



# Standard Specification for Stainless Steel Metric Bolts, Screws, and Studs<sup>1</sup>

This standard is issued under the fixed designation F 738M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

## 1. Scope

1.1 This specification covers the chemical and mechanical requirements for stainless steel metric bolts, screws, and studs with nominal thread diameters M1.6 through M36 and is intended for use in engineering applications requiring general corrosion resistance.

1.2 Eight groups of stainless steel alloys are covered, including three austenitic (Grades A1, A2, and A4), one ferritic (Grade F1), three martensitic (Grades C1, C3, and C4), and one precipitation hardening (Grade P1).

1.3 Twenty property classes are covered, including nine austenitic, two ferritic, eight martensitic, and one precipitation hardening. The property classes with the permissible alloys for each are listed in [Table 1](#).

1.4 This specification is based in concept and content on [ISO 3506](#). The chemical and mechanical requirements specified for all property classes, except as given in [1.4.1](#), are essentially identical with classes of the same designation in [ISO 3506](#).

1.4.1 This specification includes all of the property classes covered in [ISO 3506](#). Additionally, it includes property classes A1-70, A2-70, A4-70, A1-80, A2-80, and A4-80 for products with nominal thread diameters larger than M20; and four non-ISO property classes, C1-110, C4-110, C3-120; and P1-90.

1.5 Supplementary requirements of an optional nature are provided, applicable only when agreed upon between the manufacturer and the purchaser at the time of the inquiry and order.

1.6 Suitable nuts for use with bolts, screws, and studs included in this specification are covered by Specification [F 836M](#).

1.7 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.8 The following safety hazards caveat pertains only to the test method described in this specification. *This standard*

*does not purport to address the safety problems 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:<sup>2</sup>

- [A 276](#) Specification for Stainless Steel Bars and Shapes
- [A 342/A 342M](#) Test Methods for Permeability of Feebly Magnetic Materials
- [A 380](#) Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
- [A 484/A 484M](#) Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
- [A 493](#) Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
- [A 555/A 555M](#) Specification for General Requirements for Stainless Steel Wire and Wire Rods
- [A 564/A 564M](#) Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
- [A 582/A 582M](#) Specification for Free-Machining Stainless Steel Bars
- [A 751](#) Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- [D 3951](#) Practice for Commercial Packaging
- [E 29](#) Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- [E 353](#) Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
- [F 606M](#) Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets (Metric)
- [F 836M](#) Specification for Style 1 Stainless Steel Metric Nuts (Metric)
- [F 1470](#) Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

<sup>1</sup> This specification 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 May 1, 2008. Published August 2008. Originally approved in 1981. Last previous edition approved in 2002 as F 738M – 02.

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

**TABLE 1 Property Classes of Stainless Steel Bolts, Screws, and Studs**

Property Class	Permissible Alloys
A1-50 A1-70 A1-80	304, 304L, 305 <sup>A</sup> 384, 18-9LW, 302HQ
A2-50 A2-70 A2-80	321, 347
A4-50 A4-70 A4-80	316, 316L
F1-45 F1-60	430 <sup>B</sup>
C1-50 C1-70 C1-110	410
C3-80 C3-120	431
C4-50 C4-70 C4-110	416, 416Se
P1-90	630

<sup>A</sup> When approved by the purchaser, Alloys 303, 303Se, or XM1 may be furnished.

<sup>B</sup> When approved by the purchaser, Alloy 430F may be furnished.

## 2.2 ISO Standard:

**ISO 3506** Corrosion-Resistant Stainless Steel Fasteners<sup>3</sup>

## 3. Classification

3.1 The designation of each property class is composed of three parts: a letter, followed by a single digit, followed by either two or three digits.

3.1.1 The letter indicates the general composition type of stainless steel as follows:

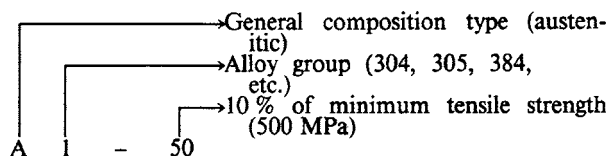
- 3.1.1.1 A for austenitic steels,
- 3.1.1.2 F for ferritic steels,
- 3.1.1.3 C for martensitic steels, and
- 3.1.1.4 P for precipitation-hardening steel.

