



Designation: **A871/A871M – 14 A871/A871M – 20**

# Standard Specification for High-Strength Low-Alloy Structural Steel Plate With Atmospheric Corrosion Resistance<sup>1</sup>

This standard is issued under the fixed designation A871/A871M; 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.

## 1. Scope\*

1.1 This specification covers high-strength low-alloy steel plate intended for use in tubular structures and poles or in other suitable applications. Two grades, 60 and 65, may be provided as-rolled, normalized or quenched and tempered as required to meet the specified mechanical requirements.

1.2 The atmospheric corrosion resistance of this steel in most environments is substantially better than that of carbon structural steels with or without copper addition (see **Note 1**). When properly exposed to the atmosphere, this steel can be used bare (unpainted) for many applications.

NOTE 1—For methods of estimating the atmospheric corrosion resistance of low-alloy steels, see Guide **G101**.

1.3 When the steel is to be welded, it is presupposed that welding procedures suitable for the grade of steel and intended use or service will be utilized. See Appendix X3 of Specification **A6/A6M** for information on weldability.

1.4 Supplementary requirements in accordance with Specification **A6/A6M** are available, but shall apply only when specified by the purchaser at time of ordering.

1.5 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 necessarily exact equivalents; therefore, to ensure conformance with the standard, each system must shall be used independently of the other. Combining other, and values from the two systems may result in nonconformance with the specification. shall not be combined.

1.6 *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:*<sup>2</sup>

- 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
- G101** Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

## 3. General Requirements for Delivery

3.1 Material furnished under this specification shall conform to the requirements of the current edition of Specification **A6/A6M**, for the ordered material, 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 finished plates. Plates produced from coil means plates 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 finished plates. Such operations include decoiling, leveling, cutting to length, testing, inspection, conditioning, heat treatment (if applicable), packaging, marking, loading for shipment, and certification.

<sup>1</sup> 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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<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.

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

NOTE 2—For plates 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 plate produced from coil are described in Specification A6/A6M.

**4. Materials and Manufacture**

4.1 The steel—When the steel is to be heat treated in accordance with Section 5, or to be heat treated as specified in the purchase order, the steel shall be made to fine grain practice.

**5. Heat Treatment**

5.1 Grade 65 in thicknesses of 3/16 to 3/4 in. [5 to 20 mm] and Grade 60 in thicknesses of 3/16 to 1 3/8 in. [5 to 35 mm] are normally furnished in the as-rolled condition. The manufacturer has the option to heat treat this material to meet the mechanical requirements of Section 7. Quenched and tempered material shall be heat treated by heating to not less than 1650°F [900°C], holding a sufficient time to attain uniform heat throughout the material, quenching in a suitable medium, and tempering at not less than 1100°F [595°C]. Heat treating temperatures shall be reported on the test certificates.

5.2 The maximum thickness of plates is limited only by the capacity of the composition to meet the specified mechanical requirements. The individual manufacturer shall be contacted to determine the actual maximum thickness for each grade and heat treatment method.

**6. Chemical Requirements**Composition

6.1 The heat analysis shall conform to the chemical requirements of **Table 1**.

6.2 The—When a product analysis is made, the steel shall conform on product analysis to the chemical requirements of **Table 1**, subject to the product analysis tolerances in Specification **A6/A6M**.

6.3 The atmospheric corrosion-resistance index, calculated on the basis of the heat analysis for the steel, as described in Guide **G101**—Predictive Method Based on the Data of Larabee and Coburn, shall be 6.0 or higher.

NOTE 3—The user is cautioned that the Guide G101 (Predictive Method Based on the Data of Larabee and Coburn) for calculation of an atmospheric corrosion-resistance index has only been verified for the composition limits stated in that guide.

6.4 When required, the manufacturer shall supply evidence of corrosion resistance satisfactory to the purchaser.

**7. Mechanical Requirements**Properties

7.1 *Tension Tests:*

7.1.1 The steel as represented by the tension test specimens shall conform to the tensile requirements of **Table 2**.

7.1.2 For adjustments in **Table 2** percentage elongation requirements for material thickness under 0.312 in. [8 mm] and over 3.5 in. [90 mm], see Specification **A6/A6M**.

7.2 *Charpy V-Notch Impact Tests:*

7.2.1 The steel, as represented by the Charpy V-Notch test, shall conform to the impact test requirements of **Table 3**. The absorbed energy values obtained for subsize specimens shall not be less than the applicable values given in Table 1 of Specification A673/A673M that are proportional to the absorbed energy values required for full-size specimens.

