

Philippine Electrical Code (PEC)



“THE ESTABLISHED LEADER IN EE REVIEW”

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PHILIPPINE ELECTRICAL CODE

As embodied in the provision of the Philippine Electrical Code, strict compliance in the application is mandatory to ensure safety in electrical installation and construction.

PEC consist of two parts. Part one consist of sets of rules which regulate electrical installation done **INSIDE** the building. Part two consist of sets of rules which regulate electrical installation done **OUTSIDE** the building.

The rules are of two categories

MANDATORY RULES – characterized by the used of the word **SHALL**
ADVISORY RULES - characterized by the used of the word **SHOULD**

SCOPE OF PEC

1. Public and Private Buildings
2. Electrical Generating Plant
3. Industrial Plant
4. Temporary and Permanent substation
5. Transformer station
6. Railway Switchyard
7. Carnivals, Parking lots, Yards etc
8. Watercraft
9. Dockyard
10. Airfields
11. Quarries and Mines
12. Mobile homes and recreational vehicle
13. Offshore facilities
14. Trailers

NOT COVERED BY PEC

1. Railway rolling stock
2. Motor Vehicles
3. Aircraft

REFERRAL CODE OF PEC

1. PD 1096- National Building Code
2. PD 1185- Fire Code of the Phil
3. Structural Code

What Covers Electrical Inspection

1. Reliability
2. Stability
3. Suitability of the design
4. Mechanical Strength
5. Spaces and dimensions
6. Grounding
7. Insulation
8. Heating effect
9. Arcing effect



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10. Availability for replacement
11. Safety
12. Class, type, sizes, ampacity, voltage and specific use

METHODS OF WIRING

- A. Raceway for general use
 1. Rigid metallic tubing
 2. Intermediate metallic tubing
 3. Non metallic tubing
 4. Electrical metallic tubing
 5. Surface raceway
- B. Cable assembly for general use
 1. Non metallic sheathed cable
 2. Underground feeder and branch circuit cable
 3. Metal clad (armored cable)
 4. Mineral insulated metal sheathed cable (IMC)
 5. Aluminum sheathed cable
 6. Messenger support wiring
 7. Shielded non metallic sheathed cable
 8. Armored cable
 9. Power and control cable
- C. Conductor system for general use
 1. Open wiring on insulator
 2. Concealed knob and tube work
- D. Cable assembly system for limited use
 1. Service entrance cable
 2. Non metallic extension
 3. Underplaster extension
 4. Integrated Gas Spacer cable
 5. Medium voltage cable
 6. Flat conductor cable
- E. Raceway system for limited use
 1. Flexible metal conduit and flexible metal tubing
 2. Liquid tight flexible metal conduit and liquid tight flexible non metal conduit
 3. Underfloor raceway
 4. Cellular metal floor raceway or Cellular concrete floor raceway
 5. Wireways
 6. Cable tray



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- F. Special system
1. Busway
 2. Cable bus
 3. Multi Outlet Assembly
 4. Electrical floor assemblies
 5. Flat cable assemblies

SERVICES

Service- the conductors and equipment for delivering energy from the electricity supply system to the wiring system of the premises served.

Service drop- the overhead service conductors from the last pole or other aerial support to and including the splices, if any, connecting to the service, entrance conductors at the building or other structure.

Service lateral- The underground conductors between the street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service entrance conductors in any terminal box or meter or other enclosure with adequate space, inside or outside the building wall.

Service Entrance- The service conductor between the terminals of the service equipment and the point of connection to the service drop or lateral.

Service Equipment- the necessary equipment usually consisting of a circuit breakers or switch and fuses, and their accessories, located near the point of the entrance supply conductors to a building or other structure, or an otherwise defined area, and intended to constitute the main control and means of cut off the supply.

CLEARANCES

OVERHEAD

1. Above roof- 2500 mm
2. Vertical Clearance from ground
 - a. 3100 mm electric service entrance to the building or at the drip loop of the building electric entrance, or above areas or sidewalks accessible only to pedestrians, measured from the final grade or other accessible surface only for service.
 - b. 3700 mm if the nominal voltage is 600 v
 - c. 4600 mm over residential property property and driveway, and those commercial areas not subject to truck traffic.
 - d. 5500 mm public street, alleys, roads, parking areas subject to truck traffic, driveways on other than residential property and other land traversed by vehicles such as cultivated, grazing, forest, and orchard.



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3. Clearance for building opening – 1000 mm

UNDERGROUND

1. 600 mm directly buried
2. 150 mm RMC and IMC installation
3. 460 mm PVC or other approved raceway

note:

total voltage drop 5%
for feeder 3% and for branch circuit 2-3%

ELECTRICAL WIRES AND CABLE

Conductor- A material, usually in the form of wire, cable, or bus bar, suitable for carrying an electric current.

- a. Bundled conductor
- b. Covered conductor
- c. Grounded conductor
- d. Grounding conductor
- e. Insulated conductor
- f. Lateral conductor
- g. Line conductor
- h. Open conductor

Stranded wire- consist of group of wires twisted to form a metallic string

Cord-A small, very flexible insulated cable

Cable- strands of insulated electrical conductors laid together, usually around a central core, and surrounded by heavy insulation.

Electrical Insulation- A material having high electrical resistivity and therefore suitable for separating adjacent conductors in an electric circuit or preventing possible future contact between conductors.

