ATSM-2780: NATE CERTIFICATION

Cuyahoga Community College

Viewing: ATSM-2780 : NATE Certification

Board of Trustees:
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Academic Term:
Fall 2020

Subject Code
ATSM - Applied Ind Tech- Sheetmetal

Course Number:
2780

Title:
NATE Certification

Catalog Description:
Advanced course for the North American Technical Excellence (NATE) certification covering the core concepts of the heating, ventilation and air conditioning (HVAC) industry including safety, basic construction and electricity. Also includes a comprehensive review of heat pumps, furnaces, and air distribution.

Credit Hour(s):
2

Lecture Hour(s):
2

Requisites

Prerequisite and Corequisite
Departmental approval: Admission to Sheet Metal Worker's Apprenticeship program.

Outcomes

Course Outcome(s):
Review and apply core concepts related to North American Technician Excellence (NATE) certification with respect to safety, tools and basic construction, general science, roles affecting desired conditions and temperature measurements and applied electrical concepts and applications.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. Interpret safety regulations including hazard recognition and identify and apply resolution procedures with respect to job safety concerns.
2. Identify the proper tools required for general construction fabrication and repair as applied to residential and light commercial structures and become familiar with structural components including floors, walls, ceilings and roofs.
3. Review basic science concepts related to Heating Ventilation and Air Conditioning (HVAC) service applications and compute air flow measurement, temperature and psychometric indices.
4. Explain how latent heat and sensible heat affect humidly and comfort and describe the tools and instruments used to achieve desired conditions.
5. Explain how electricity, wire and controls enables the operation of motors and interpret schematic diagrams to describe various phase and speed motors.

Course Outcome(s):
Discuss and review the various types of gas furnaces, including respective components, installation procedures with start up and check, the operation of each including diagnostics, electrical troubleshooting, system analysis and planned maintenance scheduling.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. List and describe the different types of gas furnaces including the efficiencies, position and applications of each.
2. Identify the respective furnace components and describe the function of each.
3. Explain the process for installing different furnace types and describe the “start up” and “check” procedures related to temperature rise, air flow, amperage and voltage.
4. Identify the respective operational aspects of different furnaces and explain the application of each.

Course Outcome(s):

Explain the refrigeration cycle of standard air to air heat pumps and explain the processes of installation, service, equipment components, calculation of design factors and review applied mechanical and electrical codes.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Discuss how thermodynamics is used to explain the refrigeration cycle.
2. Identify the components of the heat pump system and describe their respective functions and applications for troubleshooting mechanical failures.
3. Explain the importance of establishing a preventative maintenance plan to perform diagnostics used in determining the need to replace or repair components.
4. Apply basic math concepts to calculate required equipment capacities used to establish necessary heat pump BTU British Thermal Units for occupant comfort.
5. Review applied mechanical and electrical codes for equipment installation.

Course Outcome(s):

Review the relationships of air distribution with respect to different furnace types, controls affecting comfort zones, duct systems, and designs required for troubleshooting and systems analysis for energy efficiency.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Discuss the relationship of different furnace types with respect to various configurations, installations, components, and sequence of operation.
2. Identify and explain the function of the air distribution controls affecting applications, and troubleshooting operations.
3. Describe the duct systems design and installation used for air distribution and troubleshooting.
4. Analyze air flow measurements within the air distribution systems, using test instruments and balance processes.

Methods of Evaluation:

1. Class Participation
2. Quizzes
3. Final test

Course Content Outline:

1. Core: safety, tools, and construction, science, roles, and electricity
    a. Safety regulations
        i. Government regulations
            1. Department of Transportation
                a. Chemical transport
                b. Recordkeeping
                c. Cylinder labelling

