TOBYHANNA ARMY DEPOT

Electrical Requirements

Design and Construction Standards

Revised 10 January 2018

Tobyhanna Army Depot

Electrical Design & Construction Standards

TABLE OF CONTENTS

1. GENERAL REQUIREMENTS

1.1 Preface - These requirements are written for project designers. It is expected that these requirements will be used during design to understand the particular needs of TYAD. These requirements will help the designer as he prepares the plans and job specific specifications. Reference to standards is limited, as they will be covered in the job specific specifications. Annex 'A' is a compilation of requirements in bullet format for the designer to mark-up for specific jobs and include in the construction requirements.

1.2 Terms Used - The terms "as approved", "approved", or "shall be approved" means that written approval shall be granted by the Electrical Engineering Department of the Directorate of Installation Services – Division of Installation Planning and Maintenance, Tobyhanna Army Depot (TYAD). This office is the Authority Having Jurisdiction (AHJ) and is responsible for approving equipment, materials, an installation, or a procedure in accordance with the requirements of 2017 Edition of the NFPA-70.

1.3 References - All applications shall be in accordance with the latest edition of the following documents and any listing requirements. Other referenced documents in the job specifications are also applicable. Where there is any conflict between references, the most stringent shall be applicable unless approved otherwise by the AHJ. AHJ shall approve the list of applicable codes:

- 2017 Edition National Electrical Code (NEC), NFPA-70
- Life Safety Code, NFPA-101
- 2017 National Electrical Safety Code (NESC), IEEE C-2
- IESNA Lighting Handbook – 9th Edition
- EM 385-1-1, Safety and Health Requirements Manual
- 2017 Edition of NFPA 780 Standard for Installation of Lightning Protection Systems.
- OSHA 29 CFR 1910.132d requires that employers assess the workplace to determine if hazards are present, and that employees use the types of Personal Protective Equipment (PPE) needed to protect them from the hazards. Written certification must be furnished, verifying that a hazard assessment has been performed for each particular location.
- 2015 edition of the NFPA 70E, Article 110.9 (B)(1)(b) requires that an arc-flash hazard risk analysis be performed to protect personnel from the possibility of injury. The analysis is used to determine the level of hazard and the proper PPE for the given task.

- National Electrical Safety Code (NESC) Part 4, Section 41 requires that – effective January 1, 2012 – employers ensure an assessment is performed, to determine the potential exposure to an electric arc for employees who work on or near energized parts of equipment

1.4 Approval - Require that catalog cut sheets submitted for design review or approval by the Authority Having Jurisdiction (AHJ) be marked so that the selected item is obvious, such as by use of arrows. i.e. The actual item and description on a catalog cut sheet shall be highlighted in this way. Actual cut sheets of the equipment being installed shall be submitted, not sales sheets of a general nature.

1.5 Warranty - Warranty shall start at turnover and include all labor required during the warranty period. All equipment shall be new, not refurbished, unless specifically approved otherwise by the AHJ.

1.6 O&M Manuals - O&M Manuals shall be furnished in 6 copies (3 for TYAD) unless approved otherwise by the AHJ. O&M Manuals shall be available prior to placing equipment in service and transmitted on Form 4025 Transmittal Sheet.

1.7 Temporary Electrical – Temporary wiring and lighting requirements shall be in accordance with EM 385-1-1, Safety and Health Requirements Manual. Section 11 of this manual covers Electrical requirements in general and paragraph 11.D Temporary Wiring and Lighting contains the specific requirements. The term Government Designated Authority shall be interpreted to mean AHJ.

2. SPECIFIC ELECTRICAL DISTRIBUTION SYSTEM REQUIREMENTS FOR INTERIOR INSTALLATIONS.

2.1 CONDUITS

2.1.1 General

Minimum size conduit shall be 3/4” unless approved otherwise. Bushings shall be installed on the ends of all conduits and end fittings, before pulling of conductors. Where wholly insulated bushings are used, they shall be used with a locknut. Wholly insulated bushings must engage a minimum of 3 full threads. Conduits for control wiring shall be run separate from conduits containing power conductors. Conduits supported from steel beams using beam clamps shall be of the cast metal type. Conduit fill calculations shall be made in accordance with NEC Chapter 9, Table 1.