Ampacity- the current in ampere a conductor can carry continuously under the condition of use without exceeding its temperature rating.

CABLE WIRING METHODS AND MATERIALS

1. Armored Cable (AC, ACT, and ACL)

A fabricated assembly of insulated conductors enclosed in a flexible metal sheath used both in exposed and concealed work for branch circuit and feeders in both exposed and concealed work and in cable tray where identified for such use.



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2. Metal Clad Cable (MC)

A factory assembled cable of one or more conductors, each individually insulated and enclosed in a metallic sheath interlocking tape, or a smooth or corrugated tube, used specifically for services, feeders, branch circuit, either exposed or concealed, and for indoor or outdoor work.

3. Metal Insulated Cable, Metal Sheathed Cable (MI)

A factory assembled cable of one or more conductors insulated with highly compressed refractory mineral insulation and enclosed in a liquid tight and gas tight continuous copper sheath, used in a dry, wet, or continuously moist location as in service, feeders, or branch circuits, indoors or outdoors, exposed or concealed.

4. Non-metallic Sheathed Cable (NM and NMC)

- are factory assembled two or more insulated conductors having a moisture resistant, flame retardant and non-metallic outer sheath.
- Used specifically for one or two family dwellings, multifamily dwellings and other structure, except prohibited in section 5.5.9-

5. Shielded Non-metallic Sheathed Cable (SNM)

- a factory assembled two or more insulated conductors in an extruded core of moisture resistant and flame resistant non-metallic, covered with an overlapping spiral metal tape and wire shield and jacketed with an extruded moisture, flame, oil, corrosion, fungus and sunlight resistant non-metallic material.
- Used where operating temperature do not exceed the rating worked on the cable

6. Service Entrance Cable (SE & USE)

- a single or multi-conductor assembly provided with or without an overall covering, primarily and for services
- use for installation in cable trays, raceways or where supported by a messenger wire.

7. Underground Feeder and Branch Circuit Cable (UF)

- a moisture resistant cable
- used for underground, including direct burial in the earth, as feeder or branch circuit cable

8. Power & Control Tray cable (TC)

- a factory assembly of two or more insulated conductors with or without associated bare or covered grounded conductor under nonmetallic sheath.

9. Flat Cable Assemblies (FC)

- an assembly of parallel conductors formed integrally with an insulating material web specially designed for field installation in metal surface raceway.
- Used for branch circuit not exceeding 30 amp. and in locations where they will not be exposed to severe physical damage.

10. Flat Conductor Cable (FCC)

- consists of three or more flat copper conductor placed edge to edge & separated and enclosed within an insulating assembly
- used for general purpose & appliance branch circuits and for individual branch circuits specifically in hard, smooth, continuous floor surfaces.
- Specially for under carpet (up to 914 mm²) wiring to floor outlets (floor mounted type FCC)



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11. Medium Voltage Cables (MV)

- are single or multi-conductor solid dielectric insulated cable rated at 2,001 or higher
- used for power system up to 35,000 volts nominal, in wet or dry locations, in raceway, cable trays.

12. Integrated Gas Spacer Cable (IGS)

- a factory assembled cable of one or more conductors, each individually insulated and enclosed in a loose fit nonmetallic flexible conduit rated 0 – 600 V
- a cable and conduit system
- for underground use, including direct burial in the earth, as service-entrance conductors or as feeder or branch circuit conductors
- advantages low material and installation cost, eliminate field pulling or cables into conduit, eliminates the cost of assembly of conduit in the field
- insulation: SF₆ (sulfuric hexafluoride gas)

RACEWAY METHODS AND MATERIALS

Raceways

The raceways wiring accessories or channels designed for holding wires cables, or busbars which are either made of metal or any insulating material.

They provided mechanical protection to conductors while keeping them accessible for wiring changes: conduits connectors, conduit, coupling, clamps, hangers etc. cable trays, bus metal raceway, non-metal raceways.

Conduits

- either pipes or tubing, which are either flexible or rigid for electric wires are most common electrical raceways

Fittings

- accessories such as locknuts, bushing couplers, adapters nipples and connectors or other part wiring system that is intended primarily to perform a mechanical rather than function.

Connectors

- a metal sleeve, usually made of copper, that is slipped over and secure to the butted ends conductors in making a joint - also called a splicing sleeve.

1. Intermediate Metal Conduit (IMC)

- a metal raceway or circular cross-section with integral or associated couplings, connectors and fittings approved for the installation of electrical conductors
- with wall thickness less than rigid metal conduit but greater than EMT
- used in all atmospheric conditions and occupancies, or areas subject to severe corrosive influences when protected by corrosion protection.



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2. Rigid Metal Conduit

- one similar to that on IMC and when installed in concrete or in contact with soil does not generally require supplementary corrosion protection unless subject to severe corrosive influences

3. Rigid Non-metallic Conduit

- resistant to moisture and chemical atmospheres
- underground materials, fiber, soapstone, rigid polyvinyl chloride (PVC), fiberglass, epoxy, and high density polyethylene, above ground (PVC)

4. Electrical Metallic Tubing

- a general purpose raceway of the same nature as rigid metal conduit and IMC
- used for both exposed and concealed work where it will not be subjected to severe physical damage or (unless suitably protected) to corrosive agents.

