ATLANTIC CITY CONVENTION CENTER
Seminar 302 Room 412

Electrifying Issues

By Randy Wright

RKW CONSULTING
NEON SIGN FIRE PREVENTION

"Making The Sign Industry A Safer Place"

SEMINAR RULES:

- There are no Rules
- All Questions need to be asked
- Stop at any time for an explanation

SEMINAR PARTS:

Part 1: Review what the electrical consultant does for the USSC members.

Part 2: Review and outline the sections and changes in the 2008 NEC Code

Member Services provided by the Electrical Consultant:

UL Standards:
- Assistance with CSDS for all four Standards
- Help with changes to current Standards
- Access to PDE and other UL personnel
- Training on changes and updates
- Help with follow-up services

UL Sign Industry Business Panel
- USSC-ISA-WSA access to UL executive branch
- Assistance with National Industry issues
- Representative to assist industry issues

National Electric Code:
- Access to the code panel; proposals and comments
- Training on the code and its changes
- Opinion as to the intent of the code
- Help with inspection agencies
- Reports and testimony for litigation

Fire Investigation:
- Cause and origin assistance
- Help with your insurance company

Safety Training:
- OSHA regulation
- Fall Protection/ personal and safety equipment
- Lock-out/Tag-out electrical safety

Illuminating Engineers Society
- Member IDA/IESA MLO Task group
- Illumination levels and permits

Education:
- NEC code lessons
- Bounding and grounding
- Led's and how to install them

Changed from ANNEX G to H no other changes.

ANNEX H Administration and Enforcement

80.1 Scope.

80.2 Definitions.

Authority Having Jurisdiction.

Chief Electrical Inspector.

Electrical Inspector.

80.3 Purpose.

80.5 Adoption.

Article 90 Introduction

90.1 Purpose.

(A) Practical Safeguarding.

(C) Intention.

90.2 Scope.

(A) Covered.

(C) Special Permission.

90.3 Code Arrangement.

Figure 90.3 was changed to add ANNEX G

90.6 Formal Interpretations.

90.7 Examination of Equipment for Safety.

Chapter 1 General

Article 100 Definitions

Scope.

Accessible (as applied to equipment).

Accessible (as applied to wiring methods).

Accessible, Readily (Readily Accessible).

Ampacity. Approved.

Authority Having Jurisdiction (AHJ).

New Definition added in 2008

Bonded (Bonding). Connected to establish electrical continuity and conductivity.

Bonding Jumper.

Bonding Jumper, Equipment. Electric Sign.

New wording added for clarity

Grounded (Grounding). Connected (connecting) to ground or to a conductive body that extends the ground connection.

Grounding Conductor.

In Sight From (Within Sight From, Within Sight).

Labeled.

Listed.

Location, Damp.

Location, Dry.

Location, Wet.

Outline Lighting.

Special Permission.

Utilization Equipment.

Article110

Requirements for Electrical Installations

110.1 Scope.

110.2 Approval.

110.3 Examination, Identification, Installation, and Use of Equipment.

(B) Installation and Use.

110.12 Mechanical Execution of Work.

Updated date for ANSI/NECA to 2006

FPN: Accepted industry practices are described in ANSI/NECA 1-2006, *Standard Practices for Good Workmanship in Electrical Contracting,* and other ANSI approved installation standards.

Chapter 2 Wiring and Protection

Article 210 Branch Circuits

210.2 Other Articles for Specific-Purpose Branch Circuits.

Table 210.2 Specific-Purpose Branch Circuits

225.2 Other Articles.

Table 225.2 Other Articles

240.3 Other Articles.

Table 240.3 Other Articles

Article 250

Bonding and Grounding

250.1 Scope.

Figure 250.1 was added in 2008 for clarity

Figure 250.1 Grounding and Bonding.

250.2 Definitions.

Definition was added in 2008 for clarity

Bonding Jumper, System. The connection between the grounded circuit conductor and the equipment grounding conductor at a separately derived system.

Added for clarity

250.3 Application of Other Articles. For other articles applying to particular cases of installation of conductors and equipment, grounding and bonding requirements are identified in Table 250.3 that are in addition to, or modifications of, those of this article.

