Unit 18 Evacuating, Pressurizing, Leak Testing, and Charging

Unit Contents

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* Assignment Sheets and Job Sheets are located in the Student Workbook.

Suggested Activities

Instructional Plan

Preparation

- Read the unit carefully and plan for instruction or individual learning activities. Study the specific objectives to determine the order in which you will present the objectives.
- Review Teaching Suggestions section that follows. Plan for classroom activities.
- Plan your presentation to take advantage of student learning styles and to accommodate special needs students.
- Prepare classroom. Put up posters and charts and display articles and other references related to this unit.
- Obtain films, videotapes/CDs, and other resources to supplement instruction of this unit. See “Resources Used in Developing This Unit” and “Suggested Supplemental Resources” for more information.
- For self-paced instruction, review Learning Activities Sheet. Modify as appropriate to include additional activities and/or resources available in your classroom. Make one copy for each student.

Delivery and Application

Unit Introduction (self-paced instruction)

- Provide student with Unit of Instruction.
- Review unit contents with student, the location of reference materials, and the procedure for accessing the Internet, if available.
- Have the student complete the steps in the Learning Activities Sheet. Initial the student's sheet where indicated as they complete each activity.

Unit Introduction (group instruction)

- Provide students with unit of instruction.
- Discuss unit and specific objectives.
- Discuss the information sheet. Implement teaching plan to localize, supplement, and personalize the unit. Reinforce basic academic and workplace skills when applicable.

Suggested Activities

- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.

- Discuss and demonstrate the job sheets. Make sure all required tools, equipment, and materials are available. Review with students the criteria for evaluation of these activities and the rating scale that will be used to indicate job performance.

Teaching Suggestions

- This unit contains many job sheets that were saved specifically for this unit so that students would have time to acquire prerequisite skills needed to complete them. As you review and demonstrate those job sheets, you may want to integrate them with earlier job sheets where the student will have systems in a condition where many other typical service procedures can be performed.

- Demonstrate the use of a vacuum pump as you discuss objective 5. The vacuum pump is used with many of the job sheets in this unit, and each student should have a good command of setting up a vacuum pump and the attendant service equipment than can be used with a vacuum pump.

- Arrange with a local service company for groups of students to accompany local technicians who will be evacuating, pressurizing, and leak testing systems in their service work. Plan this far enough in advance that students can prepare notes about questions they want to ask on the job site. Have students report to the class about the type of equipment the technician was using, the procedure used, and the general conduct of evacuating, pressurizing, and leak testing in a real-world situation.

- Note that Job Sheet 4 involves lighting and using a halide torch for detecting leaks. This torch can pose safety problems when improperly used so remind students of proper procedures and observe them closely. The halide torch is still the least expensive and still an effective way to search for halide based refrigerant leaks; it is a tool that technicians need to learn to use.

- There are three sets of job sheets with each group of job sheets to be completed as a set. Take a look at the Learning Activity Sheet which details exactly how this should be done. Student Supplement 1 lists the job sheets in the groups. Students will usually complete all or most of each set in sequence on a single piece of equipment. Although you may separate them or the piece of equipment may not require every single job sheet. One Assignment or Work Order goes with each set. If Job Sheets are separated into more than three sets, additional copies of the Assignment/Work Order will be needed.

Evaluation

- Make copies of the written test. Add or modify test items as needed. The written test serves as both a pretest and posttest to assist in measuring each student's competency gains.

- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.

- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.

- Evaluate the job sheets. When the student is ready to perform a specific task, obtain a copy of the job sheet which may be found in the student edition. Then observe the student performing the procedure.

  Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily completed the process step(s) for each checkpoint area. If the student is unable to complete the procedure correctly, have the student review the materials and try again.

  Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria that are provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

  Two sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) that best fits your program needs.

  Sample A

  4—**Skilled**—Can perform job with no additional training.
  3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
  2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
  1—**Unskilled**—Is familiar with process, but is unable to perform job.
  0—**No exposure**—No information or practice provided during training program.

