ATSM-1070: SHEET METAL ELECTRICITY

Cuyahoga Community College

Viewing: ATSM-1070 : Sheet Metal Electricity

Board of Trustees:
March 2020

Academic Term:
Fall 2020

Subject Code
ATSM - Applied Ind Tech- Sheetmetal

Course Number:
1070

Title:
Sheet Metal Electricity

Catalog Description:
Covers basic electricity and magnetism required for servicing HVAC equipment in residential and light commercial buildings. Automatic controls used to maintain temperature and humidity is included. Various motor types and motor phases along with service and shop exercises and application are integrated.

Credit Hour(s):
3

Lecture Hour(s):
3

Requisites

Prerequisite and Corequisite
Departmental approval: admission to Sheet Metal Worker's apprenticeship program.

Outcomes

Course Outcome(s):
Discuss the basics of electricity and magnetism with respect to currents, electrical formulas and components including equipment and functions.

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 define the terms related to electricity and magnetism.
2. Explain the purpose of electricity and magnetism with respect to the Heating Ventilation and Air Conditioning HVAC technician.
3. Discuss electrical theory in terms of Ohm’s Law with respect to voltage, amperage resistance and applications.
4. Differentiate between alternating and direct current.
5. Apply basic math concepts to calculate various voltages, amperes and resistances.
6. Explain how wire size affects the operation of electrical components and equipment.
7. Differentiate between conductors and insulators.
8. Describe the function of a transformer and explain the operation of its individual components.
9. Explain how transformers are sized to ensure proper amp draw of respective equipment.

Course Outcome(s):
Discuss the automatic controls used to maintain temperature and humidity of various room sizes related to residential and commercial applications and identify the safety devices protecting equipment and respective components.

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 define the terms related to automatic controls.
2. Explain the function of temperature controls and describe the different applications.
3. List the different types of automatic controls used for temperature managements.
4. Describe how electronic controls are used to govern system overshoot and temperature swing.
5. Differentiate between high and low voltage controls.
6. Name two ways motors are protected from high voltage in order to prevent fire or equipment failure.
7. Describe the function and application of pressure sensitive controls.
8. Explain how pressure transducers interface with microprocessors by converting sensed pressure into electronic signals.

Course Outcome(s):

Identify the different types of motors used in the HVAC industry, describe the respective components of each and list and describe the application in the various operations of related equipment.

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 define the terms related to electric motors and electric motor applications.
2. Describe the different types of open single phase motors.
3. Explain how different speeds are obtained in a single phase application.
4. Explain how electrical frequency is used to control operational speed in a 3-phase motor.
5. Describe the cooling process use for maintaining operating temperature in hermetic systems.
6. Discuss the importance of proper terminal connections in different motor applications..
7. Describe the operation of high efficiency motors and explain the rating process used.

Methods of Evaluation:

1. Class participation
2. Quizzes
3. Tests
4. Shop Projects

Course Content Outline:

1. Electricity and magnetism
    a. Terminology
        i. Electricity
        ii. Voltage
        iii. Capacitance
        iv. Resistance
        v. Magnetism
        vi. Watts
        vii. Solenoid
        viii. Conductor
        ix. Insulator
        x. Sine wave
        xi. Current
        xii. Multi meter
        xiii. Ohm's Law
        xiv. Transformer
        xv. Service technician
        xvi. Amp draw

xvii. Phase
xviii. EMF
xix. AWG
xx. Series
xxi. Parallel
xxii. Semi-conductor

b. Purpose of electricity/magnetism/service
    i. Primary service call
        1. Equipment malfunction
        2. Excessive energy use
        3. Maintenance
    ii. Malfunction
        1. Motor
        2. Contacts
        3. Thermostat
        4. Relay switch
        5. Safety controls
        6. Refrigeration cycle
c. Ohm' Law
    i. Voltage = Amperage x Resistance
    ii. Amperage = Voltage/Resistance
    iii. Resistance = Voltage/Amperage
    iv. Applications
        1. Series circuit
        2. Parallel circuit
d. Alternating versus Direct current
    i. AC
        1. Single phase
        2. 3 phase
        3. Sine wave
        4. General use
            a. Residences
            b. Common appliances
            c. Standard equipment
            d. 24v-480v
    ii. DC
        1. Communications
        2. Control circuits
        3. Electronically commutated motor
e. Math concepts
    i. Basic whole numbers
        1. Addition
        2. Subtraction
        3. Multiplication
        4. Division
    ii. Fractions
    iii. Decimals
    iv. Conversions
    v. Applications
        1. Ohm's Law
            a. Voltage
            b. Amperes
            c. Resistance
        2. Wattage
            a. BTU conversion
            b. potential difference
f. Wire size

