

MIL-B-8907A  
15 August 1983  
 SUPERSEDING  
 MIL-B-8907  
 28 January 1983

## MILITARY SPECIFICATION

BOLT, ALLOY STEEL, SHEAR AND TENSILE  
 (156 KSI F<sub>u</sub> AND 260 KSI F<sub>u</sub>, 450°F),  
 EXTERNAL<sup>su</sup> WRENCHING, FLANGED HEAD

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

### 1. SCOPE

1.1 Scope. This specification covers external wrenching, tensile and shear bolts. These bolts shall be used in applications where temperatures are not greater than 450°F.

### 2. APPLICABLE DOCUMENTS

#### 2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards 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

PPP-B-566	Boxes, Folding, Paperboard
PPP-B-585	Boxes, Wood, Wirebound
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Boxes, Wood, Nailed, and Lock-Corner
PPP-B-636	Box, Fiberboard
PPP-B-665	Boxes; Paperboard, Metal Stayed (Including Stay Material)
PPP-B-676	Boxes, Set-Up, Paperboard

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, ESSD, 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.

## MIL-B-8907A

## SPECIFICATIONS (Continued)

## MILITARY

MIL-P-116	Preservation, Methods of
MIL-B-121	Barrier Material, Greaseproofed, Waterproofed, Flexible
MIL-T-5544	Thread Compound, Antiseize, Graphite-Petrolatum
MIL-I-6868	Inspection Process, Magnetic Particle
MIL-H-6875	Heat Treatment of Steels (Aircraft Practice) Process for
MIL-C-8837	Coating, Cadmium (Vacuum Deposited)
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter; General Specification for
MIL-N-8984	Nut, Self-Locking, Steel, 260 ksi $F_{tu}$ , 450°F
MIL-L-10547	Liners, Case, and Sheet, Overwrap, Water-Vaporproof or Waterproof, Flexible

## STANDARDS

## MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-1186	Cushioning, Anchoring, Bracing, Blocking and Waterproofing with Appropriate Test Methods
MIL-STD-1312	Fasteners, Test Methods

(Copies of specifications, standards, drawings and publications required by manufacturers in connection with specific acquisition functions should be obtained from the procuring 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. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

MIL-B-8907A

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

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

(Copies of the above publication may be obtained from the American  
National Standards Institute, 1430 Broadway, New York, NY 10018.)

NATIONAL AEROSPACE STANDARDS

NAS 1348                      Fasteners-Recommended Tensile Stress Areas for  
External Threaded Alloy Steel

(Copies of the above publication may be obtained from the National  
Standards Association, 5161 River Road, Washington, D.C. 20016.)

UNIFORM CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules

(Application for copies of the above publication should be addressed  
to the Uniform Classification Committee, Room 1106, 222 South Riverside  
Plaza, Chicago, IL 60606.)

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                      Qualification. The bolts 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).

3.1.1                      Retention of qualification. To maintain status on a  
Qualified Products List (QPL), certification shall be submitted to  
indicate continued compliance with the requirements of this specification  
(see 4.3.2 and 6.3).

3.2                      Material. Material shall be made from alloy steel  
specified on the applicable specification sheet or standard.

3.3                      Design and construction.

3.3.1                      Dimensions. The dimensions shall be in accordance  
with the applicable specification sheet or standard.

3.3.2                      Threads.

3.3.2.1                      Form and dimensions. Dimensions, form, and contour  
shall conform to MIL-S-8879 and shall be right handed.

## MIL-B-8907A

3.3.2.2 Rolling. Threads shall be generated subsequent to heat treatment by a process which incorporates a single rolling operation for forming the thread below the pitch diameter.

3.3.2.3 Incomplete threads. The threads shall be faired onto the shank in accordance with figure 1. The root and flanks of runout thread may deviate from true thread form but shall be smooth and free of tool marks.

3.3.2.4 Grain flow. The grain flow in the threads shall be continuous and shall follow the thread contour with the maximum density at the bottom of the root radius as shown on figure 2.

3.3.3 Bolt heads. The bolt heads shall be forged. Machined or forged holes for reduction of weight are acceptable. Only the minimum amount of metal shall be removed from the bearing surface of the bolt head as is necessary to obtain the specified angularity and a clean, smooth surface. Grinding subsequent to final tempering is not permitted.

