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Technical Information For The Collision Industry

AIR CONDITIONING COMPRESSORS ON GASOLINE/ELECTRIC HYBRID VEHICLES

Gasoline/electric hybrid vehicles are beginning to employ a different approach to powering the compressor on the air conditioning (A/C) system, and therefore require some special attention during repairs. To improve fuel mileage, gasoline/electric hybrid vehicles can gain some advantage by shutting off the gasoline engine when the vehicle is at a stoplight, or in stop and go traffic. This feature is called idle stop.

The first gasoline/electric hybrid vehicles introduced in the market, the 2000-2006 Honda Insight, 2002-2004 Toyota Prius, and 2003-2005 Honda Civic Hybrid, used a standard air conditioning compressor that was belt-driven off the gasoline engine. This caused a significant reduction in fuel mileage when the air conditioning was running. Not only was there drag from the compressor on the gasoline engine, but the idle stop feature was also disabled.

This article discusses the two approaches to this fuel mileage problem, and the issues that must be considered when doing collision repairs that involve the A/C system.

ELECTRIC DRIVE

Toyota has taken the electric-drive approach. The second generation Toyota Prius, starting in 2005, takes additional advantage of the high voltage system used in their gasoline/electric hybrid vehicles by using an electric motor with an integrated inverter and controls to drive the air conditioning compressor. The air conditioning compressor is integrated with a high voltage, 3-phase AC motor and control inverter. All other Toyota and Lexus gasoline/electric hybrid vehicles produced also use this same type of air conditioning system.

DUAL SCROLL

Honda uses a slightly different approach to solving this problem in their current gasoline/electric hybrid vehicles. Because the Honda designed gasoline/electric hybrid vehicles use a parallel configuration, the high voltage systems use lower voltages than the Toyota design. The high current draw of an electric air conditioning compressor is not practical in these systems. So Honda's approach to solving the idle stop/air conditioning issue is a "hybrid" dual-scroll air conditioning compressor. The air conditioning compressor on the 2006 Honda Civic Hybrid and the 2005-2006 Honda Accord Hybrid is actually two compressors in one (see Figure 1). It has a conventional 75cc belt-driven scroll compressor in the front, and a smaller 15cc electric scroll compressor in the rear. The rear compressor uses a 3-phase high voltage electric motor for its drive. Depending on conditions and the demand on the A/C system, the compressor can switch between "belt only," "electric only," or "belt and electric" operation. During idle stop, the compressor operates

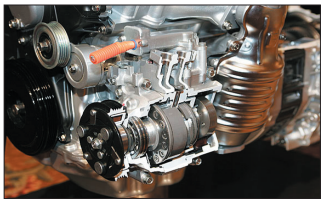

Figure 1 – In this cutaway of the "hybrid" dual-scroll air conditioning compressor, the size difference is evident between the larger belt-driven front compressor and the smaller electric motor driven rear compressor. (Courtesy of American Honda)

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in electric-only mode unless the cooling demands are too high, or the state of charge of the high voltage battery is not sufficient. In these circumstances the gasoline engine restarts and the belt drive compressor either takes over, or assists the electric compressor.

REPAIR CONSIDERATIONS

These air conditioning compressors create some considerations whenever collision repairs involve the air conditioning system. One consideration is that the orange power cables going to these compressors carry dangerous, high voltage current. The high voltage system must be disabled and the 12-volt battery disconnected before doing any repairs to gasoline/electric hybrid vehicles. Wear rubber insulated lineman's gloves whenever replacing or removing the compressor, or any other time that you are working around the high voltage orange cables (see Figure 2).

Another important consideration when doing any A/C system work on a vehicle with an electric or "hybrid" compressor is the refrigerant oil used in these systems. Special electrically insulating refrigerant oil is used to keep voltage from leaking to the compressor case through the oil. Toyota specifies compressor oil ND-OIL 11 or equivalent and Honda part number 38899RCJA01 or equivalent. Both Toyota and Honda state that if even a small amount of another oil is introduced into the system, it may significantly decrease the electrical insulation performance and damage the compressor, or set a diagnostic trouble code that disables the air conditioning system. Both vehicle makers also warn that if the wrong oil is introduced into, and circulated through the system, all of the main A/C parts (such as the evaporator, condenser, receiver/drier, and compressor) must be replaced. It is even recommended that a dedicated manifold gauge set be used when charging the system. This will ensure that any refrigerant oil left in the manifold gauges from refrigerant recovery on other vehicles does not enter the air conditioning system and deteriorate the insulating performance of the special oil.

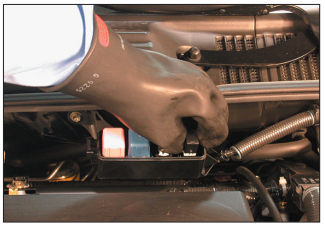

Figure 2 – The lineman's gloves are required protective equipment when working on the high voltage system on a hybrid-electric vehicle.

CONCLUSION

New approaches to driving the A/C compressor on gasoline/electric hybrid vehicles require attention when doing collision repairs. There is enough voltage present in many of these systems to be lethal. It's not difficult to protect yourself from this hazard if you know and follow the proper procedures whenever working on or near these systems.

Also, whenever replacing any parts that require the addition of refrigerant oil to the air conditioning system on a gasoline/electric hybrid vehicle, ensure that the correct oil, called for by the vehicle maker, is used. Adding the wrong oil when replacing the condenser, and then running the system can result in costly and unnecessary repairs.