3.1.2 The first digit (1, 2, 3, or 4) indicates the alloy group. The permissible alloys within each group are given in **Table 1**.

3.1.3 The last two or three digits (50, 70, 110, etc.) indicate 10 % of the specified minimum tensile strength of the property class.

3.1.4 For example, Class A1-50 is an austenitic steel of any one of six permitted alloys, and the manufactured fastener has a minimum tensile strength of 500 MPa.

<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.



## 4. Ordering Information

4.1 Orders for bolts, screws and studs under this specification shall include the following:

- 4.1.1 Quantity (number of pieces of each item).
- 4.1.2 Name of item (bolt, screw, stud, etc.; specific type and style; and reference to dimensional standard when appropriate).
- 4.1.3 Size (nominal diameter, thread pitch, length).
- 4.1.4 Property class.
- 4.1.5 ASTM designation and date of issue. When date of issue is not specified, fasteners shall be furnished to the latest issue.
- 4.1.6 Supplementary requirements, if any (S1 through S5).
- 4.1.7 Additional requirements, if any, to be specified on the purchase order:
  - 4.1.7.1 Forming (5.2.1).
  - 4.1.7.2 Threading (5.2.2).
  - 4.1.7.3 Alloy condition (5.2.3).
  - 4.1.7.4 Protective finish (5.2.5).
  - 4.1.7.5 Alloy selection (7.2).
  - 4.1.7.6 Test report (9.2).
  - 4.1.7.7 Heat number (9.1.1).
  - 4.1.7.8 Additional testing (9.3).
  - 4.1.7.9 Inspection (11.1).
  - 4.1.7.10 Rejection (12.1).
  - 4.1.7.11 Certification (13.1).
  - 4.1.7.12 Marking (14.1.3 and 14.1.4).

NOTE 1—Examples:

10 000 hex-cap screws, ANSI B18.2.3.1M, M12 × 1.75 × 50, Class A2-70, furnish test report, ASTM F 738, dated \_\_\_\_.

15 000 oval-head machine screws, Type 1 recess, ANSI B18.6.7M, M3 × 0.5 × 25, Class C4-70, 416Se, Supplementary Requirement S2, ASTM F 738, dated \_\_\_\_.

## 5. Materials and Manufacture

### 5.1 Materials:

5.1.1 Specifications **A 276**, **A 493**, **A 564/A 564M**, and **A 582/A 582M** are noted for information only as suitable sources of material for the manufacture of bolts, hex cap screws, and studs to this specification.

### 5.2 Manufacture:

5.2.1 *Forming*—Unless otherwise specified, fasteners shall be cold-formed, hot-formed, or machined, at the option of the manufacturer.

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

**5.2.3 Condition**—Fasteners shall be furnished in the condition specified for the property class in **Table 2**. If other conditions are required, the condition and resultant mechanical properties shall be as agreed upon between the manufacturer and the purchaser.

**5.2.4 Surface Finish**—Fasteners shall have a surface finish produced in accordance with Practice **A 380**.

**5.2.5 Protective Finishes**—Unless otherwise specified, fasteners shall be furnished without an additive chemical or metallic finish.