  Sample B

  Yes—Can perform job with no additional training.
  No—Is unable to perform job satisfactorily.

- Give and evaluate the posttest.

Suggested Activities

- Meet individually with students to evaluate their progress through this unit of instruction and indicate to them possible areas of improvement.

- Reteach and retest as required.

Resources Used in Developing This Unit

Print Media

- Clemons, Mark. *Fundamentals of Air Conditioning and Refrigeration*. Stillwater, OK: The Mid America Vocational Curriculum Consortium, 1996.

  1996 version was used as the primary basis for this current book. See http://www.mavcc.org/ for more information or ordering.

- Althouse, A, Turnquist, C., & Bracciano, A. *Modem Refrigeration and Air Conditioning, 18th Edition*. Tinley Park, IL: The Goodheart Wilicox Company, Inc., 2004. ISBN: 1-59070-280-8

  Provides a blend of theory with job qualifying skills. This comprehensive text teaches both fundamental principles and the service techniques needed to diagnose and remedy HVAC problems. This edition contains the most recent information and advances in the field needed to prepare the technician for success in today's world and provides a solid and thorough knowledge of all aspects of refrigeration and air conditioning. See http://www.goodheartwillcox.com/ for more information or ordering.

Suggested Supplemental Resources

Print Media

- Whitman, W., Johnson, W., & Tomczyk, J. *Refrigeration & Air Conditioning Technology, 5th edition*. Albany, NY: Delmar Thomson Learning, 2004. ISBN 0-7668-0667-7

  Provides superior hands on information needed to successfully maintain and troubleshoot today's complex heating, air conditioning, and refrigeration systems. It fosters a solid foundation and understanding of environmental problems and their solutions, and displays a depth and detail of theory, diagnostics, and repair procedures. It includes information on typical operating conditions, and offers ample systematic troubleshooting techniques and scenarios. See http://www.delmarleaming.com/ for more information or ordering.

Electronic Media

- See the ARI links page, http://www.ari.org/links for websites of many organizations both public and private that can provide a wealth of information.•

Written Test

Name _____

Date _____ Score_____

Objective 1

Select the correct term that matches the definition.

1. A small brush used for applying flux or liquid leak testing detergent.

   a. Scrub brush
   b. Acid brush

2. That part of an evacuation procedure that removes moisture from a refrigeration system.

   a. Evacuation
   b. Dehydrating

3. Oil pumped nitrogen in a pressurized cylinder, used for pressurizing a refrigeration system for leak testing or sweeping system lines during certain soldering or brazing activities.

   a. Wet nitrogen
   b. Dry nitrogen

4. The removal of non-condensable gases, moisture, and oil-entrapped refrigerant from an appliance.

   a. Evacuation
   b. Dehydrating

5. A metering device used to reduce high nitrogen pressure to a safe, low working pressure.

   a. Expansion valve
   b. Nitrogen regulator

6. A refrigeration product fully manufactured, charged, and hermetically sealed with five pounds or less of refrigerant in a factory.

   a. Small appliance
   b. Package unit

Written Test

Objective 2

Select whether statements concerning preparing a refrigeration system for operation are true or false.

7. Preparing a new system for initial operation or preparing an older system for operation requires that assembly or repairs be made without danger to personnel, equipment, or the environment.

   a. True
   b. False

8. On a new or repaired system, the first step in preparing the system for operation is to verify that no refrigerant or other gases are present in the system or any portion of the system being worked on, or to remove any refrigerant that may be in the system.

   a. True
   b. False

9. Pressurize the system for leak testing with dry nitrogen only.

   a. True
   b. False

10. Leak test the system to assure that it is sealed so that refrigerant will not escape from the system and that air or other matter cannot enter the system.

    a. True
    b. False

11. Evacuate the system to assure that it is dehydrated, free of all moisture, and free of air or other gases.

    a. True
    b. False

12. Charge the system with the proper amount of the refrigerant specified by the equipment manufacturer or a suitable alternative if the system has been retrofitted.

    a. True
    b. False

Objective 3

Select the correct answers to questions concerning removing refrigerant or other gases.

