

1. A hospital owns a nursing home. The nursing home is located one hundred feet from the hospital, on property adjoining the hospital's property. The nursing home is not physically connected with the hospital. The nursing home has an essential electrical system (EES) requiring 400 Amperes, 208Y/120 Volts.

A. May the EES be supplied from the hospital's emergency generation system?

B. How many transfer switches are required by Code to supply the nursing home's EES?

Answer: A. Yes 517.40(C)
B. One 517.41(B)

2. What is the minimum copper THW conductor that may be used for a 480 volt, 3-phase, 25kW space heater? Assume terminations are 75°C.

Answer: #8 AWG
 $25\text{kW} = 25,000\text{watts}$
 $25,000 \div 480 = 52.08$
 $52.08 \div 1.73 = 30.1$
 $30.1 \times 125\% = 37.6$
Table 310.15(B)(16), #8=50 amperes

3. Can you use more than one Romex in a non duplex cable connector?

Answer: No, Except for duplex connectors or when otherwise marked on the carton to indicate connecting of more than one cable or cord, the connectors covered under this category have been investigated for connecting one cable or cord only. See Nonmetallic-sheathed Cable Connectors (PXJV) are on p. 303 in 2012 UL WhiteBook.

4. What is the minimum size of EMT raceway required for three each #3 AWG aluminum THWN, three each #8 AWG copper THW, and two each #10 AWG copper Type THW conductors?

Answer: 1 1/4" EMT
#3 AWG aluminum THWN=.0973 sq in (Table 5, Chapter 9)
#8 AWG Copper THW=.0437 sq in (Table 5, Chapter 9)
#10 AWG Copper THW=.0243 sq in (Table 5, Chapter 9)
 $3\text{-}\#3 \times .0973 = .2919$
 $3\#8 \times .0437 = .1311$
 $2\#10 \times .0243 = .0486$
Total: .4716 sq in
 $1\ 1/4" = 0.598\text{ sq in}$ (Table 4, Chapter 9, Article 358, 40%)

5. A single-phase transformer is rated at 25 kVA. The primary is 480 volts and the secondary is 240 volts. What is the maximum rated current on the secondary?

Answer: 104 Amps

25 kVA = 25,000 VA
25,000 ÷ 240 = 104.16

6. Is it permitted to tap a bus in a switchboard?

Answer: No, not unless marked. See Dead-front Switchboards (WEVZ) located on pg. 413 in UL White Book, the Guide Information states :

Field Terminations

Switchboards may have terminals or provisions for terminals located on the supply side of the service disconnecting means. These terminals or provisions for terminals are marked "TAP," and the switchboard is marked to indicate the specific terminals or terminal kits intended to be field installed. The suitability of equipment connected to these taps is to be determined in accordance with NEC Sections 230.46, 230.82, 690.64(A), 701.11(E) and 705.12 by the AHJ at the final installation.

7. I have an installation where three switches are installed in a 3-gang plastic box. Each switch is fed by a 12/2 w/ground NM cable. I have installed the individual ground wire for each switch on each switch. The inspector claims I have to tie all three grounds together in the box. Do I have to do this?

Answer: Yes, all grounding conductors must be bonded together and each switch must be bonded to the grounding conductors.
NEC 250.148

8. Is the box that comes with a Listed door jamb switches considered an outlet box?

Answer: No, see Switches, Door (WLFV) on page 422 in the 2012 White Book. The Guide Information states : This category covers an assembly consisting of a switch, special switch box and cover. The special switch box is not an outlet box. It is only intended to terminate the switch leads. It is not intended for any other type of field wiring.

9. I am wiring a 36-unit apartment building. Each unit will have a 4500W electric clothes dryer and will be fed by two legs of a 120/208 service. What is the maximum demand load I must include in my service calculation?

Answer: 164 amperes

Dryer kW = 50000	Article 220.54
5000 ÷ 208 = 24.04	Amperes per Dryer
24.04 x 12 = 288.48	Maximum number between any two phases (36 ÷ 3 = 12)
288.48 x 2 = 576.9	Twice the maximum number connected to any two phases Article 220.54
35% - 6.5% = 28.5%	Demand Factor Table 220.54

$$28.5\% \times 576.9 = 164.42$$

10. A center pivot irrigation system has 10 towers. Each tower has a ½ HP 3-phase, 480 volt motor. What would be the calculated load, in amperage, to determine the disconnect and conductor size that may be used for the feeder to these 10 towers?

