

Special Conditions

CHAPTER E-700

EMERGENCY SYSTEMS

A. General

E-700.01. Scope.

The provisions of this Chapter apply to the installation, operation and maintenance of circuits, systems and equipment intended to supply illumination and power in the event of failure of the normal supply or in the event of accident to elements of a system supplying power and illumination essential for safety to life and property where such systems or circuits are legally required by Municipal, State, Federal or other Codes, or by any governmental agency having jurisdiction.

Note 1. Emergency systems are generally installed in places of assembly where artificial illumination is required, such as buildings subject to occupancy by large numbers of persons, hotels, theaters, sports arenas, hospitals and similar institutions. Emergency systems may provide power for such functions as essential refrigeration, operation of mechanical breathing apparatus, ventilation when essential to maintain life, illumination and power for hospital operating rooms, fire pumps, fire alarm systems, industrial processes where current interruption would produce serious hazards, public address systems and similar functions.

Note 2. See Wisconsin Administrative Code rules Ind 54.06(2), Ind 55.11(1), Ind 56.08, Ind 51.15 and Ind 57.11 for specification of locations where emergency lighting is considered essential to life safety.

Note 3. The methods of supplying exit and emergency illumination in existing buildings will be determined in each individual case.

E-700.02. Other Requirements.

All requirements of the Wisconsin State Electrical Code shall apply to emergency systems, except as modified by this Chapter.

E-700.03. Equipment Approval.

All equipment shall be approved for use on emergency systems.

E-700.04. Tests and Maintenance.

- (1) The authority having jurisdiction shall conduct or witness a test on the complete system upon installation and periodically afterward.
- (2) Systems shall be tested periodically on a schedule acceptable to the authority having jurisdiction to assure their maintenance in proper operating condition.
- (3) Where battery systems or unit equipments are involved, including batteries used for starting or ignition in auxiliary engines, the authority having jurisdiction shall require periodic maintenance.
- (4) A written record shall be kept of such tests and maintenance.

E-700.05. Capacity.

Emergency systems shall have adequate capacity and rating for the emergency operation of all equipment connected to the system.

B. Sources of Power

E-700.06. Systems.

- (1) Current supply shall be such that in event of failure of the normal supply to or within the building or group of buildings concerned, emergency lighting, or emergency power, or both emergency lighting and power will be immediately available. The supply system for emergency purposes may comprise one or more of the types of system covered in E-700.07 to E-700.10. Unit equipments in accordance with E-700.22 shall satisfy the applicable requirements of this Chapter.
- (2) Emergency auxiliary service supply from a storage battery, generator, etc. when used to replace a part or all of normal service, shall be provided with a double throw switch or throw over switches mechanically interlocked to prevent energy from flowing into the normal source of supply.
- (3) Consideration must be given to the type of service to be rendered, whether of short time duration, as for exit lights of a theater, or of long duration as for supplying emergency power and lighting due to a long period of current

failure from trouble either inside or outside the building, as in the case of a hospital.

(4) The emergency service switch shall be identified.

Note: Assignment of degree of reliability of the recognized emergency supply system depends upon the careful evaluation of the variables at each particular installation.

E-700.07. Storage Battery.

(1) One service, in accordance with Chapter E-230, and a storage battery of suitable rating and capacity to supply and maintain at not less than 91 per cent of system voltage the total load of the circuits supply emergency lighting and emergency power for a period of at least $\frac{1}{2}$ hour.

(2) Batteries whether of the acid or alkali type shall be designed and constructed to meet the requirements of emergency service. When of the lead-acid type, this shall include low gravity acid (1.20 to 1.22 SP-GR), relatively thick and rugged plates and separators, and a transparent jar.

E-700.08. Generator Set.

One service, in accordance with Chapter E-230, and a generator set driven by some form of prime mover and of sufficient capacity and proper rating to supply circuits carrying emergency lighting or lighting and power, with suitable means for automatically starting the prime mover on failure of the normal service. (See E-700.04)

E-700.09. Separate Service.

Two services, each in accordance with Chapter E-230, widely separated electrically and physically to minimize possibility of simultaneous interruption of supply.

Note: This method is not acceptable as a source of power for emergency lighting or power occupancies where people are housed, assembled, confined or congregated as follows:

<u>Number of Persons</u>	<u>Typical Occupancies</u>
1. Over 30.	hospitals, clinics, homes for the aged, nursing homes, childrens' homes, asylums and similar buildings; also natatoriums.
2. Over 200.	theaters, assembly halls, dining rooms, libraries, stores, hotels, motels and similar buildings.
3. Over 400.	apartment buildings, dormitories, office buildings, convents, factories and similar buildings.

E-700.10. Connection Ahead of Service Disconnecting Means.

Connections on the line side of the main service if sufficiently separated from main service to prevent simultaneous interruption of supply through an occurrence within the building or group of buildings served. Feeder conductors entering a separate building may be considered service conductors as far as emergency supply is concerned.

Note: Refer to note following E-700.09 for listing of occupancies where this method is not acceptable as a source of power for emergency lighting or power.

E-700.11. Auxiliary Source.

The requirements of E-700.05 and E-700.06 shall also apply to installations where the entire electrical load on a service or sub-service is arranged to be supplied from a second source. Current supply from a standby power plant shall satisfy the requirements of availability in E-700.06.

E-700.12. Derangement Signals.

Audible and visual signal devices shall be provided where practicable for the following purposes:

- (1) To give warning of derangement of the emergency or auxiliary source.
- (2) To indicate that the battery or generator set is carrying load.
- (3) To indicate when battery charger is properly functioning.

C. Emergency Circuits for Lighting and Power

E-700.13. Loads on Emergency Branch Circuits.

No appliances and no lamps, other than those specified as required for emergency use shall be supplied by emergency lighting circuits.

E-700.14. Emergency Illumination.

(1) Emergency illumination shall include all required exit lights and all other lights specified as necessary to provide sufficient illumination.

(2) Emergency lighting systems should be so designed and installed that the failure of any individual lighting element, such as the burning out of a light bulb, cannot leave any space in total darkness.

E-700.15. Circuits for Emergency Lighting.

