



Designation: A345 – 04

Standard Specification for Flat-Rolled Electrical Steels for Magnetic Applications¹

This standard is issued under the fixed designation A345; 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 general procedures for specifying requirements in the procurement and delivery of flat-rolled electrical steels for magnetic applications. When an applicable individual specification does not exist, this specification enables the user to order a suitable material to be supplied under controlled conditions with respect to magnetic quality, sampling, testing, packaging, and so forth, by specifying certain requirements on the purchase order and citing this specification.

1.2 Individual specifications that are in conformity with this specification are Specifications [A677](#), [A683/A683M](#), [A726](#), [A840](#), and [A876](#).

NOTE 1—For more information on procedures associated with this specification, refer to the following: Test Methods [A341/A341M](#), [A343/A343M](#), [A348/A348M](#), [A596/A596M](#), [A712](#), [A719/A719M](#), [A720/A720M](#), [A721/A721M](#), [A773/A773M](#), [A804/A804M](#), [A889/A889M](#), [A937/A937M](#), [A971](#), and Practice [A664](#).

1.3 The following safety hazards caveat pertains only to the test methods portion, Section 13, of this specification. *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.*

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

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

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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.

- [A341/A341M](#) Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods
- [A343/A343M](#) Test Method for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method and 25-cm Epstein Test Frame
- [A348/A348M](#) Test Method for Alternating Current Magnetic Properties of Materials Using the Wattmeter-Ammeter-Voltmeter Method, 100 to 10 000 Hz and 25-cm Epstein Frame
- [A596/A596M](#) Test Method for Direct-Current Magnetic Properties of Materials Using the Ballistic Method and Ring Specimens
- [A664](#) Practice for Identification of Standard Electrical Steel Grades in ASTM Specifications
- [A677](#) Specification for Nonoriented Electrical Steel Fully Processed Types
- [A683/A683M](#) Specification for Nonoriented Electrical Steel, Semiprocessed Types
- [A700](#) Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment
- [A712](#) Test Method for Electrical Resistivity of Soft Magnetic Alloys
- [A717/A717M](#) Test Method for Surface Insulation Resistivity of Single-Strip Specimens
- [A719/A719M](#) Test Method for Lamination Factor of Magnetic Materials
- [A720/A720M](#) Test Method for Ductility of Nonoriented Electrical Steel
- [A721/A721M](#) Test Method for Ductility of Oriented Electrical Steel
- [A726](#) Specification for Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types
- [A773/A773M](#) Test Method for dc Magnetic Properties of Materials Using Ring and Permeameter Procedures with dc Electronic Hysteresigraphs
- [A804/A804M](#) Test Methods for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Sheet-Type Test Specimens
- [A840](#) Specification for Fully Processed Magnetic Lamination Steel
- [A876](#) Specification for Flat-Rolled, Grain-Oriented,

- Silicon-Iron, Electrical Steel, Fully Processed Types
A889/A889M Test Method for Alternating-Current Magnetic Properties of Materials at Low Magnetic Flux Density Using the Voltmeter-Ammeter-Wattmeter-Varmeter Method and 25-cm Epstein Frame
A937/A937M Test Method for Determining Interlaminar Resistance of Insulating Coatings Using Two Adjacent Test Surfaces
A971 Test Method for Measuring Edge Taper and Crown of Flat-Rolled Electrical Steel Coils
A976 Classification of Insulating Coatings for Electrical Steels by Composition, Relative Insulating Ability and Application

3. Terminology

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

4. Ordering Information

4.1 Orders for material under this specification shall include as much of the following information as necessary to describe the desired material:

4.1.1 Specification A345 or the individual specification number for the specification that shall govern.

4.1.2 Class of electrical steel, whether grain-oriented electrical steel, nonoriented electrical steel, or magnetic lamination steel.

4.1.3 Whether semi- or fully processed.

4.1.4 Core loss type number or standard grade designation. If an individual specification is not cited, the limiting value of the core loss or other magnetic property that shall control, as well as all applicable test conditions and test methods, shall be stated on the order.

4.1.5 Insulation coating type.

4.1.6 Thickness, width, and length, if in cut lengths instead of coils, for the ordered item.

4.1.7 Total weight of ordered item.

4.1.8 Limitations on coil size or lift weight.

4.1.9 End use. Whenever possible, state a single end use for the desired material. For instance, specify whether it is for punched or stamped laminations, sheared laminations, wound cores, formed cores, welded lamination cores, adhesive-bonded cores, and so forth. This will help the producer to provide material with the most desirable physical characteristics for the user's fabricating practices.

4.1.10 Exceptions to the cited specification or a statement of special requirements.

5. Materials and Manufacture

5.1 Normally, these electrical steels are composed principally of iron with relatively small amounts of alloying elements such as silicon and aluminum. Other chemical elements are either in residual amounts or added in small amounts to improve fabrication. The producer shall provide on request a statement of nominal chemistry being supplied.

5.2 The chemical composition and the method of manufacture shall not be unduly prescribed. Any restriction on the conditions of manufacture shall be negotiated between the producer and the user.

5.3 When changes in the manufacture of successive shipments of material because of changing technology are believed to increase the likelihood of adverse effects upon magnetic or fabrication performance in the specified end use, the producer shall notify the user before shipment is made so that he can be afforded an opportunity to evaluate the effects.

6. Magnetic Properties

6.1 Electrical steels are normally graded and purchased to specified maximum core-loss requirements. The user shall make clear to the producer the limiting values of core loss required for the ordered material. The grain direction of the test specimen, whether as sheared or given a specific anneal, the test induction and frequency, the test method, and other information pertinent to the proper qualification of the material shall be specified.

6.2 When the desired end use imposes definite limits on other magnetic properties such as specific exciting power, relative permeability, coercive field strength, and so forth, the user is responsible for so specifying on the order. The user shall also state whether specific tests are required for these other properties or whether the specified characteristics are for informational purposes only.

6.3 The user may request statistical monitoring of product quality by the producer. If mutually agreed upon, any deviation from established product quality limits shall be promptly reported to the user prior to shipment even though the steel being provided conforms in all other respects to the specification.

7. Electrical Properties

7.1 Electrical steels are normally provided with an electrical resistivity appropriate to the core-loss limit and the specified end use. If the electrical resistivity must be restricted, the limiting value shall be negotiated with the producer.

7.2 The surface insulation ability inherent in the processing of electrical steels for magnetic applications may differ widely with the class of electrical steel and the intended end use. Several types of applied coatings are available to attain different levels of insulation ability as needed for critical applications. These inherent and applied coating types C-0, C-2, C-3, C-4, C-4AS, C-5, C5-AS, and C-6 are described and characterized in Classification **A976**. If the inherent mill-processed surface lacks sufficient insulating ability for the user's purposes, the user shall specify the applied coating type to be used, whether tests shall be made by Test Method **A717/A717M** or Test Method **A937/A937M**, any special test conditions under these test methods, and any limiting value of the insulation ability.

8. Mechanical Properties

8.1 Requirements for ductility, lamination factor, tensile or yield strength, and so forth that differ from those inherent in the usual product meeting the magnetic requirements should be specified. Any limiting value(s), the test method(s), and test conditions that apply should be specified also.