



SURFACE VEHICLE STANDARD

J2280™**DEC2021**Issued 1996-04
Revised 2021-12

Superseding J2280 APR1996

(R) Ship Systems and Equipment - Fasteners - Selection and Identification Guidance

RATIONALE

This document has not been revised since 1996; due to extensive changes, this document has been rewritten and retitled appropriately as a guidance document. Definitions have been rewritten for consistency with SAE J2270 and/or modified to be in accordance with Navy and other industry standards. References have been updated and new references added.

TABLE OF CONTENTS

1.	SCOPE.....	4
1.1	Purpose.....	4
1.2	DoD Requirements.....	4
2.	REFERENCES.....	4
2.1	Applicable Documents	4
2.1.1	SAE Publications.....	4
2.1.2	NAS Publications	5
2.1.3	ASME Publications.....	6
2.1.4	ASTM Publications.....	7
2.1.5	U.S. Government Publications.....	8
2.1.6	NAVSEA Publications	10
2.1.7	ISO Publications.....	10
2.1.8	Other Publications.....	10
3.	DEFINITIONS	10
4.	FASTENER SELECTION.....	15
4.1	Fastener Part Standard Selection.....	15
4.1.1	Order of Preference for Part Standard Selection	15
4.2	Panel Fasteners and Welding Studs.....	16
4.3	Washers	16
5.	PERFORMANCE REQUIREMENTS FOR FASTENER MATERIAL SELECTION	16
5.1	Nonmagnetic Applications	17
5.1.1	Nickel Alloys.....	17
5.1.2	Titanium Alloys.....	17
5.1.3	CRES	18
5.1.4	Magnetic Permeability Tests.....	18
5.2	Corrosion Resistance.....	18
5.2.1	Inherent Corrosion Resistance	18

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2021 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE J2280_202112

For more information on this standard, visit
https://www.sae.org/standards/content/J2280_202112

Documents

Document Sharing Hub

5.2.2	Galvanic Corrosion.....	18
5.3	High-Strength Fasteners	18
5.3.1	Stress-Corrosion Cracking	19
5.4	Minimizing Galling	19
5.5	Temperature Limits	19
5.6	Material Standards	20
5.6.1	Ni-Cu-Al (K-Monel).....	20
5.6.2	Powder-Metallurgy	20
5.6.3	Industry Fastener Material and Dimension Standards.....	20
6.	FASTENER THREAD SELECTION CRITERIA.....	23
6.1	Fastening	23
6.2	Thread Form	23
6.3	Thread Series.....	24
6.3.2	Unified Fine Threads.....	24
6.3.3	Constant Pitch Threads.....	25
6.3.4	MJ, UNR, and UNJ Threads	25
6.3.5	Nonstandard Threads	25
6.4	Thread Class	26
6.4.1	Metric Threads	26
6.4.2	Selection Criteria	26
6.4.3	Class 5	26
6.5	Thread Length	27
6.5.1	Tapped-Hole Installation	27
6.5.2	Through-Hole Installation	28
6.6	Fasteners for Use in Critical and Vital Systems.....	28
6.6.1	Critical and Vital Systems	28
6.6.2	Requirements for Fasteners in Critical and Vital Systems.....	28
7.	PLATINGS, COATINGS, AND SURFACE TREATMENTS	29
7.1	General Guidance	29
7.1.1	Dry Applications	29
7.1.2	Wet Applications	29
7.1.3	Submerged Applications	29
7.2	Selection Criteria	29
7.3	Zinc, Zinc-Nickel and Cadmium Coating.....	32
7.3.1	Restrictions and Limitations on Use of Electroplated Coatings	32
7.3.2	Hot-Dipped Zinc Coating.....	33
7.3.3	Mechanically Deposited Zinc	33
7.3.4	Zinc Flake and Zinc-Aluminum Flake Coatings	33
7.4	Metallic-Ceramic Coating	33
7.5	Black Oxide Coating.....	33
7.5.1	Usage Restrictions	33
7.6	Silver Plating	34
7.7	Solid Film Lubricants.....	34
7.8	Surface Treatments.....	34
8.	LOCKING DEVICES AND ELEMENTS	34
8.1	Alternate Locking Devices and Methods.....	34
8.1.1	Fasteners Subject to Tampering	34
8.1.2	Inserts.....	34
8.1.3	Inaccessible Fasteners	34
8.1.4	Fasteners Used in Reassembly	35
8.2	Selection Criteria	35
8.2.1	Self-Locking Fasteners	35
8.2.2	Anaerobic Locking Compounds	35
8.2.3	Mechanical Thread-Locking Devices	35
9.	SCREW THREAD FASTENER INSERTS	36
9.1	General Requirements	36

