Servicing Hybrid Transmissions

by David Skora
www.atra.com

One of these days, a very ordinary looking vehicle is going to come into your shop for what should be a normal service. But hold on a second; before you give your standard price estimate, take a closer look: Your customer may be driving a hybrid. Besides the extra precautions of working around high-voltage, there are several other systems that have been modified to operate the hybrid powertrain. You need to know about them and how to service them, too.

Hybrid vehicles are designed to be able to drive the vehicle from one of two sources of power. One source is the typical internal combustion engine. The other source is from a bank of batteries. Each manufacturer has designed its own unique system to operate the vehicle. There may be specific or even updated information that you'll need before you start.

Make sure you go over any specific information or TSBs you find at ATRA, Mitchell, AllData or ideally, the OEM service information site. Here are some important general precautions:

1. Never leave the vehicle unattended unless the ignition is off and the transmission's in park.
2. Keep the ignition key in your pocket whenever you're away from the vehicle.
3. Some vehicles include autostart, which may automatically start or restart the engine under certain conditions, such as when the vehicle has already been turned on.
4. Use extra care when positioning jacks or hoists. There may be high voltage wiring underneath the chassis.
5. Make sure the vehicle won't run out of gas while it's in the shop.
6. Some vehicles use a high voltage motor which will operate the A/C compressor or cooling fans. This motor may automatically come on if the battery compartment gets too hot.
7. Whenever service is required near the battery or other high voltage devices, always use the appropriate safety gloves. Never wear anything metal that might come in contact with a high voltage source.
8. Some vehicles' electronic modules may be damaged if you use the wrong scan tool. Consult your scan tool manufacturer to be sure it's appropriate for the vehicle you're working on.

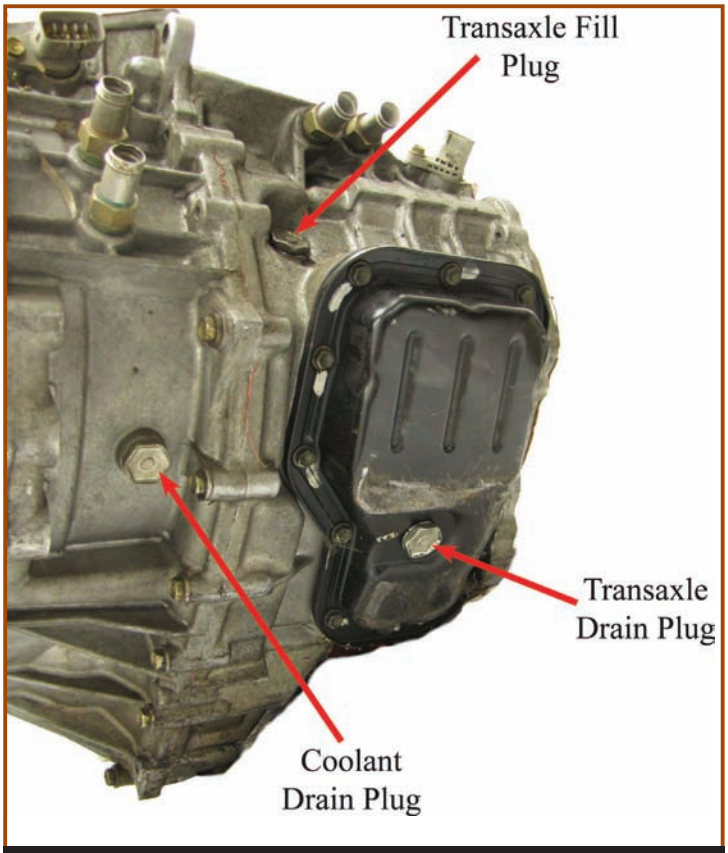

Figure 1

For example: We connected a Launch scan tool with the power feed connected to the cigarette lighter socket on a Gen 1 Prius. The dashboard display panel went into a factory programming mode. Since we weren't familiar with Japanese, we decided not to press our luck!

