



Designation: A1066/A1066M – 22

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.

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 cannot 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 *Units*—This specification is expressed in both inch-pound units and SI units; however, unless the purchase order or contract specifies the applicable M specification designation

(SI units), the inch-pound units shall apply. 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. Combining values from the two systems may result in nonconformances with the standard.

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
[A770/A770M](#) Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications

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](#), including any supplementary requirements indicated in the purchase order or contract. Failure to comply with the general requirements of Specification [A6/A6M](#) constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification [A6/A6M](#), this specification shall prevail.

4. Materials and Manufacture

4.1 The steel shall be killed.

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

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.

*A Summary of Changes section appears at the end of this standard



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 6 in. [150 mm]	Max 6 in. [150 mm]	Max 6 in. [150 mm]	Max 3 in. [75 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, max	0.10	0.20	0.25	0.30	0.40
Columbium/Niobium, max ^B	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 ^C	0.020 total or 0.015 soluble ^C	0.020 total or 0.015 soluble ^C	0.020 total or 0.015 soluble ^C	0.020 total or 0.015 soluble ^C
Boron, max	0.002	0.002	0.002	0.002	0.002

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

^B Columbium (Cb) and Niobium (Nb) are considered interchangeable names for the same element and both names are acceptable for use in A01 specifications.

^C 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]
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. 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**.

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