



MECHANICAL CONTRACTORS GENERAL TRADE KNOWLEDGE EXAMINATION CONTENT INFORMATION

Revised for August 2017

The Mechanical General Trade Knowledge Examination is composed of 130 questions. It will be administered in one session via computer in the calm atmosphere of one of our convenient testing centers at a time of your choosing..

The examination will have questions relating to the following content areas and necessary knowledge for each area includes:

- reading and interpreting plans and specifications
- reading and interpreting codes
- basic mathematics (addition, subtraction, multiplication, division, calculations of area and volume, fractions, decimals, percentages, calculating the sides of triangles, square roots, powers of numbers, and solving simple algebraic equations for unknown variables)

You should be prepared to respond to examination questions on any of the content areas listed. Questions asked and content areas tested on previous examinations should not be assumed to be the only possible questions to be asked or content areas to be tested on this examination.

The percentage of questions shown for each content area may vary by as much as plus or minus three (3) percent. Please refer to the Candidate Information Brochure and the Reference List for additional information.

Content Area A **9%** **Pre-Installation and Design Engineering**

- 1. Reading and interpreting plans and specifications**
knowledge of symbols
knowledge of scales
- 2. Recommending changes to plans and specifications**
knowledge of equipment costing
knowledge of equipment efficiency
knowledge of design requirements
- 3. Recommending different types of equipment**
knowledge of equipment costing
knowledge of effects on equipment efficiency
knowledge of heating and cooling loads
knowledge of seasonally adjusted and energy efficiency ratio
knowledge of air flow and duct design
knowledge of psychrometric diagrams
knowledge of pump curves
knowledge of fan curves
- 4. Applying energy conservation principles**
knowledge of effects on equipment efficiency
knowledge of Florida energy codes
knowledge of seasonally adjusted energy efficiency ratio
knowledge of pump curves
knowledge of fan curves
- 5. Discussing EER and SEER with owners and architects**
knowledge of EER and SEER calculations
knowledge of Florida energy codes
knowledge of Florida Building Energy Rating System
knowledge of ARI listings
knowledge of cost analysis and cost effectiveness

6. Determining material and equipment live load requirements

knowledge of weights of materials
knowledge of structural capabilities
knowledge of rigging

7. Designing HVAC systems (Heating, Ventilation, Air Conditioning)

knowledge of equipment efficiency
knowledge of psychrometrics
knowledge of heating and cooling loads
knowledge of seasonally adjusted and energy efficiency ratio
knowledge of pressure and enthalpy relationship (diagrams)
knowledge of air flow and duct design
knowledge of pipe sizing
knowledge of wiring requirements, procedures and techniques
knowledge of types of controls and requirements
knowledge of refrigeration requirements

8. Designing duct systems

knowledge of air flow and duct design
knowledge of insulation requirements

9. Determining proper HVAC equipment (Heating, Ventilation, Air Conditioning)

knowledge of manufacturer's equipment
knowledge of proper sizing
knowledge of loads
knowledge of psychrometrics
knowledge of proper locations of equipment
knowledge of codes

10. Determining proper pipe sizes

knowledge of pipe sizing tables
knowledge of valves and fittings
knowledge of liquid flow
knowledge of resistance to flow and friction losses

11. Determining proper control requirements

knowledge of wiring requirements and procedures and techniques
knowledge of types of control and requirements
knowledge of air conditioning equipment
knowledge of refrigeration equipment

12. Determining proper fan motor requirements

knowledge of wiring requirements, procedures and techniques
knowledge of fans
knowledge of fan motors
knowledge of fan performance and CFM

13. Determining proper pipe insulations

knowledge of heating and cooling loads
knowledge of R and U factors
knowledge of insulating techniques and requirements

14. Determining proper compressor capacities

knowledge of heating and cooling loads
knowledge of refrigeration requirements

15. Designing grease handling duct systems

knowledge of air flow and duct design
knowledge of sizing
knowledge of fan and motor capabilities
knowledge of filter requirements
knowledge of fire and building codes
knowledge of fire codes
knowledge of requirements for installing ansul system

16. Unloading, lifting and lowering materials

knowledge of safety requirements
knowledge of loading and lifting equipment
knowledge of rigging techniques and requirements

17. Designing mechanical systems

knowledge of safety requirements
knowledge of fire codes
knowledge of pump capacities and installation requirements
knowledge of tank capacities and installation requirements
knowledge of insulation requirements
knowledge of boiler installation requirements
knowledge of pressure requirements
knowledge of gauges installation requirements

18. Determining proper mechanical equipment

knowledge of fire codes
knowledge of safety requirements
knowledge of sprinkler and standpipe requirements
knowledge of design requirements

- 19. Determining proper pump requirements**
knowledge of pump types, capacities, and requirements
knowledge of fluid flow
- 20. Determining proper boiler requirements**
knowledge of boiler requirements
knowledge of pressure requirements
knowledge of steam properties
knowledge of fuel gas requirements
knowledge of fuel oil requirements
- 21. Layout and determining pipes, valves, fittings, and related components**
knowledge of pump types and requirements
knowledge of valve and fitting types and requirements
knowledge of tank sizing
knowledge of fluid flow
knowledge of pipe fitting
knowledge of metal pipe requirements
knowledge of plastic pipe requirements
- 22. Determining appropriate pipe sealants**
knowledge of welding
knowledge of pipe fitting
knowledge of metal pipe properties
knowledge of plastic pipe properties
- 23. Complying with piping plans and specifications**
- 24. Determining size and capacity of vents**
knowledge of fire codes
knowledge of sprinkler and standpipe codes

