

MIL-STD-1515A
NOTICE 1
24 September 1979

MILITARY STANDARD

FASTENER SYSTEMS FOR AEROSPACE APPLICATIONS

TO ALL HOLDERS OF MIL-STD-1515A:

1. THE FOLLOWING ITEMS OF MIL-STD-1515A HAVE BEEN REVISED AND SUPERSEDE THE ITEMS LISTED:

NEW ITEM	DATE	SUPERSEDED ITEM	DATE	TYPE CHANGE
Page 111	24 September 1979	Page 111	12 July 1978	Minor
Page 1v	24 September 1979	Page 1v	12 July 1978	Major
Page v	24 September 1979	Page v	12 July 1978	Major
Page vi	12 July 1978			
Page 1	12 July 1978			
Page 2	24 September 1979	Page 2	12 July 1978	Major
Page 3	24 September 1979	Page 3	12 July 1978	Major
Page 4	24 September 1979	Page 4	12 July 1978	Major
Req 103	24 September 1979	Req 103	12 July 1978	Major
Note: Pages 103.11 and 103.12 are deleted entirely.				
Req 106	24 September 1979			
Req 112	24 September 1979	Req 112	12 July 1978	Minor
Req 203	24 September 1979			
Req 204	24 September 1979	Req 204	12 July 1978	Typo
Req 208	24 September 1979	Req 208	12 July 1978	Major

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-1515A will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or cancelled.

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

Preparing Activity:
Air Force - 11

Review Activities:
Army - AR, MI
Navy -
Air Force - 10, 99
DLA - IS

Project 5300-0093-13

FSC 53GP

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FOREWORD

The purpose of this document is to establish standardization in the selection, development, and use of aerospace fastening systems, including hole characteristics and inspection criteria. Existing fasteners cover a wide variety of configurations, sizes, materials, and finishes. Various aerospace fastener systems have common fastener needs but lack defined application *** exchangeability. This document provides contractual design requirements and guidelines for proper selection and application of approved fastening systems. The basic objectives of this standard can be summarized as:

To document selection and application information for approved fastening systems and procedures so the designer can achieve an optimum balance of performance, reliability, and exchangeability with minimum cost, logistic inventory and maintenance.

Selections and procedures are limited to those listed herein.

*** Denotes change

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* Requirement not yet published as of the date of this basic document.

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* Requirement not yet published as of the date of this basic document.

** Proposed Sections - Work to be initiated after sections 100 and 200 are completed.

*** Denotes change.

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FASTENER SYSTEMS FOR AEROSPACE APPLICATIONS

1. SCOPE

1.1 Scope. This standard covers the methods of fastening, materials, finishes, test methods, and hole size and criteria of fasteners and fastening systems used in the design and construction of aerospace systems. In addition, it provides a comprehensive presentation of approved engineering practices, procedures, processes, and characteristics for fasteners.

1.2 Purpose. The purpose of this standard is to document selection and application information for approved fastening systems and procedures so the designer can achieve an optimum balance of performance, reliability, and exchangeability with minimum cost, logistic inventory, and maintenance.

2. APPLICABLE DOCUMENTS

2.1 Issues of Documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this standard to the extent specified herein.

STANDARDS

MILITARY

MS17855 Fasteners, Screw Threaded, Descriptive Factor Symbols and order of Notes for Engineering Documents for

2.2 Referenced Documents. A list of referenced documents is presented in the individual requirements contained in this standard. The applicable issues shall be those in effect on the date of the invitation for bids or request for proposal.

2.2.1 Nongovernment Documents. Nongovernment documents referenced herein show the specific issue applicable. Other revisions are not applicable.

2.2.2 Sources for Nongovernment Documents. Addresses for obtaining documents referenced herein but not obtainable from the Government are as follows:

AMS, AS, Society of Automotive Engineers, Inc.
ARP, AIR, 400 Commonwealth Drive
AMD Warrendale, PA 15096

ANSI American National Standards Institute
 1430 Broadway
 New York, NY 10018

ASTM American Society for Testing and Materials
 1916 Race Street
 Philadelphia, PA 19103

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** NAS National Standards Association, Inc.
4827 Rugby Avenue
Washington, DC 20014

3. DEFINITIONS

3.1 Definitions Applicable to complete standard. The definitions provided in this document shall be for those special words, phrases, or usages which are peculiar to the fastenings area. This paragraph contains definitions (as defined above) for those words which are found in three or more requirements. Definitions for words used in only one or two requirements will be found with the particular requirement.

3.1.1 Airframe structure. In the context of this document, the airframe structure includes the fuselage, wing, and empennage.

3.1.2 Allowables. (See design allowables.)

3.1.3 Anchor nut (plate nut). A nut that resists turning during bolt installation by being attached to, or contained in, one or more of the parts being assembled.

3.1.4 Approved fastener. A fastener that is listed in this document.

3.1.5 Bearing face. (See bearing surface.)

3.1.6 Bearing surface. The load-carrying surface of a fastener or structural component.

3.1.7 Blind fastener. A fastening system which is installed from one side of the structure.

3.1.8 Chamfer. A beveled surface on a component to facilitate entry of one part into the other. A beveled surface on a component to eliminate a sharp corner.

3.1.9 Critical application. Any application of a fastener where loss or failure of the fastener could cause one or more of the following:

- a. Loss of aircraft.
- b. Preclusion of continued flight and landing within the design limitations of the aircraft using normal pilot skill and strength.
- c. Significant injury to the occupants of the aircraft or ground personnel.
- d. Rendering of major subsystems or special mission systems inoperative or causing its destruction.

3.1.10 Design allowables. Tensile and shear ultimate strengths of fasteners and shear ultimate and yield strengths of mechanically fastened joints used for design of aircraft joint structures.

** Denotes change

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3.1.11 Fastening system. An installed fastener, its component parts, the geometry of the hole where it affects the performance of the system, and installation and removal tooling and procedures.

3.1.12 Grip or grip accommodation. The allowable variation of material thickness in which a specific fastener can function.

3.1.13 Impedance locking. A resistance that impedes disengagement of mating fastener components.

3.1.14 Locking device. A part or mechanism designed to prevent loss of preload or disengagement of a fastener.

3.1.15 Permanent fastener. A fastener which does not require removal to service or maintain the aircraft and that normally requires the destruction of the fastener or one of its components during removal.

3.1.16 Plate nut. (See anchor nut)

3.1.17 Self locking. An attribute of a fastener or fastener assembly having an integral locking element to impede relative rotation of mating components.

3.1.18 Shank. The untreaded portion of a fastener between the head and the threads, locking grooves, formed head, etcetera.

4. GENERAL STATEMENTS

4.1 Guidelines. A separate publication, "AMFRG Manual on Organization and Operations of the Aeromechanical Fastener Requirements Group for MIL-STD-1515", has been distributed to organizations participating in the preparation of MIL-STD-1515. This publication presents guidelines for the preparation and coordination of requirements for inclusion in this standard. These guidelines shall be followed for all requirement additions or changes and shall be revised as necessary by the preparing activity or his designee.

* 4.2 Application.

a. The sections contained herein are intended to provide uniform requirements applicable to mechanical aerospace fasteners and shall be incorporated by reference in general and detail weapon systems and equipment specifications.

b. If a requirement contained herein conflicts with a requirement in the general or detail weapon system or equipment specification, the weapon system or equipment specification shall take precedence. If a requirement listed in the contents has not been published but is referenced herein, it is not applicable and the requirements of the general or detail weapon system or equipment specification shall apply.

c. Section 100 Requirements apply only to Section 200 Structural fastener requirements (excluding subsequent proposed sections such as nonstructural, propulsion, etcetera, not published or in preparation).

* Denotes change.

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4.3 Descriptive factors and symbols. The descriptive factor symbols used in this standard shall be in accordance with MS17855.

5. NOTES

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

6. INTENDED USE AND GUIDANCE CRITERIA

6.1 Information and guidance. Paragraph 6 in all applicable requirements in this document presents information and guidance for use of that requirement or parts listed therein. The paragraph is not contractual.

* 6.2 Implementation. This standard may not be applicable to programs in the experimental, developmental, exploration, prototype, demonstration, validation program phases where the advantages of the standard will not be realized.

Custodians:

Army - AV
Navy - AS
Air Force - 11

Preparing Activity:

Air Force - 11

Reviewer Activities

Army - WC, MI
Navy -
Air Force - 10, 99
DLA - IS

Project No. 5300-0039

* Denotes change.

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* LUBRICATION

1. Purpose. This document establishes the requirements for the use of lubrication with mechanical fastener systems which are used in structural applications in the design, construction, and repair of aerospace/airframes, excluding propulsion systems. The purposes of lubrication in this requirement encompass wear reduction, prevention of lessening of galling and seizure, inhibiting fretting, aid in installing and removing fasteners, control of installation torque or preload of joint, fastener system internal lubrication, and combinations of these factors. Lubrication of fasteners where the fastener acts as a bearing shaft is not covered by this document. Reference MIL-STD-1599 for appropriate bearing, equipment or functional systems specifications in this area.

* 1.1 Where appropriate military or industry documentation does not exist, this document establishes the requirements placed on the lubricant materials and the application to the fastener components.

* 1.2 Classification. Lubricant requirements discussed herein shall be identified by the type and class designation established in this paragraph. The categories of lubricants are reduced to four basic areas; solid or dry film, liquid film, metallic coatings, and lubricants involving encapsulation or transitions from liquid to solid or other peculiarities, herein called the Special Properties Lubricants. When lubricants are specified in MIL-STD-1515, the lowest level(s), types, and classes will be specified; for example, type I, class 2A-1, not simply type I, class 2. Type and class designations are not intended for notation or reference on parts standards drawings or in procurement specifications.

* 1.2.1 Type I solid or dry film lubricants. Solid or dry film lubricants shall be one of the following classes as determined by this document and application conditions and must conform to the applicable noted military specification.

a. Class 1. Solid or Dry Film, General Purpose

- (1) Class 1A - Air dry, unbonded lubricative powders.
None included at this time.
- (2) Class 1B - Air dry, resin bonded, solid film lubricant
Class 1B1 - MIL-L-23398 -54°C to 260°C (-65°F to 500°F)
- (3) Class 1C - Heat cured resin bonded solid film lubricant.
None included at this time.
- (4) Class 1D - Inorganic binder, solid film, extreme environment
Class 1D1 - MIL-L-81329 184°C to 399°C (-300°F to 750°F)

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b. Class 2. Solid or dry film, nongraphitic with no metallics

- (1) Class 2A - Air cured, Corrosion inhibiting.
 Class 2A1 - MIL-L-46147 -54°C to 121°C (-65°F to 250°F)
- (2) Class 2B - Heat Cured, Corrosion inhibiting.
 Class 2B1 - MIL-L-8937 -54°C to 260°C (-65°F to 500°F)
 Class 2B2 - MIL-L-46010 -54°C to 260°C (-65°F to 500°F)
- (3) Class 2C - Air or heat cured, extreme environment.
 None included at this time.

c. Class 3. Solid or dry film, inert compounds. None included at this time.

d. Class 4. Special categories.

- (1) Class 4A - Electrical insulation compounds
 Class 4A1 - MIL-S-8860

1.2.2 Type II liquid film lubricants. Liquid film lubricants shall be one of the following classes as determined by this document and application conditions and must meet the requirements of addendum A to this requirement or applicable noted military specification.

a. Class 1. Liquid film fastener installation lubricants - organic:

- (1) Class 1A
 Class 1A1 - Cetyl alcohol in accordance with MIL-L-87132.

b. Class 2. Corrosion preventive compounds

- (1) Class 2A
 Class 2A1 - MIL-C-16173 (grade 1 or 2)

c. Class 3. Petrolatum and greases

- (1) Class 3A
 Class 3A1 - Petrolatum in accordance with VV-P-236
 Class 3B1 - MIL-G-6032
 Class 3C1 - MIL-G-4343

d. Class 4. Anti-seize compounds, Metallic

- (1) Class 4A
 Class 4A1 - White lead compound in accordance with MIL-L-25681
- (2) Class 4B
 Class 4B1 - Anti-seize compound in accordance with MIL-T-5542
- (3) Class 4C
 Class 4C1 - Anti-seize compound in accordance with MIL-T-83483

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- (4) Class 4D
 Class 4D1 - Anti-seize compound in accordance with MIL-A-907
- (5) Class 4E
 Class 4E1 - Anti-seize compound in accordance with MIL-A-13881
 Class 4E2 - Anti-seize compound in accordance with MIL-T-5544.

1.2.3 Type III metallic coatings. Metallic coatings intended for use as lubricants in the fastener system shall meet the requirements and specifications noted herein. Care should be exercised to assure that metallic coatings do not allow dissimilar metal/galvanic corrosion incompatibility with structural materials.

a. Class 1.

(1) Class 1A - Silver plating. Silver plating shall be in accordance with AMS 2412 for applications not exceeding 260°C (500°F) maximum.

(2) Class 1B - Silver plating. Silver plating shall be in accordance with AMS 2410 for applications not exceeding 518°C (965°F) maximum. May be used where class 1A is specified.

(3) Class 1C - Silver plating. Silver plating shall be in accordance with AMS 2411 for applications not exceeding 760°C (1400°F) maximum. May be used where classes 1A and 1B are specified.

1.2.4 Type IV special properties lubricants. Lubricants possessing special properties outside the scopes of types I, II, and III shall be one of the following classes as determined by this document and application conditions. No specific lubricants are included at this time.

1.2.5 Combination of lubricants. Types I, II, and III may be used in combination unless restricted for specific applications noted herein.

