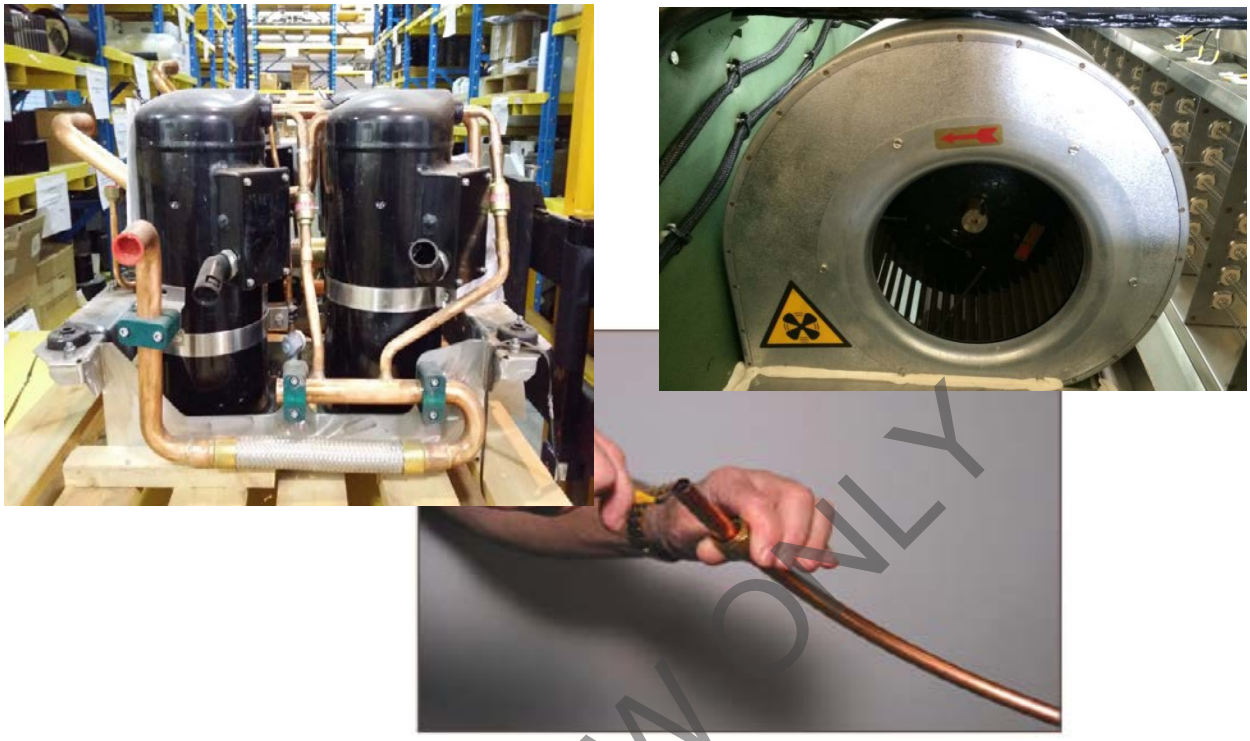

Course 206

HVAC Systems
Inspection and Maintenance

Module 3:
Refrigeration Components

INSTRUCTOR GUIDE

RAIL CAR TRAINING CONSORTIUM

Table of Contents

Overview

Slide 1

INSTRUCTIONAL ACTIVITY:
This is the opening slide for Course 206 Module 3

TIME: 30 seconds

SAY: Welcome to Module 3 of Course 206: Refrigeration Components. The goal of this module is ensure every participant has working knowledge and hands-on experience with the inspection and preventive maintenance of HVAC refrigeration components. Upon completion of this course, the participant should be able to apply their knowledge and demonstrate the ability to inspect and maintain HVAC refrigeration components.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: __

