MIL-F-81177E
15 February 1984
SUPERSEDING
MIL-F-81177D
30 October 1980

MILITARY SPECIFICATION

FASTENERS, BLIND, HIGH STRENGTH, INSTALLATION FORMED, ALLOY STEEL, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification establishes the requirements for installation formed high strength, alloy steel blind fasteners.

1.2 Classification. Fasteners furnished under this specification shall be of the following types:

Type I Pull Type - Positive Mechanically Locked (see 6.4)

Type II Threaded - Self Locking (see 6.4)

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards and handbooks. Unless otherwise specified, the following specifications, standards and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-P-35 Passivation Treatments for Corrosion-resisting Steel

QQ-P-416 Plating, Cadmium (Electrodeposited)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FEDERAL (continued)

PPP-H-1581	Hardware (Fasteners and Related Items), Packaging of

MILITARY

MIL-I-6866	Inspection, Penetrant Method of
MIL-I-6868	Inspection Process, Magnetic Particle
MIL-H-6875	Heat Treatment of Steels (Aircraft Practice) Process for
MIL-L-8937	Lubricant, Solid Film, Heat Cured
MIL-L-87132	Lubricant, Cetyl Alcohol, 1 Hexadecanol, Application to Fasteners

(See Supplement 1 for applicable specification sheets.)

STANDARDS

FEDERAL

FED-STD-66	Steel, Chemical Composition and Hardenability
FED-STD-151	Metals, Test Methods

MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-889	Dissimilar Metals
MIL-STD-1312	Fasteners, Test Methods

(See Supplement 1 for applicable military standards.)

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

Society of Automotive Engineers

AMS 5737	Bars, Forgings, and Tubing -15 Cr 26 Ni 1.3 Mo 2.1 Ti
AMS 5690	Steel Wire, Corrosion and Heat Resistant, 17 Cr - 12 Ni - 2.5 Mo (SAE 30316)

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

American Society for Testing and Materials

A-331 Steel Bars, Alloy, Cold Finished

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

American National Standards Institute

ANSI B46.1 Surface Texture (Surface Roughness, Waviness and Lay)

(Application for copies should be addressed to the American Standards Institute, 1430 Broadway, New York, NY 10018.)

National Aerospace Standards

NAS 672 Plating, High Strength Steels, Cadmium

(Application for copies should be addressed to the Aerospace Industries Association of America, 1725 DeSales St. N.W., Washington, DC 20036.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Specification sheets and standards. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet or standard. In the event of any conflict between the requirements of this specification and the specification sheet or standard, the latter shall govern.

3.2 Qualification. The fasteners furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.3 and 6.3).

3.2.1 Retention of qualification. The continued listing of a product on the Qualified Products List (QPL) shall be dependent upon periodic verification of the manufacturer's continued compliance with the requirements of this specification (see 4.3.3).

3.2.2 Product change. Any change in materials or design shall require requalification of the product.

3.3 Design and Construction, type 1.

3.3.1 Design. The fastener shall be of multiple-piece construction. It shall be an integral assembly and shall include a means, other than friction, of mechanically locking the serrated pin to the fastener body.

3.3.2 Construction. The fasteners shall consist primarily of a sleeve and a serrated pin with additional parts to lock the pin to the sleeve.

3.3.2.1 Locking feature. The locking feature shall be a secured component of the fastener assembly and shall not become disassembled during assembly or normal handling. Locking collars may be slotted for ease of assembly. Slot width shall not exceed 0.020-inch after assembly.

3.3.3 Installation. Installation of the fastener shall be accomplished by the action of the serrated pin being pulled into the sleeve, forming a blind head on the back side of the assembly, and removing the pulling portion of the pin after the locking feature has been installed. The pin protrusion of the driven fastener shall be within limits shown on Figure 1 and Table I. The fastener shall meet the performance requirements of this specification when installed with the tools listed in Appendix "A." No additional lubricant shall be used on the fastener. A means of visual inspection for proper installation shall be provided. Pin and collar position shall be as specified in Table I and Figure 1.

3.3.4 Blind head diameters (installed). When driven in minimum grip, the blind head of the installed fastener shall have a minimum diameter as specified in Table I.

3.3.5 Grip lengths increments. Grip lengths for all fastener diameters shall be in 0.0625-inch increments and conform to the applicable military specification sheet or standard.

3.3.6 Dimensions. After plating and finishing, fastener dimensions shall conform to the applicable military standards (see 4.5.1).

3.3.7 Roundness and concentricity of heads. Fastener heads shall be round and concentric within the limits specified in Table II (see 4.5.1).

3.3.8 Materials. The materials used in the manufacture of the high strength, blind fastener shall be as follows:

Sleeves and serrated pins shall be alloy steel in accordance with ASTM-A-331. The mechanical lock collar shall be of carbon steel or alloy steel conforming to the chemical composition of 1010, 1020, 1144, 4037 or 4130 of FED-STD-66 or A286 conforming to the chemical requirements of AMS 5737, or Type 316 CRES conforming to the chemical requirements of AMS 5690.

3.3.8.1 Dissimilar metals. The use of dissimilar metals in fabrication of fasteners shall conform to MIL-STD-889.

3.3.9 Heat treatment. Heat treatment of alloy steel components shall be in accordance with MIL-H-6875.

3.3.9.1 Hardness. All alloy steel sleeves shall be within Knoop 326 to 466 employing a 1000 gram load when tested in the core of the head at the center of head cross section (see 4.5.5). Alloy steel serrated pins shall be within Rockwell C 48-53 (see 4.5.3).

3.3.9.2 Carburization and decarburization. Alloy steel serrated pins shall meet the requirements of MIL-H-6875 for carburization and decarburization. Alloy steel sleeves shall show no more than 0.020-inch total decarburization (complete plus partial) (see 4.5.5).

3.3.10 Passivation. All corrosion and heat-resistant steel components shall be passivated in accordance with QQ-P-35.

3.3.11 Protective treatment. Alloy steel sleeves, alloy steel mechanical lock collars, and carbon steel mechanical lock collars shall be cadmium plated in accordance with QQ-P-416, Type II, Class 2. Alloy steel serrated pins shall be cadmium plated in accordance with QQ-P-416, Type I, Class 3.

3.3.11.1 Hydrogen embrittlement relief. The alloy steel serrated pins shall be heated to 375°±25°F within 4 hours after plating, and held at this temperature for not less than 23 hours.

3.4 Discontinuities, type I (see 4.5.2).

3.4.1 Seam and tool marks. Except as specified in 3.4.1.1 and 3.4.2, fasteners may possess seams and tool marks that do not exceed the limits of Table III on any of the components of the fastener.

3.4.1.1 Fastener head. The fastener head shall not have more than three openings, seams, inclusions, nicks, or gouges in the following areas:

(a) On the top of the fastener head exceeding twice the depth limits shown in Table III.

(b) On the periphery of the fastener head exceeding four times the depth limits shown in Table III for protruding and flush head fasteners.

(c) On the bearing surface of the head to depths exceeding Table III values.

The bearing surface shall not be mutilated to the degree that it will prevent firm seating.

3.4.2 Head shank junction. Only longitudinal seams not exceeding the limits of Table III shall be permitted. Slight tool marks or undercuts of depth not exceeding the limits of Table III will be permitted, provided they fair into the shank with no sharp scratches, gouges, or corners.

3.5 Mechanical properties, type I.

3.5.1 Ultimate single shear strength. The ultimate single shear strength of the driven fastener shall be as specified in Table IV (see 4.6.2).

3.5.2 Ultimate tensile strength. The ultimate tensile strength of the driven fastener shall be as specified in Table IV (see 4.5.4).

3.5.3 Tensile preload. The driven fastener shall be capable of a tensile preload as specified in Table IV (see 4.5.4).

3.5.4 Tension-tension fatigue. The fastener shall withstand an average of not less than 60,000 cycles, but no single specimen shall fail in less than 40,000 cycles. The test may be discontinued on any single fastener under test if the fastener does not fail below 200,000 cycles (see 4.6.3). No value above 200,000 shall be used in calculating the average.

3.5.5 Pin retention. The pin of a driven fastener shall withstand a steadily applied axial push out minimum load as shown in Table V (see 4.6.4).