2. Documents applicable to requirement 103

VV-P-236	Petrolatum, Technical
MIL-A-907	Anti-seize Compound High Temperature
MIL-G-4343	Grease, Pneumatic Systems
MIL-T-5542	Thread Compound, Anti-seize and Sealing, Oxygen Systems
MIL-T-5544	Thread compound, Anti-seize, Graphite-petrolatum
MIL-G-5572	Gasoline, Aviation, Grades 80/87, 100/130, 115/145
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance
MIL-T-5624	Turbine Fuel, Aviation, Grades, JP-4 and JP-5
MIL-G-6032	Grease, Plug Valve, Gasoline and Oil Resistant
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-A-8243	Anti-icing and Deicing - Defrosting Fluid
MIL-H-8446	Hydraulic Fluid, Nonpetroleum Base, Aircraft
MIL-S-8660	Silicone Compound

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MIL-S-8802	Sealing Compound, Temperature-resistant, Integral Fuel Tanks and Fuel Cell Cavities, High-adhesion
MIL-L-8937	Lubricant, Solid Film, Heat Cured
MIL-A-13881	Anti-Seize Compound, Mica Base (For Threaded Fitting)
MIL-C-16173	Corrosion Preventive Compound, Solvent Cutback Cold-application
MIL-L-22851	Lubricating Oil, Aircraft Piston Engine (Ashless Dispersant)
MIL-L-23398	Lubricant, Solid Film, Air Drying
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engines, Synthetic Base
MIL-L-25681	Lubricant, Molybdenum Disulfide, Silicone Base, High Temperature
MIL-L-46010	Lubricant, Solid Film, Heat Cured Corrosion Inhibiting
MIL-L-46147	Lubricant, Solid Film, Air-cured (Corrosion inhibiting)
MIL-L-81329	Lubricant, Solid Film Extreme Environment
MIL-T-83483	Thread Compound, Anti-seize, Molybdenum Disulphide-petrolatum
* MIL-L-87132	Lubricant, Cetyl Alcohol, 1-Hexadecanol, Application to Fasteners
MIL-STD-1523	Age Control of Age-Sensitive Elastomeric Material
AMS 2410	Silver-Plating, Nickel Strike, High Bake
AMS 2411	Silver-Plating, High Temperature application
AMS 2412	Silver-Plating, Copper Strike, Low Bake

3. Definitions. Appropriate definitions are contained in the documents referenced in Section 2 of this requirement.

4. General Requirements

4.1 Compatibility

4.1.1 Fluid materials and coatings compatibility. For design purposes, lubricants may be considered compatible with all materials listed in table 103-I when an "X" appears in the applicable block.

4.1.2 Temperature limits. For design purposes, lubricants may be used where temperature limits are in accordance with table 103-II when an "X" appears in the applicable block.

4.1.3 Age control and relubrication. Lubricants which have a limited shelf life and require age control shall be controlled in accordance with MIL-STD-1523.

4.1.3.1 Fastener system internal lubricant. Multiple-piece fasteners, not normally disassembled, which utilize lubricants internally to assure the proper functioning of the fastener during installation shall not be relubricated without approval of the fastener manufacturer.

* Denotes change.

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4.1.3.2 Fastener external lubricant. Fasteners utilizing type II lubricants for ease of installation or removal or for torque control may be relubricated with the same lubricant previously used.

4.1.4 Structural materials compatibility. For design purposes, lubricants may be considered compatible with all materials listed in table 103-III when an "X" appears in the applicable block. Others shall not be used in combination. Compatibility in this case is defined as not causing or contributing to stress corrosion, not leaving detrimental deposits, or not reacting chemically with the material, such as galvanic corrosion.

4.2 Fastener system lubricants. Lubricants used on bolts, screws, pins, nuts, collars, washers, and other fastener elements shall follow the criteria specified herein when lubricants are used for general applications and for the specialized purposes noted in 4.3 and 5. In addition, lubricants must be one of the types and classes listed in 1.2 with the fluid compatibility, temperature limits, and structural materials compatibility of the application in accordance with tables 103-I, 103-II, and 103-III for all applications.

4.2.1 Fastener ease of insertion and removal. When this criterion is one of the intended purposes of the lubricant, the following requirements, restrictions, cautions, or allowances apply:

a. Caution. In interference-fit applications, lubricant shall permit full installation of the fastener without detriment to the hole or fastener. Minor scraping of plating from plated fastener is not considered detrimental in this regard.

b. Restriction. Type II lubricants shall not be the sole lubricant used on reusable fasteners when the pin element and nut or collar element are both stainless steel or titanium or a combination of the two.

4.2.2 Electrolytic corrosion barrier. When this criterion is a secondary purpose of the lubricant, the following requirements, restrictions, cautions, or allowances apply:

a. Restriction: Types I, II, and III are not considered sufficient for an electrolytic corrosion barrier and shall not be used as the sole barrier for this purpose regardless of metallic material combinations or environment.

b. Restriction: Type III coatings shall not be applied to titanium pins, nuts, or collars or be used in contact with titanium structure.

c. Requirement: All lubricated washers used in a system shall have lubricant which is compatible with the fastener components and sheet surfaces regardless of whether or not the washer will actually contact the components.

d. Requirement: See 5.1.2 for fastener system internal lubricants.

4.2.3 Preload control. When the lubricant is used for the purpose of producing a controlled preload in the fastener system, the following requirements, restrictions, cautions, or allowances apply:

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a. Requirements: Fasteners may be installed in the received condition. No lubricants shall be added prior to installation.

b. Allowances: Fasteners may be installed with the addition of wet sealant and/or wet primer. Note that torque-tension factor must be considered.

4.2.4 Repeated removal and reinstallation of fasteners. When this criteria is one of the requirements of the fastener system, the following requirements, restrictions, cautions, or allowances apply: None at this time.

4.3 Lubricated fastener requirements. Lubricated fastener and other fastening threaded components shall comply with the following requirements.

4.3.1 Structural fasteners

4.3.1.1 Permanent fasteners

4.3.1.1.1 Rivets. Rivets installed in clearance holes do not require lubrication. Rivets installed in interference fits may require lubrication.

4.3.1.1.2 Pins and collars

a. Straight shank interference pins and collars. Any type and class or combination thereof approved herein may be specified but parts shall be lubricated. Collars and pins do not require the same lubricant.

b. Straight shank noninterference pins and collars. Any type and class lubricant or combination thereof approved herein may be specified or parts may be unlubricated. Collars and pins do not require the same lubricant.

c. Tapered shank pins shall be lubricated with at least one of the lubricants specified herein.

4.3.1.2 Removable fasteners

4.3.1.2.1 Bolts and screws. Any type and class of lubricant or combination thereof approved herein may be specified or parts may be unlubricated.

4.3.1.2.2 Nuts. Any type and class of lubricant or combination thereof approved herein may be specified or parts may be unlubricated.

4.3.1.2.3 Nutplates. Any type and class of lubricant or combination thereof approved herein may be specified or parts may be unlubricated.

4.3.1.2.4 Inserts. Any type and class of lubricant or combination thereof approved herein may be specified or parts may be unlubricated.

4.3.1.2.5 Panel fasteners. Any type or class of lubricant or combination thereof approved herein may be specified or parts may be unlubricated.

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4.3.2 Function systems attachment fasteners

4.3.2.1 Equipment attachment. Bolts, screws, nuts used to attach miscellaneous equipment to structure shall comply with the requirements of 4.3.1.2.1 and 4.3.1.2.2.

4.3.2.2 Tubing and wire bundle clamp fasteners. Fasteners used for attaching clamps for tubing and wire bundle support may not require lubrication.

4.3.2.3 Quick release fasteners. Panel fasteners and other quick release fasteners may not require lubrication.

4.3.2.4 Fluid systems fasteners

4.3.2.4.1 Couplings. Duct coupling and V-band coupling fasteners shall meet the requirements of 4.3.1.2.1 and 4.3.1.2.2.

4.3.2.4.2 Fluid systems. Fluid systems connection nuts shall utilize lubricants with fluid compatibility requirements of 4.1.1 and 4.1.2.

5. Detailed requirements. The following specific application allowances and restrictions shall be observed in the use of fasteners in the design of aerospace vehicles and equipment.

5.1 Specific system fluid compatibility. In addition to the requirements of Table 103-I, lubricants used on mechanical fasteners and threaded connections must be compatible with applicable fluids.

5.2 Electrical bonding or insulation. Fastener pins or bolts/screws intended to provide electrical continuity shall not be lubricated except with type III lubricant where applicable. Fastener systems intended to be insulated against electrical continuity shall be coated with type I class 4A insulating compound, unless a compatibility problem exists.

5.3 Application of lubricant to fastener elements. Lubricants shall be applied to fastener elements as specified in the applicable Military Specification or Addendum for types I, II, and IV and applicable specification for type III.

5.4 Reapplication of lubricant to fastener elements. Parts using type II lubricants may be relubricated. Sufficient drying time should be observed for assurance of proper torque-tension relationships.

5.5 Fastener system internal lubrication. Lubricants used for various purposes internally in the fastener system and which do not contact the structure must meet the requirements of this document except that electrolytic corrosion barrier properties apply only to the materials of the fastener components.

5.6 Change of lubricant. Where the lubricant is a necessary factor in the usage of a fastener system requiring qualification, the specified lubricant shall be used in the qualification testing of the system, and continued as part of the requirements of the qualified system. Any change of lubricant(s) type or class requires requalification of the system.

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TABLE 103-1. FLUID COMPATIBILITY

TYPE AND CLASS	TYPE I										TYPE II										TYPE III		
	1B-1	1D-1	2A-1	2B-1	2B-2	4A-1	1A-1	2A-1	3A-1	3B-1	3C-1	4A-1	4B-1	4C-1	4D-1	4E-1	4E-2	1A	1B	1C			
MATERIAL																							
MIL-A-907																							
MIL-C-5572			X	X	X		0	0	0	X	0	0	0					X	X	X			
MIL-H-5606			X	X	X		0	0	0	X		0	0					X	X	X			
MIL-T-5624			X	X	X		0	0	0	X		0	0					X	X	X			
MIL-L-7808			0	X	X		0	0	0			0	0					X	X	X			
MIL-A-8243						X	0	X	X	X	X	X	X					X	X	X			
MIL-H-8446			X	X	X	X	0	0	0	X		0	0					X	X	X			
MIL-S-8802						X	X	X	X	X	X	X	X					X	X	X			
MIL-C-16173			X	X	X	X	X	X	X	X	X	X	X					X	X	X			
MIL-A-13881																							
MIL-G-21164																							
MIL-L-22851							0	0	0	X	0	0	0					X	X	X			
MIL-L-23699			0	X	X		0	0	0			0	0					X	X	X			
MIL-T-27730																							
Type II Cl.1A-1																							
LPS No. 1																							

NOTES:

1. "X" in the block indicates that experience and/or testing concludes that in normal use, exposure of the lubricant to the fluid in the acceptable temperature range of the lubricant does not detrimentally affect the properties of the lubricant or contaminate the fluid.
2. "0" in the block indicates known incompatibility between the fluid and the lubricant.
3. Blank indicates unknown characteristics of the combination.

SUPERSEDES
REQUIREMENT 103
12 July 1978

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24 September 1979

TABLE 103-II. TEMPERATURE LIMITS

TYPE AND CLASS TEMP. LIMITS		TYPE I						TYPE II										TYPE III			
		1B-1	1D-1	2A-1	2B-1	2B-2	4A-1	1A-1	2A-1	3A-1	3B-1	3C-1	4A-1	4B-1	4C-1	4D-1	4E-1	4E-2	1A	1B	1C
-65° to 100°F (-54° to 38°C)								X	X	X											
-65° to 250°F (-54° to 121°C)				X																	
-65° to 400°F (-54° to 204°C)							X				X	X									
-65° to 500°F (-54° to 260°C)		X			X	X													X		
-300° to 750°F (-184° to 399°C)			X																		
HIGHER RANGES																					
													1400°F X (760°C)						9650°F X (518°C)	1400°F X (760°C)	

NOTES:

1. "X" indicates lubricant is acceptable to the temperature limits indicated.
2. Blank indicates unknown or not applicable.
3. Lubricants may be detrimentally affected by extended exposure to temperature extremes.

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 REQUIREMENT 103
 24 September 1979

SUPERSEDES
 REQUIREMENT 103
 12 JULY 1978

TABLE 103-III. METALLIC MATERIAL COMPATIBILITY

TYPE AND CLASS METALLIC MATERIAL		TYPE I						TYPE II										TYPE III			
		1B-1	1D-1	2A-1	2B-1	2B-2	4A-1	1A-1	2A-1	3A-1	3B-1	3C-1	4A-1	4B-1	4C-1	4D-1	4E-1	4E-2	1A	1B	1C
ALUM.	2000 SERIES	X		X	X	X	X	X	X	X	X	X	X	X					0	0	0
	6000 SERIES	X		X	X	X	X	X	X	X	X	X	X	X					0	0	0
	7000 SERIES	X		X	X	X	X	X	X	X	X	X	X	X					0	0	0
ALLOY STEEL —— CADMIUM PLATED		X		X	X	X	X	X	X	X	X	X	X	X					0	0	0
CORROSION		X		X	X	X	X	X	X	X	X	X	X	X					X	X	X
RESISTANT		X		X	X	X	X	X	X	X	X	X	X	X					X	X	X
STEEL		X		X	X	X	X	X	X	X	X	X	X	X					X	X	X
		X		X	X	X	X	X	X	X	X	X	X	X					X	X	X
TITANIUM ALLOYS		X		X	X	X	X	X	X	X	X	X	X	X					0	0	0
GRAPHITE FIBERS																					
MAGNESIUM		X		X	X	X	X	X	X	X	X	X	0	0					0	0	0

NOTES:

1. "X" indicates that experience and/or testing concludes that no detrimental effects are caused by intimate contact of the lubricant with the material.
2. "0" indicates known detrimental conditions are caused by contact of the lubricant with the material.
3. Blank indicates unknown characteristics of the combination.

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REQUIREMENT 106
24 September 1979

HEAD CONFIGURATION

1. Purpose. This requirement establishes engineering criteria and requirements for the selection and design of fastener head configurations used in the construction of aerospace and airborne mechanical equipment.

2. Documents applicable to Requirement 106.

ASEC Air Standard 17/2 Hexagon Bolt Head and Nut Sizes (Inch Series)

3. Design, usage limitations. This requirement establishes head envelope dimensions for aerospace bolts, threaded and nonthreaded pins, and solid rivets for flush and protruding head configurations. For internal drive recesses and external wrenching elements, see Requirement 120.

4. Detailed requirements. Head configurations for fasteners shall be in accordance with the following requirements except for those that are incorporated on specific fasteners approved for selection in other segments of this standard.

4.1 Flush head fasteners. Flush head fasteners shall have 100° heads.

4.1.1 Solid rivets. Head dimensions for solid rivets shall be in accordance with tables 106-I and 106-II. Rivet heads may have a crown in accordance with figure 106-1.

4.1.2 Bolts with head driving recess. Head dimensions for bolts shall be in accordance with tables 106-III and 106-IV. Bolt heads of table 106-III shall have a dome in accordance with figure 106-2 for sizes .190, .250, and .312. Dome optional on sizes larger than .312.

4.1.3 Bolts and pins without head driving recess. Head dimensions shall be in accordance with tables 106-I, 106-IV, and 106-V.

