SAE International™ SURFACE VEHICLE STANDARD

SAE J2656

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Fastener Part Standard – Hexagon Socket, Square Head, and Slotted Headless Set Screws - Inch Dimensioned

1. Scope—This SAE Part Standard covers selected inch dimensioned set screws manufactured in accordance with American Society for Mechanical Engineers dimensional standards. This SAE standard covers material most often used in ship systems and equipment but its use may be applied wherever fasteners of the covered materials are used. This standard permits the fasteners to be identified and ordered by a part or identifying number (PIN) as defined in this document.

1.1 Purpose—The purpose of this document is to assist the designer and other personnel in providing requirements and PIN's for the most commonly used set screws for ship systems and equipment. A PIN is normally required for all military applications and provides a useful means of communicating set screw requirements to suppliers and manufacturers in a very succinct manner.

1.2 Set Screw Part Numbers—This document provides PIN's that can be used to identify set screws covered by this standard. The parts covered by this standard are manufactured in accordance with materials and processes identified in standards issued by ASTM. The PIN identifies the thread form, type of head, type of drive, nominal diameter, special features (plating, locking elements), nominal length and fastener material.

2. References

2.1 Applicable Publications—The following documents form a part of this standard to the extent specified herein. The latest issue of the documents shall be used except in those cases where an invitation for bid or procurement contract specifically identifies the issues in effect on a particular date.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, Pa 15096-0001. Web site: www.sae.org Tel: (724) 776-4970

SAE AMS 2485—Black Oxide Coating
SAE AMS 2487—Anodic Treatment of Titanium and Titanium Alloys—Solution pH 12.4 maximum
SAE AMS 2488—Anodic Treatment, Titanium and Titanium Alloys
SAE AS1701—Lubricant, Solid Dry Film
SAE J2270—Ship Systems and Equipment—Fasteners—Test, Inspection and Installation Requirements
SAE J2280—Ship Systems and Equipment—Fasteners—Selection and Identification Requirements

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
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2.1.2 NATIONAL AEROSPACE STANADARDS PUBLICATIONS—Available from the Aerospace Industries Association of America, Inc., 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3901 Web site: www.aia-aerospace.org; Tel: (202) 371-8400

NAS 1283—Fasteners, Male Threaded, Self-locking

2.1.3 ASME PUBLICATIONS—Available from the American Society of Mechanical Engineers, 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900. web site: www.asme.org Tel. (800) 843-2763

ASME B1.1—Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B18.6.2—Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws (Inch Series)
ASME B18.3—Socket Cap, Shoulder, and Set Screws, Hex and Spline Keys (Inch Series)

2.1.4 ASTM PUBLICATIONS—Available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Web site: www.astm.org Tel. (610) 832-4585

ASTM A 342/A 342M —Standard Test Methods for Permeability of Feebly Magnetic Materials
ASTM A 380—Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A 453/A 453M—Bolting Materials, High-Temperature, 50 to 120 ksi [345 to 827 MPa] Yield Strength, With Expansion Coefficients Comparable to Austenitic Steels
ASTM B 580—Standard Specification for Anodic Oxide Coatings on Aluminum
ASTM F 468—Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
ASTM F 880—Stainless Steel Socket Set Screws
ASTM F 912—Alloy Steel Socket Set Screws
ASTM F 1136—Chromium/Zinc Corrosion Protective Coating for Fasteners
ASTM F 1137—Phosphate/Oil; and Phosphate/Organic Corrosion Protective Coatings for Fasteners
ASTM F 1941—Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))

2.1.5 DEPARTMENT OF DEFENSE PUBLICATIONS—Available from the DOD Single Stock Point - DODSSP Building 4 / Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5098. web site: http://assist.daps.mil or http://assist2.daps.dla.mil/quicksearch/ Tel. (215) 697-2179

MIL-DTL-13924—Coating, Oxide, Black, For Ferrous Materials
MIL-DTL-16232—Phosphate Coating, Heavy, Manganese or Zinc Base

3. Fastener Part or Identifying Numbers

3.1 SAE Set Screw Standards—This set screw part standard utilizes ASME dimensional standards for set screws and primarily ASTM standards for materials.