Content Area B **9%**
Ductwork and HVAC Materials

- 1. Fabricating rectangular ducts under 2 ft**
knowledge of sheet metal duct
knowledge of fiberglass duct
knowledge of flex duct
knowledge of duct fittings
knowledge of duct outlets and grilles
- 2. Fabricating rectangular ducts over 2 ft.**
knowledge of sheet metal duct
knowledge of fiberglass duct
knowledge of duct fittings
knowledge of duct outlets and grilles

- 3. Fabricating round ducts**
knowledge of sheet metal duct
knowledge of duct fittings
knowledge of duct outlets and grilles
knowledge of flex duct
knowledge of duct socks
- 4. Taping duct seams**
knowledge of sheet metal duct
knowledge of fiberglass duct
knowledge of flex duct
knowledge of duct fittings
knowledge of duct outlets and grilles
knowledge of mastics and tape
- 5. Fabricating standing seams for sheet metal ducts**
knowledge of duct fittings
knowledge of sheet metal duct
- 6. Fabricating snap lock seams for sheet metal ducts**
knowledge of duct fittings
knowledge of sheet metal duct design requirements
- 7. Fabricating interior lined sheet metal ducts**
knowledge of duct fittings
knowledge of sheet metal duct design requirements
- 8. Fabricating fittings for rectangular ducts**
knowledge of duct fittings
knowledge of sheet metal duct
- 9. Fabricating fittings for round ducts**
knowledge of duct fittings
knowledge of sheet metal layout
- 10. Fabricating locks and seams**
knowledge of duct fittings
knowledge of sheet metal duct
- 11. Fabricating kitchen hoods**
knowledge of codes
knowledge of sheet metal layout
- 12. Fabricating kitchen hood exhausts**
knowledge of codes
knowledge of sheet metal layout

Content Area C **12%**
Installation of Refrigeration and HVAC Systems

1. Installing split system air conditioners

knowledge of duct fittings
knowledge of sheet metal duct
knowledge of air handlers
knowledge of refrigerant piping
knowledge of insulation requirements
knowledge of thermostats
knowledge of heat strips
knowledge of condensate piping
knowledge of condensate overflow protection

2. Installing package system air conditioners

knowledge of refrigeration cycle
knowledge of thermostats
knowledge of heat strips
knowledge of condensate piping
knowledge of condensate overflow protection

3. Installing split system heat pumps

knowledge of refrigeration cycle
knowledge of condensers
knowledge of air handlers
knowledge of refrigerant piping
knowledge of insulation
knowledge of thermostats
knowledge of heat strips
knowledge of condensate piping
knowledge of condensate overflow protection
knowledge of fire stats

4. Installing package heat pumps

knowledge of refrigeration cycle
knowledge of heat pump installation requirements
knowledge of thermostats
knowledge of heat strips
knowledge of condensate piping
knowledge of condensate overflow protection
knowledge of fire stats

5. Installing air-cooled systems

knowledge of air-cooled condensers
knowledge of air-cooled system installation requirements

6. Installing water-cooled systems

knowledge of water-cooled condensers
knowledge of water-cooled system installation requirement

7. Installing secondary coolant systems

knowledge of secondary coolant condensers

8. Installing chilled water (or other temperature) systems

knowledge of hydronics
knowledge of release vents
knowledge of air separators

9. Installing water towers

knowledge of evaporative cooling
knowledge of water tower principles forced drag and induced draft
knowledge of secondary coolant condensers

10. Installing systems under 25 tons

knowledge of installation techniques for system and associated components
knowledge of dead loads
knowledge of controls
knowledge of wiring procedures and techniques
knowledge of compressor capacities

11. Installing systems between 25 - 100 tons

knowledge of installation techniques for system and associated components
knowledge of dead loads
knowledge of wiring procedures and techniques
knowledge of compressor capacities

12. Installing systems over 100 tons

knowledge of installation techniques for system and associated components
knowledge of dead loads
knowledge of wiring procedures and techniques
knowledge of compressor capacities

13. Installing centrifugal compressor systems

knowledge of centrifugal compressors
knowledge of chilled water systems
knowledge of chilled water loops
knowledge of water chillers evaporators
knowledge of pipe fitting
knowledge of motor starters
knowledge of gauges
knowledge of valves and fittings

14. Installing absorption cycle systems

knowledge of absorption cycle
knowledge of absorption cycle refrigerants
knowledge of refrigerant piping

15. Installing ultra-low temperature systems

knowledge of multistage refrigeration
knowledge of cryogenics
knowledge of low temperature refrigerants
knowledge of refrigeration equipment
knowledge of refrigerant piping techniques

16. Installing low and medium temperature systems

knowledge of refrigeration equipment
knowledge of refrigerant piping techniques
knowledge of CFCs, HFCs, and blends
knowledge of refrigerant recovery and retrofit
knowledge of EPA regulations

17. Installing walk-in coolers

knowledge of refrigeration equipment
knowledge of evaporators
knowledge of expansion valves
knowledge of defrost equipment
knowledge of refrigerant piping
knowledge of controls

18. Installing reach-in coolers

knowledge of refrigeration equipment
knowledge of evaporators
knowledge of expansion valves
knowledge of defrost equipment
knowledge of refrigerant piping
knowledge of controls

19. Installing ventilation systems (duct work)

knowledge of air flow and duct design
knowledge of fire codes
knowledge of scale dimensions
knowledge of sheet metal duct
knowledge of fiberglass duct
knowledge of flex duct
knowledge of duct fittings
knowledge of duct outlets and grilles
knowledge of handling requirements

20. Installing pneumatic control systems

knowledge of control requirements
knowledge of pneumatic piping
knowledge of pneumatic controls