4.2 Protruding head fasteners

4.2.1 Solid rivets. Head dimension for solid rivets shall be in accordance with table 106-IV.

4.2.2 Pan head with head driving recess. Pan head bolts with internal driving recesses shall be in accordance with table 106-VII.

4.2.3 Hexagon head external wrenching. Head dimensions for hexagon head bolts shall be in accordance with table 106-VIII.

4.2.4 Tension head bolts, external wrenching. Head dimensions for high strength tension bolts (180 KSI F_{tu} and above) shall be in accordance with table 106-IX.

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4.2.5 Shear head bolts, external wrenching. Head dimensions for high strength shear bolts (108 KSI F_{8U} and above) shall be in accordance with table 106-X.

4.2.6 Reduced and tension head pins without head driving recess. Head dimensions shall be in accordance with tables 106-XI and 106-XII.

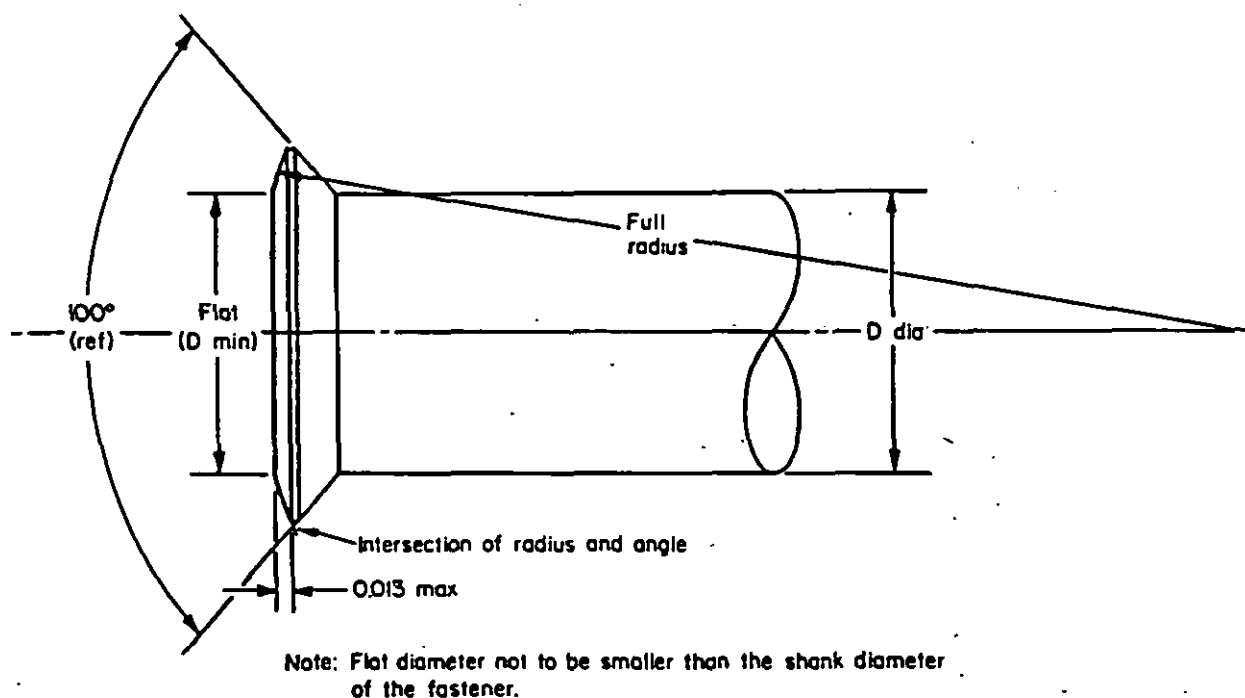


FIGURE 106-1. Crown for 100° flush head rivet.

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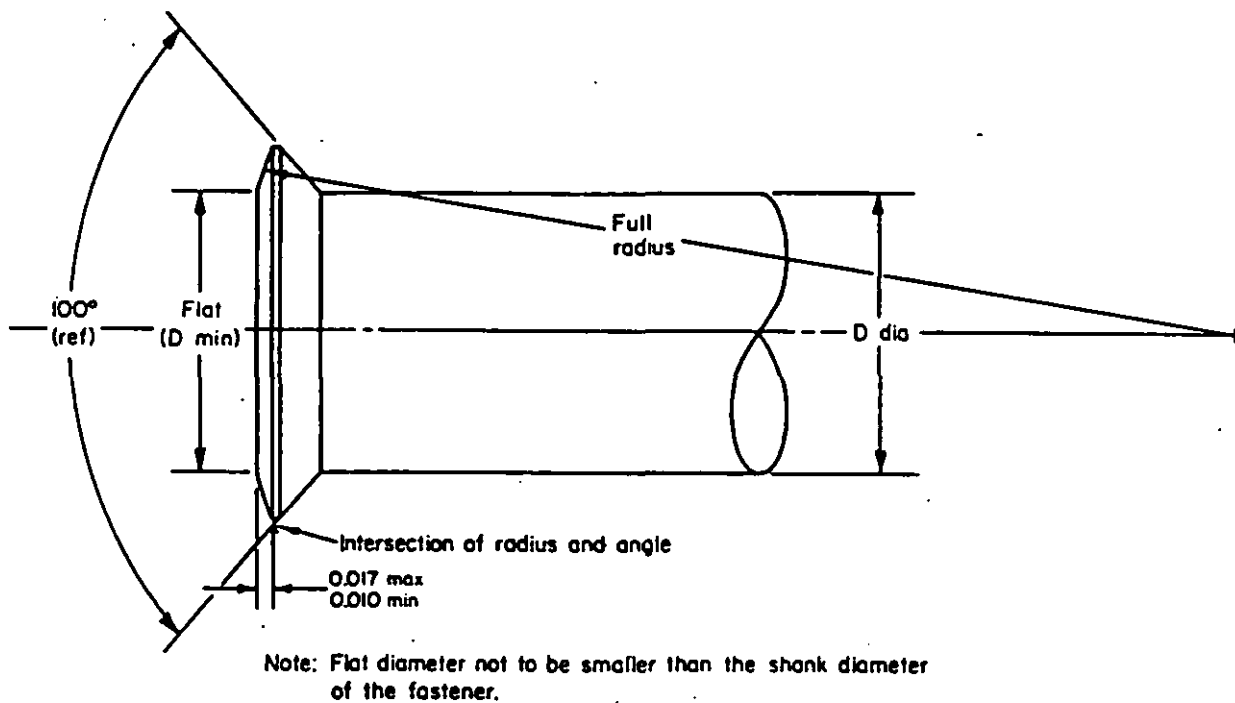
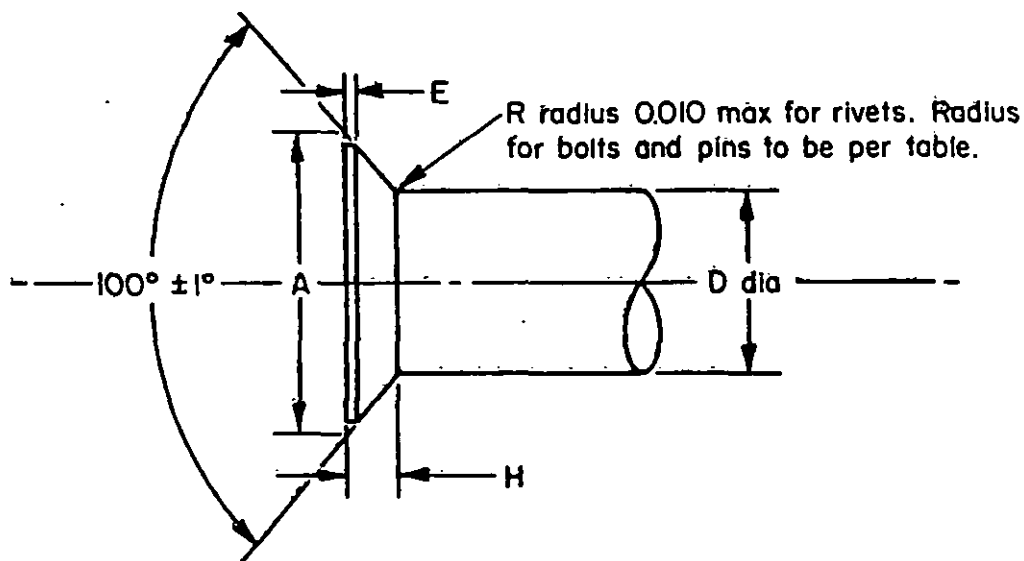


FIGURE 106-2. Dome for 100° flush head bolts.

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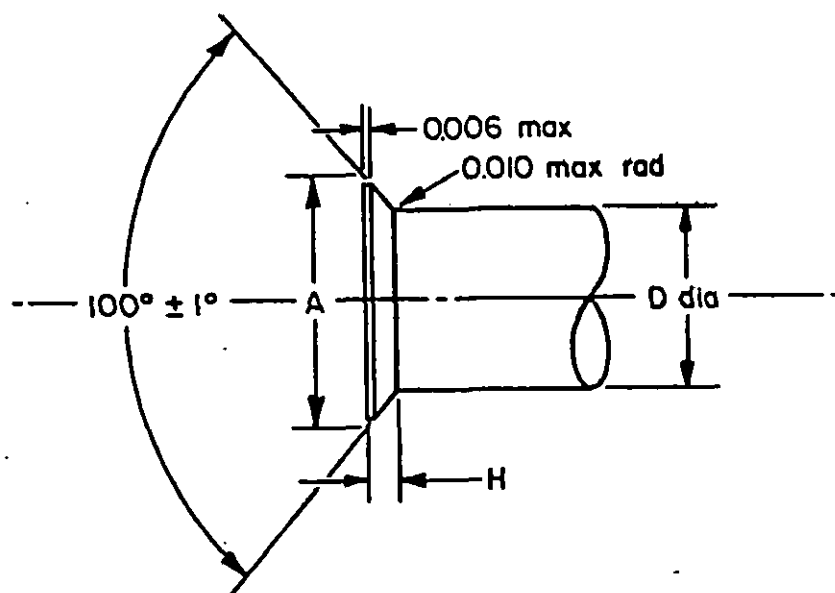
TABLE 106-I. 100° flush head for rivets, pins, and bolts without head driving recesses.



D Diameter Nominal Size	A Max.	H Min.	E Max.	R Bolts & Pins	
				Max.	Min.
.062	.118	.019	.006	-	-
.094	.183	.032	.006	-	-
.125	.229	.038	.006	-	-
.156	.290	.049	.010	.020	.010
.187	.357	.065	.013	.030	.020
.250	.480	.090	.015	.030	.020
.312	.568	.100	.015	.040	.030
.375	.698	.127	.015	.040	.030

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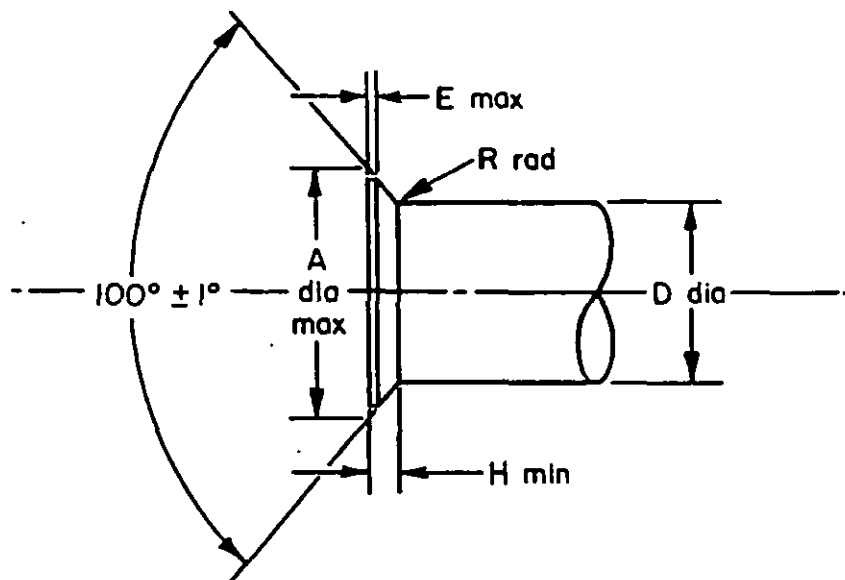
TABLE 106-II. 100° flush, reduced head rivet.



D Diameter Nominal Size	A Max.	H Min.
.094	.1478	.018
.125	.1957	.025
.156	.2469	.033
.187	.3016	.044
.250	.3948	.056

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TABLE 106-III. 100° flush, reduced head bolts with head driving recess.*

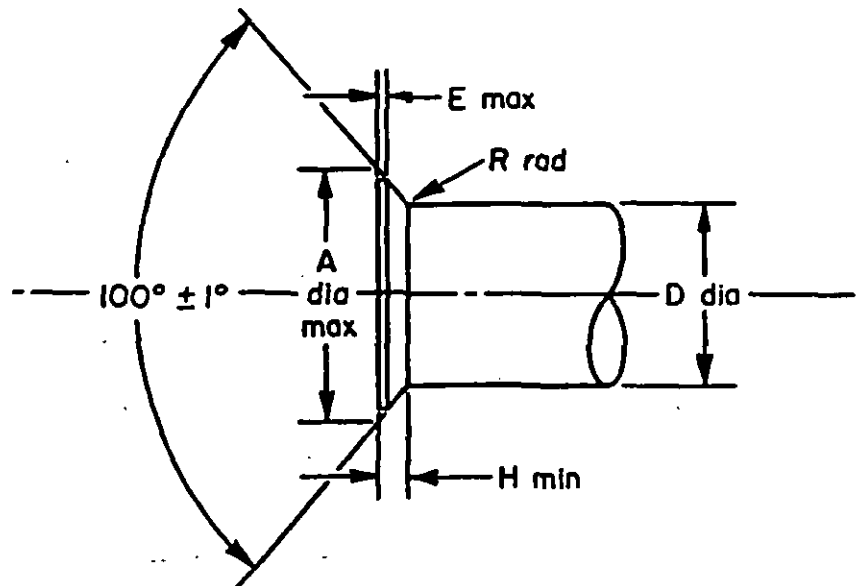


D Diameter Nominal Size	A Dia.	H Min.	E Max.	R Radius	
				Max.	Min.
.190	.298	.042	.012	.030	.010
.250	.393	.056	.014	.030	.010
.312	.476	.064	.016	.040	.010
.375	.563	.074	.018	.040	.015
.438	.670	.092	.020	.050	.015
.500	.753	.100	.022	.050	.015
.562	.839	.109	.024	.050	.015
.625	.926	.119	.026	.050	.015
.750	1.104	.140	.030	.050	.015
.875	1.328	.180	.034	.050	.015
1.000	1.523	.211	.038	.050	.015

* See requirement 201 for limitations of usage.