13. Your coworker is working on a system that is suspected of having refrigerant entrapped in the oil. The coworker knows that the system will have to be evacuated, but the problem is, how far does it have to be evacuated?

    a. Evacuate to at least 28˝ hg.
    b. Evacuate to at least 18˝ hg.

14. You have been given a component to install on a new system, and you know the component is pressurized with nitrogen, and you have to decide whether to try to recover the nitrogen or simply vent it to atmosphere. What would you do?

    a. Vent the nitrogen to atmosphere; de minimus venting does not reply to nitrogen charges.
    b. Nitrogen is an expensive as most refrigerants, so recover it.

Objective 4

Select the correct word(s) to complete statements concerning guidelines for assembling components.

15. Whether new or under repair, the components of a system must be properly assembled to assure proper operation and _____ efficiency.

    a. minimum
    b. maximum
    c. evacuation

16. Proper assembly is accomplished through mechanical means by using flare, quick connect, or compression fittings, or by soldering or _____.

    a. welding
    b. brazing
    c. adhesive

17. Take special care not to introduce any foreign substance or excess _____ into the system.

    a. liquid
    b. moisture

18. Add a _____ line drier to a new system or replace the _____ line drier after a system has been opened to the atmosphere.

    a. suction/suction
    b. liquid/liquid
    c. liquid/suction

19. Add a _____ line drier when extra protection is needed or desired for the compressor; adding a _____ line drier is essential after a burnout.

    a. suction/suction
    b. liquid/liquid
    c. liquid/suction

20. Make the drier the _____ connection in the assembly so that it will be exposed to the atmosphere no longer than necessary.

    a. final
    b. longest
    c. first

21. Take special care to create no _____ with tight bends or kinks in tubing, excess brazing materials, or the improper connection of fittings.

    a. extensions
    b. abstensions
    c. restrictions

Objective 5

Select whether statements concerning guidelines for pressurizing a system are true or false.

22. Once refrigerant has been removed from a system and the system has been assembled or repaired, the system must be pressurized for leak testing.

    a. True
    b. False

23. Attach a manifold gauge set to the system and attach the center hose from the manifold gauge set to a cylinder of R-22.

    a. True
    b. False

24. Give the system a preliminary charge to about 3 psig of R-22, if you intend to leak test with a halide torch or an electronic leak detector.

    a. True
    b. False

25. Use oxygen or compressed air for pressurizing only as a last resort.

    a. True
    b. False

26. Use a pressure regulator between the high pressure nitrogen or CO_2 and the system.

    a. True
    b. False

27. Hook up the manifold gauge set compound gauge hose to the outlet of the inert gas cylinder.

    a. True
    b. False

28. Close the pressure regulator valve and open the valve on the inert gas cylinder.

    a. True
    b. False

29. Slowly open the regulator valve until it indicates the system pressure recommended for pressurizing.

    a. True
    b. False

30. Open the low side valve on the manifold gauge set.

    a. True
    b. False

31. Keep the presure at the recommended level while leak testing the system.

    a. True
    b. False

Objective 6

Select the correct answers to problems concerning leak testing with soap solution.

32. You notice another technician starting to leak test a system with soap bubbles, and the technician starts by applying a detergent solution to a point on the suction line. There seems to be no problem, but there could be. What should he have done?

    a. The technician needs to leak test the manifold gauge set first because once it is hooked up it becomes part of the system, and if it is leaking and not properly check it could provide misleading information.
    b. The technician needs to start at the nearest or farthest point in the system and work back to it.

33. You know a system is suspected of having a leak, but you don't know exactly where to start testing. How should you proceed?

    a. Pick any point, start leak check there, and then return to the point; then do everything a second time to be sure.
    b. Look for oil around any point in the system; this is a common clue that there is probably a leak at or near that point.

