

STARTUNED[®]

INFORMATION FOR THE INDEPENDENT MERCEDES-BENZ SERVICE PROFESSIONAL

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INSIDE:

- HEAD-UP DISPLAY
- KEEPING COOL: HVAC
- SINGLE-USE FASTENERS
- TIMING CHAIN TENSIONERS
- GETTING THE MOST FROM STAR WIRING



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STARTUNED®

June 2020

Welcome to *StarTuned*®, the magazine for independent service technicians working on Mercedes-Benz vehicles. Your Mercedes-Benz dealer sponsors *StarTuned*® and provides the information coming your way in each issue.

Mercedes-Benz wants to present the information you need to know to diagnose and repair Mercedes-Benz vehicles accurately, quickly and the first time; text, graphics, online and other technical sources combine to make this possible.

Feature articles, derived from approved company sources, focus on being useful and interesting.

Our digest of technical information can help you solve unanticipated problems quickly and expertly.

We want *StarTuned*® to be both helpful and informative, so please let us know just what kinds of features and other diagnostic services you'd like to see in it. We'll continue to bring you selected service bulletins from Mercedes-Benz and articles covering the different systems on these vehicles.

Send your suggestions, questions or comments to us at:

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In This Issue

4 Eyes Forward: Head-up Display

Keeping your eyes on the road and your hands on the wheel

10 Keeping Cool: Solving HVAC Troubles

Help with intermittent operation or a system that does not maintain proper temperature

16 Single-use Fasteners

The lowdown on these humble but critical components

20 Timing Chain Tensioners

Rattles and startup noises? While no other carmaker's engines outlast those from Mercedes-Benz, eventually parts wear out or fail. Find out fast if cam timing has jumped.

28 Getting the Most from Star Wiring

Understanding what the Star Wiring diagrams have to offer is key to any successful diagnosis and repair. In this article, we will dive deep into all that Mercedes-Benz offers in this valuable tool.

Also Inside:

15 Back to Business

Restarting your business while keeping everyone safe

35 20 Years of *StarTuned*

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Eyes Forward: Head-up Display

Keeping your eyes on the road
and your hands on the wheel



The 1937 Mercedes-Benz 540 K Cabriolet featured one of the automotive industry's earliest production car radios. What was then a premier product for owners of luxury vehicles has now become one of many components that aggregate vehicle performance data, real-time road condition information, and entertainment into one system. These newest infotainment systems combine several formerly standalone capabilities, including applications for navigation, vehicle functionality, communications, and multimedia entertainment.

Available since 2014, the Mercedes-Benz Head-up Display (HUD) projects much of that information onto the windshield to help reduce the need for the driver to take his or her eyes off of the road ahead. The HUD projects speed, navigation, driver assistance, and other driving-relevant information onto an area of the windshield where it is easily viewed without obstructing the line-of-sight to the road ahead. Note that it's not a "heads-up" display, but a head-up display.

The information presented varies based on how the vehicle is equipped, e.g. DISTRONIC adaptive cruise control, COMAND navigation system, etc., and the operator's



The 1937 Mercedes-Benz 540 K Cabriolet could be had with one of the newest luxury features: a factory-installed radio.

Opposite Page: The Head-up Display projects an image onto an area at the bottom third of the windshield. The image appears to the driver to be floating a few feet beyond the front of the car, just a few inches above the hood.

display preferences. The driver can adjust the position and brightness of the display on the windshield, and may also select which information he or she would like displayed. However, the HUD can display only information that is also available on the instrument cluster.

On Mercedes-AMG vehicles equipped with HUD the driver can select "Race Timer" to see the lap number and lap time in the HUD. On vehicles with "AMG Track Pace," the HUD can display further details including speed and gear indication, lap and sector times, acceleration and braking, graphic track layout, and other information.

HUD operation

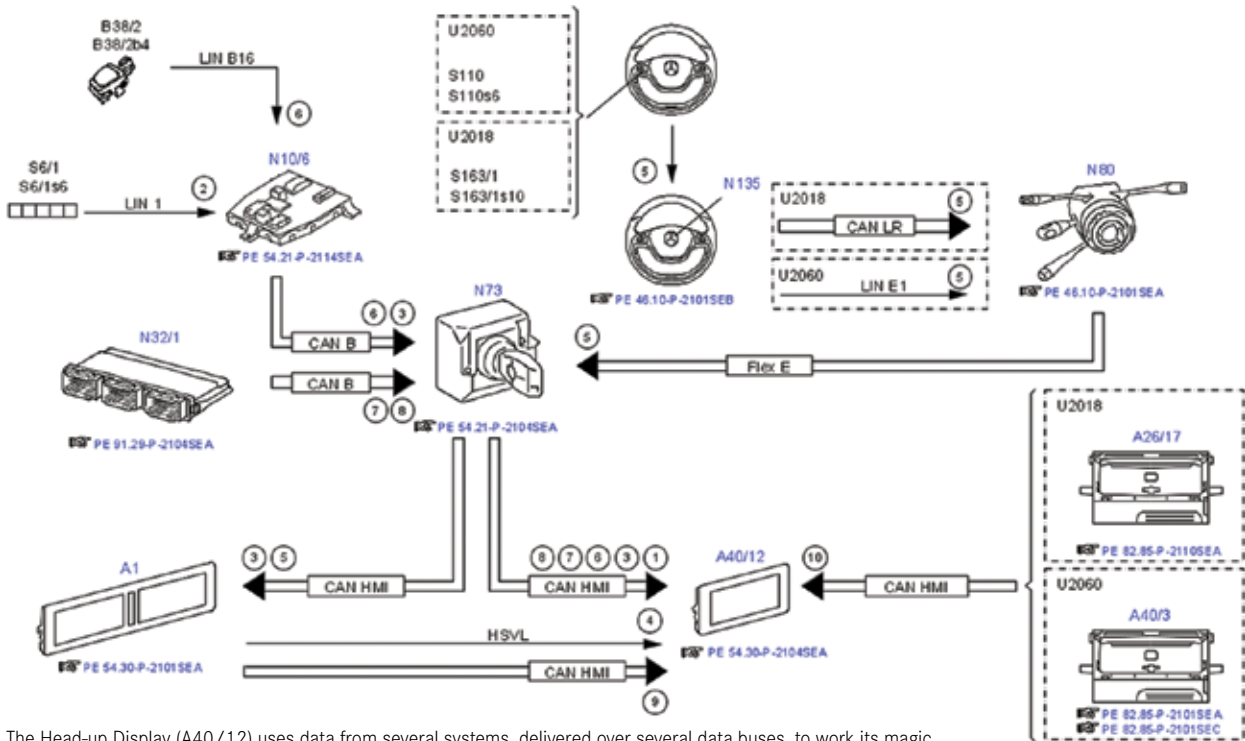
Drivers use buttons on the multifunction steering wheel to operate or change settings for the HUD. For this description, we'll be using the S-class as of MY18 as an example, but the system is similar in all models. The driver can use the finger navigation pad (S163/1s10 in the HUD electrical function schematic) on the instrument cluster multifunction steering wheel button group (S163/1). Alternatively, they can use the OK button (S110s6) in the left multifunction steering wheel button group (S110).

The steering wheel electronics (N135) read user inputs to the button group and transmit those to the steering column module control unit (N80) via the steering wheel CAN (CAN LR), or for older models through the steering LIN (LIN E1). The steering column module control unit sends signals over the suspension FlexRay (Flex E), through the electronic ignition lock control unit (N73) and the user interface CAN (CAN-HMI) to the instrument cluster (A1). The instrument cluster then sends display data over CAN-HMI to the HUD.

Personalized choices can be saved on vehicles with memory function capability, for retrieval by different drivers. A driver can save different profiles, for example, one for routine weekday commutes, and another for weekend racetrack fun.

Driver height and seat position affect the position on the bottom third of the windshield where the driver can best





The Head-up Display (A40/12) uses data from several systems, delivered over several data buses, to work its magic.

see the HUD images. When the driver saves their preferred head-up display placement, algorithms in the HUD look at the image position on the windshield and the distance to the HUD control unit and triangulate to determine the location of the driver’s head. The “head motion box,” as Mercedes-Benz engineers call the area, allows the system to save in memory a mathematical description of that driver’s unique location for the HUD image. For each different driver who saves his or her preferred windshield location for the HUD display, the head-up display controller can access and act upon that saved description.

In Mercedes-Benz models with Memory Package (Code 275), this mathematical description is saved in combination with the driver’s preferred seat position. So, if the customer complaint is that the HUD image is not as easy to see as it once was, one thing to explore is whether the driver has changed his or her seat settings without also adjusting their preferred location of the HUD projection on the windshield. Seeing the display from even only a slightly different angle may make it appear blurry, distorted, or less bright.

The request to save or retrieve the memory position is transmitted by the driver seat control unit (N32/1) via the interior CAN, electronic ignition lock control unit and user interface CAN to the head-up display. To confirm

the settings being saved, the instrument cluster control module emits a beep tone through its speaker.

Basic requirements for the HUD and memory save/recall functions in Mercedes-Benz models 217 and 222 (with Code 463: Head-up Display) to operate correctly, include that there is no over- or under-voltage condition, the ignition (Circuit 15) is ON, and the seat adjustment is normalized. Check the repair instructions in the Mercedes-Benz Workshop Information System (WIS) for specific vehicle applications, as different conditions may exist for saving seat and mirror adjustment settings to memory.

Saved head-up display settings may be retrieved by activation of user-profiles via the multimedia system control. The head-up display control unit then recalls the previously stored settings to lay out the desired content, position, and brightness of the image on the windshield.

Transmitting high-speed video

The instrument cluster control unit calculates the image information requested for the head-up display and sends it over a High-Speed Video Link (HSVL) to the HUD. Before it transmits the image information, the instrument cluster controller must convert the data to a format that is acceptable to the HSVL and its software. The head-up display includes a “warping matrix” that talks to the instrument cluster’s “warping engine,” which is

a fancy way of saying that it has software that tells the instrument cluster how to process visual information for display on a non-flat surface. The warping engine ensures that the head-up display image does not appear distorted when it is projected onto the windshield.

If you replace the instrument cluster or the head-up display, you must also recalibrate the HUD so the “warping matrix” is updated in the instrument cluster control unit, and to allow both devices to communicate with each other. Similarly, if you replace the windshield, you must also recalibrate the HUD. Make sure the correct windshield is installed: a non-HUD windshield will display a double image because it doesn’t have the special coating required for the HUD. Genuine Mercedes-Benz glass will ensure you don’t have to repeat the job.

You can perform the basic recalibration using the workshop menu in the instrument cluster. Don’t skip this step. Otherwise your customer may see a distorted HUD image – one that might be reminiscent of a badly corrupted hologram in an old space adventure television show.

The instrument cluster control unit is placed in different locations depending on the vehicle model. For example, on the Mercedes-Benz CLA Coupe, front-wheel-drive subcompact (Model X118), the instrument cluster control unit (N133/1) is located under the driver’s seat. On the third-generation Mercedes-Benz GLS full-size luxury SUV (Model X167) which began production in October 2019, the instrument cluster control unit (N133/1) is located behind the instrument panel on the driver’s side. On the new all-electric EQC (Model N293), the instrument cluster control unit (N133/1) is located in the front passenger footwell behind the footrest.

Check head-up display function

To check or adjust the head-up display, first put the vehicle in ready-to-drive condition. That means set tire

pressure at the factory specification, ride height to the normal level, and the steering wheel in the straight-ahead position. Correct values for these parameters help ensure that the head-up display accurately represents the vehicle position relative to the road. Close the engine hood, doors, and trunk lid.

Insert the SmartKey into the ignition and turn it to position 1. For vehicles with KeylessGO, with the key in the passenger compartment and the brake pedal not engaged or pressed, press the Start button once. Either of these actions should switch Circuit 15R on. Adjust the driver seat to your preferred position, then check the head-up display.