Table 250.3 Additional Grounding and Bonding Requirements

250.4 General Requirements for Grounding and Bonding. 250.8 Connection of Grounding and Bonding Equipment.

(A) Permitted Methods.

250.12 Clean Surfaces.

V. Bonding

250.90 General.

250.96 Bonding Other Enclosures.

(A) General.

Words added for clarity

250.112 Fastened in Place or Connected by Permanent Wiring Methods (Fixed) – Specific.
Except as permitted in 250.112(I), exposed, non-current-carrying metal parts of the kinds of equipment described in 250.112(A) through (K), and non-current-carrying metal parts of equipment and enclosures described in 250.112(L) and (M), shall be connected to the equipment grounding conductor regardless of voltage.

(G) Electric Signs. Electric signs, outline lighting, and associated equipment as provided in 600.7.

FPN and additional words added for specific type of connectors

250.118 Types of Equipment Grounding Conductors.
The equipment grounding conductor run with or enclosing the circuit conductors shall be one or more or a combination of the following:
FPN: For effective ground-fault current path, see 250.2 Definition.
(5) Listed flexible metal conduit meeting all the following conditions:
a. The conduit is terminated in listed fittings.
(6) Listed liquidtight flexible metal conduit meeting all the following conditions:
a. The conduit is terminated in listed fittings.
(7) Flexible metallic tubing where the tubing is terminated in listed fittings and meeting the following conditions:

Exception added for low voltage

250.119 Identification of Equipment Grounding Conductors.
Exception: Power-limited, Class 2 or Class 3 circuit cables containing only circuits operating at less than 50 volts shall be permitted to use a conductor with green insulation for other than equipment grounding purposes.
250.120 Equipment Grounding Conductor Installation.
(C) Equipment Grounding Conductors Smaller Than 6 AWG.

Added words for clarity

250.122 Size of Equipment Grounding Conductors. (A) General. Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122, but in no case shall they be required to be larger than the circuit conductors supplying the equipment. Where a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Chapter 3 Wiring Methods and Materials

300.1 Scope.

(A) All Wiring Installations.

Table reference added for clarity

300.3 Conductors.

(A) Single Conductors. Single conductors specified in Table 310.13(A) shall only be installed where part of a recognized wiring method of Chapter 3.

(C) Conductors of Different Systems.

(2) Over 600 Volts, Nominal.

300.4 Protection Against Physical Damage.

300.5 Underground Installations.

(A) Minimum Cover Requirements.

Table 300.5 Minimum Cover Requirements, 0 to 600 Volts, Nominal, Burial in Millimeters (Inches)

300.11 Securing and Supporting.

(A) Secured in Place.

300.17 Number and Size of Conductors in Raceway.

Article 310

Conductors for General Wiring

310.1 Scope.

310.8 Locations.

(A) Dry Locations.

(B) Dry and Damp Locations.

(C) Wet Locations.

(D) Locations Exposed to Direct Sunlight.

310.11 Marking.

(A) Required Information.

(B) Method of Marking.

Article 314

Outlet, Device, Pull, and Junction Bowes;

Conduit Bodies; Fittings; and Handhole Enclosures

314.1 Scope.

II. Installation

314.15 Damp or Wet Locations.

314.16 Number of Conductors in Outlet, Device, and Junction Boxes, and Conduit Bodies.

(A) Box Volume Calculations.

(B) Box Fill Calculations.

(C) Conduit Bodies.

314.29 Boxes, Conduit Bodies, and Handhole Enclosures to Be Accessible.

334 Not building code allowed

ARTICLE 336

Power and Control Tray Cable: Type TC

336.1 Scope.

336.2 Definition.

Power and Control Tray Cable, Type TC.

336.10 Uses Permitted.

336.12 Uses Not Permitted.

ARTICLE 340

Underground Feeder and Branch-Circuit

Cable: Type UF

340.1 Scope.

ARTICLE 342

Intermediate Metal Conduit: Type IMC

342.1 Scope.

ARTICLE 344

Rigid Metal Conduit: Type RMC

344.1 Scope.

ARTICLE 348

Flexible Metal Conduit: Type FMC

348.1 Scope.

II. Installation

348.10 Uses Permitted.

Wet locations was added

348.12 Uses Not Permitted. FMC shall not be used in the following:

(1) In wet locations

(7) Where subject to physical damage

348.20 Size.

(A) Minimum.

