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HVA/C COMMON PROBLEMS, QUICK FIXES

Due to the frequency of damage to A/C systems in collisions, shops should consider adding in-house service for these repairs

Most collision repair technicians have done, or at least have a rudimentary understanding of, mechanical repairs. Yet many don't consider themselves service technicians and might shy away from collision-related mechanical repairs.

One of the most common, if not the most common, mechanical malfunction in a collision is air conditioning damage. Front collisions are the most frequent collisions, and because the condenser is up front, the A/C is damaged often. Sometimes the damage is seen easily. Often though, the damage isn't easily noted, and a system check should be done. Even minor damage might cause the refrigerant to leak, rendering the system unusable.

While inspecting the vehicle for an estimate, the A/C unit should be operated, if possible. The system temperature should be noted. If the system is suspected of operating optimally, a better check is to attach pressure manifold gauges to check the pressures on the high and low side of the system.

Refrigerant escapes easily from small leaks in a damaged system, and the evidence of the leak isn't always noted easily. This kind of damage is missed most often during colder weather, because the A/C isn't always on an estimator's or technician's minds then.

Air-conditioning systems are relatively simple, and most collision repairers should be able to understand how they work and the practical application for their repair.

How does air-conditioning work?

Many car owners think their A/C system makes cold air. The reality is that modern A/C systems work based on some very simple principles. First, heat energy moves to the colder element until both are equalized. In the car, that's the heat in the cabin air and it

is transferred to the colder refrigerant in the evaporator, or interior heat exchanger. It is also the trapped heat in the refrigerant entering the condenser, or front heat exchanger, transferring the energy to the cooler outside air.

The next principle is the relationship between temperature and pressure. The temperature of an element increases with pressure, and vice versa. This relationship between temperature and pressure allows us to manipulate when an element changes from a liquid to a gas and back again. Water becomes a vapor at 212 degrees Fahrenheit at sea level pressure, but it only takes 201 degrees to change its state at 5,000 feet, a lower pressure.

The third principle is the greatest heat transfer occurs during these changes of state. Let's start at the evaporator and follow the process through the system. High pressure liquid refrigerant is forced through either an orifice tube or expansion valve that causes the pressure to drop to roughly 30 to 40 psi. The temperature of the refrigerant also drops and it enters the evaporator as cold liquid droplets. Hot cabin air is blown over the evaporator, and heat is transferred to the refrigerant. When the refrigerant molecules have absorbed all the heat they can, the refrigerant changes state to a vapor and leaves the evaporator on its way to the compressor as a cold gas.

This gas is compressed to 150 to 250 psi by the compressor. This raises the temperature of the refrigerant, but does not affect how much heat energy it can hold, as it is already full. The reason the gas is pressurized is to make the temperature of the refrigerant higher than the outside air surrounding the condenser, making it possible for the contained energy to pass out the atmosphere as the air passes over the condenser fins.

The refrigerant under pressure also raises its boiling point and this allows the gas to change state back to a liquid as it cools even further in the condenser. The refrigerant passes out of the condenser as a high pressure liquid, back to the metering device, where the cycle begins again.

Air-conditioning parts

There are two common A/C systems that work using the same principles, with a few minor component system differences. With the accumulator, refrigerant enters the condenser (a radiator outside in front of the vehicle) as a hot high-pressure gas that condenses to a high-pressure liquid as it gives up heat. Both systems use a condenser. The high-pressure lines are smaller because the refrigerant is under pressure, thus called the high side.

As the high-pressure refrigerant passes through an orifice tube that allows it to expand rapidly (lowering its pressure and temperature-more volume equals lower pressure and temperature), it passes through the evaporator (the small radiator inside the car), attracting its heat.

Refrigerant passes through an accumulator where any moisture is removed, then on to the compressor, where the low-pressure/low-temperature gas is changed into a high-pressure gas and pumped to the condenser, where its heat is given up and it changes to a liquid.

The second system is called a receiver/dryer system. Moisture is removed in a receiver/dryer in the high-pressure side just beyond the condenser. Instead of an orifice tube, a metering valve allows the liquid to change to a low-pressure gas. There are additional parts in both systems that help regulate the flow and fan the system.

Tools

The majority of the tools needed to remove and replace A/C components are standard hand tools, though there are a few A/C specific tools needed to measure pressure as well as a recovery/recycle/recharge machine, refrigerant identifier and leak testing equipment, either dye or electronic. Though some of the tools are expensive, they're essential for A/C repair and/or testing.