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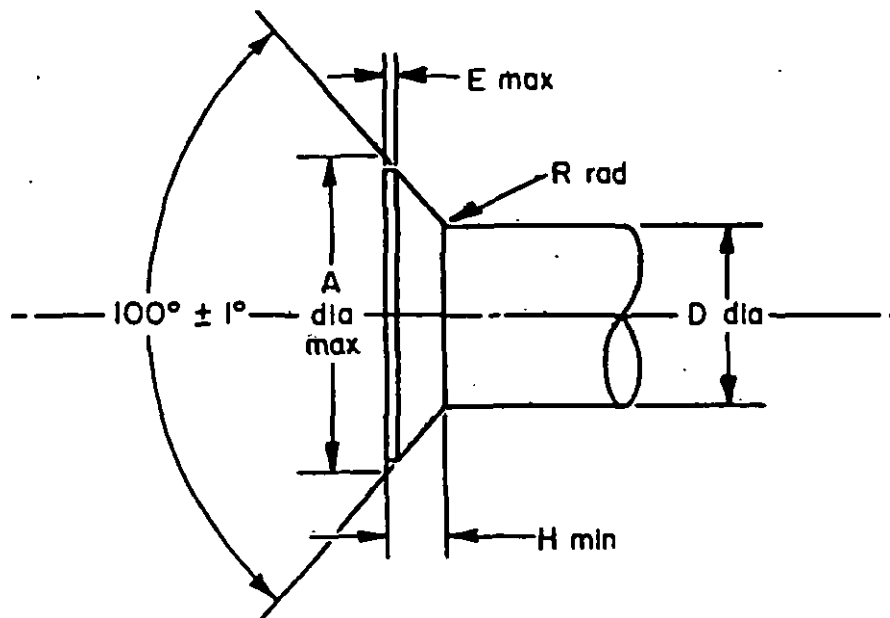
TABLE 106-IV. 100° flush head for bolts and pins.



D Diameter Nominal Size	A Dia. Max.	H Min.	E Max.	R Radius for less than 108 ksi F _{su}		R Radius for 108 ksi F _{su} and up	
				Max.	Min.	Max.	Min.
.164	.335	.068	.012	.025	.010	.035	.020
.190	.387	.079	.015	.030	.010	.035	.020
.250	.512	.105	.018	.030	.010	.035	.020
.312	.638	.131	.021	.040	.010	.045	.030
.375	.765	.157	.025	.040	.010	.045	.030
.438	.891	.183	.028	.050	.015	.055	.035
.500	1.020	.210	.031	.050	.015	.055	.035
.562	1.146	.236	.034	.050	.015	.065	.045
.625	1.272	.262	.038	.050	.015	.065	.045
.750	1.528	.315	.044	.050	.015	.080	.060
.875	1.781	.367	.050	.050	.015	.080	.060
1.000	2.037	.420	.057	.050	.015	.080	.060

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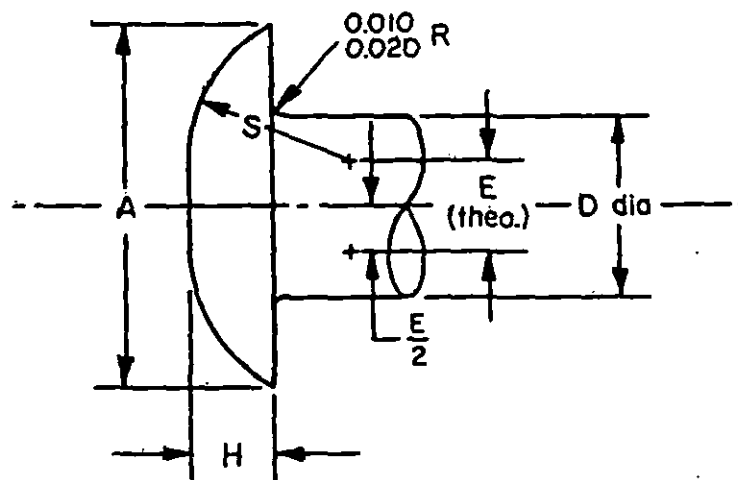
TABLE 106-V. 100° flush, reduced head bolts and pins
without head driving recess.



D Diameter Nominal Size	A Max.	H Min.	E Max.	R Radius	
				Max.	Min.
.164	.257	.036	.010	.025	.015
.190	.298	.042	.012	.030	.020
.250	.393	.056	.014	.030	.020
.312	.476	.064	.016	.040	.030
.375	.563	.074	.018	.040	.030
.438	.670	.092	.020	.050	.040
.500	.753	.100	.022	.050	.040
.562	.839	.109	.024	.050	.040
.625	.926	.119	.026	.050	.040
.750	1.104	.140	.030	.050	.040
.875	1.328	.180	.034	.050	.040
1.000	1.527	.211	.038	.050	.040

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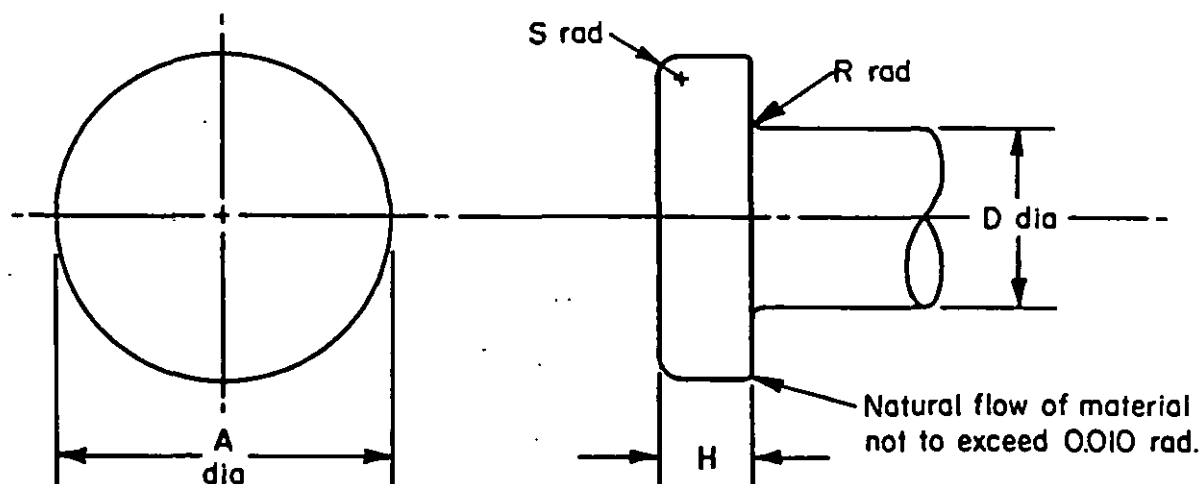
TABLE 106-VI. Universal head for solid rivet.



D Diameter Nominal Size	A Diameter		H		S Radius		E (Theo.)
	Max.	Min.	Max.	Min.	Max.	Min.	
.062	.131	.119	.037	.027	.064	.044	.031
.094	.197	.178	.050	.040	.092	.072	.046
.125	.262	.238	.064	.054	.118	.098	.062
.156	.328	.296	.077	.067	.145	.125	.078
.187	.394	.356	.090	.080	.174	.154	.093
.250	.525	.475	.117	.107	.227	.207	.125
.312	.656	.594	.143	.133	.282	.262	.156
.375	.787	.713	.171	.161	.338	.318	.187
.438	.918	.832	.199	.189	.393	.373	.218

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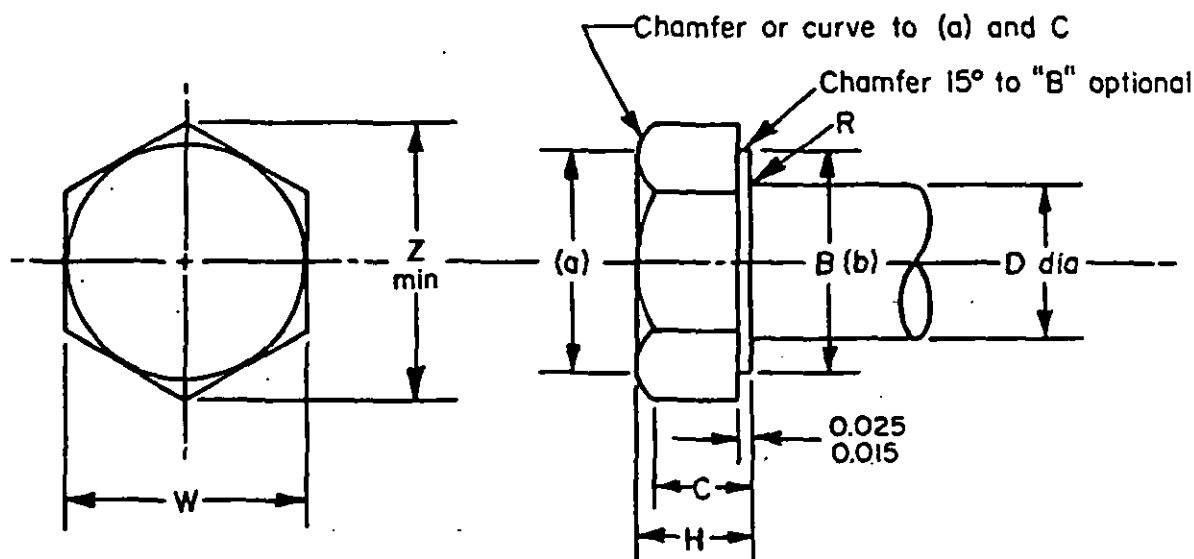
TABLE 106-VII. Pan head with head driving recess for bolts.



D Diameter Nominal Size	A Diameter		H		R Radius		S Rad. Max.
	Max.	Min.	Max.	Min.	Max.	Min.	
.112	.219	.205	.069	.059	.015	.010	.020
.138	.270	.256	.090	.080	.015	.010	.025
.164	.322	.308	.110	.100	.020	.010	.030
.190	.374	.360	.125	.115	.020	.010	.035
.250	.492	.473	.150	.140	.020	.010	.040
.312	.615	.594	.188	.176	.025	.015	.050
.375	.740	.722	.220	.206	.025	.015	.050
.438	.813	.795	.235	.220	.030	.015	.060
.500	.925	.905	.266	.251	.030	.015	.065
.562	1.035	1.015	.297	.282	.030	.015	.070

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TABLE 106-VIII. Hexagon head, external wrenching.



D Diameter Nominal Size	B Dia. Min.	H		C Min.	R		W(c)		Z Min.
		Max.	Min.		Max.	Min.	Max.	Min.	
.190	.335	.125	.110	.073	.025	.010	.376	.367	.419
.250	.398	.140	.125	.083	.025	.010	.439	.430	.491
.312	.460	.171	.156	.104	.025	.010	.502	.492	.561
.375	.522	.203	.188	.125	.025	.015	.564	.553	.631
.438	.648	.234	.219	.146	.030	.015	.690	.679	.775
.500	.710	.265	.250	.167	.030	.020	.752	.741	.846
.562	.835	.296	.281	.188	.035	.020	.877	.865	.987
.625	.898	.327	.312	.208	.040	.025	.940	.928	1.059
.750	1.022	.390	.375	.250	.045	.030	1.064	1.052	1.200
.875	1.210	.453	.438	.292	.050	.035	1.252	1.239	1.414
1.000	1.398	.515	.500	.333	.060	.045	1.440	1.427	1.628
1.125	1.585	.577	.562	.375	.070	.055	1.627	1.614	1.842
1.250	1.772	.640	.625	.417	.075	.060	1.814	1.801	2.055

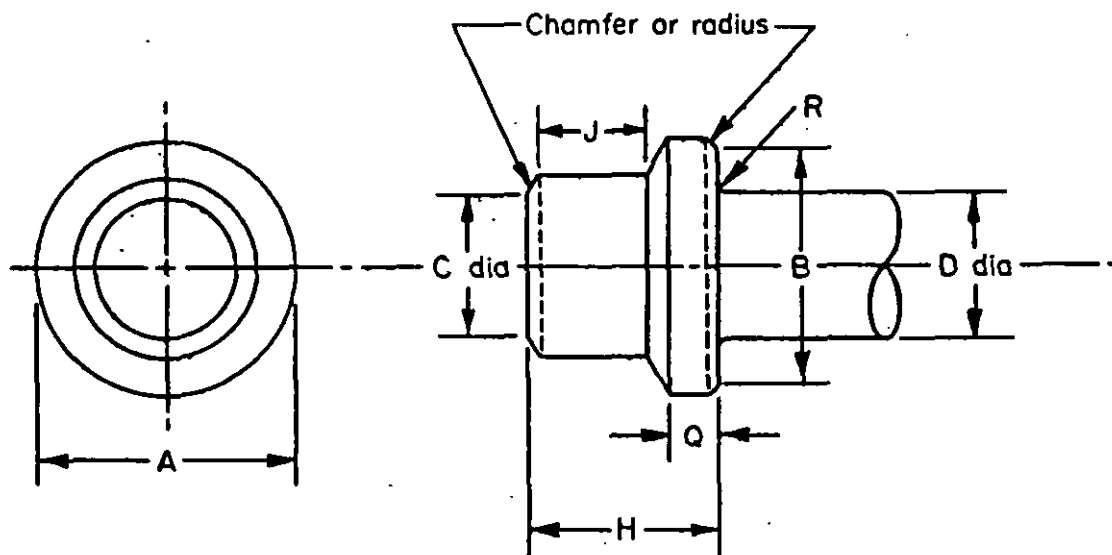
NOTES: (a) Not to exceed actual "W".

(b) Washer face diameter maximum not to exceed actual width across flats; minimum as tabulated.

(c) The dimensions across the wrenching flats are in accordance with American British Canadian ABC AIR-STD 17/2.

