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Your Instructor For This Webinar

- National Trainer, ASE World Class, Master Auto, Truck, School Bus, L1, L3, CNG
- ATTP Master Instructor, New York State, CT and New Jersey
- STS (Service Technician Society) 2003 President
- TST (Technicians Service Training) Founder and President
- Author / Co Author/ Technical adviser on 25 plus books including
- OBD II and Mode 6, and Understanding and Diagnosing Hybrid Vehicles
- Published articles for multiple newsletters, and magazines
- Picked as one of the Top Instructors in the country by EPA & SAE
- Numerous Radio, TV, Internet, and SAE Video appearances
- PTEN, Motor Age and TST Webcast Instructor - Dorman Training Director
- Motor Magazine Top 20 award winner
- Provider of OBD II Training for 14 states, Ontario Canada and the US EPA
- Guest speaker at SAE Congress, IM Solutions and Clean Air Conference

"G" Jerry Truglia

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What Will Be Covered

Instructions For This Webinar

This webinar will be approx. 1 + hour long

- **All slides that are presented are in your handout and are numbered**
- **Have a pen or pencil and paper for notes**
- **Questions can be asked at anytime**

01 **Heating System Issues**

02 **Equipment**

03 **R134a - R1234yf**

04 **Mix Bag**

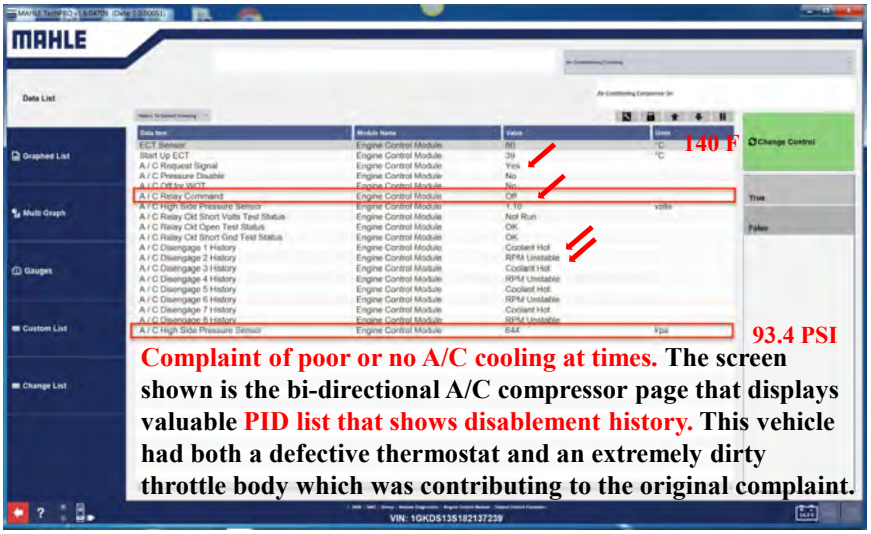
05 **Tips…**

3

Coolant

4

A/C Command OFF

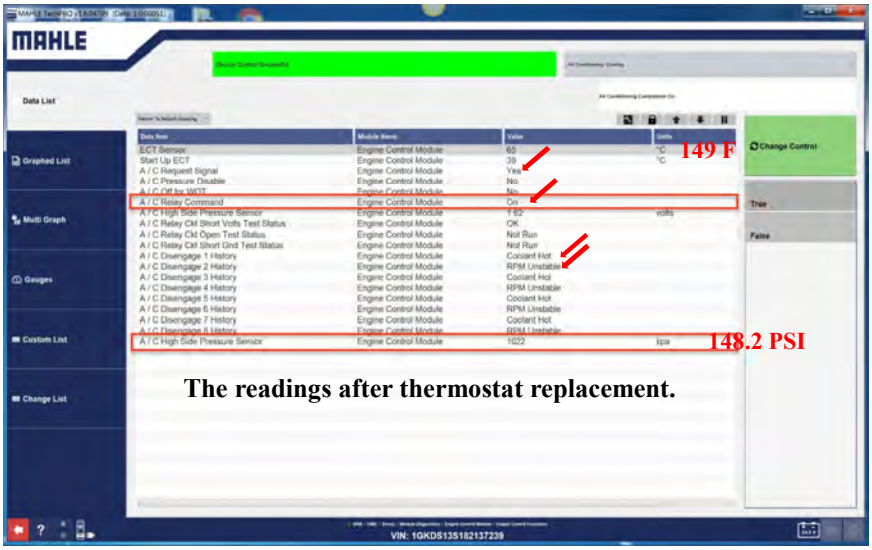


Complaint of poor or no A/C cooling at times. The screen shown is the bi-directional A/C compressor page that displays valuable **PID list that shows disablement history.** This vehicle had both a defective thermostat and an extremely dirty throttle body which was contributing to the original complaint.

