A/C Refrigerant

Air Conditioning systems use refrigerant to move heat from air inside the car to air outside the car.

Refrigerants are HAZARDOUS to you and the environment.
Motor Vehicle Air Conditioning

• Technicians servicing MVAC systems must be Trained and Certified

• Equipment used to service MVAC system must meet Society of Automotive Engineers (SAE) standards
LOOK UP THE STANDARDS

• You are expected to look up – read – and become familiar with many specific standards

• During the test, LOOK UP the answers in the ASE review materials.

• LBCC will pay for 1 test only! No retakes without your payment.
Environmental Hazards

• The Environmental Protection Agency – EPA first regulated MVAC systems using R-12

• R-12 was found to be Ozone-Depleting

• Ozone in the Stratosphere filters out harmful Ultraviolet Radiation

• Pages 5 – 7 in ASE review booklet
Environmental Hazards

• R-12 is a ChloroFluoroCarbon molecule - CFC.

• As the CFC's reach the upper atmosphere, sunlight will cause chlorine atoms to separate.

• Chlorine reacts with Oxygen to create Chlorine Monoxide

• This causes a "Hole" in the ozone layer
Environmental Hazards

• Without an Ozone layer in the stratosphere, Ultraviolet radiation increases causes:
  • Increased Skin Cancer
  • Suppressed Immune System
  • Increased Eye Cataracts
  • Damage to marine and plant life

Pages 5 – 7 in ASE review booklet
Environmental Hazards

• R-12 is a ChloroFluoroCarbon or CFC-12

• This was the MVAC refrigerant used until 1995

• Newer refrigerants are designed to protect the Ozone layer

• The most recent refrigerants are designed to reduce Global Warming

Pages 5 – 7 in ASE review booklet
Types of Refrigerant for MVAC

Refrigerants are identified by chemical compound OR the letter R

CFC-12 \( I = \) R-12

HFC-134a = R-134a

HFO-1234yf = R-1234yf

Pages 5 – 7 in ASE review booklet
## Environmental Impact of MVAC Refrigerants

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Global Warming Potential</th>
<th>Ozone Depleting?</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-12 (CFC-12)</td>
<td>10,900</td>
<td>Yes</td>
</tr>
<tr>
<td>R-134a (HFC-134a)</td>
<td>1,430</td>
<td>No</td>
</tr>
<tr>
<td>R-152a</td>
<td>124</td>
<td>No</td>
</tr>
<tr>
<td>R-1234yf (HFO-1234yf)</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>R-744 (CO₂)</td>
<td>1</td>
<td>No</td>
</tr>
</tbody>
</table>

*Global warming potential values are from the IPCC Fourth Assessment Report: Climate Change 2007 (AR4)*
R-134a

• R-134a is a HydroFluoroCarbon or HFC-134a

• R-134a is the only refrigerant that manufacturers recommend for Retrofitting older R-12 systems
  • (other refrigerants have been approved by EPA but are not authorized by manufacturers)

• R-134a does not harm the ozone however it is a significant contributor to global warming

Pages 5 – 7 in ASE review booklet
R-1234yf

• R-1234yf is a HydroFluoroOlefin or HFO-1234yf

• HFO-1234yf is the newest MVAC refrigerant due to its low Global Warming Potential (GWP)

• Other refrigerants are being considered – CO₂ technology is being developed.
EPA Regulations

Any technician servicing MVAC systems must be trained and certified for **section 609** of the Clean Air Act.

You are being certified for Motor Vehicle A/C.

Separate standards exist for **section 608** stationary and commercial A/C systems.

you ARE NOT being trained or certified to handle Non-MVAC refrigerants.

Pages 8 – 10 in ASE review booklet
<table>
<thead>
<tr>
<th>MVAC (609)</th>
<th>Non-MVAC (608)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Passenger cars</strong></td>
<td><strong>Trains</strong></td>
</tr>
<tr>
<td><strong>Buses</strong></td>
<td><strong>Aircraft – passenger &amp; cargo</strong></td>
</tr>
<tr>
<td><strong>Trucks</strong></td>
<td><strong>Refrigerated trailers</strong></td>
</tr>
<tr>
<td><strong>MVAC-like (609 or 608)</strong></td>
<td><strong>Ship/boat – passenger &amp; cargo</strong></td>
</tr>
<tr>
<td><strong>Off-road vehicles</strong></td>
<td></td>
</tr>
</tbody>
</table>

*If R-22, then 608*

**Please note:** Because of some overlap between Section 608 and Section 609, MVAC-like appliances such as off-road vehicles can be covered by this ASE Section 609 program. Any application using R-22 refrigerant is governed under Section 608 for service and for the purchase of R-22 refrigerant. For more information about Section 608, visit: [http://www.epa.gov/ozone/title6/608](http://www.epa.gov/ozone/title6/608)
EPA Regulations

• You are responsible to make sure any equipment you use to service MVAC systems meet Society of Automotive Engineers SAE standards.

• You must ensure refrigerant used is not contaminated with other refrigerants, or non-condensable gases (air).

