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Information for the Independent Mercedes-Benz Service Professional

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INSIDE:

Mercedes-Benz

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June 2017

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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, on-line 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.

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StarTuned®
303 Perimeter Center North, Suite 202, Atlanta, GA 30346
Phone: +1.770.705.2069
E-mail: Stefanie.A.Schweigler@mbusa.com

MBUSA Technical Content Advisor
Donald Rotolo
Donald.Rotolo@mbusa.com

Collision Content Advisor
Benito Cid
Benito.Cid@mbusa.com

MBUSA Project Manager
Stefanie Schweigler
stefanie.a.schweigler@mbusa.com

Group Publisher
Christopher M. Ayers, Jr.
cayers@automotivedatamedia.com

Editorial Director
Bob Freudenberger
bfreud@automotivedatamedia.com

Contributing Editors
Joel Alson, Tim Amun, Dave Facciuto, Wayne Riley, Frank Walker

Automotive Data Media Project Mgr.
Tamra Ayers Banz
tayers@automotivedatamedia.com

Art Director
Christopher M. Ayers III
ayersc3@automotivedatamedia.com

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In This Issue

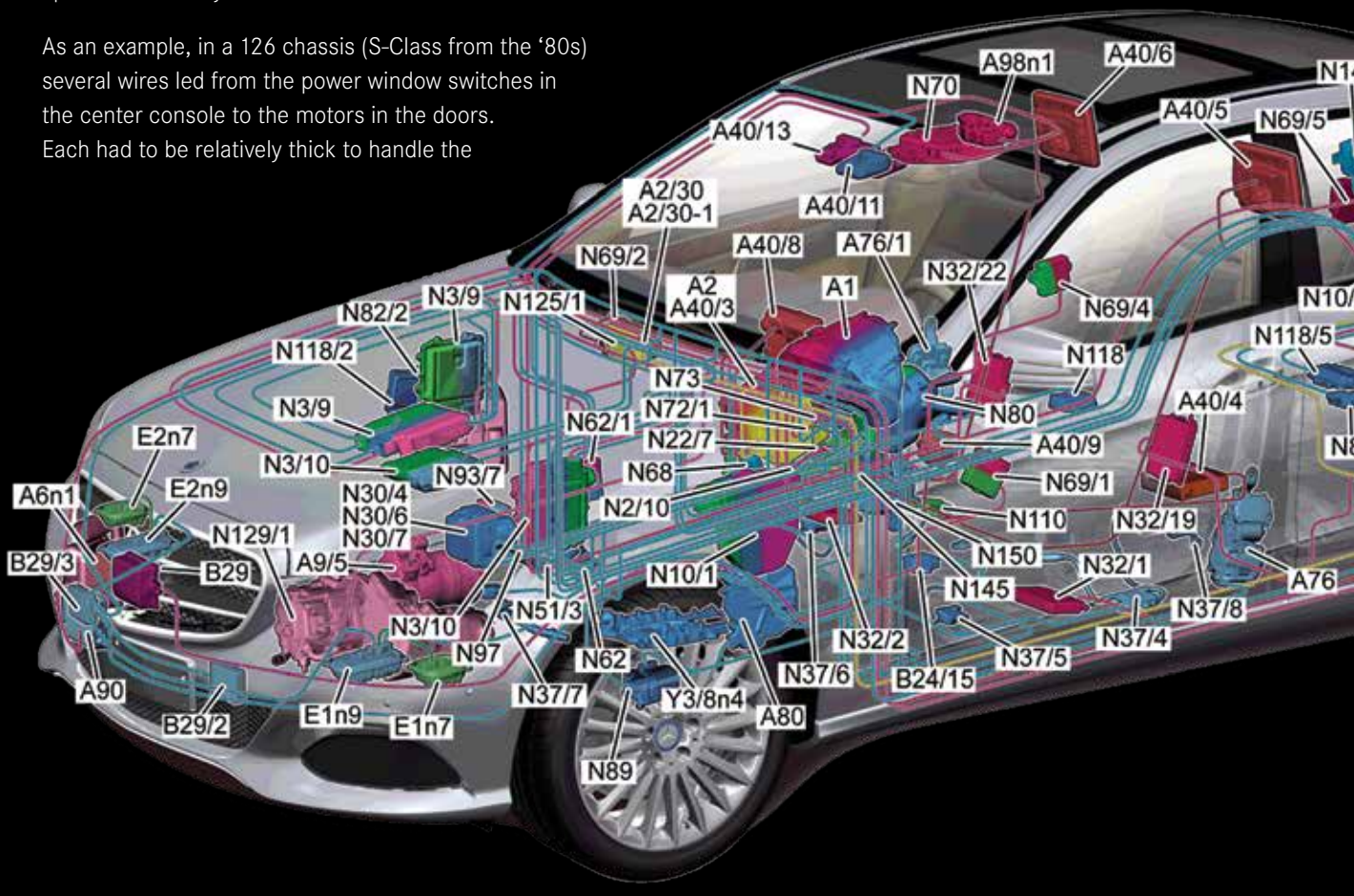
Mercedes-Benz
The best or nothing.

CAN Bus Review

If you've been around Mercedes-Benz for a while, you've heard about CAN bus. This is a digital data network used to send and receive information messages throughout the car. First introduced in the early 1990s, it saw its first major usage in the Model 210/202/208 platforms. In this article, we'll go through a brief introduction to CAN, and then focus on what's most important: troubleshooting.

CAN was introduced to deal with the proliferation of electrical and electronic devices in motor vehicles. Using dedicated and direct wiring as was the practice in earlier models was starting to get expensive, not only for the cost of the wire and its installation, but for the space needed to run the wires, and the weight of the wires and its impact upon fuel economy.

As an example, in a 126 chassis (S-Class from the '80s) several wires led from the power window switches in the center console to the motors in the doors. Each had to be relatively thick to handle the current, and there were at least eight of them to handle the four different motors. Add the multiple wires from the power seat switch and the in-door lighting, and the wiring harness soon became almost too thick to bend where it enters the door. In a 210 (E-Class from mid-'90s), there

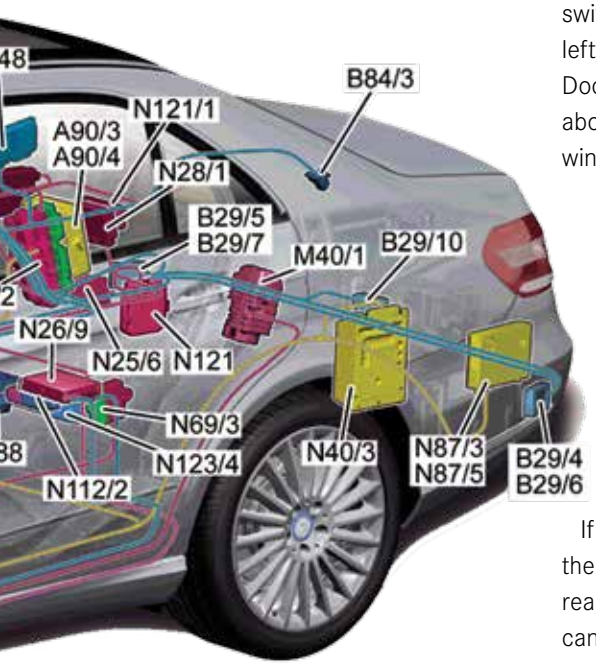


are just four wires: power, ground, and two CAN bus wires (named CAN-High and CAN-Low), a significant improvement.

A, B, or C

When first introduced, two different types of CAN buses were used: Class B and Class C. Class B CAN operates at lower speeds (83.3 or 125 kb/s) than Class C, allowing it to function even if one of the wires has no continuity. Class B CAN was used in the interior, since the communications demands were not as large. Class C was used for the Engine CAN bus, since the higher speeds (around 500 kb/s) were necessary to carry all the data.

More recently, all CAN buses have been moved over to Class C, starting in the early 2000s. From a diagnosis standpoint, the approach is the same; only some details of specific voltages are different. We'll get into that in just a moment.



The details of how CAN works are somewhat complex, but for our purposes (fixing a problem) we don't need to worry about most of all that. If you are really interested, WIS does a good job of explaining it, and the Internet has hundreds of articles on this topic. The general idea is that there are senders and receivers on the bus. When a message is sent onto the bus, every other CAN node on the bus hears it, but only the ones programmed to use a particular message will react to that message. If, for example, a power window switch sends the message "lower left front window," only the left front Door Control Module will do anything about it, namely deliver power to the window motor to lower the window.

When troubleshooting, you need to consider that there are only three parts to the whole system: The sender, the receiver, and the wiring in-between. In every case, the problem is going to be with one or more of these elements.

If you have XENTRY, you can watch the CAN bus to see if the sender is really sending a message, and you can operate the receiver's circuitry to see if, when it receives the message, it can do what it is supposed to. If both are okay, the problem must be the in-between wiring.

CAN bus wiring is a little bit special: It uses *two-wire differential-voltage signaling*. What that means is that the same signal is sent over both of the wires, but one signal is inverted (flipped) from the other. The receiver doesn't look at the voltage signal itself, but the difference between the voltage signals.

Why is that important? First, by looking at the differential voltage, any electromagnetic interference (EMI) that the wires might pick up has no effect, since both wires will get the same voltage noise signal. So if some kind of interference puts a 7 or 8V pulse onto both wires, the differential voltage between the two wires is still zero. In this way, CAN bus is nearly immune to EMI.

Second, if one of the wires in a Class B CAN bus is shorted to ground (or power), the voltage difference is still about the same as if the wire wasn't shorted, so the message can still be read and understood. This makes the CAN bus fault-tolerant. As a case in point, we found a 210 E-Class where one of the CAN bus wires was shorted to ground by the left rear door control module while chasing down an intermittent no-crank condition. Turns out the car needed a new Electronic Ignition Switch (EIS) for the repair, but as far as we know that car is still driving around with that door module installed, because

there were no symptoms and the customer didn't think it necessary to replace it. A Class C CAN bus, which operates at higher speeds and is therefore less tolerant of faults, would not function in single-wire mode.

Since every control unit hears every message on a given CAN bus, it stands to reason that they are all connected together. In some cases, Mercedes-Benz uses a solder splice to connect all the CAN-High and CAN-Low wires together, but Voltage Distribution Blocks are much more common. These blocks consist of several rows of two-pin connectors, with all the CAN-High pins connected together, and all the CAN-Low pins connected together.

This forms a so-called "Star" network, because if you stretch out the wires from the block in different directions they will form a kind of star. Contrast this with a "Linear" network where Node A connects to Node B, B to C, C to D and so on: This is how the D2B and MOST optical networks are connected. In a Linear network if a node fails, part of the network is cut off, while in a star network a node failure might have no impact (beyond the failed node).

