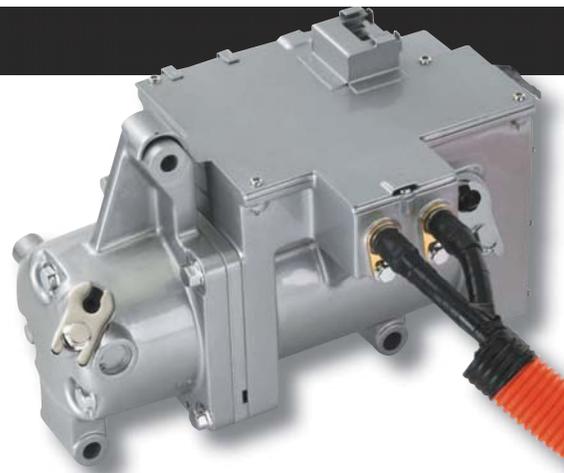


Hybrid A/C Repair



by Craig Van Batenburg

Servicing the air conditioning systems in hybrid vehicles brings concerns about their high-voltage electric compressors to the forefront.

The good news about hybrid A/C systems is that not much has changed, except for the compressor drive. Where there had been a belt and engine, now the compressor is powered with energy stored in a large battery pack that charges as the car slows down. This is the future, along with 150 volts or more being inverted to three-phase alternating current and supplied to an electric motor inside the compressor, which can spin it at any speed desired. The result of these high-voltage A/C systems are greater efficiency and the accompanying improvement in miles per gallon. As of March 2009 the three suppliers are Sanden, Denso and Mitsubishi.

An obviously important element of servicing any A/C system is the re-charging process. So one note of caution when it comes to performing this function on a hybrid vehicle is to ensure that the hoses on your re-charging machine are not contaminated with PAG oil. Cleaning all the hoses before hooking up to an HV compressor is required so that PAG oil will not enter the high voltage A/C system. The provided chart shows which hybrids use them. Also, watch for new A/C machines designated with an "H" that are part of SAE standards for high-voltage systems. These steps will help prevent any cross contamination of oils.

Chart for A/C Hybrid System Compressor © ACDC 2009

Make Model Years * Not for sale in US as of 3/06/09	Belt A/C Comp	High Volt Comp	High Volt Comp with belt drive
Honda Insight 2000-06	X		
Honda Civic HEV 2003 -05	X		
Honda Civic Gen II 06-09			X
Honda Accord HEV 05-07			X
Honda Insight 5d 2010 *	X		
Toyota Prius Gen I 01 - 03	X		
Toyota Prius Gen II 04-09		X	
Toyota Prius Gen III 2010 *		X	
Toyota Highlander HEV 06 - 07		X	
Toyota Highlander HEV 08 - 09		X	
Toyota Camry HEV 07 - 09		X	
Nissan Altima Hybrid 2007 - 2009		X	
Lexus RX400h 2006 - 2009		X	
Lexus RX450h 2010 *		X	
Lexus GS450h 2007 - 2009		X	
Lexus LS 600h L 2008 - 2009		X	
Lexus HS250h 2010 *		X	
Ford Escape Hybrid 2005 -2009	X		
Ford Fusion Hybrid 2010 *		X	
Mercury Mariner Hybrid 2006-2009	X		
Mercury Milan Hybrid 2010 *		X	
Mazda Tribute Hybrid 2008 - 2009	X		
Mercedes S400 Hybrid 2010 *	unknown	unknown	
Saturn Vue Green Line BAS Hybrid 2007 -2009	X		
Saturn Aura Green Line BAS Hybrid 2008 - 2009	X		
Chevy Malibu BAS Hybrid 2008 - 2009	X		
Chevy Silverado Hybrid PHT 2005 -2006	X		
Chevy Silverado Hybrid 2Mode 2010		X	
Chevy Tahoe 2 Mode Hybrid 2008 - 2009		X	
GMC Sierra Hybrid 2005 -2006	X		
Chevy Silverado Hybrid 2 Mode 2010		X	
GMC Yukon 2 Mode Hybrid 2008 - 2009		X	
Cadillac Escalade 2 Mode 2009		X	

If you accidentally add the wrong oil into an A/C system that uses high voltage to spin the compressor, the manufactures all say the same thing – replace every component. That’s easy to say, but what about the reality of the cost involved to the owner or the shop if it was their mistake?

The Best Teacher

In the U.S.A. there are over 1.4 million hybrids, with better than 1 million containing high voltage compressors. This represents the largest concentration of hybrids in the world. As a busy hybrid instructor I come in contact with many A/C shop owners and technicians. So with that in mind, here are a couple of things I’ve learned that weren’t found in any book or manual.

Two years ago a shop owner from Florida confessed that he had added ester oil into two Generation II Priuses (2004-2009), and didn’t know until I mentioned it in my class that it was a mistake. I asked him how long the ester oil was installed, and he replied that, “it had been over a year for both”.

I asked if these were good customers. He answered that he knew them well. It has now been over three years since the “mistake”. If the Prius owners had a problem, it would make sense that at least one would have returned to complain. That was my first hint that maybe the OEMs are just playing it safe by requiring their own oil.