**TABLE 2 Mechanical Property Requirements**

Property Class	Condition <sup>A</sup>	Alloy/ Mechanical Property Marking	Nominal Thread Diameter	Product Length <sup>B</sup>	Full Size Product Tests				Machined Specimen Tests			Hardness			
					Tensile Strength, MPa <sup>C</sup>	Yield Strength, MPa <sup>C,D</sup>	Exten- sion <sup>E</sup>	Torsional Strength, N·m <sup>F</sup>	Tensile Strength, MPa	Yield Strength, MPa	Elonga- tion, %	Vickers		Rockwell	
					min	min	min	min	min	min	min	min	max	min	max
A1-50		F 738A	M1.6–M5	all	500	...	...	Table 6	...	...	...	...	165	...	B85
A2-50 A4-50	AF	F 738B F 738C	M6–M36	all	500	210	0.6D	...	500	210	30	...	165	...	B85
A1-70 A2-70 A4-70	CW	F 738D F 738E F 738F	M1.6–M5 M6–M20 over M20–M36	8D 8D 8D	700 700 550	... 450 300	... 0.4D 0.2D x	Table 6 ... ...	... 650 520	... 400 270	... 20 25	220 220 160	330 330 310	B96 B96 B83	C33 C33 C31
A1-80 A2-80	SH	F 738G F 738H	M1.6–M5 M6–M20 over M20–M24	8D 8D	800 800	... 600	... 0.3D	Table 6 ...	... 780	... 600	... 12	240 240	350 350	C23 C23	C36 C36
A4-80		F 738J	over M24–M30 over M30–M36	8D 8D	650 600	400 300	0.2D 0.2D	... ...	620 570	370 270	20 28	200 180	310 285	B93 B89	C30 C28
F1-45	AF	F 738K	M1.6–M5	all	450	...	...	...	...	...	...	...	165	...	B85
			M6–M36	all	450	250	0.2D	...	...	450	250	25	...	165	...
F1-60	CW	F 738L	M1.6–M5	8D	600	...	...	...	...	...	...	180	285	B89	C28
			M6–M36	8D	600	410	0.2D	...	...	550	360	20	180	285	B89
C1-50 C4-50	A	F 738M F 738N	M1.6–M5 M6–M36	all all	500 500	... 250	... 0.2D	... ...	... 500	... 250	... 20	... ...	165 165	... ...	B85 B85
C1-70 C4-70		H	F 738P F 738R	M1.6–M5 M6–M36	all all	700 700	... 410	... 0.2D	... ...	... 700	... 410	... 18	220 220	330 330	B96 B96
C1-110 C4-110	HT		F 738S F 738T	M1.6–M5 M6–M36	all all	1100 1100	... 820	... 0.2D	... ...	... 1100	... 820	... 12	350 350	440 440	C36 C36
C3-80		H	F 738U	M1.6–M5	all	800	...	...	...	...	...	...	240	340	C23
	M6–M36			all	800	640	0.2D	...	...	800	640	15	240	340	C23
C3-120	HT	F 738V	M1.6–M5	all	1200	...	...	...	...	...	...	380	480	C39	C48
			M6–M36	all	1200	950	0.2D	...	...	1200	950	10	380	480	C39
P1-90	AH	F 738W	M1.6–M5	all	900	...	...	...	...	...	...	285	370	C28	C38
			M6–M36	all	900	700	0.2D	...	...	900	700	16	285	370	C28

<sup>A</sup> Legend of conditions:

AF — headed and rolled from annealed stock and then reannealed.

CW — headed and rolled from annealed stock, thus acquiring a degree of cold work; products with nominal thread diameters larger than M20 may be hot-worked and solution annealed.

SH — machined from strain-hardened stock or cold worked to develop the specified properties.

A — machined from annealed or solution-annealed stock, thus retaining the properties of the original material.

H — hardened and tempered at 565°C minimum.

HT — hardened and tempered at 275°C minimum.

AH — solution-annealed and age-hardened after forming.

<sup>B</sup> For product lengths:

“all” means all lengths

“8D” means 8 times nominal diameter maximum.

<sup>C</sup> Tensile strength and yield strength values for full-size products of each property class are given in table on yield and tensile strength.

<sup>D</sup> Yield strength is the stress at which an offset of 0.2 % gage length occurs.

<sup>E</sup> Extension measurement is determined in accordance with the test procedure specified in 10.2.3.

<sup>F</sup> Torsional strength requirements apply only to austenitic steel fasteners with nominal thread diameters M5 and smaller. Values are given in table on torsional strength.