Designation: A 801/A 801M – 99

Standard Specification for Wrought Iron-Cobalt High Magnetic Saturation Alloys UNS R30005 and K92650[1]

This standard is issued under the fixed designation A 801/A 801M; 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 two wrought iron-cobalt alloy types currently manufactured and supplied commercially for use in magnetic components requiring high permeability at and above 15 kG [1.5 T] or high magnetic saturation. The specific alloy types covered are:

Alloy Type	UNS	Nominal Composition
1	R30005	49 % Co, 49 % Fe, 2 % V
2	K92650	27 % Co, 0.50 % Cr, balance Fe

1.1.1 This specification also covers material supplied by a producer or converter in the form and physical condition suitable for fabrication into parts that will later be given final heat treatment to achieve the desired magnetic characteristics and, where required, mechanical properties. It covers material supplied in form of forging billets, hot-rolled products, cold-finished bars, and strip.

1.2 This specification does not cover parts produced by casting or by powder metallurgical techniques.

1.3 The values stated in either customary (cgs-emu and 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 shall be used independently of the other. Combining values from the two systems may result in nonconformance with this specification.

2. Referenced Documents

2.1 *ASTM Standards:*

A 34/A 34M Practice for Sampling and Procurement Testing of Magnetic Materials[2]

A 340 Terminology of Symbols and Definitions Relating to Magnetic Testing[2]

A 341 Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods[2]

A 596 Test Method for Direct-Current Magnetic Properties of Materials Using the Ballistic Method and Ring Specimens[2]

A 773 Test Method for D-C Magnetic Properties of Materials Using Ring and Permeameter Procedures with D-C Electronic Hysteresigraphs[2]

E 1019 Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys[3]

3. Terminology

3.1 The terms and symbols used in this specification are defined in Terminology A 340.

4. Ordering Information

4.1 Purchase orders for material under this specification shall include such of the following information to adequately describe the desired product.

4.1.1 Reference to this specification and year of issue/revision,

4.1.2 Alloy type,

4.1.3 Form and conditions (see Section 6),

4.1.4 Dimensions and tolerances, (tolerances other than those in Section 9 must be stated as mutually agreed upon between the producer and the user),

4.1.5 Quantity (weight or number of pieces),

4.1.6 Magnetic property requirements if other than shown in this specification (see Section 7),

4.1.7 Certification of analysis or magnetic quality evaluation, or both, if needed,

4.1.8 Marking and packaging, and

4.1.9 Exceptions to this specification or special requirements.

[1] This specification is under the jurisdiction of ASTM Committee A06 on Magnetic Properties and is the direct responsibility of Subcommittee A06.02 on Material Specifications.

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[2] *Annual Book of ASTM Standards*, Vol 03.04.

[3] *Annual Book of ASTM Standards*, Vol 03.06.

4.2 *End Use*—Whenever practicable, the user should specify whether the material will be machined, blanked into flat pieces, wound into a core, punched into laminations, or photo-etched.

5. Chemical Composition

5.1 The material shall conform to the requirements prescribed in Table 1. Since magnetic and possibly mechanical properties are of primary importance, analysis variations are permitted subject to mutual agreement between the producer and user.

5.2 Determination of metallic constituents shall be by a method acceptable to both producer and user. Analysis of carbon, nitrogen, sulfur, and oxygen shall be done in accordance with Test Method E 1019.

6. Form and Condition

6.1 These materials are capable of being produced in forms and conditions described suitable for further manufacture into specific magnetic components. The desired form and condition should be discussed with the producer to ensure receiving the correct product. Available forms and conditions are:

6.1.1 *Forging Billet*—Hot-worked and surface prepared by grinding.

6.1.2 *Hot-Rolled Product*—Hot-rolled, hot-rolled and acid cleaned, and hot-rolled and mechanically cleaned.

6.1.3 *Cold-Finished Bars*—Centerless ground.

6.1.4 *Strip*—Cold-rolled.

