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Navigating Electrical Standards

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Navigating Electrical Standards Definitions

- Code
  - A systematically arranged and comprehensive collection of laws
- Standard
  - An acknowledged measure of comparison for quantitative or qualitative value; a criterion
- Specification
  - A detailed, exact statement of particulars, especially a statement prescribing materials, dimensions, and quality of work for something to be built, installed, or manufactured

www.dictionary.com

Navigating Electrical Standards

- Who?
- What?
- Where?
- Why?
- How?
- Development of:
  - Codes
  - Standards
  - Specifications
- Application Examples
  - Single Line

Navigating Electrical Standards Who, What, Where

- Who? The specifying /design engineer
- What? Equipment and Construction Specifications
- Where? Any Job

Navigating Electrical Standards
Why indeed?

"Fiber conduit shall be Orangeburg, Type I …and Type II " (no longer manufactured)

Non-metallic cable tray systems shall comply with …NEMA Standard VE1 (should be FG1)

Appleton Electric Company, Type "PTC," (now Type "BF")

Navigating Electrical Standards
Why

"All electrical work … shall be in conformance with … the requirements of the current editions of the National Electrical Code , … the National Electrical Safety Code … and with all applicable state and/or local laws and ordinances"

Navigating Electrical Standards
Why (The Law)

- OSH Act: 5. Duties [General Duty Clause]
- GA Code 43-15
  - 43-15-1
  - 43-15-2
- GA Board Rules
  - 180-6-.02

Why
OSH Act: 5. Duties [General Duty Clause]

- (a) Each employer --
  - (1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;
  - (2) shall comply with occupational safety and health standards promulgated under this Act.

Why GA Code 43-15

- 43-15-1: This chapter is enacted to safeguard life, health, and property and to promote the public welfare.
- 43-15-2: "Professional engineering" means the practice of the art and sciences… wherein the public welfare or the safeguarding of life, health, or property is concerned or involved…

Why Board Rules

- 180-6-.02 The engineer or land surveyor shall at all times practice in such a manner as to protect the safety, health and welfare of the public.

Navigating Electrical Standards How

- National (& International) Codes
- Client Standards
- In-House Standards
- Manufacturer References
- Be Specific

Navigating Electrical Standards How(cont.)

OSHA 1910.303(a)

Approval. The conductors and equipment required or permitted by this subpart shall be acceptable only if approved.

OSHA 1910.399(a)

Approved. Acceptable to the authority enforcing this subpart…

NEC® 100 Part I

Approved. Acceptable to the authority having jurisdiction.

Navigating Electrical Standards How(cont.)

OSHA 1910.399(a)

Approved. … The authority enforcing this subpart is the Assistant Secretary of Labor for Occupational Safety and Health…

NEC® 100 Part I

Authority Having Jurisdiction. The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

Navigating Electrical Standards How(cont.)

NEC® 100 Part I

Labeled. ***Equipment or materials*** to which has been ***attached*** a ***label***, symbol, or ***other*** identifying ***mark*** of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner. ***(emphasis added)***

Navigating Electrical Standards How(cont.)

NEC® 100 Part I

Listed. ***Equipment, materials, or services*** included in a ***list published*** by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose ***listing states*** that the equipment, material, or services either meets appropriate ***designated standards*** or has been tested and found suitable for a specified purpose. ***(emphasis added)***

Navigating Electrical Standards How(cont.) OSHA NRTL Presentation

- NRTLs are third-party organizations recognized by OSHA as having the capability to provide product safety testing and certification services to the manufacturers of a wide range of products for use in the American workplace.
- The testing and certifications are based on product safety standards developed by U.S.-based standards developing organizations and often issued by ANSI.

Navigating Electrical Standards Development of Codes

- Federal Level
  - OSHA (http://www.osha.gov/) CFR 1910 Subpart S
- State Level
  - Usually adopt the NEC®, occasionally with modifications
- Local Level
  - Chicago Electric Code

Navigating Electrical Standards Development of Standards

- ANSI (American National Standards Institute)
- IEEE (Institute of Electrcial & Electronics Engineers)
- NEMA® (National Electrical Manufacturers Associaton)
- NFPA (National Fire Protection Association)
- UL (Underwriter's Laboratory)

Development of Standards ANSI http://www.ansi.org/

- ANSI is a private, non-profit organization (501(c)3) that administers and coordinates the U.S. voluntary standardization and conformity assessment system.
- Does not independently develop standards
- 270 ANSI-accredited standards developers representing approximately 200 distinct organizations

Development of Standards ANSI (cont.)