3.5.6 Sheet take-up. The fasteners shall have sufficient sheet take-up or pull-together to meet the requirements of Table V, when tested in steel plates having a total thickness equal to maximum grip of fastener (see 4.5.6).

3.5.7 Stress durability (pin). The pin shall not fail when subjected to the stress durability test values in Table V (see 4.6.5).

3.6 Design and construction, type II.

3.6.1 Construction. The fastener shall be constructed of three separate components (nut body-corebolt-sleeve) assembled as an integral single unit. A visible means shall be provided to lock the installed components together. The dimensions, concentricity, roundness and marking requirements shall be as specified on the applicable specification sheet or standard.

3.6.2 Installation. The fastener shall be installed by threading the corebolt into the nut, forming the sleeve into a blind head on the back side of the assembly and thereafter breaking off the wrenching portion of the corebolt.

The fastener when installed with the applicable driving tool shall meet the visual acceptance criteria of Figure 4. The fastener shall also meet the corebolt break off limits, the formed sleeve outside diameter, the backside protrusion, and the seating torque as specified in Table XII and Figure 3. The driving tool shall be of a type listed in Appendix "B" (see 4.7.1). A means of visual inspection for proper installation shall be provided.

3.6.3 Component heads. The heads of all corebolts and nuts shall be forged.

3.6.4 Threads. The threads shall be left hand and the corebolt thread shall be formed by a single rolling process. Thread form, contour and dimensions are optional.

3.6.5 Material. Fasteners furnished to this specification shall be constructed of the following materials:

3.6.5.1 Nut and corebolt: The nut and corebolt shall be alloy steel in accordance with the applicable specification sheet.

3.6.5.2 Sleeve: The sleeve shall be corrosion and heat resistant steel or nickel base alloy in accordance with the applicable specification sheet.

3.6.6 Heat treatment. Heat treatment of all components shall be as required to meet the strength requirements and metallurgical properties defined herein.

3.6.6.1 Hardness. All alloy steel components shall be within the hardness range specified on the applicable specification sheet (see 4.5.3).

3.6.6.2 Surface effects. When examined in accordance with 4.5.5, alloy steel components shall show no evidence of carbon enrichment, nitrogenization or complete decarburization. Partial decarburization shall be not greater than a depth of .003-inch on the bearing surface of the heads, head shank fillets, or threads. The average of three microhardness readings taken at the thread root shall be within 30 Knoop numbers of the average of three readings taken at the centerline (see Figure 5).

3.6.7 Protective treatment.

3.6.7.1 Nut and corebolt. The nut and corebolt shall be cadmium plated in accordance with NAS 672, with supplementary chromate treatment in accordance with QQ-P-416.

3.6.7.2 Sleeve. The sleeve shall be cadmium plated in accordance with QQ-P-416, Type II, Class 2.

3.6.8 Lubricant. Lubricant may be used on any component to improve driving, provided the lubricant is not detrimental to the corrosion-resisting capabilities of the fastener. The lubricant shall be identified on the qualified products list and shall not be changed without retesting to assure compliance with the installation requirements of 3.6.2. The lubricant may be Cetyl Alcohol in accordance with MIL-L-87132, WWM CARBO-WAX or dry film lubricant in accordance with MIL-L-8937.

3.7 Discontinuities, type II (see 4.5.2).

3.7.1 Cracks. Fastener components shall be free of cracks in any direction or location. A crack is defined as a clean crystalline break passing through the grain boundary with or without the inclusion of foreign elements.

3.7.2 Laps and Seams. Fastener components may possess laps and seams not exceeding the depths specified in Table IX, except in prohibited locations (see Figure 2).

3.7.2.1 Nuts. Discontinuities shall not be permitted in the head to shank fillet. Laps, seams, nicks and gouges are acceptable on the non-bearing surface of head provided the depth does not exceed two times the value specified for the nut component in Table IX.

3.7.2.2 Corebolts. Discontinuities shall not be permitted in the head to shank fillet. Thread laps which are not permissible and thread laps which are permissible within the limits of Table IX are illustrated in Figure 2. Laps, seams, nicks and gouges are acceptable on the non-bearing surface of head provided the depth does not exceed three times the value specified for the bolt components in Table IX.

3.7.2.3 Sleeves. The sleeves shall contain no longitudinal discontinuities.

3.8 Mechanical properties, type II.

3.8.1 Ultimate double shear strength. The shear strength of the fastener shall be as specified in Table X (see 4.7.2).

3.8.2 Ultimate tensile strength. The tensile strength of the driven fastener shall be as specified in Table X (see 4.5.4).

3.8.3 Tensile preload. The driven fastener shall develop tensile preload values as specified in Table X (see 4.5.4).

3.8.4 Tension-tension fatigue. The fastener shall withstand an average of not less than 30,000 cycles, but no single specimen shall fail in less than 15,000 cycles (see 4.6.3 and Table XI). The test may be discontinued on any single fastener under test if the fastener does not fail below 100,000 cycles. No value above 100,000 shall be used in calculating the average.

3.8.5 Sheet take-up. The fasteners shall have sufficient sheet take-up or pull-together to meet the requirements of Table XI when tested in steel plates having a total thickness equal to maximum grip of bolts (see 4.5.6).

3.8.6 Vibration. Specimens prepared and tested as specified (see 4.7.4) shall withstand not less than 30,000 cycles without failure. The relative rotation of the nut and corebolt shall not exceed 360 degrees. The fastener shall not develop any cracks or broken segments.

3.8.7 Locking torque. The assembled fasteners shall develop locking torque values equal to or greater than the minimum required torque in accordance with Table XI (see 4.7.5).

3.8.8 Stress durability. The fastener shall not fail when subjected to the stress durability test (see 4.7.6).

3.8.9 Workmanship. The fastener shall be free from burrs, scale, excessive seams, and other defects which would interfere with their intended use.

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 as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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

(a) Qualification inspection (see 4.3)

(b) Quality conformance inspection (see 4.4)

4.2.1 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified (applicable test method document of applicable paragraph(s) in this specification).

4.3 Qualification inspection. Qualification inspection shall consist of the inspections listed in Table VI for Type I and Table XIII for Type II.

4.3.1 Sampling. Qualification test samples shall consist of fasteners of each diameter, for which qualification is desired, in quantities indicated in Table VI for Type I and Table XIII for Type II. The fasteners shall be of a grip length adequate to accommodate the test fixtures. The samples shall be identified with the following information and forwarded to the destination designated by the activity responsible for qualification (see 6.3).

Samples for qualification testing

FASTENER, BLIND, HIGH STRENGTH, INSTALLATION
FORMED, ALLOY STEEL

Name of manufacturer
Manufacturer's part number
Submitted by (name) (date) for qualification testing in accordance with MIL-F-81177 under authorization (reference letter of authorization)

Qualification of the flush head configuration constitutes qualification of the equivalent protruding head configuration; except on Type 1, tensile strength and tension-tension fatigue tests shall be performed on both head types.

4.3.2 Certified qualification inspection test report. The manufacturer shall furnish three copies of a certified test report showing that the manufacturer's product satisfactorily conforms to this specification. The test report shall include, as a minimum, actual results of each of the tests specified herein in their order of appearance. When this report is submitted, it shall be accompanied by the applicable drawing(s).

4.3.3 Retention of qualification. Certification shall be requested by NADC from each manufacturer and forwarded to the preparing activity for those specifications which do not contain a requirement for retention of qualification by testing. Certification shall be at the time of the two year review and shall be signed by a responsible official of management, attesting that the listed product(s) is still available from the listed plant, can be produced under the same conditions as originally qualified; i.e., same process, materials, construction, design, manufacturer's part number, or designation; and meets the requirements of the current issue of the specification. Failure to provide the certification will be cause for removal from the QPL. After completion of the certification review, the QPL shall be reprinted to show the date of validation. (DD Form 1718, Certification of Qualified Products, shall be used for obtaining certification.)

4.4 Quality conformance inspection. Quality conformance inspections shall consist of all the examinations and tests listed in Table XIV for type I and Table XV for type II.

4.4.1 Inspection lot. An assembly inspection lot shall consist of finished assembled components of the same configuration, diameter, and heat of material. The inspection lot assemblies and their components shall have been manufactured under the same conditions, heat treated in the same manner in one continuous run, and presented for delivery at the same time.