9.2	Insert Selection	36
9.3	Insert Materials.....	36
9.4	Insert Length	37
9.5	Temperature Limits	37
10.	FASTENER PART OR IDENTIFYING NUMBERS	37
10.1	Scope and Purpose.....	37
10.2	General Requirements	37
10.3	Detailed Requirements.....	37
10.3.1	Part Numbering Systems	37
11.	IDENTIFICATION MARKINGS	38
11.1	Scope and Purpose.....	38
11.2	Fastener Marking	38
11.3	Fastener Marking Guidance.....	38
11.3.1	Military	38
11.3.2	Commercial	39
11.3.3	Marking Methods.....	39
11.3.4	Self-Locking Identification	39
11.4	Manufacturer's Identification	39
12.	FASTENER TEST REQUIREMENTS.....	39
12.1	Fastener Testing	39
12.2	Fastener Inspection.....	39
12.3	Thread Gaging Requirements for Small Lots.....	39
12.4	Manufacturer's Test Reports.....	39
13.	NOTES	40
13.1	Revision Indicator.....	40
13.2	Implementation.....	40
13.3	Military and Government Applications	40
APPENDIX A	SUPPLEMENTAL MILITARY REQUIREMENTS	41
Table 1	Material selection guide for fasteners	17
Table 2	Magnetic acceptability of corrosion resistant steel (300 series)	18
Table 3	Maximum temperature limits for fastener materials	19
Table 4	Selected industry and fastener material standards ⁽¹⁾	21
Table 5	Thread type comparison	25
Table 6	Finish selection for selected steel and CRES fasteners	30
Table 7	Recommended temperature limits for screw thread inserts	37

1. SCOPE

This SAE Standard provides a comprehensive list of guidelines for the selection, identification, and control of metric- and inch-sized fasteners for use in shipboard applications for both shipbuilder installed joints and for use in shipboard components. This guidance includes the following:

- a. Fastener material selection.
- b. Fastener thread form and fit selection.
- c. Selection of fastener finish, when needed.
- d. Selection of locking devices and elements, when needed.
- e. Selection of screw thread fastener inserts, when needed.
- f. Use of fastener part or identifying numbers.
- g. Identification marking requirements.

1.1 Purpose

The purpose of this document is to assist the designer in selecting a fastener and in determining what fastener options should be specified for a particular application. This document is intended to provide uniform guidance for the shipboard use of threaded fasteners and their associated hardware. It is also intended to promote the use of standardized fasteners and to minimize the variety of fasteners used.

1.2 DoD Requirements

[Appendix A](#) lists additional requirements that apply to military ships and other ships when specifically invoked.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2411	Plating, Silver, for High Temperature Applications
AMS2700	Passivation of Corrosion Resistant Steels
AMS5732	Steel, Corrosion and Heat Resistant, Bars, Wire, Forging, Tubing, and Rings, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution and Precipitation Heat Treated
AS478	Identification Marking Methods
AS567	Safety Cable, Safety Wire, Key Washers, and Cotter Pins for Propulsion Systems, General Practices for Use of
AS3509	Cable, Safety, Kit, Nickel Alloy, UNS N0660

AS3510	Cable, Safety, Kit, Corrosion And Heat Resistant Steel, UNS S32100
AS3511	Cable, Safety, Kit, Corrosion Resistant Steel, UNS S30400
AS4536	Safety Cable Kit Procurement Specification and Requirement for Use
AS7468	Bolts, Cobalt-Chromium-Nickel Alloy UNS R30035, Tensile Strength 260 ksi, Procurement Specification
SAE J429	Mechanical and Material Requirements for Externally Threaded Fasteners
SAE J995	Mechanical and Material Requirements for Steel Nuts
SAE J1781	Ship Systems and Equipment - Materials for Fluid Systems
SAE J2270	Ship Systems and Equipment - Threaded Fasteners - Inspection, Test, and Installation Guidance
SAE J2271	Ship Systems and Equipment - Part Standard for Studs - Continuous and Double End (Inch Series)
SAE J2271M	Ship Systems and Equipment - Part Standard for Studs - Continuous and Double End (Metric)
SAE J2295	Fastener Part Standard - Cap Screws, Hex, Heavy Hex, and Heavy Hex Structural Bolts and Hex Nuts (Inch Dimensioned)
SAE J2295M	Fasteners - Part Standard - Cap Screws, Hex Bolts, and Hex Nuts (Metric)
SAE J2655	Fastener Part Standard - Washers and Lockwashers (Inch Dimensioned)