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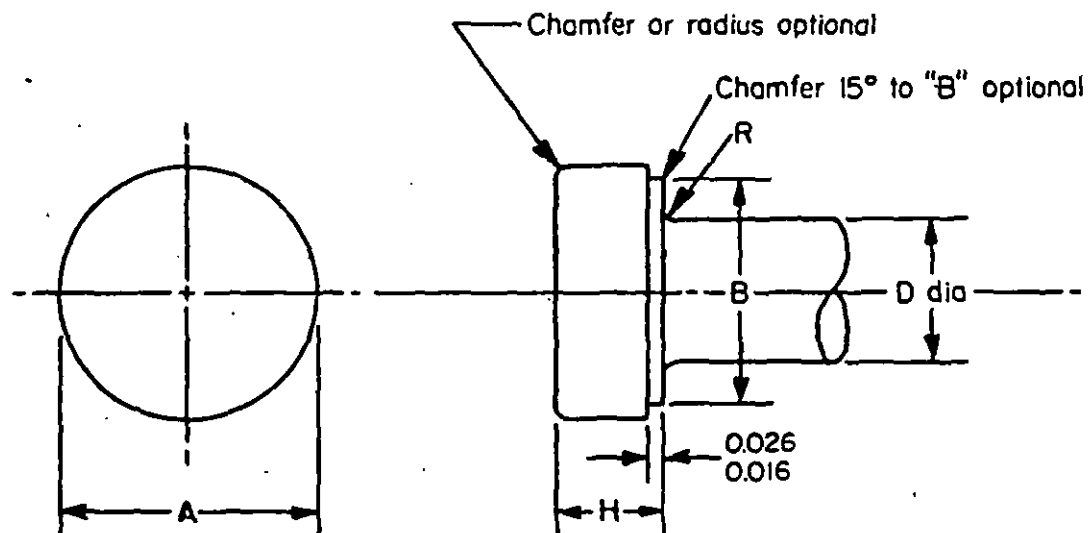
TABLE 106-IX. External wrenching flanged, tension heads.



D Diameter Nominal Size	A Dia. Max.	B Min.	C Dia. Min.	H ±.010	J Min.	Q		R	
						Max.	Min.	Max.	Min.
.190	.359	.334	.173	.205	.116	.037	.017	.022	.016
.250	.470	.445	.235	.250	.138	.046	.026	.028	.022
.312	.585	.560	.360	.312	.188	.055	.035	.035	.029
.375	.701	.676	.423	.337	.189	.064	.044	.043	.033
.437	.817	.792	.485	.393	.220	.073	.053	.049	.039
.500	.932	.907	.547	.450	.263	.082	.062	.055	.045
.562	1.047	1.022	.610	.505	.276	.091	.071	.061	.051
.625	1.163	1.132	.673	.562	.327	.100	.080	.068	.058
.750	1.394	1.369	.797	.600	.316	.118	.098	.080	.070
.875	1.625	1.600	.923	.700	.368	.136	.116	.093	.083
1.000	1.856	1.831	1.047	.800	.430	.154	.134	.105	.095
1.125	2.087	2.062	1.235	.900	.493	.172	.152	.118	.108
1.250	2.318	2.293	1.360	1.000	.554	.190	.170	.130	.120
1.375	2.548	2.524	1.485	1.100	.606	.208	.188	.143	.133
1.500	2.780	2.755	1.610	1.200	.658	.226	.206	.155	.145

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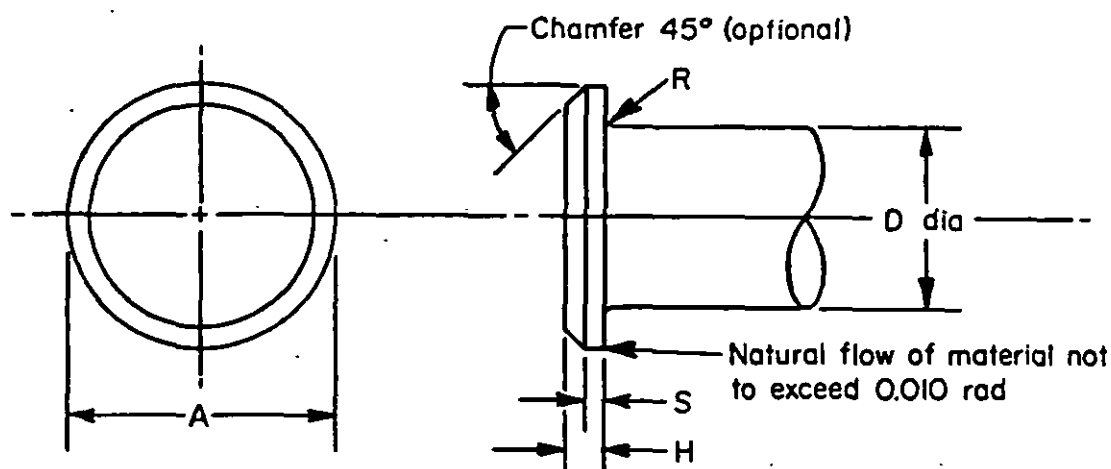
TABLE 106-X. External wrenching shear heads.



D Diameter Nominal Size	A Max.	B		H		R	
		Max.	Min.	Max.	Min.	Max.	Min.
.190	.456	.380	.359	.150	.130	.022	.016
.250	.531	.446	.422	.174	.154	.028	.022
.312	.605	.511	.484	.197	.177	.035	.029
.375	.679	.574	.546	.220	.200	.043	.033
.437	.828	.703	.671	.267	.247	.049	.039
.500	.901	.765	.734	.291	.271	.055	.045
.562	1.049	.891	.859	.338	.318	.061	.051
.625	1.124	.954	.922	.360	.340	.068	.058
.750	1.270	1.063	1.031	.410	.390	.080	.070
.875	1.493	1.250	1.218	.478	.458	.093	.083
1.000	1.715	1.438	1.406	.549	.529	.105	.095
1.125	1.937	1.625	1.593	.619	.599	.113	.103
1.250	2.085	1.812	1.781	.700	.680	.130	.120
1.375	2.307	2.000	1.968	.760	.740	.143	.133
1.500	2.528	2.189	2.157	.830	.810	.155	.145

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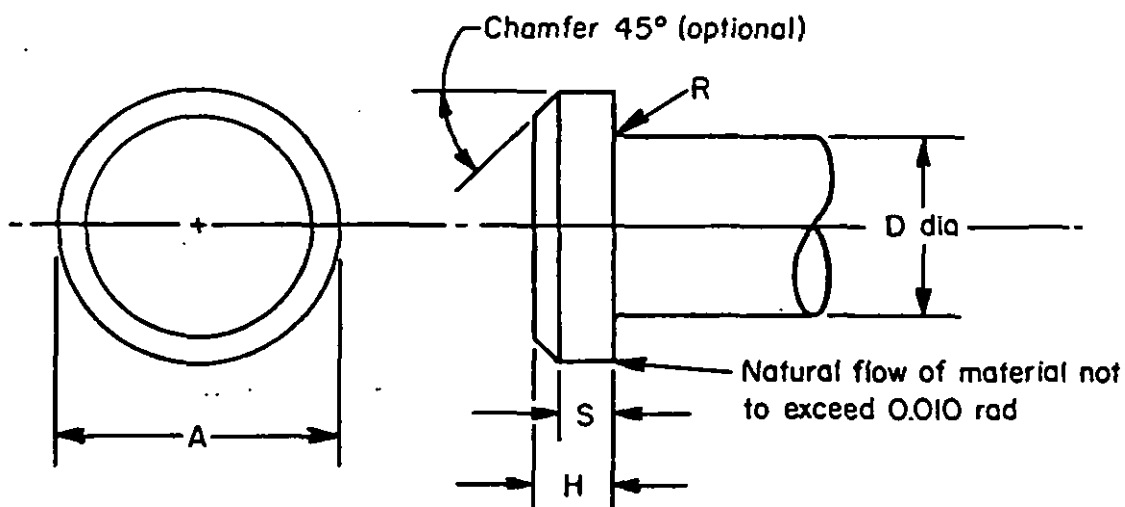
TABLE 106-XI. Reduced head for pins without head driving recess.



D Diameter Nominal Size	A Diameter		H		R Radius		S Min.
	Max.	Min.	Max.	Min.	Max.	Min.	
.156	.262	.242	.047	.037	.025	.015	.020
.190	.315	.295	.055	.045	.025	.015	.025
.250	.412	.387	.069	.059	.025	.015	.030
.312	.505	.475	.078	.068	.030	.020	.035
.375	.600	.565	.088	.078	.030	.020	.040
.437	.678	.641	.105	.093	.030	.020	.045
.500	.770	.735	.115	.103	.030	.020	.050
.562	.864	.829	.127	.112	.040	.025	.055
.625	.953	.918	.137	.122	.040	.025	.060
.750	1.108	1.066	.151	.136	.045	.030	.070
.875	1.285	1.241	.187	.172	.050	.035	.090
1.000	1.468	1.424	.218	.203	.060	.045	.110

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TABLE 106-XII. Tension head for pins without head driving recess.



D Diameter Nominal Size	A Diameter		H		S	R Radius	
	Max.	Min.	Max.	Min.	Min.	Max.	Min.
.156	.322	.306	.060	.055	.030	.025	.015
.190	.377	.357	.074	.064	.035	.025	.015
.250	.440	.415	.090	.080	.045	.025	.015
.312	.505	.475	.112	.102	.055	.030	.020
.375	.600	.565	.140	.130	.075	.030	.020
.437	.686	.656	.160	.150	.095	.030	.020
.500	.770	.742	.188	.176	.095	.030	.020
.562	.877	.841	.210	.200	.125	.040	.025
.625	.978	.939	.238	.228	.140	.040	.025
.750	1.160	1.124	.335	.320	.200	.045	.030
.875	1.350	1.312	.385	.370	.250	.050	.035
1.000	1.542	1.502	.435	.420	.300	.060	.045

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SUPERSEDES
 REQUIREMENT 112
 12 July 1978

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 REQUIREMENT 112
 24 September 1979

RELEASE FOR USE OF NONAPPROVED FASTENERS

1. Purpose. Fastening systems, fasteners, and installation requirements identified and listed in the applicable requirements of this standard are approved and shall be given selection priority in new aerospace systems design. Those not listed as approved for use require a release for use by the procuring activity prior to incorporation into design, during development, or for use in assembly during production. This requirement establishes preparation and submission procedures for justification and engineering data necessary for the evaluation and use of fasteners not listed herein. It also establishes the point of contact for release requests.

2. Documents applicable to Requirement 112.

MIL-D-8706	Data and Tests, Engineering, Contract Requirements for Aircraft Weapon Systems
MIL-STD-965	Parts Control System

3. Procedures for use. When a determination has been made that a fastening system or fasteners not listed herein should be used, a request for release for use, with the justification and engineering data specified herein, shall be submitted to the procuring activity in accordance with the procedures of MIL-D-8706 and MIL-STD-965. When contracts do not call out any of the above documented procedures, the requests shall be made to the contact points listed in table 112-1, through the procuring activity in accordance with procedure 1 of MIL-STD-965 and the data requirements of 3.1 of this requirement.

3.1 Engineering data required. When applicable, the following engineering data shall be furnished for each fastener not listed herein for which release for use is requested.

- a. The reason an approved fastener would not be a satisfactory selection to perform the function required by the design problem or application.
- b. The specific materials from which the fastener is manufactured.
- c. The specific plating, coatings, surface treatments, and lubricants, as applicable. These shall be completely identified.
- d. Values for the physical and mechanical properties, and available installation performance requirements, and available structural design load allowable data.
- e. An illustration of the fastener with the dimensions required to establish the geometrical material limits necessary for design selection and for determining interchangeability. (See Requirement 115). This includes the geometrical material limits of installation formed fasteners after installation and clearances required for installation.
- f. The maximum weight limit per one hundred of the fasteners.
- g. The design and usage limitations to be applied.
- h. The installation or process instruction for the part.

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3.2 Contract data requirements. Contract data requirements shall include the data specified in 3.1.

TABLE 112-I. Request contact points

Department	Submit to	Action Required
Air Force	Aeronautical Systems Division ATTN: ENFEM Wright-Patterson AFB, OH 45433 Telephone: 513-255-4158	Disapprove or Release
Army	US Army Aviation R&D Command ATTN: DRDAV-EKS P. O. Box 209 - Main Station St. Louis, MO 63166 Telephone: 314-268-5791	Disapprove or Release
Navy	Naval Air Development Center ATTN: 6013 Warminster, PA 18974 Telephone: 215-441-2833	Review and Recommendation to NAVAIR
	Naval Air Systems Command ATTN: AIR-5303 Washington, DC 20361	Disapprove or Release
All Military Services DISC/MPCAG	Defense Industrial Supply Center ATTN: DISC-EPM Philadelphia, PA 19111 Telephone: 215-697-4395	Information and Recommendation

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BOLTS, SELF-RETAINING

1. Purpose. The purpose of this requirement is to establish engineering criteria and requirements for the application of self-retaining bolts. This requirement shall apply to both positive-locking and impedance-type bolts.

1.1 Classification. Self-retaining bolts shall be of the following types:

Type I - Positive-locking bolts. Type I bolts are designed to be installed and removed after the retaining element release button is actuated to allow the locking elements to retract into the bolt body (see figure 203-1).

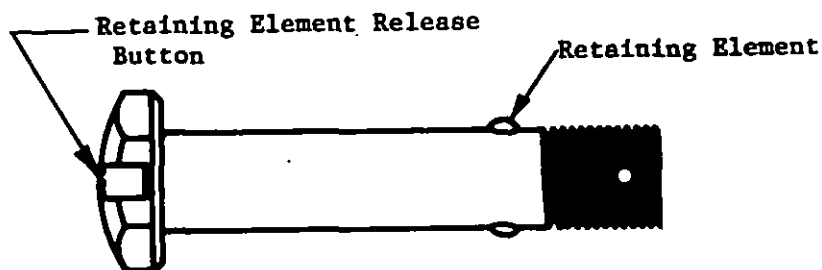


FIGURE 203-1. Positive-locking bolts.

Type II - Impedance-type bolts. Type II bolts are designed to be installed and removed by overcoming the frictional force of the retaining elements (see figure 203-2).

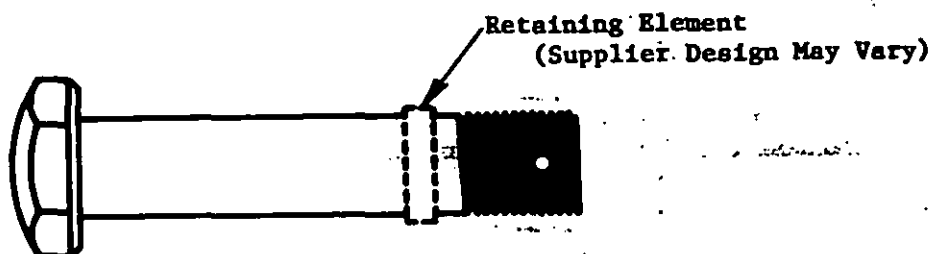


FIGURE 203-2. Impedance-type bolts.