3.2 Part or Identifying Numbers (PINs) for Selected Set Screws—PIN's are provided herein for selected set screws for the purpose of common logistics parts identification between designers, fastener manufacturers, construction and repair activities, and equipment operators. PIN's are provided for only those set screw configurations and materials most likely to be needed for ship systems and equipment. Figure 1 provides part or identifying numbers for selected set screws. The PIN consists of a number of fields in order as identified in Figure 1. (There are no blank spaces in the PIN.) The next to last field in the PIN, field 7, designates the set screw material. Table 1 lists the material designators for field 7 of the PIN along with the chemical and mechanical properties of the material.

3.3 Dimensional Requirements for Set Screws—The dimensional requirements for a particular set screw configuration are to be as shown in ASME B18.3 and ASME B18.6.2 for inch dimensioned set screws.

3.3.1 LENGTHS OF SET SCREWS—Length tolerances for inch dimensioned set screws shall be in accordance with ASME B18.3 and B18.6.2 as applicable.

3.3.2 DIAMETERS OF SET SCREWS—Diameters shall be restricted to those identified in ASME B18.3 and B18.6.2 as applicable.

3.3.3 THREAD TYPES AND FITS—Thread types and fits shall be restricted to those identified herein and permitted in the applicable dimensional standard. Threads, tolerances, allowances for plating, and gauging shall be Class 3A in accordance with ASME B18.3 for inch set screws. The threads on inch size screws shall be Unified Standard Class 3A in accordance with ASME B1.1. For threads with additive finish, the maximum diameters of Class 3A shall be met after coating. The basic diameters (Class 3A GO) shall apply to the finished part whether coated or not coated.

3.4 Coating Requirements—Coatings shall be limited to those identified herein. General industry practice is to provide set screws uncoated. Coatings may be applied to alloy steels for corrosion protection. The applicable coating shall be designated in the part identification number as indicated in Figure 1. All titanium set screws shall be coated and the coating is not identified in the PIN. While not normally recommended, the black oxide coating can be specified for materials other than carbon steels where a shiny natural appearance must be avoided.

J2656 C XX H C YY S1 F

Field 8 Coatings and Special Features
Field 7 Material
Field 6 Nominal Length
Field 5 Type of Point
Field 4 Type of Head
Field 3 Nominal Diameter
Field 2 Thread Form
Field 1 SAE Standard

Field 1 - SAE **J2656** Set Screw Part Standard

Field 2 Thread Form (See 3.3.3 for thread class)
C = UNC/UNRC (ASME B1.1) **F** = UNF/UNRF (ASME B1.1)

Field 3 Nominal Diameter (See 3.3.2 for selection of diameters.)

Field 3	UNC	UNF	Diameter	Field 3	UNC	UNF	Diameter
N2	2-56	2-64	0.086	**09***	9/16-12	9/16-18	0.5625
N3 *	3-48	3-56	0.099	**10**	5/8 - 11	5/8 – 18	0.625
N4	4-40	4-48	0.112	**12**	3/4 - 10	3/4 – 16	0.750
N5*	5-40	5-44	0.125	**14**	7/8 - 9	7/8 – 14	0.875
N6	6-32	6-40	0.138	**16**	1 - 8	1 - 12	1.000
N8	8-32	8-36	0.164	**18**	1-1/8 - 7	1-1/8-12	1.125
03	10-24	10-32	0.190	**20**	1-1/4 – 7	1-1/4 –12	1.250
04	¼-20	¼-28	0.250	**22**	1-3/8 – 6	1-3/8 –12	1.375
05	5/16-18	5/16-24	0.3125	**24**	1-1/2 – 6	1-1/2 –12	1.500
06	3/8 - 16	3/8 - 24	0.375	**28**	1-3/4 – 5	--	1.750
07 *	7/16-14	7/16-20	0.4375	**32**	2 - 4-1/2	---	2.000
08	1/2 - 13	1/2 - 20	0.500				