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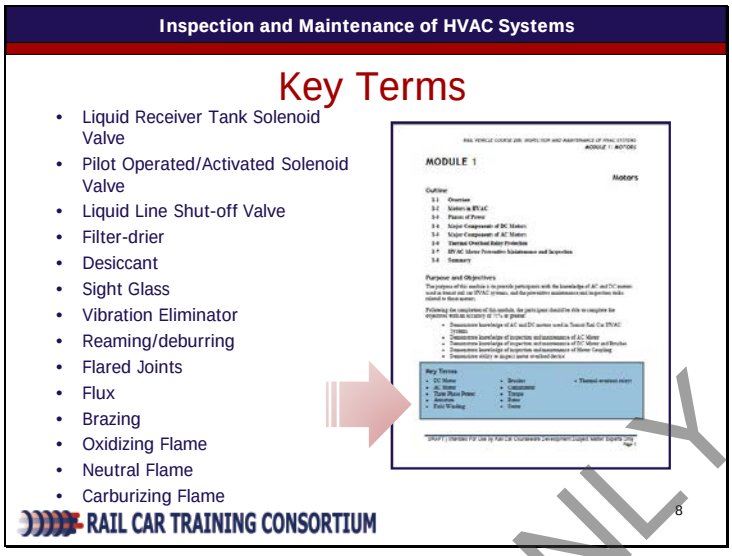
Slide 8



INSTRUCTIONAL ACTIVITY: List Key Words for Module 3

TIME: 2 minutes

INSTRUCTION METHOD: Lecture with discussion

SAY: This module contains several key terms. They are listed on the bottom of the Page __ in the Participant Guide. Some you may know and some you may not know. I am going to pull up the list of each key term. As I do so, make a note of which term you would like to know more about by circling that in your Participant Guide.

DO: Read each key term. **Click on mouse to advance to next term.**

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: __

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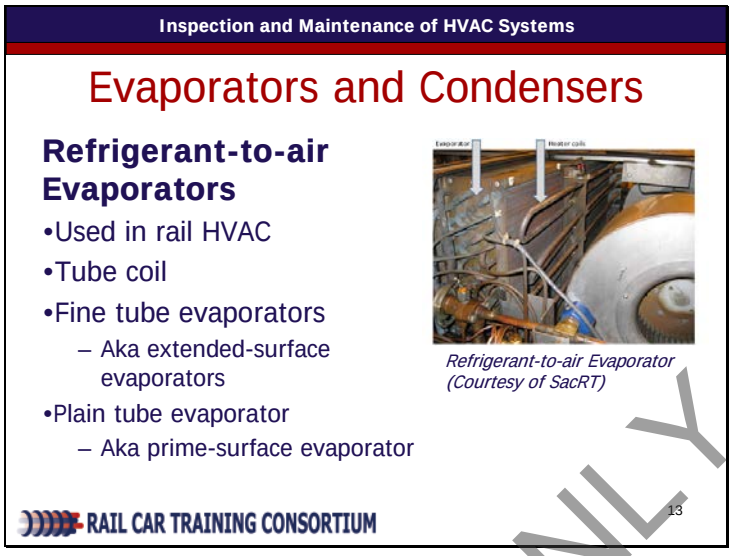

INSTRUCTIONAL ACTIVITY: Explain evaporators and condensers

TIME: 1 minutes

INSTRUCTION METHOD: Lecture

SAY: The **refrigerant-to-air evaporator** is a tube coil. The tubes usually have fins to expose more surfaces to the air passing through the evaporator.
Fine tube evaporators are also called extended-surface evaporators, plain tube evaporator are called prime-surface evaporator.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: __

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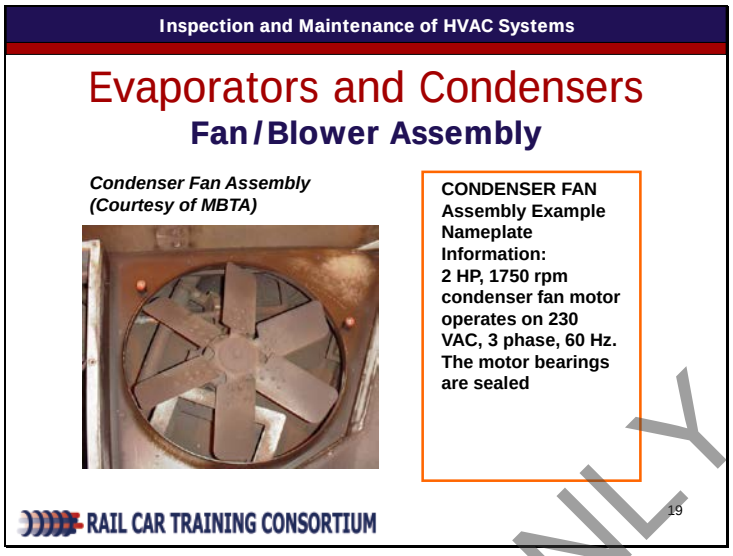

