



Designation: **A1077/A1077M – 12** **A1077/A1077M – 14**

Standard Specification for Structural Steel with Improved Yield Strength at High Temperature for Use in Buildings¹

This standard is issued under the fixed designation A1077/A1077M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. ~~Scope~~ Scope*

1.1 This specification covers alloy steel in bars, plates up to and including 4 in. [100 mm] in thickness and shapes of structural quality with improved yield strength at high temperature. Two grades, 36 [250] and 50 [345] are available for use in bolted or welded buildings or for general structural purposes. Class 2 requires a maximum yield to tensile ratio – this ratio is not required for Class 1.

1.2 When 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.

1.3 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.

1.4 The text of this specification contains notes or footnotes, or both, that provide explanatory material. Such notes and footnotes, excluding those in tables and figures, do not contain any mandatory requirements.

1.5 For structural products produced from coil and furnished without heat treatment or with stress relieving only, the additional requirements, including additional testing requirements and the reporting of additional test results, of Specification **A6/A6M** apply.

1.6 Supplementary requirements are provided for use where additional testing or additional restrictions are required by the purchaser. Such requirements apply only when specified in the purchase order.

2. Referenced Documents

2.1 *ASTM Standards*:²

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

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

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

E8 Test Methods for Tension Testing of Metallic Materials

E21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials

3. General Requirements for Delivery

3.1 Products furnished under this specification shall conform to the requirements of the current edition of Specification **A6/A6M**, for the specific structural product ordered, unless a conflict exists in which case this specification shall prevail.

3.2 Coils are excluded from qualification to this specification until they are processed into a finished structural product. Structural products produced from coil means structural products that have been cut to individual lengths from a coil. The processor directly controls, or is responsible for, the operations involved in the processing of a coil into a finished structural product. Such operations include decoiling, leveling or straightening, hot-forming or cold-forming (if applicable), cutting to length, testing, inspection, conditioning, heat treatment (if applicable), packaging, marking, loading for shipment, and certification.

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

NOTE 1—For structural products produced from coil and furnished without heat treatment or with stress relieving only, two test results are to be reported for each qualifying coil. Additional requirements regarding structural products produced from coil are described in Specification A6/A6M.

4. Materials and Manufacture

4.1 The steel shall be killed, and this shall be confirmed by one of the following statements: (1) *killed steel*, (2) the silicon content is 0.10 % or more, (3) the total aluminum content is 0.015 % or more, or (4) the titanium content is 0.006 % or more.

5. Chemical Composition

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

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

5.3 The maximum permissible Pcm carbon equivalent values shall be:

Grade	Pcm Value max %
36 [250]	0.26
50 [345]	0.29

5.3.1 The Pcm Carbon equivalent value shall be based upon heat analysis. The required chemical analysis as well as the Pcm carbon equivalent shall be reported. The Pcm carbon equivalent shall be calculated using the following equation:

$$P_{cm} = C = \frac{Si}{30} + \frac{(Mn + Cu + Cr)}{20} + \frac{Ni}{60} + \frac{Mo}{15} + \frac{V}{10} + 5B \% \quad (1)$$

6. Tensile Requirements

6.1 The product as represented by the test specimens shall conform to the requirements for tensile properties given in Table 2.

7. Charpy Impact Requirements

7.1 Charpy V-notch tests shall be conducted in accordance with Specification A673/A673M, frequency H. The test results for full-size test specimen shall conform to the following minimum average value for Grade 36 [250] and 50 [345]:

7.1.1 20 ft lbf [27 J] at 32°F [0°C]

TABLE 1 Chemical Requirement (Heat Analysis)

Element	Composition, %	
	Grade 36 [250]	Grade 50 [345]
Carbon, max	0.15	0.15
Manganese	0.50—1.40	0.50—1.60
Phosphorus, max	0.035	0.035
Sulfur, max	0.035	0.035
Silicon, max	0.35	0.55
Nickel, max	0.50	0.50
Chromium, max	1.00	1.00
Molybdenum	0.20—0.70	0.20—0.90
Copper, max	0.50	0.50
Vanadium, max	0.15	0.15
Columbium, max	0.05	0.05
Titanium, max	0.03	0.03
Boron, max	0.002	0.002

TABLE 1 Chemical Requirements (Heat Analysis)

Product	Shapes		Plates		Bars	
	36 [250]	50 [345]	36 [250]	50 [345]	36 [250]	50 [345]
Carbon, max %	0.15	0.15	0.15	0.15	0.15	0.15
Manganese, max %	0.50—1.40	0.50—1.40	0.50—1.40	0.50—1.40	0.50—1.40	0.50—1.40
Phosphorus, max %	0.035	0.035	0.030	0.030	0.035	0.035
Sulfur, max %	0.035	0.035	0.030	0.030	0.035	0.035
Silicon, max %	0.35	0.35	0.35	0.35	0.35	0.35
Nickel, max %	0.50	0.50	0.50	0.50	0.50	0.50
Chromium, max %	1.00	1.00	1.00	1.00	1.00	1.00
Molybdenum %	0.20—0.70	0.20—0.70	0.20—0.70	0.20—0.70	0.20—0.70	0.20—0.70
Copper, max %	0.50	0.50	0.50	0.50	0.50	0.50
Vanadium, max %	0.15	0.15	0.15	0.15	0.15	0.15
Columbium, max %	0.05	0.05	0.05	0.05	0.05	0.05
Titanium, max %	0.03	0.03	0.03	0.03	0.03	0.03
Boron, max %	0.002	0.002	0.002	0.002	0.002	0.002