2.1.2 Rigid Aluminum Conduit – Only allowed for 400 Hz circuits, unless approved otherwise. Where rigid aluminum conduit is specified, aluminum boxes and fittings shall be used also. For in-slab, conduit, boxes and fittings for use with 400Hz circuits shall be rigid plastic. Support in accordance with NEC 344.30.

2.1.3 Rigid Nonmetallic Conduit - PVC Type EPC-40 in accordance with NEMA TC 2, in ground only to include under slabs, but not installed in rock. Stub-ups shall be PVC coated IMC. Allowed for corrosive locations as approved. Support in accordance with NEC 352.30.

2.1.4 Intermediate Metal Conduit (IMC) - Zinc-Coated Steel only – As allowed by the NEC, except that it shall be PVC coated at the factory (NEMA RN-1, 40 mils thick), when used in concrete or rock beneath a slab-on-grade and when installed in wet or damp locations indoors and outdoors. Minimal field repair of PVC coating shall be allowed. Support in accordance with NEC 342.30**.**

2.1.5 Electrical, Zinc-Coated Steel Metallic Tubing (EMT) - Shall be allowed within buildings in dry locations, both exposed and concealed. Use in wet areas and outside in protected areas such as under canopies, with use of compression type fittings. Support in accordance with NEC 358.30.

2.1.6 Flexible Metal Conduit (FMC) - Allowed only for connection of equipment subject to vibration. FMC is not intended as a general-purpose raceway for long distances and shall be limited to 6 feet in length unless approved by the AHJ. Use Liquidtight Flexible Metal Conduit (LFMC), Steel, for damp or wet locations as allowed by the NEC. Support in accordance with NEC 348.30.

2.1.7 Metal-Clad Cable, Type MC – This type cable shall be allowed on a limited basis such as within existing metal stud walls. In new construction, MC cable shall only be allowed within metal stud walls to a junction box mounted at the top of the wall. Typically, runs of MC cable shall be limited to 10 feet or less for lighting. Use in other locations shall be as approved by the AHJ.

2.1.8 Surface Metal Raceways – Shall be allowed, as approved, only in administrative areas in buildings being renovated or improved.

2.1.9 Busways – All busways shall be non-ventilated and shall have full neutrals and grounding conductors. Plug-in switches or breakers shall be used on the busway for feeds to equipment.

2.2. CABINETS, BOXES AND FITTINGS

Close any unused openings in cabinets, boxes or fittings. All boxes and fittings shall match the type of conduit being used. Provide all pull boxes, junction boxes and fittings with covers approved for the purpose. As part of the design, provide fill calculations and wire bending space calculations for cabinets, boxes and fittings. Boxes and fittings supports from steel beams shall use cast metal beam clamps. Box fill calculations shall be made in accordance with NEC 314.16(B)

2.3. WIRES AND CABLES

2.3.1 Grounding Conductors - A separate green grounding conductor shall be run with all circuits. Raceways shall not be used as the sole grounding means. Grounding conductors No. 4 AWG and larger may be marked in the field with green marking tape or other methods allowed by NEC 250.119(A).

2.3.2 Neutrals – Full neutrals shall be run with every branch circuit. i.e. No shared neutrals for branch circuits. For circuits with nonlinear loads of 25% or greater, the neutral shall be considered a current carrying conductor. Where the load is likely to exceed the neutral conductor rating due to nonlinear loads, such as in systems furniture, the neutral shall be oversized to compensate for this additional loading. In all cases, the neutral conductor shall conform to the requirements of NEC 310.15(B)(4)(c). True RMS measuring ammeters shall be used to determine neutral loading where nonlinear loads are encountered.

2.3.3 Conductors – All conductors shall be copper. Conductors No. 6 AWG and larger diameter shall be stranded. Conductors No. 8 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, may be stranded unless specifically approved otherwise. Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG. Run control circuits in a separate conduit, unless otherwise approved by the AHJ.

2.3.3.1 Insulation – Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt rated. In outdoor damp or wet locations XHHW-2. In indoor dry applications - Type THWN/THHN except that grounding wire may be type TW; remote-control and signal circuits shall be Type TW or TF. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better. Be sure conduit fill calculations are based on largest diameter insulation type allowed. Designer may select other insulation types which may be more suitable for a particular project with prior approval. For rewiring project where existing conduit is to be utilized, specify types THHN and THWN. Designer should use THWN values (75ºC) for ampacities of THWN/THHN per NEC 110.14(C)(1)(a) or (b). Fire alarm cable shall be type FPL unless designated otherwise.

