

Questions for the 2008 Grounding and Bonding Correspondence Course, Part 1

**1. The total opposition to current flow in an electrical circuit is referred to as:**

- A) resistance.
- B) capacitance.
- C) impedance.
- D) inductance.
- E) all of the above.

**2. Following proper grounding and bonding methods for an electrical installation will result in a system where:**

- A) there is only one path for fault currents.
- B) there are likely to be parallel paths for fault currents.
- C) normal operating currents may exist through bonded surfaces.
- D) there are likely to be parallel paths for normal currents.
- E) none of the above are true.

**3. An effective ground fault current path, provided by bonding all conductive enclosures and raceways together:**

- A) must be electrically continuous.
- B) must be capable of carrying the maximum fault current likely to be imposed.
- C) must have sufficiently low impedance to facilitate the operation of overcurrent devices.
- D) should help provide a stable voltage reference.
- E) all of the above.

**4. Circuit components such as conductors and windings can be tested for their insulation integrity by introducing a voltage potential on the circuit and measuring the leakage. This process is done:**

- A) with a clamp-on amp probe.
- B) with the normal system voltage connected.
- C) with a meg-ohm meter.
- D) to make sure the overcurrent device will function correctly.
- E) with a continuity tester.

**5. Electrical equipment intended to protect the system must be designed and installed so it has \_\_\_\_\_ to prevent catastrophic failure and destruction.**

- A) a voltage rating of 600 volts,
- B) a rating for 50 or 60 cycles,
- C) a listing or certification from UL,
- D) special permission,
- E) an adequate fault current interrupting rating at the line terminals,

**6. Localization of a fault condition to restrict outages to the circuit or equipment affected is referred to as:**

- A) selective coordination.
- B) utilization equipment.
- C) service equipment.
- D) an overcurrent protective device.
- E) a branch circuit panelboard.

**7. A component that establishes an electrical connection to the earth is called a:**

- A) bonding jumper.
- B) grounding electrode.
- C) green conductor.
- D) water pipe clamp.
- E) primary protector.

**8. Which of these items is not to be considered an effective ground fault current path?**

- A) An aluminum bonding jumper.
- B) Listed EMT fittings.
- C) Galvanized rigid conduit couplings.
- D) The earth.
- E) A solid #8 copper conductor.

**9. Which of these AC systems is not required by the 2008 National Electrical Code to be solidly grounded?**

- A) A single phase, 120/240 volt system.
- B) A 480 volt, 3 phase, 3 wire system.
- C) A 24 volt system derived from a 120 volt primary.
- D) A 120/208 volt three phase system.
- E) A 277/480 volt three phase system.

**10. The grounded conductors of electrical systems with different voltage characteristics, installed in the same building must be identified:**

- A) where they occupy the same raceway or enclosure.
- B) by system, unique to each system.
- C) with a white or gray covering or distinctive marking, or three white stripes.
- D) and posted at each branch circuit panelboard.
- E) all of the above.

**11. An electrical system that supplements utility power, and is derived from batteries, fuel cells, photovoltaics, or a generator, is not required to be grounded as a separately derived system unless:**

- A) the transfer equipment breaks the grounded conductor.
- B) it is not equipped with a main breaker.
- C) it is connected directly to the grid.
- D) there is no transfer equipment.
- E) it is located in a separate building.

**12. When high impedance grounded systems, or ungrounded systems are employed to obtain an additional degree of service continuity:**

- A) more stringent overcurrent protection must be utilized.
- B) the serving utility must monitor the system.
- C) ground fault indicator equipment must be installed.
- D) additional education for equipment operators is required.
- E) Voltage regulators are required for each phase.

**13. The 2008 National Electrical Code identifies \_\_\_\_\_ as circuits that are not to be grounded.**

- A) crane circuits in Class III locations, (article 503.155),
- B) health care facility circuits as provided in 517.61 and 517.160,
- C) equipment circuits in electrolytic cell working zones, (article 668.21),
- D) lighting secondary circuits as provided in 411.5(A),
- E) all of the above

**14. In general, the grounded conductor of most AC systems is allowed to be identified by white or gray tape encircling the wire at each termination:**

- A) for all wire sizes.
- B) if the conductor size is #4 or larger.
- C) regardless of the continuous insulation color.
- D) if the conductor size is #6 or larger.
- E) only if the insulation is black.