2. OSHA
    a. 1926.400 subpart K electrical
    b. 1926.20 subpart C general safety and health
    c. 1926.95 subpart E PPE
    d. 1926.1100 subpart Z
    e. toxic and hazardous substance
ii. Local ordinances
    1. Heating
    2. Air conditioning
    3. Electrical
iii. NFPA National Fire Protection Association

b. Tools and Basic Construction
i. Tools
    1. Hand
    2. Power
    3. Equipment
    4. Specialized
        a. Service and equipment
        b. Installation tools/equipment
ii. Basic construction
    1. Floor
        a. Material
        b. Insulation
        c. Joist: spacing and unit location
    2. Walls
        a. Insulation R values
        b. Stud spacing
    3. Windows
        a. Size
        b. Type of pane
        c. Direction facing
        d. Location
        e. Protection
        f. Type
    4. Ceiling
        a. Insulation
        b. Construction material
    5. Roof
        a. Slope
        b. Material
        c. Vents

c. Science concepts
i. Thermodynamics
ii. OHM'S law
iii. Boyle's law
iv. Charles's law
v. Calculation
    1. Air flow
        a. Cubic feet per minute
        b. Velocity
        c. Friction loss
    2. Temperature
        a. Latent heat
        b. Sensible heat
    3. Psychometric indices
        a. Humidity
        b. Wet bulb
        c. Dry bulb

        d. Dew point
        e.
    d. Heat and controls
        i. Heat
            1. Latent
                a. Moisture content
                b. Change in state
                c. Lowering dew point
            2. Sensible
                a. Change in temperature, not state
                b. Comfort level
        ii. Controls
            1. Tool
                a. Psychomotor (digital)
                b. Sling psychomotor
            2. Instruments
                a. Thermostat
                b. Humidistat
    e. Motor operation
        i. Electrical type
            1. Alternating current AC
                a. Single phase
                b. Three phase
            2. Direct current DC
        ii. Wire
            1. Size
            2. Material
            3. Insulation
        iii. Controls
            1. Inverted
            2. Motor starter
        iv. Schematic diagram
            1. Ladder
            2. Pictorial
            3. Wiring
        v. Motors
            1. Phase: alternating legs of current
            2. Speed: multi, variable
2. Furnaces
    a. Furnace types
        i. Up-flow
        ii. Counter flow
        iii. Horizontal
        iv. Efficiency
            1. Ratio of air to fuel mixture
            2. Energy consumption
                a. Natural gas
                b. Electric
                c. Propane
        v. Position
            1. Up-flow
                a. Basement installation
                b. Natural convection
            2. Counter flow
                a. Limited access installation
                b. Decreased airflow/limitations
            3. Horizontal
                a. Attic/crawlspace installation
                b. Higher efficiency
                c. Limited access/combustion air

b. Components
    i. Standard
        1. Blower
        2. Gas valve
        3. Ignition
        4. Safety devices
        5. Combustion motor
        6. Thermostat
        7. Primary heat exchanges
        8. Burner assembly
    ii. High efficiency
        1. Standard components
        2. Secondary heat exchanger
        3. Condensate drain system
        4. PVC combustion and flue pipes
    iii. Applications
        1. Cost effectiveness
        2. Building design
c. Installation start-up and checks
    i. Temperature
        1. Rise
        2. Limits
        3. Range determined by manufacturer
    ii. Air flow
        1. Measure air exchange
        2. Cubic feet per minute
        3. Rate of air distribution
    iii. Amperage
        1. Blower motor
        2. Combustion motor
        3. Determined by manufacturer
        4. Affects efficiency and component failure
    iv. Voltage
        1. Manufacturer specification
        2. Affects safety
d. Operational aspects
    i. Sequence
        1. Thermostat operation
        2. Motor operation
    ii. Safety
        1. Controls
        2. Pressure switch
        3. Limit
        4. Roll-out
        5. Motor overloads

