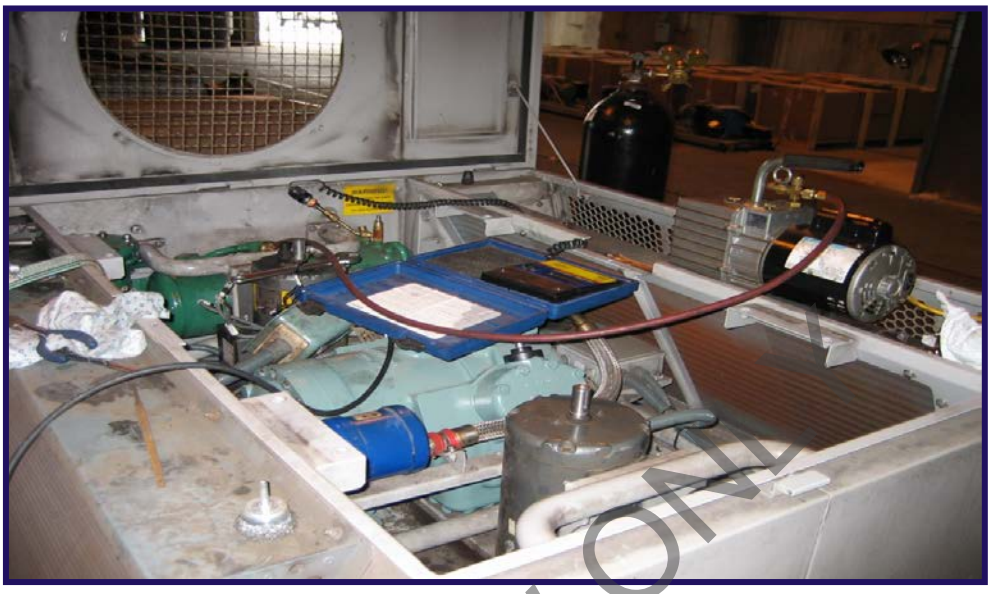


Course 206

HVAC Systems
Inspection and Maintenance

Module 2:
Refrigerant Handling

INSTRUCTOR GUIDE

RAIL CAR TRAINING CONSORTIUM

Table of Contents

Overview to Module 2

- Duration of this module: 290 minutes (Close to 4 hours including field trip)
- PowerPoint slides: 59
- This module has a quiz.

Videos, Handouts, Job Aids, Take-aways

Links to nine (9) YouTube and Vimeo videos are made available to enhance participants' learning:

- ✓ Video – Leak Detection Methods: Electronic Leak Detector by MBTA (Vimeo)
- ✓ Video - Effective Refrigerant Recovery – Getting Started by Yellow Jacket
- ✓ Video – Refrigerant Recovery - Techniques Overview by Yellow Jacket
- ✓ Video – Recovery Techniques – Liquid Recovery by Yellow Jacket
- ✓ Video – Recovery Techniques – Vapor Recovery by Yellow Jacket
- ✓ Video – Recovery Techniques – Push-Pull Recovery by Yellow Jacket
- ✓ Video – Vacuum Pump Maintenance by Yellow Jacket
- ✓ Video – How to set up the Micron Gauge by Grayfurnaceman
- ✓ Video – The Evacuation and Charging Process by Yellow Jacket

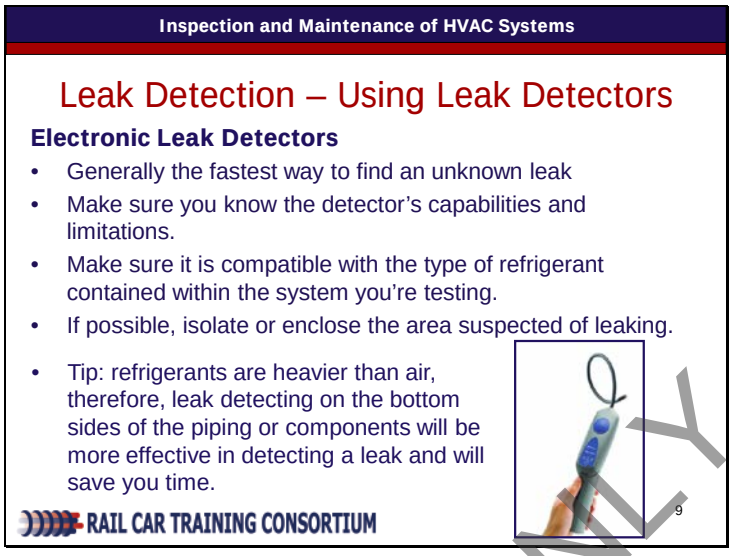
The Instructor should bring the following materials/equipment if applicable:

- ✓ An electronic leak detector used on your property.
- ✓ An ultraviolet lamp if used on your property.
- ✓ An ultrasonic leak detector if used on your property.
- ✓ A refrigerant recovery machine used on your property.
- ✓ A vacuum pump used on your property.
- ✓ Property-specific vapor, liquid, or push-pull recovery setup diagram

Outline of PowerPoint Presentation

Topic Title	Slides	Duration (Minutes)
Overview	1-6	10
Leak Detection	7-20	40
Recovery, Recycling, Reclaiming and Disposal	21-36	55
Evacuation and System Charge	37-56	80
Field Trip	57	90
Summary and Quiz	58-59	15
		290 minutes (Close to 4 hours including Field Trip)

Slide 9



INSTRUCTIONAL ACTIVITY: Provide Information on Leak Detection using an Electronic Leak Detector

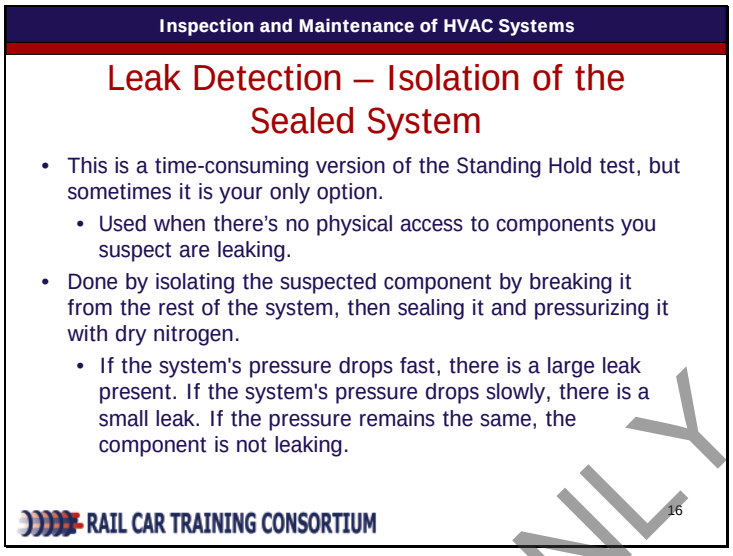
TIME: 3 minutes

INSTRUCTION METHOD: Lecture with hands-on demonstration in lab or during field trip

SAY: Using an electronic leak detector is generally the fastest way to find an unknown leak. They can be used to find a leak quickly or to find the area in which the leak exists. After you find the area in which the leak is detected, you can usually decrease the sensitivity of some types of detectors to pinpoint the area of the leak. The leak area is then coated with soap solution to verify the exact point of the problem.
Here are some important pointers when using electronic leak detectors: If you suspect the leak is very small, it may be possible to enclose the suspected area for a period of time to allow the leaking refrigerant time to accumulate. When accumulated, it's more readily sensed by the detector.
This may be done by wrapping a suspected leak in cellophane and leaving it pressurized with a refrigerant charge for a period of time. Then, by using an electronic leak detector, cut the cellophane at the bottom while using an electronic detector to detect any refrigerant that may have accumulated in the pouch over time.

Instructor Notes

Slide 16



INSTRUCTIONAL ACTIVITY: Provide Information on Isolation of Sealed System

TIME: 3 minutes

INSTRUCTION METHOD: Lecture with hands-on demonstration in lab or during field trip

SAY: This method is usually used when you have no physical access to components you suspect are leaking or when you want to identify which part of the system contains the leak. This process involves isolating the component suspected of leaking from the rest of the system. This is done by breaking the suspected part of the system from the rest of the system, sealing it and pressurizing only that component with dry nitrogen. Then use the standing hold test.
If the system's pressure drops fast, there is a large leak present in the component or that section of the system. If the system's pressure drops slowly, there is a small leak present. If the pressure remains the same, the component is not leaking.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: __