Courtesy of Scott Brown

5

A/C Command ON



The readings after thermostat replacement.

Courtesy of Scott Brown

6

Coolant Replacement Tips

- About 15 to 20% remains in the system after it has been drained
- Fill system with antifreeze/coolant first and top off with the correct water
- Or use premixed antifreeze/coolant for good results, and adjust to 50 - 50 mix
- Be sure to use the specified coolant
- OEs warns not to reuse coolant drained from the system

7

Equipment

8

Check Your Machine

33 Pennies = 3 ounces. Place the pennies on your refrigerant bottle and check the scale reading. If the scale is adjusted properly the reading on the machine should read 3 oz more. If it does not read the correct amount + or – 1 ounce adjust the scale.

9

A/C Machine R134a & R1234yf - Oil & Filter Change

10

Non - Condensables

- **Non - condensable are air bubbles in the refrigerant.**
- **Why are they a problem? They raise system pressures, reduce cooling, can cause the compressor to cycle rapidly, and may result in evaporator freeze up. In some cases, they will damage the compressor.**
- **How do we get rid of non - condensable if our supply becomes contaminated? By opening the valve on a manual machine and remove the air until the gauge equals the ambient temperature. On an automatic A/C machine it will purge itself, you will hear a noise when it purges.**

11

A/C Storage Tank & New R134a Tank

The tank need to be hydrostatically tested every 5 years

Disposal of any container that refrigerant is purchased in must be sucked down to a vacuum followed by punching a hole in the tab on the top of the container. The word EMPTY must be marked on two sides of the tank.

12

Contaminated Refrigerant

- You'll have to send your contaminated reclaimed refrigerant to a professional recycler.
- Warning: Some recyclers charge a premium for handling extremely contaminated refrigerant. That's one reason your refrigerant identifier is so important. If the vehicle contains heavily contaminated refrigerant, you'll want to charge extra to remove and properly dispose of it.

- Call the EPA hotline 1-800-296-1996 for a list of approved recyclers.
- A/C oil that is removed from an air condition system must be saved in a separate container. DO NOT POUR THE REMOVED A/C OIL INTO WASTE OIL!

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Real World Helpers

- Can you use nitrogen to check for leaks with no refrigerant in system or use soapy water?
  Yes, but what are you going to use to detect the nitrogen? Better alternatives are; using an approved A/C J 2791/ J2913 Electronic Refrigerant Leak Detector with the refrigerant still in the system, A/C dye, ultrasound and the best for small leaks, CO2 leak detection with BullsEye after all refrigerant has been recovered. Soapy water is not really that helpful when it comes to finding small leaks.
- J2791/ J2913 sensitive to R12, R134a, R1234yf and other refrigerants detects leaks down to 0.1 oz./year (3 g/year).
- 1 psi of A/C pressure roughly equals 1 degree
- With the A/C system at rest the Low and High Side pressures should be equal if there are no blockages in the system.

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Refrigerant Identification Procedure

- **Step 1. SAFETY is everything! ALWAYS use googles (clear or yellow) to protect your eyes. Use the yellow googles to view dye.**
- **Step 2. Make sure to check for A/C Sealant in EVERY SYSTEM.**
- **Step 3. Is to check Refrigerant purity.**





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Leak Checking Equipment






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R12 / R134 Leak Detector

This Tracerline R12 / R134 Leak Detector meets the SAE J2791 standard and has the able to Detect a 0.1 oz or 3 gram leak per year set to its highest sensitive settings.

17

Leak Detectors - R1234yf

Not all leak detectors are the same. Be wary of those that say "meets or exceeds" the SAE standards. There are two phases to SAE certification - a technical test and listing requirements to be met and not all have met either or both. Stick with a name brand toolmaker when selecting a new sniffer.