2.1.2 NAS Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NAS1283	Fasteners, Male Threaded, Self-Locking
NAS1351	Screw, Cap, Socket Head, Undrilled and Drilled, Plain and Self-Locking, Alloy Steel, Corrosion-Resistant Steel and Heat-Resistant Steel, UNRF-3A
NAS1352	Screw, Cap, Socket Head, Undrilled and Drilled, Plain and Self-Locking, Alloy Steel, Corrosion-Resistant Steel and Heat-Resistant Steel, UNRC-3A AND UNRC-2A
NASM8846	Insert, Screw-Thread, Helical Coil
NASM15981	Fasteners, Externally Threaded, Self-Locking Design and Usage Limitations for
NASM17828	Nut, Self-Locking, Hexagon Regular-Height (Non-Metallic Insert) 250 °F Or 450 °F, Nickel-Copper Alloy
NASM17829	Nut, Self-Locking, Hexagon Regular-Height (Non-Metallic Insert) 250 °F, Non-Metallic Insert, Non-Corrosion Resistant Steel
NASM17830	Nut, Self-Locking, Hexagon Regular-Height (Non-Metallic Insert) 250 °F Or 450 °F, Non-Metallic Insert, 300 Series CRES
NASM25027	Nut, Self-Locking, 250 °F, 450 °F, 800 °F
NASM33537	Insert, Screw Thread, Helical Coil, Inch Series, Course and Fine Thread, Standard Assembly, Dimensions for

NASM33540	Safety Wiring, Safety Cabling, Cotter Pinning, General Practices
NASM33588	Nut, Self-Locking, Aircraft, Reliability and Maintainability Usage Requirements for
NASM45915	Stud, Locked in, Key Locked, General Specification for

2.1.3 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.2	Gages and Gaging for Unified Inch Screw Threads
ASME B1.3	Screw Thread Gaging Systems for Acceptability, Inch and Metric Screw Threads (UN, UNR, UNJ, M and MJ)
ASME B1.12	Class 5 Interference-Fit Thread
ASME B1.13M	Metric Screw Threads - M Profile
ASME B1.15	Unified Inch Screw Thread, UNJ Thread Form
ASME B1.16M	Gages and Gaging for Metric M Screw Threads
ASME B1.21M	Metric Screw Threads - MJ Profile
ASME B18.2.1	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
ASME B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange and Coupling Nuts (Inch Series)
ASME B18.2.3.3M	Metric Heavy Hex Screws
ASME B18.2.3.5M	Metric Hex Bolts
ASME B18.2.4.1M	Metric Hex Nuts, Style 1
ASME B18.2.6	Fasteners for Use in Structural Applications
ASME B18.2.6M	Metric Fasteners for Use in Structural Applications
ASME B18.3	Socket, Cap, Shoulder, Set Screws and Hex Keys - Inch
ASME B18.3.1M	Socket Head Cap Screws - Metric
ASME B18.31.1.M	Metric, Continuous and Double-End Studs
ASME B18.31.2	Continuous Thread Studs, Double-End Stud and Flange Bolting Stud (Stud Bolt) (Inch Series)
ASME Y14.34	Associated Lists

