StarTuned®

Information for the Independent Mercedes-Benz Service Professional

StarTuned.com

June 2021

U.S. $7.00 | €5.76

Volume 21 | Number 2

Image courtesy TEXA S.p.A.

Inside:

Mercedes-Benz

The best or nothing.

STARTUNED®

Mercedes-Benz *StarTuned*®: Diagnostic and Repair Information for Independent Technicians

Attention Independent Technician readers: After 20 years in production, we are pleased to announce *StarTuned* has launched a new, improved format with digital component.

StarTuned now consists of:

- StarTuned.com – A website with free, digital access to searchable database of 20 years of *StarTuned* articles. Simply create a login and have immediate digital availability of newly and previously published articles.
- New 16-page print format containing all original content: One full feature article and highlights from at least three articles that can be read in their entirety online.
- Regular Mercedes-Benz program information applicable to shops that work on Mercedes-Benz vehicles.

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Thank you for your interest in *StarTuned* and the opportunity to provide Mercedes-Benz approved diagnostic and repair procedures.

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Mercedes-Benz
The best or nothing.

NASTF and the VSP Registry

Valuable resources for independent repair shops

The National Automotive Service Task Force (NASTF) was created to provide a technology solution to ensuring access to the information needed to diagnose and repair every make and model vehicle. But if information is king in the service and repair business, then security is the queen. Both old-fashioned physical security, as well as 21st century cybersecurity, are a growing focus in the vehicle diagnosis, service and repair business.

If you haven't yet created your NASTF membership, you're missing an important piece of the puzzle to maximize your shop's capabilities and productivity. Joining is easy–and free!–at nastf.org, with online resources available at your fingertips. If you haven't yet made the decision to join, here's some helpful information so you can better understand what NASTF is, how it works and what it can mean to your business success.

The National Automotive Service Task Force is a cooperative effort between the automotive service industry, the equipment and tool industry, and automotive manufacturers (like Mercedes-Benz) to ensure that independent automotive service professionals outside the dealer network have the information, training and tools needed to properly diagnose and repair today's high-tech vehicles.

NASTF was established in 2000 to work constructively at improving the delivery systems for that information. Today's rapidly-advancing vehicle technologies are adding enormous amounts of information that automotive professionals need to access and manage in the day-to-day process of diagnosis, maintenance and repair of an increasingly sophisticated vehicle fleet. But if technology is the problem, it can also be the solution, and NASTF facilitates the identification and correction of gaps in the availability of automotive service information, training, diagnostic equipment and communications to automotive service professionals.

Before NASTF, there was no national advocate for independent workshops like yours to get access to manufacturer-specific information. While many manufacturers offered this, not all did, and there were some gaps in what was available. NASTF helped bring all the stakeholders to the same table and develop a cooperative organization to ensure important information...

Read the complete article online at: bit.ly/NASTFVSP

CO_2 as a Refrigerant is Happening

Under development for many years, R744 systems will be showing up soon. Are you ready?

I know what many shop owners and technicians are thinking right now: When will it ever end, this constant changing of automotive air conditioning systems? Well the short answer is maybe never. As with all systems in the automobile, the drive to improve on safety, performance and efficiency characteristics will always be evolving. Much to the chagrin of independent repair facilities this is, and will be, the norm for the foreseeable future. We can only hope all other manufacturers will follow Mercedes-Benz's lead (and it appears many are) and standardize to one refrigerant. Those shops that service multiple car lines are otherwise forced to purchase different equipment to service different vehicles. We might be averse to the many changing regulations regarding the environment but any of us who live in the Western U.S. are keenly aware of aware of the air we breathe due to the smoke from all the wildfires. Hydrofluorocarbons (HFCs) are colorless and virtually odorless, but just because we can't see and smell them doesn't mean they aren't there.

