HVAC-R

Exam Information

Exam number
518

Items
92

Points
92

Prerequisites
None

Recommended course length
2 Years

National Career Cluster
Architecture & Construction
Manufacturing

Performance standards
Included (Optional)

Certificate available
Yes

Description

The HVAC-R industry certification exam assesses understanding of the principles and fundamentals of HVAC-R systems. Learners demonstrate their ability to fabricate, install, and maintain these systems, and use diagnostic equipment for troubleshooting. The exam evaluates skills in working with electrical testing equipment, plastic, steel, and copper pipe and tubing, sheet metal, hand tools, and specialized tools of the trade. Learners must show knowledge of thermodynamics, fluid mechanics, heat transfer, electricity and electrical systems, and hydronics, radiation, and convection. Safety procedures and the appropriate use of tools are also integral parts of the assessment.

Exam Blueprint

Standard	Percentage of exam
1. Air Conditioning and Refrigeration	10%
2. Electrical	11%
3. Forced Air Heat and Venting	11%
4. Hydronic Heat	11%
5. Tools	6%
6. Professional Skills	9%
7. Service and Troubleshooting	4%
8. Safety	13%
9. Refrigeration Cycle	12%
10. Pipe Fitting	13%

Standard 1

Students will be able to understand Refrigeration & Air Conditioning systems.

Objective 1 Explain the similarities and differences between the components of a refrigeration system and the air conditioning system.

Objective 2 Explain the function of refrigeration specific components.

Objective 3 Identify the symptoms of/and troubleshoot common refrigeration system issues.

Objective 4 Identify installation considerations in various circumstances.

Objective 5 Identify EPA 608 specific practices to be used for refrigerant management

Standard 2

Students will be able to understand and demonstrate the use of Electrical Principles.

Objective 1 Explain basic electrical theory, common methods to create electricity, and the terminology used to describe electrical values.

Objective 2 Identify schematic and ladder diagram components and characteristics.

Objective 3 Identify various electrical motor types and their uses and operating features.

Objective 4 Identify common electrical control devices and their uses and operating features.

Objective 5 Calculate series and parallel circuit values using ohm's law.

Standard 3

Students will be able to identify, explain or demonstrate knowledge in or of the following:

Objective 1 Heating systems and components

Objective 2 Combustion theory and different fuels

Objective 3 Explain the theory of operation

Objective 4 Furnace installation and service

Objective 5 Furnace troubleshooting

Objective 6 Explain temperature rise

Objective 7 Identify different types of blowers

Objective 8 Troubleshoot forced air gas

Objective 9 Understand proper measurement gas pressure

Objective 10 Demonstrate knowledge of reading gas meters, calculating gas consumption

Objective 11 Test flame sensors, thermocouples, and power piles

Objective 12 Understand flue and installation

Objective 13 Identify fittings used in ductwork

Objective 14 Understand how to calculate materials list for a duct system

Objective 15 Use measurements from blueprints

Objective 16 Understand how to fabricate metal duct

Objective 17 Understand use of duct fasteners and supports

Objective 18 Understand how to layout duct fittings and components

Standard 4

Students will be able to understand, identify and explain types of hydronic heating systems and components.

Objective 1 Identify various types of hot water and steam boiler systems.

Objective 2 Identify different types of terminal units and how they transfer heat.

Objective 3 Identify hydronic system components, controls and safety devices.

Objective 4 Demonstrate the ability to properly select a circulator pump or pumps.

Objective 5 Demonstrate the ability to properly design and size a piping system.

Objective 6 Discuss stand-alone and indirect domestic hot water heating systems.

Standard 5

Students will be able to understand and demonstrate the use of tools and equipment used in HVAC-R.

Objective 1 Identify various types of hot water and steam boiler systems.

Objective 2 Identify different types of terminal units and how they transfer heat.

Objective 3 Identify hydronic system components, controls and safety devices.

Objective 4 Demonstrate the ability to properly select a circulator pump or pumps.

Standard 6

Students will be able to understand and demonstrate the professional skills necessary to work in the HVAC-R field, which include the following areas:

Objective 1 Basic skills include the ability to read, write, listen, and speak as well as perform arithmetic and mathematical functions. Use a combination of techniques to read or listen to complex information and analyze what they hear or read; convey information confidently and coherently in written or oral form; and analyze and solve mathematical problems requiring use of multiple computational skills.

Objective 2 Thinking skills lead to problem-solving, experimenting, and focused observation and allow the application of knowledge to new and unfamiliar situations.

Objective 3 Personal qualities generally include competence in self-management and the ability to plan, organize, and take independent action.

Objective 4 Positive interpersonal qualities lead to teamwork and cooperation in large and small groups in family, social, and work situations.

Objective 5 Technology is the process and product of human skill and ingenuity in designing and creating things from available resources to satisfy personal and societal needs and wants. Apply their knowledge of technology to identify and solve problems.

Objective 6 Information management focuses on the ability to access and use information obtained from other people, community resources, and computer networks, use technology to acquire, organize, and communicate information by entering, modifying, retrieving, and storing data.