3.3.3.1 Wrenching element. The wrenching elements shall be in accordance with the applicable standard or drawing.

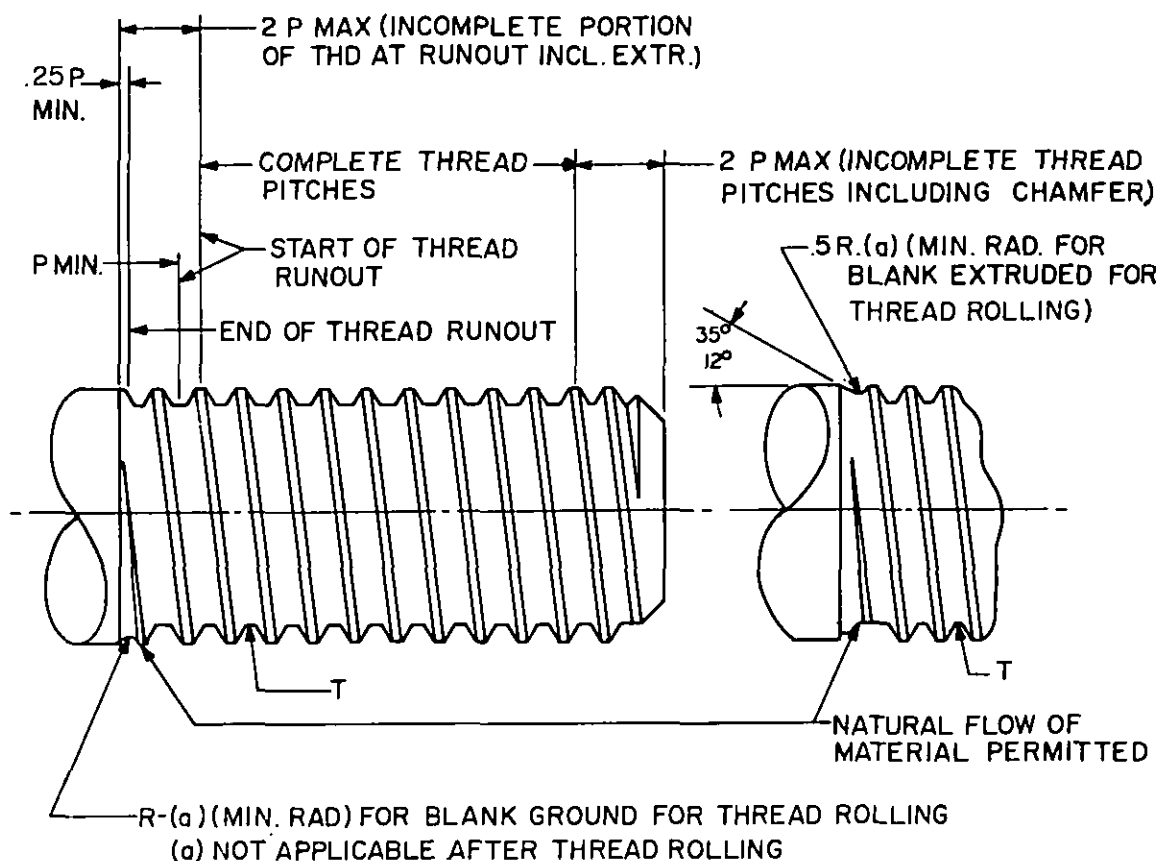
3.3.3.2 Bearing surface. The bearing surface of bolt heads shall be at right angles to the shank within the limits shown on figure 3. The angular variation of the underside of the head must be uniform around the shank within a tolerance of 10 minutes, as measured between the bearing surface of the head and the shank at a length along the shank from head equal to the diameter of the bolt.

3.3.3.3 Head structure and grain flow. The head structure and grain flow lines in the fillet area immediately below the surface shall conform to the fillet contour as shown on figure 4. The intersection of the longitudinal axis of the bolt and the transverse axis of the flow lines shall not be less than  $D/7$  inches from the bearing surface of the bolt where "D" is the nominal diameter of the bolt. The metal removed from the bearing surface shall be as small as practicable to obtain a clean, smooth surface (see 4.5.4.10).

3.3.4 Fillet (head-to-shank). The head-to-shank fillet radius shall be produced in such manner as to insure meeting the fatigue strength requirements specified herein. The radius shall be as specified on the applicable standard. The cold-working of the fillet radius shall be subsequent to the heat treatment of the bolt. The radius shall show no evidence of seams or inclusions (see 4.5.3.3).

3.3.4.1 Distortion of radius. Distortion of the radius (due to cold work) shall not be greater than a height A and depth B of 0.002 inch and the distorted area shall not extend beyond C (see figure 5).

3.4 Surface texture. The surface texture of the bolts after coating shall not be greater than the values shown in Table I or as specified by the applicable standard or drawing. The surface texture shall be measured in accordance with ANSI B46.1.

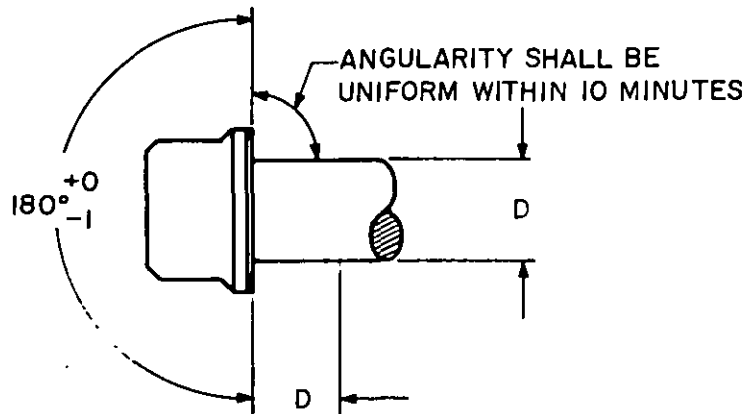
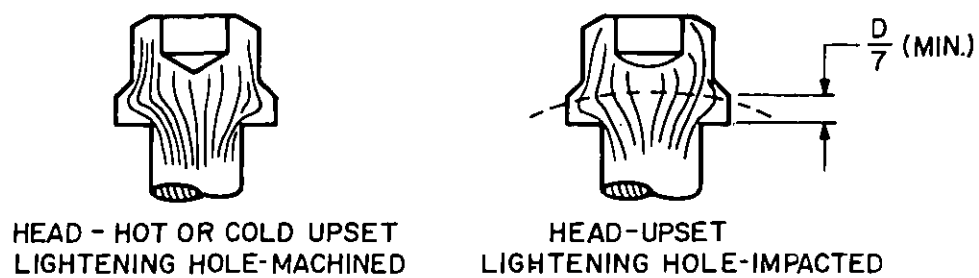