Objective 7

Select the correct word(s) to complete statements concerning leak testing with a halide torch.

34. For a halide torch to work as a leak detector, the system has to be charged with a mixture of nitrogen and _____.

    a. copper
    b. R-22
    c. oxygen

35. A halide torch is ready for leak testing when the _____ element heats up.

    a. aluminum
    b. iron
    c. copper

36. When using a halide torch, you actually "sniff" for leaks with a _____ hose attached to the unit.

    a. flexible
    b. solid
    c. metal

37. Always keep the halide "sniffer" below the spot of a suspected leak because refrigerant is _____ than air.

    a. heavier
    b. lighter
    c. thinner

38. When _____ amount of halogen refrigerant reaches the heated copper element of a halide torch, the clear looking flame will present a definite change of color to indicate a leak.

    a. a large
    b. even a tiny
    c. the proper

Objective 8

Select word(s) to complete statements concerning leak testing with refrigerant additives.

39. Leaks may be located by adding an additive such as a colored dye or a fluorescent additive to the _____ in the system.

    a. oil
    b. nitrogen
    c. refrigerant

40. Refrigerant dye in a system produces a bright red color at the point of leakage; but may take up to ____ hours to indicate leaks.

    a. 12
    b. 2
    c. 24

41. When a fluorescent additive is used the leak is found by scanning the system with a(n) _____ light.

    a. ultraviolet
    b. fluorescent
    c. incandescent

Objective 9

Select whether statements concerning leak testing with electronic leak detectors are true or false.

42. Three commonly used types of electronic leak detectors are electrochemical sensor, dielectric and ultrasonic.

    a. True
    b. False

43. Both the electrochemical sensor and ultrasonic leak detectors operate using transistorized circuitry powered by batteries and are available in models sensitive to many types of refrigerants.

    a. True
    b. False

44. The electronic leak detector is turned on, allowed to warm up and adjusted in a normal atmosphere in preparation for using.

    a. True
    b. False

45. The electronic leak detector probe is passed slowly around components suspected of leaking and if even a tiny bit of refrigerant is drawn into the probe the detector will emit a piercing sound or a light will flash or both.

    a. True
    b. False

46. Position the electronic leak detector probe above suspected areas if possible because the refrigerant is lighter than air and will drift upward.

    a. True
    b. False

47. Electronic leak detector probes must be kept clean and on some models a small filter in the tip must be changed regularly.

    a. True
    b. False

48. Ultrasonic leak detectors use headphones and a portable, hand held detector which detects sound waves within the range of human hearing.

    a. True
    b. False

49. Ultrasonic leak detectors detect the sound of the vapor as it escapes from the pressurized system and emit a signal.

    a. True
    b. False

Objective 10

Select whether statements concerning why refrigeration systems require evacuation are true or false.

50. Through leaks, improper charging, or during repairs, moisture and noncondensable gases can enter a refrigeration system and accelerate system wear, cause poor performance, and lead to system breakdown.

    a. True
    b. False

51. A major objective of evacuation is to dehydrate the system, to take all the moisture out of the system to keep it from causing compressor damage or causing ice crystals to form at the evaporator and stop system operation.

    a. True
    b. False

52. Getting moisture out of the system prevents moisture from combining with refrigerants to form both hydrochloric and hydrofluoric acuds which accelerate wear on all metal parts, especially compressors.

    a. True
    b. False

53. Removing moisture also prevents the creation of sludge which forms when a mixture of refrigerant oil and moisture is heated.

    a. True
    b. False

54. Another major objective of evacuation is to remove noncondensable gases, especially air, from the system to help avoid accelerated corrosion, acid formation, and sludge that can damage a compressor and dimish system efficiency.

    a. True
    b. False

55. Air in a system should be removed, but a small amount of air will not decrease performance.

    a. True
    b. False

56. Still another objective of evacuation is to remove refrigerant that can become entrapped in the oil.

    a. True
    b. False

57. Evacuation properly accomplished prepares a system for pressurizing, leak testing, and charging with reasonable assurance that the system will operate leak free at maximum efficiency.

    a. True
    b. False

58. Evacuation should not be used as a means of checking a system for leaks.

    a. True
    b. False

Objective 11

Select the correct word(s) to complete statements concerning pressure/temperature requirements for dehydration.