5. Flexible Metallic Tubing

- circular in cross-section, flexible, metallic and liquidtight without a nonmetallic jacket
- used in dry locations, in accessible locations when protected from physical damage or concealed such as above suspended ceilings and branch circuits

6. Surface Metal Raceway

- used for exposed wiring where the possibility of severe physical damage is not problem.
- Restricted to dry locations and voltages under 300 volts
- Its principal used is for rewiring or extending existing electrical system

7. Under Floor Raceways

- also called under floor ducts, consist of separate duct system buried in the concrete floor or flush with surface of the floor
- it come complete with junction boxes and fittings to provide access along the length of the duct for receptacles and telephone outlets
- may consists of single, double, or triple ducts run parallel to provide telephone signal and power raceways

8. Cellular Floor Raceways

- maybe metal or concrete, where cells of the cellular floor system is assigned with particular usage for power or signal wiring, and a header ducts tap into the cells and a carry the wiring to the necessary panel board or boxes.

9. Wire ways

- are ducts with square or rectangular cross-section made of sheet metal and the standard length of each ducts is 10 feet
- where the wiring is readily accessible through cover plates which make up one of the walls of the ducts is 10 feet.
- Its cover plate may be hinged or unhinged, screwed in place, or merely snapped into place
- Cannot be buried, concealed in walls or exposed to corrosives atmosphere for in general they are mounted exposed outdoors and may carry systems rated at 600 volts.



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10. Busways

- an approved completely assemble metal troughing and fitting when contain bare conductors intended for use as feeders, the conductors being suitably supported of insulators.
- Are factor made systems of copper of aluminum bars, rods, or tubes designed to carry heavy currents from 50 to 6,000 amp
- The conductors can be solid bars, square or rectangular hollow tube hollow ovals or solid 1 – beams
- Can be mounted horizontally or vertically and can be also used as service entrance feeders.

Continuous plug in Busways

- used to serve equipment that may be relocated periodically, such as in wood working shops.
- Have regularly spaced openings that permitted plugging in switches or circuit breakers and conduit or flexible cable is then run from devices to the equipment being served.

Trolley Busways

- permits travelling equipment to be connected to a power source
- a rolling power takeoff is contact with the busways conductors
- as the equipment moves, the trolley contact on the conductor.

11. Cable Trays

- are not raceways are open raceway like assemblies made of steel aluminum or a suitable non-metallic material
- they are used in buildings to route cables and support them out of the way of normal building activities

Trough Type Trays

- protect cables from damages and give good support and ample ventilation through straight sections

Ladder Trays

- provide maximum ventilations to power cables and other heat-producing cables

**Cables suitable for use cable trays are marked CT (Cable Tray) on the outside of the jacket

12. Cablebus

- an approved assembly of insulated conductors with fittings and conductors termination in a completely enclosed, ventilated protective metal housing



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- Which of the following wires is not suitable for both dry and wet locations?
A. THHW B. RH C. XHHW D. TW
- The equipment grounding conductor of a branch circuit shall be identified by a continuous _____ color.
A. green B. black C. white D. yellow
- Which of the following colors of insulation or marking are permitted to identify "hot" phase conductors in conduit wiring methods?
A. Black, red, and blue for 120/208-volt systems
B. Yellow, orange, and brown for 277/480-volt systems
C. Any colors except white, gray, or green
D. All of the above
- A copper THHN feeder conductor consists of 40 amperes of continuous load and 35 amperes of non-continuous load, and supplies a load that does not contain any general use receptacles but has three current-carrying conductors in a raceway with terminations rated at 75 degrees C. This means that the minimum standard overcurrent device required for the feeder is which of the following:
A. 70 amps B. 76 amps C. 86 amps D. 90 amps
- For a 30 amp receptacle connected to a 30 amp branch circuit supplying two or more outlets, the total cord-and-plug load may not exceed which of the following sizes:
A. 24 amps B. 16 amps C. 15 amps D. 12 amps
- The ampacity of a conductor must be derated where the ambient temperature exceeds which of the following:
A. 30 degrees C B. 32 degrees C C. 26 degrees C D. 20 degrees C
- Disregarding any exceptions, a conductor rated 56 amperes shall be protected by a fuse sized at which of the following:
A. 60 amp B. 50 amp C. 30 amp D. 20 amp
- What is the allowable ampacity of THW insulated copper conductor with an area of 8 sq mm and exposed to an ambient temperature of 30 C.
A. 50 A B. 20 A C. 30 A D. 60 A
- What is the ampacity of 5.5 sq mm. TW copper conductor?
A. 35 B. 45 C. 40 D. 30
- What is the size in square millimeters (mm^2) of the cable 250 MCM in size?
A. 150 mm^2 B. 135 mm^2 C. 125 mm^2 D. 145 mm^2
- Which one is a standard rating of a fuse or CB?
A. 140 A B. 130 A C. 120 A D. 110 A
- In estimating the loading of a branch circuit, what loading shall be used for each receptacle?
A. 160 VA B. 120 VA C. 180 VA D. 150 VA