THREAD SIZE	P (PITCH OF THREAD)	.25 P (MIN)	2 P (MAX)	R (MIN) $\frac{1}{R}$ (RUNOUT RADIUS)	.5R	T (MIN ROOT RADIUS)
0.190-32	0.03125	0.008	0.062	0.012	0.006	0.0047
.250-28	.03571	.009	.071	.013	.006	.0054
.312-24	.04167	.010	.083	.015	.008	.0063
.375-24	.04167	.010	.083	.015	.008	.0063
.437-20	.05000	.012	.100	.018	.009	.0075
.500-20	.05000	.012	.100	.018	.009	.0075
.562-18	.05556	.014	.111	.020	.010	.0083
.625-18	.05556	.014	.111	.020	.010	.0083
.750-16	.06250	.016	.125	.023	.012	.0094
.875-14	.07143	.018	.143	.025	.012	.0107
1.000-12	.08333	.021	.167	.030	.015	.0125
1.125-12	.08333	.021	.167	.030	.015	.0125
1.250-12	.08333	.021	.167	.030	.015	.0125
1.375-12	.08333	.021	.167	.030	.015	.0125
1.500-12	.08333	.021	.167	.030	.015	.0125

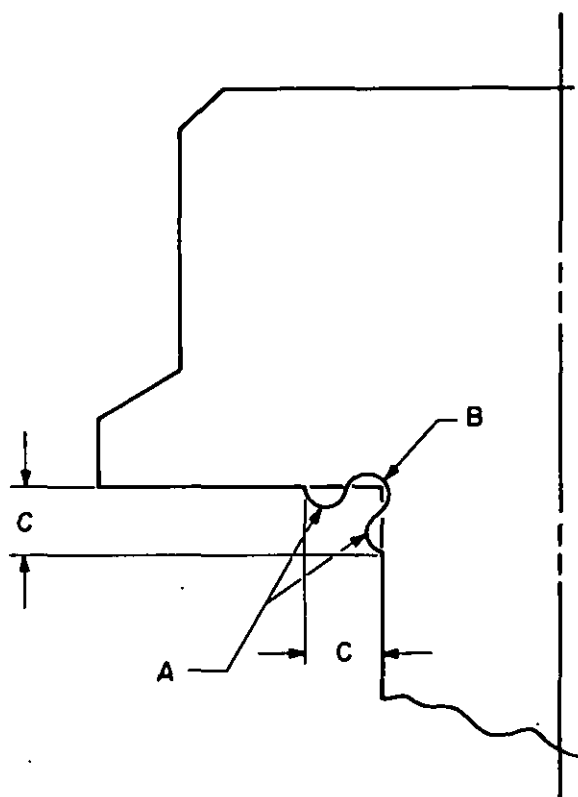
$$\frac{1}{R} = .36P$$

FIGURE 1. Incomplete thread pitches, runout radius and root radius (optional designs)

MIL-B-8907A

FIGURE 2. Grain flow.FIGURE 3. Head angularity.FIGURE 4. Head structure and grain flow.

MIL-B-8907A



NOMINAL SIZE	UNDER .312	.312 AND .375	.437 THRU .625	.750 THRU 1"	OVER 1"
A & B MAX	.002	.002	.003	.003	.004
C MAX	.062	.094	.125	.156	.188

DIMENSIONS IN INCHES.

FIGURE 5. Fillet rolling permissible distortion

MIL-B-8907A

TABLE I. Surface texture.

Area	Maximum Microinches ( $\mu$ )
Shank to underside of head	32
Head-to-shank fillet	32
Flanks of thread and root area	32
Other Surfaces	125

3.5 Straightness. The straightness of the bolt shank shall be within the values specified in Table II (see 4.5.1.1).

TABLE II. Straightness of shank.

Nominal Size	Bolt shank straightness TIR (inch per inch of bolt length) (maximum)
.312 and under	.0030
.375 and .437	.0025
.500 and larger	.0020

3.6 Heat treatment. Bolts shall be heat treated, including triple tempering, to develop the mechanical properties specified herein (see Table III). Bolts shall be retempered, subsequent to grinding and prior to thread rolling and radius forming, at a temperature of 25 F below the original tempering temperature. The heat treatment process shall be in accordance with MIL-H-6875.

3.7 Cadmium coating. Bolts shall be vacuum cadmium coated in accordance with MIL-C-8837, type II, class 2 (see 4.5.1.1).

3.8 Mechanical properties.

3.8.1 Ultimate tensile load. The ultimate tensile load shall be as specified in Table III (see 4.5.4.3).



## MIL-B-8907A

TABLE III. Mechanical properties.