Check the HUD manually

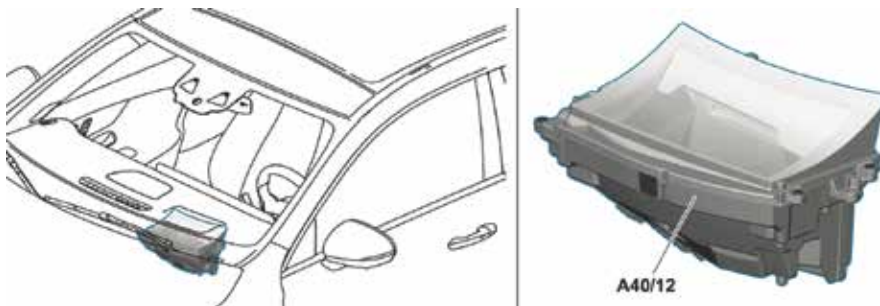
You can check the head-up display manually on models with Code 463 for head-up display. This includes Models 205, 217, 222, and 253 with Code 463. The manual process uses buttons on the steering wheel to check and, if necessary, modify head-up display settings. XENTRY Diagnosis can also be used for this process.

Different Mercedes-Benz models may have variations in the exact procedure to access and modify settings for the head-up display, so check in the Workshop Information System (WIS) for the work instructions that apply to the vehicle you have in your bay. For example, look for WIS document number AR54.30-P-6401-02LW entitled “Check Head-up Display” for detailed step-by-step instructions to access HUD display settings on Models 205, 217, 222, and 253 (all with Code 463).

As you follow the WIS instructions, you will call up the first test image to begin the diagnostic process. Here we’ll start at the point when the first image is shown, using Models 205, 217, 222, and 253 as our example.

Test image 1 is an example of typical HUD information

displayed to the driver (here using German and metric units). If test image 1 displayed by the HUD appears correctly – the instructions advise using two different persons to assess the image – confirm the settings as follows: Press OK (S110s6), press the Scroll Forward/Back



On Mercedes-Benz models with Code 463, the head-up display unit – labeled “A40/12” – is located within the top of the instrument panel on the driver’s side. It is attached to the instrument panel crossmember.

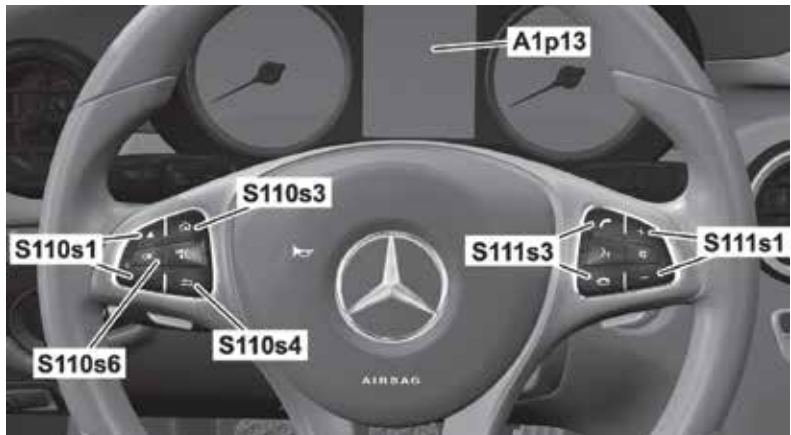
button (S110s1) repeatedly until “OFF” (original picture) is highlighted, and confirm the selection by pressing OK again. Press and hold the Back button (S110s4) for approx. 5 seconds. The test is complete and you can now exit the workshop menu.

If the image display was not correct, the WIS work instructions lead you through the detailed steps to identify and correct display problems. This involves a second test pattern display, along with several steps to take for alignment. If the image is still incorrect after all the parameters are reset, you will need a XENTRY Diagnosis machine to adjust the system, although this is rarely the case.

If any of the graphics are missing from test image 1, the information from the instrument cluster control unit may not be reaching the HUD. There could be a loose, broken, or damaged wire or connector somewhere in the circuit between the instrument cluster control unit and the HUD. Similarly, a problem with the High-Speed Video Link (HSVL) could be the cause of one or more elements not appearing properly in test image 1.

Before digging into wiring diagrams and fault codes, try to rule out simple misalignment issues. Just as a pinched optic nerve can cause eyesight problems, misalignment or distortion may cause test image 1 to display improperly. The WIS work instructions lead you through the detailed steps to identify and correct image alignment or distortion problems using buttons on the steering wheel.

After finding test image 1 not displaying properly, continue to the next step: Still in the workshop menu, press the OK button, then tap the Scroll Forward/Back button repeatedly until “Test Image 7” is highlighted. Click OK to confirm the selection of test image 7. Again, the WIS instructions advise that the image is to be evaluated by at least two persons.



Using the buttons on the steering wheel allows you to check and modify the head-up display settings through the workshop menu.



The head-up display test image 1 is an example of the typical layout of information as it would be projected onto the windshield for the driver.

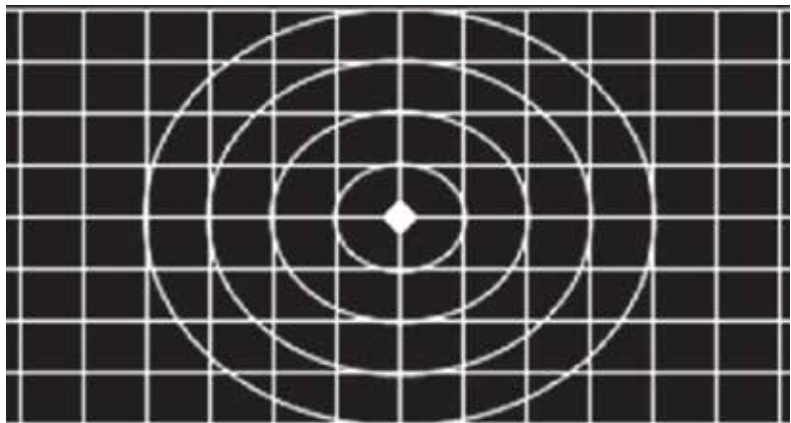


Image 7, shown here, is used to identify and correct any distortions on the head-up display.

This test image is a horizontal rectangular grid with a large bullseye in the center. The rectangle represents the space where the HUD projects all information to the driver. The HUD settings are OK if test image 7 displayed at the windshield is centered and not skewed or distorted in any way. If test image 7 appears correct to both persons, the settings are OK. Confirm this by pressing the OK button (S110s6). Next, press the Scroll Forward/Back button (S110s1) repeatedly until “OFF” (the original picture) is highlighted, then press OK to confirm that you want to

turn off the test image. Last, hold down the Back button (S110s4) for approximately five seconds. The correct settings are saved and you can exit the workshop menu.

Any HUD image other than a perfectly centered, non-distorted test image 7 means you need to reset the parameters in the workshop menu. To do this, press the Back button, then tap the Scroll Back/Forward button until "Parameters" is highlighted. Press OK. Then scroll until "Warp configuration" is highlighted and press OK. You have just reset the HUD parameters.

Now, call up test images 1 and 7 again. If they are now undistorted and correct, press OK (S110s6), press the Scroll Forward/Back button (S110s1) repeatedly until "OFF" (original picture) is highlighted, and confirm the selection by pressing OK again. Press and hold the Back button (S110s4) for approximately 5 seconds. The test is complete and you can now exit the workshop menu.

Again, if the manual reset of the parameters using the workshop menu does not adequately correct the display issues, you will need a XENTRY Diagnosis machine to adjust the system.

The head-up display system has been proven over the years to be extraordinarily reliable. Dealers report few problems.

One issue that has been seen was when the customer had an aftermarket windshield installed – one that was not properly set up for the HUD. A correct windshield has a coating that prevents a double reflection – one from each side of the glass – from displaying. Incorrect glass shows a double reflection, making the HUD virtually useless.

The only other issue we heard of was a damaged HSVL cable. A technician was working behind the dash on a different problem and accidentally damaged the wire. Mercedes-Benz has replacement cables available just in case this happens.

Just as the head-up display makes it easy for drivers to keep their eyes on the road, Mercedes-Benz engineers have made it simple to test and reset a distorted HUD image using, in most cases, just a menu within the instrument cluster. While we don't expect you'll ever have to work on one of these systems. Just in case, we've provided you with just about everything you'll need to know for fast and easy repairs. |



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Keeping Cool: Solving HVAC Troubles

Help with intermittent operation or a system that does not maintain proper temperature

It seems like we just got ready for winter and performing cold weather maintenance on customer's vehicles and now summer is upon us. It's time to look at the HVAC system as it relates to air conditioning. Customers that noticed their air conditioning performance drop towards the end of summer or fall may not have been too concerned about it but the first 70 plus degree day and they are knocking your doors down to get an appointment for HVAC service. Quite often the customer states something like, "I need to get my AC recharged."



A/C season is here!



A quality thermal imaging meter can give you accurate duct temperatures.

Opposite Page: The dark staining around the fittings at the compressor are an indication of a possible leak.

We all know how that ends sometimes. A good start is a service advisor with a sound knowledge of HVAC theory and operation who can explain that it may be as simple as that or it can be far more complicated.

Where to begin?

If the customer concern is that the air conditioning performance is not adequate, a likely culprit is a low refrigerant charge from a slow leak. Conversely, these systems are quite complicated and it's easy to assume the problem might be something that you've diagnosed recently and get ahead of yourself. First things first: Always verify the customer concern. Perform a complete A/C performance check as prescribed by Mercedes-Benz as well as the Mobile Air Conditioning Society (MACS). What is the ambient temperature? It is far easier to tell if the performance of the A/C system is not quite right on a hot day than a cool one. An infrared temperature meter or thermometer placed in the central A/C duct will take the temperature of your patient. Use only a good quality infrared temperature meter. Remember that an infrared meter reads the temperature of surfaces, so wait for the duct to cool down before taking a measurement. Some of the better ones will show you a picture of the heat (or absence of it) so that you can distinguish between the duct and the air coming out.

Here are the conditions for testing performance that you should follow:

- Know the ambient temperature for comparison.
- Do not park the vehicle in direct sunlight.
- Roll all windows up.
- Place the HVAC system on Max A/C with the vent door in recirculation mode, and the fan on a lower setting.
- Consult the Mercedes-Benz Workshop Information System (WIS) or the diagnostic manuals in STAR TekInfo for a correct chart of acceptable temperature readings.

Below is a sample table of typical performance and pressure readings. Again, consult WIS for your specific model, but these numbers can give you a fairly accurate reading for an HFC-134a system.



Ambient temp.	Center outlet temp.	Low side pressure (psi)	High side pressure (psi)
70°F	27-38°F	26-35	180-240
80°F	33-44°F	32-41	200-260
90°F	37-48°F	38-47	250-300
100°F	43-55°F	44-53	270-340
110°F	50-64°F	50-60	300-390

Customer concern confirmed

By comparing your performance readings with the system specifications, you can confirm the customer complaint of insufficient cooling. Regardless of whether the system is performing normally or not, you should now connect a XENTRY Diagnostics system or other compatible scan tool and run a quick test of the vehicle. You may have relevant fault codes stored in the SAMs as well as the A/C control unit, so check the entire vehicle. In the case where your customer's complaint couldn't be verified, perhaps you are dealing with an intermittent issue, in which case, your quick test could turn up some useful information.

It should be noted that Mercedes-Benz does provide step-by-step diagnostic trees for most newer models. However, these can only be found in the XENTRY Diagnostics system, so without one, you may be flying blind. A thorough knowledge of basic A/C system theory and operation, along with any possible diagnostic trouble codes and Actual Values from the A/C system front SAM, and engine control unit should allow you to proceed with a working diagnosis of the concern.