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13. For a 1,500 VA branch circuit, maximum computed number of power outlet allowed by the code is.
A. 4 B. 6 C. 8 D. 10
14. When circuit breaker is installed in enclosed switchboards, they are usually derated to a certain percentage. What is this percentage?
A. 60% B. 80% C. 50% D. 70%
15. Equipment for installation in hazardous locations must be tested and approved for use according to the classification of the hazards involved. These are divided into _____ groups.
A. 4 B. 3 C. 7 D. 6
16. A single family dwelling unit has a floor area of 145 sq. meters. It has the typical household appliances including one 1.5 – Hp room air conditioning unit. The number of branch circuit required is;
A. 3 – 20 A B. 4 – 20 A C. 5 – 20 A D. 6 – 20 A
17. For barber shop and beauty parlors, the general lighting load per square meter of area shall be
A. 24 VA B. 28 VA C. 16 VA D. 8 VA
18. In a group of four motors, one motor draws 10 A, one draws 45 A and two draws 75 A. What size of conductor must be used for the feeder circuit?
A. 224 A B. 230 A C. 300A D. 124 A
19. A 5 Hp, 230 volts, 1 phase wound rotor induction motor no code letter has a full load efficiency of 80 % and power factor of 72 %. The maximum rating of inverse time delay circuit breaker for branch circuit protection is:
A. 60 A B. 56 A C. 70 A D. 42 A
20. Three, 230 volts, 1 phase squirrel cage induction motor each draws a current of 50 ampere are supplied by copper feeder conductors. The maximum rating of inverse time delay circuit breaker for feeder protection is:
A. 200 A B. 250 A C. 225 A D. 150 A
21. If the full load current of a 2 Hp, 115 volt, 1 phase motor is 24 A, the branch circuit protection to this motor should not be set a more than _____ A using dual element time delay circuit breaker fuse.
A. 30 B. 40 C. 60 D. 80
22. What is the maximum fuse rating allowed by the code to protect a single-phase motor that draws 20 A at full load against short circuit but at the same time will not fail at start?
A. 30 A B. 60 A C. 50 A D. 20 A
23. Four fire pump motor, rated at 230 volts, single phase squirrel cage induction motor draws an individual current of 50 A, 45 A, 30 A and 40 A ampere are supplied by copper feeder conductors. The basis for the computations of the rating of the feeder conductor and the maximum rating of inverse time delay circuit breaker for feeder protection is:
A. 177.5 A, 240 A B. 190 A, 250 A C. 125 A, 225 A D. 150 A, 250 A
24. A 220 V, 10 hp, single-phase induction motor operates at an efficiency of 86% at a power factor of 90%. Determine the size of the disconnect used.
A. 45 A B. 55 A C. 65 A D. 50 A



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25. What is the current carrying capacity of each conductor if 36-8.0 sq mm THWN copper conductors are install in an auxiliary gutter? Considering one 8.0 sq mm THWN has an ampacity of 50 A.
 A. 20 A each B. 40 A each C. 50 A each D. 45 a each

26. According to PEC how many conductors maybe computed for a given raceway containing a conductor of where the load is purely resistive.
 2 signal, 3 control conductor, 1 neutral wire and 1 grounding wire
 A. 7 B. 5 C. 6 D. none

THEY ARE NOT INCLUDED IN CALCULATING D.F

27. The carrying capacity of aluminum wire when compared to a similar size of copper wire, which has the same kind of insulation, is
 A. 84% B. 74% C. 94% D. 100%

28. It is good practice to connect the ground wire for a building electrical system to a
 A. Gas pipe B. Cold water pipe C. Vent pipe D. Steam pipe

29. For service entrance conductors, the minimum size of copper wires the code allows is _____
 A. 3.5 mm² B. 5.5 mm² C. 8.0 mm² D. 14 mm² → for AL

30. What will be the general lighting load for a bank with an area of 500 sq m.
 A. 18 kVA B. 14 kVA C. 12 kVA D. 10 kVA

$28(500) + 2(500) = 18kVA$

31. What shall be the rating of a branch circuit consisting a load of 1/8 hp motor and ten 40 watts fluorescent bulb.
 A. 20 B. 15 C. 30 D. not possible

32. How many 2 A lighting fixture that can be connected to a 20 A continuous duty Branch circuit
 A. 8 B. 10 C. 12 D. 14

33. How many conductors would be counted in a branch circuit raceway for the purpose of derating conductor ampacity given the following:
 3 bare conductors-3 black insulated conductors-3 white insulated conductors-3 red insulated conductors. The service is single-phase, the load is balanced on each circuit and there are no harmonic currents on the neutrals.
 A. 3 B. 6 C. 9 D. 12

34. A beauty shop is located in a 6m x 10m single story building. The shop is subdivided into the following spaces:

- 6 m x 6 m customer service area (24 VA) = 864
- 4 m x 4 m office area (24 VA) = 448
- 4 m x 2 m storage area (2 VA) = 14

$1328 VA$

what is the connected lighting load for this building?
 A. 1,462VA B. 1,328 VA C. 2,052 VA D. 2,388 VA

35. A 5 hp single phase 208 volt induction motor has a nameplate current rating of 25.0 amps. Disregarding exceptions, what is the MINIMUM size type THW copper conductor which may be used to supply this motor?
 a. 3.5 sq mm B. 5.5 sq mm C. 8 sq mm D. 14 sq mm

36. What is the total number of mechanical degrees of the PVC conduit run with 5 bent from pull points (pull boxes, junction boxes or utility boxes)?
 A. 90-degrees B. 180 degrees C. 450 degrees D. 270 degrees



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37. Determine the minimum standard size of over-current protective device and the minimum standard conductor size for the following circuit:

25 amperes of continuous load

60°C overcurrent device terminal rating

Type THWN conductors

Four current-carrying copper conductors in a raceway

- A. 35 A, 8.0 sq mm, THHN
B. 35, 8.0 sq mm THWN
C. 30 A, 8.0 sq mm, THHN
D. 30, 8.0 sq mm THWN

38. Twenty five equal resistors connected in series draw 100 watts from a DC source. How much power will they draw from the same source if the resistances are connected in parallel?