348.30 Securing and Supporting.

Words after installation added for clarity

348.60 Grounding and Bonding. Where used to connect equipment where flexibility is required after installation, an equipment grounding conductor shall be installed. Where flexibility is not required after installation, FMC shall be permitted to be used as an equipment grounding conductor when installed in accordance with 250.118(5).

250.118 Types of Equipment Grounding Conductors.

ARTICLE 350

Liquidtight Flexible Metal Conduit:

Type LFMC

350.1 Scope.

350.30 Securing and Supporting.

350.60 Grounding and Bonding. (See requirements 348.)

ARTICLE 352

Rigid Polyvinyl Chloride Conduit: Type PVC

Polyvinyl chloride (PVC) was added for clarity

352.1 Scope. This article covers the use, installation, and construction specifications for rigid polyvinyl chloride conduit (PVC) and associated fittings.

PVC conduit was added for clarity

II. Installation

352.10 Uses Permitted. The use of PVC conduit shall be permitted in accordance with 352.10(A) through (H).

PVC conduit was added for clarity

352.12 Uses Not Permitted. PVC conduit shall not be used under the conditions specified in 352.12(A) through (F).

352.30 Securing and Supporting.

352.60 Grounding.

(see 600.7(6) for exception)

ARTICLE 356

Liquidtight Flexible Nonmetallic

Conduit: Type LFNC

356.1 Scope.

356.12 Uses Not Permitted.

356.20 Size.

(A) Minimum.

356.30 Securing and Supporting.

ARTICLE 358

Electrical Metallic Tubing: Type EMT

358.1 Scope.

358.60 Grounding.

ARTICLE 360

Flexible Metallic Tubing: Type FMT

360.1 Scope.

360.10 Uses Permitted.

360.12 Uses Not Permitted.

ARTICLE 362

Electrical Nonmetallic Tubing:

Type ENT

362.1 Scope.

362.10 Uses Permitted.

362.12 Uses Not Permitted.

362.30 Securing and Supporting.

362.60 Grounding.

(see 600.7(6) for exception)

Chapter 4 Equipment for General Use

Article 400

Flexible Cords and cables

400.1 Scope.

Word luminaires replaces lamps

400.7 Uses Permitted.

(A) Uses. Flexible cords and cables shall be used only for the following:

(3) Connection of portable luminaires, portable and mobile signs, or appliances

400.8 Uses Not Permitted.

ARTICLE 404

Switches

404.1 Scope.

Damp or added to section

404.4 Damp or Wet Locations.

404.14 Rating and Use of Snap Switches.

ARTICLE 406

Receptacles, Cord Connectors,

and Attachment Plugs (Caps)

406.1 Scope.

406.3 General Installation Requirements.

ARTICLE 410

Luminaires, Lampholders, and Lamps

Portable luminaires added

410.1 Scope. This article covers luminaires, portable luminaires, lampholders, pendants, incandescent filament lamps, arc lamps, electric-discharge lamps, decorative lighting products, lighting accessories for temporary seasonal and holiday use, portable flexible lighting products, and the wiring and equipment forming part of such products and lighting installations.

410 is an FYI section which allows the installation cold cathode lighting as a listed system (IFAY) without secondary circuit ground fault protection.

Chapter 6 Special Equipment

ARTICLE 600

Electric Signs and Outline Lighting

I. General

600.1 Scope.

600.2 Definitions.

Electric-Discharge Lighting.

Neon Tubing.

Last sentence added for clarity.

Section Sign. A sign or outline lighting system, shipped as subassemblies, that requires field-installed wiring between the subassemblies to complete the overall sign. The subassemblies are either physically joined to form a single sign unit or are installed as separate remote parts of an overall sign.

Sign Body.

Skeleton Tubing.

600.3 Listing.

(A) Field-Installed Skeleton Tubing.

(B) Outline Lighting.

600.4 Markings.

(A) Signs and Outline Lighting Systems.

