Designation: A1066/A1066M – 11 (Reapproved 2015)ε1

Standard Specification for High-Strength Low-Alloy Structural Steel Plate Produced by Thermo-Mechanical Controlled Process (TMCP)[1]

This standard is issued under the fixed designation A1066/A1066M; 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.

ε1 NOTE—Editorial corrections were made to Table 1 in September 2015.

1. Scope

1.1 This specification covers steel plates produced by the thermo-mechanical controlled process (TMCP). Five grades are defined by the yield strength: 50 [345], 60 [415], 65 [450], 70 [485], and 80 [550]. The plates are intended primarily for use in welded steel structures.

1.2 The TMCP method consists of rolling reductions and cooling rate controls that result in mechanical properties in the finished plate that are equivalent to those attained using conventional rolling and heat treatment processes, which entail reheating after rolling. A description of the TMCP method is given in Appendix X1.

1.3 The maximum thicknesses available in the grades covered by this specification are shown in Table 1.

1.4 Due to the special combination of mechanical and thermal treatment inducing lower rolling temperatures than for conventional hot rolling the plates can not be formed at elevated temperatures without sustaining significant losses in strength and toughness. The plates may be formed and post-weld heat-treated at temperatures not exceeding 1050°F [560°C]. Higher temperatures may be possible if proven that minimum mechanical characteristics are retained after tests with specimens in the post-weld heat treatment (PWHT) condition. For flame straightening higher temperatures can be used in accordance with the steel manufacturer's recommendations.

1.5 If the steel is to be welded, a welding procedure suitable for the grade of steel and intended use or service is to be utilized. See Appendix X3 of Specification A6/A6M for information on weldability.

1.6 Supplementary requirements are available but shall apply only if specified in the purchase order.

1.7 The values stated in either inch-pound-units or SI units are to be regarded separately 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 is to be used independently of the other, without combining values in any way.

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A673/A673M Specification for Sampling Procedure for Impact Testing of Structural Steel

3. General Requirements for Delivery

3.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A6/A6M.

4. Materials and Manufacture

4.1 The steel shall be killed.

4.2 The plates shall be produced by the thermo-mechanical controlled process.

5. Chemical Composition

5.1 The chemical composition on heat analysis shall conform to the requirements given in Table 1.

5.2 The steel shall conform on product analysis to the requirements prescribed in Table 1 subject to the product analysis tolerances in Specification A6/A6M.

[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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[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.

TABLE 1 Chemical Requirements (Heat Analysis)

Element	Content in [%]				
	Grade 50 [345]	Grade 60 [415]	Grade 65 [450]	Grade 70 [485]	Grade 80 [550]
Thickness	Max 4 in. [100 mm]	Max 4 in. [100 mm]	Max 3 in. [75 mm]	Max 2 in. [50 mm]	Max 1 in. [25 mm]
Carbon, max	0.14[A]	0.16	0.16	0.16	0.16
Manganese	0.70–1.60	0.80–1.70	0.80–1.70	0.80–1.70	1.00–2.00
Phosphorus, max	0.030	0.030	0.030	0.030	0.030
Sulfur, max	0.020	0.020	0.020	0.020	0.020
Silicon	0.15–0.50	0.15–0.50	0.15–0.50	0.15–0.50	0.15–0.50
Copper, max	0.35	0.35	0.35	0.35	0.35
Nickel, max	0.30	0.70	0.70	0.70	0.70
Chromium, max	0.30	0.30	0.30	0.35	0.40
Molybdenum	0.10	0.20	0.25	0.30	0.40
Columbium, max	0.05	0.05	0.05	0.05	0.10
Vanadium, max	0.08	0.08†	0.08	0.09	0.09
Aluminium, min	0.020 total or 0.015 soluble[B]	0.020 total or 0.015 soluble[B]	0.020 total or 0.015 soluble[B]	0.020 total or 0.015 soluble[B]	0.020 total or 0.015 soluble[B]
Boron, max	0.002	0.002	0.002	0.002	0.002

† Editorially corrected.

[A] When Supplementary Requirement S75 is ordered the carbon content is 0.16 % max.

[B] By agreement the steel may be produced with titanium, in which case the minimum aluminum content shall not apply. When this option is exercised, the titanium content, by heat analysis, shall be 0.006 % to 0.02 %, and the actual titanium content shall be reported on the test report.

TABLE 2 Maximum Carbon Equivalent (Heat Analysis)

	Maximum Carbon Equivalent in [%]				
	Grade 50 [345]	Grade 60 [415]	Grade 65 [450]	Grade 70 [485]	Grade 80 [550]
Thickness	Max 4 in. [100 mm]	Max 4 in. [100 mm]	Max 3 in. [75 mm]	Max 2 4 in. [50 mm]	Max 1 in. [25 mm]
CE	0.40	0.43	0.45	0.47	0.50

TABLE 3 Tensile Requirements

Grade		Yield Point, min		Tensile Strength, min		Elongation, min	
		ksi	[MPa]	ksi	[MPa]	8 in. [200 mm], %	2 in. [50 mm], %
50	[345]	50	[345]	65	[450]	18	20
60	[415]	60	[415]	75	[520]	16	18
65	[450]	65	[450]	80	[550]	15	17
70	[485]	70	[485]	85	[585]	14	16
80	[550]	80	[550]	90	[620]	13	15

5.3 The carbon equivalent on heat analysis shall not exceed the limits listed in Table 2. The chemical analysis (heat analysis) of the elements that appear in the carbon equivalent formula and the actual carbon equivalent shall be reported. For the calculation of the carbon equivalent the following formula shall be used:

$$CE = C + \frac{Mn}{6} + \frac{(Cr+Mo+V)}{5} + \frac{(Cu+Ni)}{15}$$

6. Mechanical Properties

6.1 *Tensile Properties*—The material as represented by the test specimens shall conform to the tensile properties given in Table 3.

6.2 Charpy V-notch tests shall be made in accordance with Specification A673/A673M, Frequency H.

6.2.1 The test results of full-size specimens taken from the longitudinal direction of the product shall meet an average value of 35 ft-lbf [48 J] at –10°F [–23°C]. Subsize specimens are permitted as allowed by Specification A673/A673M.

6.2.2 Charpy-V-notch test requirements varying from the value specified in 6.2.1 or other test temperatures are subject to the agreement between the purchaser and the producer.

7. Keywords

7.1 steel plates; high-strength low-alloy steel; thermo-mechanical controlled rolling; structural steel; welded construction