9. Some vehicles with regenerative brake systems develop voltage that could damage a module even if you just push the vehicle around the shop. If you need to push the vehicle, it's a good idea to place each wheel on a tire dolly.
10. Never connect a conventional battery charger to the vehicle. Even the auxiliary, 12-volt batteries that most hybrid vehicles use are specially sealed.

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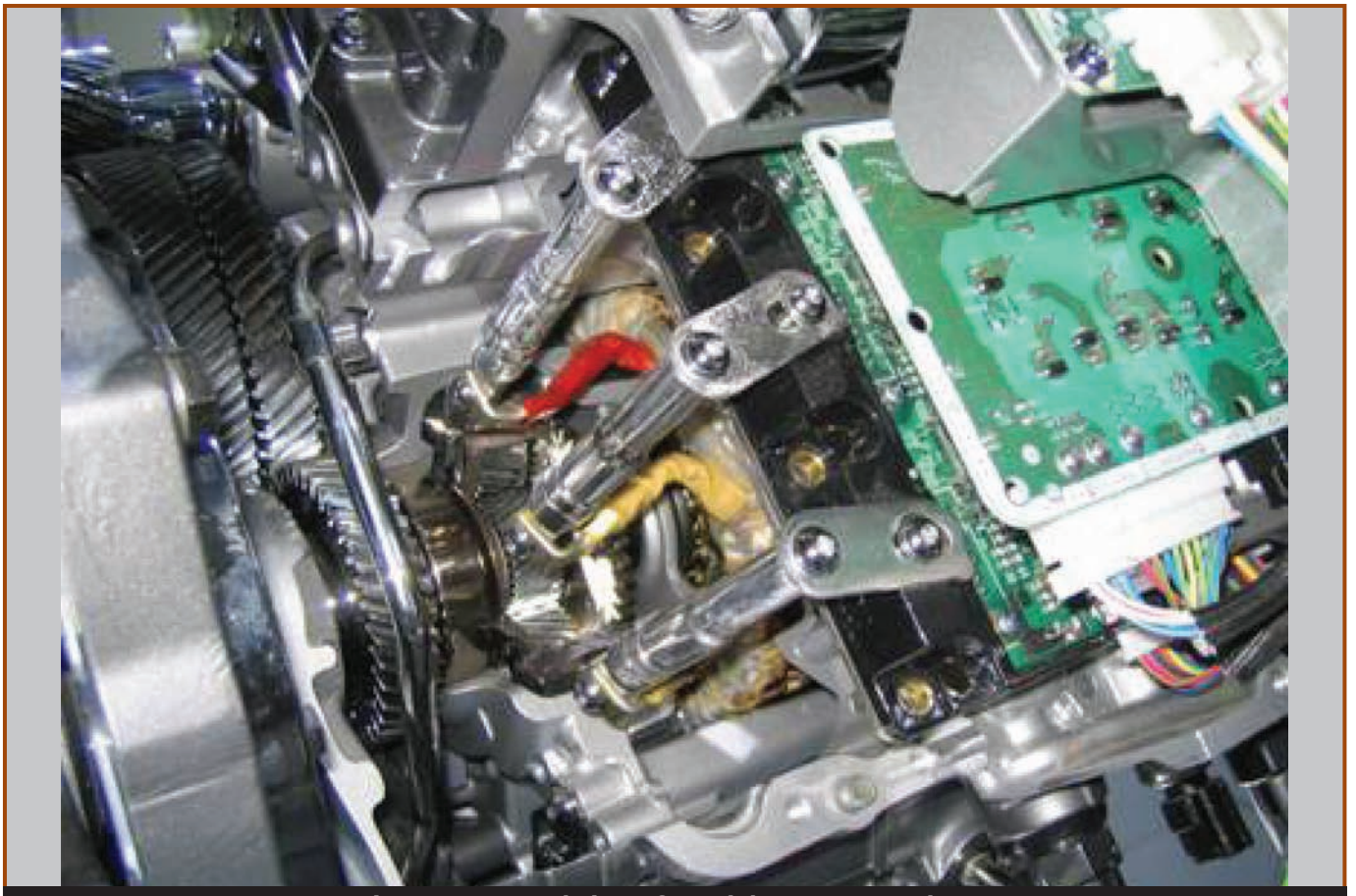