Evolution

Early automotive AC systems were run on Dichlorodifluoromethane (R-12) a colorless gas usually sold under the brand name Freon-12. Although R-12, a chlorofluorocarbon (CFC), has excellent cooling properties,

Shown here: Mercedes-Benz S-Class with the R744 CO_2 air conditioning system in a wind tunnel test.

it was found to be terrible for the environment. According to the United States Environmental Protection Agency (EPA), chlorine and bromine atoms coming into contact with ozone in the stratosphere disassemble the ozone molecules. One chlorine atom can destroy over 100,000 ozone molecules, far more quickly than ozone can be naturally created. A reduction of upper-atmosphere ozone is blamed as a component of climate change.

In the early 1990s, the EPA banned the use of R-12 in new motor vehicles and began the phase in of R-134a, a potentially less ozone depleting substance. 1,1,1,2-Tetrafluoroethane (HFC-134a, commonly known as R-134a) has been atmospherically modeled for its impact on depleting ozone and as a contributor to global warming. Research suggests that over the past 10 years the concentration of R-134a has increased significantly in the earth's atmosphere, with a recent study revealing a doubling in atmospheric concentration between 2001 and 2004. It has insignificant ozone depletion potential, significant global warming potential and negligible acidification (acid rain) potential. Because of its high GWP, R-134a has been banned from use in the European Union, starting with cars in 2011 and phased out completely by 2017. In the United States the EPA bans R-134a in new light-duty motor vehicles as of model year 2021, with some narrow exceptions for export vehicles.

One of the next in line of possible replacement refrigerants comes the refrigerant R-1234yf. It is one of the first in a new class of refrigerants, acquiring a global warming potential (GWP) rating 335 times less than that of R-134a. Briefly used by Mercedes-Benz in the middle of the last decade, and clearly more environmentally-friendly, it has some safety concerns. More on that later.

That brings us to CO_2 as a refrigerant. From an environmental perspective, CO_2 (Carbon Dioxide, also called R744, which must not be confused with R744a, which is Nitrous Oxide) is a very attractive refrigerant with a zero Ozone Depletion Potential and a Global Warming Potential of 1, as compared to R-134a at 1300. It is a naturally occurring substance, inexpensive and abundant in the atmosphere.

The Future is Here

In order to comply with the legal provisions going into effect in 2017, Mercedes-Benz began to equip its vehicles with air conditioning systems that meet all the relevant performance and safety requirements. This production change exceeds the EU's climate protection requirements. Since 2017, they have offered in Europe the S- and E-Class as the first production passenger cars equipped with CO_2 air conditioning systems. These completely newly-developed systems are based on the DIN specifications defined by the automotive standards committee of the German Association of the Automotive Industry (VDA). Thanks to their especially quick and high cooling performance, CO_2 air conditioning systems immediately provide a comfortable climate-controlled cabin even during very hot weather. This, in combination with their high environmental consciousness, makes them the long term premium solution among air conditioning systems.

Safety First

It seemed as though we were headed at one time for the use of R-1234yf as the go-to refrigerant, so what gives? Many scientists and engineers felt that it was only a temporary solution at best, including Mercedes-Benz engineers, and initially resisted its use.

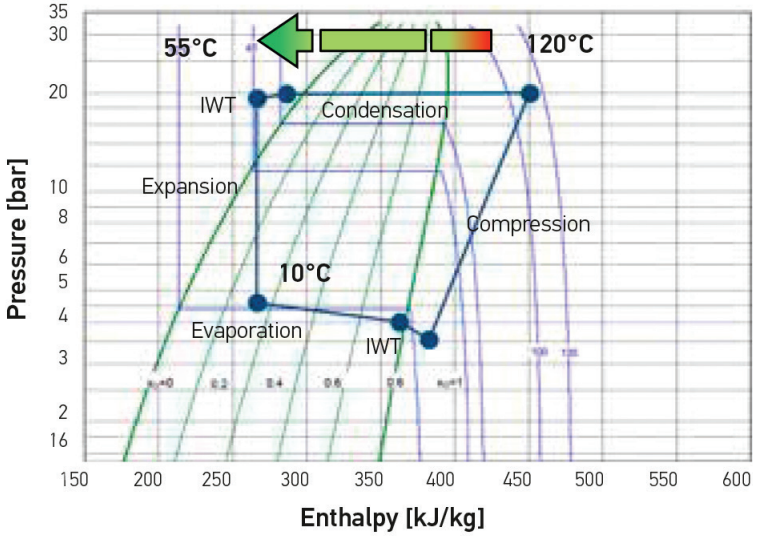
In August 2012, Mercedes-Benz testing showed that the substance ignited when researchers sprayed it and A/C compressor oil onto a car's hot engine. A senior