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2. Documents applicable to Requirement 203

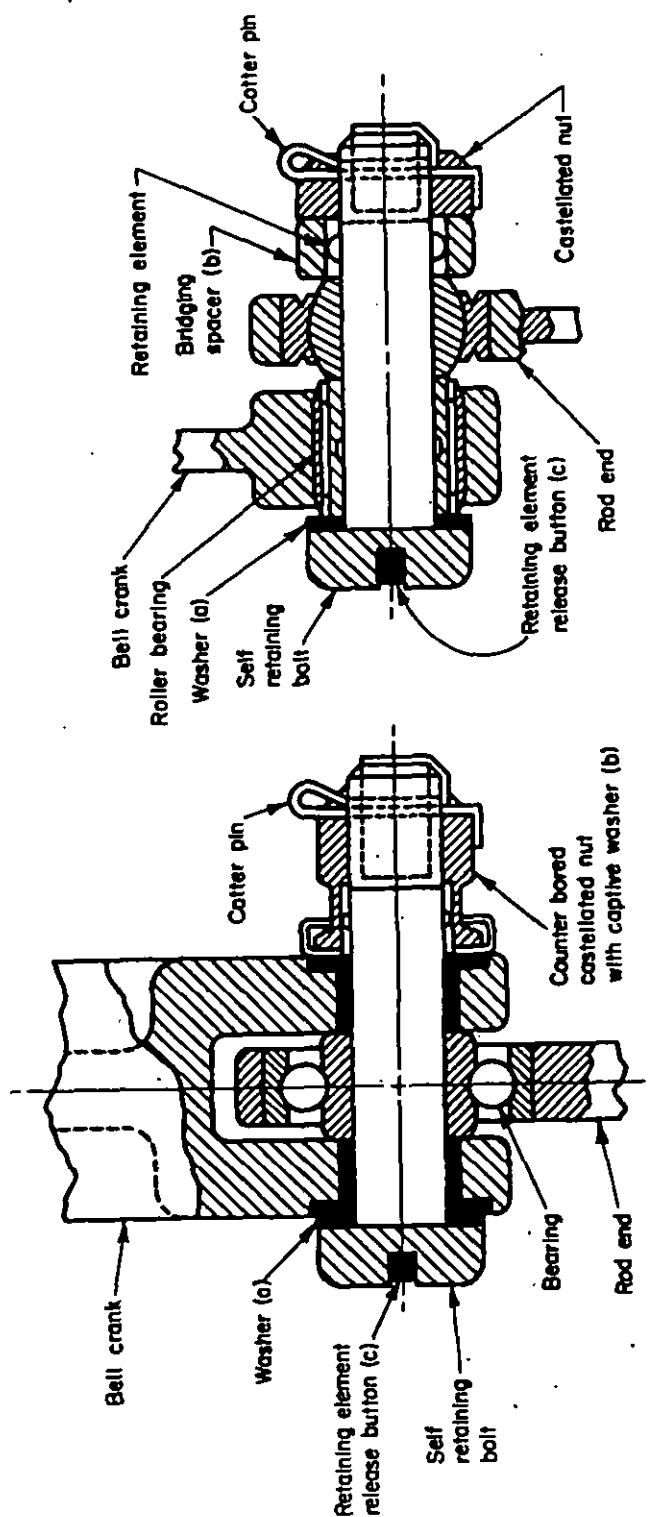
MIL-B-23964	Bolts, Self-Retaining, Positive-Locking
MIL-B-83050	Bolts, Self-Retaining, Impedance-Type
AN310	Nut, Plain, Castellated, Airframe
AN320	Nut, Plain, Castellated, Shear
MS3369	Bolts, Self-Retaining, Positive-Locking, CRES 90 ksi F_{su} , 63 ksi F_{tu} , Hexagon Slotted Head, 450°F
MS14144	Nut, Self-Locking, Lightweight, Castellated, 450°F
MS14145	Nut, Self-Locking, Lightweight, Thin, Castellated, 450°F
MS14146	Nut, Self-Locking, Castellated, Hexagon, Counterbored Captive Washer, 450°F
MS17825	Nut, Self-Locking, Castellated, Hexagon, 250°F, Non-Metallic Insert
MS17826	Nut, Self-Locking, Castellated, Hexagon, 250°F, Thin, Non-Metallic Insert
MS21125	Bolts, Self-Retaining, Positive-Locking, CRES 90 ksi F_{su} , 63 ksi F_{tu} , Pan Head, 450°F
MS21126	Spacer, Grooved, Self-Retaining Bolt, Aluminum Alloy
MS21128	Spacer, Grooved, Self-Retaining Bolt, CRES
MS21130	Bolts, Self-Retaining, Positive-Locking, CRES, 90 ksi F_{su} , 63 ksi F_{tu} , 100° Flush Head, 450°
MS21224	Nut, Self-Locking, Castellated, Hexagon Counterbored, Captive Washer, 250°F, Non-Metallic Insert
MS21244	Nut, Castellated, Hexagon-Counterbored, Captive Washer, 450°F
MS27576	Bolts, Self-Retaining, Impedance-Type, 95 ksi F_{su} , Hex Head, 450°F
MS27577	Bolts, Self-Retaining, Impedance-Type, 95 ksi F_{su} , Flush Head, 450°F
MS33540	Safety Wiring and Cotter Pinning, General Practices for

3. Design and usage limitations. Fasteners in the category established by this requirement shall be subject to the following design and usage limitations.

3.1 Joint design. The joint shall be designed so that with a self-retaining bolt installed, the joint integrity is not dependent on washers or any other normally removable parts, other than the bolts. Maximum of two washers may be used to adjust for tolerance variation and, when required, they shall be used under the head of the bolt, but not under the nut. Bridging spacers may be used on positive-locking bolts only. Illustrations of acceptable joints are presented in figure 203-3.

3.2 Usage. Self-retaining bolts shall be of any approved type and shall be used in accordance with the following design and usage requirements.

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- (a) Washer selected to take up excess bolt grip length and build up in length due to tolerances.
- (b) A bridging spacer may be used or a castellated nut with a counter bore or recess for the retaining element may be used.
- (c) Retaining element release button applies to positive locking bolts and not to impedance type bolts.

FIGURE 203-3. Typical acceptable joints.

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3.2.1 Self-retaining bolts shall be used in control systems where the bolt serves as an axis of rotation and where separation of the linkage will affect safety of flight. These include controls for flight, fuel, engine air induction, and propeller systems.

3.2.2 The bolts shall be additionally locked in position by nonself-locking or self-locking castellated nuts properly secured by cotter pins in accordance with MS33540.

3.2.3 When self-retained bolts that are not identified by an MS part number are used, the retaining element and its locking device shall be a design used on bolts that have qualification approval to MIL-B-23964 for positive-locking bolts and MIL-B-83050 for impedance-type bolts.

3.2.4 Self-retaining bolts that have had the retaining element or locking device reworked or reprocessed shall not be used.

3.2.5 Bridging spacers shall not be used with impedance-type bolts. Bridging spacers shall be selected from MS21126 or MS21128.

3.2.6 Counterbored castellated nuts with captive washers shall be selected from MS14146, MS21224, or MS21244.

3.2.8 Impedance-type bolts (Type II) shall not be used in control systems of Navy aircraft.

3.3 Preferred parts. Corrosion-resistant steel parts are preferred over alloy steel parts.

4. Design selection and approved call out. Fasteners in the category established by this requirement shall be selected from and specified by standard part numbers in documents listed in paragraph 2.

5. Intended use and guidance criteria. Table 203-I is presented as an aid in the selection of self-retaining bolts.

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TABLE 203-I. Aid in the selection of self-retaining bolts.

Head Style	Drawing Number	Procurement Specifications	Material	Temperature Limit	Finish	Remarks
Hex	MS3369	MIL-B-23964	CRES	450°F	Passivated	Positive Locking
Pan	MS21125	MIL-B-23964	CRES	450°F	Passivated	Positive Locking
Flush	MS21130	MIL-B-23964	CRES	450°F	Passivated	Positive Locking
Hex	MS27576	MIL-B-83050	CRES STEEL	450°F	Passivated Cadmium Plated	Impedance Type
Flush	MS27577	MIL-B-83050	CRES STEEL	450°F	Passivated Cadmium Plated	Impedance Type

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NUTS

1. Purpose. This requirement provides the criteria for selection of nuts established as approved hardware for use in airframe structural joining.

2. Documents applicable to Requirement 204

FF-N-836	Nut, Square, Hexagon, Cap, Slotted, Castellated, Clinch, Knurled, and Welding
MIL-N-7873	Nut, Self-Locking, 1200°F
MIL-N-8922	Nut, Self-Locking, Steel, 220 ksi F _{tu} , 450°F
MIL-N-8984	Nut, Self-Locking, Steel, 260 ksi F _{tu} , 450°F
MIL-N-8985	Nut, Self-Locking, Steel, 180 ksi F _{tu} , 450°F
MIL-N-25027	Nut, Self-Locking, 250°F, 450°F, and 800°F, 125 ksi F _{tu} , 60 ksi F _{tu} and 30 ksi F _{tu}
MIL-STD-143	Standards and Specifications, Order of Precedence For the Selection of
AN256	Nut, Self-Locking, Right-Angle Plate
AN310	Nut, Plain, Castellated, Airframe
AN315	Nut, Plain, Airframe
AN316	Nut, Jam, Hexagon
AN320	Nut, Plain, Castellated, Shear
MS14144	Nut, Self-Locking, Lightweight, Castellated, 450°F
MS14145	Nut, Self-Locking, Lightweight, Thin Castellated, 450°F
MS14146	Nut, Self-Locking, Castellated, Hexagon, Counterbored, Captive Washer, 450°F
MS14156	Nut, Wheel, Self-Locking, Flanged, Steel, 180 ksi F _{tu} , 450°F, Spline Drive
MS14164	Nut, Wheel, Self Locking, Flanged, Steel, 220 ksi F _{tu} , 450°F, Spline Drive
MS17825	Nut, Self locking, Castellated, Hexagon, 250°F Non-metallic Insert
MS17826	Nut, Self-locking, Castellated, Hexagon, 250°F, Thin, Non-metallic Insert
MS20500	Nut, Self locking, Hexagon, 1200°F, 125 ksi F _{tu}
MS20501	Nut, Self Locking, Plate, Two Lug, 1200°F, 125 ksi F _{tu}
MS21042	Nut, Self Locking, 450°F, Reduced Hexagon, Reduced Height, Ring Base, Noncorrosion Resistant Steel (Asg)
MS21043	Nut, Self-locking, 800°F, Reduced Hexagon, Reduced Height, Ring Base, Corrosion Resistant Steel (Asg)
MS21044	Nut, Self Locking, Hexagon-regular Height, 250°F, 125 ksi F _{tu} and 60 ksi F _{tu} (Asg)
MS21045	Nut, Self Locking, Hexagon-regular Height, 450°F, 125 ksi F _{tu} (Asg)
MS21046	Nut, Self Locking Hexagon regular Height, 800°F, 125 ksi F _{tu} (Asg)
MS21047	Nut, Self-locking, Two Lug, Low Height, Steel, 125 ksi F _{tu} , 450°F
MS21048	Nut, Self-locking, Plate, Two Lug, Low Height, CRES, 125 ksi F _{tu} , 450°F
MS21049	Nut, Self-locking, Plate, Two Lug, 100° Countersunk, Low Height, Steel 125 ksi F _{tu} , 450°F
MS21050	Nut, Self-locking, Plate, Two Lug, 100° Countersunk, Low Height, CRES, 125 ksi F _{tu} , 450°F and 800°F

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MS21051	Nut, Self-locking, Plate, One Lug, Low Height, Alloy Steel, 125 ksi Ftu, 450°F
MS21052	Nut, Self-locking, Plate, One Lug, Low Height, CRES 125 ksi Ftu, 450°F and 800°F
MS21053	Nut, Self-locking, Plate, Alloy, One Lug, 100° Countersunk, Low Height, Steel, 125 ksi Ftu, 450°F
MS21054	Nut, Self-locking, Plate, One Lug, 100° Countersunk, Low Height, CRES, 125 ksi Ftu, 450°F and 800°F (Asg)
MS21055	Nut, Self-locking, Plate, Corner, Low Height, Steel, 125 ksi Ftu, 450°F
MS21056	Nut, Self-locking, Plate, Corner, Low Height, CRES, 125 ksi Ftu, 450°F and 800°F (Asg)
MS21057	Nut, Self-locking, Plate, Corner, 100° Countersunk, Low Height, Steel, 125 ksi Ftu, 450°F
MS21058	Nut, Self-locking, Plate, Corner, 100° Countersunk, Low Height, CRES, 125 ksi Ftu, 450°F and 800°F (Asg)
MS21059	Nut, Self-locking, Plate, Two Lug, Floating, Low Height, Steel, 125 ksi Ftu, 450°F (Asg)
MS21060	Nut, Self-locking, Plate, Two Lug, Floating, Low Height, CRES, 125 ksi Ftu, 450°F and 800°F (Asg)
MS21061	Nut, Self-locking, Plate, One Lug, Floating, Low Height, Steel, 125 ksi Ftu, 450°F (Asg)
MS21062	Nut, Self-locking, Plate, One Lug, Floating, Low Height, CRES, 125 ksi Ftu, 450°F and 800°F (Asg)
MS21063	Nut, Self-locking, Channel, Floating, Low Height, Steel, 125 ksi Ftu, 250°F
MS21064	Nut, Self-locking, Channel, Floating, Low Height, Steel, 125 ksi Ftu, 450°F
MS21065	Nut, Self-locking, Channel, Floating, Low Height, CRES, 125 ksi Ftu, 450°F and 800°F
MS21066	Nut, Self-locking, Channel, 100° Countersunk, Floating, Low Height, Steel, 125 ksi Ftu, 250°F
MS21067	Nut, Self-locking, Channel, 100° Countersunk, Floating, Low Height, Steel, 125 ksi Ftu, 450°F
MS21068	Nut, Self-locking, Channel, 100° Countersunk, Floating, Low Height, CRES, 125 ksi Ftu, 450°F and 800°F
MS21069	Nut, Self-locking, Plate, Two Lug, Reduced Rivet Spacing, Low Height, Steel, 125 ksi Ftu, 450°F
MS21070	Nut, Self-locking, Plate, Two Lug, Reduced Rivet Spacing, Low Height, CRES 125 ksi Ftu, 450°F and 800°F
MS21071	Nut, Self-locking, Plate, One Lug, Reduced Rivet Spacing, Low Height, Steel, 125 ksi Ftu, 450°F
MS21072	Nut, Self-locking, Plate, One Lug, Reduced Rivet Spacing, Low Height, CRES, 125 ksi Ftu, 450°F and 800°F
MS21073	Nut, Self-locking, Plate, Corner, Reduced Rivet Spacing, Low Height, Steel 125 ksi Ftu, 450°F
MS21074	Nut, Self-locking, Plate, Corner, Reduced Rivet Spacing, Low Height, CRES, 125 ksi Ftu, 450°F and 800°F
MS21075	Nut, Self-locking, Plate, Two Lug, Floating, Reduced Rivet Spacing, Low Height, Steel, 125 ksi Ftu, 450°F
MS21076	Nut, Self-locking, Plate, Two Lug, Floating, Reduced Rivet Spacing, Low Height, CRES 125 ksi Ftu, 450°F and 800°F
MS21077	Nut, Self-locking, Plate, Two Lug, Floating, Non-metallic Insert, Steel, 125 ksi Ftu, 250°F

