Designation: F3042 – 13

Standard Specification for Nonferrous Hex Socket, Slotted Headless, and Square Head Set Screws[1]

This standard is issued under the fixed designation F3042; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the requirements for nonferrous socket set screws sizes 0.125 (#5) through 2.000 in., square head set screws sizes 0.190 (#10) through 1.500 in., and slotted headless set screws 0.125 (#5) through 0.750 in. in diameter manufactured from a number of nonferrous alloys in use in the marine industry and the U.S. Navy subject to seawater wetting and salt atmosphere but that also may be used in other applications. It is recommended that copper-based alloys not be used in attempting to prevent mechanical components from rotating, such as locking shafts, because of the low hardness of the alloys. Some alloys or sizes or both of set screws may not be readily available. Manufacturers or suppliers should be contacted before design development or anticipated procurement.

1.2 *Units*—The values stated in inch-pound units are to be regarded as the standard.

NOTE 1—A complete metric companion to Specification F3042 will be developed—F3042M; therefore, no metric equivalents are shown in this specification.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B154 Test Method for Mercurous Nitrate Test for Copper Alloys

E18 Test Methods for Rockwell Hardness of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry

E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)[3]

E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]

E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)[3]

E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)[3]

E120 Test Methods for Chemical Analysis of Titanium and Titanium Alloys (Withdrawn 2003)[3]

E165 Practice for Liquid Penetrant Examination for General Industry

E350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E354 Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

E384 Test Method for Knoop and Vickers Hardness of Materials

E478 Test Methods for Chemical Analysis of Copper Alloys

E1409 Test Method for Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by Inert Gas Fusion

F788/F788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series

F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

2.2 *ASME Standards:*[4]

ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)

ASME B18.3 Socket Cap, Shoulder and Set Screws, Hex and Spline Keys (Inch Series)

[1] This test method is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.04 on Nonferrous Fasteners.

Current edition approved Nov. 1, 2013. Published March 2014. DOI: 10.1520/F3042-13.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

ASME B18.6.2 Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws Inch Series

2.3 *SAE Standards:*[5]

AMS2485 Coating, Black Oxide

AMS2487 Anodic Treatment of Titanium and Titanium Alloys Solution pH 12.4 Maximum

AMS2488 Anodic Treatment—Titanium and Titanium Alloys Solution pH 13 or Higher

J2656 Fastener Part Standard—Hexagon Socket, Square Head, and Slotted Headless Set Screws—Inch Dimensioned

2.4 *Federal Standards and Specifications:*

QQ-N-286 Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500)

3. Classification

3.1 The designation of the alloys of this specification shall be consistent with the nonferrous designations in Table 1.

4. Ordering Information

4.1 Orders for material under this specification shall include the following information:

4.1.1 Quantity (number of screws);

4.1.2 Name of the screw (hex socket set screw, slotted headless set screw, or square head set screw);

4.1.3 Dimensions, including nominal thread designation, thread pitch and fit, nominal screw length (inches), and point configuration. A standard part number in accordance with a nationally recognized organization or society may be used for this definition;

4.1.4 Alloy number;

4.1.5 Stress relieving, if required;

4.1.6 If titanium is not to be coated;

4.1.7 Black oxide coating, if required (not recommended);

4.1.8 Shipment lot testing, as required;

4.1.9 Source inspection, if required;

4.1.10 Certificate of compliance or test report, if required;

4.1.11 Additional requirements, if any, to be specified on the purchase order (see Supplementary Requirements); and

4.1.12 ASTM International specification and year of issue.

4.2 *Example*—50 000 pieces, 0.250-20 × 0.375 cone point, nickel copper socket set screw, stress relieved, ASTM F3042–13.

5. Materials and Manufacture

5.1 *Materials:*

5.1.1 The screws shall be manufactured from material having a chemical composition conforming to the requirements in Table 1 and capable of developing the required mechanical properties for the specified alloy in the finished fastener.

5.1.2 The starting condition of the raw material shall be at the discretion of the fastener manufacturer but shall be such that the finished products conform to all of the specified requirements.

5.2 *Manufacture:*

5.2.1 *Forming*—The screw may be forged, cold or hot formed, or machined from suitable material at the option of the supplier to meet requirements.