4.4.1.1 Plating lot. A plating lot shall consist of all parts cadmium plated in the plating tank in any one 24-hour period. Cadmium plating shall be in accordance with QQ-P-416 or NAS 672, as applicable.

4.4.2 Sampling. Samples shall be selected at random in accordance with MIL-STD-105, Inspection Level and Acceptance Quality Level (AQL) as specified in Table XIV for Type I and Table XV for Type II. Identical sample items may be used for any of the tests, provided selection of random samples is maintained and known characteristics of the sample are not used to influence the integrity of the test results. Reduced sampling level shall be instituted after five consecutive lots have passed the acceptance criteria.

4.5 Test methods, types I and II.

4.5.1 Examination. Each of the sample fasteners selected at random in accordance with Tables VI and XIV for type I and Tables XIII and XV for type II shall be examined for conformance to the requirements for dimensions, concentricity, roundness, locking feature integrity, protective treatment, and marking. These examinations shall be accomplished visually. Optical aids or special gages shall be used when necessary. Fasteners are considered defective when dimensions are out of tolerance.

4.5.2 Discontinuities. Components made of magnetic material shall be magnetic particle inspected in accordance with MIL-I-6868. Components made of non-magnetic material shall be fluorescent penetrant inspected in accordance with MIL-I-6866, Type I, Method B. Apply magnetic inspection after plating; apply penetrant inspection before plating or with plating removed. Fasteners shall not be marked for identification of magnetic or penetrant inspection. If magnetic or penetrant indications are apparent, representative samples showing the indications shall be sectioned, mounted, and microscopically examined for conformance to Section 3.

4.5.3 Hardness. Hardness testing of alloy steel components shall be in accordance with MIL-STD-1312, Test 6.

4.5.4 Tensile strength and tensile preload. Tensile strength and tensile preload tests shall be performed in accordance with MIL-STD-1312, Test Methods 8 and 16, except load deflection curves are required for qualification tests only (for test 8). Type I fasteners having a grip less than one diameter and type II fasteners having a grip less than two diameters need not be tested; acceptance shall be based on hardness test of pin and sleeve.

4.5.5 Carburization and decarburization. The presence of an undesirable surface condition shall be determined by microexamination. Specimens shall be taken from a transverse section of the fastener. The etchant shall be 5 percent nital. Microscopic examination shall be made at a magnification of 100 diameters. In addition to microexamination, a microhardness test using Knoop indentor with a 500 gram load shall also be made on the same mounted specimens (for Type II fasteners). Impressions shall be made at six locations on the alloy steel components as illustrated in Figure 5. If one or more of the six readings on a part is suspected of being inaccurate, the suspected reading shall be replaced by the average of three additional readings taken from a similar location; however, the average of any one set of three additional readings can be used to replace only one suspected reading.

4.5.6 Sheet take-up test. Each fastener of the sample lot for sheet take-up or pull-together shall be driven in a device as shown in figure 7. Hole diameter for fasteners shall be in accordance with Table XII for type II and Table VII for type I. The nuts supporting the lower plate shall be adjusted to provide a gap between plates as specified in Table V for type I and Table XI for type II. Each fastener of the sample lot shall engage the lower plate of the test device and shall clamp it against the upper plate when driven.

4.6 Test methods, type I.

4.6.1 Installation. Fasteners shall be driven in minimum grip +0.000, -0.002 and maximum grip +0.002, -0.000 in holes drilled with tolerances specified in Table VII.

4.6.1.1 Drive. Driven fasteners shall be visually examined for proper drive characteristics as specified on Figure 1, Table I, 3.3.3, and 3.3.4.

Discontinuities of the blind head shall not exceed the following limits:

(a) Longitudinal discontinuities shall not exceed three times the limits of Table III.

(b) Circumferential discontinuities shall not exceed twice the limits of Table III.

(c) General folds shall not exceed twice the limits of Table III.

4.6.2 Ultimate single shear strength, type I. Single shear tests shall be performed in accordance with MIL-STD-1312, Test 20. Hole diameter shall be as specified in Table VII. Shear tests are not applicable to fasteners having a grip of less than one diameter for protruding head type and one and one half diameters for flush head type. All fasteners in this test shall meet the minimum loads specified in Table IV. This test not need to be continued to destruction.

4.6.3 Tension-tension fatigue, type I. Tension-tension fatigue tests shall be conducted using a thimble type fixture in accordance with Figure 6. Hole diameters shall be within limits specified in Table VII. Fasteners shall be tested in minimum grip +0.000, -0.002 and in maximum grip +0.002, -0.000. Set-up Figure 6 allows for visual inspection of blind head after driving. Fasteners in this test shall have preload eliminated by removal of a low temperature melting washer (Cerrolow or equivalent) .0312-inch thick from between the thimble and shim. Fatigue testing machine and test set-up shall conform to MIL-STD-1312, Test 11.

Test loading shall cycle between minimum and maximum loads shown in Table V. Tests need not be conducted beyond 200,000 cycles.

4.6.4 Pin retention, type I. Pin retention tests shall be performed using test plates and fixtures in accordance with MIL-STD-1312, Test 8, as modified in Figure 8. Hole diameter shall be within limits as specified in Table VII. The load shall be steadily applied, at rate shown in Table VIII, to the top of the pin from the top of the bolt. The lock shall withstand the minimum axial push-out load values specified in Table V. Caution shall be exercised that mandrel force is applied directly in line with the axis of the pin of the fastener. A means of accurately determining the force applied to the mandrel shall be provided. Fasteners having a grip length of less than one diameter shall be tested with a bushing support having a clearance of approximately .0312-inch around the blind head.

4.6.5 Stress durability (type I, pin). Within each 15 days of plating, two pins shall be subjected to the tensile loads in Table V for not less than 72 hours. If one pin does not meet the tensile loads, the cadmium plating tank shall be disqualified for production plating until corrective action has been taken.

All lots of fasteners whose serrated pins were plated during the 15 day period in which failure occurred shall have five serrated pins subjected to this test. Failure of any pin to meet the requirements shall be cause for rejection of that lot of fasteners.

Upon successful completion of the test, the loads shall be increased until pin breakage occurs. The pin shall break in the breakneck area.

The identification of the cadmium plating tank, the production lot and the date of plating shall be recorded. Records shall be maintained in the manufacturer's Quality control section for not less than three years.

4.7 Test methods, type II

4.7.1 Installation, type II. The fasteners shall be driven in steel plates having a minimum hardness of 46 HRC and a surface finish on the blind side of 63-125HR in accordance with ANSI B46.1. The bolts shall be driven in both the max grip +0.000, -0.002 and the min grip +0.002, -0.000. The installation holes sizes shall be as specified in Table XII and the countersinks for flush head bolts shall be equal to the bolt max theoretical sharp head diameter +.003. The driven fastener shall be examined for the requirements shown in Figure 3 and Table XII. The seating torque shall be checked on the minimum grip samples only.

4.7.2 Ultimate double shear strength, type II. The double shear test shall be conducted as follows:

a. Assemble the fastener until the corebolt breakneck groove is protruding through the head of the nut.

b. Test the fastener as specified in MIL-STD-1312, Test 13.

For quality conformance testing, if the required shear strength has been exceeded, discontinue further loading. Shear tests are not applicable to protruding head bolts having a grip length less than two diameters and to flush head fasteners having a grip length less than two and one-half diameters.

4.7.3 Tension-tension fatigue, type II. The fasteners shall be fatigue tested in accordance with MIL-STD-1312, test 11, except fixture hole sizes shall be equal to the maximum shank diameter of the fastener +0.002, -0.000 and the fixture assembly shall include a removable shim so that preload may be eliminated before testing. The test need not be continued past 100,000 cycles.

4.7.4 Vibration test, type II. The vibration test shall be in accordance with MIL-STD-1312, test 7, except fixture hole sizes shall be equal to the maximum shank diameter of the fastener +0.004, -0.000.

4.7.5 Locking torque, type II. The minimum locking torque shall be determined on assembled fasteners, which have been driven in air to simulate an installed condition. One of the threaded components, either the nut or the corebolt, shall be retained in a vise or similar fixture to prevent it from rotating. The remaining threaded portion of the assembly shall then be rotated in the direction of disassembly with a torque wrench and the locking torque shall be recorded as the minimum reading of the torque wrench during the final 90° of the first revolution. Axial forces applied to the torque wrench shall be no more than necessary to maintain engagement of the wrenching surfaces.