59. Water cannot be removed from a system in liquid form so it has to be _____ before it can be removed.

    a. cooled
    b. heated
    c. vaporized

60. Evaporation can be accomplished by heating the system or portions of the system or by _____ the pressure to an evaporation point, or both.

    a. raising
    b. vaporizing
    c. lowering

61. A common _____ drier can be used to heat a coil to evaporate moisture, and in a combination heating/cooling unit, the heater can be used to raise coil temperature.

    a. defrost
    b. hair
    c. clothes

62. In a commercial refrigeration system, heating in order to evaporate moisture can be accomplished by energizing the _____ cycle, if the system uses electric defrost.

    a. compressor
    b. heat pump
    c. defrost

63. Evacuating the system to a sufficient level _____ atmospheric pressure will lower the boiling or evaporation point of water in the system to the temperature of the system itself.

    a. above
    b. below
    c. around

64. To measure pressures below atmospheric pressure, or zero psig, use inches of mercury, "hg, millimeters of mercury, mm hg, or _____".

    a. microns
    b. degrees
    c. PSIG

65. Knowing the evaporation temperature of _____ at various pressures is essential to proper dehydration, and a good vacuum/ temperature chart will have the information.

    a. refrigerant
    b. nitrogen
    c. H_2O (water)

66. Once the temperature of the system, or the temperature of _____ the part of the system has been measured, that temperature can be located on the chart and guide a technician to the desired evacuation level.

    a. freezing
    b. coldest
    c. warmest

Objective 12

Select whether statements concerning the use and care of vacuum pumps are true or false.

67. Evacuation is accomplished with a vacuum pump rated as a high- or a low-vacuum pump depending on the depth of vacuum it can pull.

    a. True
    b. False

68. A low-vacuum pump is a two-stage pump, usually a hermetic type, and rated at 1 cfm or less.

    a. True
    b. False

69. A high-vacuum pump is generally a two-stage pump, may have a directcoupling drive or be driven by a belt, and is rated at 1 to 5 cfm.

    a. True
    b. False

70. To assure long life of a vacuum pump, change the pump oil after ever third or fourth evacuation.

    a. True
    b. False

71. When not in use, keep caps on the outlet and inlet ports, and discharge refrigerant through an evaucation pump very slowly.

    a. True
    b. False

72. To check the operation of a vacuum pump, see how deep a vacuum the pump can pull on itself; a low-vacuum pump should pull 29″ hg, and a high-vacuum pump should pull a vacuum of 100 microns.

    a. True
    b. False

73. The amount of time it takes to reach the reach the required vacuum is related to both pump displacement and the size of the connecting line between the pump and the system.

    a. True
    b. False

Objective 13

Select the correct word(s) to complete statements concerning the use and care of vacuum measuring equipment.

74. _____ piece of equipment for measuring a vacuum is the compound gauge on a technician's manifold gauge set.

    a. The most commonly used
    b. A frequently used

75. The compound gauge can accurately measure a vacuum to _____ but there are service situations where the compound gauge should not be used as the sole indicator of the level of vacuum.

    a. 28″ to 29″ hg
    b. 29.9″ hg

76. Vacuums _____ 29.8″ hg should be measured in microns, and this is accomplished with a micron gauge.

    a. above
    b. below

77. Micron gauges are either of a _____ type or electronic, but in either case, they are expensive and should be handled with care.

    a. thermocouple
    b. thermometer

Objective 14

Select whether statements concerning using/reading a micron gauge are true or false.