Those distribution blocks are important for you: They represent key points for CAN bus operation and offer a great opportunity for testing. Some of them are a challenge to get to, but many are located where access takes just a minute or two. Also note that these can fail: Many have a "terminating resistor" that is essential for proper bus operation, and if it fails it can bring the bus down.

In troubleshooting, our goal is to identify the problem without any doubt, using the least amount of effort. If we deconstruct a CAN bus into its parts, we find that it (like any network) consists of several "layers." At the lowest level, we find the physical layer, which consists of things you can touch, see, and measure: wire, connectors, voltages, and the like. Above this layer are things like the data, network, session and application layers (and others), but we don't care about these. Why not? Because there is *nothing we can do about them if they have a problem.*

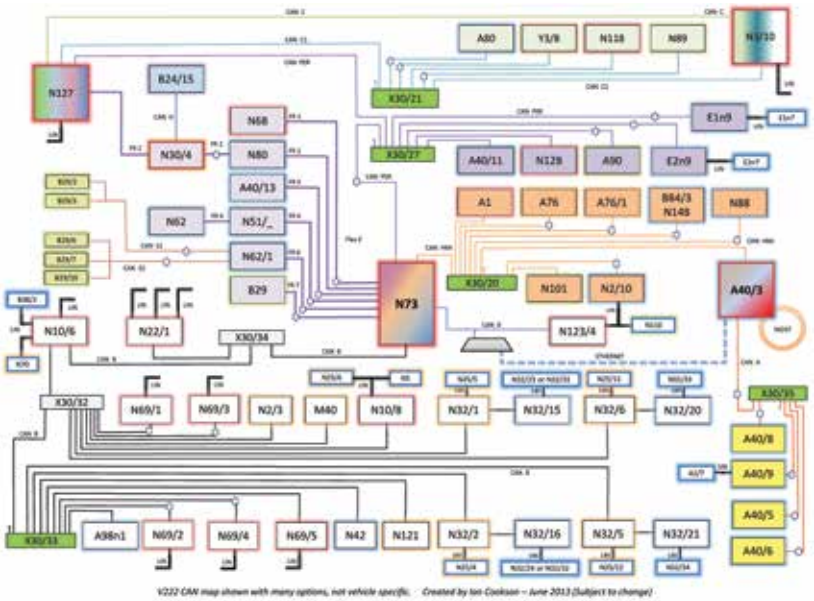
For example, if a particular control unit goes crazy and starts sending garbled messages, we can't go into the control unit and reprogram it, or replace a failed integrated circuit or other component: We can just replace the whole control unit. It's the same situation if a receiver goes deaf: Our only option is to buy a new one and install it.

That brings us to a key point about CAN diagnosis: ***You are only concerned with the physical layer***. That means wires, connectors, and voltages. That really is all that can go wrong with a CAN bus.

As with any diagnosis, the first step is to identify all the symptoms. You already know how to do this: Ask

Network	Bus Name	Speed (kBit/s)	Wire Colors (H – L)
CAN A	Telematics CAN	125	BK/WT – BK
CAN B	Interior CAN	250	BN/RD – BN
CAN C	Drivetrain CAN	500	BU/WT – BU
CAN D	Diagnosis CAN	500	GY/WT – GY
CAN E	Chassis CAN	500	GN/WT - GN

Modern vehicles use Class C CAN networks exclusively, but some older models also used Class B networks. This table shows a few typical CAN buses and how the network speeds (and wire colors) can vary. The CAN High wire generally has the tracer stripe.



This networking diagram for a new S-Class (222 chassis) shows the complexity of modern vehicle networks. Note that the CAN B (interior CAN) has two distribution blocks (X30/32 and X30/33), but only one has a ground connection: Find the small symbol on X30/33 (lower left) and see which other blocks also have grounds.

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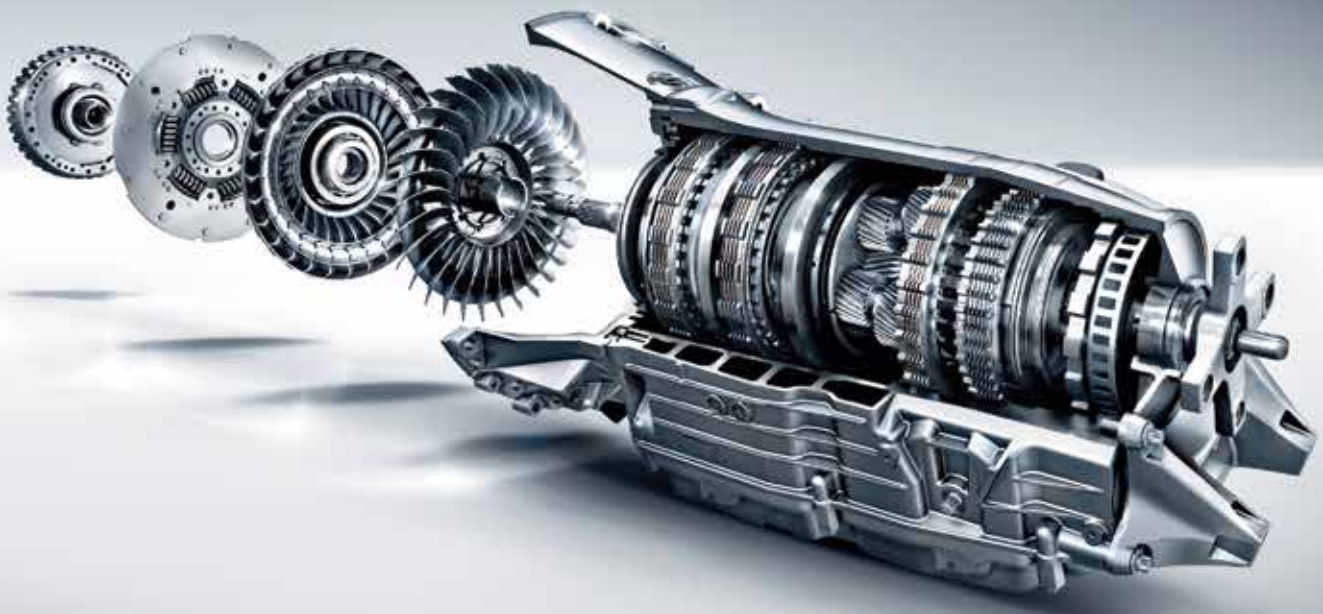

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the customer, and look at any fault codes that are present. For fault codes, don't look at the systems that are complaining about the CAN bus, but look at who they are complaining about. Another thing is to look at any systems that are missing from the quick test, but you know are in the car. For example, if the instrument cluster doesn't show up on a quick test, it's obviously got a problem communicating.

With intermittents, try to reproduce the problem under the same operating conditions as the customer complained about. We want to nail this on the first try, if possible, and seeing it for yourself will help a lot.

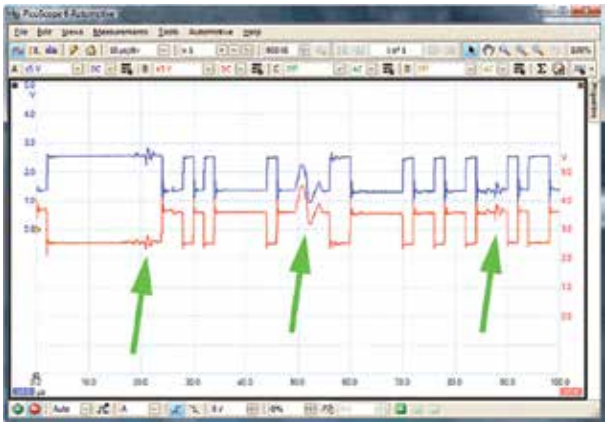
With the symptoms and the wiring diagrams, the steps of a diagnosis are:

1. **Determine which CAN bus has the fault.**
   Modern cars have dozens of buses, but they are not directly connected to each other, so any problems will be isolated to a single bus. Use the wiring diagrams to determine which CAN bus has the components affected.
2. **Determine electrically if the CAN bus is open or shorted.**
   Again using the bus wiring diagram, find a place where you can measure the CAN bus voltages without disconnecting anything (so the system doesn't reset and temporarily remove the fault). Try to avoid having to take the whole car apart for this stage of testing, since you know the voltage should be the same everywhere on the bus. For the interior bus, the overhead control panel (dome light) is a good choice. Measure the CAN High and CAN Low voltage relative to chassis ground. Mercedes-Benz recommends back-probing the connector, as long as the wires don't have a seal that can be damaged.
3. **Determine which "branch"of the bus has the fault.** We do this by disconnecting branches at a distribution block until the problem goes away. Instead of doing this one branch at a time, keep dividing the network in half to speed up the process.
4. **Determine if the fault is from wiring or a module.** Disconnect the module at the far end from the distribution block, and carefully test the wiring for shorts (including to power and ground) and continuity. If the problem comes back only when the module is connected, suspect the module instead of the wiring.

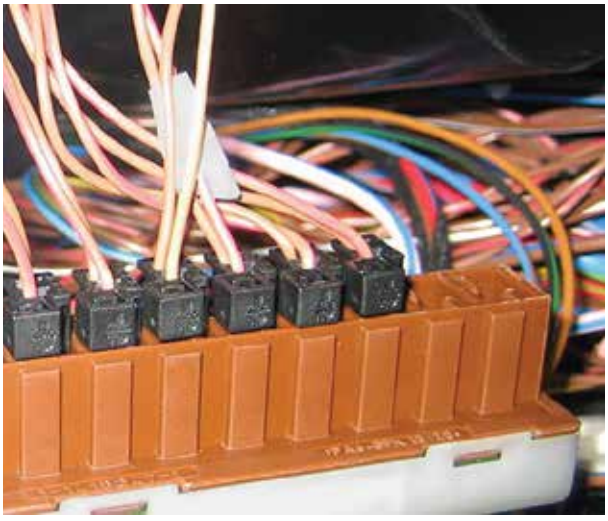
Here is an exercise for you that will pay you back every time you need to check a CAN bus:

There are only so many ways a CAN bus physical layer can fail, as listed in the chart on Page 9. On a car that's working fine, create each fault and read the CAN voltages, then write down your readings in the chart. What this does is give you a reference chart. If your problem car has a voltage that isn't quite right, you've found the problem. You should repeat this on a few different CAN buses and make up a chart for each one, since some vehicles and buses will have different voltages.

For example, if CAN High is shorted to ground, you'll measure 0.0V and the chart will tell you exactly that. Realistically, over 95% of CAN bus problems can be found this way. Yes,



On this oscilloscope trace of a CAN bus in operation, we can see that the electromagnetic interference (EMI) that is affecting the signals (arrows) causes the voltage to change in both wires at the same time. Since CAN only cares about the difference in voltage between the signals, this strong interference has virtually no effect on the bus performance.



A typical CAN distribution block. This one does not have a ground wire.