Now it is time to take a moment and analyze exactly what you have found. Is the cabin temperature too high? This could be a cabin temperature sensor electrical or mechanical issue. Does the air not come out of the proper duct? Perhaps you have a blend or mode door issue. You can exercise each flap manually using XENTRY Diagnostics and some scan tools. Do you have proper air volume? If your air temp is cool enough, but you can't get enough of it, you may have a blower or cabin filter issue, perhaps a blockage in an air duct. Many a tech has a story of finding a nest of critters in one of the air ducts or cabin filter housing.

Good maintenance

Speaking of critters in the heating ducts, we have found that many issues with low airflow can be attributed to lack of maintenance of the cabin or combination filters. Mercedes-Benz generally recommends changing the filter every 2 years or 20,000 miles on most models. Using Genuine Mercedes-Benz cabin air filters helps eliminate problems with poor fit and performance. They don't cost a lot more than cheap, ill-fitting and ineffective aftermarket imitations which can lead to customer complaints of odors and poor filtering.

If cost is concern for your customer, consider the Mercedes-Benz StarParts line. These are lower-cost alternatives to common maintenance parts, saving money where it doesn't matter (such as packaging and labeling) but still delivering the outstanding performance (and carrying a warranty!) that you can expect from Genuine Mercedes-Benz parts. Ask your dealer about the StarParts line or visit mbwholesaleparts.com/starparts.

All A/C systems extract moisture from the air as a normal part of their operation. It's just plain physics and cannot be avoided. Under certain conditions, this moisture can leave a damp, musty odor even in a system that is operating normally. But your customer may ask if anything can be done about this.

Of course, verify that the evaporator housing drains are clean and functional. Ask the customer about their parking habits, since parking on an incline might reduce



Check those cabin filters! In our shop we've seen even worse than this. Using Genuine Mercedes-Benz filters has many advantages, including superior fit and performance. Consider the StarParts line for price-sensitive customers.

the ability for any water condensate to drain out as intended. Mercedes-Benz suggests the use of a Wynn's® product "Airco-Clean" in conjunction with a Wynn's® Airromatic™ ultrasonic cleaning system. In extreme cases, you might consider using the Mercedes-Benz HVAC cleaner, part number BQ1830001, as described in Dealer Technical Bulletin S-B-83.00/135.

Visual inspection

Be sure to do a thorough visual inspection of the mechanical components of the HVAC system. Check the compressor for smooth and quiet operation, the belts and engine cooling fan as well. Connect an approved A/C machine or manifold gauge set to get a reading on the system pressures using the manufacturer's specifications. You should verify that the engine cooling fan is coming on and working properly. High pressures may indicate that the fan is not working. With a XENTRY



Mercedes-Benz evaporator cleaner can help improve heat transfer and ensure the evaporator fins are clean.



The inside of this suction hose has collapsed, causing a blockage, resulting in high low-side pressure readings and poor performance. Photo courtesy of Daimler AG.

Diagnostics system you can manually engage it, as with some scan tools, to verify its integrity.

Pressure issues

Both low and high pressures can cause poor performance in the A/C system. High pressure on the low side and high temperatures in the evaporator may indicate a blockage in the system, which might not show any fault codes. Use your thermal imaging meter to check temperatures along the length of each hose – an abrupt change indicates a blockage. Check XENTRY TIPS document LI83.00-P-047480 from 2009, which addresses a potential suction hose fault which can also be intermittent.

Your XENTRY Diagnostics system or scan tool may direct you to a fault with the A/C pressure sensor, which we have come across on occasion. Compare the pressure reading in Actual Values with your gauges. The sensor itself can also be checked: Back-probe the connector to look for 5-volts between the Red/Black and Brown wires. With the A/C compressor OFF, the Violet/White wire should read about 1 V.

Other high pressure readings may indicate a blockage in the high side of the system, possibly the compressor or condenser. Your infrared gun can help pinpoint any blockages. Typically, these will show up as high side with high pressures and low side lower or even in vacuum.

What about low pressures? Low or no pressure in both low and high sides of the system may indicate a low refrigerant charge. If you have that, combined



This STAR Finder image shows the refrigerant pressure sensor B12.

with a compressor not coming on, the system probably has a fault code stored and has shut down. Clear the codes and recharge the system with the proper amount.

A word here about getting the charge amount right: In today's vehicles, the refrigerants used are known as critical charge gases. Whether you're using HFC-134a, R1234yf, or the European mandated CO2, what that means is that they need to be at just the right volume and pressure to operate at maximum capacity. This quite often can be the cause of what seems to be an intermittent cooling problem. A low charge may cool for a while but then begins to blow warm air.

Be sure to charge your vehicle to the exact amount called for. If you are replacing a component be sure to add oil – the correct type! – to the system. The model you are servicing should have the proper refrigerant and oil types and amounts on a label under the hood. If the label is missing, consult WIS. After a proper charge and a code clearing, you should have nice cool air blowing out of the vents, but you're not out of the woods yet. In the case of a low charge, where did that refrigerant go? Was the system empty? Just a little low? These are good questions to reflect on. An empty system indicates a large leak, while a low system indicates a small leak. In either case, you now need to find the source of that leak.

Mercedes-Benz has long recommended the use of a refrigerant leak detector, or 'sniffer' to identify leaks. In some years, the factory fill of refrigerant included a leak detection dye. We've found that most leaks are best found with the sniffer, but for very small leaks it may be necessary to add some dye to the system and run it for several days.

Before you do, check over the entire system with your ultraviolet (UV) lamp to see if there might be any dye from a previous repair. Clean any that you find so you aren't chasing a wild goose. Have the customer use the system and return in a few days for a courtesy inspection of the leak. Many times, with smaller leaks, the dye won't show up right away and this will protect you from having to explain why you didn't catch it the first time.

Next, use your ultraviolet (UV) lamp to scan every inch of the system, with a focus on connections between hoses and components. Check the condensate water coming from the underbody drains for traces of dye. Even the smallest trace of dye needs to be investigated. In our experience, an inexpensive o-ring solves the problem in most cases.

Other telltales of leaks include oil staining, again, mostly where hoses connect to components. Dark oil stains around an A/C compressor's fittings are good clues. Clean the area and run the system a few days to make sure the oil isn't from a previous repair.

Cooling fan output

As stated earlier, high system pressures can come from a malfunctioning cooling fan. Verify the fan's operation: Spin the fan to check for a seized motor. Disconnect the electrical connector and check for power and ground on the large wires. The two smaller wires are for Circuit 15 (key-on power) and the controlling PWM signal, which can be checked with a lab scope or with some advanced multimeters for the percentage ON time.

In cases where the fan runs full-on all the time, the cause could be a bad sensor reading in the engine control module or A/C module, particularly those related to coolant temperature or refrigerant pressure. In cases where the system doesn't know whether to run the fan or not, it will command it to run 100 percent as a fail-safe, so check the Actual Values in both systems for unexpected readings. Check for DTCs as well, as these can indicate missing or implausible signals.

While monitoring the PWM control signal, compare it to the engine suction fan request: If they don't match, find out why. In the case where the fan isn't running, but the commanded fan operation is above 0 percent, suspect



Refrigerant or oil containing a leak identification dye can help with finding smaller leaks.

a motor fault. Note that in fans using these two control wires simply applying power and ground on the large wires won't cause the fan to run, unlike older fans with only the to large power connections.

It is also possible that the engine control unit needs re-flashing. According to XENTRY TIPS document LI07.08-P-057165, a complaint of fans running at 100 percent with no obvious cause in vehicles equipped with system 'ME97'. If you find Fault Code 2237 (Coolant temperature sensor 1 – malfunction), this may be caused when driving from cold temperatures into very warm temperatures, such as driving out of a cool garage on a very hot day. The control unit sees this as a fault, setting the code and running the fan at 100 percent. Reflashing the control unit can address this problem.

Blower faults and intermittents

Many times the A/C is plenty cool but there is insufficient air flow, or air flows only intermittently. If the blower is not operating, a simple trick is to access the motor housing and give it a whack or two (with the power applied) to see if it begins to operate. If it does, then the blower will need to be replaced because the motor brushes, commutator or bearings have likely worn to the point of failure.

On many models, you can access the blower cage by removing the cabin filter. Check to see if the motor has gotten wet. If it has it should be replaced. At the blower motor speed regulator, verify that there is battery voltage on the large red wire. If there isn't, check the fuse. The brown wire should be the ground. Consult the wiring diagram and disconnect the blower if possible. Using a fused jumper and a ground, supply power to the blower motor to see if it operates, if not it should be replaced. Determine the signal wire from the blower speed regulator and, using a lab scope, check the PWM control signal. If your signal is good, then most likely you will have a faulty speed regulator. Also check the input to the regulator for the proper signal, which is an output from the A/C controller.

Even though the systems we service today have gotten far more advanced in terms of customer comfort, efficiency and environmental safety, the "bones" of the A/C system remain the same. Remember first things first when it comes to keeping your customers cool this summer. |



Back to Business

Restarting your business while keeping everyone safe

We at *StarTuned* recognize that your business outlook is radically different from just a few months ago, and want to remind you that Mercedes-Benz USA and your Authorized Mercedes-Benz Dealer are here to support you. MBUSA has maintained its parts stock levels to ensure that you can get the parts you need. The supply chains of MBUSA and Daimler run deep, operating with reliable and loyal business partners for decades, the usual parts availability of over 99 percent hasn't changed at all. All online systems are up and running at full steam to ensure vehicle repairs can be completed in a timely and efficient manner. And the StarRewards program, offering rebates on your parts purchases, is still in full force.

Dealers are taking precautions to ensure that keep you, your employees and your customers safe. Although a few dealers closed briefly to beef up their precautions, virtually all are open and operating, ready to serve your needs. Contactless delivery, extra sanitizing measures, personal protective equipment and more are the themes of the day.

Now is the time to reach out to your customers and assure them of their safety. Offering much more than safe vehicle operations, you should be publicizing (and implementing) virus-safe processes like vehicle pick-up and delivery, interior sanitization of the vehicle at touch points (particularly the steering wheel and any controls you've operated), employee precautions like face masks and gloves, mandatory regular hand-washing, and respecting the customer's space when accepting payments and collecting signatures. Have disinfectant wipes and hand sanitizer available for all visitors, clean high-touch surfaces like doorknobs, pens and countertops frequently, and post signs (anywhere you can – including an outdoor banner) to tell your customers what you are doing to protect them.

After all, we're all in the protection business, making customer vehicles as safe as possible by performing high-quality maintenance and repairs. You build trust by advising customers on what their vehicles may need next. Double down on that trust by telling them just what you're also doing to keep them safe. After all, your customers deserve it. |

Single-use Fasteners

The lowdown on these humble but critical components

Mercedes-Benz vehicles use thousands of fasteners to keep things from coming apart and, as technicians, we encounter dozens of these each day in our work. The majority of these fasteners do their job, day in and day out, for decades without trouble. But some fasteners serve a critical safety function, where failure could result in a crash, injury or death.

Most fasteners – not limited to nuts and bolts – can be reused until they show signs of deterioration. But some fasteners can only be used once – a so-called Single-use Fastener. Blind rivets, for example, are an obvious example, as they are destroyed during the removal process. Others, like stretch bolts, are designed to deform during installation and are likely to break if reinstallation is attempted. And still others have self-locking features that are destroyed during removal. It is these fasteners we will discuss here.

Daimler engineers design fasteners and connections for their intended usage using science and math. While one of the biggest influences of fastener performance is the installation torque, even a properly-torqued bolt can come loose. It is a well-documented fact that cyclic loading, which is the regular and repeated increase and decrease of the load on a fastener, can cause a fastener's clamping force to be reduced over time and increase the risk for loosening and failure.

For this reason, certain fasteners are designed with self-locking features, designed to ensure that the fastener remains tight. Here we will explain how to recognize and work with these fasteners so you don't accidentally reuse them.