21. Installing ground water (geothermal) heat pumps

knowledge of water cooled condensers
knowledge of refrigeration cycle

22. Installing smoke detectors

knowledge of codes
knowledge of equipment

23. Installing exhaust systems (make-up air)

knowledge of fire codes
knowledge of air flow and duct design
knowledge of sheet metal duct
knowledge of fan and motor capacities

24. Installing grease handling duct systems

knowledge of fire codes
knowledge of air flow and duct design
knowledge of sheet metal duct
knowledge of filter requirements

25. Installing ammonia refrigerant systems

knowledge of absorption cycle
knowledge of ammonia as refrigerant

26. Installing kitchen exhaust systems

knowledge of air flow and duct design
knowledge of fan and motor capacities
knowledge of sheet metal fabrication
knowledge of national and local fire and building codes
knowledge of welding

27. Testing and balancing systems

knowledge of properties of air
knowledge of fans
knowledge of testing instruments
knowledge of duct systems
knowledge of register and grilles
knowledge of equations

28. Performing fire department required smoke tests

knowledge of properties of air
knowledge of fans
knowledge of duct systems
knowledge of codes

29. Installing DDC control systems

knowledge of control requirements
knowledge of DDC controls

Content Area D 14%
Installation of Mechanical Systems

1. Installing large mechanical systems

knowledge of scale dimensioning
knowledge of rigging requirements
knowledge of wiring requirements, procedures and techniques
knowledge of types of controls and requirements
knowledge of safety requirements
knowledge of pump capacities and requirements
knowledge of valves and fittings
knowledge of tanks
knowledge of insulation requirements and installation techniques
knowledge of boiler requirements and installation techniques
knowledge of pressures
knowledge of gauge installation requirements
knowledge of steam
knowledge of surveying and leveling equipment

2. Installing lift stations

knowledge of scale dimensioning
knowledge of pump capacities and installation requirements
knowledge of valves and fittings capacities and installation requirements
knowledge of gauge installation requirements
knowledge of earth moving and excavating
knowledge of surveying and leveling equipment
knowledge of pipe fitting

3. Installing gasoline handling systems

knowledge of pump installation requirements
knowledge of valves and fittings installation requirements
knowledge of tank installation requirements
knowledge of wiring requirements, procedures and techniques
knowledge of types of controls and requirements
knowledge of safety requirements
knowledge of electrolysis
knowledge of fuel oils
knowledge of fire codes
knowledge of pipe fitting
knowledge of fluid flow

4. Installing gaseous oxygen handling systems

knowledge of dangers of various chemicals and fluids
knowledge of pump installation requirements
knowledge of valves and fittings installation requirements
knowledge of tank installation requirements
knowledge of electrolysis
knowledge of types of controls and requirements
knowledge of fire codes
knowledge of pipe fitting
knowledge of fluid flow
knowledge of safety requirements

5. Installing other chemical systems

knowledge of dangers of various chemicals and fluids
knowledge of pump installation requirements
knowledge of valves and fittings installation requirements
knowledge of tank installation requirements
knowledge of electrolysis
knowledge of types of controls and requirements
knowledge of fire codes
knowledge of pipe fitting
knowledge of fluid flow
knowledge of safety requirements

6. Installing other fluid handling systems (gases and liquids)

knowledge of dangers of various chemicals and fluids
knowledge of pump capacities and installation requirements
knowledge of valves and fittings installation requirements
knowledge of tank installation requirements
knowledge of electrolysis
knowledge of types of controls and requirements
knowledge of fire codes
knowledge of pipe fitting
knowledge of fluid flow
knowledge of safety requirements
knowledge of temperature/pressure ratings for valves

- 7. Installing vacuum systems**
 - knowledge of vacuum pumps
 - knowledge of pump installation requirements
 - knowledge of valves and fittings installation requirements
 - knowledge of tank installation requirements
 - knowledge of types of controls and requirements
 - knowledge of safety requirements
 - knowledge of pipe fitting
- 8. Installing cathodic protection systems**
 - knowledge of electrolysis
 - knowledge of cathode and anode current flow
 - knowledge of corrosion
 - knowledge of metal capacities
- 9. Installing continuous monitoring systems**
 - knowledge of pressure requirements
 - knowledge of gauges
- 10. Installing line pressure monitoring systems**
 - knowledge of pollution control
 - knowledge of well drilling
 - knowledge of water chemistry
- 11. Installing gauging systems**
 - knowledge of gauges
- 12. Installing pre-engineered protection systems**
 - knowledge of DC current flow
 - knowledge of electrolysis
 - knowledge of cathode and anode current flow
- 13. Installing impressed current systems**
 - knowledge of cathode and anode current flow
 - knowledge of electrolysis
 - knowledge of DC current flow
- 14. Installing closed liquid and solar systems**
 - knowledge of solar system installation requirements
 - knowledge of pipe fitting
 - knowledge of metal pipe compatibility
 - knowledge of plastic pipe joining
 - knowledge of welding
 - knowledge of brazing
 - knowledge of pump capacities and installation requirements
 - knowledge of valves and fittings
 - knowledge of tank installation requirements
 - knowledge of insulation requirements

Content Area E **9%**
Installation of Refrigeration and HVAC Equipment and Components

- 1. Installing air-cooled condensers**
 - knowledge of wiring requirements and procedures and techniques
 - knowledge of air-cooled condenser characteristics
 - knowledge of metal pipe
 - knowledge of refrigerant piping
- 2. Installing water-cooled condensers**
 - knowledge of wiring requirements and procedures and techniques
 - knowledge of water tower characteristics
 - knowledge of water cooled condensers characteristics
 - knowledge of secondary coolant condensers
 - knowledge of metal pipe
 - knowledge of plastic pipe
 - knowledge of pipe fitting
 - knowledge of refrigerant piping
 - knowledge of all refrigerants
- 3. Installing hermetic and semi-hermetic compressors**
 - knowledge of wiring requirements, procedures and techniques
 - knowledge of compressor characteristics
 - knowledge of metal pipe
 - knowledge of refrigerant piping
 - knowledge of all refrigerants
- 4. Installing centrifugal compressors**
 - knowledge of wiring requirements, procedures and techniques
 - knowledge of centrifugal compressor characteristics
 - knowledge of types of refrigerants
 - knowledge of power requirements
 - knowledge of design operating pressures
 - knowledge of motor efficiency rating
 - knowledge of metal pipe fitting
 - knowledge of refrigerant piping