78. A micron gauge is an electronic instrument used to measure vacuum, and is popular because it is small and can be hooked up directly to the system or to a vacuum pump.

    a. True
    b. False

79. Some micron gauges are hand-held and require no auxiliary power because they have an on-board battery.

    a. True
    b. False

80. To read a micron gauge, hook it up, turn it on, and check the color-coded LED display for the vacuum level; it will record effectively form 5,000 microns to 2,000 microns.

    a. True
    b. False

81. Keep the mincron gauge in its cover in a secure spot in your took kit when it is not in use because it is an expensive instrument.

    a. True
    b. False

Objective 15

Select the correct word(s) to complete statements concerning guidelines for evacuation.

82. Evacuation of a system should not begin until the _____ of the system has been verified; verifying system _____ means leaks have been repaired, the system has been pressurized and leak tested, and the pressurizing gas has been removed.

    a. integrity
    b. center
    c. pressure

83. Attach a manifold gauge set to the system with the _____ hose attached to the evacuation equipment.

    a. center
    b. left
    c. right

84. Measure the temperature of the system, and use a vacuum table to determine the vacuum required to _____ the moisture in the system.

    a. vacuum
    b. vaporize
    c. condense

85. Measure system _____ with a micron gauge.

    a. pressure
    b. vacuum
    c. vapor

86. If a manifold gauge set is attached to both the high and low sides of the system and you want a verifying vacuum measurement from a micron gauge or a manometer, use a _____ off one of the service ports to make the hook up.

    a. tee
    b. connection
    c. hose

87. Begin evaucation through the _____ side of the system until you reach 5˝ hg, and then evacuate through the side.

    a. high/low
    b. low/high

88. If the evacuation equipment will not permit a deep evacuation to at least 500 microns, you should double or triple evacuate the system, and the system may also require _____.

    a. cooling
    b. warming

89. If you reach a level of 500 microns, continue to evacuate for at least _____ minutes more to assure that the system has all of the air and gases removed and is completely dehydrated.

    a. 20
    b. 30
    c. 10

90. In all cases, the vacuum level must be low enough to vaporize moisture at the temperature of the _____ part of the system.

    a. warmest
    b. coolest
    c. lowest

91. To assure that moisture levels are reduced to acceptable levels, use double or triple evacuation and insert dry _____ after each evacuation.

    a. nitrogen
    b. oxygen
    c. refrigerant

92. After reaching a final vacuum it is good procedure to allow the system to stand for at least _____ minutes to verify that there are no leaks or moisture present.

    a. 10
    b. 25
    c. 15

93. If the vacuum level changes more than a _____ microns the system probably still contains moisture or a leak is allowing air to enter the system; the evacuation procedure has to be repeated.

    a. thousand
    b. few hundred
    c. hundred

94. If the vacuum holds for at least _____ minutes, the system is ready for charging.

    a. 15
    b. 30
    c. 20

Objective 16

Select whether statements concerning guidelines for charging a system are true or false.

95. Overcharging or undercharging a system can cause many problems; always follow manufacturer recommendations for charging as closely as possible.

    a. True
    b. False

96. Manufacturers provide charts or calculators for determining system charge or charts to measure minimum performance; you should use the manufacturer recommended method if these are available.

    a. True
    b. False

97. Manufacturers' recommended procedures for system charging will require reading any or all of the outdoor or ambient dry bulb temperature, the indoor wet bulb temperature, suction line temperature, liquid line temperature and the system pressures; then refer to the appropriate manufacturer provided chart or table.

    a. True
    b. False

98. In systems using fixed metering devices manufacturers will usually recommend using superheat in some manner to determine proper refrigerant charge.

    a. True
    b. False

99. In systems using thermostatic expansion valves manufacturers will recommend using subcooling in some manner to determine proper refrigerant charge.

    a. True
    b. False

100. If you can determine the exact weight of the refrigerant required, the most accurate method for charging a system is by weight.

    a. True
    b. False

101. The weight of the required refrigerant charge should be available on the system data plate or in the manufacturer's installation instructions.