Reworded for clarity

(B) Signs with Lampholders for Incandescent Lamps. Signs and outline lighting systems with lampholders for incandescent lamps shall be marked to indicate the maximum allowable lamp wattage per lampholder. The markings shall be permanently installed, in letters at least 6 mm (1⁄4 in.) high, and shall be located where visible during relamping.

New wording added for clarity for the electrical inspector

(C) Section Signs. Section signs shall be marked to indicate that field-wiring and installation instructions are required.

600.5 Branch Circuits.

(A) Required Branch Circuit.

(B) Rating.

(1) Incandescent and Fluorescent.

(2) Neon.

(C) Wiring Methods.

(1) Supply.

(2) Enclosures as Pull Boxes.

Nonmetallic was added to the pole section

(3) Metal or Nonmetallic Poles. Metal or nonmetallic poles used to support signs shall be permitted to enclose supply conductors, provided the poles and conductors are installed in accordance with 410.30(B).

600.6 Disconnects.

Last sentences added for clarity and to require a permanent device at the disconnect.

(A) Location.

(1) Within Sight of the Sign. The disconnecting means shall be within sight of the sign or outline lighting system that it controls. Where the disconnecting means is out of the line of sight from any section that is able to be energized, the disconnecting means shall be capable of being locked in the open position. The provision for locking or adding a lock to the disconnecting means must remain in place at the switch or circuit breaker whether the lock is installed or not. Portable means for adding a lock to the switch or circuit breaker shall not be permitted.

(2) Within Sight of the Controller.

(3) The disconnecting means shall be designed such that no pole can be operated independently and shall be capable of being locked in the open position. The provisions for locking or adding a lock to the disconnecting means must remain in place at the switch or circuit breaker whether the lock is installed or not. Portable means for adding a lock to the switch or circuit breaker shall not be permitted.

(B) Control Switch Rating.

The section has been rewritten with the help of the grounding and bonding task group

600.7 Grounding and Bonding.

(A) Grounding.

(1) Equipment Grounding. Signs and metal equipment of outline lighting systems shall be grounded by connection to the equipment grounding conductor of the supply branch circuit(s) or feeder using the types of equipment grounding conductors specified in 250.118.

Exception: Portable cord-connected signs shall not be required to be connected to the equipment grounding conductor where protected by a system of double insulation or its equivalent. Double insulated equipment shall be distinctively marked.

(2) Size of Equipment Grounding Conductor. The equipment grounding conductor size shall be in accordance with 250.122 based on the rating of the overcurrent device protecting the branch circuit or feeder conductors supplying the sign or equipment.

(3) Connections. Equipment grounding conductor connections shall be made in accordance with 250.130 and in a method specified in 250.8.

(4) Auxiliary Grounding Electrode. Auxiliary grounding electrode(s) shall be permitted for electric signs and outline lighting systems covered by this article and shall meet the requirements of 250.54.

(5) Metal Building Parts. Metal parts of a building shall not be permitted as a secondary return conductor or an equipment grounding conductor.

(B) Bonding.

(1) Bonding of Metal Parts. Metal parts and equipment of signs and outline lighting systems shall be bonded together and to the associated transformer or power-supply equipment grounding conductor of the branch circuit or feeder supplying the sign or outline lighting system and shall meet the requirements of 250.90.

(2) Bonding Connections. Bonding connections shall be made in accordance with 250.8.
(3) Metal Building Parts. Metal parts of a building shall not be permitted to be used as a means for bonding metal parts and equipment of signs or outline lighting systems together or to the transformer or power-supply equipment grounding conductor of the supply circuit.

Word neon was added for clarity

(4) Flexible Metal Conduit Length. Listed flexible metal conduit or listed liquidtight flexible metal conduit that encloses the secondary circuit conductor from a transformer or power supply for use with neon tubing shall be permitted as a bonding means if the total accumulative length of the conduit in the secondary circuit does not exceed 30 m(100 ft).
(5) Small Metal Parts.
(6) Nonmetallic Conduit.

Wording added to remind about protection of conductor

(7) Bonding Conductors. Bonding conductors shall comply with (a) and (b).
(a) Bonding conductors shall be copper and not smaller than 14 AWG.
(b) Bonding conductors installed externally of a sign or raceway shall be protected from physical damage.