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Testing

19

Refrigerant Identification Procedure

- **Sealant Issues caused by just a few of these products that can be purchased online or in many stores.**

20

Refrigerant Identification Procedure

- **Sealant Issues**






Equipment

AirSept
Dual Automatic Recycle Guard Sealant Remover


AirSept
AC Charge Guard
Keeps PAG Oil Out Of Hybrid / Electric Compressors

Check Duct Air Flow With An Anemometer

The blower motor airspeed at its highest setting should measure about 13 - 16 mph (1000 - 1450 CFM).

Anything less than 10 mph (approx. 900 CFM) airspeed should be considered severely restricted.

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AirSept Sight Glass

Courtesy of Scott Brown

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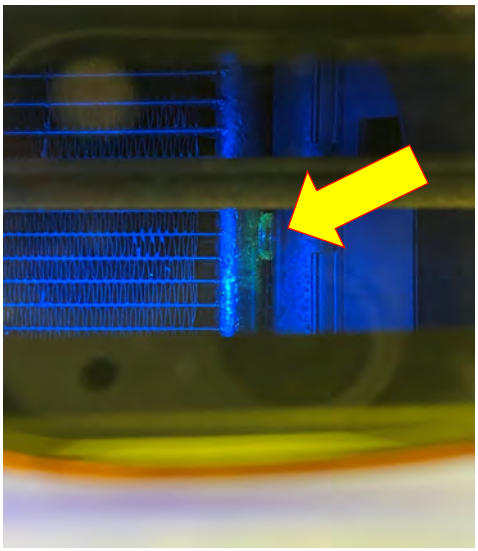
Condenser Leaks

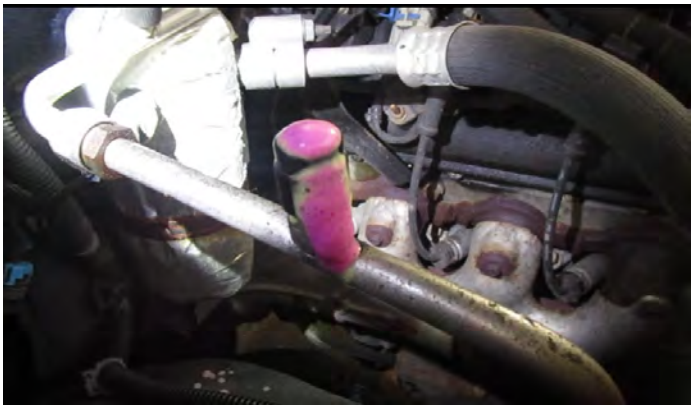
There are different spectrums of UV light. Not all will work the same with different dyes



Most condensers leak on the left lower side. Why?

25

Common Leak Sources



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Mix Bag

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Fans -Electric Fans

- **Belt driven fans are typically mounted on the water pump and have a fan shroud.**


- **Electric fans are located either in front or behind the radiator. Usually inside a shroud. They may operate at one speed, two speeds (High and Low) or variable.**
- **These fans are driven by an electric motor that is switched on and off, depending on coolant temperature. The fan electrical circuit is usually triggered by a signal from the coolant sensor or fan thermal switch and is powered through a fan relay.**
- **If either a belt driven or electric fan is not operating as designed the A/C system will not function properly.**
- **Caution: Many of these fans will operate with the ignition OFF, so watch your knuckles!**

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MACS A/C Refrigerant Recover Procedure

Engine Pre-Heat for Refrigerant Removal Procedure

The following procedure will aid in refrigerant removal when the work area is cool and J2210 and J1732 recovery equipment is being used. In general if the work area is warmer than 90° F (32° C) this procedure is not required.

Recovery equipment certified to J2788, J2810, J2843, J2851, J3030 do not require this pre-warming procedure.