INSTRUCTIONAL ACTIVITY: Explain fan/blower assembly
TIME: 2 minutes

INSTRUCTION METHOD: Lecture

SAY: The propeller fan is used as an exhaust fan and condenser fan. It will handle large volumes of air at low pressure differentials. The propeller can be cast iron, aluminum, or stamped steel and is set into a housing called a venturi to encourage airflow in a straight line from one side of the fan to the other. The propeller fan makes more noise than the centrifugal blower so it is normally used where noise is not a factor.

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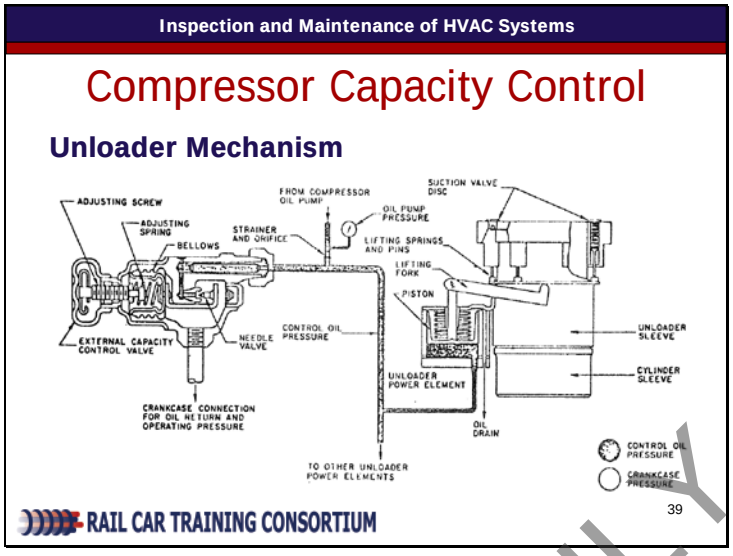
Slide 39



INSTRUCTIONAL ACTIVITY: Explain the unloader mechanism
TIME: 5 minutes

INSTRUCTION METHOD: Lecture

SAY: An increase in suction pressure, which requires increased compressor capacity, causes needle valve to close. Therefore, the lubrication oil pressure in the power element increases. Increased oil pressure in the power element moves the power piston upward and the suction valve discs are allowed to seat. The capacity control is of the step type in which variation in capacity is obtained by unloading two compressor cylinders in sequence. This is accomplished by holding the suction valve open continuously. The vapor drawn into the cylinder during the suction stroke is thus forced back through the suction valve to the suction manifold instead of being compressed and discharged through the discharge valve. As a result, cylinder capacity is reduced to zero with the minimum use of power. Two of the three cylinders may be unloaded providing 100%, 66-2/3%, and 33-1/3% of full capacity.
Capacity control is automatically obtained in response to suction pressure change. The lubrication oil supply is used to furnish the power to operate the mechanism which is so arranged that in the absence of oil pressure, the cylinder suction valves are held open. This automatically provides for starting the compressor without load.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: __
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Other Refrigerant Components

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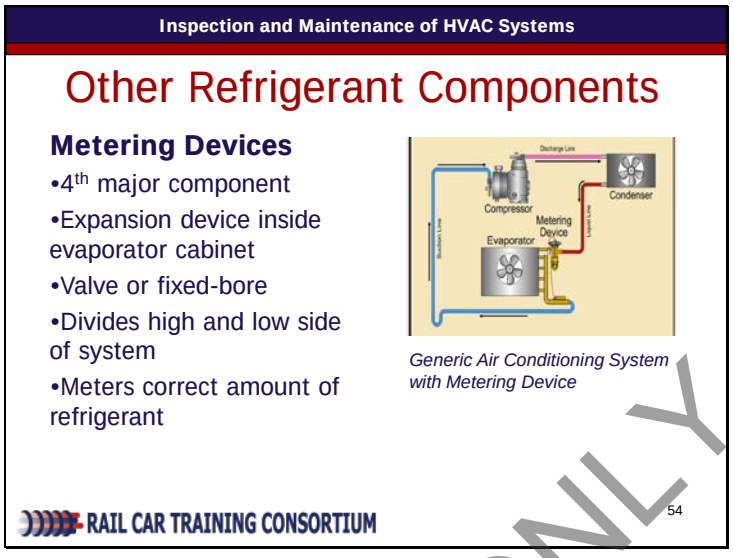