* These diameters are often not available and should not be used for new design

FIGURE 1—PART IDENTIFICATION NUMBERS FOR SET SCREWS (INCH DIMENSIONED)

Field 4 Type of Head

H – Hex Socket (See ASME B18.3)
L – Slotted Headless (See ASME B18.6.2)
S – Square Head (See ASME B18.6.2)

Field 5 Type of Point (See Head Type Dimensional Standard and 4.4 for additional information.)

C - Cup Point
D – Dog Point
F - Flat Point
H - Half Dog Point
N – Cone Point
V - Oval Point

Note: Dog Point is not to be specified for Hex Socket configuration (See ASME B18.6.2 for minimum length limitations.)

Field 6 Nominal Screw Length - Nominal Screw lengths shall be as identified below:

Field 6	Nominal Length	Field 6	Nominal Length	Field 6	Nominal Length
01	0.06	**07**	0.44	**20**	1.25
02	0.13	**08**	0.50	**24**	1.50
03	0.19	**10**	0.63	**28**	1.75
04	0.25	**12**	0.75	**32**	2.00
05	0.31	**14**	0.88		
06	0.38	**16**	1.00		

For lengths over 2.00 inches, Field 6 shall be the length in 16ths of an inch. Length tolerances shall be in accordance with the applicable dimensional standard as identified in Field 4. The following length increments are recommended:

Length	Recommended increments
< 1 inch	$1/16^{th}$ inch
1 to 2 inches	$1/8^{th}$ inch
2 to 5 inches	$1/4^{th}$ inch
> 5 inches	1/2 inch

Field 7 Material (See Table 1 and 3.5 for designator and mechanical property requirements)

Field 8 Coatings and Special Features (See 3.4 and 3.6)
Note: If no coating or special feature leave blank

Coatings— If no coatings are applicable, do not use coating designation. Otherwise select from the coatings below:

A = Aluminum plate (see 3.4.2)
B = Black oxide with supplementary treatment for corrosion resistance (see 3.4.3)
C = Cadmium electroplate (see 3.4.5)
D = Dry Film Lubricant (see 3.4.4)
M4 = Manganese Phosphate Coating with chemically converted Class 4 supplementary treatment (See 3.4.6)
Z = Zinc Electro-deposited (see 3.4.5)
Z1 = Zinc Phosphate with supplementary protective oil type compound (See 3.4.6)
Z2 = Zinc Phosphate Coating with supplementary zinc rich epoxy resin coating (See 3.4.6)
Z3 = Zinc/Aluminum Inorganic Coating (see 3.4.7)
Z4 = Zinc-Nickel Electro-deposited (see 3.4.5)

Special Features – The special features designations always follow the coating designator, if any.

L = Self-Locking (See 3.6)

FIGURE 1 PART IDENTIFICATION NUMBERS FOR SET SCREWS (INCH DIMENSIONED) (CONTINUED)