4.7.6 Stress durability (type II). The fasteners shall be subjected to, for not less than 23 hours, an axial tensile load equal to not less than 75 percent of the tensile strength of the fastener (average of 5 tests).

4.8 Inspection of preparation for delivery (types I and II). The sampling and inspection of the preservation, packaging, and container marking shall be in accordance with PPP-H-1581 and MIL-STD-129.

5. PACKAGING

5.1 Packaging. Packaging shall be level A or C as specified (see 6.2).

5.2 Preservation. Preservation shall be level A or C as specified (see 6.2).

5.2.1 Level A. The fasteners shall be preserved and packaged in accordance with the applicable level A requirement of PPP-H-1581.

5.2.2 Level C. The fasteners shall be preserved and packaged in accordance with the supplier's standard practice.

5.3 Packing. Packing shall be level A, B, or C as specified (see 6.2).

5.3.1 Level A. The fasteners shall be packed in accordance with the applicable level A requirements of PPP-H-1581.

5.3.2 Level B. The fasteners shall be packed in accordance with the applicable level B requirements of PPP-H-1581.

5.3.3 Level C. The fasteners shall be packed in a manner that will insure arrival at destination in satisfactory condition and be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules, or with National Motor Freight Classification rules.

5.4 Marking. In addition to any special marking specified in the contract or purchase order, marking shall be in accordance with MIL-STD-129 (see 6.2).

6. NOTES

6.1 Intended use. Fasteners covered by this specification are intended for structural attachments.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. Type of fastener (see 1.2).

c. Part number (see applicable specification sheet or military standard).

d. Selection of applicable levels of packaging and packing (see 5.1 and 5.2).

e. Special marking (see 5.3).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in the Qualified Products List, whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, 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 be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Systems Command (AIR-5303B), Washington, D.C. 20360 and information pertaining to qualification of products may be obtained from the Naval Air Development Center (60132), Warminster, PA 18974.

6.4 Definitions, types I and II. Both type I and type II fasteners have design elements that maintain the integrity of the installed fasteners. The positive mechanical locking, type I fastener has a locking element that keys the sleeve and pin together and thus prevents their disassembly when the structural joint is subjected to vibration and varying loads.

The self-locking type II fastener has a locking element that provides breakaway and prevailing frictional forces that prevent disassembly of nut and corebolt when the structural joint is subjected to vibration and varying loads.

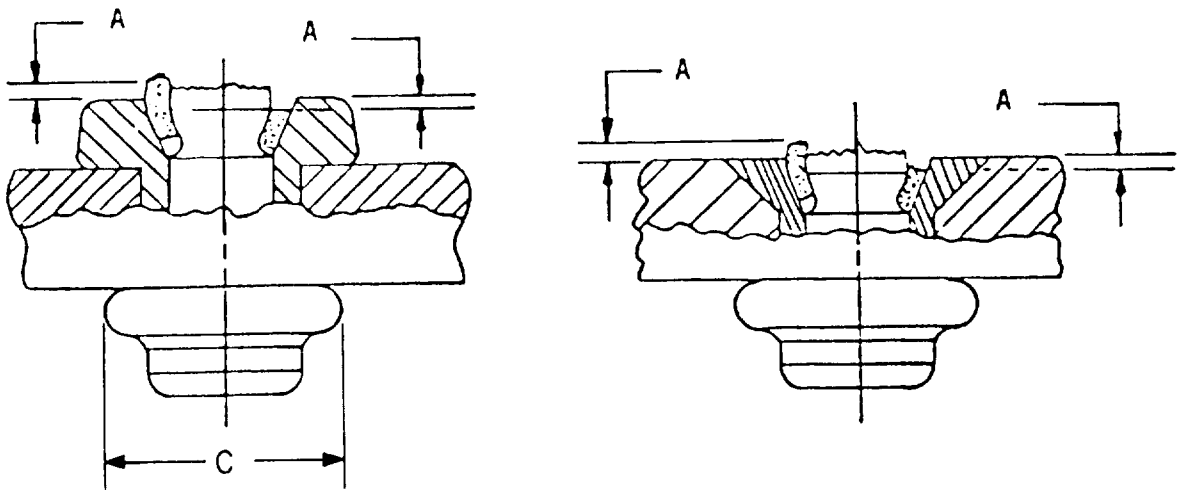
6.5 Changes from previous issue. Asterisks are not used in this revisions to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Navy-AS
Air Force-11
Army-AV

Review:
DLA-IS
Air Force-99
Army-AR

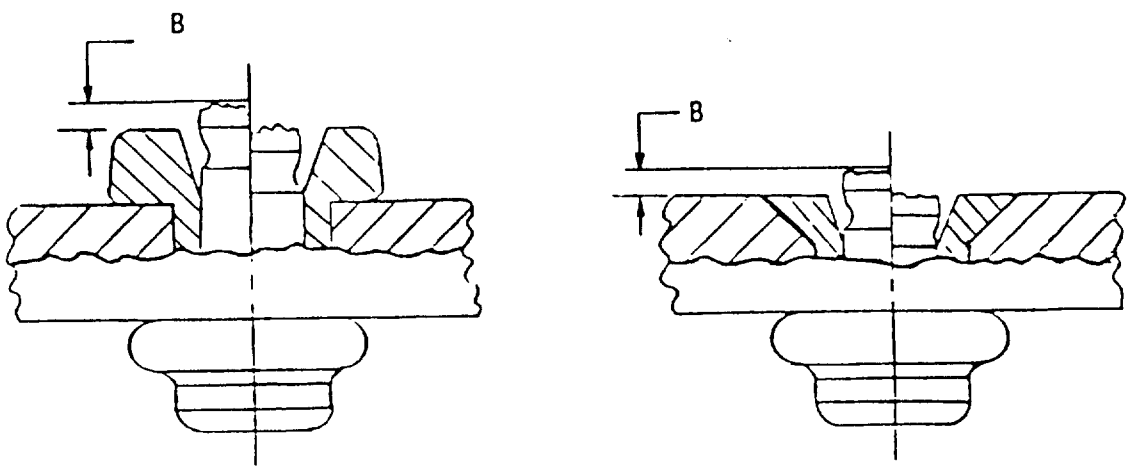
Preparing Activity:
Navy-AS
(Project No. 5320-0467)

INSPECTION OF
MECHANICAL LOCK COLLAR POSITION



A . . . Maximum allowable distance of mechanical lock collar above or below fastener head.

INSPECTION OF
PIN POSITION



B . . . Maximum allowable distance above fastener head to pin nominal fracture surface. Pin nominal fracture surface may not recede below top of fastener head.

FIGURE 1. Visual inspection illustration, Type I.