    a. True
    b. False

102. For small appliances or package type systems that hold 5 pounds of refrigerant or less, a less accurate method of charging is to measure weight by volume using a charging cylinder.

    a. True
    b. False

103. The weight by volume charging method with a charging cylinder can also be used for small split systems if you can determine the approximate amount of refrigerant required.

    a. True
    b. False

104. A refrigerant charge can be weighed into the system using a good set of mechanical or digital scales which are also necessary to measure how much refrigerant to bill the customer for.

a. True
b. False

105. When manufacturer instructions, charts or tables are not available, charging may be done fairly accurately for thermostatic expansion valve systems by using a sight glass, or for fixed metering device systems by using a standard superheat charging chart.

a. True
b. False

106. Regardless of the method used for charging, keep records for customer billing and EPA requirements, and tag the equipment with service information that service technicians can reference in the future.

a. True
b. False

Objective 17

Select whether statements concerning charging with a portable charging cylinder are true or false.

107. Charging cylinders measure weight by volume and it is important to select a charging cylinder calibrated for the type of refrigerant used.

a. True
b. False

108. Charging cylinders come in various sizes, and it is important to select a size that will permit you to read the largest increments of weight; in other words, select a cylinder that will measure pounds and ounces or ounces and increments of ounces.

a. True
b. False

109. Some charging cylinders are equipped with built in heaters that will raise the pressure of the refrigerant charge in order to vaporize the refrigerant for slower charging.

a. True
b. False

110. A charging cylinder should be calibrated for the specific refrigerant being used and for the pressure it will be under, and then the cylinder can be filled to an exact amount by monitoring the level in the clear tube that runs up the side of the cylinder.

a. True
b. False

111. Vapor charge from the valve in the top of the charging cylinder and liquid charge from the valve in the bottom of the cylinder.

a. True
b. False

Objective 18

Select the correct word(s) to complete statements concerning charging with scales.

112. Scales selected to weigh refrigerant must be approved by the Bureau of Weights and Measures if the scales are used to determine the cost to a customer; bathroom scales _____

a. are just fine.
b. are not accurate enough.
c. must be calibrated.

113. Electronic scales are _____ and will measure to tenths or even hundredths of a pound.

a. very accurate
b. very fragile
c. not very accurate

114. When charging with scales place refrigerant drum on the scales, hook all hoses and gauges to the drum and to the equipment and then calibrate the scales to _____ if that option is available, if not then simply read the scales.

a. 50
b. 15
c. 0

115. If charging with scales that do not have a 0 calibration option, calculate what the scales will read when the system is charged by subtracting the system charge from the _____.

a. initial scale reading
b. final scale reading
c. nameplate reading

116. When using charging scales that have a 0 calibration option add refrigerant to the system while watching the scales and shut the drum off when the scale shows that the _____ has been added to the system.

a. approximate system charge
b. calculated ending weight
c. exact system charge

117. When using charging scales that do not have a 0 calibration option add refrigerant to the system while watching the scales and shut the drum off when the _____ is reached.

a. approximate system charge
b. calculated ending weight
c. exact system charge

Objective 19

Select the correct word(s) to complete statements concerning using a sight glass for charging.

118. On systems with a thermostatic-type expansion valve, the sight glass shows the condition of the refrigerant reaching the _____.

a. vapor
b. liquid
c. thermostat
d. metering device

119. When a sight glass or liquid indicator shows bubbles, it may mean the system _____.

a. is low on refrigerant
b. has too much refrigerant
c. is full
d. has too much vapor

120. To charge a system by using the sight glass simply add refrigerant until the sight glass is _____, which indicates that only liquid is reaching the metering device.

a. empty
b. full
c. clear
d. frothy

121. When charging by sight glass care must be taken not to _____ the system, if you continue to add refrigerant after the sight glass clears you could very easily add too much.

a. undercharge
b. overcharge
c. fill
d. pressurize

Objective 20

Select the correct word(s) to complete statements concerning charging with a superheat charging chart.