i. Sizes
1. 18 gauge
2. 16 gauge
3. 14 gauge
4. 12 gauge
5. 10 gauge
6. 8 gauge
7. 6 gauge
8. 4 gauge
9. 2 gauge

ii. AWG
1. Standardized wire system
2. Establish wire diameter

iii. Wire size effects
1. Amperage
2. Voltage

iv. Effects on components
1. Overheating
2. Fire potential
3. Component failure

v. Effects on equipment
1. Increased operating cost
2. Shorter life span
3. Excessive energy use

g. Conductors vs insulator

i. Conductors
1. Wire
2. Copper
3. Aluminum
4. Silver
5. Gold
6. Mercury

ii. Applications
1. Circuit boards –gold
2. General use-copper
3. Thermometers-mercury
4. Circuit breaker –silver
5. Contacts-silver

iii. Insulators
1. Glass
2. Rubber
3. Plastic
4. uses
   a. Prevent grounding
   b. Heat control
   c. Safety

h. Transformers

i. Function
1. Voltage reduction
2. Voltage increase

ii. Types
1. Step up
2. Step down

iii. Component
1. Coil
   a. Primary
   b. Secondary
2. Core

iv. Component operation

1. Applied
2. Induced
3. Magnetic field generator

i. Transformer size
   i. Rating equals volts times amps (V) (A)
   ii. Range 10 to 75
   iii. Purpose
      1. Adequate voltage
      2. Equipment protection
      3. Overload protection

2. Automatic controls
   a. Terminology
      i. Thermocouple
      ii. Transducer
      iii. Control bulb
      iv. Sensed pressure
      v. Operational device
      vi. Safety control
      vii. Automatic re-set
      viii. Manual re-set
      ix. System lag
      x. System overshoot
      xi. Temperature swing
      xii. Thermostat
      xiii. Heat anticipator
      xiv. Bi metal
      xv. Snap disc
      xvi. Thermopile
      xvii. Limit switch
      xviii. Regulator
      xix. Relay
      xx. contactor
   b. Temperature control: function and application
      i. Function
         1. Temperature management
         2. Safety device
         3. Humidity
      ii. Application
         1. Thermostat
         2. Refrigeration
         3. Heating
         4. HVAC equipment
   c. Automatic control types
      i. Electrical
         1. High voltage
         2. Low voltage
      ii. Mechanical
         1. Water pressure regulator
         2. Gas regulator
      iii. Electro mechanical
         1. Relay
         2. Contactor
      iv. Electronic
         1. Digital thermostat
         2. Control board
      v. Pneumatic
         1. System sequence
            a. Air compressor
            b. Dryer

            c. Thermostat
            d. Actuator
        2. Early control system
d. Electronic controls
    i. System overshoot
        1. Heat anticipator
        2. Prevention control
    ii. Temperature swing
        1. Upper and lower limits
        2. Tolerance
        3. Room comfort and efficiency
e. Voltage controls: high and low
    i. High voltage
        1. Industrial application
        2. Safety
        3. Equipment durability
        4. Less accurate
    ii. Low voltage
        1. Residential
        2. Light commercial
        3. Greater accuracy
        4. Efficient
        5. Economical
f. Motors: high voltage protection
    i. B metal
        1. Brass
        2. Steel
        3. Snap disc
    ii. Safety
        1. Overheating
        2. Fire
    iii. Equipment protection
        1. Motors
        2. Compressors
g. Pressure sensitive controls
    i. Function
        1. Low pressure
            a. Refrigerant controls
            b. Compressor protection
            c. Safety
        2. High pressure
            a. High temperature protection
            b. Overcharging prevention
    ii. Application
        1. Residential air conditioning systems
        2. Residential furnace
        3. Commercial
h. Pressure transducers
    i. Microprocessor interface
        1. Human interface module
        2. Digital read/signaling
    ii. Conversion process
        1. Sensed pressure to electronic signal
        2. Alarm system
        3. Operating status report

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.

Resources Other
Additional Resource
https://www.supercoolsliderule.com/
http://www.ahrinet.org/

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