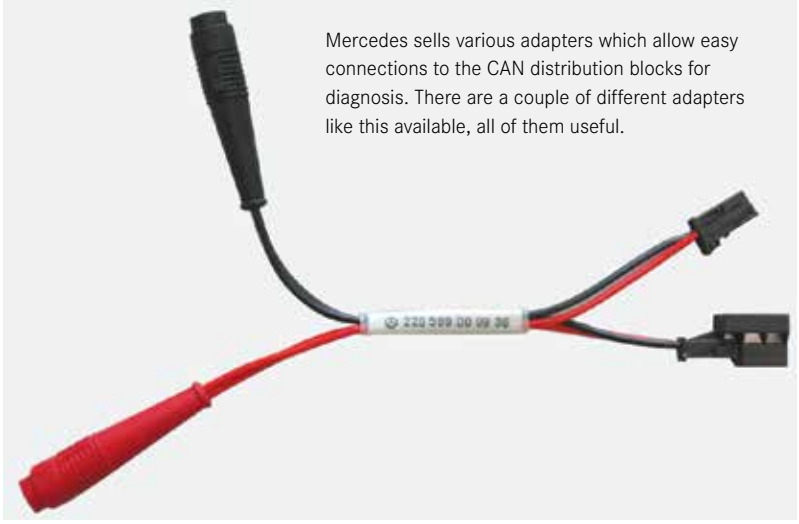
for intermittents you might have to monitor the voltage for some time, but you WILL find it this way.

If we jump ahead for a moment, once we have found the problem, it becomes a matter of locating it. For this, we go to one of those distribution blocks and start measuring and isolating the individual bus lines going out to the various modules. For intermittents, this might take some time, but there's no easier way. A broken or chafed wire, a damaged connector, or whatever, can be repaired once you locate it. For non-intermittent problems this is almost too easy. Disconnect one connector from a distribution block at a time to isolate the specific wires involved.

Now let's talk about test equipment. For most problems, a voltmeter is all you'll need. For those intermittent problems, a two-channel oscilloscope will really come in handy. A 'scope is just a voltmeter that shows its measurements over time, so watching the 'scope reading (trace) while driving will easily show when something changes for a tenth of a second.

You want to set your vertical (voltage) range so you can see CAN High and CAN Low as separate traces, usually around 1V per division (full height for most scopes is eight divisions). Then set your horizontal (time) range to about 1/2 or 1 second per division (most scopes have 10 horizontal divisions) so the trace stays on the screen for several seconds. A voltage that drops to zero for a fraction of a second will be really obvious.

If you are wary of oscilloscopes, there's really nothing to be afraid of. You can get a nice 2- or 4-channel oscilloscope with a 10 MHz bandwidth (more than enough) for well under $400, particularly those that connect to a laptop computer via USB. Used scopes on eBay are a good choice as well, but older analog models usually can't display a very slow trace, and don't have any memory for later review. With a



Mercedes sells various adapters which allow easy connections to the CAN distribution blocks for diagnosis. There are a couple of different adapters like this available, all of them useful.

Here we can see a group of four CAN voltage distribution blocks [2], located in the dash near the hood release handle [1]. The CAN bus physical layer, consisting of wires, connectors, and voltages, is the only part of the CAN bus that really matters for diagnosis.

Fault Type	DC Voltage: CAN H to Ground	DC Voltage: CAN L to Ground
No fault (normal)	2.6 - 2.7	2.35 – 2.45 V
CAN H shorted to Ground	0.0	0.1
CAN H shorted to Power	12	11.5
CAN L shorted to Ground	0.2	0.0
CAN L shorted to Power	11.5	12
CAN H shorted to CAN L	2.3	2.3
CAN H Open	0.0	2.4
CAN H and L Reversed	2.4	2.7
CAN L Open	2.7	0.0
Incorrect terminating resistor (<20 Ohms)	2.55	2.45

This chart shows the ways a CAN bus physical layer can fail, and we've written in some typical voltages you might see under those conditions. On a working car, create each fault and make your own chart. Later when diagnosing, the chart will point you to the exact kind of fault on the CAN bus just by reading the voltages. Different types of CAN bus, and in different models, may have different voltages, so make a few charts for yourself from different buses and models.

laptop model, you can drive alone and look at the data later, after you've seen the problem happen and don't need to keep your eyes on the road.

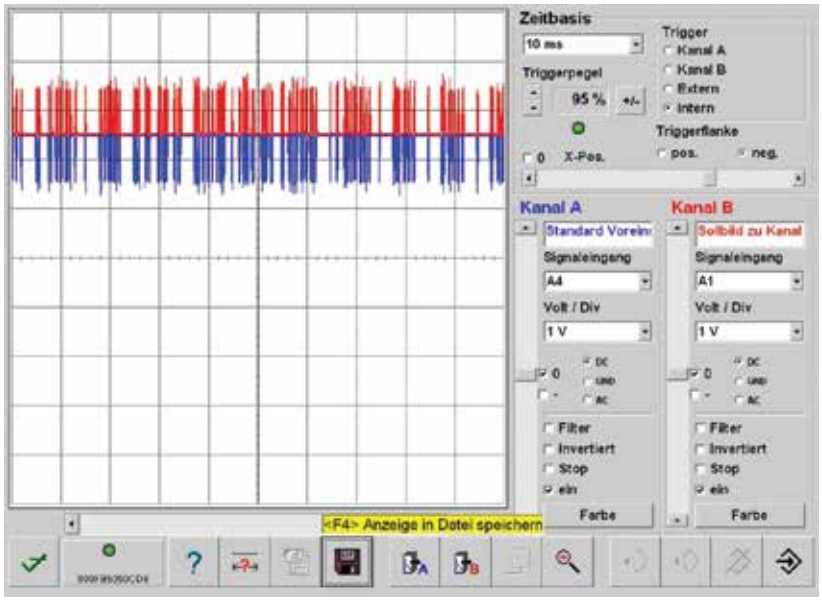
From a practical point of view, the majority of problems we have seen are caused by damaged wires. Connectors sometimes get disconnected, perhaps partially, as well. In the case of a disconnected connector, only one control module (the disconnected one) will have a serious problem, but others may also have some impairment because they're not getting messages from the disconnected one.

Rarely, but not unheard of, are the connector blocks. We mentioned the terminating resistors – these are essential to bus operation. With the bus asleep and not sending any messages (the voltages will go away), you should measure about 60 Ohms (for most CANs) between CAN High and CAN Low. Anything else indicates a problem. A very few control units have terminating resistors inside; mostly these are in the distribution blocks, but not every block has one.

You can tell if a block has a resistor by either one connector having three wires, or the symbol on the wiring diagram. Or, of course, by measuring the block with everything disconnected. Most CAN buses will work until the resistance from CAN high to CAN Low drops below about 16 Ohms.

Rarer still are control units that have gone bad, but this does happen every once in a long while.

We hope this brief explanation of the CAN Bus helps you time and again with squashing those networking gremlins.



This shows a normal CAN bus signal as seen on an oscilloscope. In contrast to the slow-timebase testing described in the text, a fast-timebase (10 mSec) look at the signals (like this one) can show if the signals are getting distorted. Distorted signals usually point to a bad terminating resistor or corrosion at a connector messing with bus resistance.

This CAN distribution block has one connector with a third wire, connected to ground for the terminating resistor. Note the brown wire at upper left. If this becomes disconnected, the CAN signals will be distorted, which can only be seen with an oscilloscope. The blue wires indicate this is from the Chassis CAN.

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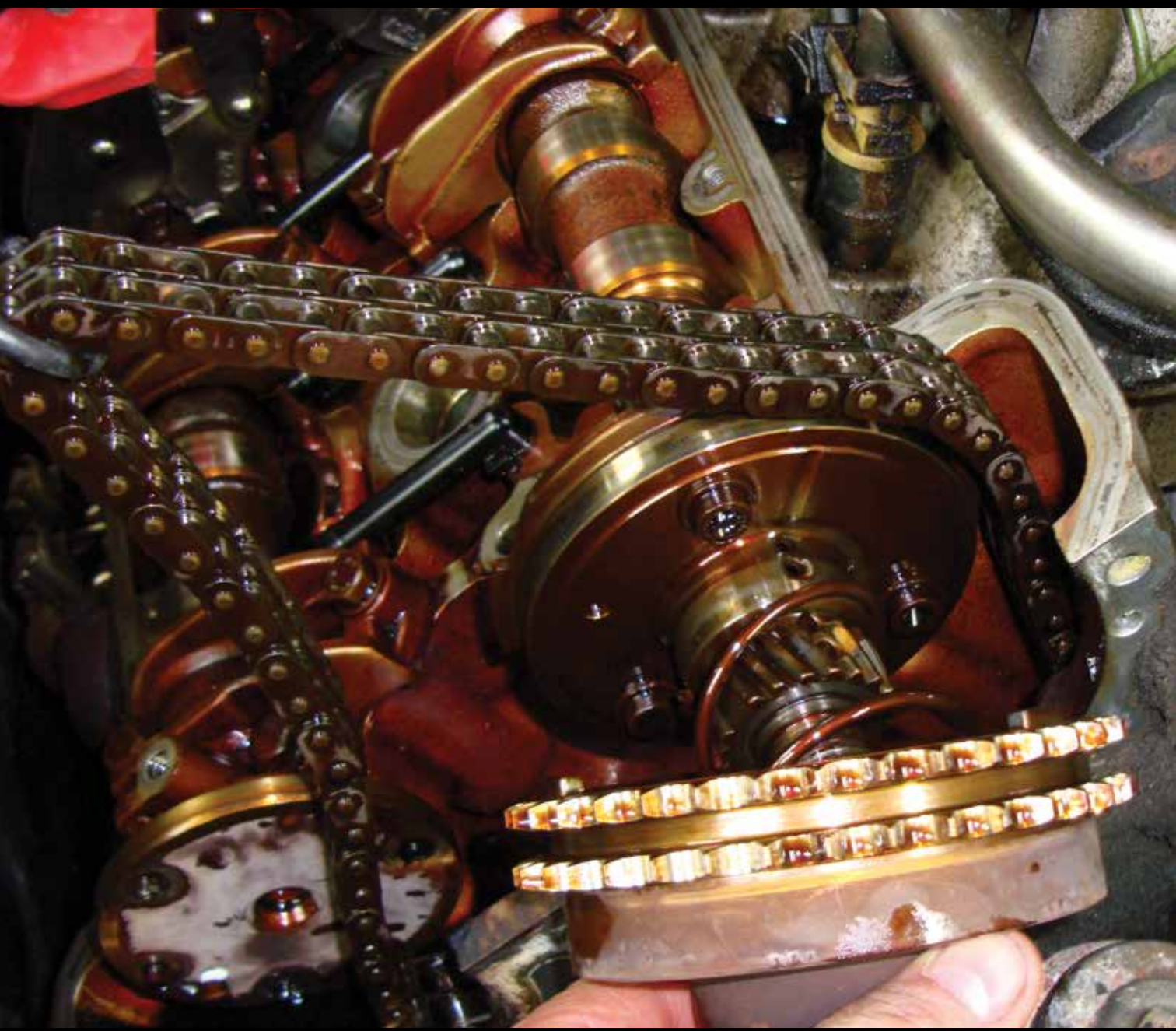
High-Mileage VVT Issues



Sure, it's a boon to performance, but the system is a possible trouble spot when a big number's on the odometer. The mechanism itself, stretched chains and worn tensioners that sometimes don't set DTCs, and zeroing in on the problems associated with troubleshooting these systems.