5.2.2 *Condition*—The fasteners shall be furnished in the following conditions:

Alloy	Condition
Copper (all alloys)	As formed or stress relieved at manufacturer's option
Nickel alloys:	
400 and 405	As formed or stress relieved at manufacturer's option
500	Solution annealed and aged
625	Annealed
686	As formed
Titanium	As formed

5.2.3 *Stress Relieving*—When required, stress relieving shall be specified by the purchaser for nickel alloys 400 and 405 and all copper alloys.

5.2.4 *Threads*—Unless otherwise specified, the threads shall be rolled or cut at the option of the manufacturer.

6. Chemical Composition

6.1 The analysis of the screw material shall conform to the chemical composition specified in Table 1.

6.2 *Manufacturer's Analysis*—When test reports are required on the inquiry or purchase order (see 4.1.8), the manufacturer shall make individual analyses of randomly selected finished fasteners from the product to be shipped and report the results to the purchaser, except as provided in 6.3.2. Alternatively, if heat and lot identities have been maintained, the analysis of the raw material from which the fasteners have been manufactured may be reported instead of product analysis.

6.3 *Product Analysis:*

6.3.1 Product analyses may be made by the purchaser from finished products representing each lot. The chemical composition thus determined shall conform to the requirements in Table 1.

6.3.2 In the event of disagreement, a referee chemical analysis of samples from each lot shall be made in accordance with 11.1 and 11.1.1.

7. Mechanical Properties

7.1 The hardness limits from Table 2 shall be met as determined using Test Methods E18.

8. Dimensions

8.1 Unless otherwise specified by the purchaser, the product shall conform to the requirements of ASME B18.3 for hex socket set screws or ASME B18.6.2 for slotted headless set screws or square head set screws. Threads shall be in accordance with ASME B1.1. Unless otherwise specified by the purchaser, socket set screws shall be UNC-3A and square head set screws and slotted headless set screws shall be UNC-2A.

9. Workmanship, Finish, and Appearance

9.1 *Workmanship*—Screws shall be clean and have a workmanlike finish free of injurious burrs, seams, laps, irregular

[5] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

TABLE 1 Chemical Requirements

Composition, %

Copper and Copper-Base Alloys

UNS Designation Number	Alloy	General Name	Aluminum	Copper, min	Iron, max	Manganese, max	Nickel, max	Phosphorus	Silicon	Zinc, max[A]	Lead, max	Tin	Arsenic, max
C26000	260	brass	. . .	68.5-71.5	0.05	. . .	. . .	. . .	. . .	balance	0.07	. . .	. . .
C27000	270	brass	. . .	63.0-68.5	0.07	. . .	. . .	. . .	. . .	balance	0.10	. . .	. . .
C27400	274	brass	. . .	61.0-64.0	0.05	. . .	. . .	. . .	. . .	balance	0.10	. . .	. . .
C46200	462	naval brass	. . .	62.0-65.0	0.10	. . .	. . .	. . .	. . .	balance	0.20	0.5-1.0	. . .
C46400	464	naval brass	. . .	59.0-62.0	0.10	. . .	. . .	. . .	. . .	balance	0.20	0.5-1.0	. . .
C61300	613	aluminum bronze	6.0-7.5	[A]	2.0-3.0	0.10	0.15[B]	0.015	0.10	0.05	0.01	0.20-0.50	. . .
C61400	614	aluminum bronze	6.0-8.0	88.0[C]	1.5-3.5	1.0	. . .	. . .	. . .	. . .	. . .	. . .	. . .
C63000	630	aluminum bronze	9.0-11.0	78.0[C]	2.0-4.0	1.5	4.0-5.5	. . .	0.25 max	. . .	. . .	0.20 max	. . .
C65100	651	silicon bronze	. . .	96.0[C]	0.8	0.7	. . .	. . .	0.8-2.0	1.5	0.05	. . .	. . .
C65500	655	silicon bronze	. . .	94.8[C]	0.8	1.5	0.6	. . .	2.8-3.8	1.5	0.05	. . .	. . .
C66100	661	silicon bronze	0.25 max	94.0[C]	0.25	1.5	. . .	. . .	2.8-3.5	1.5	0.20-0.8	. . .	. . .