- 5. Installing air handlers and evaporators**
 - knowledge of wiring requirements, procedures and techniques
 - knowledge of metal pipe
 - knowledge of refrigerant piping
 - knowledge of all refrigerants
 - knowledge of control needs and requirements
 - knowledge of air handlers and characteristics
- 6. Installing fans and blowers**
 - knowledge of wiring requirements, procedures and techniques
 - knowledge of air flow and duct design
 - knowledge of fans
 - knowledge of fan motors
 - knowledge of air handlers
 - knowledge of condensers
- 7. Installing motors for fans and blowers**
 - knowledge of wiring requirements, procedures and techniques
 - knowledge of air flow and duct design
 - knowledge of fans
 - knowledge of fan motors
 - knowledge of air handlers
- 8. Installing sheet metal duct work**
 - knowledge of sheet metal duct
 - knowledge of duct fittings
 - knowledge of duct outlets and grilles
- 9. Installing fiberglass duct work**
 - knowledge of fiberglass duct
 - knowledge of duct fittings
 - knowledge of duct outlets and grilles
 - knowledge of duct hanging techniques and requirements
- 10. Installing other duct work (flexible)**
 - knowledge of air flex duct installation and fastening techniques
 - knowledge of duct fittings
 - knowledge of duct outlets and grilles
- 11. Installing grilles, registers and volume dampers**
 - knowledge of air flow and duct design
 - knowledge of duct outlets and grilles
- 12. Installing fire dampers and metal chimneys**
 - knowledge of fire codes
 - knowledge of fire dampers and metal chimney installation and fastening

- 13. Installing refrigerant piping**
 - knowledge of brazing
 - knowledge of refrigerant piping
 - knowledge of pipe fitting
 - knowledge of pipe hanging
 - knowledge of pipe sizing
- 14. Installing steel pipes**
 - knowledge of welding
 - knowledge of metal pipe
 - knowledge of pipe fitting
- 15. Installing steam and condensation piping**
 - knowledge of piping material required for different delivery systems
 - knowledge of characteristics of steam and condensation
 - knowledge of codes
- 16. Installing plastic pipe and fittings**
 - knowledge of plastic pipes and fittings
 - knowledge of different grades of pipe
 - knowledge of pressure testing
 - knowledge of safety codes
 - knowledge of joining materials
 - knowledge of cleaning and gluing materials
- 17. Installing horizontally supported piping**
 - knowledge of weights of materials
 - knowledge of structural capabilities
 - knowledge of hangers
 - knowledge of supports
- 18. Installing flues**
 - knowledge of sheet metal duct installation techniques
 - knowledge of duct fittings
 - knowledge of gas codes
- 19. Installing air filters**
 - knowledge of air filter installation techniques
- 20. Installing warm air appliances (heaters)**
 - knowledge of heater installation techniques
 - knowledge of wiring procedures and techniques
 - knowledge of fire codes
- 21. Installing gas appliances**
 - knowledge of fuel gases
 - knowledge of gas appliances
 - knowledge of controls installation
 - knowledge of wiring procedures and techniques
 - knowledge of gas codes

22. Installing fuel oil appliances

knowledge of fuel oils
knowledge of fuel appliance installation technique
knowledge of types of controls and requirements
knowledge of wiring requirements, procedures and techniques

23. Installing heat exchangers

knowledge of heat transfer
knowledge of controls installation
knowledge of wiring requirements, procedures and techniques

24. Installing receivers

knowledge of receivers
knowledge of refrigerant piping
knowledge of local codes

25. Installing heat strips

knowledge of wiring requirements, procedures and techniques
knowledge of heat strips
knowledge of fire stats
knowledge of fire codes

26. Installing copper tubing and fittings

knowledge of copper tubing
knowledge of refrigerant piping
knowledge of brazing
knowledge of pressure testing

27. Installing other tubing or fittings

knowledge of metal pipe
knowledge of welding
knowledge of brazing
knowledge of pressure testing

28. Welding and brazing copper tubing

knowledge of welding
knowledge of copper tubing

29. Silver brazing copper to steel joints

knowledge of welding
knowledge of copper tubing
knowledge of metal pipe

30. Flaring copper tubing

knowledge of copper tubing
knowledge of flaring tools

31. Soft soldering copper tubing

knowledge of brazing
knowledge of copper tubing

32. Soldering swaged joints

knowledge of brazing
knowledge of copper tubing
knowledge of metal pipe
knowledge of swaying tools

33. Welding metal with filler rods

knowledge of metal pipe
knowledge of welding

34. Threading pipes

knowledge of pipe fitting
knowledge of metal pipe

35. Cutting mild steel with oxy-acetylene torches

knowledge of oxy-acetylene torches
knowledge of metal pipe characteristics

36. Installing refrigerant tubing under 2 inches

knowledge of brazing
knowledge of copper tubing
knowledge of flaring tools
knowledge of swaying tools
knowledge of copper fittings
knowledge of oxy-acetylene torches

37. Installing refrigerant tubing 2 inches or over

knowledge of brazing
knowledge of copper tubing
knowledge of flaring tools
knowledge of swaying tools
knowledge of oxy-acetylene torches
knowledge of copper fittings