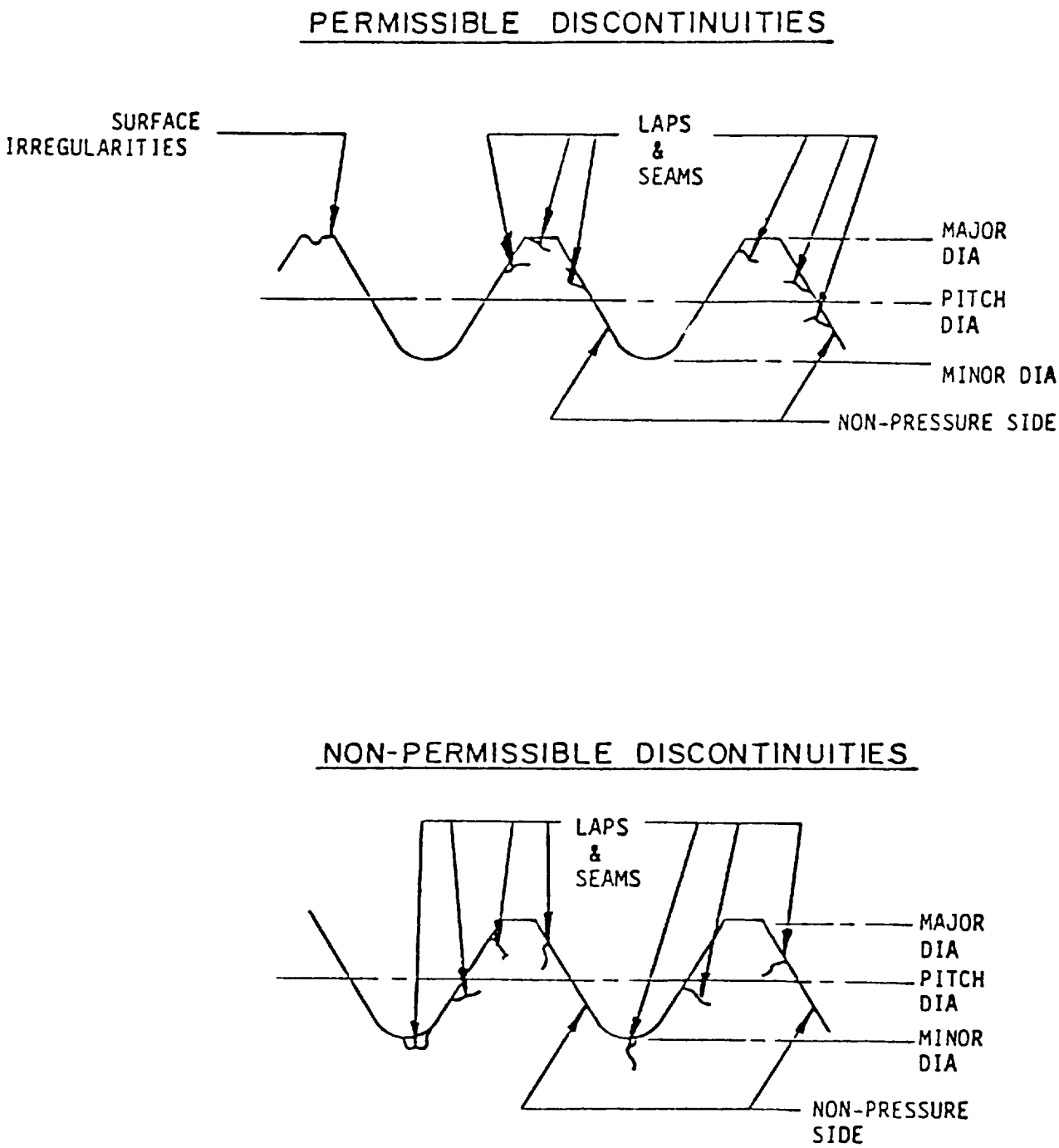
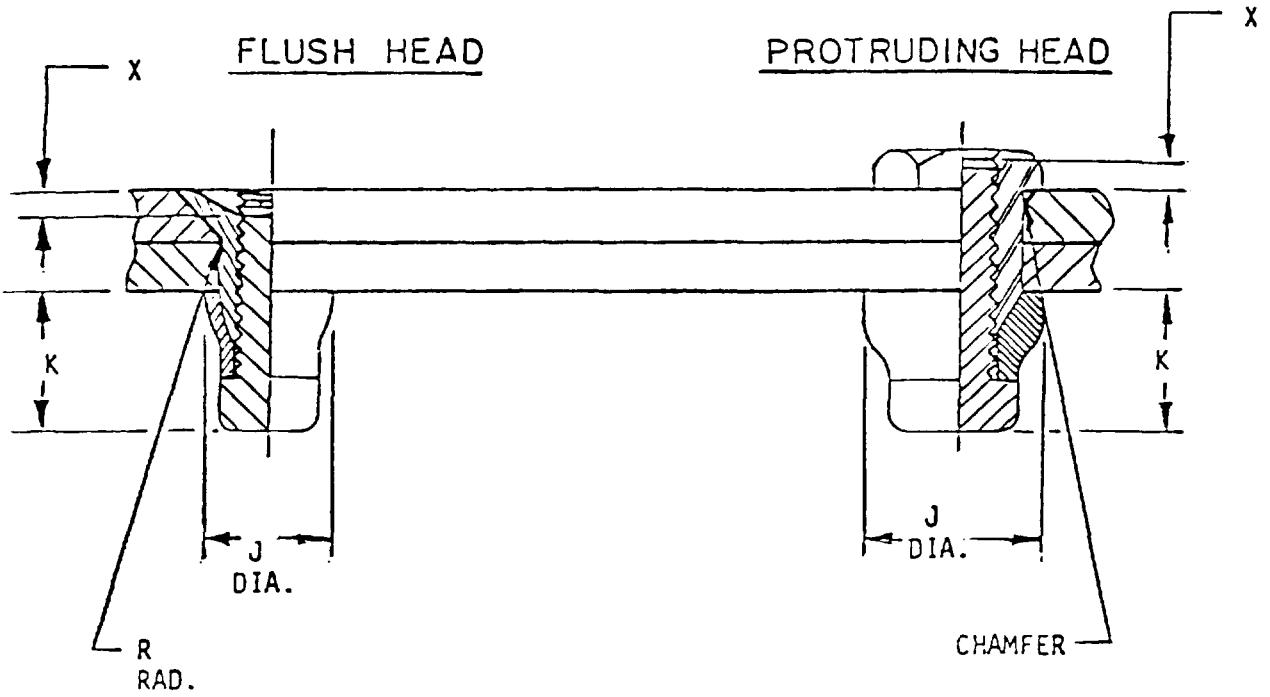


FIGURE 2. Fastener thread discontinuities, Type II.



1. "X" Breakoff values are measured from the skin surface (for prot. head) (+) Values are above the skin surface (-) values are below the surface ("X" values are measured from top of head for flush head).

2. Seating torque is the torque required to turn the bolt in a counter-clockwise direction when the bolt is installed in the minimum grip condition.

FIGURE 3. Installation dimension, Type II.

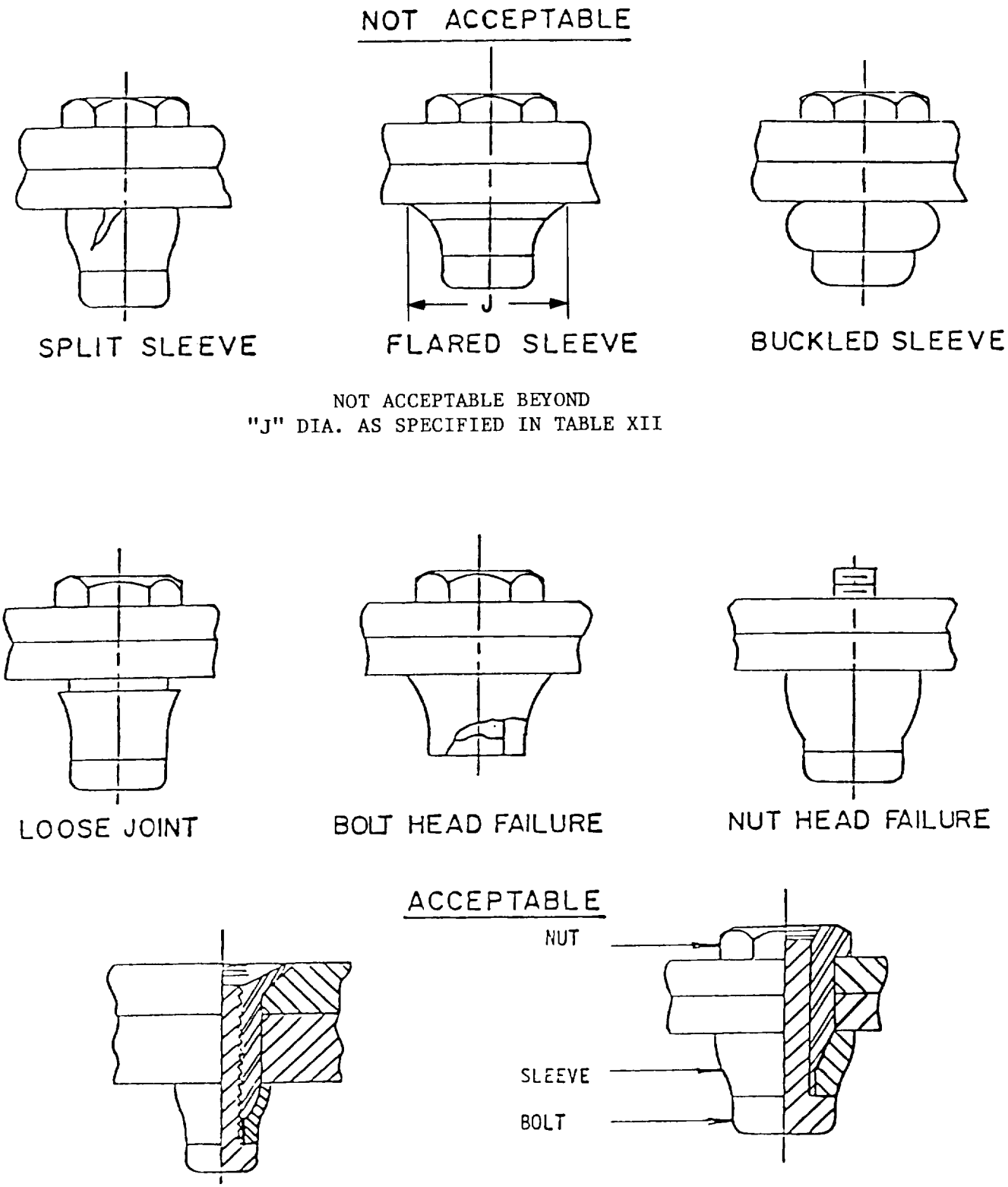


FIGURE 4. Installation - visual inspection, Type II.

