Designation: A 689 – 97 (Reapproved 2007)$^{\epsilon 1}$

Standard Specification for Carbon and Alloy Steel Bars for Springs[1]

This standard is issued under the fixed designation A 689; 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.

ϵ^1 NOTE—Table 1 editorially corrected in January 2008.

1. Scope

1.1 This specification covers hot-wrought steel bars to be used for the manufacture of general-purpose springs such as coil, torsion, and leaf.

1.2 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for

A 255 Test Methods for Determining Hardenability of Steel

A 304 Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements

A 322 Specification for Steel Bars, Alloy, Standard Grades

A 576 Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality

E 112 Test Methods for Determining Average Grain Size

3. Ordering Information

3.1 Purchase orders for material to this specification shall include the following information as required to describe the desired material adequately:

3.1.1 ASTM designation A 689,

3.1.2 AISI grade number indicating the chemical composition (see 5.1), special chemistry required (see 5.2), or hardenability (see 5.3),

3.1.3 Quantity (number of bars or weight),

3.1.4 Cross section description and dimensions or drawings of section,

3.1.5 Bar lengths,

3.1.6 When purchaser's processing requires cold shearing, cold punching, and cold trimming, this should be noted.

3.1.7 When special straightness or machine-cut lengths are required, reference on the purchase order should be made to Tables A1.10 and A1.9 or Tables A2.10 and A2.9 for SI units of Specification A 29/A 29M, and

3.1.8 Weight limitations per shipping bundle.

4. Melting Practice

4.1 The steel shall be made by one or more of the following primary processes: open-hearth, basic-oxygen, or electric-furnace. The primary melting may incorporate separate degassing or refining and may be followed by secondary melting using electroslag remelting or vacuum arc remelting. Where secondary melting is employed, the heat shall be defined as all of the ingots remelted from a single primary heat.

5. Chemical Composition or Hardenability Requirements

5.1 When the steel is specified by chemical composition, the standard steel grades are the AISI series 1000, 4100, 5100, 6100, 8600, and 9200, and those including Boron AISI series 10B00, 15B00, 50B00, and 51B00. The specific grades are listed in Specifications A 322 and A 576.

5.2 Modifications may be made in the chemistry of the standard AISI grades to suit the hardenability required for a particular bar size, spring shape, or other special requirements. The steel supplier should be consulted on availability of any special chemical compositions.

5.2.1 A chemical analysis of each heat of steel purchased under 5.1 and 5.2 shall be made by the steel producer to determine the percentage of the elements, which percentages shall conform to the requirements of the designated AISI grade or special chemistry. The chemical analysis thus determined shall be reported to the purchaser.

5.3 When the steel is specified by end-quench hardenability requirements (alloy steels), the grade is identified by the suffix letter "H." The standard alloy steel grades are the AISI series 4100H, 5100H, 6100H, 8600H, and 9200H and those including Boron AISI series 50B00H and 51B00H. The specific grades are listed in Specification A 304.

[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 A01.15 on Bars.

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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.

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TABLE 1 Rounded Corner Radii

Specified Sizes,[A] in. (mm)	Nominal Corner Radii, in. (mm)
0.250 (6.35) to 0.375 (9.52)	0.031 (0.78)
0.375 (9.52) to 0.500 (12.70)	0.063 (1.60)
Over 0.500 (12.70) to 0.813 (20.65)	0.094 (2.38)
Over 0.813 (20.65) to 1.469 (37.31)	0.125 (3.18)
Over 1.469 (37.31) to 1.938 (49.23)	0.250 (6.35)
Over 1.938 (49.23) to 2.438 (61.93)	0.313 (7.94)

[A] Sizes are distances between opposite sides of square bars and the thickness of rectangular bars.

5.3.1 Hardenability requirements (band limits) shall be shown on the purchase order as outlined in the applicable sections of Specification A 304.

5.3.2 The end-quench hardenability tests from each heat of steel shall be made in accordance with Test Methods A 255, with the exception that a cast hardenability test specimen may be acceptable. The test results shall conform within the specified limits and shall be reported to the purchaser.

6. General Requirements

6.1 The hot-wrought bars shall be furnished in the as-wrought condition and shall conform to the general requirements as outlined in Specification A 29/A 29M, excepting that the spring steel bars shall not be marked by hot- or cold-stamping unless specified by the purchaser.