REMOVAL PROCEDURE

1. **A/C System Controls**
   - Compressor clutch off
     - Turn clutch off or remove electrical connection
   - Set panel system controls
     - Outside air (not max)
     - High fan speed
     - Airflow panel outlets
     - ATC Systems: Set temperature mid range
       - Check to make sure system is on outside air, drawing air from vehicle cowl air inlet area

2. **Vehicle hood open to allow warm engine air to enter cowl inlet to A/C system**
   - Operate engine idle condition
     - Neutral (park) with parking brake applied
     - Depending upon engine compartment temperature:
       - Run engine to warm up A/C system components for 15 minutes
   - After idling engine for 15 minutes (hot condition)
     - Stop engine and then turn ignition to on position allowing operation of:
       - A/C fan high; system on Outside air
       - When applicable – Operation of electric engine cooling fan to circulate air in engine compartment
       - Do not change any control or conditions listed in steps 1 and 2 above
       - Start refrigerant recovery process
   - When refrigerant recovery is completed, including the required 5 minute recheck for system pressure (system refrigerant out gassing), shut vehicle and equipment off.

A/C Facts

- **R1234yf / SAE J2842 design criteria and certification for OEM Mobile Air Conditioning Evaporator and Service Replacements.**
- **ND 11 Hybrid/Electric A/C POE Oil is anywhere $172.00 an ounce for GM - Ford vehicles and $160.00 for Chrysler only sold as a 3 - ounce minimum.**
- **Only use an oil installer that has NEVER had a PAG oil in it.**
- **Make sure only to install the special Hybrid / Electric A/C oil.**

Expansion Valve Operations

- What causes this valve to open?
- This valve will open once the sensing bulb/capillary tube has detected that the evaporator is beginning to warm back up again.
- Opening the valve more increases refrigerant flow into the evaporator that increases cooling.

31

Orifice Tube

- Are all these tubes the same?
- Which way is the correct way to install this device?

Fixed and Adjustable Orifice Tubes

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Evaporator Issues

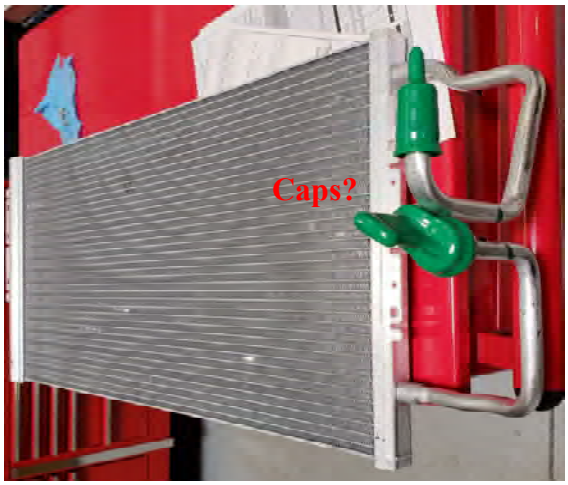
Make sure the drain is clear

Don't forget the cabin air filter

Dirty or an incorrect filter can cause low air flow.

33

Condenser & Drier



Condenser With Built in Receiver Drier

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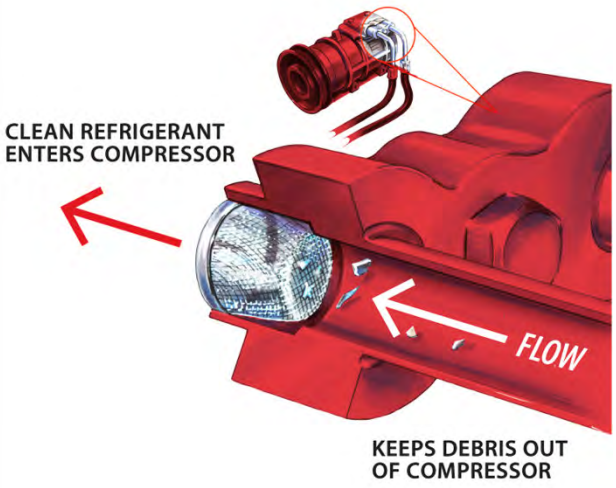
Prevent Compressors Failure

- **There are aftermarket solutions to help protect the new compressor, like these inlet screens**



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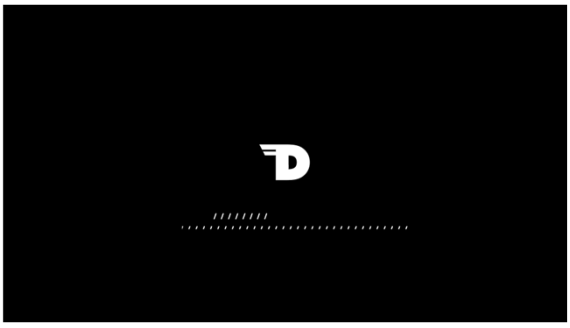
Toyota Compressor Flow Sensor

This Hall Effect sensor fails when it reads over 3.7 volts. That will prevent the A/C amplifier sending a request to PCM to turn the compressor clutch on.