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MS21078	Nut, Self-locking, Plate, Two Lug, Non-metallic Insert, Steel, 125 ksi F _{tu} , 250°F
MS21079	Nut, Self-locking, Gang Channel, Non-metallic Insert, 125 ksi F _{tu} , 250°F
MS21080	Nut, Self-locking, Plate, One Lug, Non-metallic Insert, Steel 125 ksi F _{tu} , 250°F
MS21081	Nut, Self-locking, Plate, Corner, Non-metallic Insert, Steel, 125 ksi F _{tu} , 250°F
MS21082	Nut, Self-locking, Plate, One Lug, Floating, Non-metallic Insert, Steel 125 ksi F _{tu} , 250°F
MS21083	Nut, Self-locking, Hexagon, Nonmetallic Insert, Low Height, 250°F
MS21084	Nut, Self-locking, Steel, 220 ksi F _{tu} , 450°F, Flanged, MS 33787 Wrenching Element
MS21085	Nut, Self-locking, Steel, 260 ksi F _{tu} , 450°F, Flanged, MS 33787 Wrenching Element
MS21086	Nut, Self-locking, Plate, Side by Side Reduced Rivet Spacing, Low Height, Steel 125 ksi F _{tu} , 450°F
MS21087	Nut, Self-locking, Plate, Side by Side Reduced Rivet Spacing, Low Height, CRES, 125 ksi F _{tu} , 450°F and 800°F
MS21133	Nut, Self-locking, Steel, 180 ksi F _{tu} , 450°F, Flanged, MS33787 Wrenching Element
MS21224	Nut, Self-locking, Castellated, Hexagon, Counterbored, Assembled Washer, 250°F, Non-metallic Insert (For Self Retaining Bolts)
MS21244	Nut, Castellated, Hexagon, Counterbored
MS21245	Nut, Self-Locking, Hexagon, Thin, 450°F, 70 ksi F _{tu}
MS27130	Nut, Plain, Blind, Rivet-flat and Countersunk Head, Open End
MSFC 10M90001	Requirements and Procedures for Contamination Control Due to Vacuum Outgassing
NAS 577	Nut, Self Locking, Barrel Floating (Note: Code "X" not approved for general use.) (14 June '74)
NAS 1291	Nut, Self-Locking, Hexagonal, Low Height, Lightweight, 450°C, 800°F* (Ref. 7)
NAS 1329	Nut, Blind Rivet, Flat Head, Internal Thread, Nonlocking (Free Running) or Self-Locking (14 June '74)
NAS 1330	Nut, Blind, Rivet, Countersunk Head, Internal Thread, Nonlocking (Free Running) or Self-Locking (14 June '74)
NAS 1473	Nut, Self-locking, Plate, Two Lug, Cap, Floating, Self-Sealing (14 June '74)
NAS 1474	Nut, Self-locking, Plate, Two Lug, Cap Floating, Reduced Rivet Spacing, (14 June '74)
NAS 1770	Nut, Self-Locking, Plate, Two Lug, Low Height, Counterbored, 160 ksi, 450°F, 800°F* (Oct '74)
NAS 1771	Nut, Self-Locking, Plate, One Lug, Low Height, Counterbored, 160 ksi, 450°F, 800°F* (Oct., '74)
NAS 1772	Nut, Self-Locking, Plate, Corner, Low Height, Counterbored, 160 ksi, 450°F, 800°F* (Oct., '74)
NAS 1773	Nut, Self-locking, Plate, Two Lug, Low Height, Counterbored, Floating, 160 ksi, 450°C, and 800°F* (Oct., '74)

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NAS 1774	Nut, Self-Locking, Plate, One Lug, Low Height, Counterbored, Floating, 160 ksi, 450°F and 800°F* (Oct '74)
NAS 1775	Nut, Self-Locking, Plate, Two Lug, Low Height, Counterbored, Reduced Rivet Spacing, 160 ksi, 450°F, 800°F* (Oct '74)
NAS 1776	Nut, Self-Locking, Plate, One Lug, Low Height, Counterbored, Reduced Rivet Spacing, 160 ksi, 450°F, 800°F* (Oct '74)
NAS 1777	Nut, Self-Locking, Plate, Corner, Low Height, Counterbored, Reduced Rivet Spacing, 160 ksi, 450°F, 800°F* (Oct '74)
NAS 1778	Nut, Self-Locking, Plate, One Lug, Low Height, Counterbored, Side by Side, 160 ksi, 450°F, 800°F* (Oct '74)
NAS 1779	Nut, Self-Locking, Plate, Two Lug, Low Height, Counterbored, Floating, Reduced Rivet Spacing, 160 ksi, 450°F, 800°F* (Oct '74)
NAS 1780	Nut, Self-Locking, Plate, Two Lug, Low Height, 100° Countersunk 160 ksi, 450°F, 800°F* (Oct '74)
NAS 1781	Nut, Self-Locking, Plate, One Lug, Low Height, 100° Countersunk, 160 ksi, 450°F, 800°F* (Oct '74)
NAS 1782	Nut, Self-Locking, Plate, Corner, Low Height, 100° Countersunk, 160 ksi, 450°F, 800°F* (Oct '74)
NAS 1783	Nut Assembly, Self-Locking, Gang Channel, Low Height, Counterbored, 160 ksi, 250°F, 450°F, 800°F* (Oct '74)
NAS 1784	Nut Assembly, Self-Locking, Gang Channel, Low Height, Countersunk, 160 ksi, 250°F, 450°F, 800°F* (Oct '74)
NAS 1789	Nut, Self-Locking, Plate, Side by Side, Floating, Low Height, Reduced Rivet Spacing, C Bored, 160 ksi, 450°F, 800°F
NAS 3350	Nuts, Self-Locking, 450°F, High Quality* (Rev. 1)

*No Acceptance Notice.

3. Procurement specification provisions. Fasteners in the category established by this requirement shall conform to the documents specified in 2.

4. Design and usage limitations. Fasteners in the category established by this requirement shall be subject to the following design and usage limitations:

a. At joints in control systems at single attachments or where loss of the bolt would affect safety or flight unless the threaded parts are held by a positive locking device that requires shearing or rupture of materials before torsional loads would relieve the initial stresses of the assembly.

b. On any externally threaded part that serves as an axis of rotation for another part unless there are no possible torsional loads which can be applied to either the externally or internally threaded part in such a manner as to relieve the initial stresses of the assembly, or unless the threaded parts are held by a positive locking device that requires shearing or rupture of material before torsional loads would relieve the initial stresses of the assembly.
 Example: Pulleys, cranks, levers, linkages, hinge pins, and cam followers.

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- c. With bolts or screws on jet engine aircraft in locations where the loose nut, bolt or screw could fall or be drawn into the engine air intake duct.
 - d. With bolts, screws, or studs to attach access panels, doors or to assemble any parts that are routinely disassembled prior to or after each flight.
 - e. Bolts, studs, or screws must extend through the self-locking nut for a length equivalent of two threaded pitches. This length includes the chamfer.
 - f. Self-locking nuts which are attached to the structure shall be attached in a positive manner to eliminate the possibility of their rotation or misalignment when tightening is to be accomplished by rotating the bolts or screws. The manner of attachment shall permit removal without injury to the structure and permit replacement of the nuts. When projection spot-welding is used for attaching plate nuts, control shall be maintained in order that removal, by drilling out the welds, permits replacement with drilled plate nuts.
 - g. Self-locking nuts that have been reworked or reprocessed shall not be used by contractors or field maintenance personnel of the services.
 - h. Cadmium plated self-locking nuts shall not be used in contact with titanium and titanium alloy bolts, screws or studs and in application where the operating temperatures exceed 450°F.
 - i. Silver plated self-locking nuts shall not be used in contact with titanium and titanium alloy bolts, screws or studs in application where the operating temperatures exceed 600°F.
 - j. Silver plated self-locking nuts shall not be used with silver plated bolts.
5. Design selection and approved call out. Fasteners in the category established by this requirement shall be selected from and specified by part numbers listed in Section 2.
6. Intended use and guidance criteria. Table 204-I is presented as an aid in the selection of nuts.
- 6.1 General criteria notes.
- a. The ultimate stress classification (ksi) of nuts listed corresponds with the ultimate strength level of the mating externally threaded fastener. The ultimate stress classification of nuts listed is a guide, and generally obtained when tested with bolts having a minimum tensile strength greater than the rated tensile strength of the nut. Consult specific standards for ultimate tensile values and details.
 - b. Where possible and practicable, mating parts (except where flush head bolts or anchor nuts are used) should have similar external wrenching configurations.
 - c. When outgassing characteristics are a requirement, refer to Requirements 102 and 103 and Marshall Space Flight Center document 10M90001.

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d. Cadmium-plated nuts shall not be used in space vehicle components or systems. Nuts that are lubricated with dry film lubricants may be used in space applications provided the lubricant has been approved as meeting the outgassing requirements.

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TABLE 204-I. Aid in the selection of nuts

Ultimate Tensile Stress, ksi	Drawing Number	Procurement Specification	Material	Temper- ature Limita- tion, °F	Coating or Plating	Remarks
<u>Plain (Nonself-Locking)</u>						
55	AN315	FF-N-836	Aluminum	250	Anodized	
55	AN316	FF-N-836	Steel	450	Cadmium	
110	AN315	FF-N-836	Steel	450	Cadmium	
110	AN315	FF-N-836	CRES	450	Passivated	
<u>Plain Castellated (Nonself-Locking)</u>						
29	AN320	FF-N-836	Aluminum	250	Anodized	
55	AN320	FF-N-836	Steel	450	Cadmium	
55	AN320	FF-N-836	CRES	450	Passivated	
55	AN310	FF-N-836	Aluminum	250	Anodized	
110	AN310	FF-N-836	Steel	450	Cadmium	
110	AN310	FF-N-836	CRES	450	Passivated	
<u>Plain-Castellated and Counterbored (Nonself-Locking)</u>						
60	MS21244	FF-N-836	Steel	450	Cadmium	
60	MS21244	FF-N-836	A 286 CRES	450	Passivated	
<u>Plain (Self-Locking)</u>						
30	MS21083	MIL-N-25027	Aluminum	250	Anodized	
60	MS21044	MIL-N-25027	Aluminum	250	Anodized	
60	MS21083	MIL-N-25027	Steel	250	Cadmium	
60	MS21083	MIL-N-25027	CRES	250	Passivated	
80	MS21045	MIL-N-25027	Steel	450	Cadmium	
80	MS21245	MIL-N-25027	Steel	450	Cadmium	
125	MS21043	MIL-N-25027	A 286 CRES	800	Silver	
125	MS21044	MIL-N-25027	Steel	250	Cadmium	
125	MS21044	MIL-N-25027	CRES	250	Passivated	
125	MS21045	MIL-N-25027	Steel	450	Cadmium	
125	MS21045	MIL-N-25027	CRES	450	Passivated	

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TABLE 204-I. Aid in the selection of nuts Continued

Ultimate Tensile Stress, ksi	Drawing Number	Procurement Specification	Material	Temper- ature Limita- tion, °F	Coating or Plating	Remarks
<u>Plain (Self-Locking)</u> Continued						
125	MS21046	MIL-N-25027	CRES	800	Silver	
125	MS20500	MIL-N-7873	CRES	1200	Silver	
125	NAS 1291	MIL-N-25027	A 286 CRES	450/800	Dry Film/ Silver	
160	MS21042	MIL-N-25027	Steel	450	Cadmium	
180	MS21133	MIL-N-8985	Steel	450	Cadmium	
180	MS14156	MIL-N-8985	Steel	450	Cadmium	Spline Drive Wheel
220	MS21084	MIL-N-8922	Steel	450	Cadmium	Spline Drive
220	MS14164	MIL-N-8922	Steel	450	Cadmium	Spline Drive Wheel
260	MS14164	MIL-N-8922	Steel	450	Cadmium	
260	MS21085	MIL-N-8984	Steel	450	Cadmium	Spline Drive
<u>Castellated (Self-Locking)</u>						
35	MS17826	MIL-N-25027	Steel	250	Cadmium	
60	MS14145	MIL-N-25027	Steel	450	Cadmium	
95	MS17825	MIL-N-25027	Steel	250	Cadmium	
125	MS14144	MIL-N-25027	Steel	450	Cadmium	
<u>Castellated and Counterbored (Self-Locking)</u>						
60	MS14146	MIL-N-25027	Steel	450	Cadmium	
60	MS21224	MIL-N-25027	Steel	250	Cadmium	

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TABLE 204-1. Aid in the selection of nuts Continued