TABLE 1—MECHANICAL PROPERTY REQUIREMENTS FOR SET SCREW MATERIALS

Field 7 Designator	UNS Designation	Name/Material Specification[1]	Hardness	Additional Requirements
A1	UNS A96061	Aluminum 6061-T6	40 - 50 HRB	
A2	UNS A97075	Aluminum 7075-T73	80-90 HRB	
C2[2]	UNS C27000 or UNS C27400	Brass – Cu 270 or Brass – Cu 274	55-80 HRF	
G4	As applicable	Through Hardened Alloy Steel	45 – 53 HRC	ASTM F 912 for socket screws
G6	As applicable	Case Hardened Low Carbon Steel	See ASME B18.6.2	For B18.6.2 configurations
N4[2] (See 4.3)	UNS N04400 or UNS N04405	NI-Cu Alloy 400 or Ni-Cu Alloy 405	≤0.750 Diam. 85HRB - 25 HRC >0.750 Diam. 75HRB – 25HRC	
N5	UNS N05550	Ni-Cu-Al	24 – 37 HRC	
N6	UNS N06686	Ni-Cr-Mo-W Alloy 686	23 - 45 HRC	
S1[2] (See 4.3)		Austenitic Stainless Steel	96 HRB - 33 HRC	Alloys 303, 303se and XM1 not permitted (See 3.5.2).
	UNS S30400	Alloy 304		
	UNS S30403	Alloy 304L		
	UNS S30500	Alloy 305		
	UNS S38400	Alloy 384		
	UNS S30430	Alloy XM7		
	UNS S30433	Alloy 302 HQ		
	UNS S31600	Alloy 316		
	UNS S31603	Alloy 316L		
S2[2] (See 4.3)		Austenitic Stainless Steel	96 HRB - 33 HRC	(See 3.5.2)
	UNS S31600	Alloy 316		
	UNS S31603	Alloy 316L		
S6	UNS S66286	Alloy A 286 ASTM A 453/ A453M	99 HRB - 37 HRC	
T1	UNS R55111	Titanium Alloy 5111	24-38 HRC	

1. Unless otherwise indicated the requirements of the following specifications apply: (austenitic steel) - ASTM F 880, (alloy steel) - ASTM F 912, (non-ferrous) - ASTM F 468
2. For a specific designator, the supplier may furnish any of the alloys listed.

3.4.1 REQUIRED TREATMENTS/COATINGS FOR ALUMINUM, STAINLESS STEEL AND TITANIUM SET SCREWS—The following treatments are required for all set screws of the indicated material and is not identified in the part identification number since the treatment is mandatory.

3.4.1.1 *Aluminum*—All aluminum set screws shall be anodized in accordance with ASTM B 580.

3.4.1.2 *Stainless Steel*—All corrosion-resistant steel set screws shall be passivated in accordance with ASTM A 380. Additional coatings are not necessary for protection of corrosion resistant steel set screws but solid dry film lubricants (see 3.4.4) may be added for lubricity.

3.4.1.3 *Titanium*—Set screws of titanium alloy shall be anodized in accordance with SAE AMS 2487 or AMS 2488 Type 2 (except testing requirements may be negotiated between manufacturer and coating supplier).

3.4.2 ALUMINUM COATINGS—Aluminum coatings shall have a conversion or other top coat and shall meet the requirements of ASTM F 1137 for adhesion, coating flexibility, thread fit, dry to the touch and 400 hour corrosion resistance when tested per the procedures of ASTM F 1137. The number of coats of basecoat and topcoat and average thickness of coating as identified in ASTM F 1137 does not apply.

3.4.3 BLACK OXIDE COATINGS—Black oxide coatings shall be in accordance with SAE AMS 2485 or MIL-DTL-13924 and have an oil or other supplementary preservative treatment.

3.4.4 SOLID DRY FILM COATINGS—Dry or solid film lubricants can be used on set screws to prevent corrosion and to reduce installation friction. These coatings are suitable for use on titanium and corrosion resisting steel set screws to reduce friction and galling. Solid or dry film lubricants shall be in accordance with SAE AS1701 Class I except that heat and corrosion resistant screws shall be of a class rated for 399 °C (750 °F) or higher.

3.4.5 ELECTRO-DEPOSITED COATINGS—Electro-deposited coatings (zinc, zinc-nickel, and cadmium) shall be in accordance with ASTM F 1941 for inch dimensioned screws as provided herein. The minimum coating thickness shall be the thickness class for which the minimum thickness does not exceed one-sixth the pitch diameter allowance as identified in ASME B1.1. Low coating thickness impairs chromate adhesion and performance. The use of coated screws is not recommended when the coating thickness will be less than 0.00015 inches for inch screws when measured in accordance with ASTM F 1941. Additional corrosion protection shall be provided by a chromate or other finish that provides corrosion protection equivalent to designation D for cadmium, zinc and zinc-nickel as defined in ASTM F 1941.