2.3.3.2 Color Code - Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white or gray for neutrals as indicated below. Color of ungrounded conductors in different voltage systems shall be as indicated below.

208/120 volt, three-phase (Ø):

- Ø A – black
- Ø B – red
- Ø C – blue
- Neutral – white

480/277 volt, three-phase (Ø):

Ø A – brown
Ø B – orange
Ø C – yellow
Neutral – gray

120/240 volt, single-phase (Ø): Black and red for ungrounded conductors with a white neutral.

For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by colored marking tape designed for the purpose and shall be applied in each exposed location such as cabinets, boxes and fittings. Where more than 3' of conductor is exposed, it shall be marked at 3' intervals. Each marking shall include at least 3 complete circles around the conductor, each separated from the next by the width of the marking tape.

For rehab work, if there is no existing color code convention, the requirements here will be utilized. Where an existing system is encountered that utilizes different color coding, that color coding shall continue to be used. Travelers for 3-way and 4-way switches shall be allowed to be striped (other than green). Use wire wrap labeling for control circuits to match drawings.

2.3.3.3 Terminations – Any copper to aluminum connections or terminations, where allowed, shall be made using approved connectors and antioxidant compound as required by NEC 110.14. Integrity of electrical equipment and connections shall be maintained in accordance with NEC 110.12(B). Nonconductive coatings on equipment to be grounded shall be removed from threads and other contact surfaces to ensure good electrical continuity or be connected by means of fittings designed so as to make such removal unnecessary as required by NEC 250.12. Grounding conductors and bonding jumpers shall be connected by one of the methods listed in NEC 250.8(A).

2.4. SWITCHES

2.4.1 Toggle Switches – Minimum of 20 ampere switches shall be used. Circuit breakers shall not be used as switches.

2.4.2 Disconnect Switches – Use heavy duty-type switches at installations where frequent use interrupting large currents is required and where the voltage exceeds 240 volts. General duty switches are acceptable where used to supply workbenches from busways, unless large currents are frequently interrupted. Local switches for equipment shall be mounted adjacent to equipment and within 6'-6" above the finished floor. Each switch or breaker shall feed a single piece of equipment. Fused switches shall utilize Class R fuseholders and fuses. Switches serving as motor-disconnect means shall be

horsepower rated. Provide for use of fuse reducers, such as when a 100 ampere switch needs to be fused at 60 amperes.

2.5 RECEPTACLES

Receptacles shall meet the requirements for UL 498, hard use, heavy-duty type and minimum of 20 ampere. Use twist-lock NEMA configured receptacles for lighting fixtures in industrial areas. Use receptacles sized to match equipment ratings and plugs.

2.6 PANELBOARDS

New work – In industrial Areas, main and distribution panelboards shall be Square-D, I-Line panels and matching breakers. Smaller panels can be Type NQ for 208Y/120 volts and NF for 480Y/277 volts. Design all panels for 25% spare capacity in amperes and spaces. Smaller panels shall include 10% spare breakers. In areas other than industrial areas, use of panels other than described here shall be approved. Panelboards shall require nameplates made from engraved laminated melamine plastic with white lettering, minimum 1/4" high, as approved by TYAD.
Rehab work - Use of panels other than described above shall be approved. Where circuit breakers are added to or replaced in an existing panelboard, Labeling of new circuits and update of index cards shall be required for existing panels. All new panelboards shall require nameplates made from engraved laminated melamine plastic with white lettering, minimum 1/4" high, using the naming convention provided by TYAD. Update grounding in accordance with this document for new circuits. Where a panel is replaced that doesn't have a ground, a grounding conductor will be installed all the way to the main service ground.

Electrical circuit breaker panelboards shall be labeled with the serial number of the primary piece of equipment being supplied

Series ratings – Where series ratings are utilized, the designer shall comply with NEC 240.86(B) & (C) for new work and NEC 240.86(A) & (C) for existing installations. Series combination systems shall be marked in accordance with NEC 110.22. Any additional breakers or breaker replacement in an existing panelboard shall utilize exact replacement breakers to match existing.