But why?

In speaking with technicians, we found that few of them really understand why these fasteners need to be replaced. They've been reusing caliper bolts (for example) for years and years without any problems. Well, you might continue to do that, and the fasteners might be fine, until one day, they aren't. If your failure to replace a self-locking fastener causes a death or injury, how are you going to defend yourself in the resulting lawsuit? Think hard on that.

There are also several advantages to replacing single-use fasteners, and not just for safety and liability reasons. It is just the right thing to do. It's difficult to get in trouble if you follow the manufacturer's recommendations. You'll also sell a few more parts, and everyone knows new fasteners are easier to install and, when removal time comes, they are often easier to remove as well. Remember: This is not just for your own protection, but for your customers' safety as well. Studies show that deceased customers don't offer much in the way of repeat business.

In the Mercedes-Benz Workshop Information System (WIS), many of the work instructions start with a statement to review the "Notes on self-locking nuts and bolts", found in WIS document AH00.00-N-0001-01A. Any time you see this message, you can be sure that the work procedure has at least one self-locking fastener that needs attention.

Locking features




The locking features of fasteners fall into two categories: Mechanical and Coating-based. Mechanical features include locking splines and deformation, while coatings include micro-encapsulated and polyamide coatings.

General precautions

- Bolts and nuts with locking splines, self-locking nuts, and micro-encapsulated nuts and bolts must always be replaced after they have been used once. The removal process permanently damages the locking feature.
- No greases, oils, waxes or other materials may come into contact with, or be applied to, bolted connections and their contact surfaces. This contamination can affect the locking feature and tightening torque and lead to connection failure.

Locking splines

This mechanical feature involves teeth on bolt heads or nuts, which work their way into the material of the parts being fastened. The increased friction helps prevent loosening. When using fasteners with locking splines, care must be taken to ensure that both the nut and the bolt have the locking feature: It is of little use if only one has it, since the connection can then still work its way loose. It is also possible that anti-corrosion coatings

	Remove/install		
 Danger!	Risk of injury caused by body parts being jammed or crushed. Risk of injury to skin and eyes caused by brake fluid spraying out at high pressure when working on the SBC brake system	Deactivate SBC brake system using STAR DIAGNOSIS	AS42.46-Z-0001-01A
	Notes on self-locking nuts and bolts		AH00.00-N-0001-01A
1	Deactivate SBC brake system using STAR DIAGNOSIS	Vehicles with Sensotronic Brake Control (SBC)  The following steps should be run through in STAR DIAGNOSIS: Select menu item "SBC Sensotronic Brake Control" / "Deactivate 'SBC' system." Then process all the individual steps from top	

Many WIS work instructions carry this statement on self-locking fasteners, your clue that at least one fastener in the job will need close attention.

can be damaged, increasing the risk of corrosion: After tightening a fastener in areas likely to get wet, spray the fastener with anti-corrosion wax. These fasteners must always be replaced after loosening.

Self-locking nuts

All-metal self-locking nuts depend on the physical deformation of the nut to significantly increase friction, with a resulting locking effect. The friction is created by the elastic re-straightening of the collar, which starts out with a slightly oval shape. Other self-locking nuts have a vinyl (or other material) ring, which achieves increased friction by deforming the vinyl ring. In both kinds of nut, the act of tightening permanently changes the locking feature, so when loosened it has lost its self-locking ability. These fasteners must always be replaced after loosening.

Microencapsulated bolts and nuts

These fasteners are recognized by the colored adhesive coating applied all the way around. The color is not significant. The coating has a dull, pale and porous appearance. During tightening, the microcapsules of

adhesive and hardener are broken open, mixing them. The resulting chemical reaction creates a rigid adhesive layer, locking the fastener in place, with a sealing action as well.

During tightening, be sure to reach the final tightening position without delay, within a minute or so. Once tightened, microencapsulated fasteners must not be moved, as this will destroy the adhesive layer and render it ineffective.

When loosening a microencapsulated fastener, be careful of their habit of breaking loose suddenly. After removing a microencapsulated fastener, re-cut the threads in holes (blind and through) to remove all traces of adhesive before reassembly. These fasteners must always be replaced after loosening.

Polyamide coating

Self-locking bolts and nuts with a polyamide (Nylon) coating can be recognized by the spot of colored material that is only part-way around the fastener, with a generally shiny and waxy appearance. Some fasteners do have a coating all the way around, however. These self-locking fasteners can sometimes be re-used several times, and sometimes can be used only once. If both the fastener and the polyamide material are in good condition, re-use is possible, as long as the WIS work instructions don't specifically require replacement. If the coating is worn or deteriorated, replace it.

Replace every time!

So there you have it: We know that even a properly designed and installed fastener can come loose, so for critical connections an additional self-locking feature is added to help reduce the risk of failure. The technician has considerable legal liability if a repair was performed contrary to the manufacturer's instructions. Most self-locking fasteners must be replaced after each use. So do the right thing, every single time, by learning to recognize self-locking fasteners and replacing them. |



The four major types of self-locking fasteners: A) Locking splines B) Self-locking nuts C) Microencapsulated and D) Polyamide coating. See the text for details on handling each type.



\$1200.00
MSRP*
A 164 490 5236 80



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MSRP*
A 251 320 5613 80



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Timing Chain Tensioners

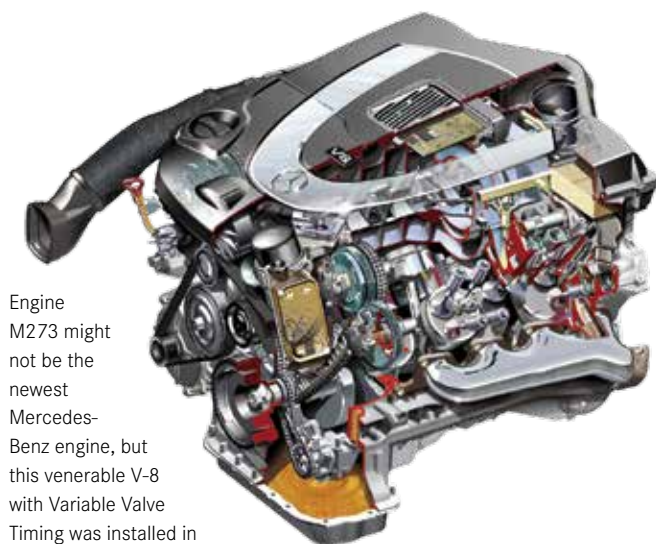
Rattles and startup noises? While Mercedes-Benz arguably makes the longest-lasting engines of any carmaker, eventually parts wear out. Find out fast if cam timing has jumped.

After removing the charge air cooler and front access cover, tensioner replacement (seen here held by two screws) is fairly easy.

Timing. That term has been around since the internal combustion engine was developed. Today it is still a crucial component of the modern day automobile engine. There are several key factors when we talk about timing in a car's engine. The time the spark occurs to ignite the air/fuel mixture in a gasoline powered engine. The timing of the fuel injection (gas or diesel) as it relates to the piston and valve orientation, and timing of the valve train as it relates to the crankshaft position. Huge advancements have been made in how we measure and trigger all these timing sequences, cam and crankshaft position sensors, hall sensors, cam phasers, etc. But the dynamic impact of proper timing is the same: If the timing of all these components is not dialed in exactly, the vehicle will not run right. We will primarily address the latter of these timing components here: crankshaft and camshaft correlation in Mercedes-Benz engines, and the use of timing chains, tensioners and other components to accomplish this extremely critical task.

Evolution of the timing chain

To produce useful work, the combustion must take place at the end of the compression stroke of the engine cycle. Following the power stroke the exhaust valve must be opened to clear the cylinder of spent exhaust gases.



Engine M273 might not be the newest Mercedes-Benz engine, but this venerable V-8 with Variable Valve Timing was installed in millions of vehicles.

The job of the timing system is to cause these various operations of the engine cycle to occur in precisely the correct sequence, at precisely the correct time.

In early engines, the timing had to be correct for the engine to simply run, in today's modern engines precision is paramount in terms of fuel efficiency, emissions and power. According to NASA one of the first internal combustion engines to use a chain system was the Wright brothers' 1903 engine. It consisted of a drive sprocket, chain, camshaft sprocket and a small tensioning wheel. Previous engines used a gear system. Obviously, the chain system allows for greater distancing between the drive sprocket and cam sprocket, which allows for overhead valve operation. The downside is, of course, wear: As the chains and sprockets pile up the miles, there is the inevitable occurrence of chain, sprocket and tensioner wear and failure.

Modern advances

Having camshafts with fixed lobes does not allow for change in the dynamics of timing, which limits optimal performance to a narrow speed range. Valve timing in the internal combustion engine generally represents a compromise with regard to the requirements placed on torque, power output and fuel economy. The need for a system to be developed to address this compromise became more evident in the latter part of the 20th century due to the demand for better fuel economy and the environmental concerns we began facing. This, combined with a thirst for ever more power, made it necessary for this technology to be developed and evolve into the sophisticated variable valve timing (VVT) systems such as those found in Mercedes-Benz vehicles today.

The simplest form of VVT is cam-phasing, where the phase angle of the camshaft is rotated forwards or backwards relative to the crankshaft. This causes the valves to open and close earlier or later, but the camshaft lift and duration cannot be altered with a cam-phasing system. Mercedes-Benz began utilizing



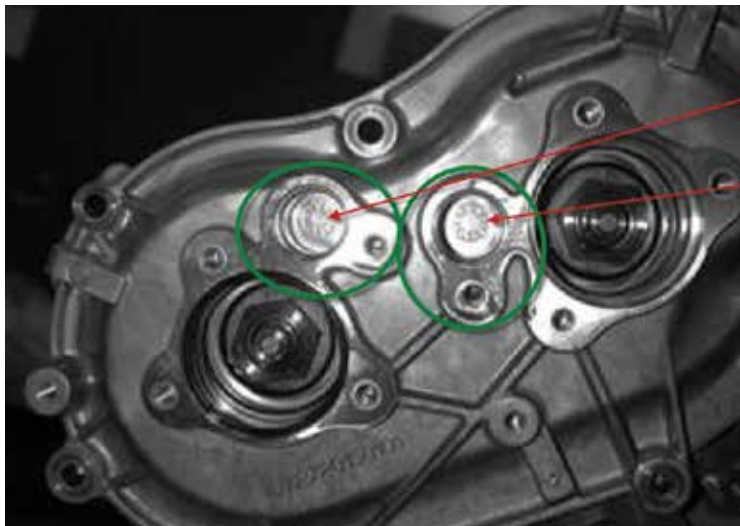
cam phasing in production cars in the 1980s. Achieving variable duration on a VVT system requires a more complex system, such as multiple cam profiles or oscillating cams which we see on some of the latest Mercedes-Benz vehicles. The M272 and M273 engines were popular engines using this technology.

The M272 and M273 engines are in the older models, but many are still on the road today and you will certainly see them in your shop. On these engines, the intake and exhaust camshafts can be adjusted continuously by up to 40 degrees. The infinitely variable adjustment of the camshafts is carried out by patented, electro-hydraulically operated vane adjusters mounted on the front end of the camshafts, with integrated control valves. Solenoids to operate these valves are located in the front of each camshaft. The solenoids actuate the control plunger on the vane-cell adjuster according to the performance-map-related duty cycle. Depending on their position, more or less oil pressure flows from the hollow camshaft to the oil galleries of the vane-type adjuster.

Since oil pressure is one of the control mechanisms, the quality of the oil and the history of maintenance is paramount to the longevity of the components. Failing to consistently use Mercedes-Benz approved engine oils, possibly with infrequent oil changes, can lead to a host of problems. Since there are many factors and components in this system, solenoids, etc. you may experience several different trouble codes related to faults in the timing system. We will primarily focus on the actual chains, cam adjusters and mechanical components as they relate to timing problems.