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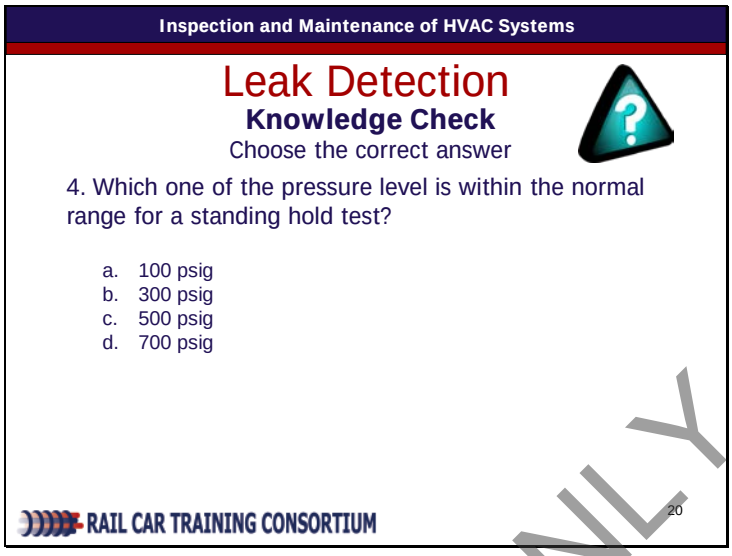
Slide 20



INSTRUCTIONAL EVENT: Assess participants' grasp of content presented so far.
TIME: 1 minute
SAY: Here's the Knowledge Check. What do you think the answer is?
DO: This should be easily answered by all participants. When they decide on the answer, advance the slide to reveal the correct answer. **Answer:** a. 100 psig.
PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE:

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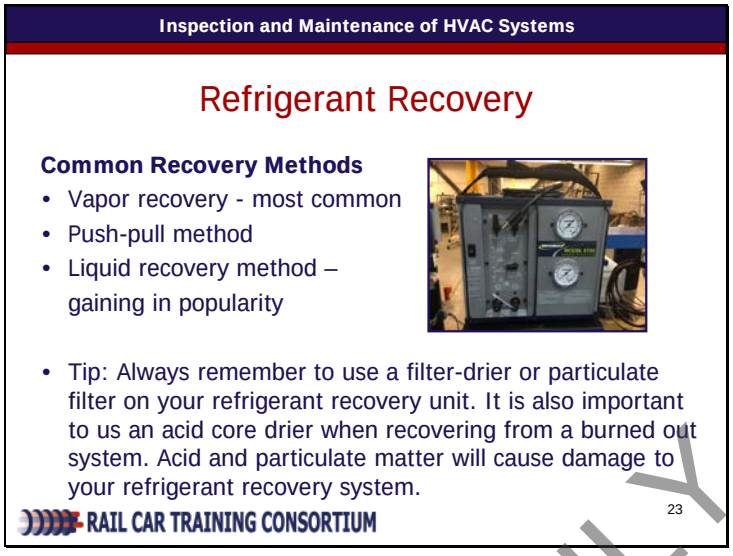

INSTRUCTIONAL ACTIVITY: Provide Overview of Common Recovery Methods

TIME: 2 minutes

INSTRUCTION METHOD: Lecture

SAY: The three different recovery methods are: vapor recovery, which is the most common; the push-pull method; and the liquid recovery method, which has gained popularity more recently. For rail HVAC refrigerant recovery, vapor and liquid recovery methods are most commonly used, although push-pull method is also occasionally used. Always remember to use a filter-drier or particulate filter on your refrigerant recovery unit. It is also important to us an acid core drier when recovering from a burned out system. Acid and particulate matter will cause damage to your refrigerant recovery system. If you use the appropriate filter on every job, your refrigerant recovery equipment should give you many years of trouble-free service. The following information describes the most common recovery configurations. Remember, your system configuration may vary. Check your operation manual to find the proper configuration for your unit.

Other Tools/Media/Materials: Bring a refrigerant recovery machine used on your property.