6.2 Flat bars for leaf springs unless otherwise specified shall be round-edge flat steel having two flat surfaces and two round (convex) edges. The cross section tolerances permit the two flat surfaces to be slightly concave. When there is concavity, the radii of the arcs of the two concave surfaces shall be approximately the same length.

6.2.1 The round edges shall approximate circular arcs with a radius of curvature between 65 to 85 % of the thickness of the bar.

6.2.2 Round-edge flat bars shall conform to the cross section tolerances specified in Table 2.

6.3 *Flat (Rectangular and Including Square) Bars with Rounded Corners:*

6.3.1 The rounded corner radii shall be in accordance with Table 1.

6.3.2 For section tolerances see Table A1.3 or A2.3 for SI units (for rectangular bars) and Table A1.1 or A2.1 for SI units (for square bars) of Specification A 29/A 29M.

6.4 *Round Bars*—For section tolerances see Table A1.1 or A2.1 for SI units of Specification A 29/A 29M.

6.5 *Special Cross Section Shapes, such as Keystone*—A drawing of the cross section including the tolerances should accompany the purchase order. It is recommended that the steel supplier be contacted concerning the availability of any special cross section.

6.6 *Length and Straightness of Bars*:

6.6.1 For straightness and length tolerances, see Tables A1.10 and A1.8, or Tables A2.10 and A2.8 for SI units of Specification A 29/A 29M.

6.6.2 When special straightness or machine-cut length are required, this must be clearly noted on the purchase order and reference made to Tables A1.10 and A1.9 or Tables A2.10 and A2.9 for SI units of Specification A 29/A 29M.

6.7 The austenitic grain size shall be No. 5 or finer as determined by Test Methods E 112.

7. Workmanship, Finish, and Appearance

7.1 The bars shall be free of injurious defects and shall have a workmanlike finish consistent with good hot-rolling practices for bars intended for use in springs.

8. Rejection and Rehearing

8.1 Steel that fails to conform to the requirements of this specification or shows injurious defects after its receipt by the purchaser, or both, shall be rejected and the supplier shall be notified for disposition.

9. Product Marking

9.1 The bars shall be properly bundled for shipment and identified as to size, weight, heat number, grade designation, purchase order number, and name of supplier.

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TABLE 2 Cross Section Tolerances for Round-Edge Flat Bars

Specified Width, in. (mm)		Tolerance in Width, in. (mm)	Tolerance[A] in Thickness, in. (mm)			Tolerance in Concavity[B] of Flat Surfaces, in. (mm)			Max Difference in Thickness,[C] in. (mm)		
Over	To and including	Minus 0.000	0.375 (9.52) or Under	Over 0.375 (9.52) to 0.875 (22.22), incl	Over 0.875 (22.22) to 1.500 (38.10), incl	0.375 (9.52) or Under	Over 0.375 (9.52) to 0.875 (22.22), incl	Over 0.875 (22.22) to 1.500 (38.10), incl	0.375 (9.52) or Under	Over 0.375 (9.52) to 0.875 (22.22), incl	Over 0.875 (22.22) to 1.500 (38.10), incl
0.00	2.50 (63.5)	+0.030 (0.76)	±0.005 (0.13)	±0.006 (0.15)	...	0.005 (0.13)	0.006 (0.15)	...	0.002 (0.05)	0.002 (0.05)	...
2.50 (63.5)	4.00 (101.6)	+0.045 (1.14)	±0.006 (0.15)	±0.008 (0.20)	±0.012 (0.30)	0.006 (0.15)	0.008 (0.20)	0.012 (0.30)	0.003 (0.07)	0.004 (0.10)	0.006 (0.15)
4.00 (101.6)	5.00 (127.0)	+0.065 (1.65)	±0.007 (0.18)	±0.010 (0.25)	±0.016 (0.40)	00.007 (0.18)	0.010 (0.25)	0.016 (0.40)	0.004 (0.10)	0.005 (0.13)	0.008 (0.20)
5.00 (127.0)	6.00 (152.4)	+0.090 (2.28)	...	±0.012 (0.30)	±0.020 (0.51)	...	0.012 (0.30)	0.020 (0.51)	...	0.006 (0.15)	0.010 (0.25)

[A] Thickness measurements are taken at the edges of the bar where the flat surfaces intersect the rounded edges.
[B] Concavity is the difference between the thickness at the center of the bar and the thickness at the edges. The thickness at the center should not exceed the thickness at the edges.
[C] Maximum difference in thickness between the two edges of each bar.

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