Designation: A 664 – 06$^{\epsilon 1}$

# Standard Practice for Identification of Standard Electrical Steel Grades in ASTM Specifications[1]

This standard is issued under the fixed designation A 664; 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—The values statement (1.3) was corrected editorially in September 2006.

## 1. Scope

1.1 This practice covers the procedure for designating (within ASTM specifications) standard grades of flat-rolled electrical steels made to specified maximum values of core loss. This practice applies to magnetically soft irons and steel (low-carbon steels and alloys of iron with silicon, aluminum, and so forth) where a core loss measurement at a stated peak value of alternating induction and a stated frequency, such as 15 kG (1.5 T) and 60 Hz, is normally used to grade the material. This practice also applies when some other property is specified (or a different induction or frequency, or both) as the limiting characteristic, provided the material also meets all the requirements of the ASTM specification.

1.2 Individual specifications that are in conformity with this practice are Specifications A 677, A 683, A 726, A 840/A 840M, and A 876.

1.3 The values stated in customary (cgs-emu and inch-pound) units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI 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 and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 340 Terminology of Symbols and Definitions Relating to Magnetic Testing

A 677 Specification for Nonoriented Electrical Steel Fully Processed Types

A 683 Specification for Nonoriented Electrical Steel, Semi-processed Types

A 726 Specification for Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types

A 840/A 840M Specification for Fully Processed Magnetic Lamination Steel

A 876 Specification for Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types

A 976 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 practice are defined in Terminology A 340.

## 4. Procedure

4.1 *General Requirements of the Core-Loss-Type Designations*—The core-loss-type designations to be used for ordering purposes and for identification of the shipped material in ASTM specifications for electrical steels shall be a six-character identification (for example, 36F145) comprised of the following basic elements:

4.1.1 *First Two Digits*—The first two digits of the grade designation shall represent the nominal decimal thickness of the material in millimetres. For instance, the number 36 represents a thickness of 0.36 mm or 0.014 in. Refer to Appendix X1 for the relationship between Electrical Sheet Gauge Number and thickness.

4.1.2 *Code Letters*—A code letter shall designate the general category of magnetic material and the standard sampling and testing practices that apply. The precise conditions of sampling and testing are given in the ASTM specification covering each class of material. The code letter to be used and

[1] This practice 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] 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 Code Letters and Sampling and Testing Conditions**

| Code Letter | ASTM Specification | Class of Material and Core-Loss Testing Conditions |
|---|---|---|
| C | A 840/A 840M | Magnetic lamination steel, fully processed, with core-loss value determined at 15 kG (1.5 T) and 60 Hz on as-sheared Epstein specimens.[A] |
| D | A 726 | Magnetic lamination steel, semiprocessed, with core-loss value determined at 15 kG (1.5 T) and 60 Hz on Epstein specimens[A] after a quality development anneal at 1450°F (790°C) with a 1-h soak period. |
| F | A 677 | Nonoriented electrical steel, fully processed, with core-loss value determined at 15 kG (1.5 T) and 60 Hz on as-sheared Epstein specimens.[A] |
| S | A 683 | Nonoriented electrical steel, semiprocessed, with core-loss value determined at 15 kG (1.5 T) and 60 Hz on Epstein specimens[A] after a quality development anneal at 1550°F (845°C) with a 1-h soak period, except that the temperature shall be 1450°F (790°C) for alloy contents less than 1.3 % silicon plus aluminum. |
| G | A 876 | Grain-oriented electrical steel, fully processed, with core-loss value determined at 15 kG (1.5 T) and 60 Hz on Epstein specimens[B] stress-relief annealed usually in the range from 1450 to 1550°F (790 to 845°C) with a 1-h soak period. |
| H | A 876 | Grain-oriented electrical steel, fully processed, with core-loss value determined at 17 kG (1.7 T) and 60 Hz on Epstein specimens[B] stress-relief annealed usually in the range from 1450 to 1550°F (790 to 845°C) with a 1-h soak period. |
| P | A 876 | Grain-oriented electrical steel, fully processed, high permeability, with core-loss value determined at 17 kG (1.7 T) and 60 Hz on Epstein specimens,[B] stress-relief annealed usually in the range from 1450 to 1550°F (790 to 845°C) with a 1-h soak period. Relative peak permeability at 10 Oe (796 A/m) typically exceeds 1880. |
| Q | A 876 | Grain-oriented electrical steel, fully processed, high permeability, laser scribed, with core-loss value determined at 17 kG (1.7 T) and 60 Hz on an as-sheared sheet-type test specimen. Relative peak permeability at 10 Oe (796 A/m) typically exceeds 1880. |