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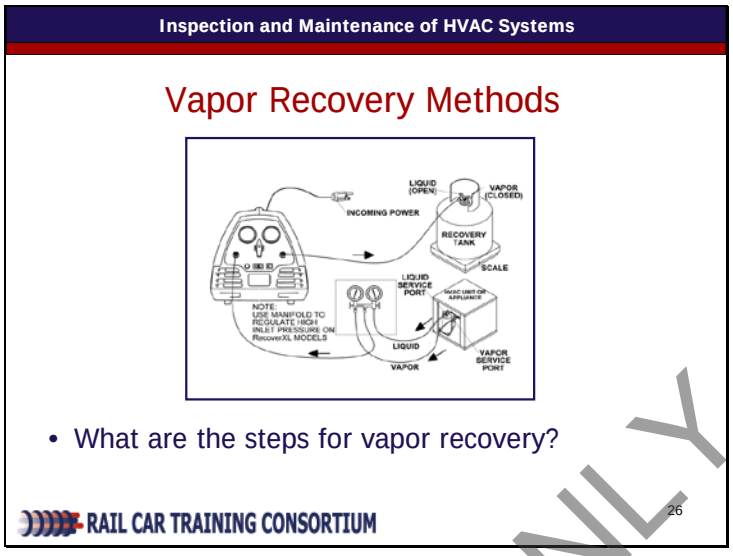

INSTRUCTIONAL ACTIVITY: Explain process of vapor recovery

TIME: 5 minutes

INSTRUCTION METHOD: Lecture with hands-on demonstration in lab or during field trip

SAY: In the **vapor recovery** method, the refrigerant is removed from the HVAC system in a vapor state. The vapor is then condensed into a liquid by the recovery unit and transferred to the recovery cylinder. Referring to the participant guide, let's walk through the general process of vapor recovery method.

Other Tools/Media/Materials: Property-specific vapor recovery setup diagram

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE: __

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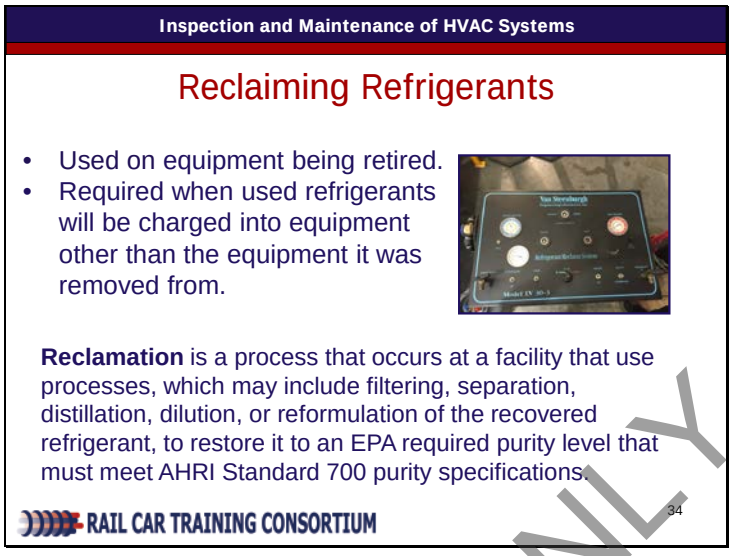

INSTRUCTIONAL ACTIVITY: Overview of Refrigerant Reclamation

TIME: 2 minutes

INSTRUCTION METHOD: Lecture

SAY: When refrigerant is recovered from equipment being retired, it is an excellent opportunity to have the used refrigerant reclaimed. Reclamation is also required when used refrigerants will be charged into equipment other than the equipment it was removed from.

Reclamation is a process that occurs at a facility that use processes, which may include filtering, separation, distillation, dilution, or reformulation of the recovered refrigerant, to restore it to an EPA required purity level that must meet AHRI Standard 700 purity specifications.

In the United States, there are about 50 EPA-certified reclaimers and many of them are rapidly expanding their programs in more areas of the country.

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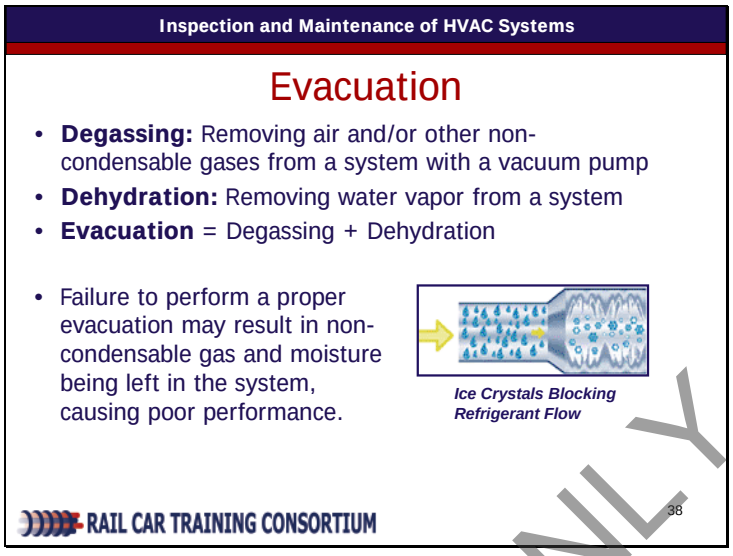