122. About the only time you might resort to using a superheat charging table is when _____.

a. you know the system holds less than a 5 lb. charge.
b. the system has an orifice or capillary tube and you can find no charging guidelines
c. the manufacturer's charging guidelines are not available.

123. To use a superheat charging table effectively you have to be able to _____.

a. measure ambient temperature at the condenser.
b. measure ambient temperatures at the condenser and the suction line temperature, and also measure pressure at the suction line.
c. measure temperature at the suction line first and then ambient temperature at the condenser.

Objective 21

Select the correct word(s) to complete statements concerning special considerations for liquid and vapor charging.

124. Adding refrigerant to a system which already contains some refrigerant is almost always accomplished with a vapor charge fed into the _____ pressure side of the system while the system is running.

a. high
b. low

125. Adding refrigerant blends to a system which already contains some refrigerant may not be advisable because of their tendency to _____; check manufacturer recommendations.

a. fractionate
b. glide

126. Refrigerant blends should always be taken from the refrigerant cylinder as a liquid; they can then be metered into the low side of the system or added as a _____ into the liquid line or receiver.

a. vapor
b. liquid

127. Take care to never add liquid refrigerant to the _____ side of a system; the liquid can severely damage or ruin the compressor.

a. low
b. high

128. Refrigerant can be added to the system in _____ form through the liquid line by using a charging cylinder or some means of raising the pressure of the refrigerant above the nonoperating pressure in the system.

a. liquid
b. vapor

129. Without raising the refrigerant pressure above the static pressure of the system, liquid charging is _____, and if attempted at all, should be done with extreme caution.

a. very time consuming
b. too fast for safe monitoring

Objective 22

Select whether statements concerning keeping charging records are true or false.

130. Keep track of the amount of refrigerant used to charge a system so the customer can be sent an accurate bill; good records also assure compliance with EPA regulations that require a business to keep track of refrigerant it uses.

a. True
b. False

131. The service date, type of refrigerant, and amount of the charge placed in the system should be recorded on a tag and left with the customer to assure that the next service technician will have accurate information to work with.

a. True
b. False

132. Other technical information that needs to be recorded and kept on file includes:
(1) Air/water temperatures in and out of the evaporator.
(2) Air/water temperatures in and out of the condenser.
(3) Suction and liquid line pressures, if access is available. (4) Suction line and liquid line temperatures.

a. True
b. False

133. Good records help a company build a life history of a system so that service can be accomplished faster, better, and at less expense to the customer; it is that part of the ACR business that builds image and prestige.

a. True
b. False

Answers to Written Test

1. b
2. b
3. b
4. a
5. b
6. a
7. a
8. a
9. b
10. a
11. a
12. a
13. a
14. a
15. b
16. b
17. b
18. b
19. a
20. a
21. c
22. a
23. a
24. b
25. b
26. a
27. b
28. a
29. a
30. b
31. a
32. a
33. b
34. b
35. c
36. a
37. a
38. b
39. a
40. c
41. a
42. a
43. b
44. a
45. a

Answers to Written Test

46. b
47. a
48. b
49. a
50. a
51. a
52. a
53. a
54. a
55. b
56. a
57. a
58. b
59. c
60. c
61. b
62. c
63. b
64. a
65. c
66. b
67. a
68. b
69. a
70. b
71. b
72. a
73. a
74. a
75. a
76. b
77. a
78. a
79. a
80. b
81. a
82. a
83. a
84. b
85. b
86. a
87. a
88. b
89. a
90. b
91. a
92. c
93. b
94. a

95. a
96. b
97. a
98. a
99. b
100. a
101. a
102. b
103. b
104. a
105. a
106. a
107. a
108. b
109. b
110. a
111. a
112. b
113. a
114. c
115. a
116. c
117. b
118. d
119. a
120. c
121. b
122. b
123. b
124. b
125. a
126. b
127. a
128. a
129. a
130. a
131. b
132. a
133. a