

## Chapter E 665

INDUCTIVE AND DIELECTRIC HEAT  
GENERATING EQUIPMENT

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## A. SCOPE AND GENERAL

**E 665.01 Scope.** The provisions of this chapter shall apply to the construction and installation of inductive and dielectric heat-generating equipment and accessories.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.02 Definitions.** (1) The term "generating equipment" as used in this chapter shall be understood to mean any equipment used to change the voltage and/or frequency of the power supplied to such equipment.

(2) Inductive heating is the heating of a nominally conducting material due to its own I<sup>2</sup>R losses when the material is placed in a varying electro-magnetic field.

(3) Dielectric heating is the heating of a nominally insulating material due to its own dielectric losses when the material is placed in a varying electric field.

(4) The term "therapeutic high frequency equipment" as used in this chapter shall be understood to mean generating equipment capable of producing alternating currents having frequencies greater than those frequencies which elicit neuromuscular response. In order to comply with the above, the output frequency of the therapeutic high frequency equipment shall not be less than 2 megacycles.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.03 Application of other chapters.** Wiring from the source of power to generating equipment shall comply with code chapters E 100 to E 400 inclusive. Circuits and equipment operating on a supply circuit of more than 600 volts shall comply with the provisions of chapter E 710.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.04 Hazardous locations.** Inductive and dielectric heat generating equipment shall not be installed in hazardous locations as defined in chapter E 500 unless the equipment is designed and approved for hazardous locations.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**B. POWER SUPPLY**

**E 665.05 Capacity of supply conductors.** (1) FOR MOTOR GENERATOR EQUIPMENT. Capacity of supply conductors shall be determined from chapter E 430 of this code.

(2) FOR OTHER THAN MOTOR GENERATOR EQUIPMENT. Capacity of supply conductors shall be determined as follows:

(a) The current-carrying capacity of the circuit shall be not less than the nameplate current rating of the equipment.

(b) The current-carrying capacity of conductors supplying 2 or more equipments shall be not less than the sum of nameplate current ratings on all equipment except as follows: Where, when supplying 2 or more equipments from the same feeder, simultaneous operation of said equipments is not possible, the capacity of the feeder shall be not less than the sum of the nameplate currents for the largest group of machines capable of simultaneous operation, plus 100% of the standby currents of the remaining machines supplied.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.06 Overcurrent protection.** (1) FOR MOTOR GENERATOR EQUIPMENT. Overcurrent protection shall be provided as specified in chapter E 430 of this code.

(2) OTHER THAN MOTOR GENERATOR EQUIPMENT. Overcurrent protection shall be provided separately or as part of the equipment, to protect the equipment as a whole. The overcurrent device shall have a rating or setting of not more than 200% of the nameplate current rating.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.07 Disconnecting means.** A readily accessible disconnecting means shall be provided by which each generating equipment can be isolated from the supply circuit. The current-carrying capacity of this disconnecting means shall be not less than the nameplate current rating of equipment. The supply circuit switch may be used as the generating equipment disconnecting means where the circuit supplies only one equipment.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**C. OUTPUT**

**E 665.08 Output circuit definition.** Output circuit parts shall include all high frequency components external to the generator, including interconnecting radio frequency transmission lines, load tuning networks, and work applicators.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.09 Output circuits.** Output circuits shall conform to the following:

(1) **GUARDING.** With respect to guarding, all such parts shall be considered with the generating equipment as a complete assembly.

(2) **GENERATOR OUTPUT.** The generator output shall be at direct-current ground potential (coupled outputs alone, without other precautions, will not suffice because of the danger existing during possible flashovers).

(3) **GENERATOR AND APPLICATOR CONNECTION.** When the connections between the generator and work applicator exceed 2 feet in length the connections shall be enclosed or guarded with noncombustible material.

