

MIL-B-83050D
25 November 1985
 SUPERSEDING
 MIL-B-83050C
 14 December 1977

MILITARY SPECIFICATION

BOLT, SELF-RETAINING, IMPEDANCE TYPE

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 an impedance-type self-retaining bolt that is intended for critical applications.

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)
QQ-S-763	Steel Bars, Wires, Shapes, and Forgings, Corrosion-Resisting
QQ-W-423	Wire, Steel, Corrosion-Resisting
PPP-B-566	Boxes, Folding, Paperboard
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-636	Boxes, Shipping, Fiberboard
PPP-B-676	Box, Setup

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to ASD/ENES, Wright-Patterson AFB, OH 45433-6503 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5306

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Military

MIL-B-121 Barrier Material, Greaseproofed, Waterproofed, Flexible
MIL-S-5000 Steel, Chrome-Nickel-Molybdenum (E4340) Bars and Reforg-
ing Stock
MIL-S-5626 Steel, Chrome-Molybdenum (4140) Bars, Rods, and Forging
Stock (For Aircraft Applications)
MIL-S-6049 Steel, Chrome-Nickel-Molybdenum (8740) Bars and
Forging Stock (Aircraft Quality)
MIL-S-6758 Steel, Chrome-Molybdenum (4130) Bars and Reforging Stock
(Aircraft Quality)
MIL-I-6866 Inspection, Penetrant Method of
MIL-I-6868 Inspection Process, Magnetic Particle
MIL-H-6875 Heat Treatment of Steels (Aerospace Practice, Process For)
MIL-S-8503 Steel Bars, Chrome-Vanadium (6150) Aircraft Quality
MIL-S-8879 Screw Threads, Controlled Radius Root With Increased Minor
Diameter, General Specification for

STANDARDS

Military

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129 Marking For Shipment and Storage
MIL-STD-810 Environmental Test Methods and Engineering Guidelines
MIL-STD-1312 Fastener Test Methods
MS27576 Bolt, Self-Retaining, Impedance Type, 95 KSI Fsu, Hex Head,
450°F
MS27577 Bolt, Self-Retaining, Impedance Type, 95 KSI Fsu, Flush
Head, 450°F

(Copies of specifications, standards, handbooks, 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 document which are indicated as DoD adopted shall be the same issue listed in the current DoDISS and the supplement thereto, if applicable.

Aerospace Material Specifications

AMS 5643 Steel Bars, Forgings, Tubing, and Rings, Corrosion
Resistant 16Cr-4.0Ni-0.30(Cb+Ta)-4.0Cu
AMS 5644 Steel Bars and Forgings, Corrosion Resistant 17Cr-7Ni-1Al
Resistant (A-286)
AMS 5678-81 Steel Wire, Corrosion Resistant 17Cr-7.1Ni-1.1Al
Precipitation Hardenable, Spring Temper
AMS 5731 Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat
Resistant, 15Cr-25.5Ni-2.1Ti-0.006B-0.30V Consumable
Electrode Melted, 1800°F (980°C) Solution Heat Treated

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

American National Standards Institute

ANSI B46.1-1978 Surface Texture (Surface Roughness, Waviness and Lay)

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

Manufacturers Material Specification

Cobalt Alloy (Elgiloy Wire)

(Application for copies should be addressed to the American Gage and Machine Company, 5205 W. Kinzie St., Chicago, IL 60644.)

(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 reference cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

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

3.2 Qualification. The self-retaining 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 and 6.3).

3.3 Materials

3.3.1 Identification. The manufacturer shall make material identification test of the metal stock used to fabricate the bolts. The test reports shall be made available upon the request of the contracting activity or as directed by the contracting officer (see 4.3.2).

3.3.2 Composition of components

3.3.2.1 Body. Alloy steel bolts shall be made of material in accordance with MIL-S-5000, MIL-S-5626 9UNS G41400), MIL-S-6049, MIL-S-6758, or MIL-S-8503. Corrosion-resistant bolts shall be made of material in accordance with AMS 5643 (UNS S17400) or AMS 5731 (UNS K66286).

3.3.2.2 Retaining element. The retaining element shall be made of material in accordance with AMS 5643 (17-4PH), AMS 5644 (17-7PH), or QQ-S-763 Class 440C.

3.3.2.3 Springs. Springs shall be made of material in accordance with AMS 5678 (UNS S17700), QQ-W-423 Composition 302 condition B, Cobalt Alloy (Elgiloy) wire, or equal.

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3.4 Protective finish. When specified in the contract or purchase order, bolts shall be plated, coated, or treated as specified in 3.4.1 or 3.4.2, as applicable.

3.4.1 Cadmium plating. Cadmium plating shall be in accordance with QQ-P-416, type II, class 2. All cadmium-plated components shall be heated to a temperature of $190^{\circ}\text{C} \pm 14^{\circ}\text{C}$ ($375^{\circ}\text{F} \pm 25^{\circ}\text{F}$) within one hour after plating and before magnetic particle inspection and shall be held at this temperature for a minimum of 23 hours, after which the bolts shall be allowed to cool normally at room temperature.

3.4.2 Passivation. Corrosion-resistant steel parts shall be passivated in accordance with QQ-P-35.

3.5 Design and construction. The design and construction of the bolt shall be as specified herein and on the applicable military standard.

3.5.1 Shank straightness. The shank straightness shall be within the values specified in table I when measured as specified in 4.5.3.

TABLE I. Shank straightness.

Shank Diameter (Inch)	Maximum Deviation of Bolt Shank From Surface Plate (Inch Per Inch Grip Length)
0.190 - 0.3125	0.0030
0.375 - 0.4375	0.0025
0.500 and up	0.0020

3.5.2 Impedance device. All bolts shall be of such design as to be retained in position by the impedance element. Retaining element shall cause no damage to linkage joints upon insertion or removal.