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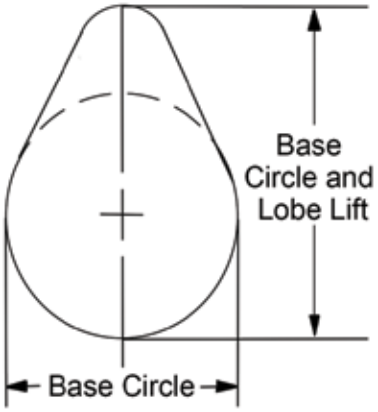
As engines evolved and running rpm became much higher than idle rpm, the need for a way to change the lift and duration of the valve timing became necessary to optimize performance and economy. It was in the 1920s that the first patents for variable-duration valve opening started appearing.

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 address this compromise became more evident in the late 20th century due to the demand for better fuel economy and the environmental concerns we began facing. Combining this with the thirst for power, car buyers made it necessary for this technology to be developed and to evolve into the sophisticated valve timing systems found on Mercedes-Benz vehicles today.

Review of Camshaft Lift and Duration

Duration at .050 in. is a measurement of the movement the cam follower, in crankshaft degrees, from the point where it's first lifted .050" off the base circle on the opening ramp side of the camshaft lobe, to the point where it ends up being .050" from the base circle on the closing ramp side of the lobe.

Lift is the measurement of the height of the lobe above the base circle.



Multiply lobe lift times the rocker-arm ratio (in cases where rocker arms are present) to establish valve lift. For example, a 0.350-in. lobe times a rocker ratio of 1.5 equals a gross valve lift of 0.525 in. Until the advent of variable valve timing (VVT), camshaft timing, lift, duration, and overlap were all fixed values determined by the location and shape of the lobes on the camshaft when the cam was ground. What's more, the profiles and locations of the lobes were ground to optimize power within a certain rpm range.

Passenger vehicles typically spend most of their time from idle to about 3,500 rpm with occasional bursts to 5500 rpm, so automotive camshafts are usually ground with relatively low duration and overlap to increase low-end torque. A cam with minimal duration and overlap also creates lots of intake vacuum, which allows for good throttle response but also creates power losses as the pistons struggle to pull air past the nearly-closed throttle plates.

A good mid-range cam gives up some low-speed torque and peak high-speed horsepower to obtain a wider power band in the middle rpm ranges. Because of these factors, most cams (including those for high performance) are still a compromise. The breathing characteristics of any camshaft work best within a fairly narrow rpm range, and everything on either side of that range is less than optimal.

Enter the Variable Valve Timing Concept

The simplest form of VVT is cam-phasing, whereby the phase angle of the camshaft is rotated forward or backward relative to the crankshaft. Thus, the valves open and close earlier or later; however, 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. This article will deal primarily with the M272 and M273 engines and those with similar valve configurations. These have been in production for some time now and we will look at those engines that have begun to acquire substantial mileage and the scenarios you will see in the field.

The introduction of the M272 brought some changes, notably:

1. Four-valve continuously-variable camshafts, intake and exhaust (DOHC)
2. Two-stage intake manifold
3. Turbulence flaps in the intake ports
4. No EGR valve – both cams adjust to reduce NOx
5. Four cam adjusters
6. Four cam sensors
7. Four impulse wheel triggers
8. Four camshaft control plungers
9. Intake cam is chain driven and drives exhaust cam via gears

The camshaft timing adjusters are vane-type oil pressure-controlled adjusters that are continuously variable. Since oil pressure is one of the control factors, the quality of the oil and the history of maintenance is paramount to the longevity of the components. The use of non-Mercedes-Benz-approved engine oils and filters, or infrequent oil changes can lead to a host of problems the technician will see in regards to this system. That being said, when faced with possible camshaft timing issues one of the most important things a technician can do in a preliminary evaluation is a visual inspection of some of the internal components of the engine. Granted, sometimes this will involve removing a valve cover, but it may save you a lot of heartache in the long run. Inspection of the underside of the oil filler cap can sometimes give you an indication that further inspection for sludge build-up is warranted.

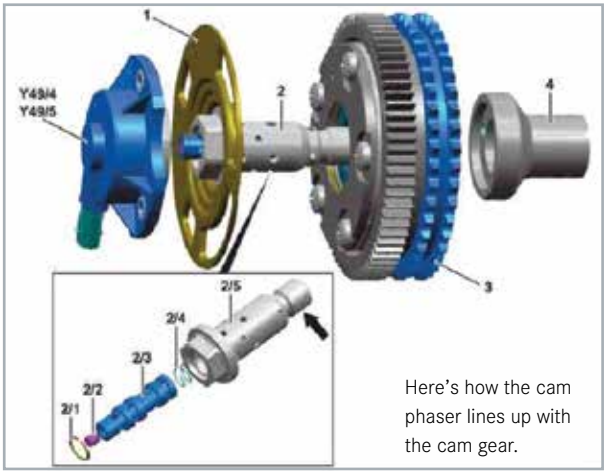
On the intake side of things, the camshafts can advance from 4 deg. BTDC up to 36 deg. ATDC. The exhaust camshaft can retard from -20 deg. BTDC to +20 deg. ATDC.

Each of the four camshaft adjusters has an impulse wheel mounted to its front, and they each have a different part number. The openings of the impulse wheels help the ME (Motor Electronics) determine the camshafts' exact position. It is important to note that the impulse wheels can only be used one time! If new impulse wheels are not used, the pins could shear off causing extensive damage to the adjusters.

Four Hall Effect sensors are mounted on the front of the engine, one for each camshaft. Right and left camshaft signals are staggered and have a quick-start function capable of detecting a cam position with a stationary engine. The crankshaft revolutions are counted by a single Hall Effect sensor. There are also four timing control solenoids, one for each camshaft, which are pulse width-modulated by the ME and push against the camshaft control plunger when activated.

How it actually works

As noted previously, the intake and exhaust camshafts can be adjusted continuously by 40 deg. 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 are located in the front of their respective camshafts. 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

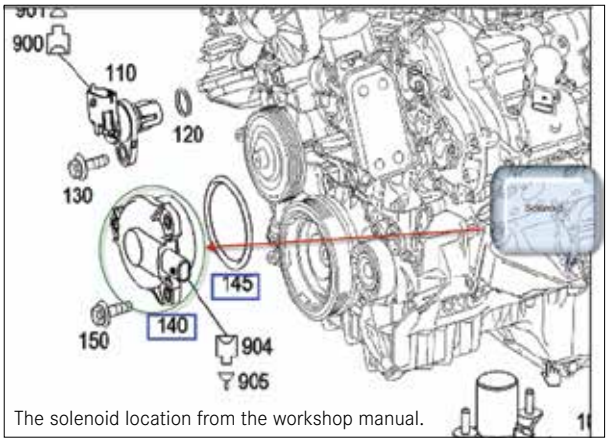


Here's how the cam phaser lines up with the cam gear.

Location of control valve, intake valve illustrated

1. Pulse wheel
2 Control Valve
2/1 Circlip
2/2 Thrust piece
2/3 Control plunger
2/4 Return spring
2/5 Valve body with right-hand thread (arrow, exhaust-side with left-hand thread)
3 Vane-type adjuster
4 Intake camshaft

Y49/4 Left camshaft intake solenoid
Y49/5 Right camshaft intake solenoid



The solenoid location from the workshop manual.

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flows from the hollow camshaft to the oil galleries of the vane-type adjuster.

The solenoids for camshaft adjustment are designed as proportional magnets, i.e. the direction of the armature and thus the position of the control plunger in the vane-type adjuster are dependent on the intensity of the current in the coil. Occasionally you will see failures in these magnets to properly advance or retard their respective camshafts. Generally, DTCs will be set for these to aid in proper diagnosis. We have provided some actual scenarios from the field showing what you might run into in the course of your service work. The solenoids before the camshafts are actuated by the ME control unit at the ground end by means of a PWM signal (150 Hz). The voltage supply for the solenoid is from circuit 87. The vane-cell adjusters are actuated according to the performance map related to duty cycle. The maximum current (duty cycle 100%) is emitted for a short time (about 0.5 second) for rapid adjusting of the anchor. A hold-in winding voltage with a small duty cycle is then set afterward. Pressurized oil flows out of the hollow camshafts into the vane-cell adjuster. The camshafts adjust themselves to the respective direction of rotation. The inlet camshafts adjust to advance, while the exhaust camshafts adjust themselves due to their reversed direction of rotation to retard. Depending on their position, the oil volume in the vane –type adjusters is controlled. This takes place through differently arranged holes in the control plunger as well as through oil ducts in the vane-cell adjusters.

The adjusting range is limited by the design of the vane-cell adjuster mechanically. If the solenoids are no longer actuated then resetting takes place against the direction of rotation. Each camshaft position is detected by a camshaft Hall sensor. Once the requested adjustment has been achieved, then the respective solenoid will be actuated in such a way that oil galleries in the vane-cell adjusters are closed.

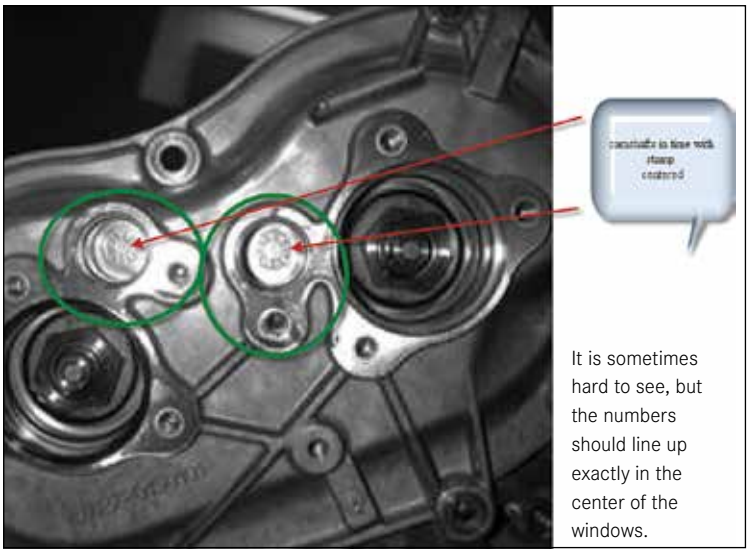
Common fault code scenarios

When confronted with complaints of lack of power or performance, which most likely will be accompanied by a MIL (Malfunction Indicator Lamp, also known as the Check Engine Light) on, a few common scenarios will turn up in the field. One scenario will be that the camshaft adjustment solenoid is leaking oil and no fault codes are stored in the control module. There are usually two areas in which you can find the leak. One will be the sealing ring between the solenoid and the cylinder head, in which case you would replace the sealing ring. If the leak is at the electrical connector, then the operation would be to replace the solenoid.