- A. 62.5 kW
B. 2.5 Kw
C. 100 W
D. 25 W

$$P_p = n^2 P_s$$

39. According to the Philippine Electrical Code at an ambient temperature of 30°C, 8.0 mm² copper conductors with the following insulation have the following ampacities: TW insulation – 30 A; THW insulation - 45 A; for THHN insulation – 50 A. If each of these insulated wires carry the same 40 amperes which will generate heat the fastest?

- A. TW insulated wire
B. THW insulated wires
C. Each will generate heat at the same rate
D. THHN insulated wire

40. The earthing transformer is used

- A. to avoid the harmonics in the transformers
B. to provide artificial neutral earthing where the neutral points of the three phase system are not accessible
C. to improve the current capacity of the neutral wire
D. to decrease the rating of the relay

41. In transformer, the purpose of breather is to

- A. extracts moisture of the air.
B. To provide cooling to the winding.
C. To take insulating oil from conservator.
D. To provide insulation to the winding.

42. What is the main use of a zigzag transformer?

- A. To step down voltage
B. To provide path to zero sequence currents
C. To stabilize transformer sequence currents
D. To step down current

43. When a circuit breaker is selected for a particular application, which one of the following rating is usually considered most important?

- A. Interrupting rating
B. Maximum rms current up to 1 sec.
C. Continuous current rating
D. Maximum rms current up to 4 sec.

44. Rigid conduit must be so installed as to prevent the collection of water in it between outlets. In order to meet this requirement, the conduit should not have a

- A. low point between successive outlets
B. high point between successive outlets
C. low point at an outlet
D. high point at an outlet



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45. For a 3-phase, 4-wire delta system with the center of one leg grounded, there are two voltages to ground. For example, on a 240-volt system, two legs would each have 120 volts to ground and the third, or "high" leg, would have _____ volts to ground.

- A. 120 B. 240 C. 208 D. 360

46. Determine the feeder capacity needed for a 120/240-volt fastened-in-place appliance load in a dwelling unit for the following:

Appliance	Rating	Load	
Water heater	4000 W, 240 V	4000 VA	$0.75 (4000 + 1176 + 1200 + 696 + 696 + 1176)$ $= 6708 \text{ VA}$
Kitchen disposal	1/2 hp, 120 V	1176 VA	
Dishwasher	1200 W, 120 V	1200 VA	
Furnace motor	1/4 hp, 120 V	696 VA	
Attic fan	1/4 hp, 120 V	696 VA	
Water pump	1/2 hp, 240 V	1176 VA	

A. 8944 VA B. 6708 VA C. 10789 VA D. 4000 VA

47. The illumination of a large industrial building measuring 35 m x 120 m will be supplied through a step down transformer. If the minimum volt-ampere requirement per square meter is 16, which of the transformers below would be most suitable?

- A. 50 KVA B. 75 KVA C. 100 KVA D. 37.5 KVA

48. A 3-phase, 4-wire (208Y/120-volt, 480Y/277-volt) system is often used to supply both lighting and motor loads, if the maximum possible unbalanced load is 500 amperes, the neutral would have to be large enough to carry _____.

- A. 350 A B. 500 A C. 410 A D. 700 A

49. In multiple-conductor armored cable construction, a color scheme is used for identifying purpose. The color-coding of a 3-conductor cable should be which one of the following ?

- A. one white, one red and one black
B. two black and one white
C. two white and one black
D. one white, one black and one blue

50. What are the colors of the wires for a single phase isolated system?

- A. red and blue B. black and red
C. orange and brown D. yellow and orange

51. What type of wiring is not acceptable to PEC for wiring jobs?

- A. Solid 14.0 THW B. Solid 3.5 sq mm TW
C. Stranded 0.75 TW D. Stranded 8.0 sq mm THHN

52. For fixed electric space heating equipment consisting of resistance elements with a motor, the branch circuit conductor ampacity and the overcurrent rating of the protective device that supplies the equipment shall not be less than which of the following:

- A. 100% of the total heating equipment load
B. 125% of the total motor load
C. 125% of the total load of the motor and the heaters
D. The combined ampacity of all of the equipment