DTC 1200 and/or 1208

Say you run a code scan which shows these codes and find that after the fault memory is erased and the engine is restarted the fault codes return immediately. This is due to a problem with the positioning of the timing-chain-driven



Camshafts in time with stamp centered

Checking cam timing in M272 or M273. Look closely, the stamped circle of numbers should line up exactly in the center of the windows.



Note how the teeth on the new gear compare with those on the old gear.

camshafts and their relationship to the crankshaft. The cause may be a worn sprocket on the balance shaft on the M272 engine, or a worn idler gear on the M273 engine. To confirm this you will need to do a quick cam timing check. Remove all the camshaft hall sensors and rotate the crankshaft balancer to the 305 degree mark with the front cover pointer. Now you can check the impulse wheels to see if they are properly lined up. The stamped numbers on the impulse wheels should be centered perfectly in the camshaft hall sensor openings. If you find that they do not line up properly it is time for some disassembly for further inspection. Note that you may have to rotate the crankshaft a second revolution to see the stamped numbers.

Remove the right timing case cover on the engine and, using a borescope, perform a visual inspection of the teeth on the balance shaft sprocket (M272) or the idler gear (M273), depending on which engine you are working on. If you read out those fault codes, the teeth will likely show some wear as seen in the photo. This wear is causing the misalignment of the camshaft timing and the cause for your DTCs. In rare cases a stretched timing chain might be the reason for the fault codes when the sprocket doesn't show any evidence of wear.

If the gear is worn, it will require replacement of the balance shaft on the M272 engine or the idler gear of the chain drive on the M273 engine. It should be noted that at this juncture you need to do a serious evaluation of the entire engine and vehicle. Since this is a 25-hour plus job, consideration of a Genuine Mercedes-Benz replacement engine may be warranted. Note that Mercedes-Benz offers complete parts kits for the job: See XENTRY TIPS document LI03.30-P-050027 for the part numbers.

M276 engines

The M276 series was introduced in late 2010 and replaced the M272 V-6 engine line. Most engines in the new series are turbocharged, however the 3.5L M276 was available in both turbo and naturally-aspirated versions. You will find this engine installed on S350, CLS350, ML350, E350, W204 C350, and several other models.

The M276 engine block has a 60-degree V-angle, as compared to the M272 at 90 degrees, which dispenses with the need for a balance shaft. The M276 engine has aluminum alloy cylinder heads with four valves per cylinder and dual overhead camshafts driven by a two-stage chain drive system. There are three gear chains, each of which is equipped with hydraulic tensioner. All four camshafts have hydraulic vane-cell camshaft adjusters for independent variable valve timing of the intake and exhaust valves. Valves are actuated by low-friction roller cam followers. Combine all this complexity with some mileage and a lack of maintenance and you have a recipe for noise and or timing problems.



StarParts oil filter on the left, Mercedes-Benz traditional filter on the right. Even up close, we can't see any difference between them... Except the price. Ask your dealer about StarParts.

Rattle upon startup

Some of the M276 and M278 Mercedes-Benz engines can develop a telltale rattle sound upon start up. The noise is essentially chain or adjuster rattle, but the cause can be any combination of the following: poor oil pressure to the secondary chain tensioners upon start up, failed chain tensioners, failed camshaft adjusters, stretched (worn) timing chains and/or damaged timing chain guide rails. The installation of oil check valves to help maintain oil pressure in the tensioner is required for all repair options regardless of the component being replaced.

As in the M272 engines, with the tensioners relying upon the system's oil pressure, it is important that oil and filter maintenance is performed as scheduled, using Mercedes-Benz approved oil and filters. While Genuine Mercedes-Benz oil filters are not that expensive, if cost is concern for your customer, consider the Mercedes-Benz StarParts line: These are lower-cost alternatives to common maintenance parts, saving money where it doesn't matter (such as packaging and labeling) but still delivering the outstanding performance (and carrying a warranty!) expected from Genuine Mercedes-Benz parts. Ask your dealer about the StarParts line or visit mbwholesaleparts.com/starparts.

Complaints of a rattle noise should be verified and then begin with an oil pressure test. Mercedes-Benz WIS document AR18.00-P-1250EL states that the oil temperature for this test should be at least 100 degrees C (212 degrees F) which is quite hot. Since the customer complaint is typically noise upon startup when the engine is cold it makes sense to get a cold reading as well. There is a screw plug either on the oil filter housing or the timing cover: Take your oil pressure reading there. Be sure to replace the sealing ring when done. With a warm engine you should have 0.9 to 1.1 bar oil pressure at idle, which will be somewhat higher with cold oil. What is important is to see immediate oil pressure upon starting the engine, in order to eliminate oil pressure (or lack of) as the culprit.

On a cold engine, rotate the crankshaft by hand and listen for clicking noises in the camshaft adjuster area. Sometimes the adjusters themselves are the cause of the noise. Start the engine and, using your Mercedes-Benz XENTRY Diagnostics system or another factory-compatible scan tool, actuate the camshaft adjusters. Movement will be noticed in both the camshaft position data on the scan tool, and in how the engine runs. If you

have no movement, verify the proper operation of the solenoids before condemning the adjusting gears.

If you perceive proper operation of the camshaft adjusters, then proceed with a manual check of the engine timing. This operation is outlined in WIS repair operation AR05.20-P-6010EL. Start by removing all the hall-effect sensors on the camshaft housings. Note that some models will have a 53 degree mark on the crankshaft pulley and some will have only the 40 degree mark.

On these engines to correctly check the timing you will need to place a 17 mm width of adhesive tape to the pulley at the 40 degree mark, effectively giving you the mark that is missing for 53 degrees. Rotate the crankshaft center bolt in the direction of engine rotation to the 53 degree mark after TDC on cylinder one ignition stroke (which can take a second turn of the crank). Now you can check the basic position of the camshafts through the opening provided by the removal of the cam sensors. If your timing is off, barring no one has been in before you and set up the camshafts improperly then you most likely have some chain stretch, worn components or tensioning failure.

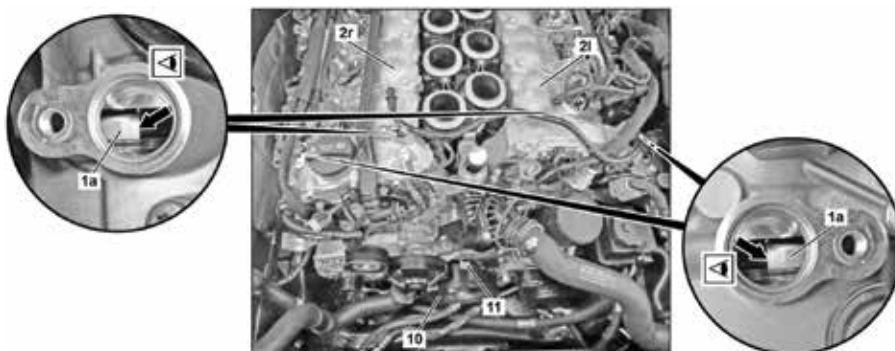
Rattles can also be found in the secondary chain tensioners, or check valves failing to keep proper tension on the chains. XENTRY TIPS document LI05.10-P-056435 outlines the procedures for dealing with rattles in this area. This calls for replacement of the secondary chain tensioners on left and right, and installation of a check valve in the oil supply bore of each secondary chain tensioner in the cylinder head on left and right. Very early engine serial numbers may not have the check valve installed. The document points out that to solve the rattle issue you might need to only install or replace the check valves.

It's worth pointing out, however, that many repair bulletins and articles are dealing with lower mileage, generally in-warranty vehicles, and they have prescribed certain service actions based on that premise. Most of the vehicles independent service providers can be expected to have significantly higher mileage. In these cases, it would be wise to consider replacing the tensioners, as well as the check valves, if you are trying to provide the longest-lasting repair for your customer. Even the TIPS document goes on to say that if the tensioner and check valve replacement doesn't repair the noise – keep digging! Experience has shown that the cam adjusters themselves can be the source of the rattle even though they appear to be operating normally.

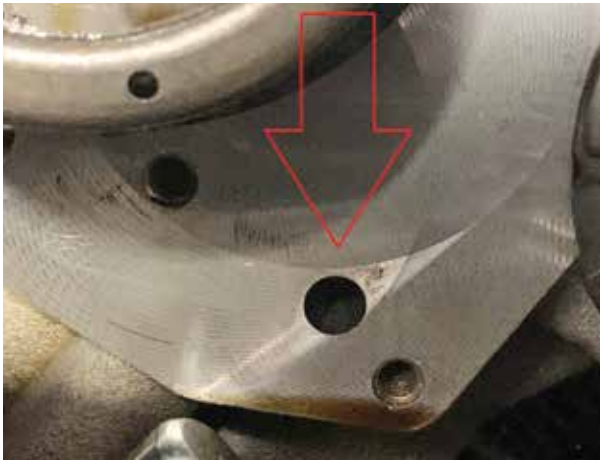
Tensioner and check valve replacement is a fairly easy operation. You will need to remove the charge air cooler to gain access, but you do not need to remove the cylinder head covers or the lower timing cover. The repair is outlined in WIS document AR05.10-P-7800EL. You will need to remove some other components to gain access



Some engines do not have a 53 degree mark, as seen on this M276 engine. In this case, simply add a 17 mm strip of tape past the 40 degree mark.



To check basic timing, look into the bores for the hall-effect sensors. The edge of the sensor wheel should be aligned in the exact center of the bore.



The oil passage seen here does not have a check valve installed.



The valve cover castings also serve as the upper camshaft bearings. To prevent damage to the camshaft, mounting a special hold-down tool set (W276 589 01 40 00) is required before removing the chain tensioner.



To remove the massive tamper-proof Torx bolt/control valve on the camshaft adjusters, you'll need Mercedes-Benz special tool W271 589 00 10 00.

to the tensioners such as the oil filter housing for the left side tensioner. Once you have removed the respective front cover, you can set the engine up to the 40 degree mark ATDC for the side you are working on and remove the tensioner. Two single-use bolts hold it on, be sure to replace them. Why? See the "Single-use Fasteners" article on page 16 of this issue.

Upon removing the tensioner you will have access to the oil feed hole where the check valve is installed. Inspect the hole: Some are straight in and some are stepped, and each uses a different valve. Install or replace the valves; for the price, we are way too far into this to not do that.

Camshaft adjusters

As the XENTRY TIPS document states, if upon replacing tensioners and check valves you still have rattle it is time to continue with your diagnostics. The camshaft adjusters can be tricky to diagnose, but if you crank the engine over by hand while watching the adjusters with the front access cover off, you might be able to hear an audible "click." Replacing the adjusters is a more difficult operation. WIS repair document AR05.20-P-7201FH lists steps to replace the adjusters. You will need to remove the cylinder head covers for the respective camshafts and mount a special hold down tool for the camshafts, since the valve covers are also the camshaft upper bearings.

Remove the chain tensioner to give some slack to the chain, then loosen the center bolt for the adjuster, which is also the adjuster control valve. You will need an assistant to hold the back of the camshaft to help with loosening and tightening of the control valve. Note that this operation is performed with the engine set at the 40 degree mark.