Answer: 10.64 amperes

½ hp, 3-phase, 480 volt motor = 1.6 amperes	430.250
125% largest motor + 60% remaining motors	675.22(A)
Largest motor = 125% x 1.6 = 2 amperes	675.22(A)
Sum of remaining motors 9 x 1.6 = 14.4 amperes	675.22(A)
60% of sum = 8.64 amperes	675.22(A)
8.64 + 2 = 10.64 amperes	

11. What is the NEMA configuration number for a 50-amp Mobile Home supply cord?

Answer: NEMA 14-50. NEC 550.10(C) FPN

12. Can PV modules rated 1000V in a PV system with a maximum system voltage rating greater than 600V be installed on the roof of a commercial building?

Answer: No, see Photovoltaic Modules and Panels with System Voltage Ratings Over 600 Volts (QIAA) on page 326 in the 2012 White Book. The Guide Information states “These modules and panels are intended for mounting on ground-supported frames, and may be mounted on a building roof when the maximum system voltage of the photovoltaic installation is limited to 600 V.”

13. Are temporary lights installed in a tent required to be grounded and protected by a GFCI?

Answer: No, GFCI protection is not required for lighting according to Article 525.23. If lighting is egress lighting, it is not permitted to be GFCI protected as in 525.23(C). Exposed metal parts of luminaires or lamp holders must be grounded. NEC 410.40, 410.42

14. A center pivot irrigation system has a raceway that runs the length of the system. The raceway contains 3 #12 power conductors, 1#12 equipment grounding conductor, and 4#14 control conductors. The insulation on the conductors is THWN. What is the de-rating factor for the #12 power conductors?

Answer: None, There is no de-rating required in this case. According to Article 675.5, the control conductors are not counted for the purpose of ampacity adjustment.

15. Can an enclosed PV Fused Switch rated for a 50C ambient temperature, be used for continuous operation at 100% of the fuse rating?

Answer: No, see SWITCHES, ENCLOSED FOR USE IN PHOTOVOLTAIC SYSTEMS (WIBC), located on page 419 in the 2012 White Book. The Guide Information states Enclosed fused PV switches are intended only for use with PV fuses and are rated for continuous load current not to exceed 80% of the maximum ampere rating of the PV fuse marked for use with the device.

16. What is the current draw for each phase of a 240-volt, 3-phase, 20 KW water heater?

Answer: 48.2 Amperes
 $20\text{kW} = 20,000 \text{ watts}$
 $20,000 \div 240 = 83.3 \text{ Amperes}$
 $83.3 \div 1.73 = 48.2 \text{ Amperes per leg}$

17. How many #12 AWG copper conductors are permitted in a box that is 56 cubic inches in volume?

Answer: 25
 $56 \div 2.25 = 24.88$ -NEC 314.16(B), free space for each #12 = 2.25

18. A 20 horsepower, 3-phase, 230-volt Design B squirrel-cage induction motor has a service factor of 1.15 and a nameplate full-load current of 50 amperes. If the branch circuit conductors are copper with 75 degree C. insulation and terminations, what is the minimum size circuit conductor?

Answer: 4AWG
430.6(A) (1) refers to Table 430.250 full load current, 20 HP = 54 amperes
430.22 requires conductor to have 125% of full load current
 $54 \times 125\% = 67.5$
Table 310.15(B)(16), #4 copper = 85 amperes

19. A raceway contains 15 #12 THWN and 6 #10 THWN conductors. What is the maximum size overcurrent protection that may be used for the #12 and #10 conductors?

Answer: #12-15 amp, #10-20 amp

12 THWN = 25 amps
10 THWN = 35 amps
Derate 45% according to Table 310.15(B)(3)(a)
12 THWN = 11.25 amps
10 THWN = 15.75 amps
12 THWN maximum 15-amp overcurrent protection
10 THWN maximum 20-amp overcurrent protection

Next size standard overcurrent device NEC 240.4(B)

20. A 480 volt, 3-phase industrial control panel feeds two motors and a 75 kW heater. Motor one is a 200 hp, 600 rpm squirrel cage induction motor rated at 273 FLA. Motor two is 125 HP, 1800 RPM, wound rotor motor. The 75kW heater is 3 phase 240 volt and is fed through a step down transformer. The feeder conductors are two paralleled, copper conductors in two separate conduits and are terminated at their 75 degree rating. What is the minimum size copper conductor that may be used to feed this panel?

Answer: 2-350 kcmil copper conductors

200 hp motor:	$273 \times 125\% = 341 \text{ amps}$	NEC 409.20, 430.250
125 hp motor:	$156 \times 100\% = 156 \text{ amps}$	NEC 409.20, 430.250
75 kW heater:	$75,000 \div 240 \times 1.73 \div 2 \times 125\% = \underline{112 \text{ amps}}$	NEC 409.20
	609 amps	
	$350 \text{ kcmil} = 310 \text{ amps} (609 \div 2 = 305)$	NEC 310.15(B)(16)