Wording added for clarity

(8) Signs in Fountains. Signs or outline lighting installed inside a fountain shall have all metal parts bonded to the equipment grounding conductor of the branch circuit for the fountain recirculating system. The bonding connection shall be as near as practicable to the fountain and shall be permitted to be made to metal piping systems that are bonded in accordance with 680.53.
600.8 Enclosures.
(A) Strength.
(B) Material.
(C) Minimum Thickness of Enclosure Metal.
(D) Protection of Metal.
600.9 Location.
(A) Vehicles.

Adding "readily" changes the meaning of accessible and FPN for clarity

(B) Pedestrians. Neon tubing, other than dry-location portable signs, readily accessible to pedestrians shall be protected from physical damage.

FPN: See 600.41(D) for additional requirements.

(C) Adjacent to Combustible Materials.

(D) Wet Location.

600.10 Portable or Mobile Signs.

(A) Support.

(B) Attachment Plug.

(C) Wet or Damp Location.

(1) Cords.

(2) Ground-Fault Circuit Interrupter.

(D) Dry Location.

This section was expanded and put into a list for clarity

600.12 Field-Installed Secondary Wiring. Field-installed secondary circuit wiring for electric signs and outline lighting systems shall be in accordance with 600.12(A), (B), or (C).

(A) 1000 Volts or Less. Secondary circuit wiring of 1000 volts or less shall comply with 600.31.

(B) Over 1000 Volts. Secondary circuit wiring of over 1000 volts shall comply with 600.32.

(C) Less Than 50 Volts. Secondary circuit wiring less than 50 volts shall be installed in accordance with either of the following:

(1) Any wiring method included in Chapter 3 suitable for the conditions.

(2) Where the power source complies with the requirements in 725.121, wiring methods shall be permitted to be installed in accordance with 725.130(A) or (B).

600.21 Ballasts, Transformers, and Electronic Power Supplies.

(A) Accessibility.

(B) Location.

(C) Wet Location.

(D) Working Space.

Change dimensions to actual; a lighting requirement was added

(E) Attic and Soffit Locations. Ballasts, transformers, and electronic power supplies shall be permitted to be located in attics and soffits, provided there is an access door at least 900 mm by 562.5 mm (36 in. by 22½ in.) and a passageway of at least 900 mm (3 ft) high by 600 mm (2 ft) wide with a suitable permanent walkway at least 300 mm (12 in.) wide extending from the point of entry to each component. At least one lighting outlet containing a switch or controlled by a wall switch shall be installed in such spaces. At least one point of control shall be at the usual point of entry to these spaces. The lighting outlet shall be provided at or near the equipment requiring servicing.

(F) Suspended Ceilings.

600.22 Ballasts.

(A) Type.

(B) Thermal Protection.

600.23 Transformers and Electronic Power Supplies.

(A) Type.

(B) Secondary-Circuit Ground-Fault Protection.

(C) Voltage.

(D) Rating.

(E) Secondary Connections.

(F) Marking.

Class 2 section was expanded for clarity

600.24 Class 2 Power Sources. Signs and outline lighting systems supplied by Class 2 transformers, power supplies, and power sources shall comply with the applicable requirements of Article 600 and 600.24(A), (B), and (C).

(A) Listing. Class 2 Power supplies and power sources shall be listed for use with electric signs and outline lighting systems and shall comply with 725.121.

(B) Grounding. Metal parts of signs and outline lighting systems shall be grounded and bonded in accordance with 600.7.

(C) Secondary Wiring. Secondary wiring from Class 2 power sources shall comply with 600.12(C).

Section expanded for clarity

II. Field-Installed Skeleton Tubing and Wiring

600.30 Applicability. Part II of this article shall apply to all of the following:

(1) Field-installed skeleton tubing

(2) Field-installed skeleton tubing wiring

Word wiring added for clarity

600.31 Neon Secondary-Circuit Wiring, 1000 Volts or Less, Nominal.

Word wiring added for clarity

600.32 Neon Secondary-Circuit Wiring, over 1000 Volts, Nominal.

(A) Wiring Methods.

