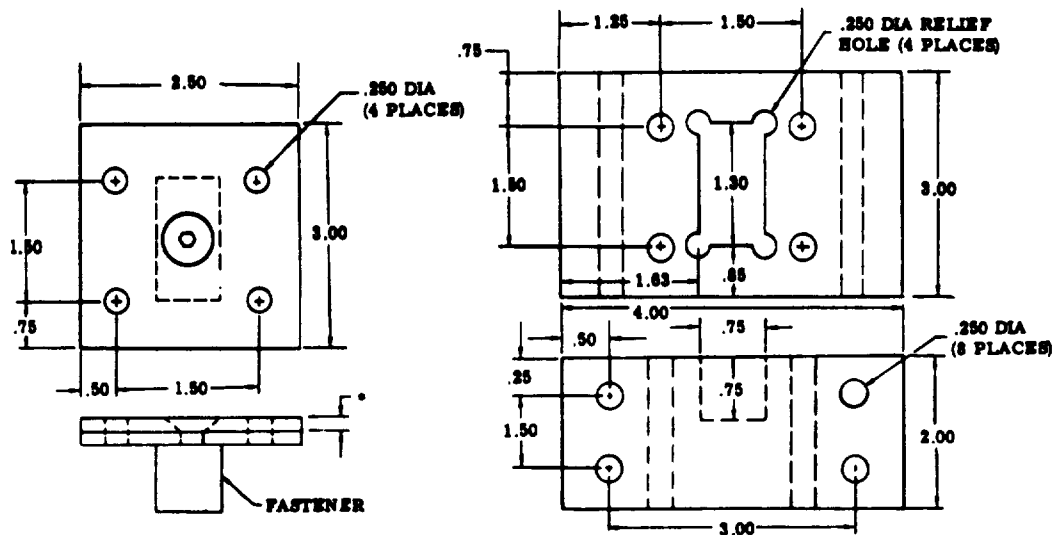


TEST SPECIMEN

NOTE: RETAINER RING NOT REQUIRED
 DO NOT COUNTERBORE FOR RETAINER RING

FIGURE 3. Mounting for shear fatigue and shear test

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TEST SPECIMEN .125 STEEL SHEET (2) FOR -2 FASTENER TEST FIXTURE
 .190 STEEL SHEET (1) FOR -5 FASTENER
 .250 STEEL SHEET (1) FOR -5 FASTENER
 .375 STEEL SHEET (2) FOR -9 FASTENER

TEST FIXTURE MATERIAL SHALL BE STEEL BAR (MIL-S-5000 OR MIL-S-6050) HEAT TREATED TO
 160,000 - 180,000 PSI
 TEST COUPON MATERIAL SHALL BE STEEL SHEET (MIL-S-18728 OR MIL-S-18729) HEAT TREATED
 TO 160,000 - 180,000 PSI

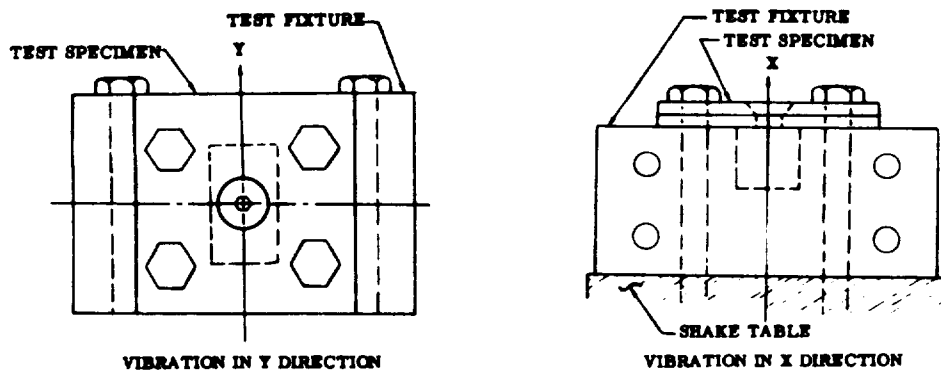


FIGURE 4. Vibration test setup

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4.6.9 Shear.- With the fastener assembly mounted as shown on figure 3, and tightened to not more than the maximum locking torque specified in table I, the rated shear load as specified in table I shall be applied and released five consecutive times, and the fastener shall then be examined for evidence of permanent deformation. The locking and unlocking torque requirement specified in 3.3.5 shall be reapplied after the last release of the shear load. The fastener shall then be remounted in the shear test fixture, loaded to the ultimate shear load specified in table I, and examined for failure.

4.6.10 Corrosion resistance.- The fastener assembly installed in two 0.125-inch-thick aluminum-alloy sheets (7075-T6) conforming to Specification QQ-A-287, and anodized in accordance with Specification MIL-A-8625, shall be subjected to the salt spray test in accordance with Method 811 of Federal Test Method Standard No. 151 for 96 hours. The fastener shall be examined for conformance to 3.5.11. Plated parts shall be examined for conformance to the governing specification of the process. Unplated parts shall exhibit no corrosive pitting.

4.6.11 Curved sheet installation.- Curved sheet adaptability shall be determined by installing fasteners in a rigid, curved panel and its mating substructure and testing for ease of installation and removal of the panel. Sheet preparation for fastener installation shall be in accordance with figure 1. It shall be possible to freely install and remove the removable panel, and the hinged panel shall be capable of swinging into full contact with and away from the mating substructures without interference due to the unlocked fasteners. Shear bushings may be manually retracted during this test to the limit allowed by the retaining device.

4.6.12 Stud push-out.- With the fastener stud assembly installed in the test fixture used for the tension test, the test load shall be applied axially to the inner end of the stud assembly and normal to the sheets, tending to force the stud assembly outward from the sheet.

4.6.13 Receptacle push-out.- The push-out test load shall be applied axially to the receptacle body through a stud of the type fastener being tested and sufficiently long to transmit the entire test load to the receptacle components. The receptacle assembly shall be mounted in the same fixture as used for the tension test specified in 4.6.5.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing.- Preservation, packaging, and packing shall be in accordance with Specification MIL-H-3982.

5.2 Marking.- Interior packages and exterior containers shall be marked for shipment in accordance with Standard MIL-STD-129.

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6. NOTES

6.1 Intended use.- The fasteners covered by this specification are intended for use on structural panels where a high-strength, rotary-type, quick-operating fastener is required for quick access.

6.2 Ordering data.- Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type of fastener (see 1.2).
- (c) MS Part No.
- (d) Applicable levels of preservation, packaging, and packing (see 5.1).

6.3 Qualification.- With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government, tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Bureau of Naval Weapons, Washington 25, D. C.; however, information pertaining to qualification of products may be obtained from Naval Air Engineering Center, Philadelphia 12, Pennsylvania.

6.4 Definitions.-

6.4.1 Failure.- A failure, as defined by this specification, will be considered to exist when any of the fastener component parts fracture or break, or where distortion, permanent set, or wear is of a degree which prevents the fastener from sustaining the applicable test load, or when the stud and receptacle of an installed fastener assembly loosens or become separated.

6.4.2 Fully locked.- For the purpose of determining conformance to this specification, the term "fully locked" condition is defined in 3.3.5.

Custodians:
Navy - Weps
Air Force - ASD

Preparing activity:
Navy - Weps

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