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53. An industrial control panel supply conductor shall have an ampacity of which of the following:
- A. No less than 125% of the full-load current rating of all resistance heating loads and no more than 125% of all combined continuous loads
 - B. No less than 125% of the full-load current rating of all resistance heating loads plus 125% of the full-load current rating of all other connected motors based on their duty cycle if they are all in operation at the same time
 - C. No less than 125% of the full-load of two or more components of a systematic assembly
 - D. Not to exceed the ampacity listed for all resistance heating equipment and connected motor nameplates
54. If a transformer vault is not protected by an automatic sprinkler system, then it must have a minimum fire resistance and structural strength of which of the following periods of time:
- A. 2 hours
 - B. 3 hours
 - C. 4 hours
 - D. 6 hours
55. Each patient bed in a hospital critical care unit must have at least how many of the following:
- A. 2 duplex receptacles
 - B. 4 single or duplex receptacles
 - C. 4 hospital-grade receptacles connected to an emergency system branch circuit
 - D. 6 hospital-grade receptacles
56. If a 480 volt motor has a full-load current of 34 amperes, then the standard disconnecting means must be which of the following:
- 34 (115%)
- A. 66 amps
 - B. 50 amps
 - C. 39.1 amps
 - D. 40 amps
57. The minimum clearance of overhead wire is
- A. 3100
 - B. 2500
 - C. 5500
 - D. 4600
58. If a motor has a service factor of 1.25, you can safely overload the motor by?
- A. 2.5%
 - B. 25%
 - C. 75%
 - D. 25%
59. The allowable fill of electrical conduits.
- YANG NAUHA
- A. 40%
 - B. 50%
 - C. 60%
 - D. 30%
60. The neutral conductor in an electrical installation has which of the following qualities:
- A. It carries the unbalanced current.
 - B. It is the white conductor.
 - C. It does not apply ampacity correction.
 - D. All of the above
61. A fixture with a combustible material shade shall not be installed in locations where temperatures exceed which of the following:
- A. 30 degrees C
 - B. 90 degrees C
 - C. 10 degrees C
 - D. 25 degrees C
62. An outlet for specific appliances, including laundry equipment, must be located within how many mm of the appliance:
- A. 2000 mm
 - B. 900 mm
 - C. 1800 mm
 - D. 1000 mm
63. Conductors that supply a fire pump motor must have a rating not less than ___ percent of the sum of the fire pump motor's full load current and ___ percent of any associated fire pump accessory equipment:
- A. 80, 100
 - B. 125, 100
 - C. 115, 125
 - D. 100, 100



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64. Temporary electrical installations for holiday displays must be permanently removed after which of the following time periods:
- A. 31 days after installation
 - B. 60 days after installation
 - C. 90 days after installation
 - D. 31 days after the end of the event
65. Open conductors shall be supported on which of the following:
- I. Glass or porcelain knobs
 - II. Racks or brackets
 - III. Strain insulators
- A. I or III B. I or II C. II or III D. Any of the above
66. Which of the following is the maximum allowable rating of a permanently connected appliance where the branch overcurrent device is used as the appliance disconnecting means?
- A. 1/8 hp B. 1/4 hp C. 1/2 hp D. 1 hp
67. Calculate the size of the service entrance conductor necessary for a single family dwelling supplying a limited load of a single branch circuit having a rating of 1200 VA lighting load and 1375 VA appliance load
- A. 5.5 sq. mm B. 8.0 sq. mm C. 3.5 sq. mm D. 14.0 sq. mm
68. If the overhead span is more than 15 meters in length, what size of conductor shall be use?
- A. The conductor size shall be 5.5 sq mm copper or 8.0 sq. mm aluminum for voltage 600 V
 - B. The conductor size shall be 8.0 sq mm copper or 14.0 sq. mm aluminum for voltage 600 V
 - C. The conductor size shall be 5.5 sq mm copper or 8.0 sq. mm aluminum for voltage 600 V
 - D. The conductor size shall be 8.0 sq mm copper or 14.0 sq. mm aluminum for voltage 600 V
69. Power levels range from _____ are used for induction melting
- A. 5 kW to 16,500 kW B. 5 kW to 42,000 kW
C. 10-100 kW D. 1-50 W
70. Frequencies used for induction melting range from about
- A. 50 Hz to 10 kHz B. 5-10 Hz C. 500-5 kHz D. 50-5000 kHz
71. According to PEC only conductors _____ or larger are permitted to be connected in parallel to form a single conductor.
- A. 50 sq mm B. 125 sq mm C. 14.0 sq mm D. 200 sq mm
72. How much free non-heating conductor must be left at each outlet box?
- A. 100 mm B. 125 mm C. 150 mm D. 200 mm
73. What is the maximum loading for branch circuits for Outline Lighting?
- A. 40 % B. 50 % C. 80 % D. 100 %
74. How many receptacles have to be provided in a basement of a house?
- A. 1 B. 2 C. 3 D. 4
75. When applying rubber tape to a lighting circuit splice, it is necessary to
- A. Have the cambric backing against the conductors
 - B. Heat the tape properly before applying
 - C. Use rubber cement on the conductors
 - D. Stretch the tape properly during application