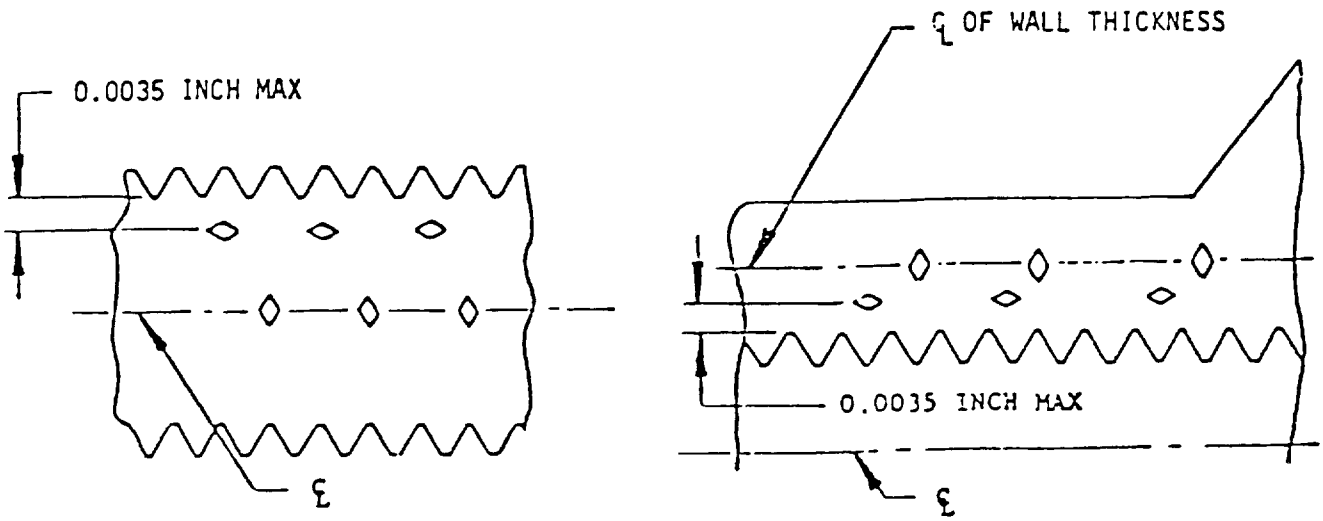


FIGURE 5. Location of microhardness impressions.

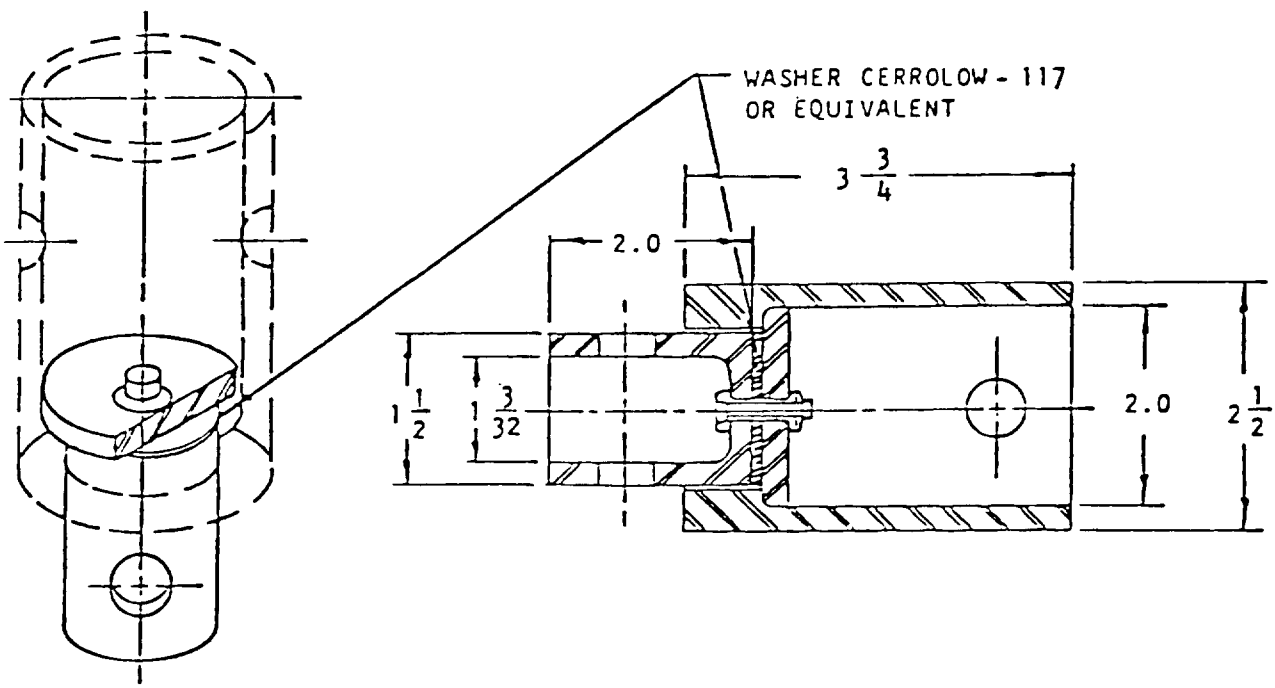


FIGURE 6. Tension-tension fatigue testing set-up, Type I.

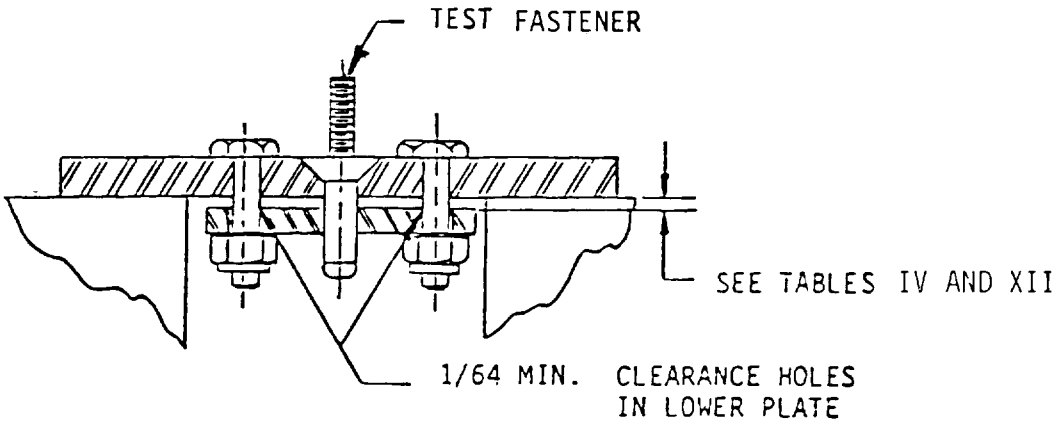


FIGURE 7. Sheet take-up fixture.