Nominal Size	Ultimate Tensile Load Pounds (min) <u>1/</u>	Area at Basic Shank Diameter (in. <sup>2</sup> ) <u>2/</u>	Double Shear Strength Pounds (min) <u>2/</u>
0.190-32	5,640	0.0284	8,840
.250-28	10,100	0.0491	15,300
.312-24	16,000	0.0767	23,900
.375-24	24,700	0.1104	34,400
.437-20	33,500	0.1503	46,900
.500-20	44,600	0.1963	61,200
.562-18	56,600	0.2485	77,500
.625-18	70,800	0.3068	95,700
.750-16	103,000	0.4418	138,000
.875-14	140,000	0.6013	188,000
1.000-12	183,000	0.7854	245,000
1.125-12	234,000	0.9940	310,000
1.250-12	292,000	1.2270	383,000
1.375-12	356,000	1.4850	463,000
1.500-12	427,000	1.7670	551,000

1/ The stress areas used for the calculations of the ultimate tensile load values are in accordance with NAS 1348 except for .190-32, .250-28 and .312-24 which are 98 percent of the values in NAS 1348.

2/ The listed shear values are based on a minimum single shear strength of 156 ksi (60 percent of 260 ksi  $F_{tu}$ ) and the stress area at the basic shank diameter.

3.8.2 Double shear strength. The bolts shall conform to the double shear values listed in Table III (see 4.5.4.4).

3.8.3 Hardness. Bolts shall have a Rockwell hardness in the range of C51 to C54 (see 4.5.3.2).

3.8.4 Fatigue life. Bolts, when loaded in accordance with Table IV, shall be capable of withstanding a minimum fatigue life of 65,000 cycles. There shall be no superficial tempering, coating, or treatment in order to satisfy this requirement (see 4.5.4.2). If no failure has occurred at 130,000 cycles, testing may be discontinued.

3.8.5 Stress durability. There shall be no failure of the bolt when subjected to the stress durability test (see 4.5.4.6).

3.9 Metallurgical properties.

3.9.1 Carburization and nitrogenization. The bolts shall show no decarburization, carburization, recarburization, or increase in nitrogenization on the bearing surface of the head, head-to-shank fillet, shank, or threads (see 4.5.4.8).

MIL-B-8907A

TABLE IV. Fatigue loading.

Nominal Size	Low Tension Load (pounds) +2 percent <u>2/</u>	High Tension Load (pounds) +2 percent <u>1/</u>
0.190-32	293	2,930
.250-28	525	5,250
.312-24	832	8,320
.375-24	1,280	12,800
.437-20	1,740	17,400
.500-20	2,320	23,200
.562-18	2,940	29,400
.625-18	3,680	36,800
.750-16	5,340	53,400
.870-14	7,290	72,900
1.000-12	9,500	95,000
1.125-12	12,200	122,000
1.250-12	15,180	151,800
1.375-12	18,500	185,000
1.500-12	22,200	222,000

1/ High tension fatigue load is based on  $.52 \times F_{tu}$  of Table III.

2/ Low tension fatigue load is 10 percent of high tension load.

3.9.2 Work effect. The bolt threads and head-to-shank fillet shall show evidence of working, when examined as specified in 4.5.4.9.

3.9.3 Discontinuities. Bolts shall be examined by magnetic particle inspection as specified in 4.5.3.3. Bolts having discontinuities equal to or greater than the limits specified in Table V shall be rejected. Care must be exercised in distinguishing cracks from other discontinuities (see 4.5.3.3).

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

3.9.3.2 Laps and seams. Bolts may possess laps and seams, except in locations specified in 3.9.3.5. The depths shall not be greater than the amounts specified in Table V. A lap is a surface defect appearing as a seam, caused by folding over hot metal fins or sharp corners and then rolling or forging them into the surface, but not welding them. A seam is an unwelded fold or lap which appears as an opening in the raw material as received from the source.

## MIL-B-8907A

TABLE V. Discontinuity depths 1/.

Nominal Size (inches)	0.190, .250, .312	0.375	0.437	0.500 through 1.500, incl.
Discontinuity depth (inch) (maximum)	0.005	0.006	0.007	0.008

1/ Depth of discontinuity shall be measured normal to the surface at the point of greatest penetration.

3.9.3.3 Inclusions. Bolts shall show no evidence of surface or subsurface inclusions at the thread root or head-to-shank fillet, when examined as specified in 4.5.3.3. Small inclusions in other parts of the bolt which are not indicative of unsatisfactory quality shall not be cause for rejection.

3.9.3.4 Head and shank discontinuities (seams, inclusions, or folds). The bolt heads and shanks shall not possess seams, inclusions, or folds greater than twice the depth limits shown in Table V. Bolts having seams on the bearing surface greater than the limits shown in Table V shall be rejected. Discontinuities shall not be permitted on the head-to-shank fillet.

3.9.3.5 Thread discontinuities (laps, seams, and surface irregularities). Threads shall have no laps at the root or along the flanks as shown on figure 6. Laps are permissible at the crest as shown on figure 7. Laps at the crest shall not be greater than 25 percent of the basic thread depth. Slight deviation from the thread contour is permissible at the crest of the thread as shown on figure 7. The incomplete thread at each end of the thread may also deviate slightly from contour.