Nickel and Nickel-Base Alloys

UNS Designation Number	Alloy	General Name	Aluminum	Carbon, max	Chromium	Copper[D]	Iron, max	Manganese, max	Nickel[D]	Phosphorus, max	Silicon, max	Titanium	Cobalt, max	Molybdenum	Sulfur, max	Vanadium	Tungsten
N04400	400	Ni-Cu Class A	. . .	0.3	. . .	balance	2.5	2.0	63.0-70.0	. . .	0.5	. . .	[E]	. . .	0.024	. . .	. . .
N04405	405	Ni-Cu Class B	. . .	0.3	. . .	balance	2.5	2.0	63.0-70.0	. . .	0.5	. . .	[E]	. . .	0.025-0.060	. . .	. . .
N05500	500	Ni-Cu-Al	2.30-3.15	0.25	. . .	balance	2.0	1.5	63.0-70.0	. . .	0.5	0.35-0.85	[E]	. . .	0.01	. . .	. . .
N06625	625[F]	Ni-Cr-Mo-Cb	0.40 max	0.010	20.0-23.0	. . .	5.0 max	0.50	58.0 min	0.015	0.50 max	0.40 max	1.00 max	8.0-10.0	0.015	. . .	3.2-4.2
N06686	686	Ni-Cr-Mo-W	. . .	0.010 max	19.0-23.0	. . .	5.0 max	0.75 max	balance	0.04 max	0.08 max	0.02-0.25	. . .	15.0-17.0	0.02 max	. . .	3.0-4.4

Titanium and Titanium-Base Alloys[G]

UNS Designation Number	Alloy	General Name	Aluminum, Al	Carbon, C	Iron, Fe	Titanium, Ti	Hydrogen, H	Nitrogen, N	Oxygen, O	Palladium, Pd	Vanadium, V	Chromium, Cr	Molybdenum, Mo	Zirconium, Zr	Tin, Sn	Silicon, Si	Ruthenium, Ru	Residuals[H]	
																		each, max	total, max
R55111	32	Titanium Ti-5-1-1-1	4.5-5.5	0.08	0.25	balance	0.0125	0.03	0.11	. . .	0.6-1.4	. . .	0.6-1.2	0.6-1.4	0.6-1.4	0.06-0.14	. . .	0.1	0.4
R56401	23	Titanium Ti-6Al-4V ELI	5.5-6.5	0.08	0.25	balance	0.0125	0.05	0.13	. . .	3.5-4.5	. . .	. . .	. . .	. . .	. . .	. . .	0.1	0.4
R58640	19	Titanium Ti-38-6-44	3.0-4.0	0.05	0.30	balance	0.0200	0.03	0.12	0.10[I]	7.5-8.5	5.5-6.5	3.5-4.5	3.5-4.5	. . .	. . .	0.10[I]	0.15	0.4

[A] Copper plus specified elements = 99.8 min; copper plus silver = 88.5–91.5.
[B] Cobalt is to be counted as nickel.
[C] Minimum content of copper plus all other elements with specified limits shall be 99.5 %.
[D] Elements shown as balance shall be arithmetically computed by deducting the sum of the other named elements from 100.
[E] Cobalt is to be counted as nickel.
[F] Alloy 625 material shall be refined using the electroslag remelting process (ESR) or the vacuum arc remelting process (VAR).
[G] All reported values are maximums, unless a range is specified.
[H] A residual is an element present in a metal or an alloy in small quantities inherent to the manufacturing process but not added intentionally. Residual elements need not be reported unless a report is specifically required by the purchaser.
[I] Ruthenium and palladium, or both, may be added to Grade 19 for enhanced corrosion resistance as negotiated between purchaser and vendor. Chemical analysis is not required unless specifically required by the purchaser.