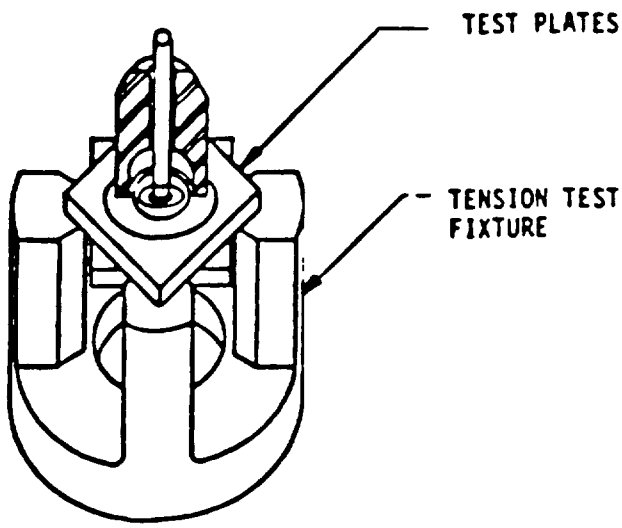


FIGURE 8. Pin retention test set-up, Type I.

TABLE I. Visual inspection tabulation, Type I.

Fastener diameter (inch)	Pin position B (max) (see Figure 1)	Blind head diameter C (Min)	Collar Position A (max) (see Figure 1)
5/32	0.020	0.195	0.017
3/16	.024	.238	.022
1/4	.030	.315	.029
5/16	.038	.373	.037
3/8	.046	.448	.045
7/16	.054	.522	.050
1/2	.062	.598	.056

TABLE II. Tolerances on roundness and concentricity of heads, Type I.

Nominal diameter (inch)	Flush head inch max	Protruding head inch max
5/32	0.010	0.015
3/16	.010	.015
1/4	.010	.020
5/16	.010	.020
3/8	.010	.025
7/16	.010	.025
1/2	.010	.025

TABLE III. Limits for surface discontinuity and tool mark depths, Type I.

Fastener dia (inch)	Depth (inch max)
5/16 and under	0.005
3/8 and over	.006

TABLE IV. Mechanical properties (shear, tensile & tensile preload) type I.

Nominal Diameter	Single Shear Strength lb min	Tensile Strength lb min	Tensile Preload lb min.
5/32	2,340	1,350	135
3/16	3,450	2,100	210
1/4	5,900	3,650	365
5/16	8,500	5,200	520
3/8	12,200	7,500	750
7/16	16,700	10,150	1,015
1/2	21,800	13,500	1,350

TABLE V. Mechanical properties (tension-tension fatigue, sheet take-up, stress durability and spindle retention) type I.

Nominal diameter	Tension-tension fatigue loads (lb)		Sheet take-up inch min	Stress durability lb	Spindle retention lb min.
	High	Low			
5/32	610	61	0.012	1300	675
3/16	940	94	.015	2025	1050
1/4	1,640	164	.020	3475	1825
5/16	2,340	234	.025	5025	2600
3/8	3,400	340	.032	7275	3750
7/16	4,620	462	.034		5180
1/2	6,050	605	.039		6800

TABLE VI. Qualification tests, type I.

Test	Reqm't Para.	Method Para.	Sample Size Grip Condition				Recm'd Grip	Number of Defectives Allowed
			Min.	Nom.	Max.	Total		
Examination	*	4.5.1	-	-	-	All Qual samples	2.D min.	0
Installation	3.3.3	4.6.1	10	-	10	20	2.D min.	0
Metallurgical	3.3.9.2	4.5.5	-	-	-	5	2.D min.	0
Hardness	3.3.9.1	4.5.3	-	-	-	5	-	0
Shear Strength	3.5.1	4.6.2	-	-	-	3	2.D min.	0
Tensile Strength **	3.5.2	4.5.4	5	-	5	10	2.D min.	0
Tensile Preload **	3.5.3	4.5.4	5	-	5	10	2.D min.	0
Tension-tension fatigue	3.5.4	4.6.3	3	-	3	6	2.D min.	0
Pin retention	3.5.5	4.6.4				5	2.D min.	0
Sheet Take-up	3.5.6	4.5.6	-	-	3	3	2.D min.	0

* Reqm't Para. 3.3.1, 3.3.4, 3.3.6, 3.3.7, 3.3.8, and 3.3.11.
** Tensile Strength & Tensile Preload may be run on same samples.

TABLE VII. Hole tolerances, Type I.

Fastener dia (inch)	Hole size (inch)
5/32	0.164 - 0.167
3/16	.199 - .202
1/4	.260 - .263
5/16	.312 - .315
3/8	.374 - .377
7/16	.437 - .441
1/2	.500 - .504

TABLE VIII. Loading Rates, Type I.

Loading rates - pounds/minute +10 percent		
Nominal diameter (inch)	Pin Retention	Preload Rate
5/32	1,400	300
3/16	2,000	450
1/4	3,600	800
5/16	5,200	1,200
3/8	7,500	1,800
7/16	10,150	2,250
1/2	13,300	2,950

TABLE IX. Depth limits of permitted laps, seams, and discontinuities, Type II.

	NOMINAL DIAMETER (inch)				
COMPONENT	5/32	3/16	1/4	5/16	3/8
Nut	.005	.005	.005	.005	.006
Bolt	.002	.002	.004	.005	.005
Sleeve	.002	.002	.003	.004	.005

TABLE X. Mechanical properties (shear, tensile & tensile preload) Type II.

Nominal Diameter	Double Shear Strength lb min.	Tensile Strength lb min	Tensile Preload lb min.
5/32	4,680	1,350	270
3/16	6,900	2,100	420
1/4	11,800	3,650	730
5/16	17,000	5,200	1,040
3/8	24,500	7,500	1,500

TABLE XI. Mechanical properties (tension-tension fatigue, sheet take-up and locking torque) Type II.

Nominal Diameter	Tension-Tension Fatigue Loads lb		Sheet Take-up inch min.	Locking Torque in. lb min.
	High	Low		
5/32	810	81	0.032	1.0
3/16	1,260	126	.032	1.5
1/4	2,190	219	.032	2.5
5/16	3,120	312	.032	3.5
3/8	4,500	450	.032	4.0

TABLE XII. Installation dimensions type II (c).

Fastener Nominal Diameter	Installation Hole Size	Chamfer		J Dia Max	K Max	R Rad	X (a) Breakoff		Seating Torque in. lb. min. (b)
		Max.	Min.				Flush Head	Protruding Head	
5/32	.168 .165	.030	.020	.244	.300	.050 .040	+.020 -.068	+.088 -.000	5
3/16	.202 .199	.035	.025	.300	.333	.060 .050	+.015 -.073	+.098 +.010	7
1/4	.263 .260	.040	.030	.384	.366	.070 .060	+.010 -.078	+.135 +.047	15
5/16	.315 .312	.045	.035	.427	.447	.080 .070	+.010 -.083	+.146 +.043	25
3/8	.378 .375	.045	.035	.516	.527	.080 .070	+.010 -.093	+.152 +.049	40

(a) "X" BREAKOFF VALUES ARE MEASURED FROM THE SKIN SURFACE (FOR PROTRUDING HEAD) (+) VALUES ARE ABOVE THE SKIN SURFACE (-) VALUES ARE BELOW THE SURFACE ("X" VALUES ARE MEASURED FROM TOP OF HEAD FOR FLUSH HEAD).

(b) SEATING TORQUE IS THE TORQUE REQUIRED TO TURN THE BOLT IN A COUNTERCLOCKWISE DIRECTION WHEN THE BOLT IS INSTALLED IN THE MINIMUM GRIP CONDITION.

(c) See Figure 3.

TABLE XIII. Qualification tests, type II.

Test	Reqm't Para	Method Para.	Sample Size Grip Condition				Recommended Grip	Number of Defectives Allowed
			Min.	Nom.	Max.	Total		
Examination	***	4.5.1	-	-	-	all qual samples	-	0
Discontinuities	3.7	4.5.2	-	-	-	all qual samples	-	0
Metallurgical	3.6.6.2	4.5.5	-	-	-	2*	-	0
Hardness	3.6.6.1	4.5.3	-	-	-	5*	-	0
Stress Durability	3.8.8	4.7.6	-	-	5	5	2.D min.	0
Driveability	3.6.2	4.7.1	10	-	10	20	-	0
Shear Strength	3.8.1	4.7.2	-	-	-	5	2.D min.	0
Tensile Strength & Tensile Preload	3.8.2 3.8.3	4.5.4	5	-	5	10**	2.D. min.	0
Tension-Tension Fatigue	3.8.4	4.7.3	3	-	3	6	2.D. min.	0
Sheet take-up	3.8.5	4.5.6	-	-	3	3	2.D. min.	0
Vibration	3.8.6	4.7.4	-	5	-	5	4.D. min.	0
Locking Torque	3.8.7	4.7.5	-	-	-	5	-	0

* Alloy Steel Components only
** Tensile and Tensile Preload may be run on same samples
*** Reqm't Para. 3.6.1, 3.6.2, 3.6.5, 3.6.7

TABLE XIV. Quality conformance tests, type I.