38. Installing refrigerant metering devices

knowledge of expansion valves
knowledge of capillary tubes
knowledge of brazing
knowledge of copper tubing

39. Installing heat pump reversing valves

knowledge of reversing valves
knowledge of copper tubing
knowledge of low-voltage wiring

40. Installing thermostatic expansion valves

knowledge of expansion valves
knowledge of copper tubing

41. Installing capillary tube metering devices

knowledge of capillary tubes
knowledge of copper tubing

42. Installing liquid line dryers and filters

knowledge of dryer and filters
knowledge of copper tubing
knowledge of vacuum systems
knowledge of refrigerant recovery

43. Installing suction line dryers and filters

knowledge of dryers and filters
knowledge of copper tubing
knowledge of vacuum systems
knowledge of refrigerant recovery

44. Installing heat pump line dryers and filters

knowledge of dryers and filters
knowledge of copper tubing
knowledge of vacuum systems
knowledge of refrigerant recovery

45. Installing oil traps

knowledge of oil traps
knowledge of copper tubing

46. Installing bellows-type temperature controls

knowledge of control requirements
knowledge of temperature requirements
knowledge of copper tubing
knowledge of bellows-type temperature controls

47. Installing chilled water low temperature controls

knowledge of low temperature control
knowledge of control requirements
knowledge of temperature requirements
knowledge of low-voltage wiring

48. Installing dual, high or low-pressure control switches

knowledge of high and low pressure control characteristics
knowledge of brazing
knowledge of copper tubing
knowledge of pressure requirements
knowledge of low-voltage wiring
knowledge of control installation techniques

49. Installing temperature controls

knowledge of temperature requirements
knowledge of pressure requirements
knowledge of control requirements
knowledge of low-voltage wiring

50. Installing oil-pressure safety control switches

knowledge of pressure requirements
knowledge of safety requirements
knowledge of pipe fitting
knowledge of control characteristics
knowledge of low-voltage wiring

51. Installing summer-winter switch-over controls

knowledge of low-voltage wiring
knowledge of temperature requirements
knowledge of control requirements

52. Installing thermostats

knowledge of low-voltage wiring
knowledge of temperature requirements
knowledge of control characteristics

53. Installing water regulating valves

knowledge of low-voltage wiring
knowledge of temperature requirements
knowledge of control requirements
knowledge of pressure requirements
knowledge of bellows type temperature controls
knowledge of water valves

54. Installing pressure regulators and strainers

knowledge of design pressure requirements
knowledge of control characteristics
knowledge of hot gas bypass

55. Installing humidity and thermostatic controls

knowledge of control characteristics
knowledge of calibration of controls
knowledge of low-voltage wiring
knowledge of manufacturer's recommendations

56. Installing pneumatic controls

knowledge of pneumatic piping
knowledge of pneumatic controls
knowledge of air compressors
knowledge of control requirements

57. Installing solid-state controls

knowledge of manufacturer's recommendations
knowledge of codes

58. Soldering electrical connections

knowledge of brazing
knowledge of electrical wiring procedures and techniques

59. Installing transformers

knowledge of electrical wiring procedures and techniques
ability to read wiring diagrams

60. Installing capacitors

knowledge of electrical wiring procedures and techniques

61. Installing contactors

knowledge of electrical wiring procedures and techniques

62. Installing current relays

knowledge of electrical wiring procedures and techniques

63. Installing safety disconnects

knowledge of electrical wiring procedures and techniques

64. Installing defrost timers

knowledge of electrical wiring procedures and techniques
knowledge of control requirements
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance

65. Installing defrost heaters

knowledge of electrical wiring procedures
knowledge of control requirements
knowledge of defrost operation

66. Installing defrost thermostats

knowledge of electrical wiring procedures and techniques
knowledge of control requirements
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical-relationship between current voltage and resistance

67. Installing air-pressure switches

knowledge of pneumatic piping
knowledge of pneumatic controls
knowledge of air compressors
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance

68. Installing electric humidistats

knowledge of electrical wiring procedures and techniques
knowledge of humidity control requirements
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance

69. Installing electronic air cleaners

knowledge of manufacturer's recommendations

70. Wiring three-phase equipment

knowledge of electrical wiring procedures and techniques
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance

71. Wiring single-phase equipment

knowledge of electrical wiring procedures and techniques
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance

72. Installing three-phase equipment

knowledge of electrical wiring procedures and techniques
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance

73. Installing single-phase equipment

knowledge of electrical wiring procedures and techniques

74. Installing capacitor start motors

knowledge of electrical wiring procedures and techniques
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance
knowledge of fan motors
knowledge of compressor requirements

75. Installing fan blades

knowledge of fans
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance

76. Installing shaded-pole motors

knowledge of electrical wiring procedures and techniques
knowledge of fan motors
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance

77. Installing split-phase motors

knowledge of electrical wiring procedures and techniques
knowledge of fan motors
knowledge of wiring diagrams
knowledge of placement of electrical wires
knowledge of electrical relationship between current voltage and resistance

78. Installing fan control switches

knowledge of electrical wiring procedures and techniques
knowledge of fan motors
knowledge of control requirements
knowledge of low-voltage wiring

79. Installing fan belts

knowledge of fans
knowledge of motor amperage requirements

80. Installing drive pulleys

knowledge of fans
knowledge of pulley ratios
knowledge of motor amperage requirements

81. Installing limit control switches

knowledge of control characteristics
knowledge of safety requirements

82. Installing hermetic compressor overload protectors

knowledge of electrical wiring procedures and techniques
knowledge of safety requirements

83. Installing solenoid coils

knowledge of electrical wiring procedures and techniques
knowledge of low-voltage wiring

