



# Standard Specification for Seamless Cold-Finished Carbon Steel Structural Frame Tubing for Automotive Racing Applications<sup>1</sup>

This standard is issued under the fixed designation A1103/A1103M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This specification is for seamless cold-finished carbon steel round structural frame tubing for automotive racing applications. The chemical requirements are listed in [Table 1](#). Tubing may be used for other applications requiring similar tolerances and properties. The specification includes requirements for heat treatment and mechanical properties to meet the needs for the application. The tubing is intended to be bent and joined by welding. The welding procedure shall be suitable for the grade, the condition of the components, and the intended service.

1.2 The tubing outside diameter size range is from 0.625 to 2.0 in. [16 to 50 mm]. The wall thickness shall be specified as a minimum wall.

1.3 Optional supplementary requirements may be provided and, when one or more of these are desired, each shall be so stated in the order.

1.4 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 may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. The inch-pound units shall apply unless the “M” designation of this specification is specified in the order.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

<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 A01.09 on Carbon Steel Tubular Products.

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## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

[A450/A450M](#) Specification for General Requirements for Carbon and Low Alloy Steel Tubes

[A751](#) Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

## 3. Ordering Information

3.1 Orders for material under this specification should include the following, as required, to describe the desired material adequately:

3.1.1 Specification designation,

3.1.2 Name of material (seamless structural frame tubing),

3.1.3 Quantity (feet, weight, or number of pieces),

3.1.4 Dimensions (outside diameters and wall thickness, (Section 11),

3.1.5 Length (specific or random, mill lengths, (Section 11)),

3.1.6 Product analysis (Section 8, if required),

3.1.7 Special mechanical tests (flare or flatten, Section 10, if required),

3.1.8 Surface finish (as-cold finished stress relieved, or ground outside surface, if required),

3.1.9 Individual supplementary requirements, if required,

3.1.10 Packaging,

3.1.11 Special marking (Section 16), and

3.1.12 Special packing (Section 17).

## 4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification [A450/A450M](#), unless otherwise provided herein.

## 5. Materials and Manufacture

5.1 The steel may be made by any process.

<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.



TABLE 1 Chemical Requirements of Carbon Steel

Grade Designation	Chemical Composition Limits, % <sup>A</sup>								
	Carbon	Manganese	Phosphorous, max	Sulfur, max	Nickel, max	Chromium, max	Niobium, <sup>B</sup> max	Vanadium, max	Titanium, max
1018	0.15–0.20	0.60–0.90	0.020	0.015	0.20	0.15	0.008	0.008	0.025

<sup>A</sup>The ranges and limits given in this table apply to heat analysis; except as required by 6.1, product analyses are subject to the applicable additional tolerances given in Table 2.

<sup>B</sup>Columbium (Cb) and Niobium (Nb) are alternate names for element 41 in the Periodic Table of the Elements.

5.2 If a specific type of melting is required by the purchaser, it shall be as stated on the purchase order.

5.3 The primary melting may incorporate separate degassing or refining, and may be followed by secondary melting, such as electroslag or vacuum-arc remelting. If secondary melting is employed, the heat shall be defined as all of the ingots remelted from a single primary heat.

5.4 Steel may be cast in ingots or may be strand cast. When steel of different grades is sequentially strand cast, identification of the resultant transition material is required. The producer shall remove the transition material by an established procedure that positively separates the grades.

5.5 Tubes shall be made by a seamless process and shall be cold finished.

5.5.1 Seamless tubing is a tubular product made without a welded seam. It is manufactured usually by hot working steel and, if necessary, by subsequently cold finishing the hot-worked tubular product to produce the desired shape, dimensions, and properties.

5.6 The tubing shall be supplied in the cold finished condition followed by a stress relief anneal (SRA).

5.6.1 A light scale after the anneal is acceptable.

5.6.2 For specification applications, the tubing may have additional outside surface grinding operations.

## 6. Chemical Composition

6.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 1.

## 7. Heat Analysis

7.1 An analysis of each heat of steel shall be made by the steel manufacturer to determine the percentages of the elements specified; if secondary melting processes are used, the heat analysis shall be obtained from one remelted ingot or the

product of one remelted ingot of each primary melt. The heat analysis shall conform to the requirements specified, except that where the heat identity has not been maintained or where the analysis is not sufficiently complete to permit conformance to be determined, the chemical composition determined from a product analysis made by the tubular manufacturer shall conform to the requirements specified for heat analysis. When requested in the order or contract, a report of such analyses shall be furnished to the purchaser.

## 8. Product Analysis

8.1 Except as required by 7.1, a product analysis by the manufacturer shall be required when specified on the purchase order.

8.1.1 One product analysis per heat on either billet or tube is required.

8.2 Samples for chemical analysis shall be taken in accordance with Practice A751. The composition thus determined shall correspond to the requirements in the applicable section of Tables 1 and 2 of this specification and shall be reported to the purchaser or the purchaser's representative.

8.3 If the original test for check analysis fails, retests of two additional billets or tubes shall be made. Both retests for the elements in question shall meet the requirements of the specification; otherwise all remaining material in the heat or lot shall be rejected or, at the option of the producer, each billet or tube may be individually tested for acceptance. Billets or tubes which do not meet the requirements of the specification shall be rejected.