Figure 2: Internal view of Honda's CVT mounted IMA

11. Wait at least 5 minutes after turning the ignition off or isolating the high voltage battery pack before performing any service on the vehicle.

Just like a regular vehicle, hybrids require regular maintenance which includes checking tires, brakes, fluids, etc. Let's look at what additional service is required for a few of the really common hybrid vehicles on the road today.

Toyota

The most common hybrid vehicle is the Prius. Three generations of Prius are on the road: Gen 1 (2001-2003), Gen II (2004-2009), and Gen III (2010-up). We're just going to look at the first two. The Toyota hybrid engine requires regular oil changes at 7500 miles, and a new oil filter at 15,000 miles. The recommended oil viscosity is 5w-30.

CAUTION: If you use a heavier oil, the engine may not start.

The transaxle includes a planetary, chain, bearings, sprockets, and a couple high-voltage A/C motors. There's no specific fluid change interval for the transaxle. But you should check the transaxle fluid at 30,000-mile intervals.

There's an inspection plug on the side of the transaxle and a drain on the bottom like a manual transmission. On the Gen I, use Toyota ATF T-IV fluid; on the Gen II, use Toyota WS fluid.

Figure 3: High voltage battery isolator

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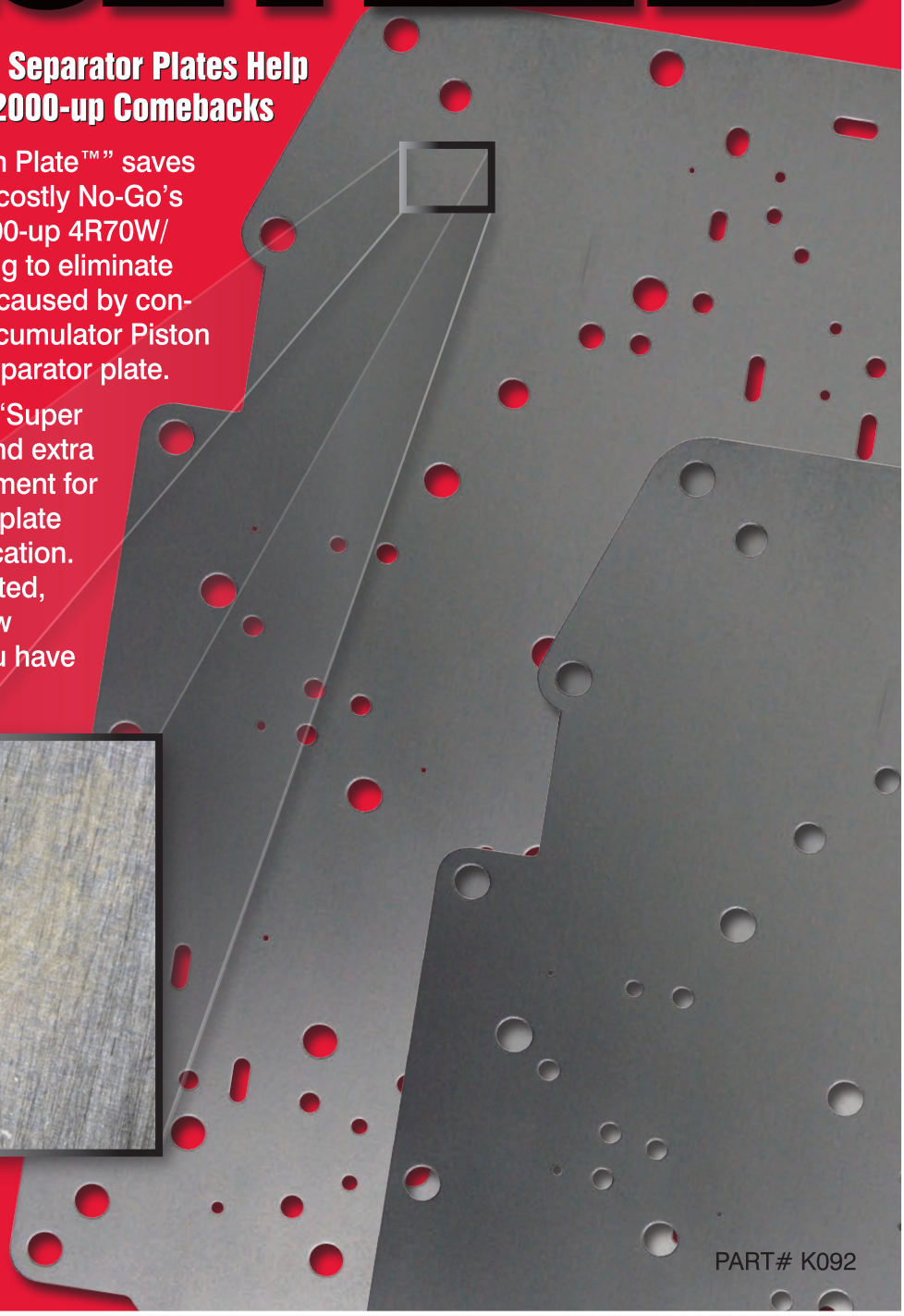