**15. In regard to re-identifying conductors, which of these statements is false?**

- A) a white #4 THHN copper conductor shall be permitted to be used as a phase conductor.
- B) green conductors are allowed to be used as phase conductors when permanently marked.
- C) white conductors in cable assemblies are allowed to be re-identified for switch loops.
- D) grounded conductors of different systems are required to be identified by system.
- E) black, red, and blue can be used for 277 volt ungrounded conductors.

**16. In a delta connected 120/240 volt service, the high leg is usually \_\_\_\_\_ to ground, and is required to be identified with orange tape.**

- A) 240 volts.
- B) 277 volts.
- C) 180 volts.
- D) 208 volts.
- E) 150 volts.

**17. The most common three phase electrical services in the United States are 120/208 volt, and 277/480 volt with \_\_\_\_\_ primary windings.**

- A) wye connected
- B) grounded
- C) delta connected
- D) 69kv
- E) 115kv

**18. In a building where more than one nominal voltage exists:**

- A) grounded conductors shall be identified by system.
- B) a grounding electrode system must be created for each nominal voltage.
- C) feeder cables must be supported differently.
- D) conductors of the different systems cannot occupy the same enclosure.
- E) impedance grounding must be utilized.

**19. A grounding auto-transformer that is occasionally used on ungrounded delta systems:**

- A) creates a neutral reference for grounding purposes.
- B) has each pair of windings on the same core leg wound in opposite directions.
- C) is called a zig-zag transformer.
- D) has no secondary windings.
- E) all of the above are true.

**20. When an AC system operating at less than 1000 volts is grounded at any point, the grounded conductor:**

- A) shall be bonded at each sub panel.
- B) shall be run to each service disconnecting means.
- C) must be bonded at all separately derived systems.
- D) must be insulated.
- E) all of the above requirements must be met.

**21. The connection of the grounding electrode conductor to the grounded conductor of the service:**

- A) is required to be made by the process of exothermic welding.
- B) must be done at the service mast for overhead drops.
- C) can be made underground in the case of service laterals.
- D) must be done in the meter base.
- E) is required to be accessible.

**22. The size of the grounding electrode conductor required for each alternating current system is:**

- A) based on the size, (ampacity) of the service disconnecting means.
- B) determined by the calculated load per 220.40.
- C) based on table 250.66.
- D) determined by the sum of the service overcurrent protective devices.
- E) based on the values in table 250.122.

**23. The main purpose for routing the service grounded conductor with the ungrounded conductors, and bonding it to each service disconnecting means is to:**

- A) limit the effect of electromagnetic interference.
- B) facilitate bonding of other utilities such as phone and television.
- C) provide protection from physical damage.
- D) provide a low impedance path for fault current.
- E) balance the loads connected to the system.

**24. If a 400 amp service is to be installed from a grounded system, 500kcmil copper is used for the ungrounded conductors, and there is no neutral load on the system, what is the minimum size for the grounded conductor to the service disconnect?**

- A) 1/0 copper.
- B) #2 copper.
- C) 3/0 copper.
- D) no neutral load means the grounded conductor is not required.
- E) same size as the ungrounded conductors.

**25. In the question above, what is the minimum size conductor required for the grounding electrode conductor to building steel?**

- A) #2 copper.
- B) #4 copper.
- C) 3/0 copper.
- D) 2/0 aluminum.
- E) 1/0 copper, or 3/0 aluminum.

**26. Special provisions exist for single phase, 120/240 volt residential services and feeders. Which of the following statements is false?**

- A) The neutral must carry the maximum unbalanced load from the phase conductors.
- B) Service conductors can be sized according to the amperage rating of the service.
- C) Section 220.61 provides the method for calculating the feeder neutral load.
- D) The grounded conductor cannot be more than two sizes smaller than the ungrounded.
- E) All of these statements are true.

**27. When three parallel 4/0 copper service conductors per phase are installed in three separate raceways:**

- A) table 250.66 requires a 2/0 grounded service conductor in one conduit.
- B) a 1/0 grounded service conductor must be run in each raceway.
- C) the code requires three 2/0 copper neutral conductors.
- D) each raceway must have a #1 copper neutral.
- E) a neutral and an equipment grounding conductor is required in each raceway.