Branch circuits intended to supply emergency lighting shall be so installed as to provide service immediately when the normal supply for lighting is interrupted. Such installations shall provide either one of the following:

(1) An emergency lighting supply, independent of the general lighting system with provisions for automatically transferring, by means of devices approved for the purpose, the emergency lights upon the event of failure of the general lighting system supply.

(2) Two or more separate and complete systems with independent power supply, each system providing sufficient current for emergency lighting purposes. Unless both systems are used for regular lighting purposes and are both kept lighted, means shall be provided for automatically energizing either system upon failure of the

other. Either or both systems may be part of the general lighting system of the protected occupancy if circuits supplying lights for emergency illumination are installed in accordance with other rules of this chapter.

E-700.16. Circuits for Emergency Power.

For branch circuits which supply equipment classed as emergency, there shall be an emergency supply source to which the load will be transferred automatically and immediately upon the failure of the normal supply.

E-700.17. Independent Wiring.

Emergency circuit wiring shall be kept entirely independent of all other wiring and equipment and shall not enter the same raceway, box or cabinet with other wiring except:

Exception No. 1. In transfer switches.

Exception No. 2. In exit or emergency lighting fixtures supplied from two sources.

D. Control

E-700.18. Switch Requirements.

(1) The switch or switches installed in emergency lighting circuits shall be so arranged that only authorized persons will have control of emergency lighting except:

Exception No. 1. Where two or more single throw switches are connected in parallel to control a single circuit, at least one of these switches shall be accessible only to authorized persons.

Exception No. 2. Additional switches which act only to put emergency lights into operation but not disconnect them are permissible.

(2) Switches connected in series or three and four way switches shall not be used. The emergency service switch shall be identified.

E-700.19. Switch Location.

(1) All manual switches for controlling emergency circuits shall be in locations convenient to authorized persons responsible for their actuation. In places of assembly such as theaters a switch for controlling emergency lighting systems shall

be located in the lobby or at a place conveniently accessible thereto.

(2) In no case shall a control switch for emergency lighting in a theater or motion picture theater be placed in a motion picture projection booth or on a stage, except that where multiple switches are provided, one such switch may be installed in such location when so arranged that it can energize, but not disconnect the circuit.

E-700.20. Other Switches.

(1) Exterior Lights. Those lights on the exterior of the building which are not required for illumination when there is sufficient daylight may be controlled by an automatic light-actuated device approved for the purpose.

(2) Hospital Corridors. Switching arrangements to transfer corridor lighting in patient areas of hospitals from overhead fixtures to fixtures designed to provide night lighting may be permitted, provided the switching system is so designed that switches can only select between two sets of fixtures and cannot extinguish both sets at the same time.

E. Overcurrent Protection

E-700.21. Accessibility.

The branch-circuit overcurrent devices in emergency circuits shall be accessible to authorized persons only.

F. Unit Equipments

E-700.22. Unit Equipments.

(1) Where permitted by the administrative authority, in lieu of other methods specified elsewhere in this chapter, individual unit equipments for emergency illumination shall consist of (a) a battery, (b) battery charging means when a storage battery is used, (c) one or more lamps, and (d) a relaying device arranged to energize the lamps automatically upon failure of the normal supply to the building. The batteries shall be of suitable rating and capacity to supply and maintain at not less than 91 per cent of rated lamp voltage the total lamp load associated with the unit

for a period of at least $\frac{1}{2}$ hour. Storage batteries whether of the acid or alkali type shall be designed and constructed to meet the requirements of emergency service. When of the lead-acid type the storage battery shall have a transparent jar.

(2) Unit equipments shall be permanently fixed in place (i.e. not portable) and shall have all wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter E-300. They shall not be connected by flexible cord. The supply circuit between the unit equipment and the service, feeders, or the branch circuit wiring shall be installed as required by E-700.17. Emergency illumination fixtures which obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by E-700.17 and by one of the wiring methods of Chapter E-300.

E-700.23. Fire Alarm Wiring.

(1) The energy for operation of fire alarm systems shall be taken from sources suited to the design of the system. Batteries on systems of less than 110 volts shall not be used.

or 120-208 volt (3-phase, 4-wire)

(2) A 3-wire 110-220 volt/service will be accepted for supervised systems provided the operating current is secured from one ungrounded conductor and the neutral or grounded conductor and the current for operating trouble signal or signals is secured from the other ungrounded conductor and the neutral or grounded conductor.

(3) Electrical wiring in connection with fire alarm systems shall be installed in rigid metal conduit, flexible metal conduit, electrical metallic tubing or surface metal raceway. Armored cable (metal) may be used where it can be fished in hollow spaces of walls or partitions in apartments or rooming houses not over three stories in height. Where the wiring is subject to excessive moisture or severe mechanical injury, rigid metal conduit shall be used. The smallest size conductor to be used in any fire alarm system in a building over three stories in height shall be No. 14 AWG or No. 16 AWG for buildings not over three stories in height. The wires shall be provided with insulation suitable for use on circuits not exceeding 600 volts. Fire

alarm systems shall be connected to the line side of the main service switch or to the emergency feeder through 2 single pole breakers or switches used for no other purpose and arranged so they can be locked in the "on" position, and under the supervision of a qualified person. The breaker and switches shall be identified by a red color. Two pole breakers shall not be used.

Note: See Ind 51.24 of the Wisconsin Administrative Code for general requirements covering fire alarm systems.

CHAPTER E-710

OVER 600 VOLTS - GENERAL

A. General

E-710.01. Scope.

This Chapter applies in general to all circuits and equipment operated at more than 600 volts. For specific installation see the chapters referred to in E-710.02.

E-710.02. Installations Covered in Other Chapters.

Provisions applicable to specific types of installations are included in Chapter E-230, Services; Chapter E-430, Motors, Motor Circuits and Controllers; Chapter E-450, Transformers and Transformer Vaults; Chapter E-460, Capacitors; Chapter E-730, Outside Branch Circuits and Feeders; Chapter E-410, Lighting Fixtures, Lampholders, Lamps, Receptacles and Rosettes; Chapter E-600, Electric Signs and Outline Lighting; Chapter E-660, X-Ray Equipment, and Chapter E-665, Inductive and Dielectric Heat Generating Equipment.