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Fig 1. Gen 1 Drain and Fill Plugs on Transaxle

Other serviceable items include the coolant and A/C systems. There are actually two separate coolant systems. One is used to cool the engine and the other cools the inverter and motor drive. Both require changing the coolant at 100,000 miles the first time, and every 50,000 miles after that.

Always use OEM coolants. The Gen 1 vehicles require Toyota's LLC or SLLC coolant; the Gen II vehicles require SLLC coolant.

The A/C system doesn't have a specific interval for service, but it's critical for maintaining the temperature of the high-voltage battery pack. A small fan is located in the rear of the body. It draws cool air from the interior and directs it into the battery pack.

NOTE: When the A/C system is set to MAX A/C on the Gen I vehicle, the gas engine will run continuously. The A/C system on the Gen II can operate with the gas engine running or not.

Gen II vehicles include a unique A/C compressor. This compressor isn't belt driven by the engine. It uses its own, high-voltage A/C motor. This type of compressor requires a special lubricant (type ND11) that's non-conductive. If you use the wrong type of lubricant, such as the lubricant from the earlier, Gen I (type ND8) system, it'll set a code and the vehicle won't move.

Since the A/C system is so important to maintaining the high voltage battery pack, it would make sense to advise your customers that A/C inspection and refrigerant service would be worth adding to their regular maintenance schedule.

CAUTION: Federal law requires anyone working on an A/C refrigeration system must be certified. Refrigerant certification is available from ASE, MACS and IMACA.

Honda

Move over Toyota: Let's look at Honda hybrids. These vehicles use an electric motor attached to the flywheel. The gas engine is still connected to either a manual or CVT transmission. Their IMA (Integrated Motor Assist) design uses the gas engine and the electric motor supplements it. The IMA adds useable power to the gas engine during acceleration.

The Honda hybrid A/C compressor is a dual scroll compressor. One scroll is belt driven; the other is driven by a high-voltage A/C motor, so the compressor will continue working with the gas engine off.

Fig. 2 Internal View of Honda's CVT mounted IMA

During braking, the IMA produces electrical power to recharge the high-voltage battery pack. The IMA is also used to auto start the gas engine when starting from a stop. On some models, when the gas engine isn't needed for power, such as coasting, the hybrid system will deactivate all or some of the cylinders.