Ultimate Tensile Stress, ksi	Drawing Number	Procurement Specification	Material	Temper- ature Limita- tion, °F	Coating or Plating	Remarks
<u>Self-Locking Plate and Channel</u>						
125	MS20501	MIL-N-7873	CRES	1200	Silver	2 Lug
125	MS21047	MIL-N-25027	Steel	450	Cadmium	2 Lug, Low Height
125	MS21048	MIL-N-25027	CRES	450	Passivated/ Dry Film	2 Lug, Low Height
125	MS21048	MIL-N-25027	CRES	800	Silver	2 Lug, Low Height
125	MS21049	MIL-N-25027	Steel	450	Cadmium	2 Lug, Countersunk
125	MS21050	MIL-N-25027	CRES	450	Passivated/ Dry Film	2 Lug, Countersunk
125	MS21050	MIL-N-25027	CRES	800	Silver	2 Lug, Countersunk
125	MS21051	MIL-N-25027	Steel	450	Cadmium	1 Lug, Low Height
125	MS21052	MIL-N-25027	CRES	450	Passivated/ Dry Film	1 lug, Low Height
125	MS21052	MIL-N-25027	CRES	800	Silver	1 Lug, Low Height
125	MS21053	MIL-N-25027	Steel	450	Cadmium	1 Lug, Countersunk
125	MS21054	MIL-N-25027	CRES	450	Passivated/ Dry Film	1 Lug, Countersunk
125	MS21054	MIL-N-25027	CRES	800	Silver	1 Lug, Countersunk
125	MS21055	MIL-N-25027	Steel	450	Cadmium	Corner, Low Height
125	MS21056	MIL-N-25027	CRES	450	Passivated/ Dry Film	Corner, Low Height
125	MS21056	MIL-N-25027	CRES	800	Silver	Corner, Low Height
125	MS21057	MIL-N-25027	Steel	450	Passivated/ Dry Film	Corner, Countersunk
125	MS21058	MIL-N-25027	CRES	450	Cadmium	
125	MS21058	MIL-N-25027	CRES	800	Silver	Corner, Countersunk

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TABLE 204-I. Aid in the selection of nuts Continued

Ultimate Tensile Stress, ksi	Drawing Number	Procurement Specification	Material	Temper- ature Limita- tion, °F	Coating or Plating	Remarks
<u>Self-Locking Plate and Channel</u> Continued						
125	MS21059	MIL-N-25027	Steel	450	Cadmium	2 Lug, Floating
125	MS21060	MIL-N-25027	CRCS	450	Passivated/ Dry Film	2 Lug, Floating
125	MS21060	MIL-N-25027	CRCS	800	Silver	2 Lug, Floating
125	MS21061	MIL-N-25027	Steel	450	Cadmium	1 Lug, Floating
125	MS21062	MIL-N-25027	CRCS	450	Passivated/ Dry Film	1 Lug, Floating
125	MS21062	MIL-N-25027	CRCS	800	Silver	1 Lug, Floating
125	MS21063	MIL-N-25027	Steel	250	Cadmium	Aluminum Channel
125	MS21064	MIL-N-25027	Steel	450	Cadmium	CRCS Channel
125	MS21065	MIL-N-25027	CRCS	450	Passivated/ Dry Film	CRCS Channel
125	MS21065	MIL-N-25027	CRCS	800	Silver	CRCS Channel
125	MS21066	MIL-N-25027	Steel	250	Cadmium	Aluminum Channel, Countersunk
125	MS21067	MIL-N-25027	Steel	450	Cadmium	CRCS Channel, Countersunk
125	MS21068	MIL-N-25027	CRCS	450	Passivated/ Dry Film	CRCS Channel, Countersunk
125	MS21068	MIL-N-25027	CRCS	800	Silver	CRCS Channel, Countersunk
125	MS21069	MIL-N-25027	Steel	450	Cadmium	2 Lug, Reduced Spacing
125	MS21070	MIL-N-25027	CRCS	450	Passivated/ Dry Film	2 Lug, Reduced Spacing
125	MS21070	MIL-N-25027	CRCS	800	Silver	2 Lug, Reduced Spacing
125	MS21072	MIL-N-25027	CRCS	450	Passivated/ Dry Film	1 Lug, Reduced Spacing
125	MS21072	MIL-N-25027	CRCS	800	Silver	1 Lug, Reduced Spacing
125	MS21073	MIL-N-25027	Steel	450	Cadmium	Corner, Reduced Spacing

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TABLE 204-I. Aid in the selection of nuts Continued

Ultimate Tensile Stress, ksi	Drawing Number	Procurement Specification	Material	Temper- ature Limita- tion, °F	Coating or Plating	Remarks
<u>Self-locking Plate and Channel</u> Continued						
125	MS21074	MIL-N-25027	CRES	450	Passivated/ Dry Film	Corner, Reduced Spacing
125	MS21074	MIL-N-25027	CRES	800	Silver	Corner, Reduced Spacing
125	MS21075	MIL-N-25027	Steel	450	Cadmium	2 Lug, Floating Reduced Spacing
125	MS21076	MIL-N-25027	CRES	450	Passivated/ Dry Film	2 Lug, Floating Reduced Spacing
125	MS21076	MIL-N-25027	CRES	800	Silver	2 Lug, Floating Reduced Spacing
125	MS21077	MIL-N-25027	Steel	250	Cadmium	Nylon Insert, 2 Lug
125	MS21078	MIL-N-25027	Steel	250	Cadmium	Non-metallic Insert, 2 Lug
125	MS21079	MIL-N-25027	Steel	250	Cadmium	Nylon Insert, Channel
125	MS21080	MIL-N-25027	Steel	250	Cadmium	Nylon Insert, 1 Lug
125	MS21081	MIL-N-25027	Steel	250	Cadmium	Nylon Insert, Corner
125	MS21082	MIL-N-25027	Steel	250	Cadmium	Nylon Insert, 1 Lug, Floating
125	MS21086	MIL-N-25027	Steel	450	Cadmium	Side-by-Side Reduced Spacing
125	MS21087	MIL-N-25027	CRES	450	Passivated/ Dry Film	Side-by-Side Reduced Spacing
125	MS21087	MIL-N-25027	CRES	800	Silver	Side-by-Side Reduced Spacing
125	NAS 1473	MIL-N-25027	Steel	225	Cadmium	Self Sealing
125	NAS 1473	MIL-N-25027	CRES	450	Silver	Self Sealing
125	NAS 1474	MIL-N-25027	Steel	225	Cadmium	Self Sealing
125	NAS 1474	MIL-N-25027	CRES	450	Silver	Self Sealing
	AN256	MIL-N-25027	Aluminum	250	Anodized	Right Angle
	AN256	MIL-N-25027	Steel	250	Cadmium	Right Angle

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Ultimate Tensile Stress, ksi	Drawing Number	Procurement Specification	Material	Temper- ature Limita- tion, °F	Coating or Plating	Remarks
<u>Self-locking Plate and Channel</u> Continued						
160	NAS 1770	NAS 3350	Steel	450	Cadmium	2 Lug, Low Height
160	NAS 1770	MIL-N-25027	CRES	800	Silver	2 Lug, Low Height
160	NAS 1771	MIL-N-25027	CRES	800	Silver	1 Lug, Low Height
160	NAS 1771	NAS 3350	Steel	450	Cadmium	Corner, Low Height
160	NAS 1772	NAS 3350	Steel	450	Cadmium	1 Lug, Low Height
160	NAS 1772	MIL-N-25027	CRES	800	Silver	Corner, Low Height
160	NAS 1773	NAS 3350	Steel	450	Cadmium	2 Lug, Floating
160	NAS 1773	MIL-N-25027	CRES	800	Silver	2 Lug, Floating
160	NAS 1774	NAS 3350	Steel	450	Cadmium	1 Lug, Floating
160	NAS 1774	MIL-N-25027	CRES	800	Silver	1 Lug, Floating
160	NAS 1775	NAS 3350	Steel	450	Cadmium	2 Lug, Reduced Spacing
160	NAS 1775	MIL-N-25027	CRES	800	Silver	2 lug, Reduced Spacing
160	NAS 1776	NAS 3350	Steel	450	Cadmium	1 Lug, Reduced Spacing
160	NAS 1776	MIL-N-25027	CRES	800	Silver	1 Lug, Reduced Spacing
160	NAS 1777	NAS 3350	CRES	450	Cadmium	Corner, Reduced Spacing
160	NAS 1777	MIL-N-25027	CRES	800	Silver	Corner, Reduced Spacing
160	NAS 1778	NAS 3350	Steel	450	Cadmium	1 Lug, Side-by-Side Reduced Spacing
160	NAS 1778	MIL-N-25027	CRES	800	Silver	1 Lug, Side-by-Side Reduced Spacing
160	NAS 1779	NAS 3350	Steel	450	Cadmium	2 Lug, Floating. Reduced Spacing

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TABLE 204-I. Aid in the selection of nuts Continued

Ultimate Tensile Stress, ksi	Drawing Number	Procurement Specification	Material	Temper- ature Limita- tion, °F	Coating or Plating	Remarks
<u>Self-Locking Plate and Channel</u> Continued						
160	NAS 1779	MIL-N-25027	CRES	800	Silver	2 Lug, Floating, Reduced Spacing
160	NAS 1780	NAS 3350	Steel	450	Cadmium	2 Lug, Low Height Countersunk
160	NAS 1780	MIL-N-25027	CRES	800	Silver	2 Lug, Low Height Countersunk
160	NAS 1781	NAS 3350	Steel	450	Cadmium	1 Lug, Low Height Countersunk
160	NAS 1781	MIL-N-25027	CRES	800	Silver	1 Lug, Low Height Countersunk
160	NAS 1782	NAS 3350	Steel	450	Cadmium	Corner, Low Height Countersunk
160	NAS 1782	MIL-N-25027	CRES	800	Silver	Corner, Low Height, Countersunk
160	NAS 1783	NAS 3350/	Steel/	250	Cadmium/ Dry Film	Aluminum Channel, Counterbore
160	NAS 1783	NAS 3350/ MIL-N-25027	Steel/CRES	450	Cadmium/ Dry Film	CRES Channel, Counterbore
160	NAS 1784	MIL-N-25027	CRES	800		CRES Channel, Counterbore
160	NAS 1784	NAS 3350/ MIL-N-25027	Steel/CRES	250	Cadmium/ Dry Film	Aluminum Channel Countersunk
160	NAS 1784	NAS 3350/ MIL-N-25027	Steel/CRES	450	Cadmium/ Dry Film	CRES Channel, Countersunk
160	NAS 1784	MIL-N-25027	CRES	800	Silver	CRES Channel, Countersunk
160	NAS 1789	NAS 3350	Steel	450	Cadmium/ Dry Film	Side-by-Side, Floating
160	NAS 1789	MIL-N-25027	CRES	800	Silver	Reduced Spacing

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TABLE 204-I. Aid in the selection of nuts Continued

Ultimate Tensile Stress, ksi	Drawing Number	Procurement Specification	Material	Temper- ature Limita- tion, °F	Coating or Plating	Remarks
<u>Miscellaneous Nuts (Self-Locking Barrel)</u>						
160	NAS 577	MIL-N-25027	Steel	450	Cadmium	Use with NAS 578 retainer. Code "X" not approved for general use.
<u>Nut, Blind Rivet</u>						
645	NAS 1329	None	6053-T4 Aluminum	250	Anodized	* NAS blind rivet nuts are not con- trolled by the Military.
90	NAS 1329	None	1180 or 1110 Steel	450	Cadmium	
125	NAS 1329	None	430 CRES	600	Passivated	Use only self- locking and closed-end types.
160	NAS 1329	None	4037 Steel	450	Cadmium	
45	NAS 1330	None	6053-T4 Aluminum	250	Anodized	
90	NAS 1330	None	1108 or 1110 Steel	450	Cadmium	
125	NAS 1330	None	430 CRES	600	Passivated	
160	NAS 1330	None	4037 Steel	450	Cadmium	
60	MS27130	None	6053-T4 Aluminum	250	Anodized	
115	MS27130	None	1108 or 1110 Steel	450	Cadmium	
130	MS27130	None	430 CRES	600	Passivated	
100	MS27130	None	Brass	250		

* Denotes change.

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SPACERS

1. Purpose. This requirement shall establish engineering criteria and requirements for the use of spacers in the design and construction of aerospace systems.

2. Documents applicable to Requirement 208.

MS21126	Spacer, Grooved, Self-Retaining Bolt, Aluminum Alloy
MS21128	Spacer, Grooved, Self-Retaining Bolt, CRES
NAS 42	Spacers Rivet
NAS 43	Spacers, Screw and Bolt
NAS 1056	Spacer, Sleeve-Rivet, High-Temperature, Nonmagnetic
NAS 1057	Spacer, Sleeve-Screw and Bolt, High-Temperature, Nonmagnetic
NAS1786.	Post, Electrical, - Mechanical Equipment

3. Definitions

3.1 Spacer

3.1.1 Spacer, plate. An item having a solid (unlaminated) cross section of any shape and designed to maintain a predetermined distance between assembled parts. (Also see Requirement 210 Shims.)

3.1.2 Spacer, sleeve. A tubular shaped item with a round or hexagon peripheral shape having two flat bearing surfaces perpendicular to the axis of the centrally located hole and designed to maintain a predetermined distance between assembled parts.

3.1.3 Spacer, stepped (sleeve). A rigid, cylindrical item having one or more internal counterbores and/or external diameters. It is used in mechanical, electrical, or optical devices to maintain a predetermined distance between assembled parts or to provide location for intermediate components located between primary assembly elements.

3.1.4 Spacer, ring. Essentially a sleeve spacer except that the diameter of the centrally located hole exceeds 75 percent of the outside diameter and the thickness is less than 25 percent of the outside diameter.

3.2 Design, usage limitations. See table 208-I

4. Design selection and approved callout. Fastener systems in this category, established by this requirement, shall be selected from table 208-I.

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TABLE 208-1. Aid in the selection of spacers.

Type	Basic Par No	Material	Finish	Remarks
Rivet Spacer	NAS 42	AL Alloy 2219 and 2024	Chem Film or Chem Film/ Anodized	Refer to the applicable Standard Drawing for available sizes, dimensional data and complete part number
		Alloy Steel 4130/8630	Cadmium Plated (1)	Note: Code A of NAS 42 and 43 not approved for Navy use (MIL-BUL-147)
	NAS 1056	CRES 303	None	
		A-286	Passivated	
		Inconel X	None	
Screw and Bolt Spacer	NAS 43	AL Alloy 2024	Chem Film/ Anodized	
		Alloy Steel 4130/8630	Cadmium Plated (1)	
	NAS 1057	CRES 303	None	
		A-286	Passivated	
		Inconel X	None	

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TABLE 208-I. Aid in the selection of spacers. - Continued

Type	Basic Par No	Material	Finish	Remarks
Self-Retaining Bolt Spacer	MS21126 (2)	AL Alloy 2024	Anodized	
	MS21128 (2)	CRES 302/303	Passivated	
Post, Electrical (Internally Threaded)	NAS 1786	AL Alloy 2024/2011	Anodized	
		Brass	Cadmium Plated (1)	
		CRES	Passivated	
		Alloy Steel 4130/8630 8740	Cadmium Plated (1)	

(1) Cadmium plated spacers shall not be used in applications where outgassing is a problem, nor in enclosed areas in the presence of electronic equipment.

(2) Also see Requirement 203.

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