84. Installing magnetic starters

knowledge of electrical wiring procedures and techniques

85. Installing starting relays

knowledge of electrical wiring procedures and techniques

86. Installing duty-motor protection devices

knowledge of electrical wiring procedures and techniques

87. Installing motor controllers

knowledge of motor controllers
knowledge of proper motor and overcurrent protection
knowledge of circuit breakers and fuses
knowledge of electrical wiring procedures
knowledge of controls

88. Installing of surge protectors

knowledge installation techniques
knowledge of surge protectors sizing

89. Installing of phase monitors

knowledge of PM installation
knowledge of PM sizing

90. Installing of geothermal systems

knowledge of sizing of geothermal loops
knowledge of loop types

Content Area F **14%**
Installation of Mechanical Equipment and Components

1. Installing gear reduction devices

knowledge of gear ratios
knowledge of motors for mechanical application
knowledge of anchoring

2. Installing lift station pumps

knowledge of pump requirements and installation techniques
knowledge of anchoring
knowledge of surveying and leveling equipment
knowledge of wiring requirements, procedures and techniques
knowledge of types of controls and requirements

3. Installing stand pipes

knowledge of valves and fittings
knowledge of pipe fitting
knowledge of sprinkler and standpipe codes
knowledge of welding
knowledge of brazing

4. Installing vacuum lines

knowledge of vacuum pumps
knowledge of pipe fitting
knowledge of pump installation techniques
knowledge of valves and fittings installation techniques

5. Installing oxygen lines

knowledge of dangers of various chemicals and fluids
knowledge of pump installation requirements
knowledge of valves and fittings
knowledge of pipe fitting
knowledge of metal pipe fitting
knowledge of fire codes
knowledge safety requirements

6. Installing nitrous oxide lines

knowledge of dangers of various chemicals and fluids
knowledge of valves and fittings
knowledge of pipe fitting
knowledge of metal pipe
knowledge of fire codes
knowledge of safety requirements

7. Installing ammonia lines

knowledge of dangers of various chemicals and fluids
knowledge of pump requirements
knowledge of valves and fittings
knowledge of pipe fitting
knowledge of fire codes
knowledge of safety requirements

8. Installing crude oil lines

knowledge of dangers of various chemicals and fluids
knowledge of pump requirements and installation techniques
knowledge of valves and fittings installation requirements
knowledge of pipe fitting
knowledge of metal pipe
knowledge of fire codes
knowledge of safety requirements
knowledge of EPA requirements

9. Installing other chemical lines

knowledge of dangers of various chemicals and fluids
knowledge of valves and fittings
knowledge of pipe fitting
knowledge of metal pipe
knowledge of fire codes
knowledge of safety requirements
knowledge of EPA requirements

10. Installing transmission lines

knowledge of dangers of various chemicals and fluids
knowledge of fuel oils
knowledge of pump installation requirements
knowledge of valves and fittings
knowledge of pipe fitting
knowledge of metal pipe
knowledge of EPA requirements

11. Performing tightness test for pipes

knowledge of pressure testing
knowledge of gauges

12. Determining storage pipe slopes

knowledge of surveying and leveling techniques

- 13. Installing double-wall pipes**
 - knowledge of pipe sizing
 - knowledge of pipe fitting
 - knowledge of earth moving and excavation equipment
 - knowledge of compaction equipment
- 14. Installing fiberglass pipes**
 - knowledge of pipe sizing
 - knowledge of pipe fitting
 - knowledge of earth moving and excavation equipment
 - knowledge of compaction equipment
- 15. Installing metal cathodic protected pipes**
 - knowledge of pipe sizing
 - knowledge of pipe fitting
 - knowledge of earth moving and excavation equipment
 - knowledge of compaction equipment
- 16. Installing isolation and contraction joints**
 - knowledge of coefficient of expansion
- 17. Installing dielectric fittings**
 - knowledge of corrosion
 - knowledge of electrolysis
 - knowledge of wiring requirements and procedures and techniques
- 18. Applying dielectric fittings**
 - knowledge of corrosion
 - knowledge of electrolysis
 - knowledge of coating requirements
 - knowledge of wiring requirements and procedures and techniques
- 19. Installing galvanic anodes**
 - knowledge of cathode and anode current flow
 - knowledge of electrolysis
 - knowledge of wiring requirements, procedures and techniques
- 20. Installing field-applied coatings**
 - knowledge of coating requirements
 - knowledge of coating techniques
 - knowledge of corrosion
- 21. Inspecting anodes and cathodic protection systems**
 - knowledge of cathode and anode current flow
 - knowledge of corrosion

Content Area G **9%**
Maintenance Analysis of Refrigeration and HVAC

- 1. Reading pressure and enthalpy diagrams for various refrigerants**
 - knowledge of pressure and enthalpy relationship
 - knowledge of reading pressure
 - knowledge of gauges
 - knowledge of refrigeration testing equipment
- 2. Reading and analyze electrical circuits**
 - knowledge of electrical wiring procedures and techniques
 - knowledge of low-voltage wiring
 - knowledge of electrical testing equipment
- 3. Testing current relays**
 - knowledge of electrical wiring procedures and techniques
 - knowledge of electrical testing equipment
- 4. Testing capacitors**
 - knowledge of electrical wiring procedures and techniques
 - knowledge of electrical testing equipment
- 5. Testing defrost thermostats**
 - knowledge of controls
 - knowledge of manufacturer's recommendations
- 6. Testing high-voltage transformers**
 - knowledge of electrical wiring procedures and techniques
 - knowledge of electrical testing equipment
- 7. Testing high-voltage relays**
 - knowledge of electrical wiring procedures and techniques
 - knowledge of electrical testing equipment
- 8. Testing low-voltage relays**
 - knowledge of low-voltage electrical wiring procedures and techniques
 - knowledge of electrical testing equipment
 - ability to utilize an amprobe
 - ability to utilize a vohm-meter
- 9. Testing magnetic starters**
 - knowledge of electrical wiring procedures and techniques
 - knowledge of electrical testing equipment