Dorman Products Part # 926-818

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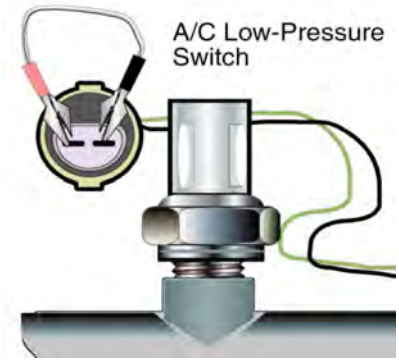
Pressure Switches

- **What are the jobs of the switches inside the refrigerant system? Pressure switches cycle the compressor on or off. They also protect the system by shutting off the compressor if the system pressure is too low or if the pressures get too high. They are also used to supply an input to the computer to aid in engine performance. The compressor may be disengaged during wide - open throttle to improve acceleration.**

- **Note: DO NOT JUMP ANY CONNECTOR WITHOUT CONSULTING A WIRING DIAGRAM.**



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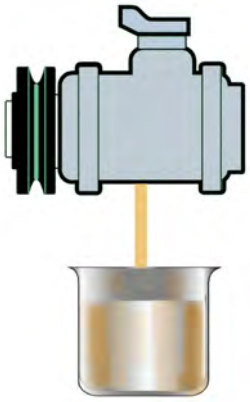
Removing The Old Oil

- **Do we need to drain the compressor? That depends. Chrysler, and Mercedes have both recommended draining compressors in some of their TSBs. Some new compressors come dry.**

- **Do all compressors have sumps? No. But you should probably drain those that do since they may contain excessive amounts of oil.**



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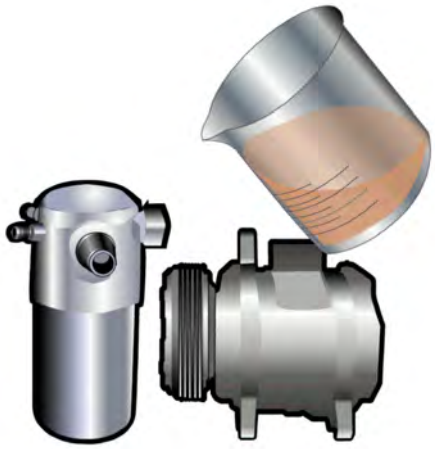
Adding Oil

- Half in Drier?
- Half in Compressor?
- NO - RTFI!
- Just before charging the air condition system add 2 ounces of oil / dye to the system. The A/C system should be in a vacuum when adding oil to the system. Some A/C machines and oil injections tools allow the technician to add oil while the system is under pressure. When the system is low on refrigerant most likely some oil escaped with the refrigerant through a hole in the system.



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Avoid "Slugging" On Initial Start Up

- Set the cabin ventilation to the "center duct" position and open the ducts completely.
- Adjust the blower speed to mid - level and the A/C to "MAX Cool" performance.
- Start the engine (without running the air conditioning system) and let the engine idle uninterrupted for 2 - 3 minutes.
- Turn on the air conditioning system for approx. 10 seconds at idle, then immediately turn the air conditioning system off again for approx. 10 seconds.
- Repeat the process 5 - 10 times while the engine is idling.
- Perform a final operational test of the air conditioning system as specified by the vehicle manufacturer to confirm system performance.

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Oils

- What kind of oil did we use with R12?
- Is it compatible with R134a and R1234yf?
- What if we put PAG oil in an R12 system?
- What oil should be used in an electric hybrid / EV compressor?

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What Is Ester Oil?

- Is it approved for all makes?
- Can it contain dye?
- Ester (POE) is less hygroscopic than PAG and will mix with small amounts of residual mineral.
- Some brands of ester come with leak detection dye.