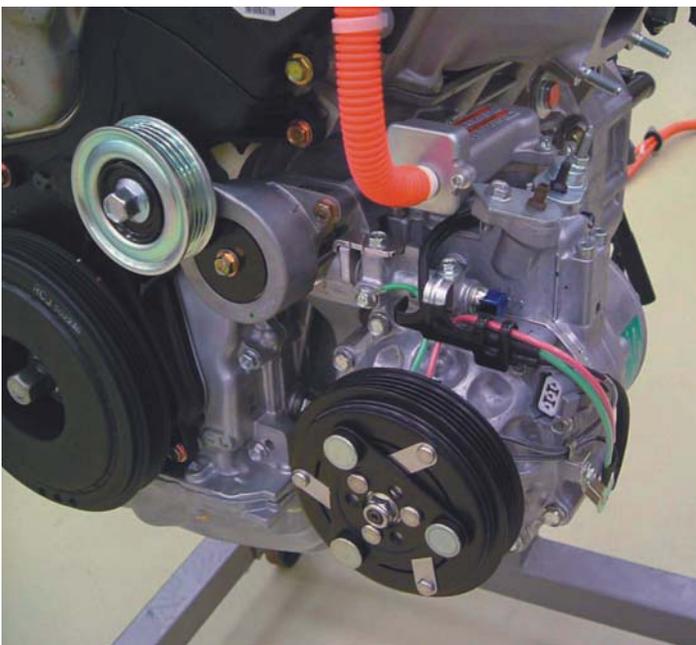
In September of 2007 I had my first road test in a Chevy Tahoe 2 Mode hybrid. It was a press car that is loaned to the media before production. I asked lots of questions, one of which inquired about the compressor manufacturer. The factory representative said she didn't know. After much searching I found that it was from Mitsubishi.

The A/C warning label on the hood stated that it required ester oil, without further mentioning a specific type. The Dodge Durango 2 Mode I drove in September of 2008 (since discontinued due to a lack of funding) required ND-11.

Not hard to figure out who supplied the compressor for the Dodge. As I asked some more questions, a good source told me that basically GM didn't want to have to make its dealers buy oil exclusively from Denso. Mitsubishi was evidently okay with ester oil, so GM went with them.

Between the two Priuses in Florida and the label under the hood on the GM about the oil required for the Mitsubishi high-voltage compressor, it looks like universal ester oil may be fine for use. My company, ACDC, is still researching this, but it looks like the OEMs may be crying wolf on ester oil. So now what about PAG oil?

In October 2008 my 2004 Prius, with 94,000 miles, was used once again for hybrid research. Karl Matis, vice president of HECAT, Inc. agreed to come to our five-day hybrid class and experiment with PAG oil in the ACDC company car.



Up above is a closer look at GM's 2 Mode A/C compressor. Directly above is the high-voltage compressor that Honda uses in their 2005-2007 hybrid electric Accord.

Before he arrived we ordered two used Denso compressors from a salvage yard, plenty of ND-11 oil, o-rings, a desiccant bag for the dryer and a service plug from a Toyota dealership. Karl shipped up a special A/C flusher and, with the help of a student and ACDC trainer Jeff, they added PAG oil into a virgin system.

The ACDC Prius A/C system has never been worked on, so a base line was established for the A/C system as it was presented. It was working properly with readings of 130 PSI on the high side and 30 PSI on the low side. After evacuating the system 16 ounces of refrigerant was added, along with 1 ounce of the wrong type of PAG oil, which came directly from the R&R machine's automatic oil injector.

Over a period of two days more PAG oil was added. Each time this was done by evacuating the system and, after a total of 5 ounces of the wrong type of PAG oil was introduced, the system still operated without bringing up any codes. The only noticeable difference was that the high side had higher pressures, but not at a level that would hinder system performance. This was not what we expected to see, based on what we read on Toyota's website.

After expecting to see the A/C system shut down due to high voltage leaking at the compressors coils, we came to the conclusion that PAG is most likely a problem over time, but how long we do not know. If you add PAG oil and run the system you may be okay if you can properly flush out the entire system as we did with the HECAT flusher and factory oil. For now we had to replace the compressor, and we did with a used unit, because you cannot buy the service parts needed to clean the compressor.

The ACDC Prius has about 8,000 more miles on it since we tried to break it. The A/C is running fine, with the PAG oil flushed out and ND-11 inside. It still hasn't generated any codes. The experiment is still in progress and will be updated as more miles are logged.

Why do the OEMs demand that their special oil be used? My guess is that it helps keep warranty costs down, provides a base line for them to analyze a failure, and satisfies the compressor manufacturers.

Why do they require replacing everything in the A/C system if the oil is contaminated with ester or PAG oil? This question most likely has to do with the first, along with a lack of confidence in flushing machines and techniques (for which HECAT appears to have the answers).

These words; craftsmanship, pride, and individual worth are words I like. When a mechanic can take a broken, worn, or contaminated part and make it useful again, they themselves feel useful. That leads to pride of workmanship. The net effect is overall better work and higher self image.

So the next time you find contaminated oil in a high voltage A/C system, before you replace everything, go to my website and get the rest of this evolving story.

Craig Van Batenburg is the CEO of ACDC. To learn more about his company and *Up Your Voltage* training seminars, go to www.fixhybrid.com. 