As we mentioned before, chain stretch (which is really wear) can be the problem, particularly in high-mileage vehicles. Be sure to evaluate the situation thoroughly in such circumstances. It may be wise to purchase and install all the timing components for your customer; chains, guides, tensioners, adjusters and check valves. Check with your Mercedes-Benz dealer for the availability of a component kit. Nothing is more frustrating to you and the customer to have a noise return in another part of the timing system. |

Mobil 1 and Mercedes-Benz Oil Offer

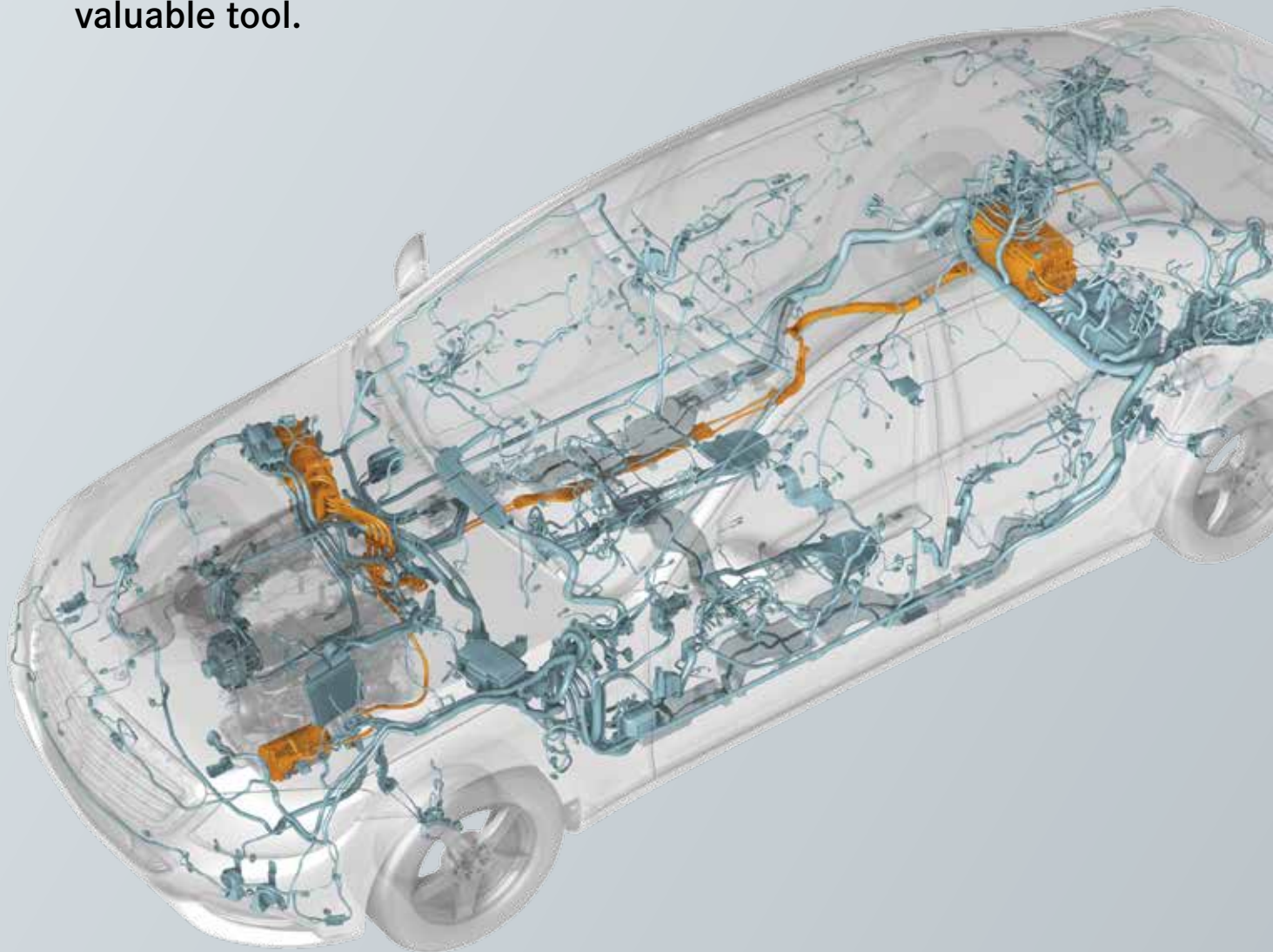
Product Name	Package Style	MBUSA Part #	Product Description	Recommended Consumer Application
MOBIL 1 0W-20	6X1 QUART	BQ.1090242	Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance	Most vehicles that specify 0W-20 (newer Toyotas and Hondas), 5W-20 and certain hybrids
	DRUM 55 GAL	BQ.1090241		
MOBIL 1 0W-30 AFE	6X1 QUART	BQ.1090174	Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance	Most vehicles that specify 5W-30 or 10W-30
MOBIL 1 5W-20	6X1 QUART	BQ.1090083	Advanced full synthetic formulation designed to meet the requirements of many newer vehicles including Hondas, Fords, Chryslers, and newer Toyotas	Vehicles that require 5W-20
	DRUM 55 GAL	BQ.1090084		
MOBIL 1 5W-30	6X1 QUART	BQ.1090250	Advanced full synthetic formula designed to meet the requirements of many domestic, including GM, and imported vehicles	Vehicles that require 5W-30. Corvette approved.
	DRUM 55 GAL	BQ.1090249		
MOBIL 1 10W-30	6X1 QUART	BQ.1090230	Advanced full synthetic formula designed for domestics and imports	Vehicles that require 5W-30 or 10W-30
MOBIL 1 15W-50	6X1 QUART	BQ.1090231	Boosted, higher viscosity, advanced full synthetic formula designed for performance vehicles	HT / HS applications. Racing and Flat tappet applications
MOBIL 1 ESP X1 0W-30	6X1 QUART	BQ.1090182	Advanced full synthetic formulas designed specifically for diesel passenger cars that have particulate filters	Low SPAsh. Available at most MB dealers.
	DRUM 55 GAL	BQ.1090183		
	BULK	BQ.1090184		
MOBIL 1 ESP 0W-30	6X1 QUART	BQ.1090278	Advanced full synthetic engine oil designed to help provide exceptional cleaning power, wear protection and overall performance	Meets MB 229.52 specification. Low Sulfur and Phosphorous content
	DRUM 55 GAL	BQ.1090279		
	BULK	BQ.1090281		
MOBIL 1 ESP 5W-30	DRUM 55 GAL	BQ.1090286	Advanced full synthetic motor oils are designed to help prolong the life and maintain the efficiency of emission systems in both diesel and gasoline-powered vehicles	Meets MB 229.52 specification. Fully compatible with passenger cars that have the latest diesel particulate filters (DPFs) and or those with gasoline catalytic converters (CATs)
	6X1 QUART	BQ.1090273		
MOBIL 1 FORMULA M 5W-40	6X1 QUART	BQ.1090213	Fully synthetic formulas designed specifically for gasoline passenger cars	Low SPAsh. Available at most MB dealers.
	DRUM 55 GAL	BQ.1090240		
	BULK	BQ.1090214		
MOBIL 1 FS 0W-40	6X1 QUART	BQ.1090015	Fully synthetic formulation designed to meet the requirements of many European vehicles	Meets MB 229.5 specification along with many other European vehicle specifications, including Porsche A40. HT / TS applications.
	DRUM 55 GAL	BQ.1090016		
	BULK	BQ.1090010		
MOBIL 1 FS X2 5W-50	6X1 QUART	BQ.1090211	Advanced full synthetic motor oils are designed with a proprietary blend of ultra-high-performance synthetic base stocks fortified with a precisely balanced component system	Suited for extreme driving conditions and motorsports applications.
MOBIL 1 SYNTHETIC ATF	6X1 QUART	BQ.1090164	Multi-vehicle, fully synthetic fluid designed to meet the demanding requirements of modern passenger vehicles	Vehicles that require Dexron III, Ford Mercon and Mercon V performance levels
	DRUM 55 GAL	BQ.1090163		
MERCEDES BENZ HIGH PERFORMANCE EO 229.5 0W-40	6X1 LITER	A000989810211BIBU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.5 specification	Mercedes-Benz engines that require 229.5 specification oil
	DRUM 208L	A000989810217BIBU		
MERCEDES BENZ GEO 229.5 5W-40	6X1 LITER	A000989790211BIFU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.5 specification	Mercedes-Benz engines that require 229.5 specification oil
	DRUM 208L	A000989790217BIFU		
	BULK	A000989790219BIFU		
MERCEDES BENZ GEO 229.52 5W-30	6X1 LITER	A000989800211BMEU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.52 specification	Mercedes-Benz engines that require 229.52 specification oil
	DRUM 208L	A000989800217BMEU		
	BULK	A000989800219BMEU		
MERCEDES BENZ GEO 229.6 5W-30	6X1 LITER	A000989820211BJEU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.6 specification	Mercedes-Benz engines that require 229.6 specification oil
	DRUM 208L	A000989800217BJEU		
MERCEDES BENZ GEO 229.71 0W-20	6X1 LITER	A000989830211BNXU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.71 specification	Mercedes-Benz engines that require 229.71 specification oil
MB GENUINE ATF FE 236.15	DRUM 208L	A000989270417BULU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 236.15 specification	Please check owners manual to verify ATF specification requirement of the vehicle prior to ordering.
MB GENUINE ATF FE 236.17	12X1L	BQ.1090287	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 236.17 specification	Please check owners manual to verify ATF specification requirement of the vehicle prior to ordering.

Product Name	Package Style	MBUSA Part #	Product Description	Recommended Consumer Application
MOBIL 1 SYN GEAR LUBE LS 75W-90	12X1 QUART	BQ1090085	Exceeds the most severe service requirements in both conventional and limited slip applications	Suitable for use in modern high performance automobiles like SUV's, vans and light duty trucks requiring an API SN / SM / SL / SJ
MOBIL SUPER 5W-20	6X1 QUART	BQ1090272	A synthetic blend motor oil recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks	Recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks
MOBIL SUPER 5W-30	6X1 QUART	BQ1090269	A synthetic blend motor oil recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks	Recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks
MOBIL SUPER 10W-30	6X1 QUART	BQ1090270	A synthetic blend motor oil recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks	Recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks
MOBIL SUPER 10W-40	6X1 QUART	BQ1090271	A synthetic blend motor oil recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks	Recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks
MOBIL SPECIAL 5W-20	6X1 QUART	BQ1090226	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and DRUM 55 GAL BQ1090254 light duty trucks requiring API SN / SM / SL / SJ
	DRUM 55 GAL	BQ1090254		
MOBIL SPECIAL 5W-30	BULK	BQ1090251	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and DRUM 55 GAL BQ1090254 light duty trucks requiring API SN / SM / SL / SJ
	6X1 QUART	BQ1090259		
MOBIL SPECIAL 5W-30	DRUM 55 GAL	BQ1090258	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and DRUM 55 GAL BQ1090254 light duty trucks requiring API SN / SM / SL / SJ
	BULK	BQ1090255		
MOBIL SPECIAL 10W-30	6X1 QUART	BQ1090264	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring API SN / SM / SL / SJ
	BULK 55 GAL	BQ1090263		
MOBIL SPECIAL 10W-30	BULK	BQ1090260	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring API SN / SM / SL / SJ
	6X1 QUART	BQ1090223		
MOBIL SPECIAL 10W-40	BULK 55 GAL	BQ1090268	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring API SN / SM / SL / SJ
	BULK	BQ1090265		
MOBIL SPECIAL 20W-50	DRUM 55 GAL	BQ109004664	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks where a higher viscosity API SN / SM / SL / SJ oil is preferred or recommended
MOBIL DELVAC 1 ESP 5W-40	JUG 4X1 GAL	BQ1090229	Fully synthetic supreme performance heavy duty diesel engine oil that helps extend engine life while providing long drain capability and fuel economy for modern diesel engines operating in severe applications	Recommended for use in all super high performance diesel applications, including modern low emission engine designs with Exhaust Gas Recirculation (EGR)
	DRUM 55 GAL	BQ1090233		
MOBIL DELVAC 1300 SUP 15W-40 (CK-4)	6X1 QUART	BQ1090219	Extra high performance diesel engine oils that help extend engine life in the most severe on and off-highway applications while delivering outstanding performance in modern, high-out-put, low-emission engines including those with Exhaust Gas Recirculation (EGR) and Aftertreatment Systems with Diesel Particulate Filers (DPFs) and Diesel Oxidation Catalysts (DOCs)	Specifically recommended for the latest low-emissions, high performance diesel applications equipped with after treatment systems using Diesel Particulate Filter (DPF) and Diesel Oxidation Catalyst (DOC) technologies
	JUG 4X1 GAL	BQ1090220		
	DRUM 55 GAL	BQ1090221		
MOBIL ATF D/M	BULK	BQ1090053	Provides excellent oxidation and friction stability, anti-wear properties and low-temperature fluidity desired for most automatic transmissions	Recommended by ExxonMobil for use in applications requiring: GM DEXRON® IIIH transmission fluid Ford MERCON® transmission fluid Allison C-4 transmission fluid
	6X1 QUART	BQ1090222		
MOBIL ATF 134	DRUM 55 GAL	BQ1090274	Mobil ATF 134 is an extra high performance automatic transmission fluid formulated with selected HVI base oils	Recommended for use in Mercedes automatic gearboxes
	BULK	BQ1090275		
MOBIL ATF 134	DRUM 55 GAL	BQ1090166	Mobil ATF 134 is an extra high performance automatic transmission fluid formulated with selected HVI base oils	Recommended for use in Mercedes automatic gearboxes
MOBILGREASE XHP 222	CART 10X0.39KG/13.7OZ	BQ1090217	Formulated to provide excellent high temperature performance with superb adhesion, structural stability and resistance to water contamination	Recommended for industrial and marine applications, chassis components and farm equipment
MOBILUBE HD PLUS 80W-90	KEG 120 LB	BQ1090096	Extra high performance, automotive lubricant formulated from select base oils and an advanced additive system specifically for limited-slip differentials	Recommended for use in limited-slip differentials, exles, and final drives requiring API GL-5 level performance
DIESEL EXHAUST FLUID (AD BLUE)	JUG 4X0.5 GAL	A0005830107	Non-toxic solution that transforms harmful Nitrogen Oxide (NOx) emissions from diesel-powered vehicles into harmless water vapor and nitrogen	Recommended for use in Mercedes-Benz, Volkswagen, and VMW AdBlue (DEF) applications
	DRUM 208L	BQ1470002		
MB POWER STEERING FLUID	6X1 QUART	BQ1460002	Automatic transmissions should be checked for proper fluid levels at regular intervals, and the fluid should be changed at manufacturer-recommended intervals	Recommended for use in Mercedes-Benz vehicles