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PAG Oils

PG Come In Different Weights - RTFI

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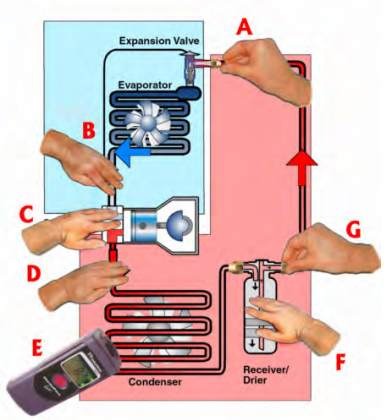
Quick Temperature Checks

- **What type of system is this?**
- **A = Expansion Valve inlet should be warm to the touch. Frost indicates low charge or restriction. Frost at outlet of expansion valve also indicates plugged or restricted valve.**
- **B = Suction line back to compressor should be cool to the touch. Some sweating normal. Heavy sweating or frost indicate restriction.**
- **C = Check for excessive compressor vibration caused by internal compressor problem or loose/improper mounting.**



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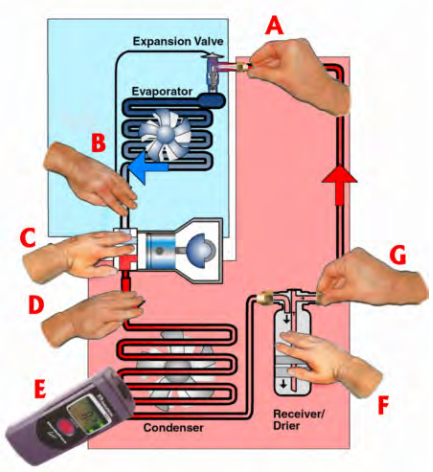
Quick Checks

- **D = Compressor outlet line temperature should be uniform across its entire length. Careful, it may be HOT, especially if there is an oil overcharge.**
- **E = Look for 40 - 50 - degree temp drop across condenser face. Excessive temperature changes indicate restrictions. Too little temp change may mean there's an airflow obstruction.**
- **F = Drier body should be warm and free of frost rings.**
- **G = Drier inlet and outlet should both be warm.**



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Quick Performance Test

Set to MAX A/C and open doors

This is the best way to test the air condition system. Make sure you have all the doors open and the A/C system set to the MAX position and the blower fan on MAX.

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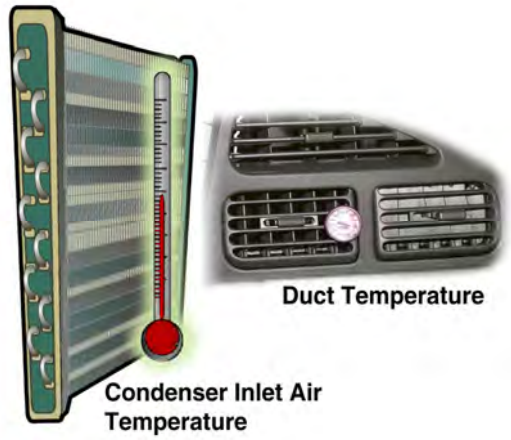
Compare Inlet Air To Duct Temperature

2

Duct temp should be 30 degrees F colder than air just ahead of condenser inlet



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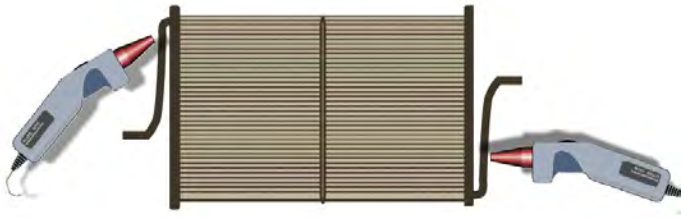
Compare Condenser Inlet & Outlet Temps

3



Difference less than 20 degrees F look for restricted condenser air flow

Difference more than 60 degrees F look for plugged condenser

An approximate 40 - 50 - degree temperature drop across the condenser maybe normal. Test and several points to be sure the temperature drops uniformly. Tip: Check a few good vehicles for a good baseline since A/C systems are changing.