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86. Which of the following is NOT an acceptable method of mounting electrical equipment to a masonry wall?
- A. With bolts through the wall supported by metal plates on the back side
 - B. With lag bolts screwed into lead masonry anchors
 - C. With molly bolts through holes drilled entirely through the wall
 - D. With screws driven into wooden plugs in the wall
87. The largest size regular plug fuse used is rated at
- A. 15 amperes
 - B. 20 amperes
 - C. 30 amperes
 - D. 40 amperes
88. For a feeder supplying household cooking equipment and electric clothes dryers the maximum unbalanced load on the neutral conductor shall be considered as _____ of the load on the ungrounded conductors.
- A. 40%
 - B. 50%
 - C. 70%
 - D. 80%
89. Conductors that supply a fire pump motor must have a rating not less than _____ percent of the sum of the fire pump motor's full load current and _____ percent of any associated fire pump accessory equipment:
- A. 80, 100
 - B. 125, 100
 - C. 115, 125
 - D. 100, 100
90. Nine 8.0 sq mm THHN copper conductors in a conduit at 30 degrees C have a maximum allowable ampacity of which of the following:
- A. 33 amperes each
 - B. 38.5 amperes each
 - C. 55 amperes each
 - D. 66 amperes each

SUPPLEMENTARY PROBLEMS

1. The code permits the use of only one circuit for small single-family dwelling unit having a floor area of not more than _____ m² with load not exceeding _____ volt-amperes.
 - A. 80, 3680
 - B. 100, 3860
 - C. 50, 3680
 - D. 60, 3860
2. What is the maximum number of over current devices allowed in a lighting and appliance panel board
 - A. 24
 - B. 30
 - C. 36
 - D. 42
3. About every 5 years new edition of PEC are issued, incorporating changes approved in the interim period. These changes are considered in the PEC by the use of
 - A. Italics
 - B. Boldface
 - C. Parenthesis
 - D. vertical Marginal line
4. At all building and structure, the PEC requires one of the FF.
 - A. Service disconnecting means
 - B. A main distribution board
 - C. A metering system
 - D. a grounding rod



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5. Which two of the following are not absolute code requirement
- I. Adequate current carrying capacity of conductor
 - II. Efficient design
 - III. Allowance for future expansion
 - IV. Accessibility of equipment
 - V. Freedom from Hazard
- A. I and II B. II and III C. I and III D. IV and V
6. The maximum number of quarter bends in one run of EMT is _____.
- A. two B. four C. five D. none of these
7. The neutral conductor shall not be _____.
- A. stranded B. solid C. insulated D. fused
8. Circuit Breaker shall open all _____ conductors of those circuits unless otherwise permitted.
- A. grounded B. ungrounded C. neutral D. grounding
9. What is the minimum diameter of wire for festoon wiring?
- A. 1.6 B. 2.0 C. 3.4 D. 4.9
10. Fuses rated _____ V nominal or less shall be permitted to be used for a voltage at or below their ratings.
- A. 24 B. 240 C. 1000 D. 600
11. A branch circuit larger than 50 A shall supply only
- A. motor B. lighting C. non lighting D. any of the above
12. What shall be the maximum height of a receptacle outside the building?
- A. 3000 mm B. 5000 mm C. 2000 mm D. 500 mm
13. The Branch circuit is rated 30 A. What should be the rating of the receptacle and the maximum connected load?
- A. 24 A, 24 A B. 30 A, 30 A C. 30 A, 24 A D. 37.5, 30 A
14. For two conductors with communication and signal conductors inside the conduit, the ampacity of the conductors shall be derated to what percent?
- A. 90% B. 80% C. 70% D. None of these
15. For optional calculation in dwelling units, the first 10 kW shall be computed at 100% while the remainder is at _____.
- A. 65% B. 60% C. 50% D. 40%
16. Given: A 120-volt lighting fixture has twelve 100-watt light bulbs which are all fed through a common fixture wire.
- The MINIMUM size fixture wire for the one common wire that feeds the entire fixture is size
- A. 2.0 sq mm. B. 3.5 sq mm C. 5.5 sq mm D. 8.0 sq mm
17. When sizing the wires that extend the power from the source to the disconnect for the electric motor, the conductors should be sized at _____ percent of the full-load current of the motor.
- A. 115 percent B. 120 percent C. 125 percent D. 250 percent



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18. The insulation material with rated class "UF" has a thermal capacity up to;
A. 75°C B. 90°C C. 60°C D. 50°C
19. The disconnecting means of a hermetic-type refrigerator compressor shall have an ampacity of at least _____ of the nameplate full load current.
A. 125% B. 80% C. 100% D. 115%
20. According to PEC it is the acceptable voltage drop for the feeder
A. 2% B. 3% C. 5% D. 2.3%
21. In number of ohms, what is the benchmark for grounding resistance?
A. 65 B. 25 C. 40 D. 10
22. What is the maximum percentage voltage drop allowable through an extension cord?
A. 1% B. 2% C. 4% D. 6%
23. It is generally not good practice to supply lamps and motors from the same circuit because _____.
I. it is more economical to operate motors on a higher voltage than that of a lighting circuit
II. overloads and short circuits are more common on motor circuits and would put the lights out
III. when a motor is started it would cause the lights to dim or blink
A. I only B. II only C. III only D. I, II and III
24. For each 2-wire laundry branch circuit, a feeder load of NOT less than _____ shall be included.
A. 1,800 VA B. 1,500 VA C. 2,000 VA D. 1,200 VA
25. Branch circuits for heating and air-conditioning equipment located on the elevator car shall not have a circuit voltage in excess of _____ volts.
A. 600 B. 13800 C. 2000 D. 220
26. What is the equivalent rating of a double duplex receptacle?
A. 180 B. 4 x 90 C. 360 D. 2 x 180
27. Where practicable, antenna conductors shall be installed so as not to cross under open electric light or power conductors. Meaning the angle between the power conductor and the communication conductor shall be.
A. 180° B. 90° C. 0° D. 45°
28. A WYE-DELTA starter for a single voltage three phase SC induction motor would require the connection of a certain number of wires from the motor. How many wires would be needed?
A. 3 wires B. 9 wires C. 6 wires D. 12 wires
29. Allowable Ampacities of Insulated Conductors Rated 0 Through _____ Volts, ____°C Through ____°C (140°F Through 194°F), Not More Than _____ Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of _____°C (86°F).
A. 13800, 75, 115, 4, 30 B. 1000, 60, 90, 3, 26-30
C. 600, 60, 75, 3, 26 D. 2000, 60, 90, 3, 30
30. Fuse protection is used for current ratings up to
A. 10 A B. 20 A C. 50 A D. 100 A