2.1.4 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A193/A193M	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194/A194M	Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A307	Carbon Steel Bolts, Studs and Threaded Rod, 60,000 psi Tensile Strength
ASTM A354	Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners
ASTM A380/A380M	Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems
ASTM A449	Hex Cap Screws, Bolts and Studs, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A453/A453M	High-Temperature Bolting, with Expansion Coefficients Comparable to Austenitic Steels
ASTM A563	Carbon and Alloy Steel Nuts
ASTM A563M	Carbon and Alloy Steel Nuts [Metric]
ASTM A574	Alloy Steel Socket Head Cap Screws
ASTM A574M	Alloy Steel Socket Head Cap Screws [Metric]
ASTM A967/A967M	Chemical Passivation Treatments for Stainless Steel Parts
ASTM B633	Electrodeposited Coatings of Zinc on Iron and Steel
ASTM B637	Precipitation Hardening and Cold Worked Nickel Alloy Bars, Forgings, and Forging Stock for Moderate and High Temperature Service
ASTM B695	Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM B805	Standard Specification for Precipitation Hardening Nickel Alloys
ASTM D5363	Anaerobic Single-Component Adhesives (AN)
ASTM F467	Nonferrous Nuts for General Use
ASTM F467M	Nonferrous Nuts for General Use [Metric]
ASTM F468	Nonferrous Bolts, Hex Cap screws, Socket Head Cap Screws and Studs for General Use
ASTM F468M	Nonferrous Bolts, Hex Cap screws and Studs for General Use [Metric]
ASTM F593	Stainless Steel Bolts, Hex Cap Screws and Studs
ASTM F594	Stainless Steel Nuts
ASTM F788	Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series
ASTM F812	Surface Discontinuities of Nuts, Inch and Metric Series

ASTM F835	Alloy Steel Socket Button and Flat Countersunk Head Cap Screws
ASTM F836M	Style 1 Stainless Steel Metric Nuts
ASTM F837	Stainless Steel Socket Head Cap Screws
ASTM F837M	Stainless Steel Socket Head Cap Screws [Metric]
ASTM F879	Stainless Steel Socket Button and Flat Countersunk Head Cap Screws
ASTM F879M	Stainless Steel Socket Button and Flat Countersunk Head Cap Screws [Metric]
ASTM F1136/F1136M	Zinc/Aluminum Corrosion Protective Coatings for Fasteners
ASTM F1941/F1941M	Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric
ASTM F2328	Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws, Studs and Nuts
ASTM F2329/F2329M	Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F2833	Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type
ASTM F3125/F3125M	High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

2.1.5 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

Industry standards that have been adopted by the Department of Defense (DOD) can be ordered by DOD activities only from this address: DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.1.5.1 Department of Defense Publications

DODISS Index of Specifications and Standards

2.1.5.2 Federal Specifications

FF-S-86 Screw, Cap, Socket Head
QQ-N-286 Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500)

2.1.5.3 Federal Standards

FED-STD-H28/2 Screw Thread Standards for Federal Services Section 2 Unified Inch Screw Threads - UN and UNR Thread Forms
FED-STD-H28/6 Screw Thread Standards for Federal Services Section 6 Gages and Gaging for Unified Screw Threads - UN and UNR Thread Forms
FED-STD-H28/22 Screw Thread Standards for Federal Services Section 22 Gages and Gaging for Metric Screw Threads - M and MJ Thread Forms
FED-STD-H28/23 Screw Thread Standards for Federal Services Section 23 Class 5 Interference Fit Screw Threads

2.1.5.4 Military Handbooks

MIL-HDBK-57 Listing of Manufacturers' Identification Symbols

MIL-HDBK-131 Identification Markings for Fasteners

2.1.5.5 Military Specifications

MIL-S-901 Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment and Systems, Requirements for

MIL-DTL-1222 Studs, Bolts, Screws and Nuts for Applications Where a High Degree of Reliability is Required

MIL-F-8961 Fastener Element, Self-Locking, Externally Threaded, 450 °F and 1200 °F

MIL-DTL-13924 Coating, Oxide, Black, for Ferrous Metals

MIL-DTL-18240 Fastener Element, Self-Locking, Threaded Fastener, 250 °F Maximum

MIL-S-24149 Studs, Welding, and Arc Shields (Ferrules)

MIL-S-22473 Sealing, Locking and Retaining Compounds (Single Component)

MIL-N-25027/1 Nut, Self-Locking, Heavy Hex (Non-metallic Insert), 250 °F and 450 °F, UNJC-3B, 1/4 through 2-1/2 Inch Nominal Diameters, Nickel-Copper Alloy

MIL-DTL-32258 Nut, Self-Locking (Ring Type Non-metallic Insert), Heavy Hex, UNJ Thread Profile Nickel-Copper Alloy

MIL-I-45914 Insert, Screw Thread - Locked In, Key Locked

MIL-I-45932 Insert, Screw Thread, Thin Wall, Locked In

MIL-S-46163 Sealing, Lubricating and Wicking Compounds: Thread-Locking, Anaerobic, Single Component