A inexpensive Carbon Dioxide cylinder like this one, used for welding and beverage dispensing, will be the new norm for A/C service.

Daimler engineer who ran the tests stated, “We were frozen in shock, I am not going to deny it. We needed a day to comprehend what we had just seen.” Combustion occurred in more than two thirds of their simulated head-on collisions. The engineers also noticed etching on the windshield caused by the corrosive gases.

On September 25, 2012, Daimler issued a press release and proposed a recall of cars using the refrigerant. Since then, to also meet the EU requirements on schedule for all other model series, the company has developed safe and reliable solutions for the use of R-1234yf. Daimler’s initial refusal to use it was based on concerns over its safety, but a suppression system combined with component placement to ensure refrigerant and hot engine components are separated in a collision has allows its safe use. Given that the R-1234yf refrigerant is the only one mandated by the European Union for use and available in sufficient quantities for use in vehicles, it appears that Daimler has come up with the best solution to a difficult problem. The German automakers have, however, lobbied for development of carbon dioxide refrigerants, which they argued would be safer. Mercedes-Benz has committed to introducing R744 soon, but for the time being North American models are expected to be equipped with R-1234yf.

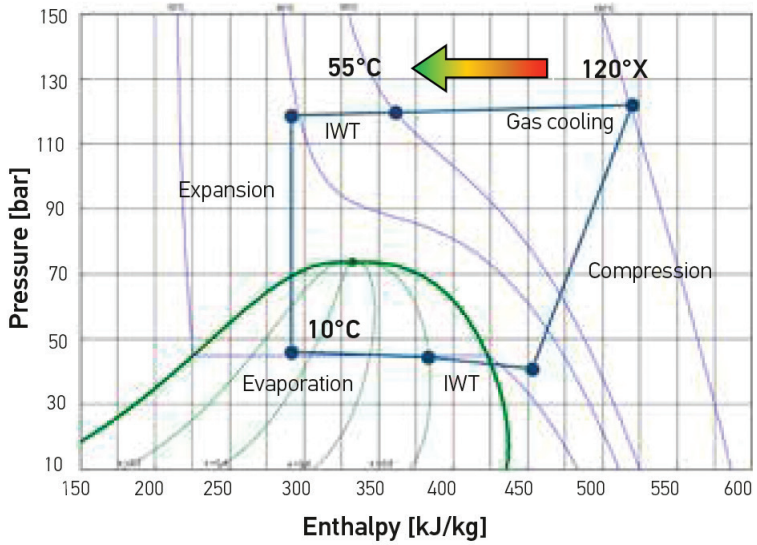
R1234YF



High-pressure level: 10-20 bar
Low-pressure level: 3-5 bar
Hot gas temperature: Up to 140 °C

Heat dissipation: Condensation
IHE: Internal heat exchanger

R744



High-pressure level: 60-130 bar
Low-pressure level: 30-50 bar
Hot gas temperature: Up to 165 °C

Heat dissipation: Gas cooling
Supercritical process with full load

Note the significant pressure (left axis) and temperature (light blue lines) variations in R744 (CO_2) as compared to R-1234yf.

Redesign

The use of CO_2 in the automotive industry requires completely new components. Operating at a pressure of more than 100 bar (1450 psi), as much as ten times higher than that of today’s systems, means that all components, including the hoses and seals, needed to be redesigned. One particular challenge is ensuring that the refrigerant circuit is leak-tight: The small size of the molecules and the high CO_2-permeability of conventional polymer hoses necessitate the use of metallic sealing rings and flexible, coated polymer hoses. Furthermore, the temperatures and pressures involved require the use of corrugated stainless steel hoses downstream of the compressor on the hot gas line.