Clarify the use of insulators

(1) Installation. Conductors shall be installed in rigid metal conduit, intermediate metal conduit, PVC conduit, RTRC, liquidtight flexible nonmetallic conduit, flexible metal conduit, liquidtight flexible metal conduit, electrical metallic tubing, metal enclosures, on insulators in metal raceways, or other equipment listed for use with neon secondary circuits over 1000 volts.

(2) Number of Conductors.

(3) Size.

To clarify spacing from what

(4) Spacing from Grounded Parts.

(5) Metal Building Parts.

(B) Insulation and Size.

(C) Installation.

(D) Bends in Conductors.

(E) Spacing.

Wording added for clarity

(F) Insulators and Bushings. Insulators and bushings for conductors shall be listed for use with neon secondary circuits over 1000 volts.

(G) Conductors in Raceways.

(H) Between Neon Tubing and Midpoint Return.

(I) Dwelling Occupancies.

(J) Length of Secondary Circuit Conductors.

(1) Secondary Conductor to the First Electrode.

(2) Other Secondary Circuit Conductors.

New section added to clarify splice enclosure type

(K) Splices. Splices in high-voltage secondary circuit conductors shall be made in listed enclosures rated over 1000 volts. Splice enclosures shall be accessible after installation and listed for the location where they are installed.

600.41 Neon Tubing.

(A) Design.

Wording added for clarity

(B) Support. Tubing shall be supported by listed tube supports. The neon tubing shall be supported within 150 mm (6 in.) from the electrode connection.

(C) Spacing.

New section added to clarify protection

(D) Protection. Field-installed skeleton tubing shall not be subject to physical damage. Where the tubing is readily accessible to other than qualified persons, field-installed skeleton tubing shall be provided with suitable guards or protected by other approved means.

600.42 Electrode Connections.

New section added for clarification

(A) Points of Transition. Where the high-voltage secondary circuit conductors emerge from the wiring methods specified in 600.32(A), they shall be enclosed in a listed assembly.

(B) Accessibility.

(C) Electrode Connections.

Words added for clarity

(D) Support. Neon secondary conductor(s) shall be supported not more than 150 mm (6 in.) from the electrode connection to the tubing.

(E) Receptacles.

(F) Bushings.

(G) Wet Locations.

(H) Electrode Enclosures.

Locations of the enclosures was clarified by a list

(1) Dry Locations. Electrode enclosures that are listed for use in dry, damp, or wet locations shall be permitted to be installed and used in such locations.

(2) Damp and Wet Locations. Electrode enclosures installed in damp and wet locations shall be specifically listed and identified for use in such locations. FPN: See 110.3(B) covering installation and use of electrical equipment.

Reference for 600.7 (8)

680.53 Bonding. All metal piping systems associated with the fountain shall be bonded to the equipment grounding conductor of the branch circuit supplying the fountain.
FPN: See 250.122 for sizing of these conductors.

ARTICLE 725

Class 1, Class 2, and Class 3

Remote-Control, Signaling, and Power-Limited Circuits

I. General

725.1 Scope.

Class 2 Circuit.

725.3 Other Articles.

III. Class 2 and Class 3 Circuits

725.121 Power Sources for Class 2 and Class 3 Circuits.

Figure 725.121 Class 2 and Class 3 Circuits.

725.127 Wiring Methods on Supply Side of the Class 2 or Class 3 Power Source.

725.130 Wiring Methods and Materials on Load Side of the Class 2 or Class 3 Power Source.

Others sections added for reference

(B) Class 2 and Class 3 Wiring Methods. Conductors on the load side of the power source shall be insulated at not less than the requirements of 725.179 and shall be installed in accordance with 725.133 and 725.154.

Contact Information:

United States Sign Council
211 Radcliffe Street,
Bristol, PA 19007-5013
Phone: 215-785-1922
Fax: 215-788-8395
www.ussc.org
Randy@ussc.org

RKW Consulting
698 Walnut Street
Montoursville, PA 17754
Phone / Fax: 570 368-1091
www.rkw-consulting.com
randy@rkw-consulting.com

Notes.