Getting the Most from Star Wiring

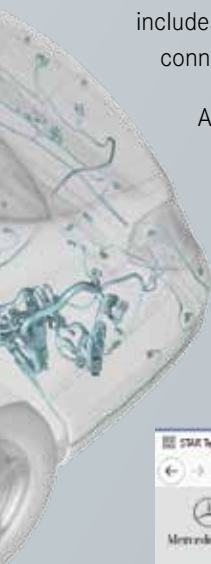
Understanding what the Star Wiring diagrams have to offer is key to any successful diagnosis and repair. In this article, we will dive deep into all that Mercedes-Benz offers in this valuable tool.



Diagnosing electrical concerns is nearly impossible without accurate wiring diagrams. Star Wiring, included with your STAR TekInfo subscription, has these and so much more.

Star Wiring shows the wiring and electrical function diagrams for vehicles since about 1994, with some information on selected earlier models. Although nearly the same information appears in the Mercedes-Benz Workshop Information System (WIS), Star Wiring offers a unique and convenient user interface, called WebETM, that makes using this information easier. WebETM is more than an electrical troubleshooting manual, going far beyond simple wiring diagrams. Additional information provided includes function diagrams, component locations, connector pin-outs and basic diagnostic information.

Access to Star Wiring is included with your STAR TekInfo subscription. Visit startekinfo.com to learn more about what is offered and to subscribe. XENTRY Diagnosis owners receive access to Star TekInfo as part of their data package. Once you have logged in to STAR TekInfo, click on the link to Star Wiring on the home page.



To open Star Wiring, simply click on the link after logging in.

If you are a first-time user of Star Wiring, there is a free plug-in known as Autodesk Design Review that you'll need to view the wiring diagrams. You'll be prompted to install it if necessary, but you can manually install it too: On the top tab "About Site," click on Installation Instructions and pick the link for Autodesk Design Review 2010. On the Autodesk site, search for Design Review: One of the top results explains where to download the free Autodesk Design Review Software. Note that you don't need the DWF Viewer option.

On the Star Wiring search page, enter the three-digit chassis designation for the vehicle of interest and click "Search." You can also leave this blank for searching, but this will bring up the WebETM links for about 50 different chassis designations. Handy if you want to browse what's available, but it could be a bit of a time-waster.

Note that some WebETM entries cover more than one chassis: In some cases, the basic chassis are almost identical so there is no need for a separate set of diagrams. A good example is the Model 117, X156 and 242 (CLA, GLA and B-Class, respectively) WebETM, which all three chassis share. Also note that some chassis have model year breaks, for example chassis 166 has a choice between "up to MY 15" and "as of MY 16." Always be sure to pick the correct one, since you'll get the wrong information by choosing the wrong WebETM.

After searching for your selected chassis, you will have a choice: WebETM with STAR Finder, or just STAR Finder

117	CLA	205	C-Class	221	S-Class
166	M, GL	207	E-Coupe	222	S-Class
167	GLE, GLS	212	E-Class	231	SL-Class
172	SLK	213	E-Class	238	E-Class Coupe/Cab.
177	SA-Class	216	CL-Class	253	GLC
199	SLR-AMG	217	S-Class Coupe/Cab.	257	CLS
204	C-Class	219	CLS	463	G-Class

These are some of the more common model types and their 3-digit chassis designations. Most technicians are already familiar with these.





After selecting the model, select “WebETM with STAR Finder” to open the wiring diagrams.

alone. In nearly all cases, you should select WebETM with STAR Finder, since this choice offers both the WebETM information and STAR Finder.

STAR Finder

What is STAR Finder? It is a small application that has a simple purpose: To show you where an electrical component is located on the vehicle. Just click the component designation and pop-up window showing the component appears. Images can be enlarged, and more than one image for a component is frequently available.

Today we’ll be using the “Pre-Facelift” Star Wiring for the 205 Model, which includes C-Class vehicles from model year 2015 to model year 2018 for the examples in this article. With very few exceptions, the basic format and operation of WebETM is exactly the same for every model listed.

After selecting the link to your desired WebETM with STAR Finder, a warning screen may remind you that certain models have high-voltage systems, meaning higher than 60-volts DC and/or 48-volts AC. Voltages like this can injure or kill you if you come into contact. Please read and follow the safety notes before proceeding.

WebETM opens to the main index screen, showing all the service



Click a component designation to open STAR Finder, which shows an image of that component’s location. Here we see that X18/7 is at the base of the driver’s A-Pillar.

groups and two drop-down selection windows at the top right. The lower one, titled “Group selection,” is just that: A way of selecting the service group by using a drop-down menu. This gives the same results as clicking one of the service groups listed on the left, but is included as a convenience.

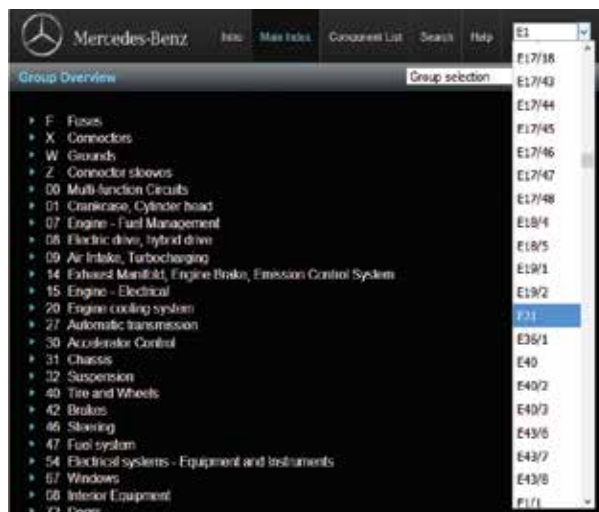
Component search

The upper, smaller box is used to find all wiring diagrams that show a specific electrical component. To use this, you’ll have to already know the component designation. For example, the main starter battery always has component designation G1, and the gasoline engine control unit almost always N3/10. The nearby chart shows common electrical component designation letters. Get to know what these letters mean, as this knowledge will greatly assist you when working with a wiring or function diagram.

If you know the designation of a component you need to work on, open the box and type the first letter of the component. This brings you right to that section of the drop-down, and saves the effort of having to scroll all the way down from A1 to your component.

If, instead, we start by selecting a group – Group 32 Suspension for example – a page opens to show all the diagrams available. Note that two kinds of diagrams are listed: Wiring and Function. These serve two completely different purposes.

A wiring diagram shows the wire connections between components. If we want to trace the wiring, measure a specific signal, or identify the ground point for a specific



The main index of WebETM lets you search by group or by component designation.

control unit or component. In other words, if we want information about the Physical Layer of the electrical system – we turn to the wiring diagram.

An Electrical Function Schematic shows the signal flow between components, particularly on in-vehicle networks such as CAN. If we want to understand how a system works, from where a particular signal originates, or which signals are carried on a CAN Bus – in other words, we want information on how a system operates – we turn to the Electrical Function Schematic.

Wiring diagrams are intuitive and generally understandable, but function diagrams need some

explanation. Before networking entered the automotive world, each signal had its own wire. Today, networks can carry multiple signals, and a way was needed to show which signals went where. For example, how could you figure out how the outside temperature reading is delivered to the air conditioning control unit? Sure, you can guess it comes in on the CAN Bus, but from where? The function diagram spells this out.

While you might not always need a function diagram, when networking is involved, the signal flow it shows does make it a lot easier to trace out the concern. Note that function diagrams generally have “jump links” to the relevant wiring diagram for a given component.

Designation	Component Type
A	Assemblies, receivers, transmitters
B	Sensors, temperature sensors
C	Condensers
E	Illumination, lamp units
F	Fuses
G	Generators, power supply, battery
H	Visual and audio signal devices (horn)
K	Electrical/Mechanical relays
L	Inductive sensors
M	Electric motors
N	Control units
R	Resistors, heating resistors
S	Switches
T	Ignition coils, transformers
U	Versions
V	Diodes
W	Ground points
X	Connectors
Y	Electromagnetic solenoids
Z	Connector sleeves, splices

Each electrical component has a unique designation. You can tell what kind of component it is by the letter.

Wiring diagrams

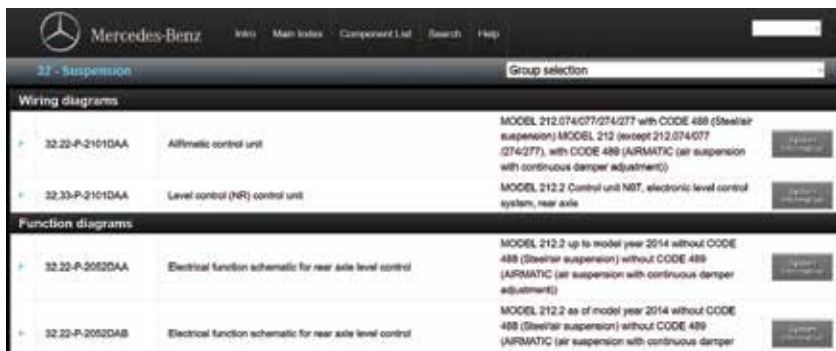
Now that you have the basics, let’s dive deeper into wiring diagrams. As we mentioned before, these are schematic diagrams of the physical wiring in the vehicle. By schematic, we mean that they are not drawn to scale, and you cannot infer the installation location or position from these drawings. All you can see is the electrical connections between two components. These components are anything that isn’t a wire: Control units, connectors, fuse boxes, solder splices, and so on.