3.9.4 Grinding burns. The bolts shall show no evidence of grinding burns when examined as specified in 4.5.4.7.

3.10 Identification of product. Each bolt shall be marked in accordance with the applicable standards. The manufacturer's identification and code marking for traceability by production lot shall be marked on the top or side of the head, on the base of the lightening hole or on the point of the bolt. Traceability code marking is required for all bolt sizes. Markings may be formed by forging or stamping. Markings may be raised or indented. Marking shall not be deeper than 0.010-inch. Only raised markings shall be used on the base of the lightening hole.

#### 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

MIL-B-8907A

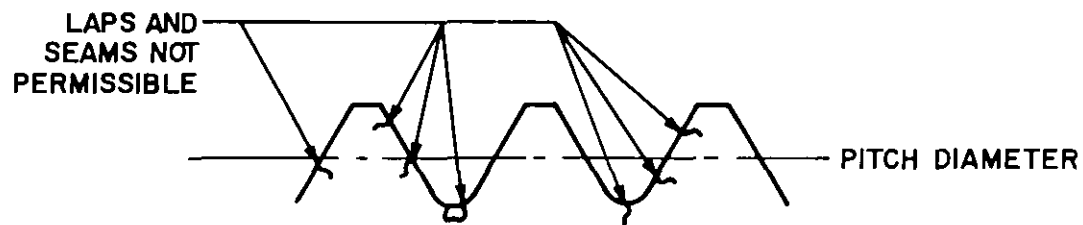


FIGURE 6. Nonpermissible laps, seams, and surface irregularities.

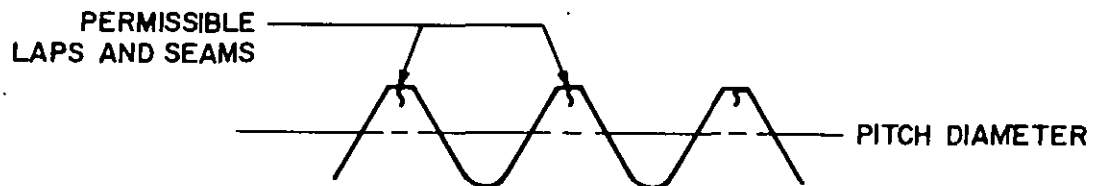
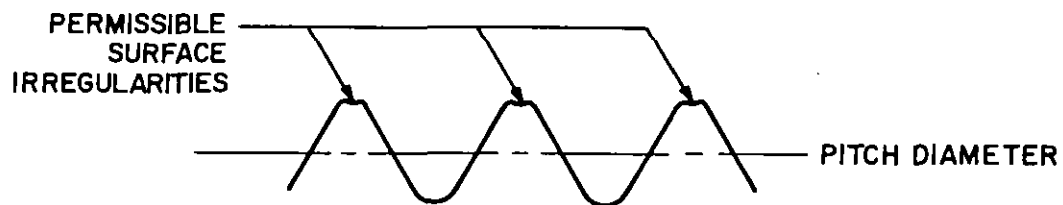


FIGURE 7. Permissible laps, seams, and surface irregularities

FIGURE 7. Permissible laps, seams, and surface irregularities.

## MIL-B-8907A

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

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

4.3 Qualification inspections. Qualification inspections shall consist of all the inspections listed in Table VI.

4.3.1 Sampling plan. The qualification inspection samples shall consist of 20 bolts for each diameter upon which qualification is desired. The number of test or examinations shall be as specified in Table VI. Samples up to and including 0.4375-inch diameter shall have a grip length of not less than 1.750 inches; samples from 0.500-inch diameter and above shall have a grip length of not less than 4.500 inches. In addition, the manufacturer shall supply at least 20 nuts conforming to MIL-STD-1312, Test 11. Samples shall be identified as required and forwarded to the activity responsible for qualification, designated in the letter of authorization from that activity (see 6.3).

4.3.2 Retention of qualification. Certification shall be requested by NAVAIRDEVCON (Naval Air Development Center), Code 6013, Warminster, PA 18974, from each manufacturer. NAVAIRDEVCON will forward certification to NAVAIRENGCON who is acting as agent for NAVAIRSYSCOM (Naval Air Systems Command), AIR-5303B. 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.)

MIL-B-8907A

TABLE VI. Qualification inspections.

Type of Inspections	No. of Inspections	Requirement Paragraph	Test Paragraph
Threads	3	3.3.2	4.5.1
Finish Dimensions and Surface Texture	3	3.4, 3.7	4.5.1.1
Discontinuities	3	3.9.3	4.5.3.3
Ultimate Tensile Load	3	3.8.1	4.5.4.3
Double Shear Strength	3	3.8.2	4.5.4.4
Fatigue Strength	3	3.8.4	4.5.4.2
Carburization/Nitrogenization	1	3.9.1	4.5.4.8
Work Effect	1	3.9.2	4.5.4.9
Head Structure and Grain Flow	1	3.3.3.3	4.5.4.10
Grinding Burns	3	3.9.4	4.5.4.7
Stress Durability	3	3.8.5	4.5.4.6
Hardness	3	3.8.3	4.5.3.2

4.4 Quality conformance inspection. The quality conformance inspections shall consist of all the tests specified in Table VII.

4.4.1 Production lot. A production lot shall consist of bolts which are of the same diameter, fabricated from a single mill heat, heat treated, and coated by identical processes, respectively, and produced as one continuous run.