E-710.03. Wiring Methods.

Circuit conductors shall be suitable for the voltage and the conditions under which they are installed. They shall be installed in rigid metal conduit, in raceways or ducts or as open runs of metal armored cable suitable for the use and purpose.

Exception: In locations accessible to qualified persons only, open runs of

non-metallic sheathed cable, bare conductors and bare bus bars may also be used.

E-710.04. Braid-Covered Insulated Conductors - Open Installation.

Open runs of braid-covered insulated conductors shall have a flame-retardant braid. When the conductors used do not have this protection a flame-retardant saturant shall be applied to the braid covering after installation. This treated braid covering shall be stripped back a safe distance at conductor terminals, according to the operating voltage. This distance should be not less than one inch for each kilovolt of the conductor-to-ground voltage of the circuit, where practicable.

E-710.05. Shielding of Rubber Insulated Conductors.

Where rubber-insulated conductors for permanent installations operate at voltages higher than those indicated in Table E-710.05 and under the conditions mentioned, they shall be of a type having metallic shielding for the purpose of confining their dielectric field.

Table E-710.05

Shielding of Rubber-Insulated Conductors

Method of Installation	Voltage in Kv (L-L) Above which Shielding is Required			
	<u>Neutral Grounded</u>		<u>Neutral Ungrounded</u>	
	Fibrous Covered	Ozone Resistant Jacket Covering	Fibrous Covered	Ozone Resistant Jacket Covering
In metallic conduit or trough above grade located indoors and in dry locations				
Single conductor	2	5*	2	3
Multi-conductor	2	5	2	5
Underground ducts and conduits and other wet locations				
Single conductor	2	3**	2	3
Multi-conductor	2	5	2	5
On insulators -				
Only multi-conductor	Not required under 5 Kv.		3	5

(Table continued next page)

(Table E-710.05 continued)

Directly in soil -			
Single conductor	-	3	3
Multi-conductor	-	5	5

*It is presumed that installation conditions will be such as to maintain a high level of jacket surface resistivity and so minimize the possibility of destructive discharge. Pulling dry or the use of insulating type pulling lubricants will help attain these conditions. Where surface contamination cannot be prevented and high surface resistivity cannot be maintained, metallic shielding shall be used at over 3 kv.

Note: Metallic sheathed single or 3-conductor cables require no metallic shielding for voltages 5 kv and less. In the case of portable equipment cables it is good practice to specify shielding for all voltages above 2 kv.

**For three single conductor cables, cabled together without overall outer covering, the value is 5 kv.

E-710.06. Grounding of Shielding Tape.

The metallic shielding or any other static voltage shields on shielded cable shall be stripped back to a safe distance according to the circuit voltage, at all terminations of the shielding, as in potheads and joints. At such points, suitable methods such as the use of potheads, terminators, stress cones or similar devices shall be employed for stress reduction and the metallic shielding tape shall be grounded.

E-710.07. Grounding.

Wiring and equipment installations shall conform with the applicable provisions of Chapter E-250.

E-710.08. Moisture or Mechanical Protection for Metal Sheathed Cables.

Where cable conductors emerge from a metal sheath and where protection against moisture or mechanical injury is necessary, the insulation of the conductors shall be protected by a pothead or other approved means.

B. Equipment - General Provisions

E-710.10. Indoor Installations.

Indoor electrical equipment installations shall conform with E-710.10(1)-(3).

(1) In Public Places. In places which are regularly open to the public, electrical installations shall conform with E-710.31 to E-710.36 inclusive.

(2) In Places Frequented Only by Persons Employed on the Premises. In places where access is normally restricted to persons employed on the premises, enclosure of electrical installations is not mandatory provided that: (a) No live parts are exposed or readily accessible; (b) The associated conduits or armored cables terminate in, and are securely fastened to, the terminal chamber, casing or enclosure of the equipment.

(3) In Places Accessible to Qualified Persons Only. Electrical installations shall conform with E-710.31 to E-710.36 inclusive.

E-710.11. Outdoor Installations.

Outdoor installations shall be accessible to qualified persons only. Installations are considered to be accessible to qualified persons only where enclosed as provided in E-710.31 or when isolated by elevation. Live parts are deemed to be isolated by elevation (1) where the clearance to ground and to buildings conforms with Chapter E-730 for outdoor installations, and (2) as provided in E-710.36 for locations accessible to qualified persons only.

C. Equipment - Specific Provisions

(See also references to specific types of installations
in E-710.02)

E-710.21. Circuit Interrupting Devices.

(1) Circuit-Breakers.

(a) Indoor installations shall consist of metal-enclosed units or fire-resistant cell-mounted units except that open mounting of circuit-breakers is permissible in locations accessible to qualified persons only.

(b) Circuit-breakers used to control oil-filled transformers should be

located outside the transformer vault.

(c) Circuit-breakers shall have a means of indicating the open and closed position of the breaker at the point(s) from which they may be operated.

(d) Oil circuit-breakers shall be so arranged or located that adjacent readily combustible structures or materials are safeguarded in an approved manner. Adequate space separation, fire-resistant barriers or enclosures, trenches containing sufficient coarse crushed stone and properly drained oil enclosures such as dikes or basins are recognized as suitable for this purpose.

(2) Fuse Holders and Fuses.

(a) Fuses which expel flame in opening the circuit shall be so designed or arranged that they will function properly without hazard to persons or property.

(b) Fuse holders shall be designed so that they can be de-energized while replacing a fuse unless the fuse and fuseholder are designed to permit fuse replacement by qualified persons using equipment designed for the purpose without de-energizing the fuseholder.

(c) When high voltage fused cutouts are installed in a building or a transformer vault, they shall be of a type designed for use in buildings. Where such cutouts are not suitable to interrupt the circuit manually while carrying full load, an approved switch or contactor shall be provided which is capable of interrupting the entire load. In addition, the cutouts shall be interlocked with the approved interrupter or bear a conspicuous sign reading "Do Not Open Cutout Under Load".