Test	Reqm't Para.	Method Para.	Sample Size (MIL-STD-105)		Acceptance Limits (%AQL)
			Normal	Reduced	
Examination	(a)	4.5.1	S-3	S-2	4.0
Installation	3.3.3	4.6.1	S-3	S-2	4.0
Shear Strength	3.5.1	4.6.2	S-2	S-1	2.5
Tensile Strength	3.5.2	4.5.4	S-2	S-1	2.5
Pin retention	3.5.5	4.6.4	S-2	S-1	2.5
Hardness (b) (c)	3.3.9.1	4.5.3	5		0 Defectives
Metallurgical(c)	3.3.9.2	4.5.5	2		0 Defectives

(a) Reqm't Para. 3.3.1, 3.3.4, 3.3.6, 3.3.11
(b) Alloy Steel Components Only
(c) Applies only to grips too short for shear or tensile test

TABLE XV. Quality conformance tests, type II.

Test	Reqm't Para.	Method Para.	Sample Size (b)		Acceptance Limits %AQL
			Normal	Reduced	
Examination	(d)	4.5.1	S-3	S-2	2.5
Discontinuities	3.7	4.5.2	S-3	S-2	1.5
Metallurgical	3.6.6.2	4.5.5	2		0 Defectives
Hardness (a)	3.6.6.1	4.5.3	5		0 Defectives
Driveability	3.6.2	4.7.1	S-3	S-2	2.5
Shear Strength	3.8.1	4.7.2	S-2	S-1	0 Defectives
Tensile Strength & Preload (c)	3.8.2 3.8.3	4.5.4	S-2	S-1	0 Defectives
Locking Torque (a)	3.8.7	4.7.5	10		0 Defectives

(a) Alloy Steel Components Only.
(b) Sampling Plan Per MIL-STD-105, unless otherwise specified.
(c) Full sample shall be tested in both Max and Min Grip Condition.
(d) Reqm't Para. 3.6.1; 3.6.2; 3.6.5; 3.6.7

APPENDIX A

INSTALLATION TOOLING FOR PULL TYPE FASTENERS (TYPE I)

Tooling Manufacturers

1. Huck Manufacturing Company, Code Ident. No. 29666.
Cherry Textron
American Pneumatic Tool (A.P.T)

10. SCOPE

10.1 Scope. This appendix covers tooling for the installation of pull type fasteners.

MS90353 and MS90354	Nominal Size (Diameter)	Huck Mfg. Co. Tool Part No. or equal	Nose Assy. Part No. or equal	Cherry Textron Part No. or equal	Nose Assy Part No. or equal	American Pneumatic Tool Nose Assy Part No.
-05 or U05	5/32	200	99-600			
S05 or U05	5/32	223 352 206 206 609-1 115	99-680 99-680 99-904 99-904-2 99-853 99-680	G85 G87	99-680 W/552-A1 Adapter	
-06 or U06	3/16	200	99-589			
S06 or U06	3/16	223 352 206 206 609-1 115	99-681 99-681 99-905 99-905-2 99-854 99-681	G85 G87	99-681 W/552-A1 Adapter	
-08 or U08	1/4	115 207 353 354 225 611-1 612-1 4801 5901	99-591 99-906 99-591 99-591 99-591 99-682 99-682 99-591 99-662	G85 G87	99-591	35050
-10 or U10	5/16	116 4801 5901	99-663 99-823 H99-663	G87	99-823	
-12 or U12	3/8	116 4801 5901	99-599 99-988 H99-599			
-14	7/16	116 5901	99-738 H99-738			
-16	1/2	116 5901	99-678 H99-678			

-05 and -06 signify Double Action (shifting) Tooling required for 5/32 and 3/16 only.

S05 and S06 signify Single Action (non-shifting) Tooling required for 5/32 and 3/16 only.

-08, -10, -12, -14 and -16 sizes have been and continue to be Single Action (non-shifting) installed.

U code fasteners utilize single action (non-shifting) tooling. For sizes 5/32 and 3/16, double action (shifting) tooling may also be used.

APPENDIX B

INSTALLATION TOOLING FOR TYPE II BLIND BOLT

Tooling Manufacturers.

1. Monogram Aerospace Fasteners, Code Ident. No. 98524.
2. Lok-Fast Incorporated, Code Ident. No. 01022.

10. SCOPE

10.1 Scope. This appendix covers tooling used in the installation of bolts covered by this specification.

Tool Type PNEUMATIC DRIVER, PISTOL GRIP

Monogram P/N MP550/Lok-Fast P/N 450 MTD

Bolt dia	Head Type	Driving Adapters			
		Monogram P/N		Lok-FastP/N	
		Wrench Adapter	Nose Adapter	Wrench Adapter	Nose Adapter
5/32	Flush	MP-5	MPF-5	TD1651	PW3652
3/16	Flush	MP-6	MPF-6	TD2001	PW3002
1/4	Flush	MP-8	MPF-8	TD2601	PW3602
5/16	Flush	MP-10	MPF-10	TD3121	PW3122
3/8	Flush	MP-12	MPF-12	TD3751	PT3752
5/32	Protruding	MP-5	MPP-5	TD1651	PW3652P
3/16	Protruding	MP-6	MPP-6	TD2001	PW3002P
1/4	Protruding	MP-8	MPP-8	TD2601	PW3602P
5/16	Protruding	MP-10	MPP-10	TD3121	PW3122P
3/8	Protruding	MP-12	MPP-12	TD3751	PT3752P

NOTE: Complete tool consists of basic tool (pneumatic driver, pistol grip), one wrench adapter and one nose adapter.

Example: MP550, MP-5 and MPF-5 components are required to install 5/32 Dia Flush Head Blind Bolt, type II.

APPENDIX B

Tool Type HAND TOOL

Bolt dia	Head TYPE	Monogram P/N MH75		Lok-Fast P/N HW 200 HW 300	
		Driving Adapters			
		Monogram P/N		Lok-Fast P/N	
		Wrench Adapter	Nose Adapter	Wrench Adapter	Nose Adapter
5/32	Flush	MH-5	MHF-5	HW1651	HW1652
3/16	Flush	MH-6	MHF-6	HW2001	HW2002
1/4	Flush	MH-8	MHF-8	HW2601	HW2602
5/16	Flush	MH-10	MHF-10	HW3121	HW3122
3/8	Flush	MH-12	MHF-12	HW3751	HW3752
5/32	Protruding	MH-5	MHP-5	HW1651	HW1652P
3/16	Protruding	MH-6	MHP-6	HW2001	HW2002P
1/4	Protruding	MH-8	MHP-8	HW2601	HW2602P
5/16	Protruding	MH-10	MHP-10	HW3121	HW3122P
3/8	Protruding	MH-12	MHP-12	HW3751	HW3752P

NOTE: Complete tool consists of basic tool (hand tool), one wrench adapter, and one nose adapter e.g., MH75, MH-75 and MHF-5 components are required to install 5/32 diameter flush head blind bolt, type II.

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification 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.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE NAVY
Commanding Officer
Naval Air Engineering Center
Engineering Specifications and Standards Department
(ESSD), Code 93
Lakehurst, NJ 08733

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 12503 WASHINGTON, D.C.

POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE NAVY

Commanding Officer
Naval Air Engineering Center
Engineering Specifications and Standards Dept.
(ESSD), Code 93
Lakehurst, NJ 08733

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-F-81177E	FASTENERS, BLIND, HIGH STRENGTH, INSTALLATION FORMED, ALLOY STEEL, GENERAL SPECIFICATION FOR

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS *(Street, City, State, ZIP Code)*

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* - Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* - Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* - Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426

PREVIOUS EDITION IS OBSOLETE.