*Correlation of*

***Modern Refrigeration and Air Conditioning,* by Althouse, Turnquist, Bracciano**
**(Goodheart-Willcox Publisher ©2021)**
**to**

# HVAC Excellence Competencies Task List: Commercial Refrigeration

The following chart correlates the *Modern Refrigeration and Air Conditioning* textbook (©2021) to an area of the HVAC Excellence Competencies Task List.

The chart lists individual competency and task standards, and the corresponding chapter numbers from *Modern Refrigeration and Air Conditioning*.

For more information on HVAC Excellence and related certifications, please visit: www.hvacexcellence.org.


| Competency / Task | Textbook Chapter(s) |
|---|---|
| **Students should have prior knowledge of:** | |
| Leak detectors | Chapters 10, 11 |
| The laws of thermodynamics | Chapters 4, 5, 6, 8, 50, 51, 53, 54 |
| Recovery and recycling processes | Chapters 9, 10, 11 |
| Refrigerant leak detection and types of leak detectors | Chapters 10, 11, 53, 54, 55 |
| Refrigerant piping | Chapters 8, 51, 52 |
| Soldering and brazing | Chapter 8 |
| Refrigerant types | Chapter 9 |
| System components such as:<br>Metering devices<br>Receivers<br>Pressure controls<br>Suction accumulators<br>Refrigerant flow and control valves | Chapters 6, 10, 11, 16, 18, 21, 22, 23 |

**Correlation of *Modern Refrigeration and Air Conditioning* to**
**HVAC Excellence Competencies Task List: Commercial Refrigeration—page 2**

| Competency / Task | Textbook Chapter(s) |
|---|---|
| Evacuation methods and equipment | Chapters 10, 11, 52, 55 |
| Refrigerant charging methods | Chapters 10, 11, 52, 55 |
| **Students must have knowledge of light commercial refrigeration systems, their components, and be able to demonstrate proficiency in:** | |
| Defining enthalpy and entropy | Chapters 4, 6, 9, 27, 31, 33, 35, 36, Appendices |
| Change of state between liquids, vapor, and solids | Chapters 5, 6, 9, 22, 35, 36, 41, 42, 44 |
| Describing and defining the following: conduction, convection, and radiant heat transfer | Chapters 4, 43, 44 |
| Describing, defining, and converting the following temperature measurements: Fahrenheit, Celsius, Rankin, and Kelvin | Chapters 4, 7 |
| Condensation of a vapor and its effect on heat | Chapters 4, 6, 27, 35, 36, 41, 42 |
| Vaporization of a liquid and its effect on heat | Chapters 4, 6, 27, 35, 36, 41, 42 |
| Describing the thermodynamics of refrigerants | Chapters 4, 5, 6, 9, 22, 50 |
| Describing and defining the following: Btu, latent heat, sensible heat | Chapters 4, 5, 6, 9 |
| Describing and defining the following: subcooled liquid, superheated vapor | Chapters 4, 5, 6, 9, 22 |
| Describing the state of refrigerant and explaining what occurs in each major component during normal operation | Chapters 4, 5, 6, 9, 22 |
| Using saturation tables | Chapters 9, 50, 51, Appendices |
| Identifying and defining the following types of blends: binary, ternary, azeotropic, and near azeotropic | Chapter 9 |
| Identifying and defining: CFCs, HCFCs, HFCs, HFOs, and HCs | Chapter 9 |
| Describing temperature glide | Chapter 9, 11, 52, Appendices |
| Describing fractionation and its causes | Chapter 9 |
| Explaining the procedures to retrofit a system from a CFC to an HFC and from an HCFC to an HFC | Chapter 11, Appendix |
| Describing and defining the following: wet-bulb temperature, dry-bulb temperature, and dew point | Chapters 9, 26, 27, 29 |
| Defining wet-bulb depression | Chapters 27, 37 |
| Measuring wet- and dry-bulb temperatures | Chapters 27, 37 |
| Describing the principles of dehumidification and humidification | Chapters 35, 36 |