- ANSI is the official U.S. representative to the International Accreditation Forum (IAF), the International Organization for Standardization (ISO) and, via the U.S. National Committee, the International Electrotechnical Commission (IEC).

ANSI "Essential Requirements"

- Provide a consensus development process.
- Elements include:
  - Openness
  - Lack of dominance
  - Balance
  - Notification of standards development and coordination

ANSI "Essential Requirements" (cont.)

- Elements (cont.):
  - Consideration of views and objections
  - Consensus vote
  - Appeals
  - Written procedures
  - Compliance with normative American National Standards policies and administrative procedures

Development of Standards IEEE

- New Projects (PAR)
  - numbered by whole numbers in sequential order
- Sponsor
  - 5 types defined in the IEEE-SA Standard Board Bylaws
- Existing Projects (at least every 5 years)
  - Reaffirm, Cancel, or Revise

Development of Standards IEEE (cont.)

- Types of Documents
  - Standards
  - Recommended Practices
  - Guides
  - Trial-Use Documents

Development of Standards NEMA

- Numbering
  - identified by an alphanumeric designator, a publication title, and a date.
  - Alphanumeric designator determined by the "Product-Related Scopes of NEMA Subdivisions"
- Existing Projects (at least every 5 years)
  - Reaffirm, Revise or Rescind

Development of Standards NEMA (cont.)

- Types of Documents
  - Standards
  - Application guides
  - Authorized engineering information
  - Suggested standard for future design
  - White papers
- Intended Audience(s)
  - Specifiers
  - Installers
  - Contractors
  - Inspectors
  - MRO
  - Engineers and Designers

Development of Standards NFPA

Types of Documents

- Code – A standard that is an extensive compilation of provisions covering broad subject matter or that is suitable for adoption into law independently of other codes and standards.
- Standard – A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fine-printnote and are not to be considered a part of the requirements of a standard.

Development of Standards UL

Types of Documents

- A Published Standard is a UL Standard that has cleared UL's standards development procedures and has been formally adopted and published as a UL Standard for Safety.
- An Outline of Investigation is a collection of requirements based upon UL's investigations of a few products and is UL's first step toward development of a Proposed Standard. Outlines of Investigation serve as guides in UL's investigations for the product categories indicated.
- Also have Proposed Standard

Navigating Electrical Standards Development of Specifications

- National Level
  - DOD (http://dodssp.daps.mil/)
  - CSI MasterFormat™
  - AIA / ARCOM MasterSpec®
- Company Level
  - Centralized
  - De-centralized (Local / Plant level)

Development of Specs CSI MasterFormat™

- 1995 Version: 16 Divisions, 5 digit numbering
- Being revised to 49 Divisions, 6 digit numbering (room for expansion)
- Electrical - Formerly Div 16
- Rev 4 Draft basically divided 16 into:
  - 25 – Electrical
  - 26 - Communications

Development of Specs "Vendor" Level

- Manufacturer
  - Molded Case Circuit Breaker
    - Cutler Hammer: Series Ĉ
    - General Electric: Spectra
    - Square D: Class 601
  - Also cross reference to CSI
    - Siemens (Spec Guide): CSI 16162
- Consultants
  - Typically follow CSI numbering

Let's Install a: Motor

Motor Single Line

- NEC® 2002 Article 430.7 (A)
  - (2) Rated volts and full-load amperes.
  - (3) Rated frequency and number of phases if an ac mtr
  - (4) Rated full-load speed.
  - (5) Rated temperature rise or the insulation system class and rated ambient temperature.
  - (7) Rated horsepower
  - (8) Code letter or locked-rotor amperes
  - (9) Design letter for design B, C, D, or E motors.

MOTOR
NEC® 2002 Article 430.7

- 430.7(A)(2) Rated Voltage
  - System voltages may be found in IEEE Red Book (141-1993), which is drawn from NEMA/ANSI C84.1(now yr 1995)
- 430.7(A)(5) Insulation
  - (ANSI/NEMA MG 1-2003 ¶1.65 & ¶1.66)
- 430.7(A)(9) FPN References:
  - ANSI/NEMA MG 1-1993 (Now yr 2003)
  - IEEE 100-1996 (Now yr 2000)

MOTOR
Non NEC® References

- UL 1004, UL 674
- IEEE 112-1996, 841-2001
- CS 16220 (210510)

MOTOR
NRTL's

- List of Test Standards Recognized - through 12/01/02
  - UL 674
  - UL 1004
- Organizations Currently Recognized By OSHA as NRTLs
  - Canadian Standards Association (CSA): Both
  - TUV America, Inc. (TUVAM): UL 1004 only

Let's Install a:
Motor Disconnect

Motor Single Line

- NEC® 2002 Article 430 Part IX
  - 430.102(B) FPN No. 2 References:
    - NFPA 70E-2000
  - 430.109 Type
    - (A)(1) Motor Circuit Switch
    - (A)(2) Molded Case Circuit Breaker
    - (A)(3) Molded Case Switch

Motor Disconnect: Motor Circuit Switch

- NEC® 2002 Article 100
  - Switch, Motor-Circuit. A switch rated in horsepower that is capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.