TABLE 2 Hardness

UNS Designation Numbers	Alloy	General Name	Nominal Thread Dia, in.	Hardness
C26000	260	Brass	All	69 - 91HRB
C27000	270	Brass	All	69 - 91HRB
C27400	274	Brass	All	69 - 91HRB
C46200	462	Naval brass	All	65 - 90 HRB
C46400	464	Naval brass	All	55 - 75 HRB
C61300	613	Aluminum bronze	All	70 - 95 HRB
C61400	614	Aluminum bronze	All	70 - 95 HRB
C63000	630	Aluminum bronze	All	85 - 100 HRB
C65100	651	Silicon bronze	Thru 0.750	75 - 95 HRB
			0.875 - 2.000	70 - 95 HRB
C65500	655	Silicon bronze	All	60 - 80 HRB
C66100	661	Silicon bronze	All	75 - 95 HRB
N04400	400	Nickel copper A	Thru 0.750	75 HRB - 25 HRC
			0.875 - 2.000	60 HRB - 25 HRC
N04405	405	Nickel copper B	All	60 HRB - 20 HRC
N05500	500	Ni-Cu-Al	All	24 - 37 HRC
N06625	625	Ni-Cr-Mo-Cb	All	85 HRB - 35 HRC
N06686	686, Grade 1	Ni-Cr-Mo-W	All	21 - 45 HRC
R55111	32	Titanium Ti-5-1-1-1	All	24 - 38 HRC
R56401	23	Titanium Ti-6Al-4V ELI	All	25 - 36 HRC
R58640	19	Titanium Ti-38-6-44	All	24 - 38 HRC

surfaces, and other imperfections affecting serviceability. Unless otherwise prohibited by the purchaser, broach petals adhering solidly to the bottom of the socket are acceptable provided the socket dimensions are in accordance with ASME B18.3.

9.2 *Finish*—Unless otherwise specified, except for titanium alloy screws, the fasteners shall be furnished without an additive chemical or metallic finish.

9.2.1 All titanium alloy fasteners shall be anodized in accordance with SAE AMS2487 or AMS2488 Type 2 (except testing requirements may be negotiated between manufacturer and coating supplier) unless otherwise specified by the purchaser.

9.2.2 Black oxide coating (BOC), if specified, shall be in accordance with SAE AMS2485. Supplementary preservative treatment is not required. It may be necessary to undercut the threads before coating to allow for thread gaging after coating.

9.3 *Surface Discontinuities*—The surface discontinuities for these products shall conform to Specification F788/F788M and the additional limitations specified herein.

9.3.1 Processing cracks that connect the socket to the periphery of the screw are not permissible. Defects originating on the periphery with a traverse indicating a potential to intersect are not permissible. For peripheral discontinuities, the maximum depth may be 0.06 *D*.

10. Sampling and Number of Tests

10.1 Guide F1470 shall be used to determine the necessary sampling plan and the number of tests that must be performed to demonstrate that all of the requirements of this standard are met for each lot.

11. Test Methods

11.1 *Chemical Analysis*—The chemical composition may be determined by any recognized commercial test method. In the event of disagreement, the following test methods shall be used for referee purposes:

Alloy	Test Method
Copper	E53, E54, E62, E75, E478
Nickel	E76, E350, E354
Titanium	E120, E1409

11.1.1 When agreed between the purchaser and manufacturer, samples for chemical analysis may be taken in accordance with Practice E55 by drilling, sawing, milling, turning, clipping, or such other methods capable of producing representative samples.

11.2 The fastener manufacturer may accept the chemical analysis of each heat of raw material purchased and reported on the raw material certification furnished by the raw material producer. The fastener manufacturer is not required to do any further chemical analysis testing provided that precise heat lot traceability has been maintained throughout the manufacturing process on each lot of fasteners produced and delivered.

11.3 *Mechanical Tests*—Hardness shall be determined in accordance with Test Method E384.

12. Significance of Numerical Limits

12.1 For purposes of determining compliance with the specified limits for requirements of the properties listed in this specification, an observed value or calculated value shall be rounded in accordance with Practice E29.

13. Inspection

13.1 If the inspection described in 13.2 is required by the purchaser, it shall be specified in the inquiry, order, or contract.

13.2 The inspector representing the purchaser shall have free entry to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy that the material is being furnished in accordance with this specification. All tests and inspection required by the specification

that are requested by the purchaser's representative and purchase order shall be made before shipment and shall be so conducted as not to interfere unnecessarily with the operation of the work.

14. Rejection and Rehearing

14.1 Screws that fail to conform to the requirements of this specification may be rejected by the purchaser. Rejection shall be reported to the supplier promptly and in writing. In case of dissatisfaction with the results of tests or inspection authorized by the purchaser, the supplier may make claim for a rehearing.

15. Certification

15.1 When specified on the Purchase Order, the manufacturer or supplier, as applicable, shall furnish a test report or certificate of conformance as specified by the purchaser.