Hydrogen embrittlement relief shall be provided in accordance with ASTM F 1941.

NOTE— Cadmium plating is not recommended for new design. See SAE J2280 Appendix for restrictions on use of cadmium in Navy applications. Some activities may restrict the use of chromate finishes.

3.4.6 PHOSPHATE COATINGS—Manganese Phosphate coatings should not be exposed to temperature in excess of 121 °C (250 °F). Zinc Phosphate coatings should not be used if contact with alkaline materials or exposure to temperatures above 93 °C (200 °F) is expected. A supplementary coating shall be provided for improved corrosion resistance and shall be selected from one of the applicable coatings below:

M4 – Manganese Phosphate with chemically converted supplemental treatment in accordance with MIL-DTL-16232, Type M, Class 2
Z1 = Zinc Phosphate with supplementary protective oil type compound (Coating shall be in accordance with MIL-DTL-16232 or ASTM F 1137 and shall meet 72 hour salt spray test.)
Z2 = Zinc Phosphate Coating with supplementary zinc rich epoxy resin coating. (Coating shall be in accordance with ASTM F 1137 Grade II or Grade III and shall meet 240 hour salt spray test.)

3.4.7 ZINC/ALUMINUM OR CHROMIUM ZINC INORGANIC COATING—This coating shall meet the requirements of Grade 3 in accordance with ASTM F1136 except that a pigmented topcoat is permitted. (If a particular pigmented topcoat color is required it must be specifically identified on the ordering documentation.)

3.5 Materials—Materials shall be limited to those listed in Table 1 and shall be designated in Field 7 of the PIN by the two character designation listed in Table 1.

3.5.1 STEEL SET SCREWS—Square Head and Slotted Headless Set Screws of steel material shall either be case hardened steel or through hardened alloy steel as identified in Table 1. Alloy steel socket set screws shall comply with ASTM F 912.

3.5.2 STAINLESS STEEL SOCKET SET SCREWS—Material for stainless steel set screws shall be in Condition CW (cold worked) per ASTM F 880. When alloy designation S2 (316 or 316L) is ordered the requirements of ASTM F 880 shall apply even though these materials are not specifically listed in ASTM F 880.

3.6 Special Features.

3.6.1 LOCKING ELEMENTS—Locate locking element in accordance with NAS 1283. Performance and test for locking element performance shall be in accordance with SAE J2270.

3.7 Quality Assurance—Unless otherwise specified in the ordering document, the quality assurance requirements identified below shall apply. For applications where the Appendix to SAE J2280 is invoked, the ordering activity should review the SAE J2280 Appendix and invoke any additional requirements not identified below:

3.7.1 STAINLESS STEEL SOCKET SET SCREWS—Stainless steel socket set screws shall be manufactured and tested in accordance with ASTM F 880. The supplementary requirement for passivation applies. Other supplementary requirements for shipment lot testing, alloy control, permeability and corrosion resistance tests do not apply unless specifically invoked on the customer's order. Package marking shall be per ASTM F 880 with the additional requirement that the SAE J2656 part identification number be identified on the package. If required, magnetic permeability requirements may be invoked (See 4.3 for guidance.)

3.7.2 ALLOY STEEL SOCKET SET SCREWS—Alloy steel set screws shall be manufactured and tested in accordance with ASTM F 912. For coated set screws, the coating thickness shall be verified by one of the methods identified in ASTM F 1941. Package marking shall be per ASTM F 880 with the additional requirement that the SAE J2656 part identification number be identified on the package.

3.7.3 NON-FERROUS SOCKET SET SCREWS—Non-ferrous socket set screws shall be manufactured and tested in general accordance with ASTM F 880 as modified below:

a. A torque test is not required unless the customer so designates and provides the applicable values.
b. The hardness limits shall be as specified in Table 1.
c. Passivation requirements do not apply.
d. The SAE J2656 part identification number shall be required for package marking.
e. Supplementary requirements do not apply unless specifically invoked. (See 4.3 regarding magnetic permeability requirements.)