**28. What is the minimum size grounded service conductor required for a service that consists of six 4/0 copper conductors per phase?**

- A) 4/0 copper.
- B) two 1/0 copper conductors in parallel.
- C) equivalent to at least 158,700 circular mils.
- D) two 2/0 aluminum conductors in parallel.
- E) 211,600 circular mils.

**29. When grouping underground parallel service conductors together by phase in non-metallic raceways:**

- A) care must be taken to reduce inductive heating of ferromagnetic materials.
- B) this practice is not allowed by the NEC.
- C) the conductors are not required to be of the same length.
- D) a grounded conductor must be pulled in each raceway.
- E) the rules in 310.4 for conductors in parallel do not apply.

**30. High impedance grounded neutral systems are not permitted in industrial applications:**

- A) where transient voltages are present.
- B) where line to neutral loads are served.
- C) unless the system is monitored by an electrical engineer.
- D) if the grounded service conductor is smaller than 1/0 copper.
- E) where the interrupting rating exceeds 22,000 amps.

**31. In a supervised industrial application, a differential relay can be used in transformer secondary conductors supplying a separately derived system:**

- A) to provide primary protection.
- B) if the system is more than 100 feet away.
- C) if maintained by a licensed electrical engineer.
- D) to provide overcurrent protection.
- E) to provide short circuit and ground fault protection.

**32. Electrical equipment, wiring, and any associated conductive material likely to become energized shall be installed in a manner that:**

- A) creates an effective ground fault current path.
- B) facilitates the operation of overcurrent devices.
- C) can safely carry any fault current likely to be imposed.
- D) All of the above.
- E) uses the earth as part of the ground fault path.

**33. This method is not acceptable when attaching grounding lugs or terminal strips to an enclosure.**

- A) exothermic welding.
- B) listed machine screws.
- C) sheet metal screws.
- D) listed clamps.
- E) scrape the paint and drill and tap holes for the mounting screws.

**34. When more than one separately derived system is installed, tap conductors are permitted to connect the grounded conductor to a common grounding electrode conductor. The minimum size for a wire type common grounding electrode conductor is;**

- A) based on total transformer kva.
- B) #4 copper.
- C) 500kcmil aluminum.
- D) 3/0 aluminum.
- E) 3/0 cu or 250kcmil alum.

**35. A grounding electrode system is not required to be installed at a separate building or structure where supplied by:**

- A) an underground 4 or 5 wire feeder.
- B) a single or multiwire branch circuit.
- C) a new utility service.
- D) an overhead feeder.
- E) a feeder with at 30 amp fused disconnect.

**36. Which of the following items is not always required to be connected to the grounding electrode?**

- A) frames of portable and vehicle mounted generators.
- B) structural metal beams.
- C) interior metallic propane piping system.
- D) copper water piping.
- E) plate electrodes.

**37 Which of the following is not an acceptable type of equipment grounding conductor?**

- A) bare stranded copper conductors.
- B) electrical metallic tubing.
- C) steel flex containing 30 amp circuit conductors.
- D) galvanized rigid conduit.
- E) intermediate metal conduit.

**38. The connection between the grounded circuit conductor and the equipment grounding conductor at the service is called the:**

- A) Bonding Jumper, System.
- B) Bonding Jumper, Equipment.
- C) Neutral Bonding Jumper.
- D) Bonding Jumper, Main.
- E) grounding electrode conductor.

**39. Where multiple service disconnects exist in a common, listed enclosure:**

- A) there must be a main bonding jumper for each disconnect.
- B) the neutral bar must be isolated from the enclosure.
- C) each disconnect must have a dedicated neutral bar.
- D) the ground bar is bonded and the neutral bar must be isolated.
- E) a single main bonding jumper is permitted.

**40. The general rule requires the grounding electrode conductor to be terminated at the grounded service conductor, or neutral. When does the grounding electrode conductor need to be terminated at the equipment grounding terminal?**

- A) When the main bonding jumper is oversized.
- B) When necessary for proper operation of Ground Fault Protection equipment.
- C) When the bonding jumper is done with exothermic welding.
- D) On 277/480 volt services over 600 amps.
- E) on 120/208 volt services over 1000 amps.

**41. What size main bonding jumper would be required at a service where 3 – 500kcmil copper conductors are installed in parallel as service entrance conductors?**

- A) 3/0 aluminum.
- B) 250kcmil copper.
- C) 4/0 copper.
- D) 3/0 copper.
- E) 4/0 aluminum.