(d) The cutouts shall be so located that they may be readily and safely operated and re-fused. Fuses shall be accessible from a clear floor space.

(3) Load Interrupters. Load interrupter switches may be used providing suitable fuses or circuit-breakers are applied in conjunction with these devices to interrupt fault currents. When these devices are used in combination they shall be so coordinated electrically that they will safely withstand the effects of closing, carrying or interrupting all possible currents up to the assigned maximum short-circuit rating.

E-710.22. Isolating Means.

Means shall be provided to completely isolate an item of equipment. The use of isolating switches is not necessary where there are other ways of de-energizing the equipment for inspection and repairs. Isolating switches should be interlocked with the associated circuit interrupting device to prevent their being opened under load, otherwise signs warning against opening them under load shall be provided. Barriers should be provided on both sides of each pole of indoor open-type isolating switches. A fuseholder and fuse, designed for the purpose, may be used as an isolating switch.

D. Installations Accessible to Qualified Persons Only

E-710.31. Enclosure for Electrical Installations.

Electrical installations in a vault, room, closet or in an area surrounded by a wall, screen or fence, access to which is controlled by lock and key or other approved means, are considered to be accessible to qualified persons only. The type of enclosure used in a given case shall be designed and constructed according to the nature and degree of the hazard (s) associated with the installation. Chapter E-450 covers minimum construction requirements for oil-filled transformer vaults.

Note: Isolation by elevation is covered in E-710.11 and E-710.36.

E-710.32. Circuit Conductors.

(1) They may be installed in conduit; in duct systems; as metal-armored cable; as bare wire, cable and buses, or as non-metallic sheathed cables or conductors as provided in E-710.03 to E-710.06 inclusive. Bare live conductors shall conform with E-710.33 to E-710.36 inclusive.

(2) Insulators, together with their mounting and conductor attachments, when used as supports for wires, single conductor cables and bus bars, shall be capable of safely withstanding the maximum magnetic forces which would prevail when two or more conductors of a circuit were subjected to short-circuit current.

(3) Open runs of insulated wires and cables, having a bare lead sheath or a braided outer covering, shall be supported in a manner designed to prevent physical damage to the braid or sheath. Supports for lead covered cables shall be designed

to prevent electrolysis of the sheath.

E-710.33. Minimum Space Separation Between Live Parts and Adjacent Surfaces.

The minimum indoor air separation between bare live conductors and between such conductors and adjacent surfaces shall be not less than the values given below. This rule applies to interior wiring design and construction. It does not apply to the space separation provided in electrical apparatus and wiring devices.

Table E-710.33

Minimum Air Separation in Inches, Indoors*

Circuit Voltage	Between Bare Live Conductors	Between Bare Live Conductors and Adjacent Surfaces
5,000	3.5	2.5
15,000	7	5.5
25,000	11	8.5

*The values given are the minimum permissible space separation under favorable service conditions. They should be increased under unfavorable service conditions or wherever space limitations permit. Proportional values may be used for intermediate voltages.

E-710.34. Guards for Live Parts.

Live parts should be enclosed, isolated or guarded against possible accidental contact.

E-710.35. Working Space.

Working space not less than the distances given in Table E-710.38, shall be provided in locations where it is necessary to work in close proximity to live parts.

E-710.36. Isolation by Elevation.

The distance from the floor, ground, or other working surface, to open-type isolating switches, fuseholders or other unguarded live parts should be not less than the values given in Table E-710.37.

Table E-710.37 - Isolation by Elevation

(See E-710.36)

Distance of Live Parts Above the Floor or Other Working Surface

Voltage Between Phases	Minimum Vertical Clearance of Unguarded Parts	
	Feet	Inches
601	8	0
2300	8	0
6600	8	0
11000	9	0
22000	9	3
33000	9	6
44000	9	10
66000	10	5
88000	11	0
110000	11	7
132000	12	2

Note: Interpolate for Intermediate Values.

Table E-710.38 - Working Space

(See E-710.35. For voltages 600 and less, see E-195.15)

Minimum Clear Space Adjacent to Live Parts

Voltage Between Phases	Minimum Horizontal Clearance of Unguarded Parts	
	Feet	Inches
601	3	2
2300	3	3
6600	3	4
11000	3	6
22000	3	9
33000	4	0
44000	4	4
66000	4	11
88000	5	6
110000	6	1
132000	6	8

Note: Interpolate for Intermediate Values.

CHAPTER E-720

CIRCUITS AND EQUIPMENT OPERATING AT
LESS THAN 50 VOLTS

E-720.01. General.

This chapter shall apply to installations operating at less than 50 volts, direct current or alternating current, except such as are treated in Chapters E-650 and E-725.

E-720.02. Hazardous Locations.

Circuits or equipment coming within the scope of this chapter and installed in hazardous locations shall comply with the appropriate provisions of Chapters E-500-E517 inclusive.

E-720.03. Larger Current at Lower Voltage.

Conductors, devices, and equipment shall have current ratings sufficient for the greater current required to deliver equal power at the lower voltage than at usual voltages.

E-720.04. Conductors.

Conductors shall be not smaller than No. 12, and for appliance branch circuits supplying more than one appliance or appliance receptacle, conductors shall be not smaller than No. 10, (See E-300.01)

E-720.05. Branch Circuit.

Not more than 8 lampholders or receptacles, nor a total load of more than 320 watts, shall be supplied by a branch circuit. Motors or appliances of rating more than 320 watts shall have a separate branch circuit.

E-720.06. Lampholders.

Standard lampholders of rating not less than 660 watts shall be used.

Note: This requirement does not apply to limited low voltage industrial lighting systems. Smaller lampholders may be used for low voltage lamps in connection with sewing machines and similar devices.

E-720.07. Receptacle Rating.

Receptacles shall have a rating not less than 15 amperes.

E-720.08. Receptacles Required.

Receptacles of not less than 20-ampere rating shall be provided in kitchens, laundries, and other locations where portable appliances are likely to be used.

E-720.09. Overcurrent Protection.

Overcurrent protection shall comply with the provisions of Chapter E-240.

E-720.10. Batteries.