**TABLE 1 Chemical Requirements (Heat Analysis)**

NOTE 1—Where “...” appears in this table, there is no requirement.

Element	Composition, %		
	Type I	Type II	Type IV
Carbon <sup>A</sup>	0.19 max	0.20 max	0.17 max
Manganese <sup>A</sup>	0.80–1.35	0.75–1.35	0.50–1.20
Phosphorus	0.030 max	0.030 max	0.030 max
Sulfur	0.030 max	0.030 max	0.030 max
Silicon	0.30–0.65	0.15–0.50	0.25–0.50
Nickel	0.40 max	0.50 max	0.40 max
Chromium	0.40–0.70	0.40–0.70	0.40–0.70
Molybdenum	...	...	0.10 max
Copper	0.25–0.40	0.20–0.40	0.30–0.50
Vanadium	0.02–0.10	0.01–0.10	...
Columbium	...	...	0.005–0.05 <sup>B</sup>
Columbium/ niobium <sup>C</sup>	...	...	0.005–0.05 <sup>B</sup>

<sup>A</sup> For each reduction of 0.01 percentage point below the specified maximum for carbon, an increase of 0.06 percentage point above the specified maximum for manganese is permitted, up to a maximum of 1.50 %.

<sup>B</sup> For plates under 1/2 in. [13 mm] in thickness, the minimum columbium is waived.

<sup>C</sup> Columbium and niobium are interchangeable names for the same element and both names are acceptable for use in A01 specifications.



**TABLE 2 Tensile Requirements<sup>A</sup>**

Grade	Yield Strength <sup>B</sup> min. ksi [MPa]	Tensile Strength min. ksi [MPa]	Minimum Elongation, % <sup>C</sup>	
			In 8 in. [200 mm]	In 2 in. [50 mm]
60	60 [415]	75 [520]	16	18
65	65 [450]	80 [550]	15	17

<sup>A</sup> For plates wider than 24 in. [600 mm], the test specimen is taken in the transverse direction. See Tension Tests section of Specification **A6/A6M**.

<sup>B</sup> Measured at 0.2 % offset or 0.5 % extension under load as described in Determination of Tensile Properties section of Test Methods and Definitions **A370**.

<sup>C</sup> For plates wider than 24 in. [600 mm], the elongation requirement is reduced three percentage points.

**TABLE 3 Charpy V-Notch Impact Test Requirements**

Plate Thickness in. [mm]	Absorbed Energy ft-lb [J]	Temperature °F [°C]
Up to ½ [12] incl	15 [20]	-0 [-18]
Over ½ [12]	15 [20]	-20 [-29]

**TABLE 3 Charpy V-Notch Impact Test Requirements**

Grade	Absorbed Energy ft-lb [J]	Temperature °F [°C]
60	15 [20]	-20 [-29]
65	15 [20]	-20 [-29]

7.2.2 If more stringent impact requirements are required, they shall be negotiated between the purchaser and the manufacturer.

## 8. Test Specimens and Number of Tests

### 8.1 Number of Tension Tests:

8.1.1 For plate supplied in the as-rolled or normalized condition, the test frequency shall be as specified in Specification **A6/A6M**.

8.1.2 For plate supplied in the quench and tempered condition, one tension test shall be taken from a corner of each plate as-heat treated. For plates ¾ in. [10 mm] and under in thickness, a tension test shall be made from a corner of each of two plates per lot. A lot shall consist of plates from the same heat and thickness, same prior condition and scheduled heat treatment, and shall not exceed 15 tons [13.6 Mg] in weight.

8.2 The purchaser shall indicate on the purchase order the frequency of Charpy V-Notch Impact Testing, as provided for in Specification **A673/A673M**. If the purchase order does not specify the frequency, “H” testing frequency shall be supplied. *Number of Charpy V-notch Impact Tests:*

8.2.1 The purchaser shall indicate on the purchase order the frequency of Charpy V-Notch Impact Testing, as provided for in Specification **A673/A673M**. If the purchase order does not specify the frequency, frequency (H) heat testing shall be supplied unless the steel has been heat treated by quenching and tempering in which case specimens shall be selected from each plate as-heat-treated, frequency (P) piece testing.

## 9. Keywords

9.1 as-rolled; atmospheric corrosion resistance; high-strength; low-alloy; normalized; plate; poles; quenched; steel; structural steel; tempered; tubular structures