3.5.3 Insertion force. The bolts, with the retaining element incorporated therein, shall not exceed the insertion forces specified in table II (see 4.5.6).

3.5.4 Removal force. The bolt, with the retaining element incorporated therein, shall withstand the removal force specified in table III (see 4.5.6.1).

3.5.4.1 Wear test. The bolt, with the retaining element incorporated therein, shall not exceed the values specified in table IV (see 4.5.6.2).

3.5.5 Dimensions. The retaining element shall be within the dimensional limitations of MS27576 and MS27577.

3.5.6 Bolt shank shear strength. The bolt shall conform to the minimum double shear strength as specified in table II, (see 4.5.8).

3.5.7 Bolt ultimate tensile strength. The bolt ultimate tensile strength shall be as specified in table II (see 4.5.9).

TABLE II. Performance characteristics.

Nominal Size	Body Double Shear Strength Min (Lb)	Bolt Ultimate Tensile Strength Min (Lb)	Bolt Insertion Force Max (Lb)
0.190 - 32	5,380	2,530	14
0.250 - 28	9,300	4,680	17
0.3125 - 24	14,600	7,510	20
0.375 - 24	21,000	11,540	22
0.4375 - 20	28,600	15,560	22
0.500 - 20	37,300	21,160	28
0.5625 - 18	47,200	26,870	28
0.625 - 18	58,300	34,100	35
0.750 - 16	83,900	50,000	35
0.875 - 14	114,200	68,350	40
1.000 - 12	149,200	88,900	40

TABLE III. Removal forces.

Nominal Bolt Size	Hole A Diameter (In.)	Bolt Removal Force For Hole A (Max) (Lb)	Hole B Diameter (In.)	Bolt Removal Force For Hole B (Min) (Lb)
0.190	0.1897	14	0.1920	3
0.250	0.2495	17	0.2520	5
0.3125	0.3120	20	0.3145	8
0.375	0.3745	22	0.3770	10
0.4375	0.4370	22	0.4395	10
0.500	0.4995	28	0.5020	15
0.5625	0.5620	28	0.5645	15
0.625	0.6245	35	0.6270	20
0.750-16	0.7495	35	0.7530	20
0.875-14	0.8745	40	0.7880	25
1.000-12	0.9995	40	1.0030	25

3.5.8 Hardness. Metal hardness shall be as specified on the applicable military standard (see 4.5.7).

3.5.9 Surface roughness. The surface roughness of the bolts shall not exceed the values shown in table V (see 4.5.4).

3.5.10 Threads

3.5.10.1 Form and dimensions. Unless otherwise specified, the threads shall be right hand and the dimensions and form shall conform to MIL-S-8879 and the applicable military standard.

3.5.10.2 Rolling. Threads shall be fully formed by a single rolling process after heat treatment.

3.5.10.3 Runout. Thread runout, consisting of a maximum of 1.5 incomplete thread pitches, shall fair onto the shank, thereby eliminating any abrupt changes in cross-sectional area. There shall be a minimum thread runout of 1/2 pitch. Bottom and sides of runout thread pitches may deviate from true thread form but shall be smooth.

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TABLE IV. Wear test limits.

Bolt Size (In.)	Hole Size B		Removal Force (Min) After 100th Cycle (Lb)	Hole Size Enlargement Allowables After 100 Cycles B Max (In.)	Max Chamfer Allowable After 100 Cycles (In.)
	Max	Min			
0.190	0.1907	0.1897	2	0.1925	0.020 x 45°
0.250	0.2505	0.2495	4	0.2525	0.020 x 45°
0.3125	0.3130	0.3120	6	0.3150	0.020 x 45°
0.375	0.3755	0.3745	8	0.3775	0.020 x 45°
0.4375	0.4380	0.4370	8	0.4400	0.025 x 45°
0.500	0.5005	0.4995	12	0.5025	0.025 x 45°
0.5625	0.5630	0.5620	12	0.5650	0.025 x 45°
0.625	0.6255	0.6245	15	0.6275	0.030 x 45°
0.750-16	0.7505	0.7495	15	0.7503	0.030 x 45°
0.875-14	0.8755	0.8745	20	0.8780	0.032 x 45°
1.000-12	1.0005	0.9995	20	1.0030	0.032 x 45°

TABLE V. Roughness height rating.

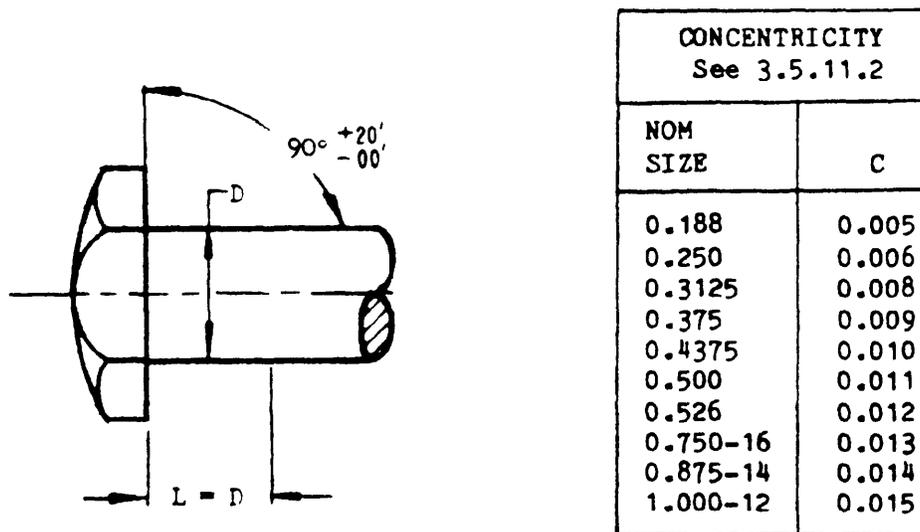
Area	Max Surface Roughness R _a (ANSI B46.1)
Shank and underside	63
Other surfaces	125

3.5.11 Heads. Heads shall be upset or forged.

3.5.11.1 Bearing surface. The bearing surface of bolt protruding heads shall be at right angles to the shank within the limits shown on figure 1. The angular variations of the underside of the head shall be uniform around the shank within a tolerance of +20, -00 minutes, as measured between the bearing surface of the head and shank, at a length along the shank from the head equal to the diameter of the bolts (see 4.5.1).