MIL-DTL-83488 Coating, Aluminum, High Purity

MIL-C-87115 Coating, Immersion Zinc Flake/Chromate Dispersion

2.1.5.6 Military Standards

MIL-STD-438 Schedule of Piping, Valves, Fittings and Associated Piping Components for Submarine Service

MIL-STD-777 Schedule of Piping, Valves, Fittings and Associated Piping Components for Naval Surface Ships

MIL-STD-1689 Fabrication, Welding, and Inspection of Ships Structure

2.1.5.7 Commercial Item Descriptions

A-A-59004 Anti-galling Compound, Thread Lubricating, Seizing Resistant, and Calcium Hydroxide Containing

A-A-59720 Sealing and Locking Compounds, Single-Component

2.1.6 NAVSEA Publications

Available from the Naval Sea Systems Command, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160 (request from appropriate contracting officer).

0908-LP-000-3010	Shock Design Criteria for Surface Ships
0941-LP-041-3010	Submarine Material Certification Design Review Procedure Manual (U) (Document is confidential, distribution restricted)
0948-LP-045-7010	Material Control Standard (Non-Nuclear)
0924-LP-062-0010	Submarine Material Certification Requirements Manual for the Submarine Safety Program (For official use only)

2.1.7 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO TR20491	Fundamentals of Hydrogen Embrittlement in Steel Fasteners
-------------	---

2.1.8 Other Publications

Ross, R.W. Jr. and Tuthill, A.H., "Practical Guide to Using Marine Fasteners," Materials Performance, Vol 29, No. 4 pp 6569 (1990) April.

3. DEFINITIONS

3.1 ALLOWANCE

The prescribed difference between the maximum material limits of mating parts. The allowance is the minimum clearance between mating parts to be assembled either loosely or tightly, depending on the amount allowed for the fit.

3.2 ALLOY STEEL

A type of steel containing significant quantities of alloying elements (other than carbon and the commonly accepted amounts of manganese, silicon, sulfur, and phosphorus) that are added to obtain specific mechanical or physical properties, such as toughness, hardness, strength at elevated temperatures and corrosion resistance.

3.3 ANAEROBIC THREAD-LOCKING COMPOUND

A compound that solidifies in the absence of air; used to secure threaded fasteners against loosening in service.

3.4 ANODE

In a metallic couple, the metal that corrodes.

3.5 BEARING SURFACE

The surface of the fastener that is at right angles to the fastener centerline and that bears against the part or parts that it fastens; the area under the nut or head of a bolt.

3.6 BOLT

A bolt is a threaded fastener with an integral, usually hexagonal, head on one end intended to be used with a nut. (Sometimes incorrectly called a cap screw; see [3.10](#).)

3.7 BOLT-STUD

See [3.42](#).

3.8 BOTTOMING

Bottoming is the process of screwing a fastener into a threaded hole until it contacts the bottom of the hole. The resulting stresses can lead to such things as cracked castings.

3.9 BREAKAWAY TORQUE

Breakaway torque is the torque required to start the rotation of a fastener. The magnitude of this torque is significant when checking the bonding of an anaerobic locking compound. The term is also used to describe the torque required to start the rotation of a fastener when loosening it or restarting its rotation when tightening a group of fasteners in successive increments. Breakaway torque will generally be higher than that required to continue the rotation.

3.10 CAP SCREW

A cap screw is a threaded fastener with an integral, head on one end that is intended to be used in a tapped hole. It has stringent controls on its dimensions so that it can be more easily screwed into a tapped hole. Cap screws typically have a hexagon, hexagon socket, or splined socket head style. Because of dimensional differences, cap screws may be used in place of bolts; however, bolts can not necessarily be used in place of cap screws.

3.11 CATHODE, CATHODIC PROTECTION

In a metallic couple, the more noble material which is protected against corrosion.

3.12 CLAMPING FORCE

Clamping force is the force created by tightening a threaded fastener.

3.13 CLASS OF THREAD

The class of thread is an alphanumeric designation to indicate the standard grade of tolerance and allowance specified for a thread.

3.14 FASTENER

A fastener is a mechanical device that holds two or more main bodies in definite positions with respect to each other.

3.15 FIT

Fit is the general term used to describe the range of looseness or tightness of two mating parts when they are assembled. This is the result of the application of a specific combination of allowances and tolerances.