Basic service includes changing the automatic transmission fluid at 30,000-mile intervals. Use Honda CVT-Z1 fluid only. On models with a manual transmission, the fluid should be changed every 90,000 miles, and only with Honda specified fluid (p/n 08798-9016).

CAUTION: On the Civic with the CVT transmission, the *yellow*, transmission fluid dipstick is very close to the large, *orange*, high-voltage IMA wires.

The coolant on Honda hybrids is only used to cool the gas engine. The factory recommends replacing the coolant at 120,000 miles and then every 50,000 miles afterward. Use Honda Type 2 coolant.

Other items, like the inverter, battery controls, high voltage battery pack, etc. use ducting and fans to direct cooled air to them.

The Honda hybrid A/C compressor is a dual scroll compressor. One scroll is belt driven; the other is driven by a high-voltage A/C motor, so the compressor will continue working with the gas engine off.

When performing any A/C service, use *only* Sanden SP-10 or SE-10Y oil. Any other oil can damage the compressor. This could require replacing the entire A/C system.

NOTE: Honda hybrid engines require changing the engine oil every 7500 miles and the oil filter every 15,000 miles. The specified oil viscosity is 0W-20 only. Never substitute any other oil.

Escape/Mariner

The hybrid system used for the Escape and Mariner includes some of the most sophisticated components. Ford requires surrounding each vehicle with a 10-foot perimeter marked with orange safety cones, and the high-voltage battery isolation switch should be turned off.

Fig. 3 The Escape & Mariner High Voltage Battery Isolator

There are several important items to be aware of when working on a hybrid Escape or Mariner. The engine coolant is specific to the state the vehicle was originally sold in.

The transaxle and DC-to-DC converter have a separate cooling system with its own electric pump. These systems require special coolant:

- California and Oregon cars use Motorcraft Gold VC-7-B coolant.
- Canadian vehicles use VC-7-C.
- All other applications use Motorcraft Gold VC-7-A.