These solenoids have been leaking for too long. They will have to be cleaned and evaluated for the leak source.

You may be confronted with fault codes 0059, 0060, 0063, 0064, 0271, 0272, 0275, and 0276. These codes are generally caused by a malfunctioning camshaft adjustment solenoid. Using Star diagnosis, XENTRY, or compatible diagnostic equipment, proceed with the proper evaluation of each DTC. The solenoids are all the same, so switching their positions can be a valuable aid in determining the solenoid adjuster at fault. If you suspect a faulty solenoid, simply swap it with one of the others and observe your data to see if the fault followed.

One of the more common scenarios is when the MIL is on and DTC 1200 and/or 1208 is present. When the fault memory is erased and the engine is restarted, the fault codes return immediately. This is due to the positioning of the timing chain-driven camshaft and its 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. To confirm, you will need to do a quick cam timing check. Remove all the camshaft hall sensors and rotate the crankshaft balancer to the 305 deg. mark with the front cover pointer. Now, you can check the impulse wheels' stamped numbers and see if they are properly lined up. Note that you may have to rotate the crankshaft more than one revolution to see the stamped numbers. The 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.



It is sometimes hard to see, but the numbers should line up exactly in the center of the windows.

Notice how the new gear compares with the old one.

Remove the timing case cover and perform a visual inspection of the teeth on the balance sprocket or the idler gear, depending on which engine you are working on. The teeth will most likely show some wear as in the photo. This wear is causing the misalignment of the camshaft timing and 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.

It is important at this juncture to refer to the previous notes in this article about paying particular attention to the overall condition of the engine in regards to proper care and oil quality. Sludge build-up due to infrequent oil changes or the use of oil that doesn't meet Mercedes-Benz standards may make this a candidate for a replacement engine. Many shops at this stage opt for a genuine remanufactured engine from Mercedes-Benz in order to give customers the best return for their investment in the repair. It is critical to have this discussion with your customer to be assured the repair will be one that results in long-term satisfaction.

The following steps can be followed if it is determined that a satisfactory result can be obtained by repairing the engine as per WIS instructions for replacing the balance shaft or idler gear:

1. Replace balance shaft or idler gear as per WIS instructions – the counterweight on the M272 engine must also be replaced. The balance shaft and counterweight are specific to engine designation, so order by VIN.
2. Replace the oil pump.
3. Replace the chain tensioner. A note of caution: chain tensioners must be installed only after the cylinder head covers have been replaced. Failure to do so will result in the overtightening of the chains and engine damage. Chain tensioners are one-time use only because during their removal the pressure pin is pressed into the end position, and the thrust pin latch prevents the return stroke. This would overstretch the timing chain on reinstallation.
4. Change the engine oil and filter using the appropriate oil from M-B sheet 229.5.
5. Drive the engine at high load and rpm for about 15 miles.
6. Change the engine oil and filter once more using the appropriate Mercedes-Benz- approved oil and filter.
7. Replace all four of the camshaft adjustment solenoids.
   Note: Cylinder heads do not need to be removed.

Although these systems have evolved and will continue to do so in terms of efficient valve timing, lift, and duration, paying attention to the details when confronted with high-mileage vehicles will pay off both for you and your customer. Proper attention to customer concerns and DTCs, and consulting the latest StarTek information will assure you of successful diagnosis and repair of these systems.

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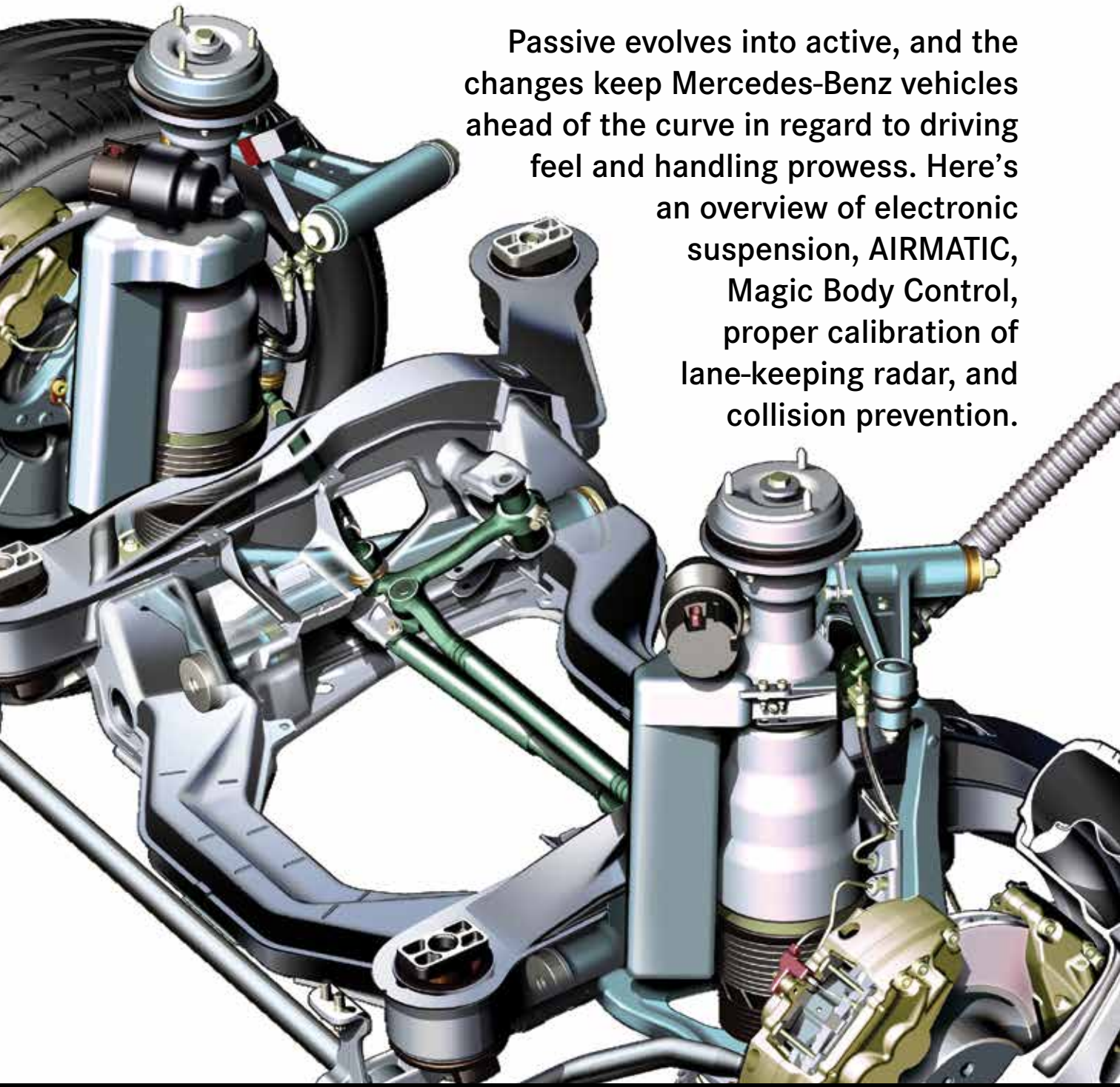
Recent Developments in Steering & Suspension



Passive evolves into active, and the changes keep Mercedes-Benz vehicles ahead of the curve in regard to driving feel and handling prowess. Here's an overview of electronic suspension, AIRMATIC, Magic Body Control, proper calibration of lane-keeping radar, and collision prevention.

Since the invention of the wheel 6,000 years ago, man has tried to find ways to smooth out the path it travels on, lessen the rolling resistance, and quickly adjust to changes in terrain. In the horse and cart days, of course, the roads were dirt, full of ruts and rocks. Changes to both the wheel and the surface it rides on helped to improve the ride and handling as carts were replaced by automobiles and the roads were paved. The invention of the rubber tire improved things immensely, but much more was needed for safety and comfort. Enter the suspension system – a flexible way of separating the carriage from the wheels. Even ancient Roman chariots had a sort of suspension system using leather straps, and centuries ago carts had some sort of spring system – steel leaf springs were used to isolate the rider from the road.

Those early carriages weren't fitted with shock absorbers, but as speeds rose, so did the need for suspension damping. Early shock absorbers, which persisted into the 1930s, were actually friction dampers. They don't really absorb shock, but rather dampen the oscillations of the springs. Frenchman Maurice Houdaille is credited with inventing the first shock absorbers to take advantage of the excellent cushioning qualities of hydraulic fluid forced through an orifice. He received his first patent in 1907, and his products eventually became used on production vehicles.


Note the springs isolating the carriage from the axle and wheels.

The simplest early versions consisted of a tube with a piston that moves up and down through a chamber filled with hydraulic fluid. Later, this fluid was augmented with pressurized nitrogen to prevent the formation of bubbles. The movement of the piston draws in or displaces fluid though orifices, the size and placement of which determine the damping characteristics. Over the years, both the mono-tube and twin-tube types were used. Both have compression and rebound strokes. In the mono-tube design, when the piston rod moves in, the separating piston compresses the gas cushion by the amount of oil corresponding to the volume of the piston rod. During the rebound stroke, the piston rod retracts and the nitrogen gas pressure pushes back on the separating piston. Damping occurs in both directions via the piston valve. In the twin-tube principle, when the piston rod moves in some of the oil flows from the lower to the upper working chamber through the piston valve. Oil is thereby pushed through the base valve in the reservoir tube providing compression and damping. On rebound, the piston valve takes over the damping function while a quantity of oil corresponding to the volume of the retracting piston rod flows back through the base valve.

Fully-active body control

The word "active" is the key here. Conventional systems can only react to road surface imperfections by resisting the changes encountered. Mercedes-Benz invented active body control (ABC) to do more than just resist, but actually makes corrections. A network of five sensors constantly measure each type of body motion, side-to-side, front-to-back, and up-and-down. These are acceleration body sensors at the left front, right front, and right rear. The lateral acceleration sensor is mounted on the tunnel under the center console, and another is usually mounted under the back seat area on the left side.