While most recovery machines have gauges built into them, a separate gauge for quick checks by either breakdown teams or damage report personnel are handy to have when evaluating a collision. If there are damaged parts that will need replacement but didn't cause a leak in the system, a manifold gauge indicates refrigerant first must be evacuated.

If refrigerant remains in the system, it must be evacuated before repair. Vehicles made in 1992 and earlier are likely to have R12 refrigerant used by the manufacturer, and vehicles made after that time were manufactured using R134a.

A refrigerant diagnostic tool should be used to identify if the gas is hydrocarbon, thus identifying risk of flammability. Also, leak testing tools should be used to determine if the system is sealed after repair. A/C systems that are repaired in cooler weather might not be used again for months. If a small leak exists, the system will operate well when run right after repairs, but not later.

A common observation when troubleshooting an A/C system with no gas is the pump doesn't turn on. When checking for leaks, remember refrigerant gas is heavier than air, and most leaks are best detected below lines and connection points.

Step 1: Inspection

This can be tricky because refrigerant might leak from what seems to be insignificant damage. One of the tell-tale markers is oil around leaks, but because many of the components of an A/C system are routed through hard-to-get-to places in an engine bay, one of the best ways to quickly identify if the system has leaked out is to attach the manifold gauges to check the gas pressure. If the leak is a result of low or no gas in the system, closer inspection is necessary as the vehicle is disassembled.

Step 2: Gas identification

If there's any gas in the system and the system must be repaired, the gas must be evacuated first. Before evacuation, the gas should be analyzed for hydrocarbons (flammable gas.) If the gas in a system is safe, it should be evacuated using a machine specific to the gas in it. Intentional vetting of refrigerant to the atmosphere is prohibited by section 609 Refrigerant Recycling Rule (all refrigerant gases) and doing so is punishable by fines.

Step 3: Evacuation

Each evacuation machine works differently, and the proper manufacturer's specific process should be followed in each instance. After the system is evacuated, it can be disassembled and inspected legally for additional damage.

Systems that will be open to atmospheric air for longer than a few hours should have their receiver/dryer or accumulator protected from moisture. (Cover the input and exit ports so that moist air is not able to get in.)

Excessive moisture will cause the parts to become saturated. If that happens, the parts will no longer work properly and should be replaced. If in doubt the technician should replace the parts at the time when the repairs are made.

Step 4: Parts replacement

Close inspection of all the component parts of the A/C system should be performed, and though most of the parts are accessible, some, such as the evaporator in the passenger compartment, might be difficult to inspect. When the system is repaired and a test vacuum is applied to the system, an evaporator leak is likely to be detected. Remember there might be more than one evaporator in a vehicle, including items such as van rear passenger evaporators and hybrid battery coolant systems.

Step 5: Recycle and recharge

Each machine operates differently, but they all recycle the gas that was evacuated (some automatically), preparing it to be recharged back into the system following repairs. (Manufacturers' recommendations for recycled refrigerant must be followed.)

Also, the machine will replace the oil needed to lubricate the system. Oil is critical, and the manufacturer's recommendations should be followed precisely. R12 systems typically use mineral-type oil, and vehicle maker specifications should be met. R134a systems typically use polyalkaline glycol (PAG) oil.

Additionally, hybrid vehicles often have an electrically powered A/C system. These require specific nonconductive oil when recharging. Caution: Some hybrids have A/C systems that cool the high-voltage battery. They have separate evaporators, but use the same compressor and might have leaked out their refrigerant during a rear collision.

Before recharging, the machine will "pull" a vacuum on the system to evacuate any air in the system, eliminate any moisture and test the system for leaks. If a vacuum can't be established or maintained, a leak is present, and it must be found.

Rechecking connections for all the components of the system is necessary for new parts and those not replaced. Most technicians dread an evaporator leak because of limited accessibility. Luckily, evaporators don't often get damaged though A-pillar/dash damage might involve the evaporator.

Also, remember the age of the vehicle might make these parts more likely to damage than newer vehicles. Leaks must be found and repaired before new refrigerant is put in.

Using your specific machine, follow the manufacturer's guidelines for required amount of refrigerant and specific type of oil. The system is operated to determine the passenger compartment reaches the proper manufacturer temperature.

A leak test should be performed using an electronic gauge or dye ingestion and UV light system. And use proper eye protection when using UV light.

Though R12 hasn't been used in new manufacturing for almost 20 years, if a vehicle with R12 is encountered, conversion kits can be easily installed. Then the system can be charged with R134a and PAG oil.

Given the frequency of damage to A/C systems, shops should consider adding in-house service for these repairs. The cost of the equipment and training will be recovered quickly, and a new profit stream can be established.

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