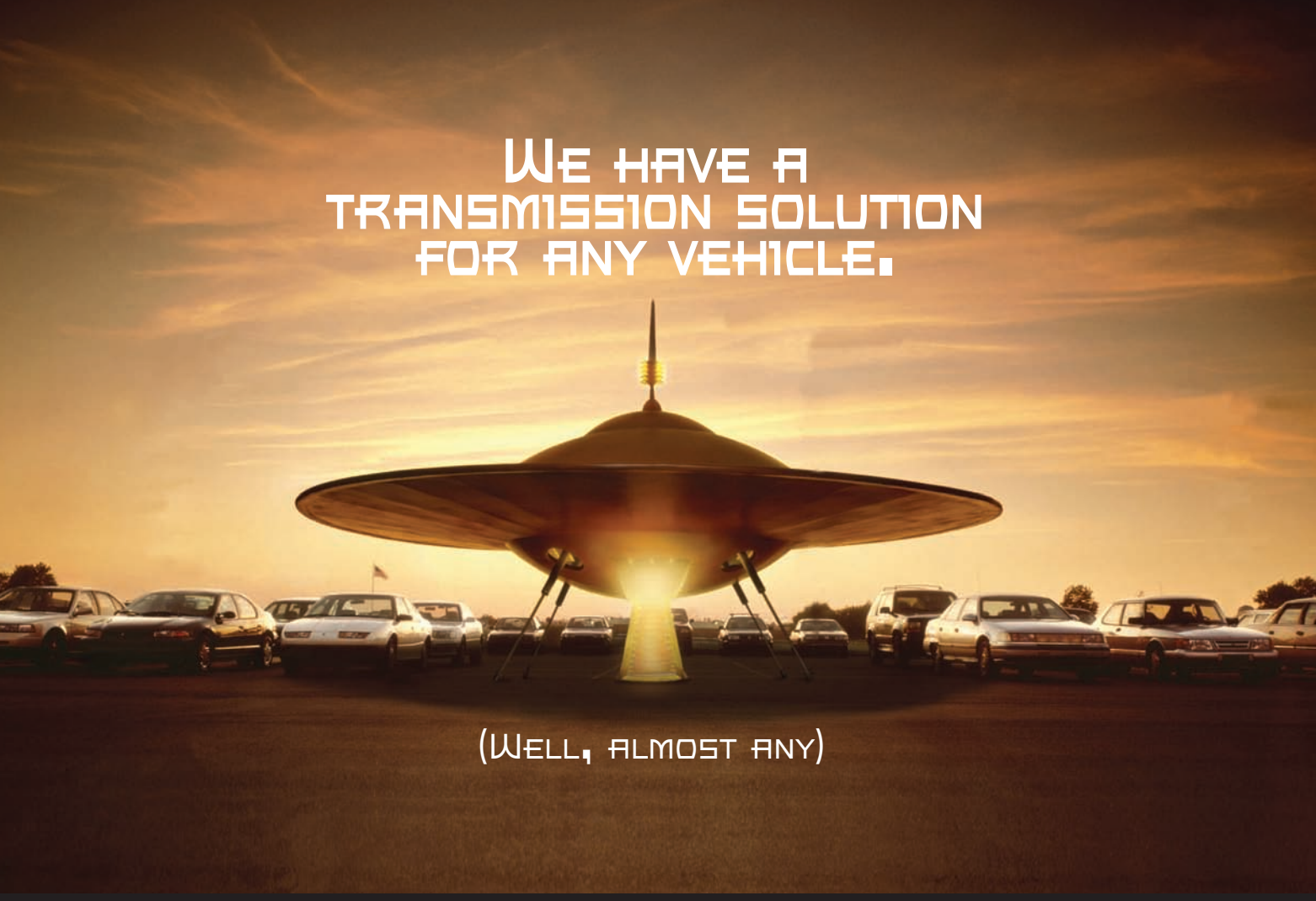
Never mix coolants.

Fig. 4 Regular Coolant Service is Important

NOTE: DC-to-DC converter is Ford's name for a controller that reduces the high voltage, system DC signal to a 12-volt signal for operating vehicle accessories. Think of it as a voltage limiter or voltage regulator.

The engine uses 5w-20 oil and a cartridge-type filter (FL-2017A). Both should be changed every 10,000 miles.

The CVT transaxle includes the electric motor. The CVT-mounted electric motor is strong enough to drive the