4.4.2 Inspection lot. An inspection lot shall consist of bolts from a single production lot. The bolts shall be of the same diameter and grip length.

4.4.3 Random sample. A random sample is a sample drawn in such a manner that each bolt in the inspection lot has the same chance of being the first bolt in the random sample; after the first bolt in the sample is drawn, each of the remaining bolts in the inspection lot has the same chance of being the second bolt in the sample, etc. A random sample shall be selected from each inspection lot in accordance with MIL-STD-105, Acceptance Quality Level (AQL) of 1.0 percent defective (see 6.4.1) for Major defects, 2.5 percent defective for Minor A defects, and 4.0 percent defective for Minor B defects.

MIL-B-8907A

TABLE VII. Quality conformance inspections.

Type of Inspections	No. of Inspections	Requirement Paragraph	Test Paragraph
Threads	3	3.3.2	4.5.1
Finish Dimensions and Surface Texture	3	3.4, 3.7	4.5.1.1
Discontinuities	3	3.9.3	4.5.3.3
Ultimate Tensile Load	3	3.8.1	4.5.4.3
Double Shear Strength	3	3.8.2	4.5.4.4
Fatigue Strength	3	3.8.4	4.5.4.2
Carburization and Nitrogenization	1	3.9.1	4.5.4.8
Work Effect	1	3.9.2	4.5.4.9
Head Structure and Grain Flow	1	3.3.3.3	4.5.4.10
Grinding Burns	3	3.9.4	4.5.4.7
Stress Durability	3	3.8.5	4.5.4.6
Hardness	3	3.8.3	4.5.3.2

4.4.4 Certified test report. The manufacturer shall furnish a certified test report showing that the manufacturer's product satisfactorily conforms to this specification. The test report shall include actual results of the tests specified herein. When this report is submitted, it shall be accompanied by a dated drawing that completely describes the manufacturer's product. The drawing shall specify all dimensions and tolerances, composition of materials selected, coating or plating applied, forming process (machined, stamped, forged, or drawn), and the Rockwell hardness and heat treatment. The drawing shall also specify the manufacturer's part number for each size.

#### 4.5 Methods of inspections.

4.5.1 Threads. The threads shall be examined for conformance to 3.3.2.

4.5.1.1 Finish dimensions and surface texture. Dimensions, thickness of cadmium coating, and surface texture shall be inspected by means of applicable gages. Straightness shall be measured by the use of a dial-type indicator gage. Surface texture of threads shall be determined by a visual comparator method. In case of discrepancy, gages certified by Government laboratories shall be used.

## MIL-B-8907A

4.5.1.2 Classification of defects. All dimensional characteristics are considered defective when out of tolerance. The classification of defects for bolts shall be as specified in Table VIII.

4.5.2 Use of identical sample bolts. Identical sample bolts may be used for the various acceptance inspections and tests, provided that none of the characteristics of the sample bolts are altered during the examination.

TABLE VIII. Classification of defects.

Category	Defect
Critical	None defined
Major: 101 102 103 104 105 106 107 108 109 110 111 112 113 114	Thread size and form Shank diameter Incomplete threads Grip length Radius under head Drilled holes in head missing (when required) Squariness between head and shank (bearing surface) Straightness of shank Surface texture Burrs and tool marks Cadmium coating (thickness) Identification Overall length, under size Wrenching dimensions
Minor A: 201 202 203 204 205 206 207	Overall length, over size Head diameter (and chamfer) Head height Concentricity of head and shank Concentricity of shank and thread pitch diameter Drilled hole diameters and location Lightening hole dimensions
Minor B: 301 302	Chamfer of thread end Flange height

4.5.3 Nondestructive tests.

4.5.3.1 Sampling plan. Except for magnetic particle inspection, sampling shall be in accordance with MIL-STD-105. Magnetic particle inspection (4.5.3.4) shall be performed on 100 percent of the production lot. Normal inspection shall be used at the start of each production lot.



## MIL-B-8907A

The reduced inspection procedure shall be R-2. The AQL shall be 2.5 percent defective and the inspection level shall be S-4. The sample bolts may be selected from those that have been subjected to and passed the dimensional inspection with additional bolts selected at random from the inspection lot as necessary.

4.5.3.2 Hardness. Each bolt of the random sample shall be inspected for Rockwell hardness in accordance with MIL-STD-1312, Test 6, on the threaded end of the bolt. Each bolt of the random sample shall have a Rockwell hardness in the range of C51 to C54 in order for the inspection lot and the production lot to be considered acceptable. If readings are obtained outside this range, two samples each of the softest and hardest bolts shall be further tested in accordance with 4.5.4.5.

4.5.3.3 Cracks and discontinuities. Magnetic particle inspection shall be used to determine the presence of cracks and discontinuities such as laps, seams, and inclusions. Magnetic particle inspection shall be performed in accordance with MIL-I-6868. The bolts shall be magnetically inspected by both the longitudinal and circular methods. Magnetic particle indications of themselves shall not be cause for rejection. If indications are considered cause for rejection, representative samples shall be taken from those bolts showing indications and these samples shall be further examined by microexamination to determine if the indicated discontinuities are greater than the limits specified herein.