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31. How many overload relays are required to protect a three phase motor circuit? When instantaneous trip breakers are used in a three phase branch circuit, how many overload protections are required by the code?
A. Three B. two C. one D. four
32. A conductor encircling a building and interconnecting all ground terminals
A. counterpoise B. Faraday cage C. electrode D. chord
33. These are standard ampere rating for inverse time circuit breakers, except:
A. 75 Amps B. 50 Amps C. 60 Amps D. 90 Amps
34. The normal operating temperatures of cartridge type fuse at its rating;
A. 100 deg. C B. 75 deg. C C. 50 deg. C D. 25 deg. C
35. Ampacities of conductors on most tables are based on this temperature.
A. 30 to 40 deg. C B. 20 to 30 deg. C C. 26 to 30 deg. C D. 30 to 50 deg. C
36. The load of an instrument transformer consisting of delicate moving elements of ammeter, voltmeter and wattmeter is termed as
A. Transformed power B. Instrument impedance
C. Burden D. meter load
37. With respect to pulling wires into a conduit, it is usually specified that a certain percentage of the conduit area must be left unoccupied. The purpose of this requirement is to permit
A. pulling in the wires without undue strain or abrasion
B. pulling in additional wires later if needed
C. pulling out the wires for replacement even if the insulation has swelled
D. circulation of air so that the insulation will not be damaged by heat.
38. Knowing the surface temperature of a certain electrical machine in degrees Centigrade, the hot spot can be determine by adding the measured surface temperature with:
A. 15 deg. C B. 20 deg. C C. 40 deg. C D. 30 deg. C
39. The current-carrying conductors in cable bus shall have an insulation rating of _____ or higher
A. 75°C B. 60 C. 90 D. 110
40. With an applied voltage of 10 percent below rating, the running current would increase _____ percent, and the operating temperature would increase by _____ percent. At the same time, torque would be reduced by _____ percent.
A. 11, 12, 19 B. 10,11, 12 C. 19, 12, 11 D. 10,10,10
41. Conductor ampacity shall be based on the individual currents determined as the sum of _____ percent of the two largest welders, plus _____ percent of the third largest welder, plus _____ percent of the fourth largest welder, plus _____ percent of all remaining welders.
A. 100, 85, 70 60 B. all 100 C. 100, 90, 70 and 70 D. all 125



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42. An electrical code requires that all the conductors connecting an AC bus to a load be placed in a single metal conduit, tube or equivalent and does not approve using one conduit for each wire. The principal reason for this requirement is
- A. a single conduit installation is cheaper
 - B. it makes testing of the wires easier
 - C. it is easier to pull the wires through a single conduit
 - D. Currents would circulate through the individual conduits.
43. How many supply services (of the same potential) are allowed to enter a residential bungalow?
- A. one
 - B. two
 - C. three
 - D. four
44. What is the spacing required between open wiring conductors operating at 240 volts in dry locations?
- A. 10mm
 - B. 25mm
 - C. 50mm
 - D. 65mm
45. A buck-boost transformer provides a means of raising or lowering (boosting or bucking) a supply line voltage by a small amount preferably ____%.
- A. 25
 - B. 20
 - C. 10
 - D. 50
46. ____ percent of the nameplate rating(s) of electric space heating if four or more separately controlled units.
- A. 30%
 - B. 40%
 - C. 100%
 - D. 125%
47. Fuseholders shall be designed so that.
- A. it will be difficult to put a fuse of any given class into a fuseholder that is designed for a current lower, or voltage higher, than that of the class to which the fuse belongs
 - B. it will be easier to put a fuse of any given class into a fuseholder that is designed for a current lower, or voltage higher, than that of the class to which the fuse belongs
 - C. a cartridge fuse can be readily replaceable by any fuse of any class
 - D. any of the above
48. Primary protection for a transformer with 5 % rated impedance and is over 600 volts, the circuit breaker feeding this shall be sized at ____.
- A. 125 %
 - B. 225 %
 - C. 300 %
 - D. 600 %
49. Secondary protection for a transformer with 5 % rated impedance and is 600 volts and below, the circuit breaker feeding this shall be sized at ____.
- A. 125 %
 - B. 225 %
 - C. 250 %
 - D. 600 %
50. The laundry area in a single-family dwelling unit must have which of the following:
- A. A minimum of one 20 amp and one 220 amp receptacle
 - B. At least one receptacle
 - C. At least one receptacle installed within 3 feet of the washing machine location
 - D. A minimum of two GFCI receptacles