10. Testing potential relays

knowledge of electrical wiring procedures and techniques
knowledge of electrical testing equipment

11. Testing for appropriate motor terminals

knowledge of electrical wiring procedures and techniques
knowledge of electrical testing equipment

12. Determining operating pressures of a refrigeration or air conditioning system

knowledge of design pressure requirements
knowledge of refrigerant pressure gauges
knowledge of pressure and temperature relationships

13. Determining air volumes

knowledge of air flow and duct design
ability to utilize a velometer
ability to utilize a pitot tube
ability to utilize a manometer
ability to utilize a volume flow meter (flow hood)

14. Determining changes in enthalpy

knowledge of refrigeration testing equipment
knowledge of psychrometrics
ability to utilize a thermometer
ability to utilize a psychrometer

15. Determining wet bulb and dry bulb temperatures

knowledge of refrigeration testing equipment
knowledge of psychrometrics
ability to utilize a thermometer
ability to utilize a psychrometer

16. Determining current draws (amperage)

knowledge of electrical wiring procedures and techniques
knowledge of electrical testing equipment
ability to utilize an amprobe
ability to utilize a volt-ohm meter

17. Determining voltages

knowledge of electrical wiring procedures and techniques
knowledge of electrical testing equipment
ability to utilize an amprobe
ability to utilize a volt-ohm meter

18. Determining power consumption

knowledge of electrical wiring procedures and techniques
knowledge of electrical testing equipment

19. Determining working pressure in pipes

knowledge of pressure testing gauges
knowledge of access valves

20. Testing non-pressure type storage tanks

knowledge of tanks and pollution control

21. Using testing equipment (velometer, amprobe, volt-ohm meter, vacuum gauges, etc.)

knowledge of electrical testing equipment
knowledge of refrigeration testing equipment
knowledge of how and when to use

22. Using chlorine and halogen leak detecting devices

knowledge of refrigeration testing equipment
knowledge of how and when to use

Content Area H

5%

Maintenance Service of Refrigeration and HVAC

1. Using nitrogen regulators

knowledge of pressure regulators

2. Using other gas regulators

knowledge of pressure regulators

3. Repairing semi-hermetic compressors

knowledge of electrical wiring procedures and techniques
knowledge of mechanical methods and procedures

4. Repairing hermetic compressors

knowledge of electrical wiring procedure and techniques
knowledge of mechanical methods and procedures

5. Repairing centrifugal compressors

knowledge of electrical wiring procedure and techniques
knowledge of mechanical methods and procedures

- 6. Repairing blowers**
 knowledge of electrical wiring procedures and techniques
 knowledge of fans
 knowledge of fan motors
- 7. Calibrating air sensitive thermostats**
 knowledge of electrical wiring procedures and techniques
 knowledge of fans
 knowledge of fan motors
- 8. Calibrating chilled-water low temperature controls**
 knowledge of low temperature control
 knowledge of control requirements
 knowledge of low-voltage wiring
 knowledge of temperature requirements
 knowledge of refrigeration testing equipment
- 9. Calibrating dual or low pressure control switches**
 knowledge of high and low pressure controls
 knowledge of brazing
 knowledge of copper tubing
 knowledge of refrigeration testing equipment
- 10. Calibrating pneumatic controls**
 knowledge of pneumatic piping
 knowledge of pneumatic controls
 knowledge of air compressors
- 11. Calibrating proportional thermostats**
 knowledge of low-voltage wiring
 knowledge of temperature requirements
 knowledge of control requirements
 knowledge of refrigeration testing equipment
- 12. Calibrating summer-winter switch-over controls**
 knowledge of low-voltage wiring
 knowledge of temperature requirements
 knowledge of control requirements
 knowledge of refrigeration testing equipment
- 13. Adjusting thermostatic temperature controls**
 knowledge of low-voltage wiring
 knowledge of temperature requirements
 knowledge of control requirements
 knowledge of refrigeration testing equipment
- 14. Adjusting thermostatic motor controls**
 knowledge of low-voltage wiring
 knowledge of temperature requirements
 knowledge of control requirements
 knowledge of refrigeration testing equipment
 knowledge of electrical wiring procedures and techniques
- 15. Adjusting superheat setting on expansion valves**
 knowledge of expansion valves
 knowledge of control requirements
 knowledge of refrigeration testing equipment
 knowledge of superheat
- 16. Adjusting oil-pressure safety controls**
 knowledge of pressure
 knowledge of gauges
 knowledge of pipe fitting
 knowledge of control requirements
 knowledge of low-voltage wiring
 knowledge of refrigeration testing equipment
- 17. Adjusting temperature controls**
 knowledge of temperature requirements
 knowledge of pressure requirements
 knowledge of control requirements
 knowledge of low-voltage wiring
 knowledge of refrigeration testing equipment
- 18. Adjusting high pressure safety cutouts**
 knowledge of high and low temperature controls
 knowledge of electrical wiring procedures and techniques
 knowledge of low-voltage wiring
 knowledge of control operating requirements
 knowledge of refrigeration testing equipment
 knowledge of pressure gauges
- 19. Adjusting freezer controls**
 knowledge of control operating requirements
 knowledge of low-voltage wiring
 knowledge of temperature measurement
- 20. Adjusting defrost time clocks**
 knowledge of control requirements
 knowledge of low-voltage wiring
 knowledge of electrical wiring procedures and techniques
 knowledge of temperature measurement