See Chapter E-480.

E-720.11. Grounding.

See E-250.008 and E-250.045(3).

CHAPTER E-725

REMOTE-CONTROL, LOW-ENERGY POWER, LOW-VOLTAGE
AND SIGNAL CIRCUITS

A. Scope and General

E-725.01. Scope.

Provisions of this chapter shall apply to remote-control circuits, including low-voltage relay switching, low-energy power circuits, low-voltage power circuits and signal circuits, as defined in Chapter E-100, Definitions.

Note: The provisions of this chapter are not intended to apply to remote-control, low-energy or signal circuits which form an integral part of a device or appliance.

E-725.02. Hazardous Locations.

Circuits or equipment coming within the scope of this chapter and installed in hazardous locations shall also comply with the appropriate provisions of Chapters E-500-E-517 inclusive.

E-725.03. Classification.

Remote-control and signal circuits shall be classified as follows:

(1) Class 1 Circuits. Control and signal circuits in which power is not limited in accordance with E-725.31.

(2) Class 2 Circuits. Control and signal circuits in which the power is limited in accordance with E-725.31.

E-725.04. Low-Energy Power Circuits.

Circuits which are neither remote-control nor signal circuits, but which have the power limited in accordance with E-725.31 shall, for the purpose of this code, be treated as Class 2 remote-control circuits.

E-725.05. Low-Voltage Power Circuits.

Circuits which are neither remote-control nor signal circuits but which operate at not more than 30 volts, where the current is not limited in accordance with E-725.31, and which are supplied from a source not exceeding 1000 volt-amperes, shall for the purpose of this code, be treated as Class 1 remote-control circuits.

E-725.06. Safety-Control Devices.

Remote-control circuits to safety-control devices, the failure of operation of which would introduce a direct fire or life hazard, shall be considered as Class 1 circuits.

Note: Room thermostats, service hot-water temperature regulating devices, and similar controls used in conjunction with electrically-controlled domestic heating equipment, are not considered to be safety-control devices.

E-725.07. Remote-Control and Signal Circuits in Communication Cables.

Remote-control and signal circuits, which use conductors in the same cable with communication circuits, shall, for the purpose of this Chapter, be classified as communication circuits and meet the requirements of Chapter E-800 of this code.

B. Class 1 System

E-725.11. Wiring Method.

Conductors and equipment of Class 1 remote-control and signal systems and low-voltage power circuits shall be installed in accordance with the requirements of

Chapters E-300 to E-391 inclusive of this code, except as provided in E-725.12 to E-725.15 inclusive.

E-725.12. Other Chapters.

The wiring method required in E-725.11 does not apply where other chapters of this code specifically permit or require other methods for remote-control or signal circuits. See Chapter E-620, Elevators, for example.

E-725.13. Conductor Sizes.

Nos. 18 and 16 gauge conductors may be used provided they are installed in a raceway or a cable approved for the purpose, or in flexible cords in accordance with the provisions of Chapter E-400.

E-725.14. Conductor Insulation.

Conductors larger than No. 16 shall be rubber-covered Type R, thermoplastic-covered Type T, or other approved type. Fixed conductors Nos. 18 and 16 gauge shall have an insulation at least equal to that of Type RF-2 rubber-covered or Type TF thermoplastic-covered fixture wire. Conductors approved for the purpose having insulation of a thickness less than specified above or having other kinds of insulation may be used.

E-725.15. Number of Conductors in Raceways.

The number of conductors of remote-control or signal circuits in a raceway may be determined according to Table 1 of Chapter E-900; and Note 8 of Tables E-310.12 through E-310.15 need not be observed. Where there are four or more conductors in a raceway, some of which are remote-control, as permitted by E-300.03, the provisions of Note 8 of Tables E-310.12 through E-310.15 shall apply, as determined by the number of power and lighting circuit conductors only.

E-725.16. Conductors of Different Systems.

Conductors of two or more Class 1 remote-control and/or signal circuits may occupy the same enclosure or raceway without regard to whether the individual systems or circuits are alternating or direct current, provided all conductors are insulated

for the maximum voltage of any conductor in the enclosure or raceway. Conductors of remote-control, low-energy power and signal circuits, in which the current is limited as for Class 2 systems, shall be considered as Class 1 system conductors for the purpose of this requirement if insulated and installed in accordance with the provisions of Class 1 system conductors. Power supply conductors may occupy the same enclosure or raceway with Class 1 system conductors when supplying only equipment to which Class 1 system conductors are connected.

E-725.17. Mechanical Protection of Remote-Control Circuits.

Where damage to a remote-control circuit would introduce a hazard as covered in E-725.06, all conductors of such remote-control circuits shall be installed in conduit, electrical metallic tubing, Type MI cable or be otherwise suitably protected from physical damage.

E-725.18. Overcurrent Protection.

Conductors shall be protected against overcurrent in accordance with the carrying capacities of Tables E-310.12 through E-310.15 except as follows:

Exception No. 1. Other Chapters. Where other chapters of this code specifically permit or require other overcurrent protection. See E-430.072 and E-620.061.

Exception No. 2. Conductors of Nos. 18 and 16. Conductors of Nos. 18 and 16 shall be considered as protected by overcurrent devices of 20-ampere rating or setting.

Exception No. 3. Omission of Overcurrent Protection. In remote-control and signal circuits having main and branch circuits, the branch circuits need not be individually protected against overcurrent where the operating voltage does not exceed 30 volts.

E-725.19. Location of Overcurrent Protection.

Overcurrent devices shall be located at the point where the conductor to be protected receives its supply unless the overcurrent device protecting the larger conductor also protects the smaller conductor in accordance with Tables E-310.12 through E-310.15.

E-725.20. Circuits Extending Beyond One Building.

Class 1 circuits which extend aerielly beyond one building shall also meet the requirements of Chapter E-730.

E-725.21. Grounding.

Class 1 remote-control and signal circuits shall be grounded in accordance with Chapter E-250 where required by E-250.008.

C. Limitation of Low-Voltage Power Circuit

E-725.22. Overcurrent Protection.