The compressor also must be designed to handle the increased pressures and flows. The

The first compressor, designed by Sanden, for use in Mercedes-Benz S-Class and E-Class models in Europe. Photo courtesy Sanden Corp.

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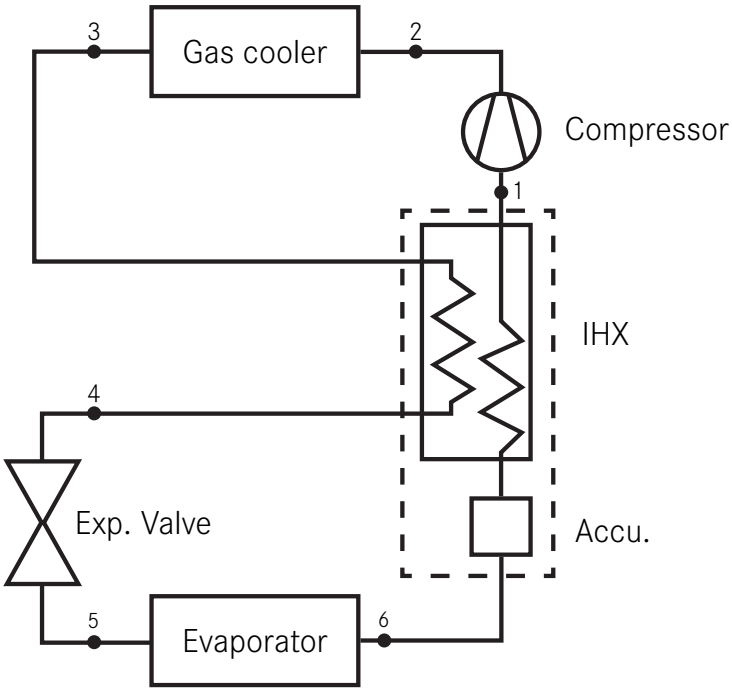
One remanufactured engine pulls the plug on climate-damaging CO_2 and saves 447 days of power for one laptop.

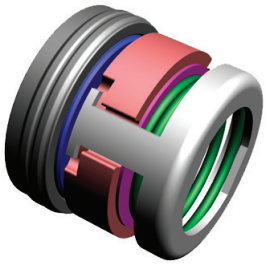
compressors' cooling performance and function exceed conventional compressors with one-fifth of the capacity (31 cc). According to manufacturer Sanden Automotive Components Corporation, Daimler's are "the world's first CO_2 compressors for mass-produced passenger cars." Sanden has been developing this product with its Japan and Germany-based teams since 2014. The newest models now use a more advanced electric compressor.

"It has been quite a challenging project... for Daimler to get the R744 AC system launched in such [a] short period," said Daimler's Dr. Ralf Theurer. Mercedes-Benz has drafted corresponding standards together with all German automobile manufacturers and numerous suppliers in the automotive standards committee of the German Association of the Automotive Industry (VDA). Mercedes-Benz has assumed a pioneering role in this respect. It is the first automobile manufacturer to award not only development contracts but also to place production orders for CO_2 air conditioning systems and their components.



Notice the work flow of the internal heat exchanger (IHX), using the relatively cool gas exiting the evaporator and accumulator to cool the hot refrigerant after it exits the gas cooler (condenser).

Higher pressures are not the only major difference. The second major difference occurs above an external temperature of around 25 °C, where the refrigerant pressure exceeds a critical point. Above this level, the R744 refrigerant can no longer be liquefied through cooling. In such conditions, the refrigerant is therefore continuously air-cooled by the condenser—more accurately named a gas cooler—accommodated in the front end near the coolant radiator.



The seals had to be redesigned to withstand the significantly higher pressures. The old Viton O-ring just won't cut it anymore!