INSTRUCTIONAL ACTIVITY: Explain metering devices
TIME: 3 minutes
INSTRUCTION METHOD: Lecture

SAY: The three major refrigeration components – compressor/motor, evaporators and condensers – were discussed in detail in prior sections. The fourth major refrigeration component is the metering device (expansion device) which is described below.
The expansion device is not as visible as the evaporator, the condenser, or the compressor. Generally, it is concealed inside the evaporator cabinet and not obvious to the casual observer. The device can be either a valve or a fixed-bore. The expansion device is one component that divides the high side of the system from the low side (the compressor is the other). It is responsible for metering the correct amount of refrigerant to the evaporator. The evaporator performs best when it is as full of liquid refrigerant as possible with none left in the suction line. Liquid refrigerant that enters the suction line may reach the compressor because only a small amount of heat is added in the suction line.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: __

Other Tools/Media/Materials:
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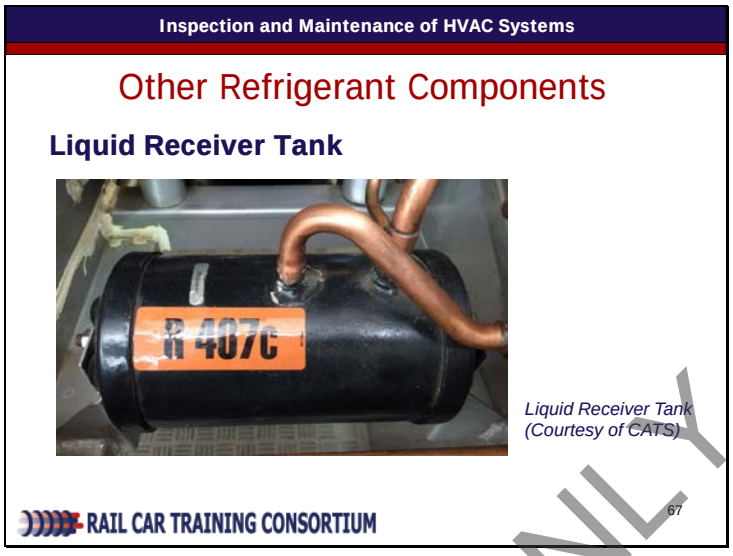

INSTRUCTIONAL ACTIVITY: Explain the liquid receiver tank
TIME: 2 minutes

INSTRUCTION METHOD: Lecture

SAY: The liquid receiver tank or receiver is located in the liquid line and is used to store the liquid refrigerant after it leaves the condenser. The receiver should be lower than the condenser so that the refrigerant has an incentive to flow into it naturally, but this is not always possible. The receiver is a tank-like device that can be either upright or horizontal, depending on the installation. The receiver inlet and outlet connection can be at almost any location on the outside of the tank body. On the inside of the receiver, however, the refrigerant must enter the receiver at the top in some manner. The refrigerant that is leaving the receiver must be taken from the bottom to ensure that it is 100% liquid. This is accomplished with a dip tube if the outlet line is at the top.

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Other Tools/Media/Materials:

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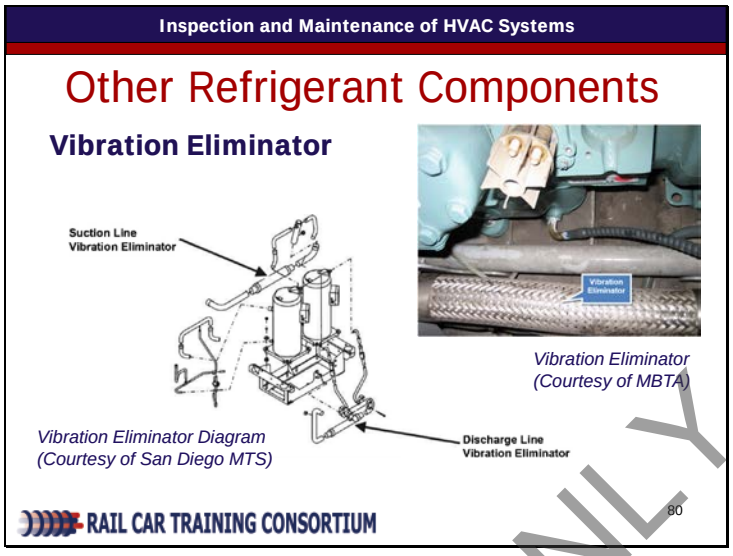

INSTRUCTIONAL ACTIVITY: Explain vibration eliminators
TIME: 5 minutes

INSTRUCTION METHOD: Lecture

SAY: Compressors produce enough vibration while running that it is often necessary to protect the tubing at the suction and discharge lines. Vibration can be eliminated on small compressors successfully with vibration loops. Large tubing cannot be routed in loops, so special **vibration eliminators** are often installed. These are constructed with a bellows-type lining and a flexible outer protective support as shown here. These devices must be installed correctly, or other problems may occur, such as extra vibration. The typical recommendation is that they be installed close to the compressor and in parallel with the compressor's crankshaft. If mounted crossways or perpendicular to the crankshaft, excess vibration may occur. Follow the manufacturer's directions.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: __

Other Tools/Media/Materials:

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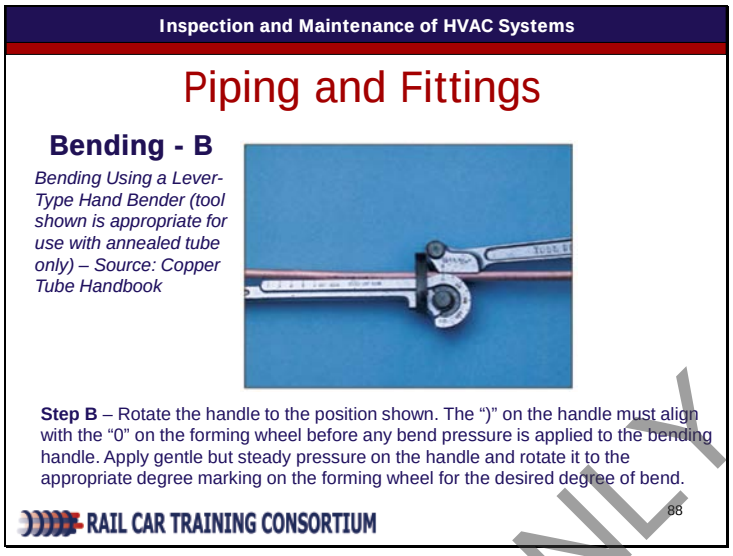

INSTRUCTIONAL ACTIVITY: Explain bending
TIME: 1 minutes

INSTRUCTION METHOD: Lecture

SAY: Step B – Rotate the handle to the position shown. The ")" on the handle must align with the "0" on the forming wheel before any bend pressure is applied to the bending handle. Apply gentle but steady pressure on the handle and rotate it to the appropriate degree marking on the forming wheel for the desired degree of bend.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: __

Other Tools/Media/Materials:

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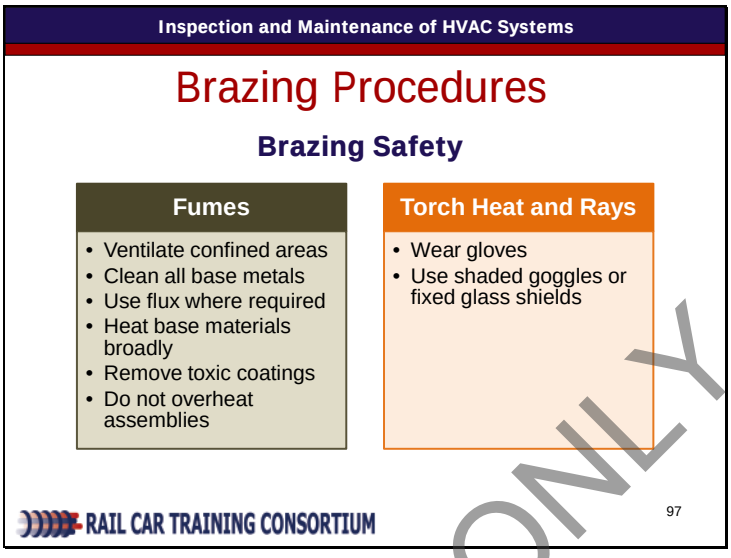
Brazing Procedures