• SAE standards are explained on pages 8 – 10 in the ASE Refrigerant Recovery & Recycling book.

Pages 8 – 10 in ASE review booklet
Alternative Refrigerants

• To replace the Ozone Depleting R-12 many alternative refrigerants were created and are regulated by the EPA Significant New Alternatives Policy or SNAP

• Only EPA-SNAP approved refrigerants may be used. Pages 13 and 14 list approved and Unacceptable alternatives for retrofit or replacement of R-12.

• From this list ONLY R-134a is approved by any vehicle manufacturer as a retrofit refrigerant

Pages 11 – 16 in ASE review booklet
Alternative Refrigerants

• To avoid contamination - every type of refrigerant must have different styles of service fittings

• SAE J639 helps standardize MVAC system design, implementation and service including refrigerant fitting sizes
SAE J639 specifies fitting sizes for each refrigerant

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Low Side</th>
<th>High Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-12 (pre-1987)</td>
<td>Threaded 7/16 in. x 20</td>
<td>Threaded 7/16 in. x 20</td>
</tr>
<tr>
<td>R-12 (post-1987)</td>
<td>Threaded 7/16 in. x 20</td>
<td>Threaded 3/8 in. x 24</td>
</tr>
<tr>
<td>R-134a</td>
<td>Quick-coupler Unthreaded 13mm O.D.</td>
<td>Quick-coupler Unthreaded 16mm O.D.</td>
</tr>
<tr>
<td>R-1234yf</td>
<td>Quick-coupler Unthreaded 14mm O.D.</td>
<td>Quick-coupler Unthreaded 17mm O.D.</td>
</tr>
</tbody>
</table>

Pages 11 – 16 in ASE review booklet
R-134a fitting
Quick coupler

R-12 fitting
Threaded coupler

Pages 11 – 16 in ASE review booklet
Air conditioning systems pose these unique safety risks:

**Contact with Escaping Refrigerant**

When pressurized refrigerant is released, it instantly freezes anything it touches.

- If it touches your skin, it can cause frostbite and tissue damage.
- If it touches your eyes, it can cause blindness.

Always wear gloves and safety glasses when servicing refrigerant systems.

**High Pressure Gas Cylinders**

Damage to cylinders or hoses can weaken them to the point of failure. Exposure to heat can cause gas pressure to rise to unsafe levels. Protect high-pressure components from heat or damage that can lead to a dangerous rupture.

⚠️ **Service Tips:**

- When servicing automotive systems, follow all safety guidelines and other precautions described in the applicable Repair Manual.
- When servicing hybrid vehicles, take extra care to make sure the vehicle is off so that the engine cannot start unexpectedly during repairs.
Refrigerant Storage Safety

• Refrigerant containers should never be exposed to temperatures higher than 125°F.

• Refrigerant cans should not be left in direct sunlight.

• Increased temperature = Increased pressure
  Hot containers can explode or rupture
A/C Refrigerant is under high pressure even when the system is not running.

A/C refrigerant must be properly discharged into a refrigerant recovery unit BEFORE components or refrigerant lines get disconnected.

Liquid refrigerant, when exposed to the air, quickly evaporates and will instantly freeze skin or eyes.

Refrigerant that escapes the A/C system can cause serious and instant frostbite to skin and can blind you if it contacts your eyes.
Personal Safety

• Wear safety glasses with side shields – Chemical splash goggles are the safest

• Wear leather or insulating gloves when working with pressure fittings or recovery equipment

• Work in well ventilated area to avoid asphyxiation
Personal Safety

• Do not use compressed air to leak test – compressed air and refrigerant are flammable

• Never use a disposable refrigerant tank for storing recycled refrigerant

• Do not fill refrigerant storage tanks over 60% of the gross weight rating
Prevent Refrigerant Contamination

• Refrigerant storage tanks are color coded

• MVAC systems use different service fittings for each refrigerant

• Gauge hoses are color coded for each refrigerant
### Refrigerant Cylinder Identification and Fitting Size

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Color</th>
<th>Fitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-12</td>
<td>White</td>
<td>7/16 in. x 20</td>
</tr>
<tr>
<td>R-134a</td>
<td>Light blue (PMS color 2975)</td>
<td>RH Thread, ½ in. 16 ACME</td>
</tr>
<tr>
<td>R-1234yf</td>
<td>White with red band</td>
<td>LH Thread, ½ in. 16 ACME</td>
</tr>
</tbody>
</table>

Pages 17 – 21 in ASE review booklet
• Most refrigerant is sold in Disposable Containers

• Disposable tanks are NOT USED to recycle or reclaim refrigerant

• Recycled or reclaimed refrigerant must be stored tanks marked DOT-4BA or DOT-4BW only.