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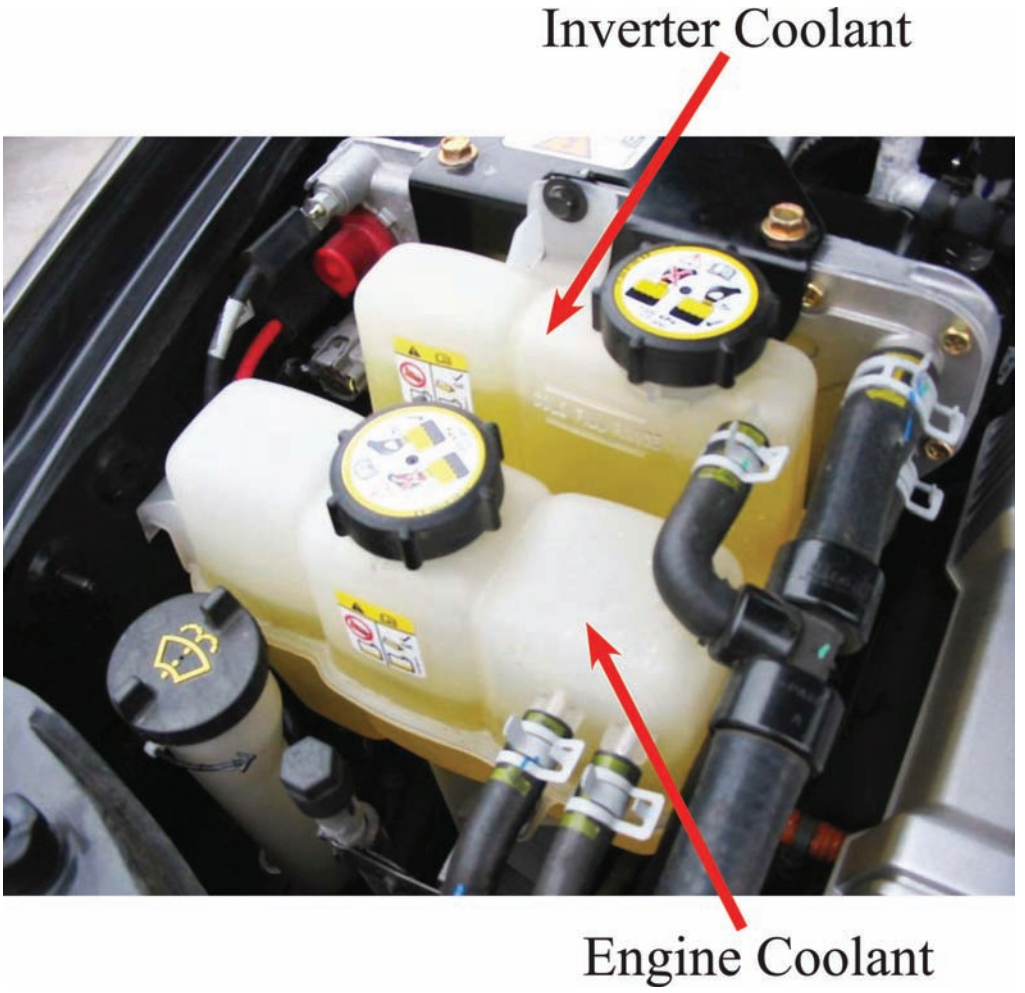

Figure 4: Regulator coolant service is important.

vehicle up to 40 MPH, start the gas engine, and produce voltage during vehicle braking.

The CVT is sealed for life with Mercon fluid. Never substitute any other type fluid. A drainplug is located on the bottom of the unit with a fill plug on the left side.

The other important service intervals unique to the hybrid Escape and Mariner is to inspect the battery A/C filter every 10,000 miles and replace it every 20,000 miles. That's right: The batteries are cooled by an extension of the A/C system, and the air inlet has its own filter. The battery A/C filter is located behind a small access panel at the left rear cargo area panel.

Since the A/C system is so important to maintaining the high-voltage battery pack, consider recommending regular A/C inspection and refrigerant service to your customers.

The Escape and Mariner vehicles have one more surprise when it comes to what should be a normal service procedure. It's about replacing or bleeding brakes: You must have a scan tool that can turn the regenerative braking system off to perform these services.

GM Two-Mode Hybrid

GM designed its hybrid vehicle with regular maintenance in mind. The engine and most of the common components are pretty much the same as they are in a standard vehicle.

The main difference is with the transmission and starter. The function of the starter is now part of the front electric drive motor in the transmission. One of the control devices that allows this to work is the Starter/Generator Control Module (SGCM) at the right rear of the engine compartment.

The SGCM unit includes its own coolant, radiator and pump system to regulate its temperature. Another pump operates electrically, to supply hydraulic pressure when the gas engine is off. This pump is located externally at the bottom of the bellhousing.

With the pan and filter removed, the transmission fill capacity is 11.5 quarts. There's a fill tube on the right side of the case. For now, GM hasn't provided any information for verifying the level or specified fluid.

With any new technology, it's best to take one step at a time to learn the ropes. Unless you're trained and familiar with hybrid vehicles, I wouldn't recommend beginning your hybrid service career trying to fix a hybrid that was towed into your shop. General maintenance is probably your best way of becoming familiar with them.

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