Heat Exchanger

A new component introduced as part of this new technology is the Internal Heat Exchanger, often referred to as HX or IHX in many cooling diagrams. In order to obtain a high overall air conditioning system efficiency it is vital to introduce wet vapor with the highest possible potential to extract heat from the cooled air. R744 systems show a certain efficiency drop at higher ambient temperatures due to various properties—a discussion for the scientists—that requires further cooling of high-pressure refrigerant after it exits the gas cooler (condenser). The IHX is often designed as an extruded aluminum counter-flow heat exchanger, sometimes embedded in the accumulator for improved system design.

Condensers

As noted above, many workshop manuals will now reference what was previously known as a condenser as a gas cooler. Although this (as well as the evaporator) are types of heat exchangers, don't confuse them with the inline heat exchanger added to R744 systems. In order to achieve the highest efficiency of heat exchange, the cooler uses multiport tube and fin technology. Refrigerant tubes have rows of micro channels with a diameter of about .5 mm to enhance heat transfer and to provide enough strength to withstand the higher operating pressures in the system. These tubes also have a thinner profile than those in R-134a systems which also enhances heat transfer.

Evaporators

Although still serving as the 'cold side' of the system, the evaporator in a CO_2 system is also completely redesigned, for the same reasons as the gas cooler. SAE Standard J639 requires vehicle manufacturers to perform assessments to minimize reasonable risks in mobile air conditioning systems, and gas at 100 bar presents its own special

Although this evaporator looks fairly conventional, it has been considerably redesigned for the high pressures used in a CO_2 (R744) refrigerant system. Photo courtesy of MAHLE Group.

An investment in a recovery machine such as this in your future if you want to service R744 systems. Photo courtesy TEXA S.p.A.

risks, particularly since the evaporator is essentially in the passenger compartment.

Safety

A couple of particular aspects must be observed when using CO_2 in terms of operational safety. The refrigerant circuit must be secured to prevent components from bursting. This protection is provided in the form of a pressure-temperature sensor and pressure limiting valves in both the high-pressure and low-pressure circuits. A CO_2 concentration above 5% in the air (normally around 0.03%) may cause headaches and dizziness, or even loss of consciousness at higher concentrations. For this reason, the system must be equipped with a CO_2 sensor that measures the concentration of carbon dioxide in the vehicle interior, switches off the air-conditioning system in an emergency, and ensures a sufficient supply of fresh air.

Equipment

The KONFORT 744 recharge station was developed in collaboration with leading German automakers and is one of the very few solutions currently available that is specially designed to service and recharge R744 refrigerant systems. These new service machines differ radically in design from those intended for use with R-134a and R-1234yf refrigerants. The KONFORT 744, from TEXA S.p.A. is fully automatic and guarantees high-precision recharging, with a maximum tolerance of only 10 grams of refrigerant (and 2 grams of oil).

Special attention also was paid to the system for releasing CO_2 into the atmosphere which, unlike other refrigerants, is allowable. Release takes place in a controlled manner to ensure the safety of the operator and of the system itself. The KONFORT 744, approved for use by Mercedes-Benz, also incorporates an accurate system for measuring the concentration of CO_2 in the surrounding air, and suspends charging if this approaches a dangerous level.

Training

Section 609 of the 1990 Clean Air Act also established in the United States an important statutory structure to control the release of refrigerants from motor vehicle air conditioners into the atmosphere. Any person repairing or servicing motor vehicle air conditioners for consideration must properly use refrigerant recycling equipment that has been approved by the EPA.

Technicians who repair or service motor vehicle air conditioners for consideration (payment) must be trained and certified by an EPA-approved technician training and certification program. For the independent service provider that means not only finding proper training for your technicians, but also making sure they are certified. Refrigerant manufacturers and distributors have adopted guidelines by which they will not supply material unless the buyer is certified. There are several good online training and certification courses that you have access to. A few are listed here:

- gcada.org/pdf/FreonStudyGuideforWebsite2016.pdf
- macsmobileairclimate.org/

So get ready and ahead of the curve so your shop will be prepared when these vehicles begin to show up in your service bays. You'll be glad you put in the extra time and preparation.