At each wheel, an advanced strut design incorporates a spring, a shock absorber, and an active hydraulic cylinder that can move up or down. A sensor in each cylinder monitors its position. Two microprocessors and a high pressure hydraulic pump are also employed. The radial piston

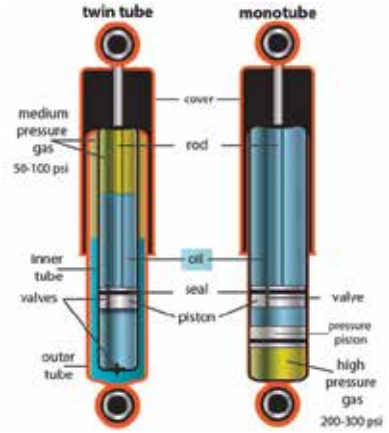
pump is capable of producing pressures between 180 and 200 Bar while driving. Should the pressure fall to below 100 Bar, the ABC control light is activated and a limp-in mode is engaged. To complete the system, there is also an oil reservoir and filter, oil cooler, pressure storage device, pulsation damper, oil temperature sensor, and hydraulic lines.

ABC can change the length in each strut in as little as 10 ms as it detects movement in the sensors. The system also allows for a self-levelling feature, which raises or lowers the vehicle in response to changing load (i.e. the loading or unloading of passengers or cargo). Vehicles equipped with ABC have a "Sport" button that allows the driver to adjust the suspension range for different driving style preferences. So, the driver can adjust the suspension to maintain a level ride in more demanding driving conditions.

Caring for ABC

Service concerns of the ABC system will consist of many of the same maintenance requirements of conventional systems, such as leaking struts and worn bushings and components. First, always check the basics when troubleshooting faults. DTCs can be easily called up using Star diagnosis, XENTRY, or compatible scan tools.
After replacement of hydraulic components, the system will need to be filled and bled. To do this properly:

- Fill the hydraulic reservoir with hydraulic fluid PN A 001 989 24 03 10 (Note: when changing the hydraulic pump, the engine must be run for two minutes before pushing the ABC button). The vehicle should be level and sitting on its wheels, not elevated.



The internal workings of conventional twin- and mono-tube shock absorbers.

- Check the dipstick. The level should be between the Min and Max marks with the engine stopped and vehicle unloaded.
- Start the engine, then push the ABC button until both lights go out. Be sure to keep the level above the minimum mark.

Bleeding:

- Charge the system manually with pressure. The special tool number is 124 589 24 21 00, however techs in the field have used a cooling system pressure system tester with an adapter to perform this task.
- Push the ABC button until both lights come on (car level high).
- Push the ABC button until both lights go off (car level normal).
- Repeat last two steps three times (15 times if changing valve blocks).
- Stop the engine and wait for 10 minutes.
- Check the dipstick and top up as necessary.
- Start the engine and check the valve blocks for noises.

If noises are heard:

- Stop the engine, lift the vehicle and open the bleeder screws until oil comes out. Close the bleeders.
- Repeat the process until the noises disappear.

Also note that a new improved filter is available for the system and is located in the reservoir. Newer models do not have a replaceable filter– the reservoir must be replaced as the filter is integral.

AIRMATIC

With AIRMATIC, ordinary steel springs are replaced by adjustable air springs that smooth the ride. The system includes semi-active adaptive damping (ADS) that instantly adjusts the shock absorbers to improve handling. As each air spring moves up or down, AIRMATIC adds or removes air to maintain comfort and also lessen body roll in corners. The ADS monitors the road surface and the driving style of the operator so that within 50 ms the system can firm up the shock absorbers to keep handling crisp and stable. The driver has the ability to choose Sport and Comfort modes to fine-tune the feel. With the addition of passengers or cargo, the vehicle has the ability to level itself automatically with no loss of comfort. Also, the driver can raise the vehicle based on road conditions (snow, etc.) and the ADC will lower the vehicle at higher speeds to reduce wind drag and improve performance, handling, and fuel mileage.

Some issues you may encounter are complaints of the vehicle sitting too low, or a warning on the instrument cluster to visit the workshop. Typically, when the air suspension compressor quits working, the whole car may lower to the ground and fail to raise. You press the button to raise the car, and nothing happens. If the air suspension compressor works as designed,

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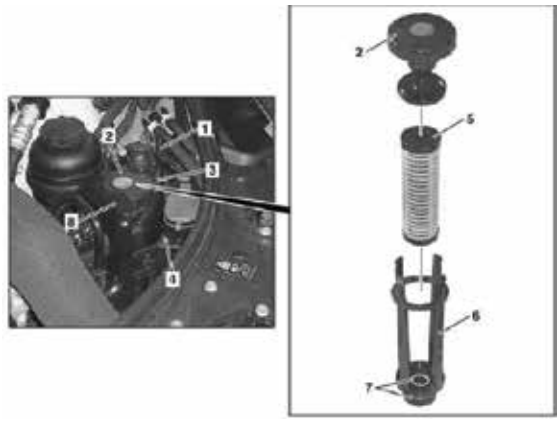
you will hear the compressor engage and run for several seconds. A common area of failure is the relay. Also check the fuse for the compressor before condemning it. Be sure to check for voltage at the pump connector.

The newest version of the hydraulic filter.



The ABC filter is critical to performance. It's located in the reservoir.

Sometimes there will be a failure in one of the air struts. When the seal in the strut degrades, it no longer provides the isolation required and a leak starts. If a major leak has developed, you may even hear a hissing sound from the wheel housing. The whole front or rear of the car will drop down, even when only one of the struts is malfunctioning. The lines can also be a source of an air leak, as well as the valve block. Checking for leaks consists of spraying a soap-and-water solution on the suspected areas and checking for bubbles. There are also some commercially available leak detector solutions that are reported to be more reliable in locating leaks. An area of leakage in the strut you should keep in mind is the top seal assembly. There is a strut shock repair kit available from Mercedes-Benz (PN A 220 320 25 38). Follow the installation instructions in WIS. Another great option is genuine Mercedes-Benz remanufactured AIRMATIC struts.

"Come with me on a magic carpet ride"

Looking at Mercedes-Benz advancements in suspension systems brings to mind the lyrics from that old song. Mercedes-Benz Magic Body Control can be found on late-model S-Class and S-Class coupes. This is the first ever predictive suspension system. It is unique in that stereo cameras are used to scan the road surface in real time up to 15 meters ahead of the vehicle. This function is known as a road surface scan. The stereo cameras measure obstacles with a precision of 3 mm, and at speeds of up to 80 mph. The measurement data from the exact road profile is then passed on to the suspension management system. The active suspension now knows ahead of time which bump it's about to go over. This way the body can adapt to the road far more smoothly than a conventional vehicle suspension ever could. The suspension can actively compensate for uneven surfaces and prevents the vehicle from oscillating and vibrating. This level of comfort is unprecedented in automotive suspension systems and lets the driver feel as though he or she were gliding over the road on a magic carpet.

The AIRMATIC strut assembly.

Lane Keeping Assist and Collision Prevention Assist

Active Lane Keeping Assist can detect if you're straying from your lane. The system can warn you by vibrating the steering wheel, then, if necessary, it can apply the brakes to help bring you safely back into your lane. A camera mounted inside the front windshield constantly monitors the areas in front of the vehicle. If the control system recognizes that the vehicle is moving toward the line at the center or the side of the road, it can compute within milliseconds whether this is intentional. If it is determined that the action is unintentional, the system can alert the driver by vibrating the steering wheel briefly. A vibration motor in the steering wheel warns the driver with a haptic signal (3x

The leak here is revealed by the bubbles on the top of the air strut.

The genuine Mercedes-Benz strut repair kit.

Stereo cameras "see" the road allowing the suspension to adapt ahead of time.

pulsation). If there is no response or corrective action taken, the wheels opposite the lane of drift will brake to bring the vehicle back on course. Warnings are only issued if the lane is clearly recognizable. Other functional impairments can also be caused by direct sun on the camera lens, heavy rain, or other visual obstructions. Course corrective interventions are only performed by the Active Lane Keeping Assist system if the lane markings are continuous and a haptic warning has previously been issued. The system operates in a range of 37 to 124 mph. Above 124 mph (who drives that fast?), only the vibration warnings are issued. Components of the system include:

- Multifunction camera
- Vibration motor in steering wheel
- Radar sensors control unit
- Front long-range radar
- 4x short-range radar – two front and two rear
- One rear multiple-mode radar

Diagnosis can be performed in the multifunction camera (MFK), radar sensors control unit (SGR), as well as guided calibration via XENTRY diagnostics.

Collision Prevention Assist/Collision Prevention Assist Plus

The Collision Prevention Assist system from Mercedes- Benz provides a visual warning when the distance from the vehicle in front is too short. If the M-B car approaches the vehicle in front at a high rate of speed or acceleration, a dynamic distance warning is activated. When the driver brakes, the system works together with Adaptive Brake Assist to perform a collision-avoiding targeted brake application to help prevent rear-end collisions. In addition to issuing a visual and acoustic warning in the event of an imminent collision, the Collision Prevention Assist Plus system also performs autonomous partial braking with up to 60% of maximum braking power of the vehicle. Diagnosis of the system is performed in the Collision Prevention Assist control unit and the DTR – DISTRONIC® module though XENTRY diagnosis.

Who's driving, anyway?

The systems described here as well as cutting-edge technology including DISTRONIC® Plus, DISTRONIC® Plus with Steer Assist, Night View Assist/ Plus, Adaptive High Beam Assist/ Plus, cruise control and Speedtronic, Downhill Speed Regulation, Speed Limit Assist/Traffic Sign Assist, Attention Assist, Parktronic with Parking Guidance, Active Park Assist, Reversing Camera, Brake Assist Plus with Intersection Assist, and Pre-Safe Brake/Plus are all indicators of the technological advancements Mercedes- Benz has made. These are great strides in providing safety and the ultimate in ride and handling.