Transformer devices supplying low-voltage power circuits shall be provided with overcurrent protection in the secondary circuit rated or set at not more than 250 per cent of the rated secondary current of the transformer. Such protection and mounting shall be approved for the purpose. Overcurrent protection required shall not be interchangeable with protection of a higher rating. The overcurrent protection may be an integral part of a transformer or other power supply device approved for the purpose.

E-725.23. Transformer Rating.

Transformer devices supplying low-voltage power circuits shall be approved for the purpose and be restricted in their rated output to not exceeding 1000 volt-amperes and to not exceeding 30 volts. They shall be marked where plainly visible to show their rated output and the voltage to be applied to the circuit.

Note: A transformer is considered as meeting the 1000 volt-ampere requirement where the approximate temperature limit is reached at 1000 volt-ampere load.

D. Class 2 System Voltage and Current Limits

E-725.31. Limits of Class 2 Systems.

Class 2 remote-control and signal systems, depending on the voltage shall have the current limited as follows:

(1) Maximum 15 Volts; 5 Amperes. Circuits in which the open-circuit voltage does not exceed 15 volts and having overcurrent protection of not more than 5-amperes rating. Where the current supply is from a transformer or other device having

energy-limiting characteristics and approved for the purpose, or from primary batteries, the overcurrent protection may be omitted.

(2) 15 to 30 Volts: 3.2 Amperes. Circuits in which the open-circuit voltage exceeds 15 volts but does not exceed 30 volts and having overcurrent protection of not more than 3.2 amperes rating. Where the current supply is from a transformer or other device having energy-limiting characteristics and approved for the purpose, or from primary batteries, the overcurrent protection may be omitted.

(3) 30 to 60 Volts: 1.6 Amperes. Circuits in which open-circuit voltage exceeds 30 volts but does not exceed 60 volts and having overcurrent protection of not more than 1.6 amperes rating. Where the current supply is from a transformer or other device having energy-limiting characteristics and approved for the purpose, the overcurrent protection may be omitted.

(4) 60 to 150 Volts: 1 Ampere. Circuits in which the open-circuit voltage exceeds 60 volts but does not exceed 150 volts, and having overcurrent protection of not more than 1-ampere rating, provided that such circuits are equipped with current-limiting means other than overcurrent protection which will limit the current as a result of a fault to not exceeding 1 ampere.

E-725.32. Overcurrent Protection and Mounting.

Where current is limited in Class 2 systems by means of overcurrent protection, such protection and its mounting shall be approved for the purpose. Overcurrent protection required shall not be interchangeable with protection of a higher rating. The overcurrent protection may be an integral part of a transformer or other power supply device approved for the purpose.

E-725.33. Transformer Rating.

Transformer devices supplying Class 2 systems shall be approved for the purpose and be restricted in their rated output to not exceeding 100 volt-amperes. They shall be marked where plainly visible to show the voltage to be applied to the circuit.

Note: A transformer is considered as meeting the 100 volt-ampere requirement

if the approximate temperature limit is reached at 100 volt-ampere load.

E-725.34. Transformer Leads.

The primary leads of transformers supplying Class 2 remote-control and signal circuits may be smaller than No. 14 but not smaller than No. 18, provided they are not over 12 inches long, have insulation at least equal to type RF-2 rubber-covered fixture wire, or approved equivalent.

E. Installation of Class 2 Remote-Control and
Signal Circuits

E-725.41. On Supply Side of Overcurrent Protection, Transformers or Current-Limiting Devices.

Conductors and equipment on supply side of overcurrent protection, transformers or current-limiting devices shall be installed in accordance with the appropriate requirements of Chapters E-300 to E-391, ^{inclusive,} of this code. Transformers or other devices supplied from electric light and power circuits shall be protected by an overcurrent device with a rating or setting not exceeding 20 amperes.

E-725.42. On Load Side of Overcurrent Protection, Transformer or Current-Limiting Devices.

Conductors on load side of overcurrent protection, transformer or current-limiting devices shall be insulated and shall comply with the following:

(1) Separation from Other Conductors. Conductors shall be separated from conductors of electric light and power circuits as follows:

(a) Open Conductors. Conductors shall be separated at least 2 inches from any light or power conductors not in a raceway unless permanently separated from the conductors of the other system by a continuous and firmly fixed nonconductor, such as porcelain tubes or flexible tubing, additional to the insulation on the wire.

(b) In Raceways and Boxes. Conductors of Class 2 remote-control and signal circuits shall not be placed in any raceway, compartment, outlet box or similar fitting with conductors for either light and power circuits of Class 1

signal and control circuits, unless the conductors of the different systems are separated by a partition; provided that this shall not apply to conductors in outlet boxes, junction boxes or similar fittings or compartments where power supply conductors are introduced solely for supplying power to the remote-control or signal equipment to which the other conductors in the enclosure are connected. (See E-725.16).

(c) In Shafts. Conductors may be run in the same shaft with conductors for light and power where the conductors of the two systems are separated at least 2 inches, or where the conductors of either system are encased in noncombustible tubing. In hoistways conductors shall be installed in rigid conduit or electrical metallic tubing except as provided for in E-620.021, Exception No. 1.

(2) Vertical Runs. Conductors in a vertical run in a shaft or partition shall have a fire-resistant covering capable of preventing the carrying of fire from floor to floor except where conductors are encased in tubing or other outer covering of noncombustible material or are located in a fireproof shaft having fire stops at each floor.

Note: The kind of insulation for the conductors shall be suitable for the particular application but is not specified in further detail as reliance is placed on current limitation to stop dangerous currents. Where 3 or more conductors are used, it is recommended that such conductors be grouped under a common braid or covering.

E-725.43. Circuits Extending Beyond One Building.

Class 2 remote-control and signal circuits which extend beyond one building and are so run as to be subject to accidental contact with light or power conductors operating at a potential exceeding 300 volts, shall also meet the requirements of E-800.02, E-800.11 and E-800.12.

CHAPTER E-730

OUTSIDE BRANCH CIRCUITS AND FEEDERS

E-730.01. Scope.