MIL Code P0513: Unauthorized Key, KEYLESS GO Not Recognized, and Key Fob Malfunction

The KEYLESS GO feature makes the KEYLESS START even more attractive

What is KEYLESS GO?

With KEYLESS START, you can step on the brake and press the START/STOP button on the dashboard to start the car—no key required. This feature comes standard across the Mercedes-Benz lineup.

KEYLESS GO is essentially an upgrade of KEYLESS START. You can still start the engine, but KEYLESS GO also has the ability to automatically lock or unlock the vehicle when the door handle is touched. This feature comes standard in models like the GLE Coupe and S-Class Coupe and available as on option on any new Mercedes-Benz.

Above: This START/STOP button is removable in most models to use the transmitter key in a conventional manner. Handy if you think the fob battery is a problem.

The key fob transmitter for KEYLESS GO looks the same as KEYLESS START depending upon the model.

Functionality

As with all systems controlled by the user, the KEYLESS GO system needs to be understood by the consumer to avoid misconceptions as to how it operates and complaints grounded in misinformation. Educating your customer sometimes solves many concerns.

With Mercedes-Benz KEYLESS GO, you can unlock and lock the vehicle, start and stop the engine, or even close the windows and sunroof from the outside of the vehicle, by simply having the SmartKey in the immediate vicinity of the vehicle, usually your customers pocket or purse.

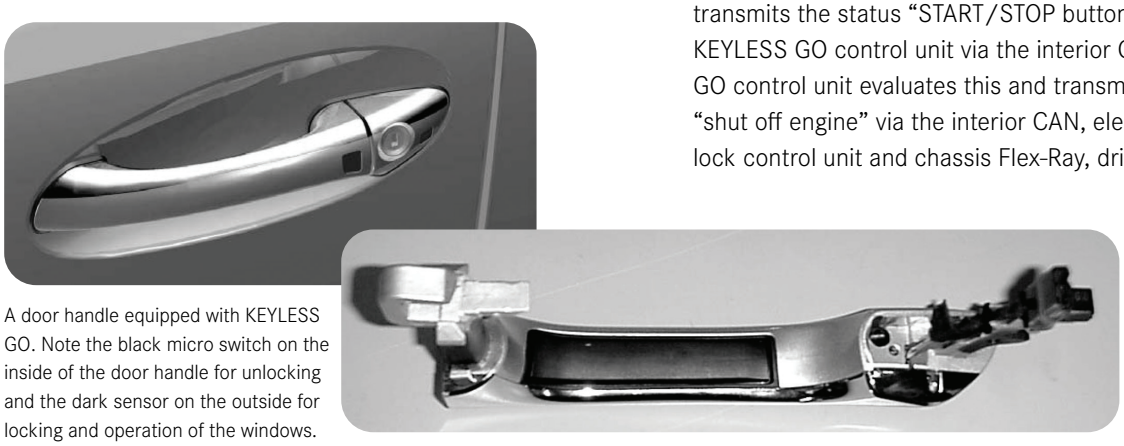
To unlock the car, firmly grip the driver door handle. To unlock all doors, grab any of the passenger handles. Most models have a removable push button located in the ignition and the dash that allows you to insert your Smart Key and start the vehicle in a conventional manner by inserting the key. This can come in handy if the key fob battery dies.

If the button is in place, each press is like turning the key one position as long as you don't press on the brake. With one touch you can turn on the vehicle's accessories such as the radio. Press the button a second time and the dash lights and all electrical items will turn on. Pressing a third time with your foot off the brake will turn everything off. You can also turn all features off by opening the door. To start the engine, simply step on the brake and push the START/STOP button. To turn the engine off, stop the car, leave your foot on the brake, shift to park and set the parking brake, then press the START/STOP button once again.