**42. If the parallel raceways in question 41 are bonded individually to the neutral bus, what is the minimum size for these equipment bonding conductors?**

- A) 1/0 copper.
- B) #2 copper.
- C) 1/0 aluminum.
- D) 2/0 copper.
- E) 2/0 aluminum.

**43. Service equipment and enclosures on the supply side of the service disconnecting means:**

- A) must be bonded separately from the neutral.
- B) are required to be bonded directly to the grounding electrode conductor.
- C) must be bonded together with insulated conductors.
- D) are permitted to be bonded directly to the grounded service conductor.
- E) are required to be bonded with ground wedges.

**44. Where concentric or eccentric knockouts are encountered in service equipment enclosures:**

- A) standard locknuts and bushings are required.
- B) bonding jumpers are required.
- C) Threaded hubs are required for bonding.
- D) steel fittings must be used.
- E) ground bushings must be used.

**45. Grounding and bonding of the service equipment on the supply side of the service disconnecting means:**

- A) is done to facilitate operation of the service disconnecting means.
- B) protects ungrounded service conductors from overcurrent.
- C) is done to prevent lightning strikes.
- D) helps protect other utility systems such as phone and television.
- E) facilitates operation of the utility transformer overcurrent protection.

**46. It is permissible to install a ground rod at a remote meter location as a supplemental grounding electrode:**

- A) only if it is bonded separately to the grounding electrode system.
- B) when the grounded conductor is isolated from the meter enclosure.
- C) and bond it to the grounded service conductor.
- D) as long as the conductor is larger than #4.
- E) when there is no grounded service conductor at the meter base.

**47. When the total circular mil area of parallel service entrance conductors exceeds 1100, the main bonding jumper must equal at least \_\_\_\_\_ percent of the total.**

- A) 12.5.
- B) 10.
- C) 15.
- D) 18.25.
- E) 20.

**48. Which of the following statements is false regarding the function and purpose of the grounding electrode?**

- A) Connects the electrical system to earth.
- B) The main function is to clear ground faults.
- C) Attempts to maintain equipment at earth potential.
- D) Connects electrical equipment enclosures to earth.
- E) Supplements the grounding electrode system.

**49. All grounding electrodes that exist in a building:**

- A) must have insulated conductors rated for 90 degrees C.
- B) must be connected to building steel.
- C) are required to be bonded according to the circuit most likely to impose a current.
- D) must be bonded together to form the grounding electrode system.
- E) are required to be bonded by exothermic welding.

**50. The actual resistance in the connection between a grounding electrode and earth will vary based on:**

- A) soil conditions.
- B) burial depth.
- C) geographic location.
- D) seasonal conditions.
- E) all of the above.

**51. Which of these items is not to be used as a grounding electrode?**

- A) A cast iron fire sprinkler piping system.
- B) A copper irrigation piping system.
- C) Underground metal gas piping systems.
- D) Structural steel in the foundation.
- E) 10 feet of galvanized water piping in contact with the ground.

**52. A concrete encased electrode in a building foundation is likely to be ineffective:**

- A) if the soil it too sandy.
- B) if isolated from the earth by a vapor barrier.
- C) for services over 1000 amps at 480 volts.
- D) if the soil is too rocky.
- E) for services less than 150 amps, 120/240 volts, single phase.

**53. A 600 amp, 120/208 volt service for a building consists of two 200 amp 3 phase panels, and a 125 amp single phase panel. A bussed gutter is fed from a CT can with 2, 300kcmil copper conductors per phase, and three meters are tapped from the bussed gutter. What size common grounding electrode conductor is required for this service?**

- A) 1/0 copper.
- B) 2/0 copper.
- C) 3/0 copper.
- D) 4/0 aluminum.
- E) 3/0 aluminum.

**54. The three meters in question 53 feed main circuit breaker service panels from the bused gutter with 3/0 copper for the 200a, and #1 copper for the 125a. What size tap conductors are required from the individual grounded conductor terminal to the common grounding electrode conductor? 200a \_\_\_\_\_ , 125a \_\_\_\_\_ .**

- A) #4 aluminum, #6 aluminum.
- B) #6 copper, #8 copper.
- C) #2 copper, #4 copper.
- D) #4 copper, #6 copper.
- E) both have to be 1/0 copper.