Motor Circuit Switch NEC® 2002 Article 404

- 404.3 Enclosures
  - (A) General
- 404.4 Wet Locations
- 404.13 Knife Switches
  - (D) Motor Circuit Switches
- 404.15 Markings
  - (D) Rating

Motor Circuit Switch Non NEC® References

- OSHA 1910-147
- NEMA KS1-2001, 250-2003
- UL 98.12, UL 363.10, UL 50.11
- CS 16410 (253171)

Motor Circuit Switch NRTL's

- Test Standards Recognized
  - UL 50
  - UL 98
  - UL 363
- NRTLs
  - UL 50: CSA, ITSNA, UL
  - UL 98: CSA, ITSNA, UL, WL
  - UL 363: CSA, ITSNA, UL, WL

Let's Install the: Motor Circuit Conductors

Motor Single Line

- 430.22 Single Motor
  - (A) General
- 430.6 Ampacity & Motor Rating Determinations
  - (A) General Motor Applications
    - (1) Table Values
    - (2) Nameplate Values
- 310.15 Ampacities for Conductors Rated 0-2000V
  - (B) Tables
- T310.13 Conductor Constructions and Applications

Motor Circuit Conductors NEC® 2002 Article 300

- 300.1 Scope
  - (A) All Wiring Installations
- 300.3 Conductors
  - (A) Single Conductors
  - (B) Conductors of the Same Circuit
- 300.17 Number & Size of Conductors in Raceway

Motor Circuit Conductors NON NEC® References

- FED Spec A-A-59544
- ICEA S-95-658 / NEMA WC70-1999
- UL 44.15, 83.13
- CS 16120 (252110)

Motor Circuit: Raceway NEC® 2002 Article 350, 344

Motor Single Line

- 350 Liquidtight Flexible Metal Conduit: Type LFMC
  - 350.6 Listing Requirements
  - 350.10 Uses Permitted
  - 350.60 Grounding & Bonding
- 344 Rigid Metal Conduit: Type RMC
  - 344.6 Listing Requirements
  - 344.10 Uses Permitted
  - 250.118 Types of Equipment Grounding Conductors
    - (2) Rigid Metal Conduit

Motor Circuit: Raceway NON NEC® References

- FED Spec WW-C-581 (S/S by UL6 & UL514)
- NECA 101-2001
- NEMA FB2.10-2003, FB2.20-2003
- NEMA (ANSI) C80.1-1994, FB1-2003
- UL 360.5, 6.12, 514B.4
- CS 16110 (253120)

Let's Install the: Motor Overload Protection

Motor Single Line

- 430.32 Continuous Duty Motors
  - (A) More Than 1 Horsepower
    - (1) Separate Overload Device (125% or 115%)
- CS: Usually included with the motor controller

Let's Install the: Motor Controller

- 430.83 Ratings
  - (A) General
    - (1) Horsepower Ratings
    - (2) Circuit Breaker
- 430.82 Controller Design
  - (A) Starting and Stopping
- 110.9 Interrupting Rating

Motor Controller NON NEC® References

- NFPA 79-2002
- NEMA ICS 2-2000 (, 250-2003)
- NEMA ICS 18-2001
- UL 508.17, 508A.1, 61010C-1.1
- UL 845.4
- CS 16420 (253181)

Let's Install the: Motor Short Circuit Protection

Motor Single Line

- 430.52 Rating or Setting for Individual Motor Circuit
  - (C) Rating or Setting
    - (1) In accordance with Table 430.52 (250%)
- 240.6 Standard Ampere Ratings
  - (A) Fuses and Fixed-Trip Circuit Breakers
  - (B) Adjustable-Trip Circuit Breaker
  - (C) Restricted Access Adjustable-Trip Circuit Breakers

Motor Short Circuit Protection NON NEC® References

- Fed Spec W-C-375C FED Spec Spreadsheet
- NEMA AB1-2002
- UL 489.10
- CS16410 (253171)
- Other References Other Breaker Information

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QUESTIONS?

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