4.5.4 Destructive tests.

4.5.4.1 Sampling plan. Sampling shall be in accordance with MIL-STD-105. Normal inspection shall be used at the start of each production lot. The reduced inspection procedure shall be R-2. The AQL shall be 1.0 percent defective and the inspection level shall be S-2. The sample bolts may be selected from those that have been subjected to and passed the nondestructive tests with additional bolts selected at random from the inspection lot as necessary.

4.5.4.2 Fatigue strength. The fatigue loading applied to bolts shall conform to 3.8.4. The fatigue test shall be conducted at room temperature. The tension-tension fatigue testing method and fixture requirements shall be in accordance with MIL-STD-1312, Test 11. Bolts having a grip length less than twice their shank diameter need not be fatigue tested.

4.5.4.3 Ultimate tensile load. The bolts shall be tested in tension between the head of the bolt and a threaded member in accordance with MIL-STD-1312, Test 8. Bolts having a grip length of less than twice their shank diameter need not be tensile tested.

4.5.4.4 Double shear strength. The double shear strength test shall be performed on the unthreaded portion of the bolt in accordance with MIL-STD-1312, Test 13. Bolts having a grip length of less than twice their shank diameter need not be shear tested.

## MIL-B-8907A

4.5.4.5 Traverse hardness. The acceptance of bolts having grip lengths less than twice the nominal size shall be based on the traverse hardness test taken on a circular cross section halfway between the head bearing surface and the thread. The Rockwell hardness range for acceptance shall be C51 to C54. Readings shall be taken at distances of 1/8 inch from the surface, at one-half the radius where practicable, and at the core.

4.5.4.6 Stress durability. Bolts shall be assembled in a steel block, heat treated to a Rockwell hardness of Rc 26-32. The threads of the bolt, the seating surface of the bolt head, and the seating surface of the nuts shall be lubricated with graphite petrolatum in accordance with MIL-T-5544. The bolt shall be preloaded by applying the torque specified in Table IX. This load shall be maintained for 24 hours without failure.

TABLE IX. Torque values for stress durability test.

Thread Size	Torque (in.-lb min)
0.190	35
.250	80
.312	140
.375	285
.437	415
.500	710
.562	1,300
.625	1,700
.750	2,600
.870	3,750
1.000	5,700
1.125	7,300
1.250	10,000
1.370	14,500
1.500	18,800

4.5.4.7 Grinding burns. Indications of grinding burns (untempered martensite) are white streaks appearing on the surface of the test sample after the test is conducted as follows:

- a. Remove all foreign matter from the bolt such as grease, dirt, plating, or oxide fiber.
- b. Rinse the bolt in cold water. If water breaks occur, bolts shall be recleaned.
- c. Immerse and agitate the bolt in a 4 percent solution of nitric acid for approximately 30 seconds.

MIL-B-8907A

- d. Rinse in cold water and dry bolt.
- e. Immerse the bolt in 2 percent solution of hydrochloric acid in acetone for 30 seconds.
- f. Rinse in cold water.
- g. Rinse the bolt in 5 percent sodium bicarbonate solution.
- h. Rinse the bolt in hot water and dry.

Indication of grinding burns shall be cause for rejection.

4.5.4.8 Carburization and nitrogenization. Carburization, decarburization, recarburization, or nitrogenization on the bearing surface of the head, head-to-shank fillet, shank, and threads shall be determined by microexamination. Specimens shall be taken from the finished bolt as shown on figure 8. The etchant shall be 5 percent nital. Microscopic examination shall be made at 100X magnification. In case of discrepancy over carburization, decarburization, recarburization of nitrogenization, microhardness testing of the shank shall be used as an arbitration method. Bolts shall conform to this requirement if the difference in Vickers microhardness, when measured in a zone between 0.003 and 0.063 from the surface, is 45 points. This requirement does not apply to the threads or fillet area.

4.5.4.9 Work effect. The cold work of the bolt threads shall be determined by microexamination as specified in 4.5.4.8. Work effect on the head-to-shank fillet shall be determined by visual examination.

4.5.4.10 Head structure and grain flow. Head structure and grain flow shall be determined by macroexamination at 10X magnification. Specimens shall be taken from the finished bolt as shown on figure 8. The bolts shall be etched in an aqueous solution containing 50 percent (by volume) hydrochloric acid at 160° to 180°F for sufficient time to reveal the macrostructure properly. The specimen shall show no detrimental defects.

4.5.5 Resubmitted inspection lots. The paragraph titled "Resubmitted lots" of MIL-STD-105 shall apply, except that a resubmitted inspection lot shall be inspected by the contractor, using tightened inspection. Before an inspection lot is resubmitted, full particulars concerning the cause of previous rejection and the action taken to correct the defects found in the inspection lot shall be furnished by the contractor to the Government inspector.

4.6 Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with Section 5.

