Designation: A913/A913M – 19

Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST)[1]

This standard is issued under the fixed designation A913/A913M; 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 high-strength low-alloy structural steel shapes in Grades 50 [345], 60 [415], 65 [450], 70 [485], and 80 [550], produced by the quenching and self-tempering process (QST). The shapes are intended for riveted, bolted or welded construction of bridges, buildings and other structures.

1.2 The QST process consists of in line heat treatment and cooling rate controls which result in mechanical properties in the finished condition that are equivalent to those attained using heat treating processes which entail reheating after rolling. A description of the QST process is given in Appendix X1.

1.3 Due to the inherent characteristics of the QST process, Grade 50 [345], 60 [415], 65 [450], and 70 [485] shapes shall not be formed nor post weld heat treated at temperatures exceeding 1100°F [595°C] and Grade 80 [550] shapes shall not be formed nor post weld heat treated at temperatures exceeding 1000°F [540°C].

1.4 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 of Specification A6/A6M for information on weldability.

1.5 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 must be used independently of the other. Combining values from the two systems may result in nonconformance with this specification.

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:*[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

A898/A898M Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes

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 shapes shall be produced by the quenching and self-tempering process (QST). Following rapid quenching to achieve a surface temperature below the martensite start temperature, Ms, the shapes shall be allowed to auto-temper to a self-tempering temperature (STT) that shall be 1100°F [595°C] minimum and 1300°F [705°C] maximum for Grades 50 [345], 60 [415], 65 [450], and 70 [485]; and 1000°F [540°C] minimum and 1250°F [680°C] maximum for Grade 80 [550]. The STT shall be reported on the mill test report.

4.2 For Grades 60 [415], 65 [450], 70 [485], and 80 [550], the requirements for fine austenitic grain size in Specification A6/A6M shall be met.

5. Chemical Composition

5.1 The chemical analysis of the heat shall conform to the requirements prescribed 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.

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

TABLE 1 Chemical Requirements (Heat Analysis)

NOTE 1—Boron shall not be intentionally added. See Specification A6/A6M, Section 7.1.2, for additional guidance regarding boron.

Element	Maximum Content in %				
	Grade 50 [345]	Grade 60 [415]	Grade 65 [450]	Grade 70 [485]	Grade 80 [550]
Carbon	0.12	0.12	0.12	0.12	0.16
Manganese	1.60	1.60	1.60	1.60	1.80
Phosphorus	0.030	0.030	0.030	0.030	0.030
Sulfur	0.030	0.030	0.030	0.030	0.030
Silicon	0.40	0.40	0.40	0.40	0.50
Copper	0.45	0.45	0.45	0.45	0.45
Nickel	0.25	0.25	0.25	0.25	0.25
Chromium	0.25	0.25	0.25	0.25	0.25
Molybdenum	0.07	0.07	0.07	0.07	0.07
Columbium (Niobium)[A]	0.05	0.05	0.05	0.05	0.06
Vanadium	0.06	0.06	0.08	0.09	0.10

[A] Columbium and niobium are interchangeable names for the same element.

6. Mechanical Properties

6.1 *Tensile Properties*—The material as represented by the test specimens shall conform to the tensile properties given in Table 2.

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 shall meet an average value of 40 ft-lbf [54 J] at 70°F [21°C].

6.2.1.1 Test reports for every heat supplied are required.

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

TABLE 2 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	21
60	[415]	60	[415]	75	[520]	16	18
65	[450]	65	[450]	80	[550]	15	17
70	[485]	70	[485]	90	[620]	14	16
80	[550]	80	[550]	95	[655]	13	15

7. Maximum Carbon Equivalent Requirement

7.1 The carbon equivalent on heat analysis shall not exceed the limits listed in this section. The chemical analysis (heat analysis) of the elements that appear in the carbon equivalent formula and the actual carbon equivalent shall be reported.

Carbon equivalent limits
Grade 50 [345]: 0.38 %
Grade 60 [415]: 0.40 %
Grade 65 [450]: 0.43 %
Grade 70 [485]: 0.45 %
Grade 80 [550]: 0.49 %

7.2 Calculate the carbon equivalent using the following equation:

$$CE = C + Mn/6 + (Cr + Mo + V)/5 + (Cu + Ni)/15$$

8. Keywords

8.1 high-strength low-alloy steel; QST; quenching and self-tempering process; steel shapes; structural shapes; structural steel

SUPPLEMENTARY REQUIREMENTS

Supplementary requirements shall not apply unless specified in the purchase order or contract. Standardized supplementary requirements for use at the option of the purchaser are listed in Specification A6/A6M. Those that are considered suitable for use with this specification are listed by title:

S1. Vacuum Treatment.

S2. Product Analysis.

S3. Simulated Post-Weld Heat Treatment of Mechanical Test Coupons.

S5. Charpy V-Notch Impact Test.

S18. Maximum Tensile Strength.

S30. Charpy V-Notch Impact Test for Structural Shapes: Alternate Core Location.