2.7 MOTORS AND CONTROLLERS

Motors 1-hp and larger shall have electronic phase-voltage monitors designed to protect motors from phase-loss, under-voltage, and overvoltage. Single-phase motors shall be rated high efficiency and poly-phase motors shall be rated premium efficiency.

2.8 LIGHTING

2.8.1 General – LED fixtures used in the industrial area shall use a color temperature range of 4000 ºK to 5000ºK. LED fixtures shall be equipped with dimming drivers.

2.8.2 Interior - Where possible, interior lighting will consist of LED fixtures with Dimmable Drivers operated at 277V. Office area LED fixtures shall be no brighter than 3500°K and must be dimmable. Fixtures will be either supported by mounting directly to the structure or below the structure with minimum 3/8" all thread rod or other means pending approval by the AHJ except, wires equivalent to ceiling supports wires shall be allowed to support fixtures in suspended ceilings. Where mounted in suspended ceilings, fixtures shall be independently supported from the structure by a minimum of four support wires, one on each corner of the fixture. A single support at each end of the fixture tied to both corners shall also be allowed. Overall support shall be rated for a total of 150 lbs/fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. In open ceiling industrial areas, all fixtures shall be furnished with 6 foot SO type cords and twist-lock NEMA configured plugs.

Fixtures shall not be used as a raceway for circuit conductors unless listed and marked for use as a raceway per NEC 410.64. Wiring supplying luminaries connected together shall comply with NEC 410.65. Branch-circuit conductors within 3 inches of a ballast shall have an insulation temperature rating of not less than 90 ºC unless supplying a fixture listed and marked as suitable for a different insulation temperature per NEC 410.68.

Unless furnished with integral disconnect means, LED fixtures installed in industrial areas and not in lay-in ceilings, shall be furnished with a 6 foot SO type cord and twist-lock NEMA configured plugs. The receptacles for the fixtures shall be within 3 feet horizontally and 2 feet vertically of the fixtures served and securely supported from the building structure or with minimum 3/8" all thread rods. Support is generally required at least in two locations per fixture, normally in the center of the each end of the fixture. Fixtures for industrial work areas shall generally be a type similar or equal (as approved) to Lithonia Lighting Corporation "I-BEAM LED" series lights with semi-diffuse acrylic diffusers for glare control and equipped with 6 foot cords and twist-lock NEMA configured plugs. Maximum fixtures allowed on a circuit will be based on NEC requirements. The minimum branch circuit conductor size, before application of any adjustment or correction factors, shall have an allowable ampacity not less than 125% of the continuous load. Adjustment and correction factors include any applicable de-rating factors such as correction factors for higher ambient temperatures and adjustment factors such as more than three current carrying conductors as described in NEC 310.15(B)(2). Lighting circuits shall be considered continuous loads.

2.8.3 Emergency Lighting

2.8.3.1 Automated Systems

An ‘Automated System’ is a centrally powered emergency lighting system that performs independent self testing for a multiple of fixtures.

All buildings with Automated Systems must be upgraded when renovated. The contractor will submit a lighting design and photometric drawing to the electrical engineer in the Engineering Division of DPW for approval. After approval, the contractor can then upgrade the emergency lighting system.

If the contractor is not upgrading emergency lighting system, then the contractor will need to provide a lighting design of the area six (6) months before construction so DPW will be able to contract the work out separately.

Buildings with Automated Systems include:

Building 1A	Building 1B	Building 1C	Building 1D
Building 1E	Building 2	Building 3	Building 4
Building 5	Building 6	Building 7	Building 8
Building 9	Building 10	Building 11	Building 12
Building 13	Building 15	Building 55	Building 58
Building 72	Building 221	Building 230	Building 333

2.8.3.2 Non-Automated Systems

A ‘Non-Automated System’ consists of individual emergency lighting fixtures that are tied in the building lighting system.

All buildings with Non-Automated Systems must be upgraded when the area lighting in is being upgraded or renovated. All fixtures must be preapproved by an Electrical Engineer in DPW Engineering Division.