3.5.11.2 Concentricity. For flush-head bolts, the conical surface of the head and shank diameter "D" shall be within 0.005 full indicator movement (FIM). Head driving recess to shank shall be within 0.016 FIM. Concentricity of the head and shank of the protruding-head bolts shall be with "C" values FIM (see figure 1).

3.5.11.3 Fillet (head-to-shank). The head-to-shank fillet radius shall be produced in such a manner as to insure meeting the strength requirements specified herein. The fillet shall be finished to the radius specified on the applicable standard. The working on the fillet radius shall be accomplished subsequent to the heat treatment of the bolt. The fillet shall show no evidence of seams or inclusions (see 4.5.12).

FIGURE 1. Head angularity.

3.5.12 Metallurgical properties

3.5.12.1 Carburization. Only the nonload bearing surfaces of the head, the recess surfaces and the chamfered end of the bolt, including the chamfered surface, may show indications of carburization, within the limitations specified in MIL-H-6875 and decarburization or recarburization as specified in MIL-H-6875, except depth shall be .003 max. All other external or internal surfaces, such as grooves and holes, shall show no indication of these heat treatment effects.

3.5.12.2 Discontinuities. Bolts shall be examined for discontinuities by magnetic particle or fluorescent penetrant inspections specified in 4.5.12 and 4.5.13. Any bolts having discontinuities equal to or exceeding the limitations specified in 3.5.12.2.1, 3.5.12.2.2, and 3.5.12.2.3 shall be rejected.

3.5.12.2.1 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.

3.5.12.2.2 Laps, seams, and inclusions. Finished bolts shall not possess laps, seams, or inclusions that exceed the depth shown in table VI.

TABLE VI. Depth limit on laps, seams, and inclusions of finished bolt.

Nominal Dia (Inch)	Depth, Max (Inch)
0.3125 and under	0.005
0.0375	0.006
0.4375	0.007
0.5000	0.008
0.6250	0.008
0.7500	0.009
0.8750	0.010
1.0000	0.010

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3.5.12.2.3 Thread discontinuities. Laps and seams that are above the pitch diameter (see figure 2) and do not exceed the depth limits of table VI will be permissible. Threads shall have no laps or seams below the pitch diameter (see figure 3).

3.6 Interchangeability. All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable.

3.7 Identification of product. The bolts shall be marked for identification in accordance with the applicable standards.

3.8 Workmanship. Workmanship shall be consistent with the type of product, finish, and the class of thread fit specified. Sharp edges shall be broken and all burrs and slivers shall be removed. Damage to the cadmium plating as a result of fabrication techniques shall not be cause for rejection, provided the corrosion requirements specified herein are met.

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 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 inspection. Qualification inspection shall consist of all the examinations and tests listed in table VII.

4.3.1 Qualification samples. The qualification samples for bolt sizes 0.190 through 0.500 inch diameter shall consist of 36 bolts for each size for which qualification is desired. Sample bolts shall have a minimum grip length of 1.3125 inches. For 0.5625 inch diameter through 1.000 inch diameter bolts, the qualification samples shall consist of 27 bolts. These sample bolts shall have a minimum grip length of 4D. A minimum of three bolts shall be subjected to each test, except that five bolts shall be used for the test specified in 4.5.13 and five bolts shall be used for tests specified in 4.5.6 and 4.5.6.1.

4.3.2 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, as a minimum, actual results of the tests specified herein. When this report is submitted, it shall be accompanied by a dated drawing which completely describes the manufacturer's product by specifying all dimensions and tolerances, composition of material selected, plating applied, and the heat treatment. The manufacturer's part number for each size and length shall be included on the dated drawing.

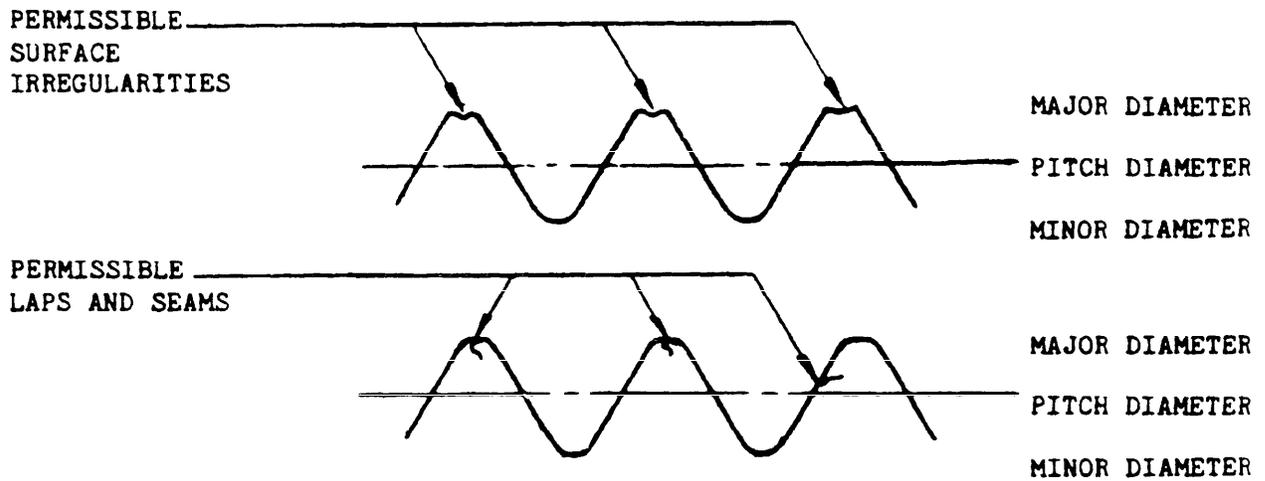


FIGURE 2. Permissible laps, seams, and surface irregularities.