3.16 FITTED BOLT

A stud or bolt that has been fitted to its mating hole so that the clearances between its unthreaded shank and its mating hole are extremely small. Normally, the hole is drilled and reamed true and square with the bearing surface and the bolt is machined to fit the hole. Fitted fasteners are used to provide for a positive location between mating parts in a joint or may remove thread shear loads resulting from specific design loading conditions (e.g., shock). Due to the dimensional tolerances involved, fitted fasteners cannot be inserted into tapped holes. A fitted bolt should not be confused with interference fit.

3.17 GALLING

A condition on any of the rubbing surfaces of one or both mating parts where friction between microscopic high spots causes localized welding, resulting in spalling, further roughening of the surface, followed by more severe localized welding.

3.18 HARDNESS

A property of metals which relates strength, elasticity, and toughness to the material's ability to resist abrasion and indentation. Hardness is usually defined quantitatively using the Rockwell, Brinell, and Vickers scales.

3.19 HEAD TYPE

The specific geometry or form of a fastener's head. Common head types are:

3.19.1 COUNTERSUNK HEAD

A head design usually characterized by a flat top surface and 82 degree or 100 degree bearing surface (as opposed to a 180 degree or flat-bearing surface found on common hex head fasteners). This head design is typically intended to be flush with the surface when installed, and usually has a hexagonal or splined socket drive or a slotted drive.

3.19.2 HEXAGON HEAD

A head design with flat top, six sides used as wrenching surfaces, and a flat bearing surface.

3.19.3 SOCKET HEAD

A circular head design with a cylindrical side surface and a flat bearing surface and hexagonal or splined recess socket.

3.20 INTERFERENCE FIT

An interference fit is the fit between mating assembled parts that provides an interference at their minimum material condition.

3.21 ksi

The abbreviation for 1000 pounds per square inch; the "k" represents kip, which is 1000 lbf.

3.22 LENGTH OF THREAD ENGAGEMENT

Length of thread engagement is the axial distance over which the complete external thread is in contact with the complete internal thread, measured at the pitch diameter.

3.23 MAGNETIC PERMEABILITY

The relationship, expressed in Oersteds, between magnetic induction and magnetizing force. Absolute permeability is the quotient of a change in magnetic induction divided by the corresponding change in magnetizing force. Relative permeability is the ratio of absolute permeability to the permeability of air.

3.24 MAJOR DIAMETER

On a straight thread, the major diameter is the diameter of the crest of the external thread or the root of the internal thread.

3.25 MAXIMUM MATERIAL

Maximum material is the condition where a feature of size contains the maximum amount of material within the stated limits of size. For example, the crest and root of an externally threaded fastener are at their maximum diameter, or the crest and root of an internally threaded fastener are at their minimum diameter.

3.26 MINIMUM MATERIAL

Minimum material is the condition where a feature of size contains the least amount of material within the stated limits of size. For example, crest and root of an externally threaded fastener are at their minimum diameter, or the crest and root of an internally threaded fastener are at their maximum diameter.

3.27 MINOR DIAMETER

On a straight thread, the minor diameter is the diameter of the root of the external thread or the crest of the internal thread.

3.28 MPa

The abbreviation for mega-pascals or 1000000 pascals, the standard unit of stress for metric fasteners.

3.29 PITCH

Pitch is the distance, measured parallel to the fastener's axis, between corresponding points on adjacent thread forms in the same axial plane and on the same side of the axis. Usually given in threads per inch (TPI). Metric threads are designated using the actual thread pitch.

3.30 PITCH DIAMETER

The pitch diameter is the diameter of an imaginary cylinder whose surface passes through the threads at the point where the width of the thread groove is the same as the width of the thread ridge, roughly halfway between the top and bottom of the thread.

3.31 PRELOAD

Preload is the amount of clamping force exerted by a fastener on joined members that is solely attributed to tightening of the fastener.

3.32 ROLL-FORMED THREADS

Threads formed by rolling the fastener blank between grooved dies.

3.33 ROOT DIAMETER

The root diameter is the diameter of an imaginary cylinder or cone bounding the bottom of the roots of a screw thread. Root diameter is the more common term for the minor diameter of an external thread or the major diameter of an internal thread.

3.34 SAFETY CABLE

Safety cable is an alternative to lock wire.