If you want to lock your vehicle from the outside, simply touch the sensor located on the door handle. If you've forgotten to close the windows and sunroof simply keep your finger on the sensor until the windows and sunroof finish closing. Many times you will solve some customer concerns with a simple demonstration of how the system operates.

Shutting Off the Engine

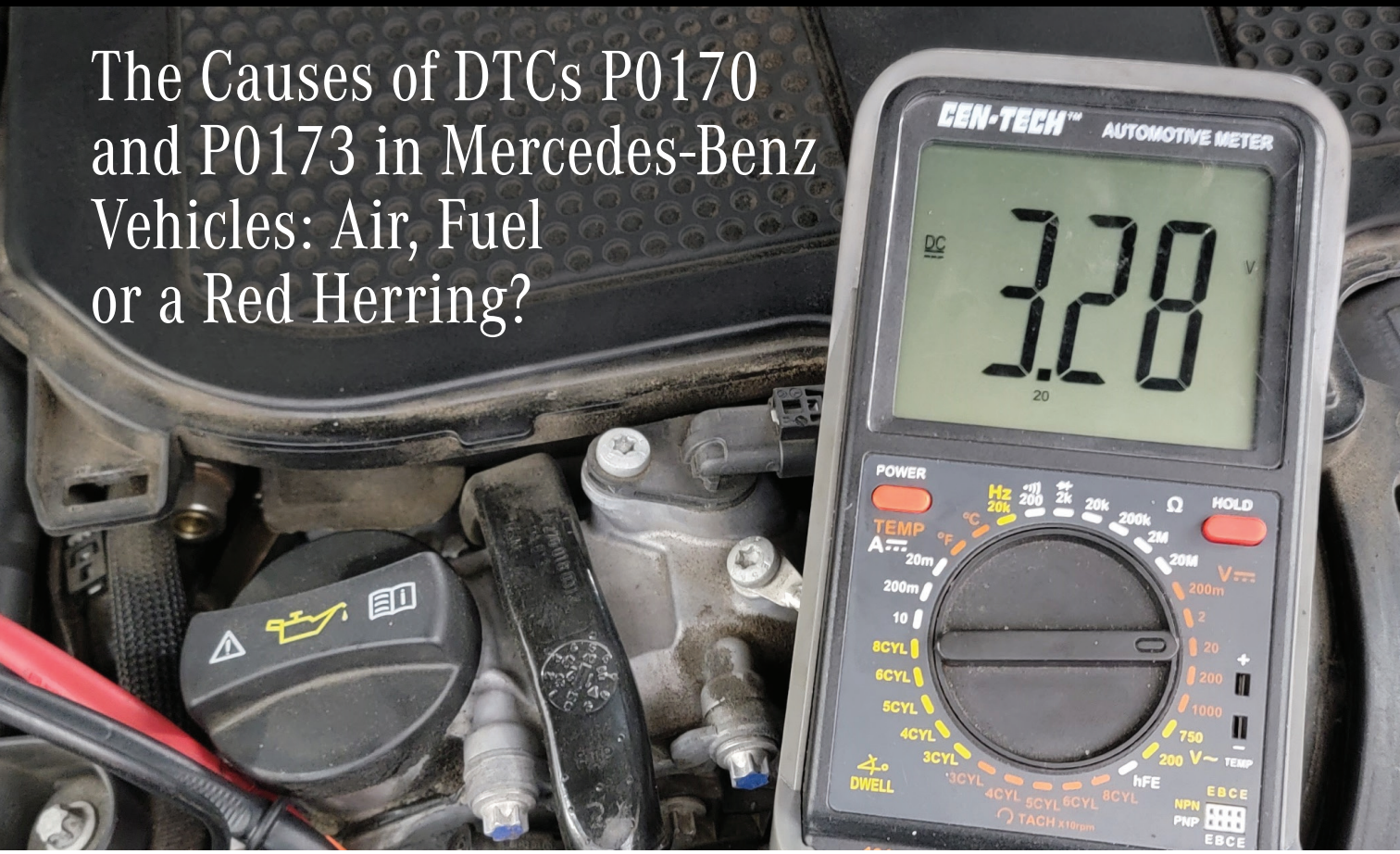
When the KEYLESS GO START/STOP button is pressed while the engine is running, the engine is requested to shut down. The electronic ignition lock control unit detects when the KEYLESS GO START/STOP button is pressed and transmits the status "START/STOP button pressed" to the KEYLESS GO control unit via the interior CAN. The KEYLESS GO control unit evaluates this and transmits the request "shut off engine" via the interior CAN, electronic ignition lock control unit and chassis Flex-Ray, drive train control unit and engine CAN to the CDI or ME-SFI control unit. The CDI or ME-SFI control unit then shuts off...