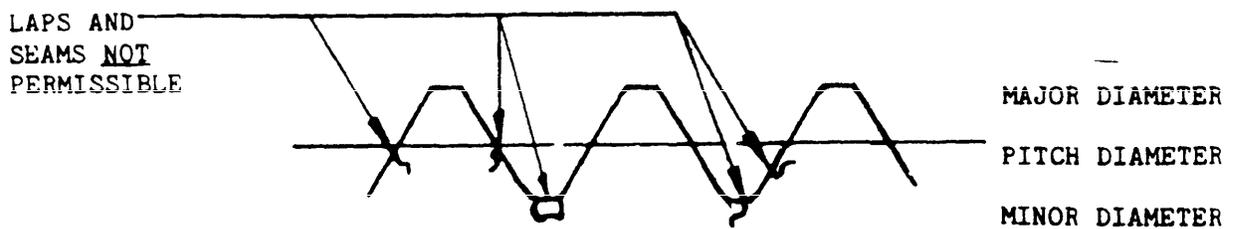


FIGURE 3. Nonpermissible laps, seams, and surface irregularities.

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TABLE VII. Qualification inspection.

Examination of Test	Number of Examinations or Test	Verification Paragraph	Requirement Paragraph
Threads	3	4.5.2	3.4.10
Visual and dimensional	3	4.5.1	3.4.10.1
Corrosion	3	4.5.5	3.3.2
Shank straightness	3	4.5.3	3.4.1
Concentricity	3	4.5.1	3.4.11.2
Surface roughness	3	4.5.4	3.4.9
Hardness	3	4.5.7	3.4.8
Shank shear strength	3	4.5.8	3.4.6
Bolt-nut assembly tensile test	3	4.5.9	3.4.7
Dust	3	4.5.10	
Carburization	3	4.5.11	3.4.12.1
Discontinuities	3	4.5.12	3.4.12.2
Magnetic particle inspection	3	4.5.12.1	3.4.12.2
Fluorescent penetrant inspection	3	4.5.12.2	3.4.12.2
Vibration test	5	4.5.13	3.4.2
Wear test	3	4.5.6.2	3.4.4.1
Insertion force	5	4.5.6	3.4.3
Removal force	5	4.5.6.1	3.4.4

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

4.4 Quality conformance inspection. Quality conformance inspection shall consist of examinations and tests for acceptance (see 4.4.3).

4.4.1 Inspection lot. An inspection lot shall consist of finished bolts which are of the same type and diameter and which are produced as one continuous run.

4.4.2 Sampling

4.4.2.1 Sampling for visual and dimensional examination. A random sample shall be selected from each inspection lot in accordance with MIL-STD-105, inspection level II.

4.4.2.1.1 Classification of defects. Classification of defects shall be in accordance with table VIII. Defects shall be classified as major or minor in accordance with MIL-STD-105. The acceptable quality levels (AQL's) for major and minor defects shall be as follows:

Major defects	1.5 percent
Minor defects	4.0 percent

4.4.2.2 Sampling for quality conformance inspection. A random sample of bolts shall be selected in accordance with MIL-STD-105, inspection level S-3, AQL-1.5 percent defective.

TABLE VIII. Classification of defects.

Category	Defect	Specification Para Number
Major		
101	Thread form and dimensions	3.5.10.1
102	Shank	3.5.5
103	Grip length	3.5.5
104	Length	3.5.5
105	Fillet from head to shank	3.5.11.3
106	Incomplete threads	3.5.10.3
107	Cotter pin hole location	3.5.5
108	Hex dimension across flats	3.5.5
109	Shank straightness	3.5.1
110	Squareness of bearing surface to shank	3.5.11.1
111	Concentricity of shank to threads	3.5.5
112	Concentricity of head to shank	3.5.11.2
113	Protective plating (visual inspection)	3.4
114	Burrs in cotter pin hole and on bearing surface under head	3.8
115	Recess in head	3.5.5
116	Protrusion of impedance element	3.5.5
117	Material identification	3.3.1
Minor		
201	Head thickness	3.5.5
202	Length at hex corner	3.5.5
203	Cotter pin hole diameter	3.5.5
205	Bearing surface under head	3.5.11.1
205	Burrs (general)	3.8
206	Recess dimensions and location	3.5.5
207	Surface roughness	3.5.9
208	Chamfer on thread end	3.5.5
209	Radial location of retaining element	3.5.5
210	Hex dimensions across corners	3.5.5
211	Chamfer or rounding of bearing surface of head	3.5.5

4.4.3 Inspection for acceptance. Samples, as specified in 4.4.2.2, shall be examined for the following:

- | | |
|---------------------------------------|-------------|
| a. Surface roughness | see 4.5.4 |
| b. Hardness | see 4.5.7 |
| c. Visual and dimensional examination | see 4.5.1 |
| d. Shank straightness | see 4.5.3 |
| e. Insertion force | see 4.5.6 |
| f. Removal force | see 4.5.6.1 |
| g. Wear test | see 4.5.6.2 |
| h. Discontinuities | see 4.5.12 |
| i. Carburization | see 4.5.11 |

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In addition, laboratory verification of all other tests shall be performed on random samples from periodic lots as specified by the contracting activity (see 6.2) to determine continued conformance to the requirements of this specification. (The acceptance number for this sampling inspection shall be zero.)

