



## Standard Specification for Copper-Clad Thermosetting Laminates for Printed Wiring<sup>1</sup>

This standard is issued under the fixed designation D 1867; 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 twelve grades of thermosetting laminate with copper foil bonded to one or both surfaces. These combination forms are intended primarily for use in fabrication of printed (etched) wiring or circuit boards.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *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:

D 709 Specification for Laminated Thermosetting Materials<sup>2</sup>

D 3636 Practice for Sampling and Judging Quality of Solid Electrical Insulating Materials<sup>3</sup>

D 5109 Test Methods for Copper-Clad Thermosetting Laminates for Printed Wiring Boards<sup>3</sup>

#### 2.2 Other Standards:

MIL-P-13949 Plastic Sheet, Laminated, Metal Clad (for Printed Wiring Boards)<sup>4</sup>

NEMA Publication Number LI-1<sup>5</sup>

### 3. Classification

3.1 *Base Laminate Grades*—Where applicable, the dielectric material forming the base of the copper-clad laminate of the types listed in Table 1 and Table 2 shall conform to the property requirements of that specific grade shown in Specification D 709.

3.2 *Copper Foil Surfaces*—The surfaces shall be copper foil, either rolled or electrodeposited, having a minimum purity

**TABLE 1 Base Laminate Grades**

NOTE 1—A cross reference table of grade designations (see Table 2) appears here for reference purposes only. The ASTM grades shown are most closely associated with the NEMA and the military grades listed in this table. There is no requirement, stated or implied, in this ASTM specification that the ASTM grade must meet the specification requirements of the NEMA or the military standards listed.

| ASTM Grade | Type                                                                              |
|------------|-----------------------------------------------------------------------------------|
| XXXP       | Paper base, phenolic resin                                                        |
| XXXPC      | Paper base, phenolic resin                                                        |
| FR-2       | Paper base, phenolic resin, flammability rated                                    |
| FR-3       | Paper base, epoxy resin, flammability rated                                       |
| FR-4       | Glass woven fabric base, epoxy resin, general purpose, flammability rated         |
| FR-5       | Glass woven fabric base, epoxy resin, temperature resistant, flammability rated   |
| FR-6       | Random glass fiber base, polyester resin, flammability rated                      |
| G-10       | Glass woven fabric base, epoxy resin, general purpose                             |
| G-11       | Glass woven fabric base, epoxy resin, temperature resistant                       |
| CEM-1      | Glass woven cloth surfaces, cellulose paper core, epoxy resin, flammability rated |
| CEM-3      | Glass woven cloth surfaces, non-woven glass core, flammability rated              |
| CFR-1      | Glass polyester non-woven fabric base, epoxy resin, flammability rated            |

of 99.50 % (silver considered as equal to copper). The thickness tolerances of the copper foil shall conform to the requirements of Table 3.

3.3 *Thickness Tolerance Classes*—Copper-clad laminates are available in two classes of thickness tolerance. Class I represents those tolerances of standard manufacturing practice. Class II represents a closer tolerance product than Class I. Any specified class shall conform to the requirements shown in Table 4.

**TABLE 2 Grade Cross References**

| ASTM Grade | NEMA LI-1 Grade | MIL-P-13949 Grade |
|------------|-----------------|-------------------|
| XXXP       | XXXP            | PP                |
| XXXPC      | XXXPC           | PP                |
| FR-2       | FR-2            | ...               |
| FR-3       | FR-3            | PX                |
| FR-4       | FR-4            | GF                |
| FR-5       | FR-5            | GH                |
| FR-6       | FR-6            | ...               |
| G-10       | G-10            | GE                |
| G-11       | G-11            | GB                |
| CEM-1      | CEM-1           | ...               |
| CEM-3      | CEM-3           | ...               |
| CFR-1      | ...             | CF                |

<sup>1</sup> This specification is under the jurisdiction of the ASTM Committee D-9 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.07 on Flexible and Rigid Insulating Materials.

Current edition approved March 10, 1996. Published May 1996. Originally published as D 1867 – 61 T. Last previous edition D 1867 – 94.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 10.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 10.02.

<sup>4</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

<sup>5</sup> Available from National Electrical Manufacturers Association, 2101 L St., N.W., Washington, DC 20037.