Buildings with Non-Automated Systems include:

Building 14	Building 16	Building 17	Building 18
Building 19	Building 20	Building 21	Building 23
Building 24	Building 34	Building 41	Building 54
Building 56	Building 66	Building 69	Building 72A
Building 74	Building 86	Building 87	Building 88
Building 89	Building 93	Building 98	Building 103
Building 104	Building 123	Building 215	Building 218
Building 220	Building 233	Building 241	Building 310
Building 334	Building 335	Building 403	Building 700
Building 701	Building 702	Building 703	Building 816
Building 3002	Building 3005	Building 73	

All exit and emergency lights shall be approved by the AHJ.

2.9 GROUNDING

2.9.1 General Grounding Requirements - Equipment grounding conductors shall be bonded to each junction box or enclosure. Exposed metal mounting brackets for boxes shall be grounded by connection to the grounding conductor by a bonding jumper. Door fronts on control cabinets that contain electrical equipment shall be provided with a bonding jumper to the box by the manufacturer unless the equipment is listed as meeting grounding requirements. All equipment installation grounding requires approval. All underground and any grounding connections that are not readily accessible shall have all connections by exothermic welding or other permanent non-reversible means approved by the AHJ. Ground Rods shall be 10 foot, ¾" copper clad.

Where critically clean low noise grounding systems are needed, consideration should be given to the use of isolated equipment grounding schemes where the equipment grounding conductor feeding receptacles is insulated and connected to the ground terminals of an isolated ground receptacle.

2.9.2 Grounding Separately Derived Systems – For separately derived systems such as dry type transformers or emergency generators, a system bonding jumper shall be installed at the same location where the grounding electrode conductor terminates to the neutral terminal of the separately derived system. This termination can be made at the separately derived system or the system disconnecting means, but not at both locations. The grounding electrode shall be as near as practicable to and preferably in the same area as the grounding electrode conductor connection to the system. Connections to the grounding electrode shall be made in the following order, depending on availability and proximity to the separately derived system: First, structural metal grounding electrode as specified in NEC 250.52(A)(2). It is expected that normally, the structural metal of the building will be grounded in accordance with NEC 250.52(A)(2) and will be used as the grounding electrode with the grounding electrode conductor sized in accordance with NEC 250.66; Second, the nearest metal water pipe grounding electrode as specified in NEC 250.52(A)(1); Third, a separate driven ground.

2.9.3 Grounding New Construction – All new construction will require a single point ground. All grounding will be tied back to this single point with separately derived systems being grounded in accordance with the paragraph above. Require all grounds to be tested to assure they are 25 ohms or less using the fall-of-potential method described in IEE Standard 81. Test instruments shall have visible dated calibration labels that are no more than 6 months old for analog instruments and 12 months for digital instruments in accordance with International Electrical Testing Association (NETA) requirements. Require additional rods or additional sections where 25 ohms is not reached with a single rod. Grounding test wells shall be provided for main service

ground. Submit written results of each test to AHJ, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

2.9.4 Grounding Rehabilitation Work – Verify existing grounding of any electrical rehabilitation work to assure the existing ground meets the 25 ohms or less. If the existing ground does not meet this requirement, require that it be modified to achieve this minimum requirement. Newly installed conduits shall contain grounding conductors that are bonded to each junction box or enclosure.

2.10 OVERCURRENT PROTECTION

2.10.1 Feeder Taps – Conductors shall be permitted to be tapped, without over-current protection at the tap, to a feeder as specified in NEC 240.21(B)(1) through (B)(5). We will concentrate on NEC 240.21(B)(1) through (B)(3) and NEC 240.21(C) for transformer secondary conductors.

General Requirements:

(1) Tap conductors shall be in raceways if they leave the enclosure.

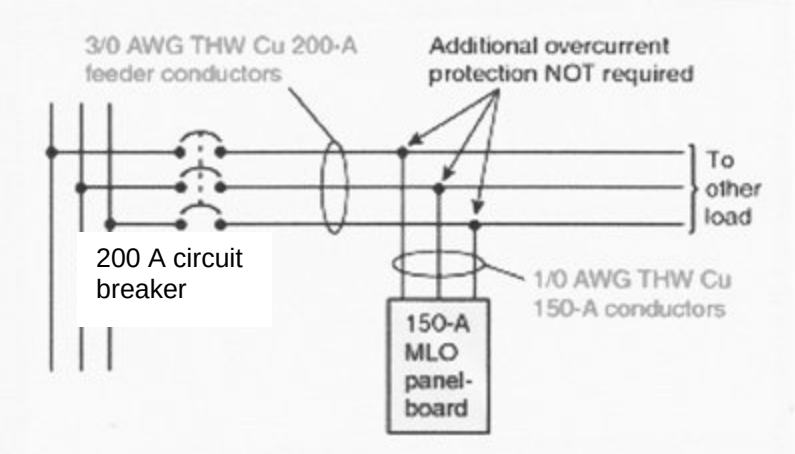
(2) Tap conductors don't extend beyond the equipment they supply.