## 9. Tensile Properties

9.1 The materials shall meet the mechanical property requirements of Table 3.

TABLE 2 Product Analysis Tolerances Over or Under Specified Range or Limit

NOTE 1—Individual determinations may vary from the specified heat limits or ranges to the extent shown in this table.

Element	Carbon Steel Seamless Tubes		
	Limit, or Maximum of Specified Range, %	Tolerance, Over the Maximum Limit or Under the Minimum Limit, %	
		Under min	Over max
Carbon	to 0.20, incl	0.02	0.02
Manganese	to 0.90, incl	0.03	0.03
Phosphorous	...	...	0.008
Sulfur	...	...	0.008
Nickel	...	...	0.03
Chrome	...	...	0.04
Niobium	...	...	...
Vanadium	...	...	...
Titanium	...	...	...



TABLE 3 Minimum Mechanical Property Requirements

Grade Designation	Condition	Ultimate Strength,		Yield Strength,		Elongation in 2 in. or 50 mm, %	Rockwell Hardness HRB
		ksi	[MPa]	ksi	[MPa]		
1018	SRA	80	[550]	65	[450]	20	80 to 95

9.2 One tension test shall be made on a specimen for lots of not more than 50 tubes. Tension tests shall be made on specimens from two tubes for lots of more than 50 tubes.

9.3 Rockwell hardness tests shall be made on specimens from two tubes from each lot.

9.4 For tension and hardness test requirements, the term lot applies to all tubes prior to cutting, of the same nominal diameter and wall thickness which are produced from the same heat of steel. When final heat treatment is in a batch-type furnace, a lot shall include only those tubes of the same size and the same heat which are heat treated in the same furnace charge. When the final heat treatment is in a continuous furnace, a lot shall include all tubes of the same size and heat, annealed in the same furnace at the same temperature, time at heat, and furnace speed.

## 10. Additional Mechanical Testing

10.1 *Flare Test*—If specified on the purchase order, each lot of tubing shall be tested with the flare test.

10.2 *Flatten Test*—If specified on the purchase order, each lot of tubing shall be tested with the flatten test.

10.3 For the flare, flatten, and expansion test using a continuous furnace, the lot shall be defined as all tubing of the same heat and size going through the same furnace at the same speed and temperature settings. If a batch furnace is used, the lot shall be defined as all tubing in that same furnace charge.

10.3.1 The lot shall not exceed 5000 ft [1500 m].

## 11. Permissible Variations in Dimensions of Round Tubing

11.1 *Outside Diameter*—The OD tolerance shall be  $+0.005/-0.000$  in. [ $+0.125/-0.000$  mm].

11.2 *Wall Thickness*—Material shall be supplied to a minimum wall condition. The wall tolerance shall be  $+9\%$ ,  $-0\%$ .

11.2.1 The tubing wall thickness shall be capable of being measured using ultrasonic methods.

NOTE 1—During use of this tubing, localized ultrasonic thickness checking is commonly used. Calibration is often performed using a similar thickness and size section that is measured using another method such as a micrometer.

11.3 *Lengths*—Mechanical tubing is commonly furnished in mill lengths, 5 ft [1.5 m] and over. Definite cut lengths are furnished when specified by the purchaser. Length tolerances shall be  $+1/8$   $-0$  in. [ $+3.2/-0$  mm].

11.4 *Straightness*—The straightness tolerances for tubing shall not exceed 0.020 in. in any 3 ft [0.60 mm in any 0.9 m] section.

## 12. Nondestructive Eddy Current Test

12.1 All tubing shall be tested in accordance with nondestructive eddy current testing in accordance with Specification A450/A450M.

## 13. Workmanship, Finish, and Appearance

13.1 The tubing shall be free of laps, cracks, seams, and other defects as is consistent with good commercial practice. The surface finish will be compatible with the condition to which it is ordered.

## 14. Coating

14.1 When specified, tubing shall be coated with a film of oil before shaping to inhibit rust. Should the order specify that tubing be shipped without rust preventive oil, the film of oils incidental to manufacture will remain on the surface. If the order specifies no oil, the purchaser assumes responsibility for rust in transit.

14.2 Unless otherwise specified, tubing may be coated with a rust preventive oil on the outside and inside surfaces, at the option of the manufacturer.

## 15. Rejection

15.1 Tubes that fail to meet the requirements of this specification shall be set aside and the manufacturer shall be notified.

## 16. Product and Package Marking

16.1 Each box, bundle of lift, and, when individual pieces are shipped, each piece shall be identified by a tag or stencil with the manufacturer's name or brand, or both, this specification number (Specification A1103/A1103M), specified size, grade, and heat number.

16.2 In addition to the requirements in 16.1, bar coding is acceptable as a supplemental identification method for the bundle.

## 17. Packaging

17.1 Tubing will normally be shipped bundled with steel banding. Special packaging requiring extra operations other than those normally used by a manufacturer must be specified in the order.

## 18. Keywords

18.1 automotive structural racing tubing; carbon steel tube; seamless steel tube; steel tube; structural frame tubing



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