**Correlation of *Modern Refrigeration and Air Conditioning* to**
**HVAC Excellence Competencies Task List: Commercial Refrigeration—page 3**

| Competency / Task | Textbook Chapter(s) |
|---|---|
| Plotting the refrigeration cycle on a pressure-enthalpy chart | Chapters 9, 27, 37 |
| Defining SEER and EER | Chapters 40, 46 |
| Describing a head master and its operation | Chapters 22, 23, 53, 54 |
| Describing the function, selection, and installation of auxiliary heat exchangers | Chapters 22, 23, 51 |
| Selecting the proper refrigerant oil to add to an operating system | Chapters 9, 10, 11, 19, 20, 50, 51, 52, 55 |
| Adjusting blower fan speed | Chapters 15, 29 |
| Sizing, designing, and installing refrigerant lines | Chapters 7, 8, 9, 10, 11, 37, 50, 51, 52 |
| Installing a condensing unit | Chapters 22, 51, 52 |
| Installing an air handler | Chapters 22, 51, 52 |
| Describing the required cfm for system operation and calculated airflow | Chapters 7, 27, 29, 30, 37, 38 |
| Installing a condensate drain | Chapters 7, 8, 22, 31, 32, 35, 36, 38, 40, 41, 47, 52 |
| Defining reclaim | Chapters 9, 10, 11 |
| Defining and demonstrating refrigerant recycling | Chapters 9, 10, 11, 52, 55 |
| Defining and demonstrating refrigerant recovery | Chapters 9, 10, 11, 52, 55 |
| Explaining the proper use and handling of nitrogen in the leak detection process | Chapters 10, 11, 54, 55 |
| Explaining the method for and pinpointing a leak | Chapters 9, 10, 11, 52, 54, 55 |
| Explaining the proper use of each type of leak detector and their applicability | Chapters 9, 10, 11 |
| Describing the six types of leak detectors and demonstrating their proper use | Chapters 10, 11 |
| Identifying proper charging of a compound refrigerant into an operating system | Chapters 9, 10, 11 |
| Identifying proper charging of a compound refrigerant into an empty system | Chapters 9, 10, 11 |
| Determining superheat and subcooling on an operating system | Chapters 11, 21, 22, 50 |
| Describing and performing a compressor efficiency test | Chapters 51, 53, 54 |
| Selecting the proper refrigerant oil and adding it to an operating system | Chapter 9 |
| Describing the following oils and their applications: mineral, alkylbenzene, glycols, and esters | Chapters 9, 10, 11, 19, 20, 25, 31, 32, 55 |

| Competency / Task | Textbook Chapter(s) |
|---|---|
| Demonstrating charging of a mini-split system with two or more evaporators | |
| Demonstrating charging using the manufacturer's literature | |
| Identifying proper charging of a blended refrigerant by weight into an empty system | Chapters 9, 10, 11 |
| Identifying proper charging of a blended refrigerant into an operating system | Chapters 9, 10, 11 |
| Demonstrating charging using the subcooling method | Chapters 9, 10, 11, 52 |
| Demonstrating charging using the superheat method | Chapters 9, 10, 11, 52 |
| Stating the reason why capillary tube systems require a critical charge | Chapters 6, 21, 25, 26, 53 |
| Describing a capillary/distributor tube sizing and selection procedure | Chapters 8, 9, 19, 21 |
| Calculating and demonstrating the weigh-in charging method | Chapters 11, 52 |
| Describing the triple evacuation method | Chapters 9, 10, 11, 52 |
| Demonstrating the triple evacuation method | Chapters 9, 10, 11, 52 |
| Soldering and brazing using correct techniques | Chapters 8, 52 |
| Evacuating and measuring system evacuation level | Chapters 10, 11 |
| Explaining vacuum pump selection | Chapters 10, 11, 52 |
| Identifying the types of micron gauges and how they should be connected to measure evacuation levels | Chapters 7, 10 |
| Defining vacuum and vacuum levels as required in the HVACR industry | Chapters 5, 9, 10, 11 |
| Obtaining gauge pressure using compound gauges and converting to absolute | Chapters 10, 11, 51 |
| Describing the operation and use of a gauge manifold assembly | Chapters 10, 11, 55 |
| Identifying and differentiating between the various types of service valves | Chapters 10, 23, 53, 54, 55 |
| Defining compression ratio | Chapters 19, 33, 49, 50 |
| Describing the automatic pump-down system and its operation | Chapters 6, 11, 21, 22, 23, 53, 54, 55 |
| Describing an air-cooled condenser, its function, and operating parameters | Chapters 6, 22, 51 |
| Installing a water-cooled system and adjusting a water-regulating valve | Chapters 8, 33, 52, 54, 55 |