(3) Provisions of 240.4(B) to allow conductors to be protected at the next higher standard over-current protective device (OCPD), does not apply to tap conductors.

(4) Do not use a tap conductor to supply another conductor, or "tap a tap".

NOTE: THE AUTHORITY HAVING JURISDICTION (AHJ) AT THE TOBYHANNA ARMY DEPOT IS THE DIRECTORATE OF INSTALLATION SERVICES, DIVISION OF INSTALLATION PLANNING & MAINTENANCE – ENGINEERING BRANCH, ELECTRICAL ENGINEERING DEPARTMENT.

Specific Requirements:



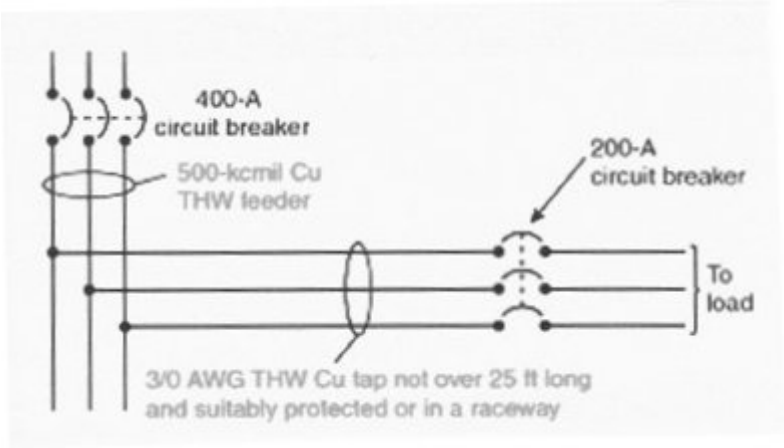
The 1/0 AWG tap conductors cannot exceed 10’ in length

(1) NEC 240.21(B)(1) Taps not over 10 feet long:

a. Not less than the load served.

b. Not less than the rating of the device served or rating of the OCPD served.

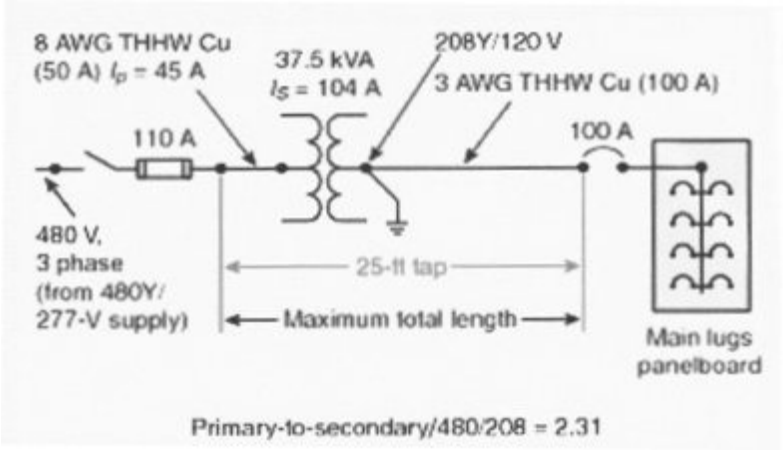
c. Have an ampacity that is not less than 10 percent of the ampacity of the OCPD that protects the feeder.



(2) NEC 240.21(B)(2) Taps not over 25 feet long:

a. Have an ampacity that is not less than 1/3 of the rating of the OCPD that protects the feeder.

b. Tap conductors must terminate in a single circuit breaker or set of fuses that will limit the load to the ampacity of the tap conductors.