**55 In the question above, what is the minimum size grounded service conductor from the bussed gutter through the meters to the panels? 200a \_\_\_\_\_ , 125a \_\_\_\_\_ .**

- A) #4 aluminum, #6 aluminum.
- B) 3/0 copper, #1 copper.
- C) both have to be 1/0 copper.
- D) 1/0 copper, #3 copper.
- E) #4 copper, #6 copper.

**56. Where used outside, aluminum or copper clad aluminum grounding conductors shall not be terminated:**

- A) above the ground.
- B) within 18 inches of the earth.
- C) on a galvanized pipe.
- D) within 24 inches of the earth.
- E) on a listed flex connector.

**57. That portion of the bonding conductor that is the sole connection to a ground ring is not required to be larger than:**

- A) 1/0 copper.
- B) #4 copper.
- C) the ground ring conductor.
- D) 3/0 copper.
- E) #6 copper.

**58. A steel building with an 800 amp service is fed with 2 500kcmil copper conductors per phase. What size conductor must be used to connect the underground metallic water piping system?**

- A) 2/0 copper.
- B) 1/0 copper.
- C) sized according to the ampacity of the circuit most likely to impose a current.
- D) 2/0 aluminum.
- E) 1/0 aluminum.

**59. In question # 58 above, what size conductor must be used to connect the concrete encased electrode to the grounded service conductor?**

- A) 1/0 aluminum.
- B) 2/0 aluminum.
- C) sized according to the ampacity of the circuit most likely to impose a current.
- D) 1/0 copper.
- E) #4 copper.

**60. In question #58, what size conductor must be used to bond the metallic propane gas piping system?**

- A) 2/0 copper.
- B) 1/0 copper.
- C) #2 copper.
- D) sized according to the ampacity of the circuit most likely to impose a current.
- E) #4 copper.

**61. When a building or structure of large area is permitted to have more than one service, \_\_\_\_\_ shall be permitted to bond grounding electrodes together.**

- A) the common black iron fire sprinkler system.
- B) the metal frame of the building, or concrete encased electrode.
- C) only a continuous 3/0 copper conductor.
- D) a continuous metal gas piping system.
- E) only the water piping system.

**62. Which of these grounding electrodes is permitted as a stand-alone system, (does not require a supplemental electrode), for a 200 amp residential service?**

- A) a concrete encased grounding electrode.
- B) interior metal piping for compressed air.
- C) water piping connected to a well casing.
- D) all electrodes are required to be supplemented.
- E) an underground natural gas piping system.

**63. When the resistance of a single rod, pipe, or plate electrode exceeds \_\_\_\_\_ ohms, a supplemental electrode is required.**

- A) 20 ohms.
- B) 35 ohms.
- C) 25 ohms.
- D) 15 ohms.
- E) a supplemental electrode is required regardless of the resistance.

**64. When a rod, pipe, or plate electrode exceeds the minimum resistance requirements:**

- A) an additional electrode must be installed within 5 feet.
- B) a ground ring must be installed.
- C) bonding the building steel will suffice.
- D) it must be augmented by an additional electrode at least 6 feet away.
- E) any of the above can be done.

**65. Oregon rules have amended the requirements for grounding regarding:**

- A) separation of ground and neutral when other conductive paths exist between buildings.
- B) access to concrete footing reinforcing bar near the electrical panel.
- C) the installation of a grounding conductor in metallic rooftop raceways.
- D) performance testing of Ground Fault Protection systems.
- E) all of the above.

**66. Lightning protection systems consisting of air terminals, down conductor, and ground terminal:**

- A) should never be connected to the electrical system grounding electrode.
- B) can be bonded to the nearest branch circuit grounding conductor.
- C) must be bonded to the mast of the service drop.
- D) require that warning signs are posted.
- E) must be bonded to the electrical system grounding electrode system.

**67. Oregon rules have amended article 250 in regard to:**

- A) the installation of concrete encased electrodes in new construction.
- B) the use of metal underground water piping as an electrode for service changes.
- C) documented verification of grounding electrode resistance testing.
- D) installation of an equipment grounding conductor in metal raceways on roof tops.
- E) all of the above.