This chapter applies to electrical equipment or wiring located on private or public premises, attached to the outside of or run between buildings or structures, but shall not apply to equipment or wiring of an electric or communication utility used in the exercise of its function as a utility.

E-730.02. Application of Other Chapters.

Application of other chapters, including additional requirements to specific cases of equipment and conductors, are as follows:

Chapters

- E-200 - Polarity Identification.
- E-210 - Branch Circuits.
- E-215 - Feeders.
- E-230 - Services.
- E-250 - Grounding.
- E-500 - Hazardous Locations, General.
- E-510 - Hazardous Locations, Specific.
- E-600 - Signs and Outline Lighting.
- E-710 - Circuits and Equipment Operating at More Than 600 Volts.
- E-725 - Remote Control and Signal Circuits.
- E-800 - Communication Circuits.
- E-810 - Radio and Television Circuits.

E-730.03. Calculation of Load.

(1) Branch Circuits. The load on every outdoor branch circuit is to be determined by the applicable provisions of Chapter E-220.

(2) Feeders. The load to be expected on every outdoor feeder is to be determined by the procedure specified in Chapter E-220.

E-730.04. Conductor Insulation.

Where within 10 feet of any building or structure, open conductors supported on insulators shall be of the rubber-covered type, thermoplastic type, or weatherproof-covered type. Conductors in cables or raceways, except Type MI Cable, shall be of the rubber-covered type or thermoplastic type and in wet locations shall comply

with E-310.05. Conductors for festoon lighting shall be of the rubber-covered or thermoplastic type.

E-730.05. Size of Conductors.

The current-carrying capacity of outdoor branch circuits and feeder conductors shall be according to the rating in Tables E-310.12 through E-310.15 in order to carry the loads determined under E-730.03.

E-730.06. Minimum Size of Conductor.

(1) Overhead Spans. Overhead conductors shall not be smaller than No. 10 for spans up to 50 feet in length, and not smaller than No. 8 for longer spans.

(2) Festoon Lighting. Overhead conductors for festoon lighting shall not be smaller than No. 12 unless supported by messenger wires. (See E-730.25).

(3) Over 600 Volts. Overhead conductors operating at more than 600 volts shall not be smaller than No. 6 when open individual conductors nor smaller than No. 8 when in cable.

E-730.07. Lighting Equipment on a Pole.

(1) For the supply of lighting equipment installed on a single pole or structure, the branch circuits shall comply with the requirements of Chapter E-210.

(2) For multiwire branch circuits, a common neutral may be employed for the branch circuits, provided not more than 8 ungrounded conductors are used. Such a common neutral shall have a carrying capacity of not less than the maximum load of all the ungrounded conductors connected to any phase or polarity.

E-730.08. Disconnection.

(1) For branch circuits as required in Chapter E-210.

(2) For feeders as required in Chapter E-215. (At each building supplied by a feeder, see E-230.076.)

E-730.09. Overcurrent Protection.

(1) For branch circuits as required in Chapter E-210.

(2) For feeders as required in Chapter E-215.

E-730.10. Wiring on Buildings.

Outside wiring on surfaces of buildings may be installed, for circuits of less than 600 volts, as open conductors on insulating supports, as multiple-conductor cable approved for the purpose, in rigid metal conduit, in busways as provided in Chapter E-364, or in electrical metallic tubing. For circuits of more than 600 volts as provided for services in E-230.101, and for sign and outline lighting as provided in Chapter E-600.

E-730.11. Circuit Exits and Entrances.

Where outside branch and feeder circuits exit from or enter into buildings the installation shall comply with those requirements of Chapter E-230 which apply to service entrance conductors.

E-730.12. Open Conductor Supports.

Open conductors shall be supported on glass or porcelain knobs, racks, brackets, or strain insulators, approved for the purpose.

E-730.13. Festoon Supports.

In spans exceeding 40 feet the conductors shall be supported by a messenger wire supported by approved strain insulators. Conductors or messenger wires shall not be attached to any fire escape, downspout, or plumbing equipment.

E-730.14. Open Conductor Spacings.

Conductors shall conform to the following spacings:

- (1) Open Conductors Exposed to the Weather. As provided in E-230.047.
- (2) Open Conductors not Exposed to Weather. As provided in E-230.048.
- (3) Over 600 Volts. As provided in E-230.101 (3).
- (4) Separation from Other Circuits. Open conductors shall be separated from open conductors of other circuits or systems by not less than 4 inches.
- (5) Conductors On Poles. Conductors on poles shall have a separation of not less than 1 foot except when placed on racks or brackets. Conductors supported on poles shall provide a horizontal climbing space not less than the following:

Power conductors, below communication conductors 30 inches

Power conductors alone or above communication conductors:

Less than 300 volts 24 inches

Exceeding 300 volts 30 inches

Communication conductors below power conductors . . .

. same as power conductors

Communication conductors alone or above power conductors . . .

. no requirement.

E-730.15. Supports Over Buildings.

See E-230.025.

E-730.16. Point of Attachment to Buildings.

See E-230.026.

E-730.17. Means of Attachment to Buildings.

See E-230.027.

E-730.18. Clearance from Ground.

Open conductors of not over 600 volts shall conform to the following:

MINIMUM VERTICAL CLEARANCES OF WIRES (IN FEET) FROM GROUND OR RAILS

<u>Location of Wires & Cables</u>	<u>Guys (a) Communication Cables, Messengers and Wires</u>	<u>Grounded (b) supply Cables, Messengers, and Lightning Protection Wires</u>	<u>Open Supply Line Wires & Service Drops (c) 0-600 V.</u>
Over track rails of railroads (e)	27 (q)	27 (q)	27 (q)
Over streets, alleys or roads (g)	18 (r)	18	18
Along streets or alleys in urban districts (g)	18 (h) (r)	18 (h)	18 (h)
Along roads in rural districts (g)	14 (h) (t)	14 (h)	15 (h)
Over areas used for agricultural purposes	13	14	15

Over fenced or otherwise guarded rights of way in which only authorized persons are permitted (i)	10 (j)	14	15 (x)
Over lakes, streams or ponds where boats are operated or used for fishing	12	14	15
Over parking lots, drive-ins, and commercial areas	12	12	12
Over driveways to:			
Residence garages	10	12	15 (s)
Commercial & Industrial areas	18 (r)	18	18
Farm areas	13	14	15
Over footwalks and spaces accessible to pedestrians only	15 (w)	15 (w)	15 (x)
Over spaces or ways not covered above:			
In rural districts (p) 10 (j)		14	15 (x)
In urban districts (p) 10 (j)		14	18 (x)

(a) Including supply line guys where effectively grounded or insulated against voltage to which they were exposed. Note: No clearance from ground is required for anchor guys not crossing streets, driveways, roads or pathways nor for anchor guys provided with traffic guards and paralleling sidewalk curbs.