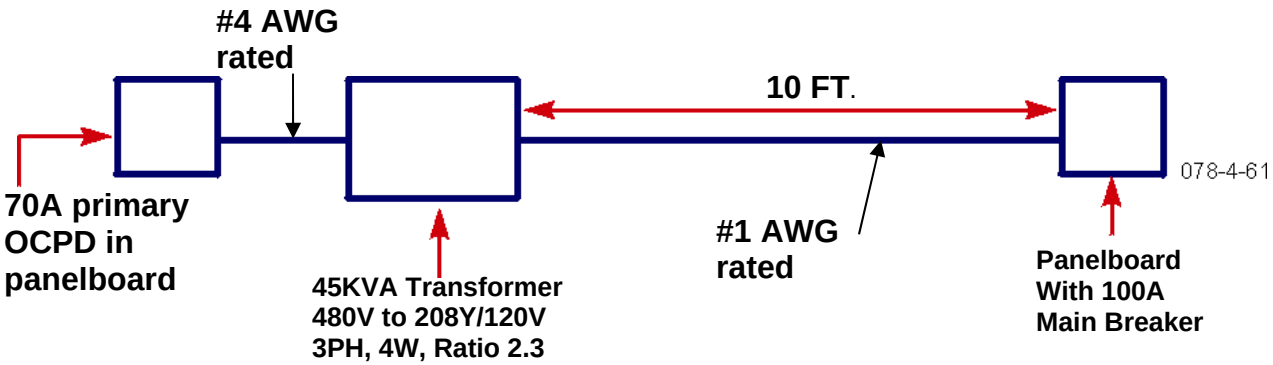


(3) NEC 240.21(B)(3) Taps supplying a transformer with primary plus secondary not over 25 feet long:

a. Transformer primary conductors must have an ampacity at least 1/3 the rating of the OCPD protecting the feeder conductors. i.e. The #8 conductors are rated 50A, which is more than the required 1/3 of the 110A fuse (37A).

b. Transformer secondary conductors must have an ampacity that is not less than the value of the primary-to-secondary voltage ratio multiplied by 1/3 of the rating of the OCPD protecting the feeder conductors. i.e. #3 transformer secondary conductors are rated 100A, which is more than 1/3 of the feeder OCPD (110/3=37A) times the primary-to-secondary voltage ratio of 2.31 (37 X 2.31=85.47A).

c. The secondary conductors terminate in a single circuit breaker or set of fuses that limit the load current to not more than the conductor ampacity.



(1) NEC 240.21(C)(2) Transformer secondary conductors supplying a single load or each set of conductors supplying separate loads, shall be allowed without an OCPD as follows:

a. NEC 240.21(C)(2) Secondary conductors not over 10 feet long.

b. Not less than the load served.

c. Not less than the rating of the device or OCPD served

2.10.2 Transformer Over-current Protection – In addition to the feeder conductor protection discussed above, transformers shall be protected in accordance with NEC 450.3 and Table 450.3(B).

3. SPECIFIC ELECTRICAL DISTRIBUTION SYSTEM REQUIREMENTS FOR EXTERIOR INSTALLATIONS.

3.1 Exterior Lighting - shall be LED type to match the existing lighting used in the area for roadways and entrances. Wall pack type lights shall require shades. All decorative type lights shall be approved by the AHJ. Lighting levels shall be in accordance with the recommendations of the IES Lighting Handbook.

3.2 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the loop feed type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

Transformers will normally be delta primary and wye secondary configuration. Impedance (Z%) shall be submitted for approval by the AHJ. Bil rating shall be 90 KV on the primary side and a minimum of 10 KV on the secondary side.

Provide nameplate information in accordance with IEEE ANSI/IEEE C57.12.00. Nameplates shall indicate the number of liters/gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric is non-PCB classified, with less than 2 ppm PCB content. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric

exceeding the 2 ppm PCB content or transformers without the certification will be considered as PCB insulated and will not be accepted. All new pad mounted oil filled transformers shall be provided with Cooper Envirotemp FR3 (or approved equal) dielectric transformer coolant

Grounding for pad mounted transformers shall include tying the neutral for the primary and secondary together and to a ground rod. As a minimum, ground rods shall be installed at each corner of the concrete pad and be interconnected by a counterpoise conductor installed around the concrete pad and sized in accordance with the NEC and NESC requirements.