INSTRUCTIONAL ACTIVITY: Overview of Evacuation

TIME: 2 minutes

INSTRUCTION METHOD: Lecture

SAY: After performing refrigeration service work on a unit, it is necessary to evacuate the unit to ensure long term operational performance and reliability. Removing air and/or other non-condensable gases from a system with a vacuum pump is called **degassing** a system. Removing water vapor from a system is known as **dehydration**. In the HVAC/R industry, the process of removing both air and water vapor is referred to as **evacuation**.

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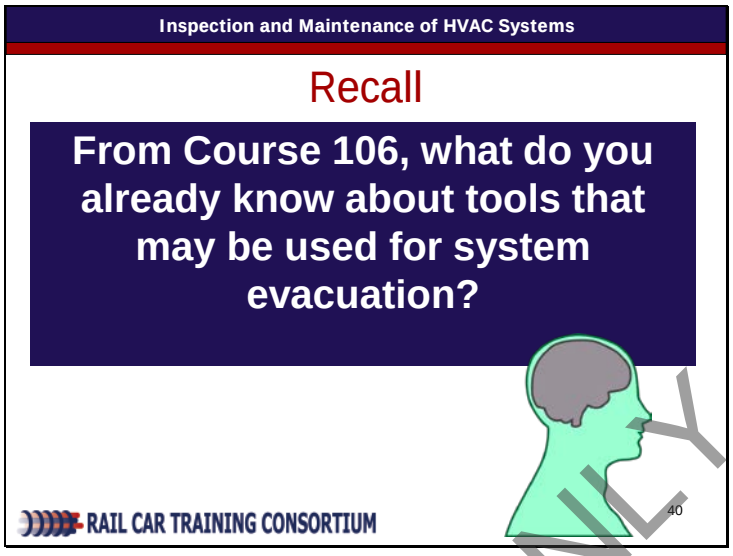


INSTRUCTIONAL ACTIVITY: Encourage recall of known topics.

TIME: 2 minutes

INSTRUCTION METHOD: Discussion

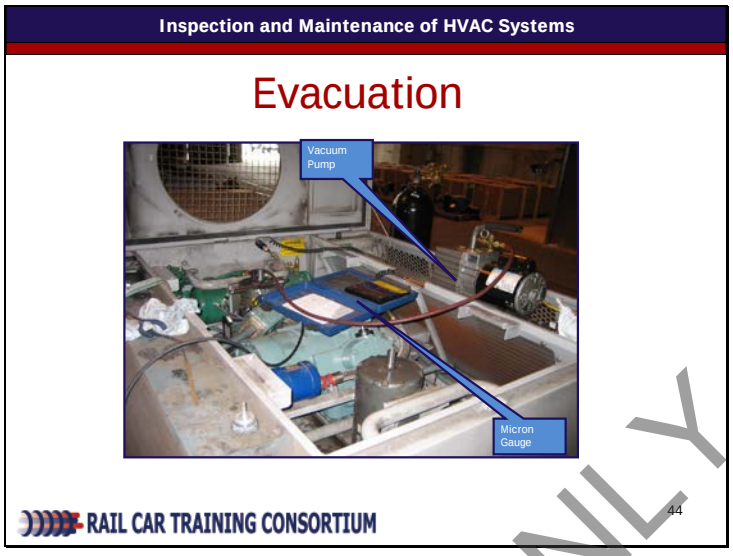
SAY:

DO: Facilitate discussion on some of the responses offered by participants.