(4) **WORK APPLICATOR.** The work applicator shall be so guarded that safe operation of the equipment will always be assured.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.10 Low frequency AC in generating equipment output.** Commercial frequencies of 25 to 60 cycle alternating-current output may be coupled for control purposes, but shall be limited to a value of 150 volts available only during periods of circuit operation.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.11 Keying.** Where high speed keying circuits dependent on the effect of "oscillator blocking" are employed, the peak RF output voltage during the blocked portion of the cycle shall not exceed 100 volts.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.12 Foot switch.** Switches operated by foot pressure, except those for electro-surgical apparatus, shall be provided with a shield over the contact button to avoid accidental closing.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.13 Remote control.** When remote controls are used for applying power, a "Local-Remote" switch shall be provided and interlocked so as to prevent the possibility of applying power from other than one selected control point or points.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

#### D. GUARDING AND GROUNDING

**E 665.14 Warning labels.** Warning labels, definitely indicating danger, shall be attached to doors, access panels or at other vantage points on equipment, so that the labels will be plainly visible when doors are opened or panels are removed from compartments containing voltages above 250 volts AC or DC.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.15 Enclosure of generating apparatus.** The generating apparatus including the DC, low-, and high-frequency electrical circuits but excluding the output circuits shall be completely contained in an enclosure of noncombustible material. The metal housings of motors, generators and the like may serve as a part of this enclosure.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.16 Panel controls.** All panel controls shall be of "dead front" construction.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.17 Access to internal equipment.** Doors or detachable panels may be employed for internal access. Where doors are used, giving access to voltages above 500 volts AC or DC either door locks shall be provided or interlocking shall be installed with the choice of precaution optional. Detachable panels not normally used for access to such parts shall be fastened in a manner not conveniently removable.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.18 Capacitors.** (1) Where capacitors in excess of 0.1 Mfd. are used in DC circuits, either as rectifier filter components, arc suppressors, etc., having circuit voltages exceeding 230 volts above ground, bleeder resistors or grounding switches shall be used as grounding devices.

(2) Where auxiliary rectifiers are used with filter capacitors in the output for bias supplies, tube keyers, etc., bleeder resistors shall be used even though the DC voltage may not exceed 230 volts.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.19 Work applicator shielding.** Protective cages or adequate shielding shall be used to guard work applicators. Interlock switches shall be used on all hinged access doors, sliding panels or other easy access means normally intended for quick access to the applicator. All interlock switches shall be connected in such a manner as to remove all power from the applicator when any one of the access doors or panels is open.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.20 Grounding and bonding.** Grounds or inter-unit bonding shall be used wherever required for circuit operation and for limiting to a safe value radio frequency potentials between all exposed non-current-carrying parts of the equipment and earth ground, also between all equipment parts and surrounding objects and between such objects and earth ground. Such grounding and bonding shall be installed in accordance with chapter E 250 of this code.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.21 Marking.** Each generating equipment shall be provided with a nameplate giving the manufacturers' name and model identification and the following input data: line volts, frequency, number of phases, maximum current, full load kva, and power factor.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

#### **E. THERAPEUTIC EQUIPMENT**

**E 665.22 Installation.** (1) Where portability is not essential, equipment shall be permanently installed in accordance with chapters E 100 to E 300 inclusive.

(2) Where portability is essential, the power supply cord shall be 3-conductor hard service cord of such current-carrying capacity as to be not less than the marked rating of the equipment, and it shall be provided with one conductor whose insulation is green in color for equipment grounding. Where the marked rating of the equipment exceeds 15 amperes the cord shall terminate in an approved 3-blade attachment-plug cap. Where the marked rating of the appliance does not exceed 15 amperes the cord may be terminated in an approved 2-blade attachment-plug cap with grounding wire. (See section E 250.059).

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 665.23 Applicators for therapeutic equipment.** Application of the high frequency power to the patient may be made by means of an electric field or of an induction field. Current-carrying parts of applicators shall be so insulated or enclosed that reliable isolation of the patient shall be assured.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.