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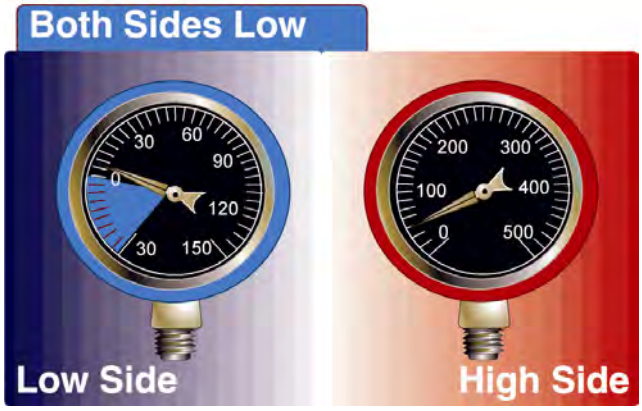
Troubleshooting



Low Refrigerant Charge

Refrigerant Restriction

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Troubleshooting

- **Refrigerant overcharge**
- **Oil overcharge**
- **Poor airflow through condenser**
- **Expansion Valve stuck open or temperature sensing bulb mounted incorrectly**

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Troubleshooting

- **Failed compressor**
- **Control Valve failure in variable displacement compressors**

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Expansion Valve System Pressure Diagnostics

Low-Pressure Gauge	High-Pressure Gauge	Action Required
IN RANGE	IN RANGE	NONE - A/C is working properly
LOW	LOW	Add Refrigerant
LOW	HIGH	Possible blockage of the expansion valve or orifice tube
HIGH	LOW	Possibly faulty compressor
HIGH	HIGH	System is overcharged - Recover refrigerant

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First Three Steps To Take In Any Diagnosis

- **Verify the concern**
- **Check for DTCs (perform a full system scan if possible)**
- **Check for TSBs (Technical Service Bulletins)**

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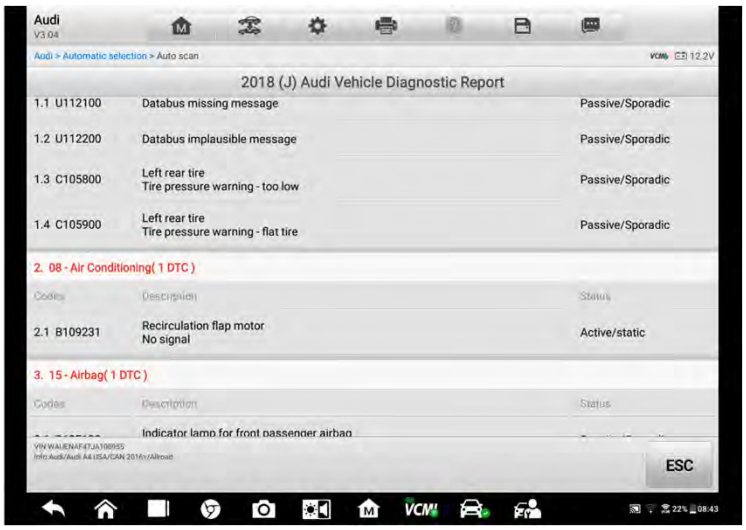
Full System Scan - First And Always



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A/C System Diagnostic Essentials

R1234yf similar to R134a and normal readings (depending on temperature):

- **Low side range 25 - 45**
- **High side range 150 - 300**

Compress Off - System @ Rest for at least 15 minutes - Gauge Reading Should be close to the Ambient Temperature under the hood

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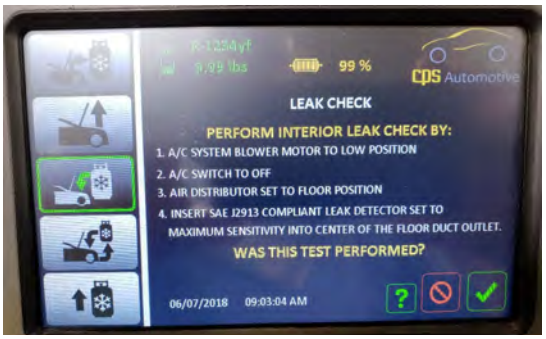
R1234yf Leak Testing



R1234yf Leak Detector J2913 directions on a CPS A/C machine. Perform this test for at least 5 minutes. This is a very important step since there is a safety and legal issue associated with this leak inspection. Remember that R1234yf is potentially FLAMMABLE !