Mercedes-Benz Mobil 1

Product Name	Part Number	Quantity	Product Description	Recommended Consumer App.
Mercedes-Benz SPEC.				
Mobil 1 Formula M 5W-40	BQ 1 09 0197	Bulk - No Equipment	Fully synthetic formulas designed specifically for gasoline passenger cars	Low SPAsh. Available at most M-B dealers
	BQ 1 09 0195	6/1 Quart Cases		
	BQ 1 09 0196	55 Gallon Drum		
Genuine Mercedes-Benz Oil MB 229.5 Specification SAE 5W-40	A0009898301USB6	6x1 Quart Cases	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.5 Specification	Mercedes-Benz Engines that require 229.5 Specification Oil
	A0009898301USB8	55 Gallon Drum		
	A0009898301USB9	Bulk - No Equipment		
Mobil 1 0W-40	BQ 1 09 0010	Bulk - No Equipment	Fully synthetic formulation designed to meet the requirements of many European vehicles	Porsche A40. Many European vehicles. HT/TS applications.
	BQ 1 09 0015	6/1 Quart Cases		
	BQ 1 09 0016	55 Gallon Drum		
Mobil 1 ESP X1 0W-30	BQ 1 09 0184	Bulk - No Equipment	Advanced full synthetic formulas designed specifically for diesel passenger cars that have particulate filters	Low SPAsh. Available at most MB dealers
	BQ 1 09 0182	6/1 Quart Cases		
	BQ 1 09 0183	55 Gallon Drum		
Genuine Mercedes-Benz Oil MB 229.52Specification SAE 5W-30	A0019893701USA9	Bulk - No Equipment	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.51 and 229.52 Specification requirements	Mercedes-Benz Engines that require 229.51 Specification Oil
	A0019893701USA6	6x1 Quart Cases		
	A0019893701USA8	55 Gallon Drum		
Mobil 1 5W-50	BQ 1 09 0133	16 Gallon Keg	Higher viscosity, advanced full synthetic formula designed for performance vehicles	Porsche A40. HT/HS applications.
	BQ 1 09 0194	6/1 Quart Cases		
Mobil ATF 134	BQ 1 09 0166	55 Gallon Drum	Extra high performance automatic transmission fluid formulated with selected HVI base oils	Recommended for use in Mercedes-Benz automatic gearboxes
M-B Genuine ATF 134FE	A0019897703USA8	55 Gallon Drum		
Mobil 1 ESP Formula MB 5W-30	BQ 1 09 0165	12x1 Liter Cases	Advanced full synthetic formulas designed specifically for passenger car diesels that have particulate filters	Low SPAsh. Available at most MB dealers.
AdBlue® ½ Gal.	A 000 583 0107	1/2 Gallon Bottle	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 + BMW AdBlue® (DEF) applications
Diesel Exhaust Fluid 55 Gal	BQ 1 47 0002	55 Gallon Drum		
Mobil 1 5W-30	BQ 1 09 0017	6/1 Quart Cases	Advanced full synthetic formulation designed to meet the requirements of many domestic, including GM, and imported vehicles	Vehicles that require 5W-30. Corvette approved.
	BQ 1 09 0018	55 Gallon Drum		
Mobil 1 10W-30	BQ 1 09 0019	6/1 Quart Cases	Advanced full synthetic formula designed for domestics and imports	Vehicles that require 5W-30 or 10W-30
	BQ 1 09 0020	16 Gallon Keg		
	BQ 1 09 0021	55 Gallon Drum		
Mobil 1 5W-20	BQ 1 09 0083	6/1 Quart Cases	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
	BQ 1 09 0084	55 Gallon Drum		
Mobil 1 0W-20 AFE	BQ 1 09 0169	6/1 Quart Cases	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
	BQ 1 09 0168	55 Gallon Drum		
Mobil 1 0W-30 AFE	BQ 1 09 0174	6/1 Quart Cases	Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance	Most vehicles that specify 5W-30 or 10W-30
Mobil 1 Synthetic ATF	BQ 1 09 0164	6/1 Quart Cases	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
	BQ 1 09 0163	55 Gallon Drum		
Mobil 1 15W-50	BQ 1 09 0023	55 Gallon Drum	Boosted, higher viscosity, advanced full synthetic formula designed for performance vehicles	HT/HS applications. Racing and Flat tappet applications
	BQ 1 09 0022	6/1 Quart Cases		
Mobil 1 Gear Oil (Mobil 1 Gear Lube 75W-90)	BQ 1 09 0085	12/1 Quart Cases	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 API GL-5 level performance

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Product Name	Part Number	Quantity	Product Description	Recommended Consumer App.
Mercedes-Benz SPEC.				
Mobil Special 5W-30	BQ 1 09 002464	Bulk - No Equipment	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 an API SN/SM/SL/SJ
	BQ 1 09 0171	12/1 Quart Cases		
	BQ 1 09 003064	55 Gallon Drum		
Mobil Special 10W-30	BQ 1 09 003164	Bulk - No Equipment	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 an API SN/SM/SL/SJ
	BQ 1 09 0172	12/1 Quart Cases		
	BQ 1 09 003764	55 Gallon Drum		
Mobil Special 10W-40	BQ 1 09 003864	Bulk - No Equipment	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/SMSL/SJ oil is preferred or recommended
	BQ 1 09 0173	12/1 Quart Cases		
	BQ 1 09 004464	55 Gallon Drum		
Mobil Special 5W-20	BQ 1 09 012464	Bulk - No Equipment	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 an API SN/SM/SL/SJ
	BQ 1 09 0170	12/1 Quart Cases		
	BQ 1 09 013264	55 Gallon Drum		
Mobil Special 20W-50	BQ 1 09 004664	55 Gallon Drum	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/SMSL/SJ oil is preferred or recommended
Mobil Delvac 1300 Super 15W40	BQ 1 09 0053	Bulk - No Equipment	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-output, low-emission engines including those with Exhaust Gas Recirculation (EGR) and After-treatment Systems with Diesel Particulate Filters (DPFs) and Diesel Oxidation Catalysts (DOCs)	Specifically recommended for the latest low-emissions, high performance diesel applications equipped with aftertreatment systems using Diesel Particulate Filter (DPF) and Diesel Oxidation Catalyst (DOC) technologies
	BQ 1 09 0058	12/1 Quart Cases		
	BQ 1 09 0059	4/1 Gallon Cases		
	BQ 1 09 0060	55 Gallon Drum		
	BQ 1 09 0179	6/1 Quart Cases		
Mobil Delvac 1300 Super 10W30	BQ 1 09 0086	Bulk - No Equipment		
Mobil Delvac 1 5W40	BQ 1 09 0051	4/1 Gallon Cases	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)
	BQ 1 09 0052	55 Gallon Drum		
Mobil Grease XHP 222	BQ 1 09 0078	60/14 oz Cartridge	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
	BQ 1 09 0079	120 lb Keg		
	BQ 1 09 0080	400 lb Drum		
	BQ 1 09 0098	40/14 oz Cartridge		
Mobil Lube HD Plus 80W90	BQ 1 09 0096	120 lb Keg	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, axles, and final drives requiring API GL-5 level performance
	BQ 1 09 0097	400 lb Drum		

Using WIS Efficiently

While the Mercedes-Benz Workshop Information System may be intimidating at first, stick with it and you'll find that it's ALL in there.

With the length and breadth of the products offered by Mercedes-Benz over the years, it is no wonder that the company has put all of its technical information into a single computer database known as the Workshop Information System or WIS. In WIS, we find work instructions for most tasks (such as component removal and reinstallation, maintenance tasks); function descriptions that explain exactly how systems work; electrical, pneumatic, hydraulic, and function diagrams; forms necessary for service tasks (such as maintenance sheets); specifications (such as torques, correct fluids and approved oils), and much more.

Aside from diagnostic information (which is found in XENTRY, the M-B diagnostic computer system), virtually all other information is found in WIS. Considering that WIS is the most important information system available to the technician, there is great value in learning how to use it well. And that is precisely what we'll be looking at in this article.

The same Workshop Information System (WIS) application that Mercedes-Benz dealers worldwide use is also available to you on STAR TekInfo. WIS is a Java application, so it is flexible in how it runs.

Most of our readers are somewhat familiar with the Workshop Information System. So, this amounts to a review, and won't make you an expert – indeed, the only way to get really good at WIS is to use it – but in this article we will explain most of what you need to know to at least use it *efficiently*.

While it is more expensive than some of the aftermarket solutions, it is more complete. WIS provides the proper way to remove a component, prepare the new one for installation and then install. It also gives you a complete list of tools, equipment and supplies needed to complete the job. By following the manufacturer's repair instructions, you greatly reduce your liability if something unfortunate happens. We've heard of shops being held responsible for obscenely large jury awards for repairs gone wrong because the technicians were not following the manufacturer's instructions – and not doing that (particularly when they are easily available) due to cost is hardly a valid defense in court. Is this how you want to check how good your insurance coverage is?

The collision industry faces the same challenge, and hundreds of shops have STAR TekInfo subscriptions because of liability. When performed according to Mercedes-Benz' instructions, the crash performance of a collision repair is as good as when the vehicle was originally produced, and that carries a lot of weight in court. In fact, just to weld structural aluminum, MBUSA requires a two-week training course in welding, and the weld samples are each individually tested: Even a single failure and the welder doesn't get certification.

The first step in bolstering your professional capabilities is to get access to WIS, which can be had at STAR TekInfo (www.startekinfo.com). Current prices are just under $300 a month, or about $3,100 a year. Although this may seem expensive, there is a lot of value in that subscription, and if your main business is the maintenance and repair of Mercedes-Benz vehicles, you will find yourself saving money every day by doing the job right, with all the details, tool lists, and everything else you need.

Of course, there are many jobs you really don't need WIS for: You've done them many times and perhaps only need to refresh your memory of the correct filling capacity or torque settings.

WIS's value is not so much as a reminder for jobs you've done often, but as a guide for those once-in-a-blue-moon jobs. You see, it's easy to get yourself down into a rabbit hole, only to figure out you did more work than needed. Then there are the details on special tools: We know of shops that make some of their tools if the official one is too pricey, but until you see what it looks like and how it is used, you might be tempted to do things the hard (and maybe expensive) way.

Mercedes-Benz USA tells us that many shops who receive this magazine are also STAR TekInfo subscribers, and that's good. The rest of you might consider what you're missing, and try a month's subscription to see if it's really worth it. Our purpose today isn't to sell more subscriptions, but to convince you that it is in your own and your customers' best interest to do it right each and every time – not to mention that liability stuff. These are MBUSA's customers too, by the way, so it is to everyone's benefit that customers feel a Mercedes-Benz is simply the best car in the world.

Before we get started on how to find information in WIS, it is important to know that this system is developed for use in all the world, so it needs to (and does) support many languages. For our English-speaking readers, there are suggested language settings that offer the greatest effectiveness for document search results. You can also find this on the STAR TekInfo site (search "language settings"), but it is important enough to repeat here.

On the options menu at the top of WIS, click Setup (or press F2) and pick the Language tab. There, set the User Interface to whatever language you are most comfortable with, and the Document Language priority to "US English" (priority 1), "English" and "English" for the three settings. Ensure that the checkbox for "Conduct document search with priority 1 only" is not checked, and click "OK". This will ensure you get the most relevant documents when you search for USA models.

If you wish to select a different priority language, note that you'll be seeing information that applies mostly to vehicles sold in the countries or markets where that language is prevalent. In many cases the information is the same, but be aware that sometimes it's not.

The first step with any document search is to **start with the VIN**. This not only filters out much of the irrelevant information, you also get to see a copy of the vehicle data card, which contains all the option codes and serial numbers you might need to decide which document applies. In cases where you don't have a VIN (maybe you are just looking for more general information), the chassis and model (such as 212.056) will at least allow you to start the search process. If you don't know the specific model number, at least start with the chassis type and use the drop-down menu to find your specific model.