4.4.3.1 Records. Copies of all records of inspection for acceptance shall be certified and shall be supplied for each production lot or portion thereof. These records shall identify the manufacturer of the bolts and shall provide the address of the plant where the bolts were manufactured. The records and reports shall be submitted to the purchaser with the shipping documents and not in each individual package.

4.4.4 Resubmitted inspection lots. The paragraph titled "Resubmitted lots or batches" of MIL-STD-105 shall apply. A resubmitted inspection lot shall be inspected using tightened inspection. Where the original acceptance number was zero, a sample represented by the next higher sample size code letter shall be selected. When 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 manufacturer to the contracting activity.

4.5 Test methods

4.5.1 Visual and dimensional examination. Samples selected in accordance with 4.4.2.1 shall be examined for conformance to the requirements listed in table VIII and the applicable military standard. Damage of the cadmium plating as a result of the fabrication technique used to retain the element shall not be cause for rejection, provided the corrosion requirements as specified herein are met.

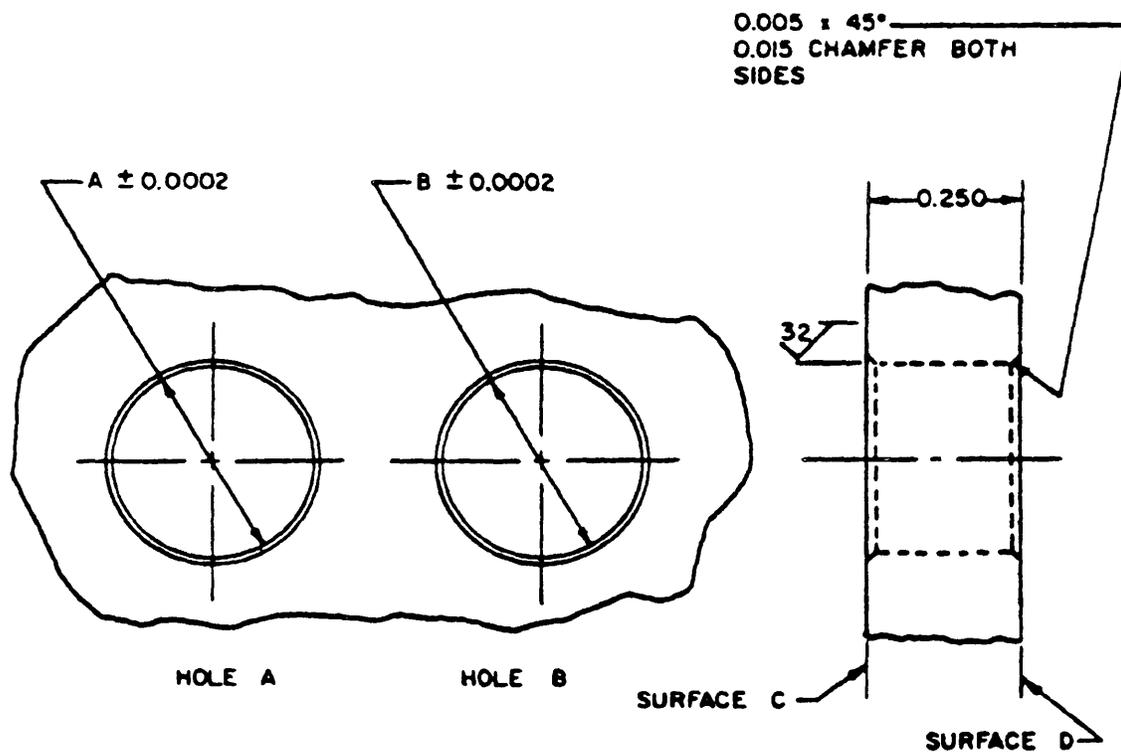
4.5.2 Threads. The threads shall be examined in accordance with MIL-S-8879, class 3A.

4.5.3 Shank straightness. Shank straightness shall be determined by rolling the shank of the bolt with the impedance element removed on a surface plate and measuring the point of greatest deviation with a .500-inch-wide feeler gage.

4.5.4 Surface roughness. Surface roughness shall be measured in accordance with ANSI B46.1 and shall conform to the requirements of 3.4.9.

4.5.5 Corrosion. Sample bolts shall be subjected to the salt spray test of MIL-STD-1312, test 1.

4.5.6 Insertion force. The threaded section of the bolt shall be inserted into hole A of the appropriate test fixture (see figure 4). Force shall be applied to the head of the bolt coaxially with the bolt and at right angles to the bearing surface of the test fixture. The forces shall be applied until the retaining element has emerged from the test fixture. A clearance hole to accept the bolt threads as they emerge from the test fixture must be provided. The maximum force required to insert and drive the retaining element through the test fixture is the maximum insertion force as specified in table II. The test shall be conducted without a lubricant on either the bolt or the test fixture.



NOTES:

1. MATERIAL TOOL STEEL
2. HEAT TREAT 45 TO 50 HRC
3. DIAMETERS A AND B TO BE PERPENDICULAR TO SURFACES C AND D WITHIN 30'.
4. FOR DIAMETERS A AND B, SEE TABLE III.

FIGURE 4. Insertion and removal test fixture.

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4.5.6.1 Removal force. The self-retained bolt which has been inserted per 4.5.6 shall have a force applied to the thread end and coaxial with the bolt and at right angles to the bearing surface of the test fixture. Clearance must be provided for the bolt head and body and support provided for the test fixture while the force is applied. The forces required to push the retaining element out of the test fixture are the forces as specified in table III. The test fixture shall be as shown on figure 4. The test for maximum removal force shall be made first in hole A and then the minimum removal force shall be tested in hole B. The test shall be conducted without a lubricant on either the bolt or the test fixture.