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Case Study - 2020 Camaro

Customer concern - "Not blowing as cold as it should."
Vehicle passed OE test procedure

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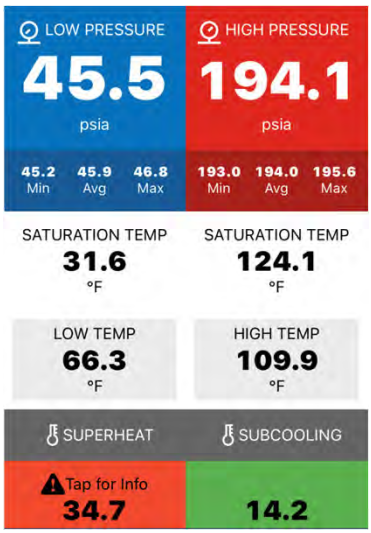
Case Study - 2020 Camaro



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Case Study - 2020 Camaro

Temperature Comparison

- Center duct
- Ambient at condenser

31°F difference - but what position is the RECIRC in?

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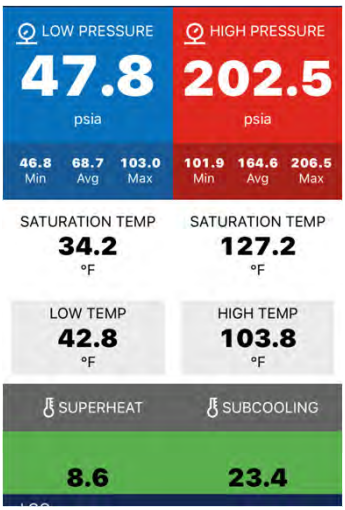
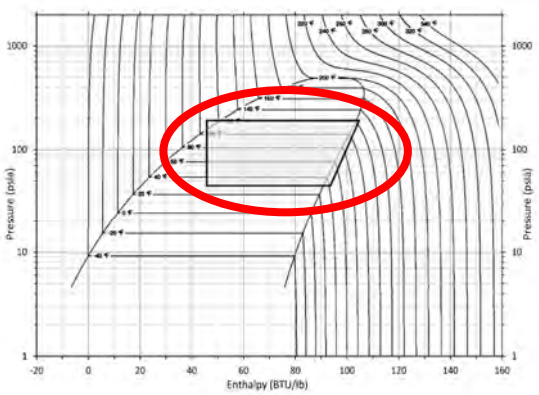
Case Study - 2020 Camaro

Correct Charge Installed - 550g





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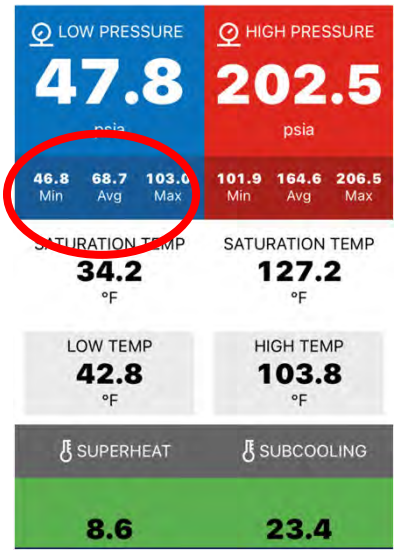
Case Study - 2020 Camaro



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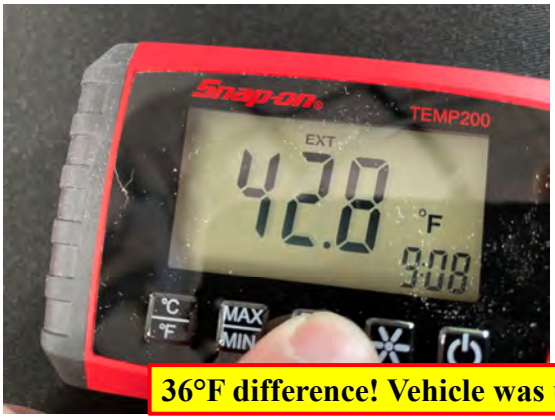
Case Study - 2020 Camaro

Temperature Comparison After Service

- **Center duct**
- **Ambient at condenser**



36°F difference! Vehicle was undercharged from the factory!

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A/C System Diagnostic App - ManTooth

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