- 21. Adjusting bellows-type temperature controls**
 knowledge of control requirements
 knowledge of temperature requirements
 knowledge of bellows-type temperature controls
 operating requirements
- 22. Operating oil safety control solid state pressure sensing devices**
 knowledge of pressure requirements
 knowledge of safety requirements
 knowledge of control operating requirements
 knowledge of low-voltage wiring
 knowledge of refrigeration testing equipment
- 23. Aligning drive pulleys**
 knowledge of mechanical alignment
- 24. Adjusting tension of v-belts**
 knowledge of how and when to adjust
- 25. Calibrating electric actuating valves**
 knowledge of mechanical operation requirements
 knowledge of refrigeration testing equipment
- 26. Calibrating electric humidistats**
 knowledge of humidity control requirements
 knowledge of control requirements
 knowledge of low-voltage wiring
 knowledge of refrigeration testing equipment
- 27. Reversing the rotation of three-phase or single-phase motors**
 knowledge of electrical wiring procedures and techniques
 knowledge of electrical testing equipment
- 28. Starting seized hermetic compressor motors**
 knowledge of electrical wiring procedures and techniques
 knowledge of electrical testing equipment
- 29. Adjusting crankcase pressure regulating valves**
 knowledge of pressure regulators
 knowledge of pressure measurement
 knowledge of evaporators
 knowledge of compressors

- 30. Adjusting evaporator pressure regulating valves**
 knowledge of pressure regulators
 knowledge of pressure measurement
 knowledge of evaporators
 knowledge of superheat
- 31. Adjusting unloaders**
 knowledge of pressure measurement (gauges)
 knowledge of effect of pressure on compressor capacity
- 32. Cleaning cooling towers**
 knowledge of cleaning chemicals
 knowledge of scale properties
 knowledge of water deposit controls
 knowledge of bleed-off
- 33. Cleaning foreign matter from systems**
 knowledge of cleaning chemicals
 knowledge of solvents
- 34. Cleaning water-cooled condensers**
 knowledge of cleaning chemicals
 knowledge of water-cooled condensers
 knowledge of organic water problems
- 35. Cleaning condensate drain lines**
 knowledge of safety switches
 knowledge of cleaning and adjusting techniques
 knowledge of repairing condensate drains
 knowledge of condensate pipe installation and traps

Content Area I **9%**
Safety and Equipment

- 1. Wearing hearing and head protection**
 knowledge of safety requirements
- 2. Installing warning signs and barricades**
 knowledge of safety requirements
 knowledge of lock-out/tag-out
- 3. Wearing eye and face protection**
 knowledge of safety requirements
- 4. Using respiratory protection**
 knowledge of safety requirements
- 5. Digging with backhoes, trenchers or tractors**
 knowledge of safety requirements

- 6. Using overhead hoists and cranes**
knowledge of safety requirements
knowledge of weights
knowledge of rigging
- 7. Using ventilation devices**
knowledge of safety requirements
knowledge of toxic materials
- 8. Using mobile equipment
(e.g., forklifts, hi-lifts and cranes)**
knowledge of safety requirements
knowledge of toxic materials
- 9. Using ladders, scaffolds and rolling
platforms**
knowledge of safety requirements
knowledge of assembly
- 10. Using various hand and power tools
(e.g., power shears, wrenches and snips)**
knowledge of safety requirements
knowledge of proper operation procedures
- 11. Using air compressors**
knowledge of safe operating pressures
knowledge of safety requirements

Content Area J **2%**
Excavating

- 1. Locating underground utilities**
knowledge of where to find information
knowledge of how to identify obstructions on plans and specifications
knowledge of when and how to notify the appropriate authority
knowledge of permissible working conditions
- 2. Coordinating and directing soil preparation**
knowledge of excavation
knowledge of soil composition
knowledge of soil testing procedures
- 3. Performing dewatering**
knowledge of pump
knowledge of well points
knowledge of piping
knowledge of soil permeability
knowledge of water table
knowledge of drawdown

- 4. Installing sheet pilings**
knowledge of soils
knowledge of stress
knowledge of wood and metal piling
- 5. Testing soil and ground water**
knowledge of excavation
knowledge of soil composition
knowledge of soil and water testing procedures
- 6. Determining locations of excavations**
knowledge of invert elevations
knowledge of basic surveying
- 7. Determining burial depths and slopes**
knowledge of excavation
knowledge of plans and specifications
knowledge of math
knowledge of surveying and leveling techniques

Content Area K **5%**
Energy Management

- 1. Conduct energy testing**
knowledge of duct pressure testing
knowledge of blower door tests
knowledge of the effects of the building envelope on the operations of the HVAC
- 2. Promote energy efficiency equipment**
knowledge of energy efficient equipment
knowledge of programmable and Wi-Fi enabled thermostats
knowledge of zoning system
knowledge of energy recovery ventilators (ERVs)
knowledge of cost analysis and cost effectiveness
knowledge of green buildings and renewable energy
- 3. Complete energy forms**
knowledge of energy form software
knowledge of building material efficiencies (R and U factors)
knowledge of how to calculate thermal resistance

4. Perform load calculations

- knowledge of building materials (R and U Factors)
- knowledge of window efficiencies (heat gain)
- knowledge of impact of outside air change requirements
- knowledge of Florida energy codes
- knowledge of heating and cooling load calculations
- knowledge of how to calculate thermal resistances

Content Area L

Indoor Air Quality

3%

1. Manage indoor air quality

- knowledge of UV bulbs
- knowledge of filter types
- knowledge of humidity control systems
- knowledge of air cleaners
- knowledge of air flows (test and balances)
- knowledge of effects of poor air quality on humans