4.5.6.2 Wear test. Sample bolts shall be mounted on a fixture conforming to figure 5. The bolts shall be subjected to a minimum of 100 insertions and removals. The insertion and removal forces and procedures shall conform to the requirements of 4.5.6, 4.5.6.1 and table IV. The fixture as shown on figure 5, upon completion of the 100th removal, shall be inspected for hole elongation, enlargement, taper, grooves, gouges, excessive chamfer or any reason that may cause "B" diameter to exceed the maximum allowable dimensions as specified in table IV. The test shall be conducted without a lubricant on either the bolt or the test fixture.

4.5.7 Hardness. Sample bolts shall be tested for hardness in accordance with MIL-STD-1312, test 6.

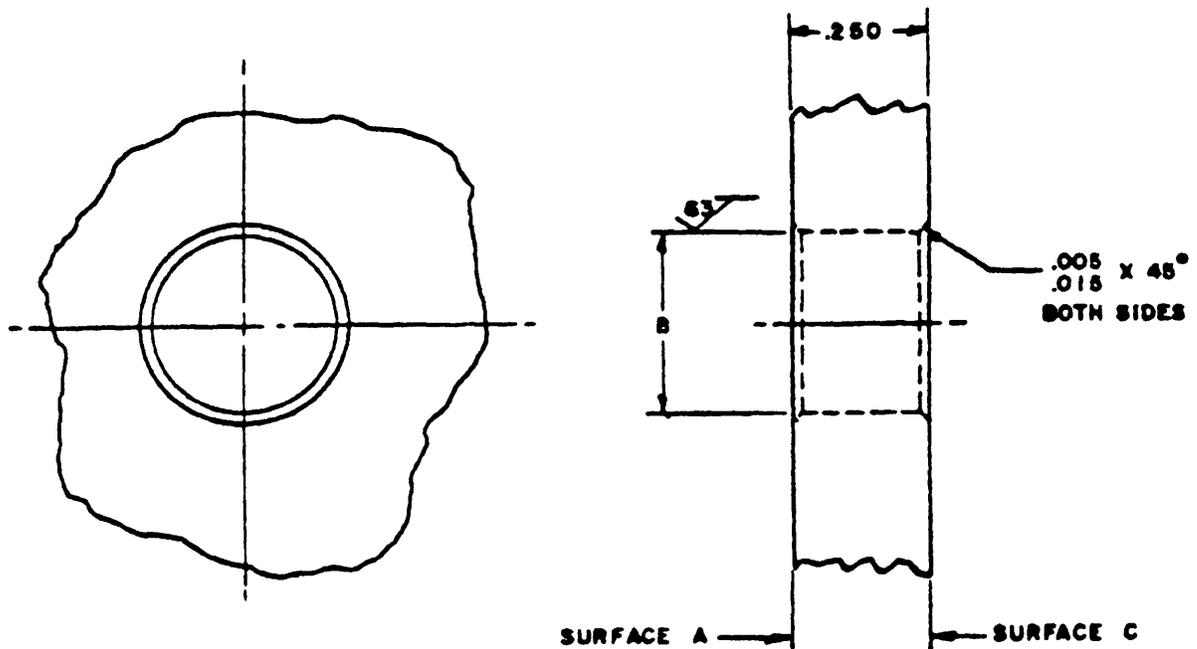
4.5.8 Shank shear strength. Sample bolts shall have one double shear test performed for each section of shank equal to two diameters of bolt shank length. The shear test shall be conducted in accordance with MIL-STD-1312, test 15.

4.5.9 Bolt ultimate tensile strength. Sample bolts shall be tested for ultimate tensile strength in accordance with MIL-STD-1312, test 8.

4.5.10 Dust test. Sample bolts shall be subjected to the dust test in accordance with MIL-STD-810, method 510. The sample shall be tested for conformance to 3.5.3, 3.5.4, and 3.5.4.1.

4.5.11 Carburization. Decarburization or recarburization limits on the bolt shall be determined by microexamination and shall be in accordance with 3.5.12.1. Specimens shall be taken from the finished bolt as shown on figure 6. The etchant shall be five percent Nital. Microscopic examination shall be made at 100X magnification. In cases of controversy over decarburization or recarburization, microhardness testing shall be used as referee method. Bolts shall have conformed to the requirements of this paragraph if they have a Vickers microhardness reading within 0.003 inch of any suspect surface and not more than 30 points higher or lower than the microhardness reading at the core. This will not apply to the threads or fillet area.

4.5.12 Discontinuities. Magnetic particle or fluorescent penetrant inspection shall be used to determine the presence of cracks and discontinuities such as laps, seams, and inclusions. (Fluorescent penetrant inspection shall be used on corrosion resistant parts.) Magnetic particle or fluorescent penetrant 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 the samples shall be further examined by microexamination to determine whether the indicated discontinuities exceed the limits specified in 3.5.12.2 and table IV.

**NOTES:**

1. MATERIAL: 2014-T6 ALUMINUM
2. DIAMETER B TO BE PERPENDICULAR TO SURFACES A AND C WITHIN 30'.
3. FOR DIAMETER B, SEE TABLE IV.

FIGURE 5. Wear test fixture.