**68. For services with multiple disconnect enclosures, grounding electrode conductors are permitted from each disconnect to the grounding electrode, and sized according to:**

- A) the ungrounded main service conductor.
- B) each individual ungrounded service conductor tap.
- C) the grounded service conductor.
- D) table 250.122.
- E) the individual service overcurrent protective device.

**69. Table 250.66 indicates the minimum size grounding electrode conductor required for connecting \_\_\_\_\_ to the grounded service conductor for AC systems.**

- A) building steel or underground water piping.
- B) a ground rod.
- C) a concrete encased electrode.
- D) a ground ring.
- E) all of the above.

**70. Connection from the grounded service conductor to a concrete encased grounding electrode is not permitted to be done:**

- A) above ground.
- B) without the benefit of exothermic welding.
- C) with a compression connector.
- D) with any kind of clamp or lug.
- E) with aluminum wire.

**71. The connection of a grounding electrode conductor to the grounding electrode must be readily accessible except:**

- A) concrete encased electrode.
- B) driven or buried electrodes.
- C) exothermic or pressure connection to building steel covered by fireproofing material.
- D) all of these are permitted to be inaccessible.
- E) none of these are exempted from the accessibility rule.

**72. A listed grounding and bonding connector consisting of a sheet metal strap with a rigid metal base that seats on the electrode:**

- A) is only permitted for indoor telecommunication purposes.
- B) is allowed for all pipe connections.
- C) is permitted for connections to fire sprinkler.
- D) can be used to bond metallic sanitary piping.
- E) can only be used for bonding pipes larger than 6 inches in diameter.

**73. Protection of ground clamps and fittings from physical damage shall be achieved by:**

- A) the placement of metal bollards.
- B) placing a bottomless 'hand hole' box over the connection.
- C) installing a two gang bell box.
- D) protection is not required.
- E) being enclosed in metal, wood, or equivalent protective covering.

**74. Grounding electrode conductors shall be installed in one continuous length without joint or splice except:**

- A) irreversible, listed compression connectors or exothermic welding.
- B) securely fastened buss bar at least 1/4 x 2 inches, and accessible.
- C) both A & B.
- D) where lengths exceed 250 feet.
- E) where spliced in an approved junction box.

**75. Where a ferrous metal raceway or enclosure is used to provide physical protection for a grounding electrode conductor:**

- A) it must be physically continuous from panel to electrode.
- B) both ends must be bonded, and the bonding jumper must be at least the size of the GEC.
- C) a #12 bonding jumper is required.
- D) only one end should be bonded to prevent the effect of a choke.
- E) a plastic bushing is required to prevent damage to the insulation.

**76. Metal raceways, fittings, and enclosures that are to serve as grounding conductors are not required to have supplemental equipment grounding conductors:**

- A) for some circuits from a 120/208 volt source.
- B) if an isolated grounding conductor is provided for reduction of electrical noise.
- C) if hazardous location methods and materials are employed.
- D) when concentric knockouts are encountered.
- E) if expansion fittings are used in the raceway.

**77. A metallic raceway entering a disconnect enclosure for the 480 V feeder conductors to a piece of equipment must have supplemental bonding to the enclosure:**

- A) any time concentric or eccentric knockouts are encountered.
- B) if installed in a wet location.
- C) regardless of the voltage of the system.
- D) if reducing washers are employed at the enclosure.
- E) unless a plastic bushing is installed.

**78. Multiple metallic raceways for feeders and branch circuits entering the bottom of a free-standing panelboard are bonded with a single, common equipment grounding conductor. Which statement is true?**

- A) the bonding conductor is sized for the sum of all overcurrent devices.
- B) 250.66 is used to size the conductor.
- C) a minimum 1/0 copper conductor must be used.
- D) the bonding conductor is sized for the combined circular mil area of all conductors.
- E) size for the largest overcurrent device ahead of conductors in raceways.

**79. The point of connection for bonding jumpers to metal water piping:**

- A) is required to be readily accessible.
- B) must be within 5 feet of entry to the building.
- C) cannot be outside the building.
- D) is not permitted to be in a crawl space.
- E) must be determined by the Authority Having Jurisdiction.

**80. Interior metallic piping systems for \_\_\_\_\_ are in general, required to be bonded to the service equipment enclosure.**

- A) hot and cold water.
- B) oxygen, air, and vacuum systems.
- C) waste, drain, and vent lines.
- D) pneumatic systems.
- E) all of the above.