3. Air to Air Heat pumps
    a. Thermodynamics and refrigeration cycle
        i. Thermodynamics
            1. First Law: Conservation of energy
                a. Change in internal energy
                b. Heat: measured and quantified
                c. Energy: cannot be created or destroyed
            2. Second Law: entropy of isolated systems always increases
            3. Third Law: entropy of a system approaches constant value approaching absolute zero
        ii. Refrigeration cycle
            1. Compressor
                a. Moves refrigerant gas
                b. High temperature
            2. Condenser

        a. High temperature “in cycle”
        b. Low temperature “out cycle”
    3. Receiver/restrictor, throttling device
        a. Low pressure refrigerant
        b. Low temperature
    4. Evaporator
        a. Removes humidity
        b. Converts to low pressure liquid
    5. Accumulator
        a. Storage tank for refrigerant
        b. Not always required

b. Heat pump components
    i. Compressor
        1. Pump
            a. Electrical
            b. Burn out
            c. Excessive voltage
        2. Valves
            a. Wear
            b. By-pass refrigerant
            c. Seize up
    ii. Reversal valve
        1. Solenoid
            a. Excessive voltage
            b. Low voltage
            c. Lock-up
        2. Motor
    iii. Condenser
        1. Coil
            a. Leaks
            b. External affects
        2. Cabinet
            a. Wear
            b. External damage
            c. Ultraviolet
            d. Light
        3. Fan
        4. Motor
    iv. Mountings for compressor
        1. Isolation pad wear
        2. Mounting brackets
    v. Evaporate coil
        1. Expansion valve
            a. Plugged
            b. Electrical
        2. Condensate pan
            a. Rust
            b. Leak
    vi. Controls
        1. Thermostat
            a. Low voltage
            b. Calibration
        2. Electronic board
    vii. capacitor

c. Maintenance plan
    i. Purpose electrical
        1. Mechanical/failure avoidance
        2. Cost savings
    ii. Plan diagnostics

1. Volt readings
2. Amperage readings
3. Cleaning

iii. Repair versus replacement
1. Repair
a. Refrigerant
b. Wire corrosion
2. Replacement
a. Component failure
b. Age driven

d. Equipment capacities
i. Square footage of living space
ii. Heat loss/gain
iii. Concepts
1. Area
2. Volume
3. Air flow/BTU per hour
4. Temperature rise

e. Codes
i. Mechanical codes
1. Local
2. State
ii. Electrical
1. County NFPA
2. National Electrical Code

4. Air distribution
a. Furnace types
i. Types
1. Electric
2. Gas
3. Oil
ii. Configuration
1. Up-flow
2. Counter flow
3. Horizontal
iii. Installations
1. Efficiencies
a. High
b. Standard
2. Retrofit
a. Air flow matches existing ducts
b. BTU compatibility
iv. Components
1. Variable speed
2. Zone system
3. Variable air volume damper
v. Operational sequence
1. Normal
2. Multi-stage

b. Air distribution controls
i. Function
1. Conditioned space temperature
2. Humidity
ii. Applications
1. Residential
2. Commercial
3. Industrial
iii. Trouble shooting

1. System type identification
2. Electrical failure
3. Combustion safety breakdowns

c. Duct systems
   i. Design
      1. Trunk
      2. Perimeter loop
      3. Fiberglass
      4. Sheet metal
      5. Tubular
      6. Conventional
   ii. Installation
      1. Sealed
      2. Insulated
      3. Chase used ducts
   iii. Troubleshooting
      1. Duct system identification
      2. Leak detection
d. Air flow analysis
   i. Measurements
      1. Cubic feet per minute
      2. External static pressure
      3. Total static pressure
   ii. Test instruments
      1. Monometer
      2. Flow hood
      3. Voltmeter
   iii. Balance process
      1. Proportional
      2. sequential

Resources

John Tomczyk. . *Refrigeration and Air Conditioning Technology*. 8th Edition. Cengage: Boston, MA, 2017.

Russell Smith. . *Electricity for Refrigeration, Heating, and Air Conditioning*. 10th Edition. Cengage: Boston, MA, 2018.

Hank Rutkowski. *ACCA Manual D.*. 2016 Edition. Air Conditioning Contractors of America:, 2016.

Resources Other

https://www.iccsafe.org/
http://www.ahrinet.org/

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