Objective 7 Using resources includes the application of financial and human factors, and the elements of time and materials to successfully carry out a planned activity and allocate resources to complete a task.

Objective 8 Systems skills include the understanding of and ability to work within natural and constructed systems. Demonstrate an understanding of how systems performance relates to the goals, resources, and functions of an organization.

Standard 7

Students will be able to understand and demonstrate troubleshooting skills and the ability to communicate effective during service calls, which include the following areas:

Objective 1 Information gathering -question customer, discuss concerns and any recent work.

Objective 2 Check the operation of equipment. Take initial readings.

Objective 3 Step-by-step procedure to determine a failed component.

Objective 4 Analyze information gathered from previous steps.

Objective 5 Determine corrective action, replacement of parts or other actions necessary.

Objective 6 Explain to customer work needed for repair.

Standard 8

Students will learn and practice basic safety.

Objective 1 Describe how to avoid job-site accidents.

Objective 2 Explain the relationship between housekeeping and safety.

Objective 3 Appreciate the importance of following all safety rules and company safety policies.

Objective 4 Explain the importance of reporting all on-the-job injuries, accidents, and near misses.

Objective 5 Explain their employer's substance abuse policy and how it relates to their safety.

Objective 6 Recognize and explain personal protective equipment uses.

Objective 7 Inspect and care for various types of personal protective equipment.

Objective 8 Follow safe procedures for lifting heavy objects.

Objective 9 Inspect and safely work with various types of ladders and scaffolds.

Objective 10 Explain the function of Material Safety Data Sheets.

Objective 11 Practice fire prevention in dealing with various flammable materials.

Objective 12 Practice safe work procedures around electrical hazards.

Standard 9

Students will be able to understand the Refrigeration Cycle & Refrigerant management.

Objective 1 Explain the components of the basic refrigeration process and their interactions with temperature and pressure changes.

Objective 2 Explain the function of the 4 major refrigeration components.

Objective 3 Identify the symptoms of/and troubleshoot common refrigeration system issues.

Objective 4 Explain the terms saturation, superheat, and subcooling as they relate to the refrigeration process.

Objective 5 Identify EPA 608 specific practices to be used for refrigerant management including safety.

Standard 10

Students will be able to understand the application of pipe fitting, procedures, and equipment.

Objective 1 Understand the difference between inside diameter (I.D.) and outside diameter (O.D)

Objective 2 Identify the application and use of various plastic, steel, and copper tubing/piping.

Objective 3 UBe knowledgeable of melting points for different solders and alloys.

Objective 4 Explain the differences between soldering and brazing.

Objective 5 Understand pressure testing and leak-checking procedures.

Objective 6 Understand setup and safety of torch equipment.

HVAC-R

Performance assessments may be completed and evaluated at any time during the course. The following performance skills are to be used in connection with the associated standards and exam. To pass the performance standard the student must attain a performance standard average of 8 or higher on the rating scale. Students may be encouraged to repeat the objectives until they average 8 or higher.

Student's Name: _____

Class: _____

Performance standards rating scale

0	Limited skills	2	→	4	Moderate skills	6	→	8	High skills	10

GAS FURNACE START-UP AND CHECK

Time allowed for assessment: 90 minutes

Students will perform the following actions to demonstrate the ability to start up and verify the operation of a gas furnace Standard 3 Forced Air Heat and Venting. (S-Standard OBJ- Objective)

1.) Leak test gas connection
(S3, OBJ 4 and 9)

2.) Test supply gas pressure and electrical connection
S3 OBJ 9 and S2 OBJ 4

3.) Start equipment
S3 OBJ4

4.) Adjust thermostat heat anticipator
S3 OBJ11

5.) Test Manifold gas pressure
S3 OBJ 9

6.) Check temperature rise
S3 OBJ 6

7.) Check motor amperage draw
S2 OBJS1, 3 AND 4

8.) Perform steady state efficiency test
S3 OBJ4

9.) Complete system conditions checklist
S7 OBJS 1-7

Score for Gas Furnace Start-Up and Check: _____

REFRIGERANT RECOVERY AND SYSTEM RECHARGE

Time Allowed for assessment: 90 minutes

Students will perform the following actions to demonstrate the ability to repair a refrigerant system and return the system to normal operating conditions. (S-Standard OBJ- Objective)

1.) Identify and adjust proper manifold gauges
S5 OBJ 1 AND 4

2.) Install gauges
S5 OBJ 1

3.) Purge gauge hoses
S5 OBJ 1

4.) Adjust service valves
S9 OBJ 3

5.) Recover refrigerant
S9 OBJ 5

6.) Replace filter dryer and sight glass
S5 OBJ 1

7.) Perform vacuum system check
S7 OBJ 2-4

8.) Install new refrigerant
S9 OBJ 1-5

9.) Restart system
S7 OBJ 1-7

10.) Check system operation
S7 OBJ 1-7

11.) Complete systems conditions check
S7 OBJ 1-7

Score for Refrigerant Recovery and System Recharge: _____

Performance standard average score:

Evaluator Name:_____

Evaluator Title:_____

Evaluator Signature:_____

Date:_____