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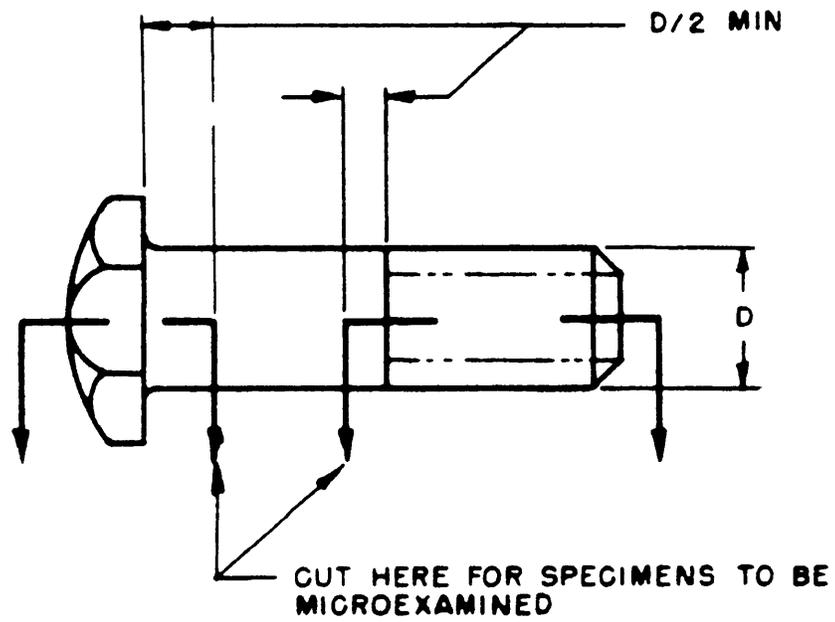


FIGURE 6. Metallurgical specimens.

4.5.12.1 Magnetic particle inspection. One hundred percent magnetic particle inspection shall be performed on alloy steel components in accordance with MIL-I-6868. The bolt shall be magnetically inspected by both the longitudinal and circular methods. Bolts shall not be marked for identification of magnetic inspection.

4.5.12.2 Fluorescent penetrant inspection. One hundred percent fluorescent penetrant inspection shall be performed on corrosion-resistant steel components in accordance with MIL-I-6866. Bolts shall not be marked for identification of fluorescent penetrant inspection.

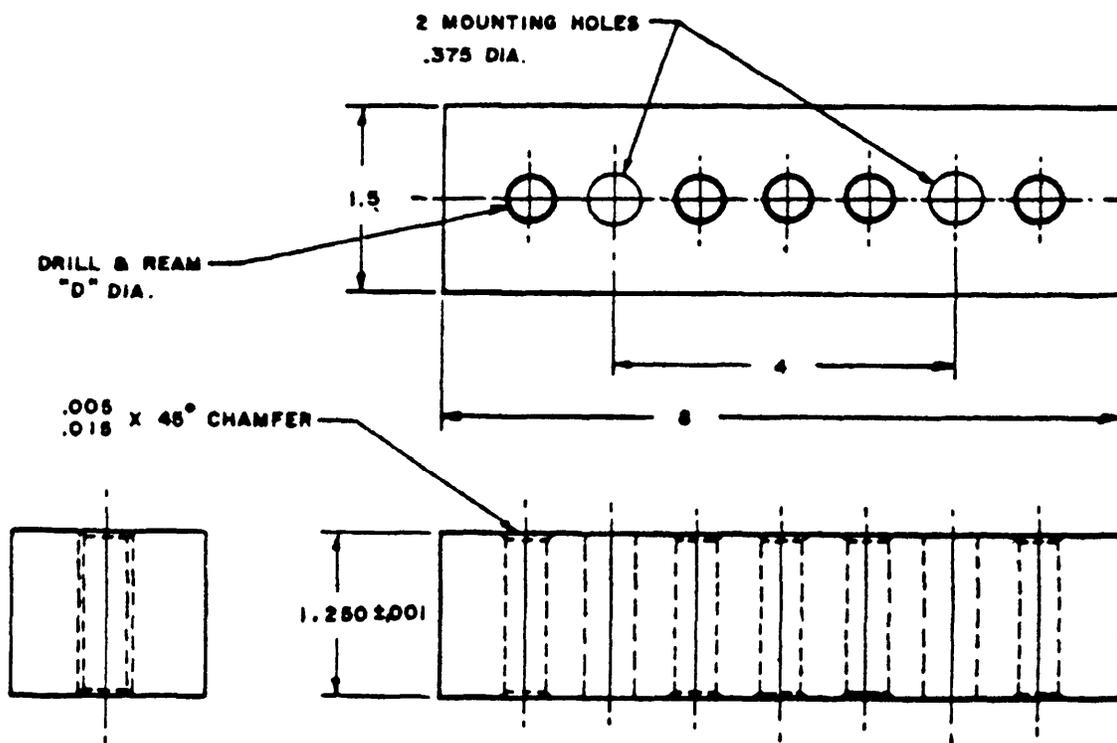
4.5.13 Vibration test. Bolts with grip lengths as tabulated in table IX shall be assembled with fixtures described on figure 7. The retaining element shall be the restraining member; nuts shall not be used. The self-retained bolts shall be free to rotate in the fixture. Bolts shall be installed in the test fixture in a vertical position, head down. The test shall be conducted in accordance with MIL-STD-810, method 514.3, procedure I, category 4 or 5, except that the bolt shall be vibrated in the vertical axis only, head down, the time at the first resonance shall be one hour, and the second, third, and fourth resonant dwell shall be omitted. The bolts shall be considered to have failed to pass the vibration tests under the following conditions:

- a. If any structural failure occurs during the test, such as broken retaining element, or retaining element falling out.
- b. If the retaining element completely enters the hole in the test fixture, or the bolt comes completely out of the test fixture.
- c. If any self-retaining bolt can be removed from the test fixture with an applied force less than the minimum specified in table II.
- d. If any self-retaining bolt cannot be removed from the test fixture without an applied force exceeding the maximum forces specified in table II.

TABLE IX. Hole size and grip lengths.