MIL-B-8907A

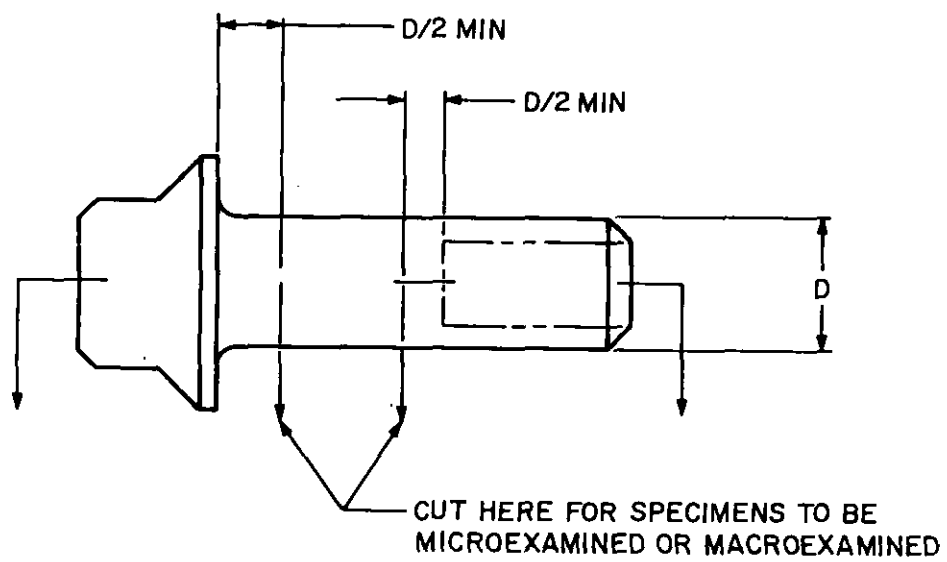


FIGURE 8. Metallurgical specimens.

MIL-B-8907A

## 5. PACKAGING

5.1 Packaging. Unless otherwise specified, each bolt shall have the shank and threads protected by a sleeve extending over the full length of the shank and thread. The sleeve shall be manufactured from cardboard, asphalt-impregnated chip board, plastic sleeve covering, or a spiral wrap of kraft paper over chip board, and shall be lined with material conforming to MIL-B-121.

5.1.1 Intermediate packaging. Only identical items shall be included in an intermediate package. Bolts, preserved and packaged as specified in 5.1.1, shall be packaged in containers conforming to PPP-B-665, PPP-B-566, PPP-B-636, or PPP-B-676. Unless otherwise specified by the procuring activity, the quantity per unit package shall be as specified in Table X.

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

TABLE X. Allowable quantities per package.

Size	Length	Maximum Quantity per Carton
0.190, 0.250, 0.312	Up to 1.500 in.	100
0.190, 0.250, 0.312	1.500 in. to 3 in.	50
0.375 and 0.562	Up to 3 in.	50
0.190 to 0.562	Over 3 in.	25
Over 0.562	All lengths	25

5.2.1 Level A. Bolts, preserved and packaged as specified in 5.1, shall be packed in overseas containers conforming to PPP-B-585, PPP-B-621, or PPP-B-601. Plywood containers shall be surface treated in accordance with the specification. As far as practicable, exterior shipping containers shall be of uniform shape and size, be of minimum cube and tare consistent with the protection required, and contain identical quantities. The gross weight of each pack shall be limited to approximately 200 pounds. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto. Containers shall be provided with a case liner conforming to MIL-L-10547 and shall be sealed in accordance with the appendix thereto. The case liner will not be required when the intermediate container conforms to PPP-B-636 class, weather-resistant, closed and taped in accordance with the appendix.

5.2.2 Level C. Packages which require overpacking for acceptance by the carrier shall be packed in exterior-type shipping containers in a manner that will insure safe transportation at the lowest rate to the point of delivery. Containers shall conform to the Uniform Freight Classification Rules or regulations of other common carriers as applicable to the mode of transportation.

## MIL-B-8907A

5.3                    Physical protection. Cushioning, blocking, bracing, and bolting, as required, shall be in accordance with MIL-STD-1186, except that for domestic shipment, waterproofing requirements for cushioning materials and containers shall be waived. Drop test of MIL-STD-1186 shall be waived when packaging and packing of the item is for immediate use or when drop tests of MIL-P-116 are applicable.

5.4                    Marking of shipments. In addition to any special requirements of the contract or purchase order, shipments shall be marked in accordance with MIL-STD-129.

## 6.    NOTES

6.1                    Intended use. Bolts procured to this specification are intended for use in tension applications which require a bolt with 260 ksi strength and high fatigue strength and not intended for use in application greater than 450°F. These bolts should be used in conjunction with high strength nuts in accordance with MIL-N-8984.

6.2                    Ordering data. Procurement documents should specify:

- a.    Title, number and date of this specification.
- b.    MS part number.
- c.    Quantity (see Table IX).
- d.    Applicable levels of packing (see 5.2).

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 applicable 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 may 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 System Command, Navy Department, Washington, D.C. 20360; however, information pertaining to qualification of products may be obtained from the Naval Air Development Center, Warminster, PA 18974, Attention: Code 60132.

6.4                    Definitions.

6.4.1                  Defective. A defective is defined as an item containing one or more defects.

MIL-B-8907A

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

**Custodians:**

Navy - AS  
Air Force - 11  
Army - AV

**Preparing activity:**

Navy - AS  
(Project No. 5306-0657)

**Reviewer activity:**

Army - AT  
DLA - IS  
Air Force - 99

**User activity:**

Army - MI

☆ U.S. GOVERNMENT PRINTING OFFICE: 1983 — 606-034/4519



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