



Designation: A901 – 19

Standard Specification for Amorphous Magnetic Core Alloys, Semi-Processed Types¹

This standard is issued under the fixed designation A901; 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 (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification covers the general requirements to which flat-cast, amorphous, semi-processed, iron-base magnetic core alloys must conform.

1.2 These alloys are produced by a rapid-quenching, direct-casting process, resulting in metals with noncrystalline (amorphous) structure. The metallic alloys are made to meet specified maximum core-loss values and are intended primarily for commercial power frequency (50- and 60-Hz) applications in magnetic devices. Desirable core-loss and permeability characteristics are developed by further heat treatment in a magnetic field by the user. The heat treatment typically consists of heating the material to a temperature of 320 to 420°C in a dry, inert atmosphere for 5 to 10 min, although soak times of up to 2 h may be used for large transformer cores. A magnetic field may be required during annealing as designated by the producer. Exact optimum annealing conditions depend on the processing of the material and the size and shape of the device.

1.3 Some of these alloys are sensitive to mechanical stress. Care must be exercised in minimizing any stresses on the material in its final application, otherwise, its magnetic properties will be significantly impaired.

1.4 This specification is developed to aid in the purchase of transformer grade amorphous strip. It provides the chemical, physical, and magnetic parameters and procedures for quality control tests.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses are numerical conversions to customary (cgs and inch-pound) units which are provided for information only and are not considered standard.

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

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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1.7 *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

A34/A34M Practice for Sampling and Procurement Testing of Magnetic Materials

A340 Terminology of Symbols and Definitions Relating to Magnetic Testing

A712 Test Method for Electrical Resistivity of Soft Magnetic Alloys

A773/A773M Test Method for Direct Current Magnetic Properties of Low Coercivity Magnetic Materials Using Hysteresisgraphs

A900/A900M Test Method for Lamination Factor of Amorphous Magnetic Strip

A912/A912M Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Toroidal Specimens

A932/A932M Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Sheet Specimens

C693 Test Method for Density of Glass by Buoyancy

D3455 Test Methods for Compatibility of Construction Material with Electrical Insulating Oil of Petroleum Origin

3. Terminology

3.1 The terms and symbols used in this specification are defined in Terminology A340.

4. Classification

4.1 The classification of iron-based amorphous alloys conforming to this material specification are given in Table 1 and Table 2.

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.

4.2 The material name in **Table 1** and **Table 2** comprises the following in the order given.

4.2.1 The letter AM for amorphous magnetic material,

4.2.2 The two-digit number following AM indicating one hundred times the specific value of maximum specific core loss at 1.3 T (13 000 G) magnetic flux density level at 60 Hz in watts per kilogram (watts per pound),

4.2.3 The two-digit number following maximum specific core loss designation indicating one thousand times the nominal thickness of the strip in millimetres,

4.2.4 The alphabet letters, S and P, following strip thickness for conventional and high permeability grade, respectively,

4.2.5 The single digit number following grade designation being one-tenth of the measuring frequency, and

4.2.6 The last two-digit number indicating one-hundred times the specified value of the minimum lamination factor.

5. Ordering Information

5.1 Order for materials conforming to the specification shall indicate the following information:

5.1.1 Reference to this specification and year of issue revision.

5.1.2 Reference to material name.

5.1.3 Depending upon the desired end use, other magnetic properties such as specific exciting power, saturation magnetic flux density, residual flux density and coercive field strength may need to be specified. The user is responsible for specifying the limits on magnetic properties. The user also states whether and what specific tests are required.

6. Dimensions

6.1 *Width*—Tolerances on nominal as-cast strip width shall be $\pm 0.65\%$ of the specified purchase width.

6.2 *Thickness*—The nominal thickness shall be 0.025 mm (0.001 in.) as measured by a 6.35 mm (0.25-in.) diameter anvil micrometer. The nominal thickness may vary ± 0.005 mm (± 0.0002 in.), but the maximum thickness variation across the width shall be within $\pm 10\%$ of the mean thickness, or as

agreed upon between the user and the producer. Alternatively, the nominal thickness may be determined by **Eq 1**:

$$d = m/\rho_m \cdot b \cdot l \quad (1)$$

where:

d = average calculated thickness of the test specimen in metres,

m = mass of the specimen in kilograms,

b = width of the specimen in metres,

l = length of the specimen in metres, and

ρ_m = conventional density of the specimen in kilogram per cubic metre.

7. Material Requirements

7.1 Amorphous magnetic core alloys are composed principally of iron with small amounts of alloying elements such as boron and silicon. Other chemical elements are in residual amounts or can be added to improve fabrication or the physical or magnetic properties. The chemistry is left to the discretion of the producer. The producer shall provide, on request, a statement of the nominal chemistry being supplied.

8. Sampling

8.1 A continuously cast strip in one coil without breaks will constitute one test lot. In practice, this may represent quantities up to 1000 kg (2200 lb), depending on the width of the strip.

8.2 Test samples normally shall be taken from both ends of the continuous strip of each test lot. Other sample frequencies may be used as agreed upon by the producer and the user.

8.3 For small coils, less than 45 kg (100 lb), and for coils containing splices, the test lot shall be as agreed upon between the producer and the user.

9. Physical and Mechanical Property Requirements

9.1 *Density*—The density shall be provided by the producer to a precision of ± 50 kg/m³ (± 0.05 g/cm³) as measured by Test Method **C693**.

TABLE 1 Magnetic and Physical Properties of the Conventional Grades of Fe-based Amorphous Strip

Material Name	Nominal Thickness mm (in.)	Maximum Specific Core Loss at 1.3 T (13 000 G) W/kg (W/lb)		Maximum Specific Core Loss at 1.4 T (14 000 G) W/kg (W/lb)		Minimum Magnetic Flux Density B at H = 80 A/m (1.0 Oe) T (G)	Minimum Lamination Factor
		50 Hz	60 Hz	50 Hz	60 Hz		
AM11-25S6-90	0.025 (0.001)	0.08 (0.036)	0.11 (0.050)	0.11 (0.050)	0.14 (0.064)	1.35 (13 500)	0.90
AM11-25S6-88							0.88
AM11-25S6-86							0.86
AM11-25S6-84							0.84
AM13-25S6-90	0.025 (0.01)	0.10 (0.045)	0.13 (0.059)	0.13 (0.059)	0.17 (0.077)	1.35 (13 500)	0.90
AM13-25S6-88							0.88
AM13-25S6-86							0.86
AM13-25S6-84							0.84
AM15-25S6-90	0.025 (0.001)	0.12 (0.055)	0.15 (0.068)	0.16 (0.073)	0.20 (0.091)	1.35 (13 500)	0.90
AM15-25S6-88							0.88
AM15-25S6-86							0.86
AM15-25S6-84							0.84