ADVANCE SLIDE

Instructor Notes

Slide 44



INSTRUCTIONAL ACTIVITY: Evacuation Process

TIME: 2 minutes

INSTRUCTION METHOD: Lecture

SAY: Evacuation should be performed through three ports in the refrigeration system. The hoses should be connected to the compressor suction and discharge service ports, and to the king valve service port. Connect the hoses from the refrigeration unit to the evacuation manifold. A refrigerant recovery system is also connected to the system. If the unit will be swept with dry nitrogen instead of refrigerant, the refrigerant recovery machine will not be needed. A vacuum gauge thermistor is connected to the manifold gauge set. The compound gauge on the manifold gauge set will be used to monitor system pressure, not vacuum. On the next slide, we will discuss specific steps of the evacuation process.

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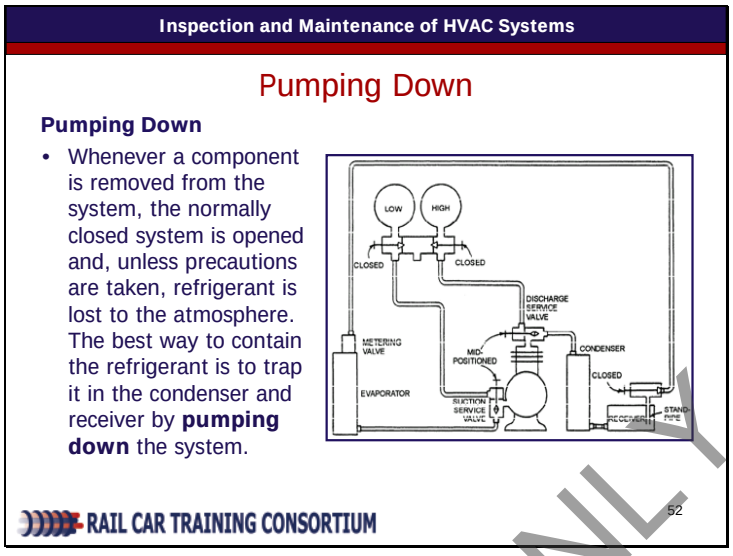

INSTRUCTIONAL ACTIVITY: Overview of Pumping Down

TIME: 2 minutes

INSTRUCTION METHOD: Lecture with hands-on demonstration in lab or during field trip

SAY: Quality refrigeration repair includes preventing loss of refrigerant in the system. Whenever a component is removed from the system, the normally closed system is opened and, unless precautions are taken, refrigerant is lost to the atmosphere. The best way to contain the refrigerant (gas and liquid) is to trap it in the condenser and receiver by **pumping down** the system.

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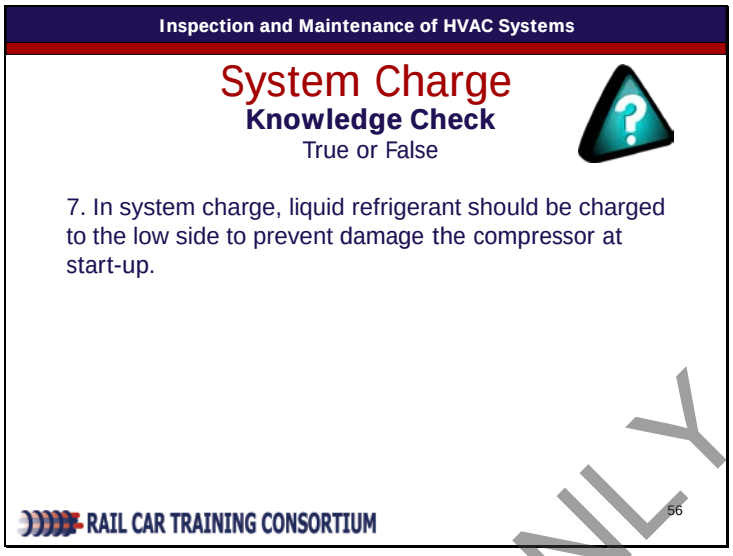

INSTRUCTIONAL EVENT: Assess participants' grasp of content presented so far.
TIME: 1 minute
SAY: Here's the t Knowledge Check. What do you think the answer is?
DO: This should be easily answered by all participants. When they decide on the answer, advance the slide to reveal the correct answer. **Answer:** False. In system charge, liquid refrigerant should be charged to the high side. Putting liquid refrigerant into the low side of the system can damage the compressor at start-up and dilute the oil in the crankcase with refrigerant, causing oil flash and scored bearings.

PARTICIPANT GUIDE (COURSEBOOK) PAGE REFERENCE:

ADVANCE SLIDE

Instructor Notes