# ATPF-1035: REFRIGERATION MOTORS AND APPLICATIONS

## Cuyahoga Community College

### Viewing: ATPF-1035 : Refrigeration Motors and Applications

**Board of Trustees:**
2015-12-03

**Academic Term:**
Spring 2019

**Subject Code**
ATPF - Applied Ind Tech - Pipefitters

**Course Number:**
1035

**Title:**
Refrigeration Motors and Applications

**Catalog Description:**
Course discusses different types of motors, motor operation and the applications of motors in the refrigeration industry. Also covered are various motor devices use for overload protection and changing electrical current.

**Credit Hour(s):**
2

**Lecture Hour(s):**
2

### Requisites

**Prerequisite and Corequisite**
Departmental approval: admission to Pipefitter's apprenticeship program.

### Outcomes

**Course Outcome(s):**
Discuss the different types of motors used in refrigeration, their components and the torque that is produced.

**Objective(s):**
1. Define the terms used with refrigeration motors.
2. List the different types of motors used in refrigeration.
3. Explain the operation of torque produced by motors and explain the internal parts of a motor.
4. Define torque and explain how it is used in refrigeration equipment.
5. Explain how torque is produced.
6. Describe a multi-speed permanent split-capacitor motor and indicate how the different speeds are obtained.

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**Course Outcome(s):**
Discuss various devices that are used to assist electric motors.

**Objective(s):**
1. Discuss the use of inverters with respect to motor speed.
2. Discuss the use of electronically commutated motors (ECM) with respect to open drive fans.
3. Explain the importance of protecting motors from overheating.
4. Explain what is meant by a current relay.
5. Explain positive temperature starting devices.
6. Explain how rectifiers are used to convert alternating current (AC) into direct current (DC).

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**Course Outcome(s):**
Identify the different power supplies, mounts and drive mechanisms.

**Objective(s):**

1. Explain how power supplies are matched to respective motors.
2. List different types of motor mounts.
3. Explain how motor noise can be reduced by using different mounting installations.
4. Identify different types of motor drive mechanisms and explain the operation of each.

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**Methods of Evaluation:**

1. Quizzes
2. Exams
3. Final

**Course Content Outline:**

1. Motors, components and torque
    a. Terminology
        i. Stator
        ii. Rotor
        iii. Bearings
            1. Sleeve
            2. Ball
        iv. Windings
        v. End bell
        vi. Core
        vii. Armature
        viii. Magnetic field
        ix. Motor slip
    b. Motors
        i. Single phase
            1. Split phase
                a. Minimum starting torque
                b. Low power
            2. Split capacitor
                a. Multi-speed
                b. Limited application
                c. Soft start up
            3. Shaded pole
                a. Light duty application
                b. Economical
                c. Reverse rotation
        ii. Three phase motor
            1. Commercial application
            2. Rotation range
                a. Low- 1750 revolutions per minute (rpm)
                b. High-3600 rpm
            3. Special mountings
    c. Torque
        i. Twisting power
        ii. Starting power
        iii. Load requirement
        iv. Motor speed
        v. Applications
            1. Fans and compressors
            2. Refrigeration equipment
    d. Torque production
        i. Magnetic field
        ii. Alternating current (AC)
        iii. Left hand rule
        iv. Rotation

v. Full load torque
vi. Horsepower
e. Split capacitor motor
i. Multi speed
1. Capacitor start
2. Identifying wiring
3. Resistance
ii. Applications
1. Fans
2. Compressors
3. Refrigeration equipment
iii. Speed controls
1. Pole designs
2. AC dependent
3. Synchronous speeds
iv. Motor slip
2. Motor devices
a. Current relay
i. Single phase
ii. Fractional horsepower motors
iii. Starting torque
iv. Parts
1. Low resistance coil
2. Open contacts
v. Applications
1. Domestic refrigeration
2. Drinking fountains
3. Window units
b. Positive temperature starter
i. Thermister
ii. Effects
1. Rapid heating
2. High resistance circuit
3. Start windings and phase angle
iii. Wiring
1. Parallel
2. Full line voltage
c. Rectifiers
i. Types
1. Phase controlled
2. Diode bridge
ii. Current conversion
iii. Capacitor bank
iv. Diode bridge
1. Filtered DC
2. Non-switching
d. Inverters
i. Types
1. Six-step
2. Pulse width modulator
ii. Frequency control
iii. Voltage control
iv. Current
e. Electronically controlled
i. Applications
1. Open drive fans
2. Small fan size
ii. Energy saving
iii. Operation

1. Speed control
2. Air flow
3. Torque
4. External static pressure

f. Cooling motors
   i. Air cooled
   ii. Water cooled
   iii. Heat dissipation

3. Power supplies, mounts, and drive mechanisms
   a. Power supply
      i. Determination
         1. Manufacturer specifications
         2. Design engineer
      ii. Types
         1. 115 volt (v)
         2. 208 v
         3. 230 v
         4. 460 v
      iii. Name plate
         1. Voltage
         2. Current capacity
         3. Frequency
         4. Phases
   b. Motor mounts
      i. Types
         1. Rigid
         2. Resilient
      ii. Characteristics
         1. Bolted
         2. Noise isolation
         3. Grounding
      iii. Styles
         1. Cradle
         2. End
         3. Belly-band strap
         4. Rigid base
   c. Drive mechanisms
      i. Direct
         1. Coupling connections
         2. Direct mount
         3. Gear drive
         4. Motor efficiency
      ii. Belt
         1. Versatile
         2. Drive speed control

## Resources

United Association Training Department. *HVAC/R Training.* current edition. International Pipe Trades Training Committee, Inc., Washington, D.C., 2006.

R. Jesse Phagan. *Applied Mathematics.* 4th edition. Goodheart-Wilcox Co./Tinley Park, Il, 2010.

Thomas W. Frankland. *Pipe Trades.* current edition. Glencoe/McGraw-Hill, New York, New York, 1969.

**Resources Other**

http://www.refrigerationbasics.com/1024x768/definitions1.htm

http://physics.about.com/od/glossary/g/heat.htm

http://www.free-ed.net/sweethaven/MechTech/Refrigeration/coursemain.asp?lesNum=4&modNum=1

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