Coordinated power system protection analysis, in accordance with UFGS for Underground Electrical Distribution Systems, shall be performed on systems with supply transformers greater than 750kVA or as required by the AHJ.

3.3 Duct Lines

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a hand-hole, or between manholes or hand-holes. Short-radius manufactured 90-degree duct bends may be used only as approved by the AHJ. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or hand-holes. In any case, ducts and cable installation shall assure that cable bending radius does not exceed 12 times the cable diameter. In no case, shall the conductors installed in duct lines be subjected to pulling tension in excess of that allowed by the cable manufacturer. Where the contractor uses RGS or IMC in duct or elbows in a duct line, they shall be factory coated plastic or equivalent field applied protection as approved by the AHJ.

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter and larger shall be determined by calculation and as shown on the drawings. The separation between adjacent electric

power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval of the AHJ. At any point, except railroad crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 5 feet below tops of rails unless otherwise indicated.

Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, pre-drilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads greater than 50 feet in length, the pre-drilling method or the jack-and-sleeve method will be used. Guided method of drilling using HDPE type duct shall be limited to those locations acceptable to the AHJ. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

Plastic duct joints shall be made by brushing plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

Duct line markers shall be provided as indicated. In addition to markers, a 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade level of such lines. Pole risers from underground duct installations shall consist of RGS, IMC or Schedule 80 PVC conduit.

3.4 Trenching And Backfilling

NOTE THAT TYAD IS A PENNSYLVANIA ONE CALL FACILITY. AT A MINIMUM OF ONE WEEK PRIOR TO DIGGING, THE CONTRACTOR SHALL SUBMIT A PA ONE CALL REQUEST TO THE COR. WHEN THE ONE CALL IS COMPLETED ISP&M - ENGINEERING WILL ISSUE DIG PERMIT SHALL BE ISSUED TO THE CONTRACTOR. ONCE THE PERMIT IS IN HAND, THE CONTRACTOR SHALL PROCEED WITH EXCAVATION.

Direct burial ducts shall be installed with the top of duct lines below the frost line in accordance with NFPA 70 and IEEE C2. Duct lines shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Duct banks shall be stacked to the ground to prevent movement during concrete placement. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the AHJ. Report any damage to utility lines or subsurface construction immediately to the AHJ.

Excavations deeper than 5 feet require shoring and sheeting unless approved otherwise by the AHJ. Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

4.0 LIGHTNING PROTECTION SYSTEMS SECTION:

4.1 A lightning protection system that is in compliance with 2017 edition of NFPA 780 shall be considered for each new or renovated building. Alternative systems that are not in complete compliance with NFPA 780 shall not be considered. The contractor shall review the building and surrounding structures to ascertain the requirements for such a system using NFPA 780 risk assessment calculation and shall coordinate the determination of risk and loss factors with the COR.

4.2 Any proposed new or modified lightning protection system shall meet the applicable requirements of 2017 version of NFPA 780. The final installation shall meet the requirements of and shall be certified as a UL Master Label System.

4.3 The contractor shall produce drawing(s) that define air terminal locations, approximate locations of conductor runs, locations of down1conductors, grounding, etc. Construction documents shall require final drawings to be produced by the installer, that confirm all air terminal locations, material selections, connection details, etc. Air terminal locations shall be reviewed by the COR to ensure that locations chosen are coordinated to the greatest extent possible with the architectural elements of the building.

4.4 All air terminals, conductors, electrodes, grounding materials, etc. shall be copper. Care shall be taken to ensure that the copper components will not come in direct contact with aluminum building materials. Components and materials used in the lightning protection system shall be tested and listed to the requirements of UL 96.

4.5 The installation shall be performed under the direct supervision of a L.P.I. (Lightning Protection Institute) certified “Master Installer”.

4.6 The lightning protection installation, including all support materials, shall be compatible with all building materials it comes into contact with. No combination of materials shall be used that form an electrolytic couple of such a nature that corrosion is accelerated in the presence of moisture. If contact between dissimilar metals is unavoidable provide waterproof seals so that moisture is permanently excluded from the junction of such metals. All embedded, buried, or otherwise inaccessible connections shall be made using listed exothermic weld kits.