3.7.4 SQUARE HEAD AND SLOTTED HEADLESS SET SCREWS—These set screws shall be manufactured and tested in general accordance with ASTM F 880 as modified below:

a. A torque test is not required.
b. The hardness limits shall be as specified in Table 1.
c. Passivation requirements only apply to stainless steel set screws.
d. The SAE J2656 part identification number shall be required for package marking.
e. Supplementary requirements do not apply unless specifically invoked. (See 4.3 regarding magnetic permeability requirements.)

4. Notes

4.1 Intended Use—This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.

This document establishes requirements and PIN's for set screws of selected materials. While this document was developed specifically for ship systems and equipment, its use is not restricted to these applications.

4.2 Identification of Part Numbering System on Drawings—On drawings where a column exists for identifying the manufacturer or his Commercial and Government Entity (CAGE) Code, indicate the CAGE Code "81343/J2656" or "SAE J2656" as required by the drawing standard. If no column exists or there is space only for the 5-digit CAGE Code, then a note must indicate that the part numbers are defined in SAE J2656.

4.3 Magnetic Permeability—For certain applications, low magnetic permeability may be required. Most non-ferrous fasteners have a relative magnetic permeability in air of 2.0 maximum when determined in accordance with ASTM A 342/A 342M on the finished fastener. However Nickel-Copper Alloy 400 and 405 fasteners should not be used when a magnetic permeability of 2.0 maximum is required as the magnetic permeability changes significantly at a transition temperature that is within the temperature range of normal usage. For CRES fasteners, alloy 316/316L should be specified when low magnetic permeability is required. The relative magnetic permeability should not exceed 2.0 maximum for 316/316L alloy fasteners while similar CRES fasteners of other 300 series alloy may exceed this value. If compliance with magnetic permeability requirements is necessary, the requirements must be identified in addition to the part or identification number for the screw.

4.4 Selection Guidance—The most readily available materials off-the-shelf are alloy and stainless steel. For alloy steel, the black oxide finish is the least expensive and most readily available. Since set screws are fairly well protected during installation, corrosion resistance may not be as important as for some other types of fasteners. Zinc phosphate coatings are much more common than manganese phosphate coatings. Guidance on the selection of the type of point is provided below:

4.4.1 CUP POINT—The most common and readily available set screw. It is used to quickly fasten items to shafts when the resulting cutting damage to the shaft is acceptable. A hardness differential of 10-15 Rockwell C between the screw point and the shaft is recommended.

4.4.2 HALF DOG AND DOG POINT—The dog point is designed to act as a shear pin. The point fits into a drilled hole or slot. These points are intended for a permanent setting, the point diameter and mating hole should be a close fit. The shorter half-dog point is half the length of the dog point.

4.4.3 OVAL POINT—Used for frequent adjustment without deformation to the part it bears against. For seating against angular surfaces such as U or V grooves put in shafts to permit axial alignment.

4.4.4 FLAT POINT—For use where frequent resetting or relocating is required on hard shafts and where minimal damage to the shaft is desired. Flats ground on the shaft improve screw performance. Sometimes used as an adjustment screw.

4.4.5 CONE POINT—Used for permanent setting on soft or hard shafts, the cone point is designed for maximum penetration into the mating part. When used with hardened shafts, predrilling the shaft to half the depth of the point is recommended since the force required to effect penetration may be too great to be accomplished solely by torque on the set screw. The cone point provides the highest torsional and axial holding power.

4.5 Metric Set Screws—The SAE Ship Systems and Equipment Committee intends to develop a companion standard covering metric set screws in the future.

4.6 Key words—Fasteners, bolts, screws, part or identifying numbers

PREPARED BY THE SAE SHIP SYSTEMS AND EQUIPMENT COMMITTEE OF THE
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