A door handle equipped with KEYLESS GO. Note the black micro switch on the inside of the door handle for unlocking and the dark sensor on the outside for locking and operation of the windows.

Read the complete article online at: bit.ly/milp0513

The Causes of DTCs P0170 and P0173 in Mercedes-Benz Vehicles: Air, Fuel or a Red Herring?



The OBDII Fuel Trim DTCs P0170 and P0173 are often the subject of robust online debate, some confusion as to their meaning, and further debate as to how to solve these faults in Mercedes-Benz vehicles. As most of us are aware, the generic OBDII DTC (Diagnostic Trouble Code) structure is governed by standards, meaning each manufacturer must meet the generic standard by associating emissions-related DTCs to the (available and pre-determined) generic DTC code sets.

In the case of OBDII codes P0170 and P0173, it is important to note that the OBDII standard does not dictate which of these various code sets must be used to (first) identify a fault; how the manufacturer arrives at the compilation of data, engineering units or scaling; nor the scope of parameters analyzed and used by the OEM as criteria to set the fault. In general terms, the standard only requires that, in the end, the emissions fault must be able to be translated and communicated over the standard's approved data exchange protocol and that the fault can be identified, tested and corrected within the standard's guidelines.

So what's the big yank then, you might ask, regarding the differences between diagnosing the P0170-P0173 DTCs, versus the P0171-P0174 Lean Bank and P0172-P0175 Rich Bank DTCs? Is there actually a substantive difference between the code sets and what they mean in our diagnostic path and approach to solve the fault?

These two different, yet closely similar, sets of codes both clearly indicate some sort of control issue related to...

Read the complete article online at:
bit.ly/dtc-p0170-p0173

Mercedes-Benz Blind Spot Monitoring System

Blind spot assist systems use not only radar sensors, but also wheel speed sensors, steering angle sensors, door control modules, exterior mirrors, the entertainment system antenna, and more. For models with active blind spot assist technology, add anti-lock braking, electronic stability program, and other systems.

Blind spot sensors and assist technologies have been on various Mercedes-Benz models for over a decade. Blind spot assist systems detect vehicles in the blind spot using a radar measuring process. Radar sensors emit electromagnetic waves that are reflected off of any obstacle in the blind spot target range. The reflected signal is received back by the radar sensor of the corresponding wheel.

How reflected electromagnetic waves pinpoint objects:

- Travel time of the reflected signals = Distance to the object
- Direction of reflection = Location of the object
- Intensity of the echo (reflected signal) = Size of the object
- Frequency (signal) shift = rate of movement of the object

Pay attention to system names, as there are different blind spot technologies and diagnostic procedures on various Mercedes-Benz models.

Early systems used a series of progressively more attention-getting warning technologies, including blinking lights in exterior mirrors and the dash, audio chirps and beeps, and haptic (vibration) in the steering wheel, to alert drivers that there was an obstacle in their blind spot. These 'warning-only' systems are called "Blind Spot Assist."

Technologies introduced on 2014 and newer models added the ability of the vehicle to autonomously initiate braking if the driver fails to respond to warnings with the appropriate avoidance maneuvers in a timely manner. Brake actuation...

Read the complete article online at: bit.ly/bl-sp-mo

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