



Designation: A345 – 19

# Standard Specification for Flat-Rolled Electrical Steels for Magnetic Applications<sup>1</sup>

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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 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 ASTM electrical steel specifications that are in conformity with this specification are Specifications A677, A683, A726, A840, A876, and A1086.

NOTE 1—For more information on other standards associated with this specification, refer to the following: Test Methods A341/A341M, A343/A343M, A348/A348M, A596/A596M, A712, A717/A717M, A719/A719M, A720/A720M, A721/A721M, A773/A773M, A804/A804M, A889/A889M, A937/A937M, A971/A971M, and Practice A664.

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

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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.*

<sup>1</sup> 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. Referenced Documents

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

- A34/A34M Practice for Sampling and Procurement Testing of Magnetic Materials
- A340 Terminology of Symbols and Definitions Relating to Magnetic Testing
- A341/A341M Test Method for Direct Current Magnetic Properties of Soft Magnetic Materials Using D-C Permeameters and the Point by Point (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 Specification for Nonoriented Electrical Steel, Semi-processed Types
- A700 Guide 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

<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.

Quality Steel, Semiprocessed Types

- A773/A773M Test Method for Direct Current Magnetic Properties of Low Coercivity Magnetic Materials Using 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 (Withdrawn 2011)<sup>3</sup>
- 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/A971M 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
- A1086 Specification for Thin-Gauge Nonoriented Electrical Steel Fully Processed Types

### 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 specific 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

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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 specific core loss requirements. The user shall make clear to the producer the limiting values of specific 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 specific 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