• Refrigerant tanks can be filled to a **MAXIMUM of 60%** gross weight rating

• Empty disposable refrigerant containers must be evacuated using a recovery machine.
R-134a Gauge Hose
Red-black stripe = high side
Blue-black stripe = low side
Yellow-black stripe = service

R-12 Gauge Hose
Solid Red or Black-Red stripe = high side
Solid Blue or Black Blue stripe = low side
Solid Yellow or Black/yellow = service

Pages 22 – 28 in ASE review booklet
Dangerous to connect Low side gauge to the High Side of the system

Gauges of refrigerant hoses not connected to the vehicle MUST have valves Shut OFF to avoid extra air contamination

Pages 22 – 28 in ASE review booklet
High and Low side of the A/C system
Non-Condensable gas

- Recycled Refrigerant can be contaminated with Air

- Air is a “Non-Condensable” gas

- Air will raise system pressures and can be detected by carefully measuring the pressure and temperature of the container

- High pressures = air

Pages 17 – 21 in ASE review booklet
Test for Non-Condensable gas (air)

• Before using any stored container of refrigerant... check for Non-Condensable gas (air)

• Make sure cylinder has been stored out of direct sunlight (this can change temperature inside cylinder)

• Make sure container was stored above 65° for over 12 hours (to ensure temperature inside is the same as outside air)

• Accurately measure temperature of air next to cylinder

• Pressure must not be higher than shown on the chart
Carefully measure temperature and pressure of the refrigerant cylinder.

Pressures higher than shown indicates air in the cylinder.
Air in Refrigerant

• Air is lighter than refrigerant

• To purge air from a stored tank slowly vent the top of the cylinder into a recycling/recovery machine.

• The recycling process will remove air.

• The pressure chart is only accurate for pure R-134a
Before recycling ANY refrigerant

• Use a refrigerant identifier before connecting to any vehicle or newly acquired refrigerant tank

• R-134a Refrigerant being reclaimed, recycled, or used must meet the SAE J2099 purity standards

• If you recycle or recover contaminated refrigerant your storage tank becomes unusable.

• Process contaminated tanks as Hazardous Waste
Refrigerants CAN NOT be mixed

- Many refrigerants are used with MVAC

- It is critical to always use an electronic refrigerant identifier before recovering and recycling any vehicle’s refrigerant

Pages 22 – 28 in ASE review booklet
Refrigerant identifier

Pages 22 – 28 in ASE review booklet
Refrigerants CAN NOT be mixed

• Mixed Refrigerants are inefficient (Poor Cooling)

• Some combinations of refrigerants will clog and ruin recovery and recycling machines

• Each type of refrigerant uses a different lubricating oil. Mixed refrigerants wear out compressors

• Some combinations of refrigerants are flammable

Pages 22 – 28 in ASE review booklet
Refrigerants CAN NOT be mixed

• R-12 and R-134a systems should ALWAYS be checked for contaminated refrigerant BEFORE recovery or recycling

• The newest refrigerant R-1234yf requires use a refrigerant identifier that is integrated into the recovery/recycling/recharging equipment

Pages 22 – 28 in ASE review booklet
Moisture Contamination

Moisture is a primary cause of contamination-related problems MVAC system.

Moisture in refrigerant will cause:

- Ice forming in evaporator, expansion valve or orifice.
- Degradation of lubricating oil.
- Acid formation.
- Corrosion of metals.
- Compressor failure

Pages 22 – 28 in ASE review booklet
Moisture Contamination

Any time an A/C component is removed

ALL openings should be tightly capped

This reduces moisture (and dirt) entering system

Receiver/Driers and Accumulators have desiccant bags to trap moisture.

This desiccant will actively suck moisture from the air!
Moisture Contamination

Evacuation and applying strong vacuum to the empty MCAV system will remove moisture from system.

Receiver/Driers and Accumulators have desiccant bags to trap moisture.

Vacuum will not dry out the desiccant

Any system open to air for more than a very brief time should have the Receiver or Accumulator replaced
Refrigerant Recovery/Recycle Process

#1 Identify refrigerant in the vehicle.
   Also do this if purging air from a stored refrigerant tank.

#2 Follow the directions on recovery machine and connect machine to the vehicle

#3 Recover all refrigerant until Vacuum is shown on gauges
Refrigerant Recovery/Recycle Process

#4 Turn OFF vacuum pump and wait. Pressure may rise if small amounts of refrigerant or moisture are present.

#5 Continue this recover process until a stable vacuum is held for at least 2 minutes
Refrigerant Recovery/Recycle Process

If vacuum will not hold for at least 2 minutes...

...perform leak checks.

(outlined on pg 24 – 26 of the ASE booklet)
Calculate the Proper Refrigerant Charge

Always look up the correct charge specification

Use the label in the engine compartment or look it up
Proper amount (charge) of refrigerant is by weight

Charging machines use very accurate scales

May be calibrated in Pounds or Ounces

You must accurately convert from weight specified to the weight shown on recharge machine
16 oz = 1 lb

Specification is 1.25 lbs – How many ounces is this?

1.25 pounds × 16 = specified ounces

20 oz

Specification is 28oz – How many pounds is this?

28 ounces ÷ 16 = specified pounds

1.75 lbs
Overcharge (too much refrigerant) = poor cooling

Undercharge (not enough refrigerant) = poor cooling

Use calculator or conversion app to get proper charge