**Correlation of *Modern Refrigeration and Air Conditioning* to**
**HVAC Excellence Competencies Task List: Commercial Refrigeration—page 5**

| Competency / Task | Textbook Chapter(s) |
|---|---|
| Describing the function of and installing a lockout relay in a circuit | Chapters 13, 15, 16 |
| Describing the operation of and installing a contactor | Chapters 13, 15, 16, 18, 19, 43 |
| Describing, testing, and installing a run and start capacitor | Chapters 13, 15, 16, 18, 19, 25, 31 |
| Describing and installing a compressor potential start relay | Chapters 13, 14, 15, 16, 18, 24 |
| Describing the operation of and testing a high-pressure switch | Chapters 13, 14, 15, 16, 18, 20, 40, 53, 54, 55 |
| Describing the operation of and testing a low-pressure switch | Chapters 7, 10, 13, 14, 15, 16, 18, 23, 53, 54, 55 |
| Describing and wiring the terminal connections of a thermostat temperature control | Chapters 13, 15, 16, 18, 36, 38 |
| Describing and testing thermistor-type temperature sensors (PTC & NTC) | Chapters 13, 14, 16, 20, 22, 24, 36 |
| Describing the function, checking the operation, and wiring an oil pressure safety control | Chapters 7, 8, 10, 11, 13, 15, 16, 18, 19, 20 |
| Installing and adjusting a low-ambient temperature control | Chapters 7, 8, 10, 11, 13, 16, 18, 22, 23, 52, 53, 54, 55 |
| Testing a blower or fan motor and its circuit | Chapters 7, 12, 13, 15, 16, 18, 22, 53, 54, 55 |
| Describing the operation of and testing a hot-gas bypass valve | Chapters 7, 8, 10, 11, 13, 15, 16, 18, 22, 23, 54 |
| Describing the operation of and adjusting an inline and pilot-operated evaporator pressure regulator | Chapters 7, 8, 10, 11, 13, 15, 16, 18, 22, 23, 53, 54, 55 |
| Describing and installing a replaceable-core liquid-line drier | Chapters 6, 8, 10, 11, 23, 40, 52, 53, 54 |
| Describing and installing a replaceable-core suction-line filter-drier | Chapters 6, 8, 10, 11, 23, 40, 52, 53, 54 |
| Describing dry-type evaporators and their operation | Chapters 6, 22, 51 |
| Describing the piping configuration for multiple-evaporator systems | Chapters 8, 9, 19, 22, 23, 49, 51, 52, 53, 54 |
| Describing the function and purpose of a multiple-compressor system | Chapters 47, 49, 51 |
| Describing compressor capacity control methods and operation | Chapters 15, 19, 22, 23, 32, 33, 36, 49, 50, 51 |
| Describing a chilled-water system and its operation | Chapters 33, 34 |
| Describing cooling towers and their operating limitations | Chapter 33 |

| Competency / Task | Textbook Chapter(s) |
|---|---|
| Describing the operation and function of a flooded evaporator and its metering device | Chapters 6, 22, 23, 51 |
| Describing the function, checking the operation, and wiring a demand ventilation control | Chapter 33 |
| Describing the function, checking the operation, and wiring a communications-type thermostat | Chapter 36 |
| Describing the function, checking the operation, and installing a variable volume air handler | |
| Describing the function, checking the operation, and installing a variable air volume (VAV) unit | |
| **Students should have knowledge of and be able to describe and demonstrate the following safety requirements:** | |
| Describe and perform "lock out and tag" procedures | Chapters 13, 16, 52, 53, 54, 55 |
| System leak-test pressures and nitrogen regulator installation and adjustment | Chapters 10, 11, 54, 55 |
| Explain and demonstrate the proper method of connecting a micron gauge to the system | Chapters 7, 10 |
| **Light commercial refrigeration troubleshooting and problem solving:** | |
| Troubleshooting and problem solving involves diagnostic procedures requiring the use of test equipment, manufacturer's installation and start-up procedures, and data plate information | Chapters 7, 8, 13, 15, 16, 17, 18, 19, 21, 22, 23, 27, 29, 30, 38, 52, 53, 54, 55 |
| **Knowledge of the following test instruments and tools is required:** | |
| Ammeter<br>Oil pressure gauge<br>Ohmmeter<br>Oil pump<br>Voltmeter<br>Nitrogen cylinder<br>Micron gauge<br>Vacuum pump<br>Sling psychrometer<br>Refrigerant throttling valve<br>Thermometers (wet and dry)<br>Recovery equipment<br>Leak detector<br>Charging scale and charging cylinder<br>Gauge manifold assembly<br>Anemometer<br>Soldering and brazing equipment<br>Valve core removal tool<br>Flaring tool/ tubing cutters<br>Tubing benders | Chapters 7, 8, 10, 11, 12, 13, 17, 22, 23, 27, 38, 52, 53, 54, 55 |