Symbols

To really understand these diagrams, we need to understand the many symbols used. The near-by chart shows examples of some common symbols used on a wiring diagram. Probably the most important symbols are wire, connector and component symbols, but in the end all of these symbols are important in their own way. We recommend studying these components and explanations to get the most from WebETM.

It’s important to mention two points: First, every diagram has a grid frame, used in the Legend to identify

a component’s place in the diagram. (The legend lists every component in a diagram and its grid location.) Second, each diagram has a unique number, like PE83.70-P-2101-97DAA (which is the same in both Star Wiring and the Mercedes-Benz Workshop Information System, WIS). Always use the full diagram number to unambiguously identify a specific diagram.



Here we see that both wiring diagrams and Function diagrams are available in WebETM. See the text to learn the purpose of each.

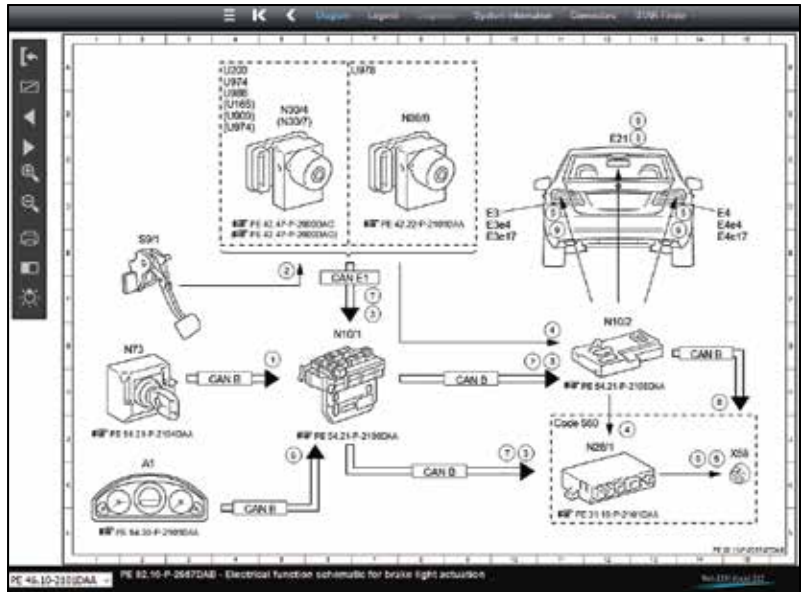
Symbol	Meaning
	Ground point
	Component designation
	Jump to another diagram
	A 20 Amp fuse, carrying circuit 30, with a designation f116
	A 2-pole connector X18x4, male connector housing and male contacts at top, only one contact (Pin 1) has a wire
	A multi-pole connector, the wavy lines on the right indicate it is not completely drawn here, with 2 wires
	An antenna with a soldered (pigtail) connection. The box shows that the entire component is drawn here.
	A component with a signal wire (S) and a shield (X), which means it uses a coaxial cable. The wavy lines show that only part of the component is drawn here.
	Connector 2, Pin 2 is used, Pins 1, 3 and 6 have no connection.
	The production variant "U966" (hover over the designation to see the meaning) as of March 2013 is shown in the dashed box.
	Different connector designations (X55/56x2, X55/56x4) and pin numbers (1 or 3, 2 or 6) depending on the production variant (those in parentheses are for U955).

Symbol	Meaning
	A partial connector (wavy lines) designated 14I, with a Circuit 30 connection at Pin 2
	Wire colors and size (cross-section in square millimeters)
	One of two production variants, showing how the wires connect
	Solenoid actuator
	Solenoid valve
	Motor
	Heater (right) with a variable resistor
	Temperature-variable resistor (thermistor)
	Electronic component, This indicates electronics inside, not necessarily a 'transistor.'
	Light-emitting
	Mechanical switch diode (LED)

Several typical symbols seen in Star Wiring, and their meanings, are shown here. Understanding the meaning helps you better understand what the diagram is trying to tell you.

Viewing options

In the *brake light system function diagram* image (right), you can see a vertical line of controls at the left side of the page. These are used to adjust your viewing options. If you hover the mouse pointer over each one, a description of the control will pop up. While panning and zooming the image are better done with a scroll mouse, the other controls let you print, invert the background color (default is a black background, easier on the eyes) and a control to highlight every clickable hotspot on the page (and there are many – every component designation at the very least).



This is the function diagram of the brake light system in a 2014 E-Class, Model 212. Read the text to follow the signal flow from the brake light switch to the center brake light. Note the vertical line of viewing options on the left side, mentioned in the text.

An example

Lets try a simple diagnosis exercise. You can follow along on the nearby image showing the function diagram of the brake light system. In a 2014 E-Class, Model 212, we have a center brake light (E21) that won't switch on. Our first guess was to look at the wiring diagrams in group 82 for exterior lights, but all four diagrams state that they are for E1 and E2, which are the headlights – none of them are for E3 and E4, the tail lights. From here, we can either search for E3 (for example), or check the function diagrams. Deciding to check for a relevant function diagram, we find one titled "Brake light actuation, as of MY 14" that is exactly relevant.

On the diagram, we see that the status of S9/1 (Brake Light Switch) is read in on a dedicated wire by the ESP control unit. The ESP control unit sends a message over CAN E1 to the Front SAM (N10/1). The Front SAM then sends a message via CAN B to N10/2, the Rear SAM. At the same time, the ESP control unit sends a message over a dedicated wire to N10/2, a redundant signal for this safety-critical function. The Rear SAM uses individual wires to switch the various tail lamp bulbs (or LEDs in this case) ON.

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Of course, you'll continue to have the peace of mind that installing only Genuine Mercedes-Benz parts can provide. |

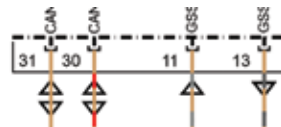


We then follow the jump-link in the function diagram to the Rear SAM wiring diagram, where we see that rear SAM connector N10/2x6HD pin 1 is where the 0.5mm2 black/red wire goes to E21x1 pin 2, the center stop lamp connector. Pin 1 of that connector goes to W7, the right rear wheel well ground point, which was found corroded from a bottle of soda that had spilled months ago. The ground was cleaned up and coated with some protection wax, and the problem cured.

While this is a trivial example – in reality the DTCs in N10/2 pointed to an open circuit in E21 – it shows how the function diagram and the wiring diagram work together to help you better understand the flow of the circuit. Indeed, if we have a look in the Legend (a list of all components and where they appear in the diagram) we can also find the ESP control unit, showing us that the discrete wire from the ESP control unit is a 0.5 mm2 black/red wire that enters at N10/2x9I pin 9. While the naming convention for these connections might seem complicated, it’s important to do it correctly: The part before the “x” is the component designation, and the part after is the connector designation. It can get tricky sometimes, but there is always only one correct way to unambiguously identify something in WebETM. So if you need to consult with your Mercedes-Benz dealer, try to use the right terminology.

Flow arrows

That brings us to another important symbol: the functional flow arrows. Signals can either flow into a component (input) or flow out (output) of a component. Some signals flow both ways (such as a CAN bus) and so we see two arrows. These arrows do not show the direction of current flow, but instead were developed to help you better understand which pins are inputs and which are outputs. In this image, we see two bi-directional flow arrows, an input and an output.

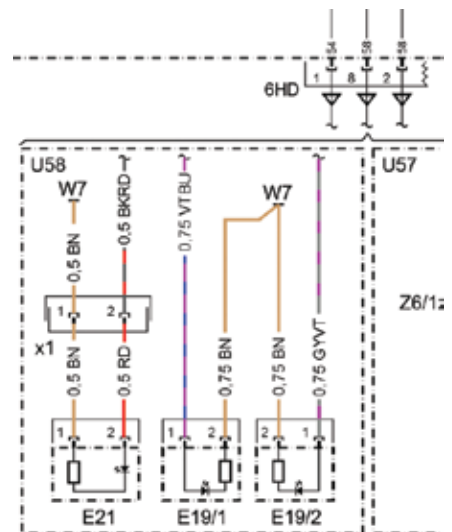


Flow arrows: See the text for their meaning.

The bottom line

So the use of Star Wiring boils down to this: Use the group system to find the wiring diagram you need, or use the search feature to find the wiring diagram showing a particular component. Verify the diagram really applies to your specific vehicle, using the data card in WIS or Parts Information if necessary. In the case of network signals, it may be fruitful to check the function diagram first. Then

The details of the wiring from the Rear SAM connector N10/2x6HD pin 1 to the center brake light, E21x1, a 0.5 mm2 BK/RD wire.



identify the specific wire that is carrying the signal of interest, and use Star Finder to locate any components you’re not familiar with. Consider checking the Diagnosis information, which explains how the circuit works, or the Connectors diagram to locate the correct cavity number on a connector.

Now that you have a clear understanding of how everything is connected together, you can start your diagnosis process: Verify the symptom, identify all the components that might be involved, eliminate the components that are working correctly (starting with the easiest ones to check) and finally perform tests to identify the exact cause. Perform your repairs, and think for a moment about how this fault could have possibly occurred. If something could cause that fault, also check for and eliminate that cause as well, to prevent a come-back. Finally, attempt to reproduce the fault again and, if it passes the tests, finalize the repair.

The ultimate goal of Star Wiring is to help you better understand how the system works, because without that understanding, any diagnosis is just shooting in the dark. Respect your own time and your customer’s wallet by spending a few minutes to learn how an unfamiliar system functions before diving in. The 10 minutes you spend learning serves two purposes: Next time, you’ll already know how this works, and this time, you can avoid wasting time by using your most powerful tool (your brain) to figure out on paper what could possibly cause the symptom being observed. Once you have a good idea of where to look, testing becomes focused and productive, and fixing cars becomes efficient and profitable. Isn’t that the whole idea? |

20 Years of *StarTuned*

Helping independent workshops like yours for two decades

Stop me if you've heard this one: What do you get when a marketing guy walks into a room full of engineers? No? Nevermind. But that's literally how *StarTuned* got started.

20 years ago this month, a team at Mercedes-Benz USA collaborated with Automotive Data Media, a leader in industry publications, to launch what had been a pet project for quite some time: A new magazine, dedicated to getting practical repair knowledge out to the tens of thousands of independent workshops and technicians who were keeping the fleet of millions of Mercedes-Benz vehicles running. Long before, it was well-understood at MBUSA that without these independent workshops it would be impossible to service, repair and maintain all the cars on the road. Since the drivers of these cars were all still Mercedes-Benz customers, the reasoning went: Why don't we help make the technicians who maintain and repair them even better at performing repairs?

Since then, we've covered hundreds of different subjects, from A/C to XENTRY, all written by working technicians for working technicians. Mercedes-Benz is no stranger to long-term thinking – we're about 134 years into this 'automobile' thing – and although 20 years almost pales in comparison, we thought we should celebrate the beginning of our third decade and our mission to support hard-working technicians everywhere.

In all those years, the impact of this humble magazine on customers and technicians has been immeasurable. While it's difficult to put into numbers, many more vehicles have been repaired to the high standards of Mercedes-Benz because of the highly-detailed explanations and practical experience shared by dozens of technician-writers over the years.

We never wanted to deliver theoretical engineering dissertations, since that is just not as useful as

having working technicians like you who have a knack for explaining what they know. You've probably encountered someone like that, one who always seems to be helping and mentoring others – you might even be like that yourself – and we keep searching for them, and asking them to write and share what they know. And they do. And every work is carefully verified by our engineers to make sure nothing but the most accurate information appears on these pages.

While we at *StarTuned* are happy to celebrate this rare and wonderful milestone, and we marvel at how much has changed in all these years, we remain focused on our core purpose: Offering professional, competent and useful technical support to our essential business partners, the tens of thousands of independent workshops and their myriad expert technicians. By the way, if there is something you'd like to see in these pages, please be sure to drop us a line. After all, everything we do, we do for you. |



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