(b) This relates to a supply cable of any voltage having an effectively grounded/metal sheath supported by a continuous grounded messenger and to insulated conductors lashed to or twisted with an effectively grounded messenger or neutral. This does not include a so-called cable where a messenger supports separate conductors with an insulating yoke.

(e) In the case of electrified railroads served by overhead trolley conductors, these clearances do not apply if other orders require greater clearances.

(g) These requirements apply only to wires within the limits of public highways or other public rights of way for traffic.

(h) Where a pole line along a road is located relative to fences, ditches, embankments, etc., so that the grounds under the line will never be traveled except by pedestrians, this clearance may be reduced to the following values:

- (1) Communication conductors limited to 160 volts to ground and communication cables 8 feet
- (2) Conductors of other communication circuits 10 feet
- (3) Supply conductors 12 feet
- (4) Guys 8 feet

(i) These clearance requirements do not apply in transformer or substation areas which are so fenced or guarded that they are never accessible to other than authorized persons. (See E-112.05)

(j) This clearance may be reduced to 8 feet for guys, cables, messengers and communication wires where the ground underneath the wires or cables is accessible to pedestrians only.

(o) These clearances also apply to the diagonal distance between the conductors and terrain of rapidly changing contour where surface can be readily walked on.

(p) See E-128.07 (5) for street lamps and drops.

(q) This value may be reduced to twenty-five feet for guys, for cables having effectively grounded continuous metal sheaths, for insulated conductors lashed to or twisted with an effectively grounded messenger or neutral, and for conductors effectively grounded throughout their length and associated with supply circuit of 0 to 22,000 volts only if such conductors are stranded, are of corrosion-resistant material, and conform to the strength and tension requirements for messengers given in E-126.02 (7).

(r) Where communication wires or cables cross over or run along alleys, this clearance may be reduced to 15 feet.

(s) Service drop operating at less than 600 volts may have the clearance reduced to 12 feet.

(t) This clearance may be reduced to 13 feet for communication conductors where no part of the line overhangs any part of the highway which is ordinarily traveled, and where it is unlikely that loaded vehicles will be crossing under the line into a field.

(w) This clearance may be reduced to the following values:

- (1) For communication conductors of circuits limited to 160 volts to ground, and communication cables 8 feet
- (2) For conductors of other communication circuits 10 feet
- (3) For guys 8 feet
- (4) For supply cable having effectively grounded continuous metal sheath or for insulated conductors lashed to or twisted with an effectively grounded messenger or neutral, all voltages 10 feet

(x) This clearance may be reduced to the following values:

- (1) Supply wires (except trolley contact wires) limited to 300 volts to ground 12 feet
- (2) Supply wires (except trolley contact wires) limited to 150 volts to ground and located at entrances to buildings. 10 feet
- (3) Where supply circuits of 550 volts or less, with transmitted power of 3,200 watts or less, are run along fenced (or otherwise guarded) private rights of way in accordance with the provisions specified in E-122.01 (2) (c) 10 feet

E-730.19. Clearances from Buildings for Conductors not in Excess of 600 Volts.

- (1) Over Roofs. Open conductors shall not be less than 8 feet from the

highest point of roofs but service drops operating at 300 volts or less may be not less than 3 feet from the highest point of roofs having a pitch of more than 3 inches per foot.

Conductors attached to roof structures shall be substantially supported. Wherever practicable, conductors crossing over buildings shall be supported on structures which are independent of the building.

(2) Horizontal Clearances. Open conductors not attached to a building shall have a minimum horizontal clearance of 36 inches.

(3) Service Drops. Service drops or final spans of feeders or branch circuits to buildings which they supply or from which they are fed may be attached to the building but they shall be kept 3 feet from windows, doors, porches, fire escapes or similar locations.

(4) Zone for Fire Ladders. Where buildings exceed 3 stories, or 50 feet in height, overhead lines shall be arranged where practicable so that a clear space (or zone) at least 6 feet wide will be left either adjacent to the buildings or beginning not over 8 feet from them, to facilitate the raising of ladders when necessary for fire fighting.

Note: For clearance of conductors over 600 volts, consult National Electrical Safety Code.

E-730.20. Mechanical Protection of Conductors.

Mechanical protection of conductors on buildings, structures or poles shall be as provided for services, E-230.046.

E-730.21. Conductors Entering Buildings.

Conductors entering buildings shall be as provided for services, E-230.044, E-230.049 and E-230.051.

E-730.22. Multiple Conductor Cables on Exterior Surfaces of Buildings.

Multiple conductor cables on exterior surfaces of buildings shall be as provided for service cable, E-230.050.

E-730.23. Raceways on Exterior Surfaces of Buildings.

Raceways on exterior surfaces of buildings shall be made raintight and suitably

drained.

E-730.24. Underground Circuits.

Underground circuits shall be as provided for services, E 230.030 to E-230.034.

E-730.25. Outdoor Lighting Equipment - Lampholders.

Lampholders shall be of molded composition, or other approved material of the weatherproof type, and where they are attached as pendants shall have the connections to the circuit wires staggered. Where lampholders have terminals of a type which puncture the insulation and make contact with the conductors, they shall be attached only to conductors of the stranded type.

E-730.26. Outdoor Lighting Equipment - Location of Lamps.

Location of lamps for outdoor lighting shall be below all live conductors, transformers, or other electrical equipment, unless clearances or other safeguards are provided for relamping operations, or unless the installation is controlled by a disconnecting means which can be locked in the open position.