Designation: A 633/A633M – 01 (Reapproved 2006)

Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates[1]

This standard is issued under the fixed designation A 633/A633M; 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.

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

1. Scope

1.1 This specification covers normalized high-strength low-alloy structural steel plates for welded, riveted, or bolted construction.

1.2 This material is particularly suited for service at low ambient temperatures of −50°F [−45°C] and higher where notch toughness better than that expected in as-rolled material of a comparable strength level is desired.

1.3 Four grades, designated Grades A, C, D, and E (essentially former Specification A 633 without a grade designation) are covered by this specification. Grade A provides a minimum yield point of 42 ksi [290 MPa] in thicknesses through 4 in. [100 mm], inclusive. Grades C and D provide a minimum yield point of 50 ksi [345 MPa] in thicknesses up to 2.50 in. [65 mm], inclusive and 46.0 ksi [315 MPa] in thicknesses over 2.50 in. to 4.0 in. [65 to 100 mm], inclusive. Grade E provides a minimum yield point of 60 ksi [415 MPa] in thicknesses up to 4.0 in. [100 mm], inclusive and 55 ksi [380 MPa] in thicknesses over 4 in. to 6 in. [100 to 150 mm], inclusive.

1.4 Current practice normally limits plates furnished under this specification to the maximum thicknesses shown in 1.3. The individual manufacturer should be consulted on size limitations for other product forms.

1.5 When the steel is to be welded, it is presupposed that a welding procedure suitable for the grade of steel and intended use or service will be utilized. See Appendix X3 no id found of Specification A 6/A 6M for information on weldability.

1.6 The values stated in either inch-pound units or SI units are to be regarded as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with this specification.

2. Referenced Documents

2.1 *ASTM Standards:*

A 6/A 6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

3. General Requirements for Delivery

3.1 Material furnished under this specification shall conform to the requirements of the current edition of Specification A 6/A 6M, for the ordered material, unless a conflict exists in which case this specification shall prevail.

4. Manufacture

4.1 The requirements for fine austenitic grain size in Specification A 6/A 6M shall be met.

5. Heat Treatment

5.1 The material shall be normalized by heating to a suitable temperature which produces an austenitic structure, but not exceeding 1700°F [925°C], holding a sufficient time to attain uniform heat throughout the material and cooling in air.

5.1.1 Grade E material over 3 in. [75 mm] in thickness shall be double normalized.

5.2 If the purchaser elects to perform the required heat treatment, the material shall be accepted on the basis of mill tests made from test coupons heat treated in accordance with the purchase order requirements. If the test coupon heat treatment requirements are not indicated on the purchase order, the manufacturer shall heat treat the test coupons under conditions considered appropriate. The manufacturer shall inform the purchaser of the heat-treatment procedure followed in heat treating the test coupons at the mill.

6. Chemical Composition

6.1 The heat analysis shall conform to the chemical composition requirements listed in Table 1.

6.2 The steel shall conform on product analysis to the requirements prescribed in Table 1, subject to the product analysis tolerances in Specification A 6/A 6M.

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.02 on Structural Steel for Bridges, Buildings, Rolling Stock, and Ships.

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TABLE 1 Chemical Requirements

NOTE—Where "..." appears in this table, there is no requirement.

Element	Grade A, %	Grade C, %	Grade D, %	Grade E, %[A]
Carbon, max	0.18	0.20	0.20	0.22
Manganese:				
1 1/2 in. [40 mm] and under in thickness	1.00–1.35	1.15–1.50[B]	0.70–1.35	1.15–1.50
Over 1 1/2 in. to 4 in. [40 to 100 mm], incl	1.00–1.35	1.15–1.50[B]	1.00–1.60	1.15–1.50
Over 4 in. to 6 in. [100 to 150 mm], incl	[C]	[C]	[C]	1.15–1.50
Phosphorus, max	0.035	0.035	0.035	0.035
Sulfur, max	0.04	0.04	0.04	0.04
Silicon	0.15–0.50	0.15–0.50	0.15–0.50	0.15–0.50
Vanadium	...	...	...	0.04–0.11
Columbium	0.05 max	0.01–0.05	...	[D]
Nitrogen, max	...	...	...	0.03
Copper, max	...	...	0.35	...
Nickel, max	...	...	0.25	...
Chromium, max	...	...	0.25	...
Molybdenum, max	...	...	0.08	...

[A]For Grade E the minimum total aluminum content shall be 0.018 %, or the vanadium nitrogen ratio shall be 4:1 minimum.
[B]For Grade C manganese content may be increased to 1.60 % maximum provided the carbon content does not exceed 0.18 %.
[C]The size and grade is not described in this specification.
[D]Columbium may be present in the amount of 0.01 to 0.05 %.

TABLE 2 Tensile Requirements[A]

	Grade A	Grades C and D	Grade E
Yield point, min, ksi [MPa]:			
2.5 in. [65 mm] and under	42 [290]	50 [345]	60 [415]
Over 2.5 in. to 4 in. [65 to 100 mm], incl	42 [290]	46 [315]	60 [415]
Over 4 in. to 6 in. [100 to 150 mm], incl	[B]	[B]	55 [380]
Tensile strength, ksi [MPa]:			
2.5 in. [65 mm] and under	63 to 83 [430 to 570]	70 to 90 [485 to 620]	80 to 100 [550 to 690]
Over 2.5 in. to 4 in. [65 to 100 mm], incl	63 to 83 [430 to 570]	65 to 85 [450 to 590]	80 to 100 [550 to 690]
Over 4 in. to 6 in. [100 to 150 mm], incl	[B]	[B]	75 to 95 [515 to 655]
Elongation in 8 in. [200 mm], min, %[C]	18	18	18
Elongation in 2 in. [50 mm], min, %[C]	23	23	23

[A]See specimen Orientation under the Tension Tests of Specification A 6/A 6 M.
[B]The size and grade is not described in this specification.
[C]For plates wider than 24 in. (610 mm), the elongation requirement is reduced two percentage points. See elongation requirement adjustments in the Tension Tests section of Specification A 6/A 6M.

7. Tension Test

7.1 The material as represented by the test specimens shall conform to the requirements listed in Table 2.

8. Keywords

8.1 bolted construction; high-strength; low-alloy; low ambient temperatures; normalized; notch toughness; plates; riveted construction; steel; structural steel; welded construction

SUPPLEMENTARY REQUIREMENTS

Standardized supplementary requirements for use at the option of the purchaser are listed in Specification A 6/A 6M. Those that are considered suitable for use with this specification are listed by title:

S5. Charpy V-Notch Impact Test.
S23. Copper-Bearing Steel (for improved atmospheric corrosion resistance).

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APPENDIX

(Nonmandatory Information)

X1. CHARPY V-NOTCH IMPACT TEST

X1.1 The values shown in Table X1.1 are included only as information as to the guarantees that are generally available. Mandatory conformance to any of the values listed is a matter for agreement between the purchaser and the manufacturer.

TABLE X1.1 Charpy V-Notch Impact Test Minimum Energy Values (Average of Three Specimens)

Test Temperature, °F [°C]	Longitudinal Specimens, ft·lbf [J]	Transverse Specimens, ft·lbf [J]
–75 [–60]	15 [20]	15 [20]
–60 [–50]	20 [27]	15 [20]
–50 [–45]	25 [34]	20 [27]
–40 [–40]	25 [34]	20 [27]
–30 [–35]	30 [41]	25 [34]
0 [–20]	40 [54]	30 [41]
32 [0]	45 [61]	30 [41]
75 [25]	50 [68]	30 [41]

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