Bolt Size (In.)	D		Bolt Grip Length		Bolts —
	Max	Min	Hex Head	Flush Head	
0.190	0.1920	0.1910	1.375	1.438	5
0.250	0.2520	0.2510	1.375	1.500	5
0.3125	0.3145	0.3135	1.375	1.500	5
0.375	0.3770	0.3760	1.375	1.562	5
0.4375	0.4395	0.4385	1.375	1.562	5
0.500	0.5020	0.5010	1.375	1.625	5
0.5625	0.5645	0.5635	1.375	1.625	4
0.625	0.6270	0.6260	1.375		4
0.750-16	0.7520	0.7510	1.375		4
0.875-14	0.8770	0.8760	1.375		4
1.000-12	1.0020	1.0010	1.375		4

4.6 Packaging, packing, and marking. Preparation for delivery shall be examined for conformance to section 5.



NOTES:

1. MATERIAL: TOOL STEEL
2. HEAT TREAT: HARDNESS 58 to 60 HRC
3. UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

FIGURE 7. Vibration test fixture.

5. PACKAGING

5.1 Preservation and packaging. Preservation and packaging shall be level A, B or C, as specified (see 6.2).

5.1.1 Level A. Unless otherwise specified, each bolt shall have shank and threads protected by means of sleeve extending over the full length of the shank and thread. The sleeve shall be manufactured from cardboard, asphalt impregnated chipboard, plastic sleeve covering, or a spiral wrap of kraft paper over chipboard, and shall be lined with material conforming to MIL-B-121. Bolts shall be further packaged in containers conforming to PPP-B-636, class weather resistant. Unless otherwise specified by the acquisition activity, the quantity of bolts per package shall be as specified in table X.

TABLE X. Allowable quantities per package.

Size	Length (Inches)	Maximum Quantity Per Carton
0.190 thru 0.3125	Up to 1.500	100
0.190 thru 0.3125	1.500 to 3	50
0.375 thru 0.625	Up to 3	50
0.250 thru 0.625	Over 3	25
0.750 thru 1.000	Over 3	20

5.1.1.1 Intermediate container. Bolts packaged level A shall be placed in intermediate containers conforming to PPP-B-566 or PPP-B-676. The containers shall not exceed 40 pounds, 100 unit packages, or 1.5 cubic feet.

5.1.2 Level B. Bolts shall be packaged as for level A except that unit containers conforming to PPP-B-636, class domestic may be used.

5.1.2.1 Intermediate container. The intermediate container shall be the same as for level A.

5.1.3 Level C. Bolts shall be packaged in a manner which affords adequate protection against deterioration and physical damage during shipment from supply source to the first receiving activity for immediate use. This level may conform to the contractor's commercial practice provided the latter meets the requirements of this level.

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

5.2.1 Level A. Bolts packaged as specified in 5.1.1 shall be packed in cleated plywood shipping containers conforming to PPP-B-601, overseas type. As far as practicable, shipping containers shall be uniform in shape and size, of minimum cube and tare, and contain identical quantities. Gross weight of each shipping container shall be limited to approximately 200 pounds. Container closure and strapping shall be in accordance with the appendix to PPP-B-601.

5.2.2 Level B. Level B shall be same as level A except that containers conforming to PPP-B-601, type domestic or PPP-B-636, class weather resistant may be used.

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5.2.3 Level C. Bolts packaged as specified in 5.1.3 shall be packed in a manner which affords adequate protection against damage during direct shipment from the supply source to the first receiving activity for immediate use. This level may conform to the contractor's commercial practice, provided the latter meets the requirements of this level.

5.3 Marking. Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. The marking on the interior packages shall include: A brief descriptive title, manufacturer's part number, manufacturer's name or trademark, quantity in package, and lot number.

6. NOTES

6.1 Intended use. The self-retaining bolts covered by this specification are primarily intended for use in shear applications (see MS33602) at dynamic points in flight control linkages, engine control mechanisms, field controls, bell crank systems, and other dynamic joint assemblies of aircraft where the failure or omission of cotter pin or locking wire would affect safety of flight or endanger personnel. For procurement purposes, this is a critical application item.

6.2 Ordering data

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification
- b. Part number of the bolt desired
- c. Quantity
- d. Applicable levels of packing (see 5.1 and 5.2)
- e. Periodic lot sampling for laboratory verification tests (see 4.4.3)
- f. Government inspection and acceptance at the source for direct government procurements.
- g. Inspection and acceptance at the source of manufacture or receiving point for nongovernment procured items intended for government applications.

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 Qualified Products List (QPL-83050) 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 Aeronautical Systems Division, ATTN: ENFEM, Wright-Patterson AFB, Ohio 45433, and information pertaining to qualification of products may be obtained from that activity.

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6.3.1 Tests. Qualification tests will be authorized only upon presentation of certified test reports indicating that the bolts conform to or will conform to this specification and the applicable MS or a standard approved by the activity responsible for qualification.

6.4 Definition. Unless otherwise specified, the word "bolt" in this specification refers to a self-retaining bolt.

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:

Air Force - 11
Army - AV

Preparing activity:

Air Force - 11

Review activities:

Air Force - 99
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Project No. 5306-0895

User activities:

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MILITARY SPECIFICATION

BOLT, SELF-RETAINING, IMPEDANCE TYPE

This amendment forms a part of Military Specification
Mil-B-83050D, dated 25 November 1985, and is approved for
use by all departments and agencies of the Department of Defense.

PAGE 4

3.5.5, delete and substitute:

“3.5.5 Dimensions. The retaining or impedance element shall be within the
dimensional limitations of MS27576 and MS27577 (see 4.5.1 4) ”

PAGE 17

Add new paragraph:

“4.5.14 Protrusion of impedance element. Verification of impedance element
protrusion may be by ring gauge ”

Custodians:

Air Force - 11

Army - AV

Preparing activity:

Air Force - 11

Project No. 5306-1157

Review activities:

Air Force - 99

DLA - IS

User activity:

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FSC 5306

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