7. Magnetic Property Requirements

7.1 *General*—Material supplied under terms of this specification shall be tested only by use of dc test methods. AC magnetic property measurements and requirements are subject to mutual agreement between the producer and user.

7.2 *Test Specimen*—Whenever possible, test specimen size and shape shall conform to Practice A 34/A 34M. Shapes such as stacked ring laminations, solid rings, and tape wound cores are the preferred test specimens. If, however, it is impossible to prepare a preferred test specimen shape from the item, the specimen shape used shall be mutually agreed upon between the producer and the user.

7.3 *Density*—The assumed densities of these materials for magnetic test purposes are:

TABLE 1 Chemical Requirements (Weight Percent)

	Alloy 1 UNS R30005	Alloy 2 UNS K92650
Carbon, max	0.025	0.025
Manganese, max	0.15	0.35
Silicon, max	0.15	0.35
Phosphorus, max	0.015	0.015
Sulfur, max	0.010	0.015
Chromium, max	0.15	0.75
Nickel, max	0.25	0.75
Cobalt	47.50 to 49.50	26.50 to 28.50
Vanadium	1.75 to 2.10	0.35 max
Iron	remainder	remainder

Alloy Type	UNS	Density g/cm^3 [kg/m^3]
1	R30005	8.12 [8120]
2	K92650	7.95 [7950]

7.4 *Test Specimen Heat Treatment*—The heat treatment applied to the test specimen shall be in accordance with a procedure mutually agreed upon between the producer and the user or a procedure recommended by the producer to achieve the magnetic properties described in this specification (see Appendix X1).

7.5 *Test Methods*—Magnetic testing shall be conducted in accordance with Test Method A 341, Test Method A 596, or Test Method A 773. Testing shall be conducted at the magnetic field strengths as shown in Table 2 for the alloy type.

7.6 *Requirements*—The material shall meet the requirements listed in Table 2.

8. Typical Physical and Mechanical Properties

8.1 For typical physical and mechanical properties, see Appendix X2.

9. Dimensions and Tolerances

9.1 *Forging Billet and Hot-Rolled Products*—As agreed upon between the producer and user.

9.2 *Cold-Finished Bars*—See Table 3.

9.3 *Cold-Rolled Strip*—See Tables 4 and 5.

10. Rejection and Rehearing

10.1 Where any material fails to meet the requirements of this specification, the material shall be handled in accordance with the procedure mutually agreed upon by the producer and the user.

TABLE 2 DC Magnetic Property Requirements

Alloy Type 1 (UNS R30005)					
		Minimum Magnetic Flux Density kG, [T] for Magnetic Field Strengths of			
Product Form	Size	10 Oe [800 A/m]	20 Oe [1.6 kA/m]	50 Oe [4 kA/m]	100 Oe [8 kA/m]
Strip	all	20.0 [2.00]	21.0 [2.10]	22.0 [2.20]	22.5 [2.25]
Bar	0.500 to 1 in. [12.7 to 25.4 mm]	16.0 [1.60]	18.0 [1.80]	20.0 [2.00]	21.5 [2.15]
Bar-billet	over 1 in. [25.4 mm]	15.0 [1.50]	17.5 [1.75]	19.5 [1.95]	21.5 [2.15]
Alloy Type 2 (UNS K92650)					
		Minimum Magnetic Flux Density kG, [T] for Magnetic Field Strengths of:			
Product Form	Size	50 Oe [4 kA/m]	100 Oe [8 kA/m]	150 Oe [12 kA/m]	200 Oe [16 kA/m]
Strip	all	18.7 [1.87]	20.3 [2.03]	21.2 [2.12]	21.7 [2.17]
Bar	up to 0.250 in. [6.35 mm]	18.7 [1.87]	20.3 [2.03]	21.2 [2.12]	21.7 [2.17]
Bar-billet	over 0.250 in. [6.35 mm]	11.0 [1.10]	17.5 [1.75]	19.5 [1.95]	21.0 [2.10]