15.2 When a test report is specified, it shall include the heat number and the results of the chemical composition, mechanical properties, metallurgical requirements, dimensional tests, and workmanship requirements.

15.3 When a certificate of conformance is specified, it shall include a statement certifying the fasteners have been manufactured, tested and inspected, and that they either conform or do not conform to the requirements of this specification.

16. Packaging and Package Marking

16.1 *Packaging:*

16.1.1 The manufacturer shall use such methods of packaging the screws as may be reasonably required to ensure their receipt by the purchaser in a satisfactory condition.

16.1.2 When special packaging requirements are required by the purchaser, they shall be defined at the time of inquiry and order.

16.2 *Package Marking*—Each shipping unit shall include or be plainly marked with the following:

16.2.1 ASTM specification,

16.2.2 Alloy number,

16.2.3 Size,

16.2.4 Name and brand or trademark of the manufacturer,

16.2.5 Country of origin,

16.2.6 Number of pieces, and

16.2.7 Purchase order number, if required by purchaser.

16.2.8 If SAE J2656 part identifying number is used 16.2.1, 16.2.2, and 16.2.3 are not required on the packaging.

17. Keywords

17.1 marine industry; nonferrous hex socket set screw; nonferrous slotted headless set screw; nonferrous square head set screw

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the purchaser in the inquiry and order (see 4.1.7). Supplementary requirements are requirements that are noted in addition to the requirements called out in the main body of the specification noted above and shall in no way negate any of the requirements already noted above.

S1. Shipment Lot Testing

S1.1 When Supplementary Requirement S1 is specified on the order, the manufacturer shall make sample tests on the individual lots for shipment to ensure that the product conforms to the specified requirements.

S1.2 The manufacturer shall make an analysis of a randomly selected finished fastener from each lot of product to be shipped. Heat or lot control shall be maintained. The analysis of the starting material from which the fasteners have been manufactured may be reported in place of the product analysis.

S1.3 The manufacturer shall perform mechanical property tests in accordance with this specification and Practice F1470 on the individual lots for shipment.

S1.4 The manufacturer shall furnish a test report for each lot in the shipment showing the actual results of the chemical analysis and mechanical property tests performed in accordance with Supplementary Requirement S1.

S2. Stress Corrosion Requirements

S2.1 *Copper Alloys*—Copper alloy fasteners shall exhibit no evidence of cracking after immersion for 30 min in an aqueous solution of mercurous nitrate when tested in accordance with Test Method B154. (**Warning—**Mercury is a definite health hazard and equipment for the detection and removal of mercury vapor produced in volatilization is recommended. The use of rubber gloves in testing is advisable.)

S3. Dye Penetrant Inspection

S3.1 When dye penetrant inspection is specified on the purchase order, the fasteners shall be tested in accordance with Practice E165 or other mutually acceptable procedures and shall conform to acceptance criteria as mutually agreed upon by the purchaser and manufacturer.

S4. Heat Control (Alloys 400, 405, and 500 Only)

S4.1 When Supplementary Requirement S4 is specified on the inquiry or order, the manufacturer shall control the product by heat analysis and identify the finished product in each shipment by the actual heat number.

S4.2 When Supplementary Requirement S4 is specified on the inquiry and order, Supplementary Requirement S1 shall be considered automatically invoked with the addition that the heat analysis shall be reported to the purchaser on the test reports.

S5. Nickel-Copper-Aluminum (500) Alloy

S5.1 When Supplementary Requirement S5 is specified on the inquiry and order, the material shall be produced in accordance with QQ-N-286 Nickel-Copper-Aluminum, Wrought (UNS N05500).

S6. Torque Testing of Hex Socket Set Screws

S6.1 When Supplementary Requirement S6 is specified on the inquiry and order, hex socket set screws shall be subjected to a torque test in accordance with S6.2 and shall withstand application of the test tightening torque without evidence of the socket reaming or the screw bursting. Torque testing values shall be as agreed upon between purchaser and supplier. Sockets shall be in accordance with ASME B18.3. Minimum lengths for torque testing are as specified in Table S6.1.