[A] Test specimen with one half of the strips cut parallel to the rolling direction and the other half cut perpendicular to the rolling direction.
[B] Test specimen with all strips cut parallel to the rolling direction.

the sampling and testing conditions associated with that letter shall be as in Table 1.

4.1.3 *Last Digits*—The last three digits of the grade designation shall represent the maximum permissible core loss in watts per pound for the test conditions indicated by the code letter. For instance, the 145 designation on a standard ASTM specification used in conjunction with the Code Letter F represents 1.45 W/lb for the maximum value of core loss determined at 15 kG (1.5 T) and 60 Hz on an as-sheared Epstein specimen consisting of one half of the strips cut parallel to the rolling direction and the other half cut perpendicular to the rolled direction.

## 5. Use of Standard Electrical Steel Grade Designations

5.1 The standard grade designation, formulated as described herein, shall be used together with the appropriate ASTM specification to designate specifically the desired material. For instance, a material designated ASTM Specification A 876 Type 35G066, would signify grain-oriented electrical steel, fully processed, in a thickness of 0.35 mm with a maximum core loss of 0.66 W/lb measured at 15 kG (1.5 T) and 60 Hz on Epstein specimens with all strips cut parallel to the rolling direction, stress-relief annealed at 1450 to 1550°F (790 to 845°C) with a 1-h soak period.

5.2 The ASTM grade designations for electrical steel shall be assigned only by ASTM. They shall apply only when an ASTM specification incorporating that grade designation has become effective through the normal standardizing activities of the Society. The ASTM grade designations shall be used to identify electrical steel grades only when the material so identified complies with the requirements of the ASTM specification of which the grade designation is a part.

## 6. Keywords

6.1 core loss; electrical steel; fully processed; grain-oriented electrical steel; identification; laser scribed; magnetic lamination steel; nonoriented electrical steel; semiprocessed



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# APPENDIXES

**(Nonmandatory Information)**

## X1. ELECTRICAL SHEET GAUGE NUMBERS

X1.1 Table X1.1 shows the relationship between Electrical Sheet Gauge Numbers and thickness. This is for information only.

**TABLE X1.1 Electrical Sheet Gauge Number**

| Electrical Sheet Gauge Number | Thickness | |
|---|---|---|
| | in. | mm |
| 16 | 0.0625 | 1.59 |
| 17 | 0.0560 | 1.42 |
| 18 | 0.0500 | 1.27 |
| 19 | 0.0453 | 1.15 |
| 20 | 0.0375 | 0.952 |
| 21 | 0.0340 | 0.864 |
| 22 | 0.0310 | 0.787 |
| 23 | 0.0280 | 0.711 |
| 24 | 0.0250 | 0.635 |
| 25 | 0.0220 | 0.559 |
| 26 | 0.0185 | 0.470 |
| 27 | 0.0170 | 0.432 |
| 28 | 0.0155 | 0.394 |
| 29 | 0.0140 | 0.356 |
| 30 | 0.0125 | 0.318 |
| 31 | 0.0100 | 0.254 |

## X2. USE OF INSULATING COATINGS DESIGNATION

X2.1 In the interest of promoting computerized databases, the electrical steel designation contained in this practice can be combined with the coatings designation listed in Classification A 976 to form an identifying alphanumeric field. The user should consult with the steel producer to verify that the combination is correct since not all coatings are applicable to a given grade of steel. Since Classification A 976 is not a specification, it is not appropriate at this time to specify insulating coating behavior.

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