3.35 SELF-LOCKING FASTENER

A fastener having a self-contained locking feature, such as a nut with an integral annular nylon ring or a bolt with a nylon pellet, that resists rotation by gripping the mating thread and does not depend upon the applied load for locking.

3.36 SOCKET CAP SCREW

A socket cap screw is a cap screw with a hexagonal or spline socket with either a cylindrical head (socket head cap screw), a low rounded top head (socket button head cap screw), or a flat top with a conical head (socket flat countersunk head cap screw).

3.37 SOCKET HEAD CAP SCREW

A socket head cap screw is a cylindrical headed, externally threaded fastener with a recessed, hexagonal, or spline socket.

3.38 SPALLING

Spalling is the breaking or chipping off of material, usually by impact forces.

3.39 STANDARD FASTENERS

Standard fasteners are fasteners which conform in all respects to recognized and published standards such as military specification sheets or industry standards.

3.40 STANDARD PIN

A standard part or identifying number (PIN) is a part number designation identified in a recognized and published industry or military fastener standard.

3.41 STRUCTURAL BOLT

A structural bolt has a heavy hex head configuration having a washer face and a controlled thread length intended for use in structural connections and assemblies.

3.42 STUD

A stud is a cylindrical rod (headless fastener) threaded on either one or both ends or throughout its entire length. Some of the more common types are defined below:

3.42.1 BOLT STUD

See continuous thread stud and double end stud (clamping type).

3.42.2 CONTINUOUS THREAD STUD

A continuous thread stud is threaded its entire length with conventional threads for the assembly of nuts on both ends. (One end may be set in a tapped hole using an anaerobic compound.)

3.42.3 DOUBLE END STUD (CLAMPING TYPE)

This stud has conventional threads on both ends of the stud. It serves the function of clamping two bodies together with a nut on either end. (One end may be set in a tapped hole using an anaerobic compound.)

3.42.4 DOUBLE END STUD (INTERFERENCE THREAD TYPE)

This stud has conventional threads on the “nut” end and threads on the “stud” or “tap” end that will give an interference fit in the hole in which it is installed.

3.42.5 STUD BOLT

See [3.42.3](#).

3.42.6 TAP END STUD

See [3.42.4](#).

3.43 TENSILE STRENGTH

Tensile strength, also called ultimate strength, is the maximum tensile stress (in pounds per square inch or mega pascals) a material can sustain without tearing apart.

3.44 THROUGH BOLT

A through bolt is a bolt that passes completely through both members to be fastened and has a head on one end and a nut on the other. (See [3.6](#).)

3.45 TOLERANCE(S)

Tolerances are specified amounts by which dimensions are permitted to vary. The tolerance is the difference between the maximum and the minimum limits permitted.

3.46 TORQUE

Torque is a turning or twisting moment exerted on a fastener.

3.47 TORQUE, BREAKAWAY

See [3.9](#).

3.48 ULTIMATE STRENGTH

See [3.43](#).

3.49 WASHER FACE

A screw or nut configuration where the fastener has a raised bearing surface. The bearing surface is smooth and has a round outer diameter, and acts as an integral washer. (The only bolt that has a washer face is a heavy hex structural bolt.)

3.50 YIELD STRENGTH

Yield strength is a mechanical property that represents the maximum tensile stress that a material can sustain without causing more than a specified amount of permanent deformation.

4. FASTENER SELECTION

Unless otherwise specified, fasteners should be selected based on the requirements specified herein. The materials and other fastener options selected shall be suited to the application.

4.1 Fastener Part Standard Selection

After determining the required materials and other fastener options, a fastener part standard that defines those requirements should be selected. Standard fasteners with an industry or government standard or specification, are preferred for use over fasteners identified by company standards and drawings. The use of fastener part or identifying numbers (PINs) is outlined in Section [10](#).

4.1.1 Order of Preference for Part Standard Selection

Fastener part standards should be selected according to the following list. The order of precedence is in descending order.

- a. Fasteners with a part or identifying numbering system developed by a nongovernment standards body (NGSB).
- b. Fasteners with a part or identifying number based on a federal or military standard.
- c. Fasteners to non-government, federal or military standards without a part or identifying number (PIN).
- d. Fasteners to drawings complying with ASME Y14.34 part identification requirements and based on nongovernment standards.

NOTE: Part identification numbers for many fasteners to industry standards are identified in SAE J2295. Many additional part identifying numbers are identified in individual ASME, NAS, and SAE fastener part standards.