S6.2 For the socket strength torque test, the test screw shall be assembled into a tapped hole of Class 3B fit in a steel block (Fig. S6.1) until the face of the screw is flush or below flush with the top surface of the test block and the set screw bears against a firm base, such as a hardened screw installed from the opposite side of the block. The applicable hexagon key bit, in accordance with ASME B18.3, shall be inserted to the full depth of the set screw socket and the test torque applied by means of a torque wrench. The screw shall be disassembled from the block and examined for compliance to the requirements of S6.1.

TABLE S6.1 Torque Testing Lengths

Nominal Screw Size	Shortest Nominal Screw Lengths Subject to Torque Testing		
	Cup and Flat Points	Cone and Oval Points	Half Dog Point
#5 - 0.125	0.188	0.188	0.172
#6 - 0.138	0.172	0.203	0.188
#8 - 0.164	0.188	0.219	0.203
#10 - 0.190	0.188	0.250	0.234
¼ - 0.250	0.250	0.312	0.297
5⁄16 - 0.312	0.312	0.391	0.359
3⁄8 - 0.375	0.375	0.438	0.438
7⁄16 - 0.437	0.438	0.547	0.484
½ - 0.500	0.500	0.609	0.547
5⁄8 - 0.625	0.63	0.88	0.88
¾ - 0.750	0.75	1.00	1.00
7⁄8 - 0.875	0.88	1.00	1.00
1 - 1.000	1.00	1.25	1.25
1-⅛ - 1.125	1.25	1.50	1.25
1-¼ - 1.250	1.25	1.50	1.50
1-⅜ - 1.375	1.50	1.75	1.50
1-½ - 1.500	1.50	2.00	1.75
1-¾ - 1.750	1.75	2.25	2.00
2 - 2.000	2.00	2.50	2.50

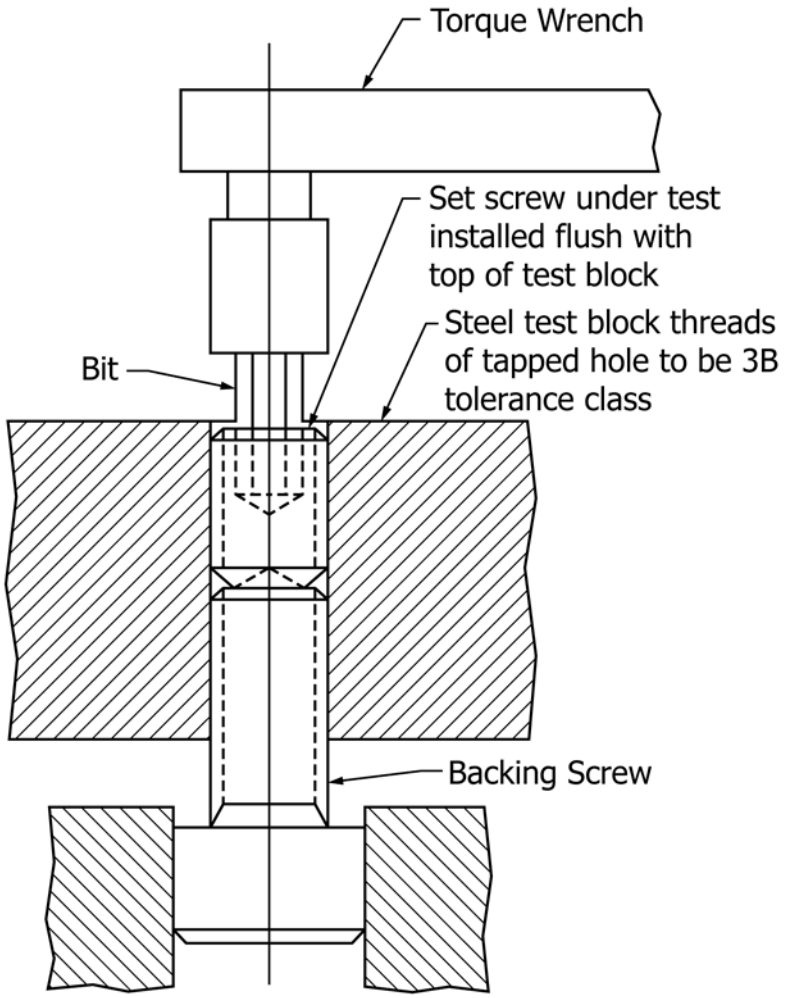

FIG. S6.1 Typical Torque Test Fixture