Slide 97



INSTRUCTIONAL ACTIVITY: Explain safety in brazing
TIME: 5 minutes

INSTRUCTION METHOD: Lecture

SAY: The basic knowledge of soldering and brazing has been covered in Module 2 of Course 106. Soldering is used for low temperature and low pressure appliances like compressed air systems and water supplies. Brazing is much stronger, and can handle the high pressures and temperatures of an HVAC system. Therefore the brazing procedures are more applicable to rail HVAC maintenance. In the following section, the safety aspects and basic procedures of the brazing process are discussed.
In brazing there are two possible sources of hazard to technicians. One consists of chemical fumes, and the other the heat and rays of the torch flame. The following general precautions should be taken to guard against these hazards.
Ventilate confined areas, using fans, exhaust hoods or respirators if necessary. Clean all base metals to remove surface contaminants that may create fumes when the metals are heated. Use flux (where required) in sufficient quantity to prevent oxidation and fuming during the heating cycle. Heat broadly, and heat only the base metals – not the filler metal. Remove any toxic coatings and be careful not to overheat assemblies.

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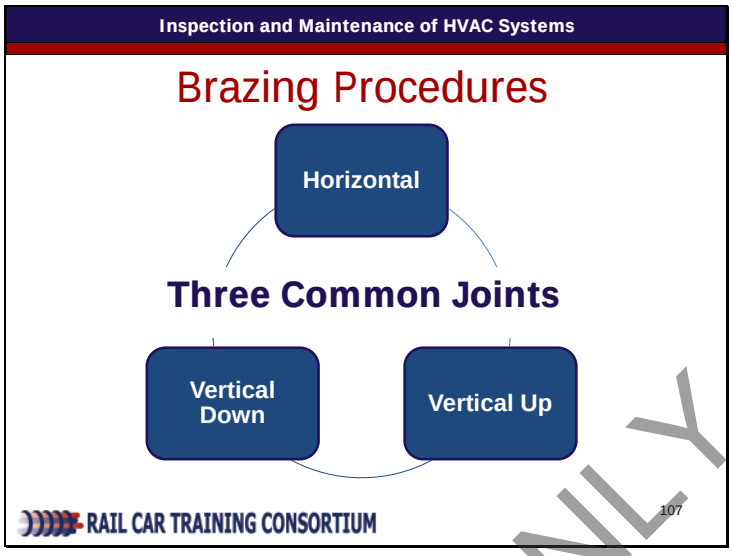

INSTRUCTIONAL ACTIVITY: Explain brazing steps
TIME: 5 minutes

INSTRUCTION METHOD: Lecture

SAY: The brazing techniques described will vary somewhat depending upon the kind of joint you're making. The three common tube-to-fitting joints used in HVAC components are the vertical down, the vertical up and the horizontal joint. The following procedures are recommended for each of these joints:
Vertical down joints: Bring the entire joint area up to temperature quickly and uniformly, heating the tube first, then the fitting. When the joint area has reached brazing temperature, apply a little extra heat to the fitting, since this is the direction in which you want the filler metal to flow.
Vertical up joints: Start by heating the tube. When it has reached a temperature of about 800° F (425° C) transfer the heat to the fitting. Then sweep back and forth from fitting to tube, all around the joint area. Be careful not to overheat the tube below the fitting, as this would encourage the filler metal to run down the tube and out of the joint. When brazing temperature is reached, touch the filler metal to the joint with the flame on the wall of the fitting. This heating pattern will draw the filler metal up and completely through the joint area.
Horizontal joints: Preheat the tubing and fitting quickly and evenly. When brazing temperature is reached, apply the filler metal to the top of the joint. The combination of

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