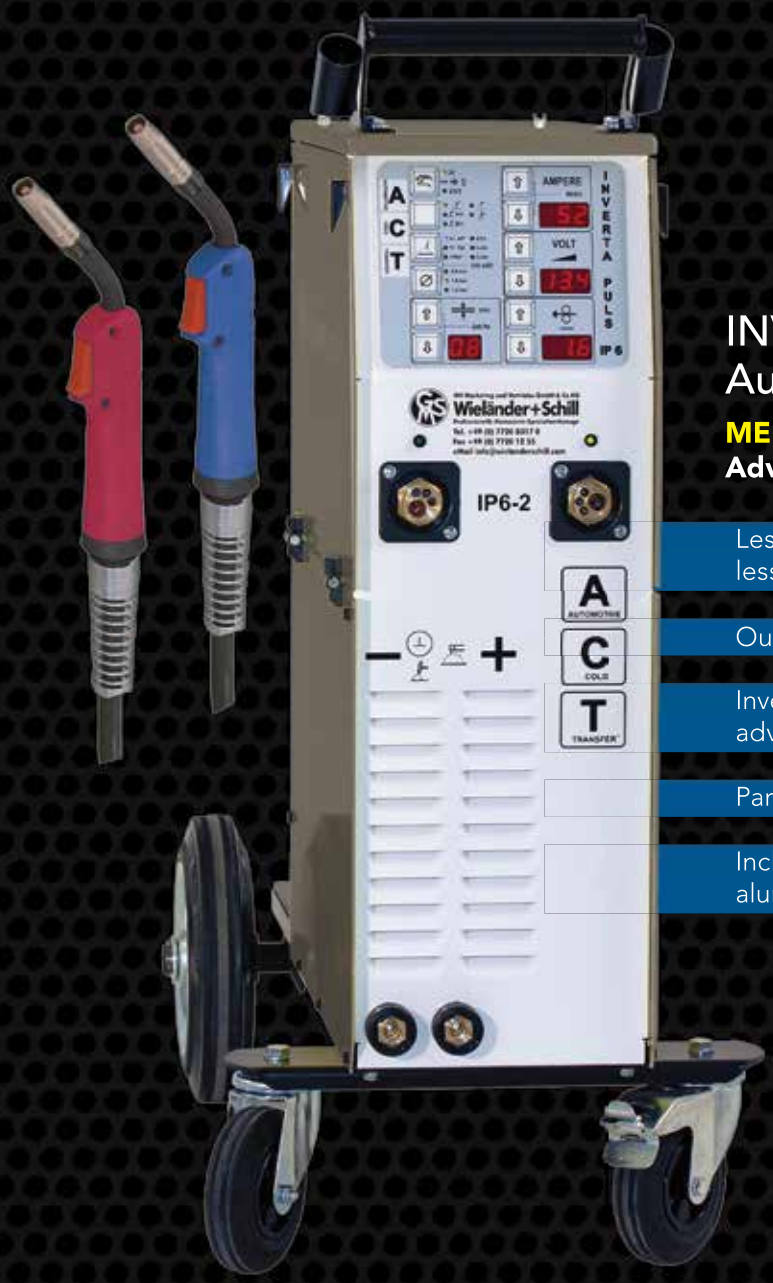
The second step is to **pick the service group(s)**. Long-time Mercedes technicians know the group system by heart, but if you're not quite there yet, you can use the menu in WIS to figure out what is where. You can also download a nice group system guide from STAR TekInfo (www.startekinfo.com) without having to log in: Just select MB Workshop Resources and then Group System Guide. There's even a version for your mobile device.

The third step is to **pick the document type(s)**. There are several document types available, but in many cases you don't need to see them all. In our shop, we usually pick only the "Repair" category for most jobs, selecting the others only

Be sure the language settings in WIS are set as you see here. This ensures your searches find the appropriate documents for our market, since the vehicles (and therefore information) for other markets are not always the same.

You can download a handy group system guide from startekinfo.com even if you're not logged in. Just look for the Group Guide link under Workshop Resources. Knowing the group system is key to working with Mercedes-Benz literature.

RAE
RELIABLE AUTOMOTIVE EQUIPMENT, INC.



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as needed. Even with everything checked, it'll only take you a few seconds to scan all the documents found and pick the one you're looking for. Click "Start Search" to bring up a list of matching documents.

Sometimes you end up with two or more documents on your list that seem to apply. In cases like that, you need to pay attention to the "Validities," or the details of which specific vehicles the document is meant for. To get a quick scan of a document's application, just hover over it with the mouse and look in the info area below. If what you need to see isn't visible (because those info area windows are not very large), you can also right-click a document to bring up the full Validity window.

Okay, so you've picked a document: Double-click it to open, then either "tear off" the page (click the icon or press F12) or "maximize" it (again, either click the Icon or press F9). We prefer the F9 trick in our shop.

There are a couple of good tricks we use in WIS, so try a few and see if they're helpful for you, too. The first one is the Bookmark system, really helpful in a busy shop with only one computer signed in to WIS. What a bookmark does is just save your document on a list, making it easier to find it again. Now, you can't let the list get too big, otherwise it gets hard to find things, but from one user to the next it helps avoid having to enter the VIN, group and doc type all over again because a co-worker needs to look up something else. Then, at the end of the job, you just delete the bookmark to keep the list clean.

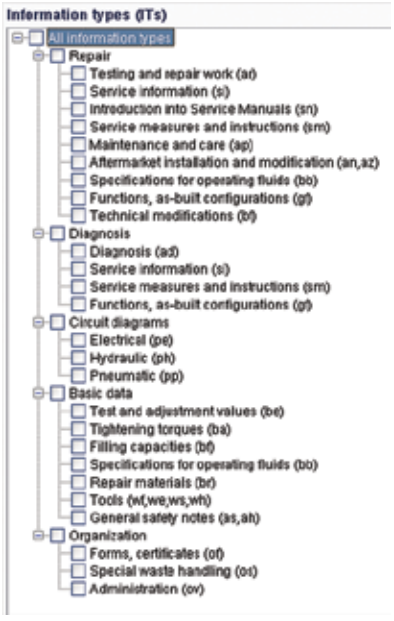
Another trick is the online help system: If there is anything you don't quite understand about using WIS, the answer is in the help system. You can get there any time by pressing F1, or clicking on the book-with-question-mark symbol at upper right. Help is context-sensitive; it knows what you were looking at and starts with the help document on that topic.

As we mentioned, WIS is built for an international audience, so they use a lot of symbols. And, true to their efficient Swabian heritage, the Stuttgarters (Stuttgart is the headquarters city of Mercedes-Benz in Germany) don't waste words when a symbol will do. Of course, it is assumed that you know what the symbol means – you'd better, because it might be important. (In case you didn't know: Stuttgart is in the middle of Swabia, and Swabians are known for being somewhat frugal).

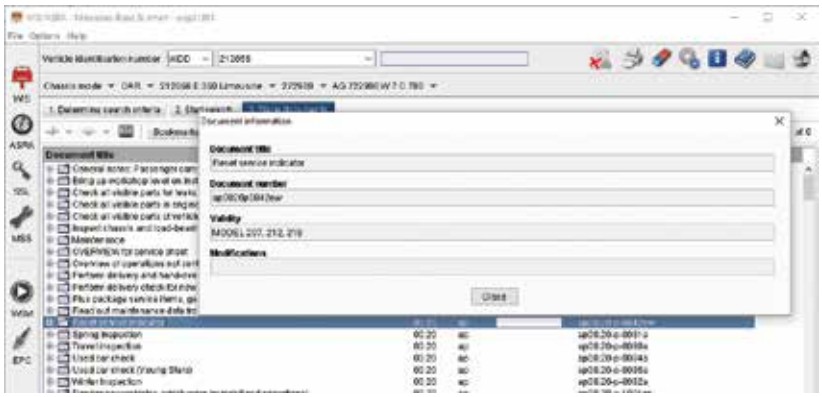
The last trick is the left menu bar, with its links to all kinds of good information:

WIS Service Media (WSM), which is a wonderful resource for videos explaining various jobs, and books and guides with detailed information on various systems. Watching a short video on a job you're about to do really helps show the steps involved and any of the possible pitfalls you might encounter. The link to change the language is at the upper right and looks like a globe.

Electronic Parts Catalog (EPC), which lists all the parts for every model since around 1946. Also handy for seeing how things fit together, and engine belt routing diagrams. As with WIS, start with a VIN (even more important in EPC), pick the group (which can differ from



This shows the Information Types menu. Most common are the AR (repair) and AP (maintenance) instructions, but GF (function) documents and PE (wiring diagrams) are particularly valuable for diagnosis in conjunction with XENTRY. You can narrow your search by limiting the Information Types to only what you need at the moment.



This is the Validities window, which can be opened by right-clicking a document. In cases where more than one document seems to apply, this is how you can tell them apart.

those in WIS), then pick the part you need from the image (understanding the image is generic and might differ a little from the actual part).

ASRA and SSL are for dealers only, showing the warranty times allowable for each job and the damage code needed for a warranty claim. And MSS isn't used in the USA: Instead maintenance sheets are posted to STAR TekInfo.

Suppose you just can't find a document you'd seen, or at least think must be in there. In cases like this, we use the many Search features.

Standard search mode is what we've already seen, but you can use the Keyword list to help find the relevant group. We'll admit there are lot of keywords in that list, but our experience shows that this is not really all that useful, particularly because we know the group system so well. But it has come in handy on occasion.

Full-text search, on the other hand, has shown to be really helpful. Just like the name says, it searches the full text of all documents to find what you are looking for. There are two minor disadvantages to using the full-text search: First, it takes some time to search (but just a minute or two usually), and, second, you need to know what word(s) the document authors used. So, if you use the search term "Rear Pumpkin" to find the rear axle middle piece (which we call a differential) you might be searching for a while. This does get easier and better with just a few months' experience, though, as you see what names the engineers use for the various components.

An option for the full-text search is the Advanced search, which lets you decide how multiple words are used: any of the words, all of the words, an exact phrase, and/or none of the words. You can use all four of these fields at the same time to really narrow things down.

The menu bar at the left edge has links to a few other valuable applications, like the WIS Service Media and the Electronic Parts Catalog. See the text for details.

If full-text seems like overkill, you can also search only the document title. This is a lot faster than the full-text search, but of course, you need to know at least part of the name of the document. A window just like the advanced search for full-text search appears

Bill Mohrmann
A Parts Guy's Parts Guy

The parts professionals at your local dealership are specially trained to give you the best service possible, and are supported by Regional Wholesale Parts Sales Managers. The northeast United States region is serviced by Bill Mohrmann who, by all accounts, is a parts guy's parts guy, supporting some 85 Mercedes-Benz dealerships in the northeast U.S.


Bill Mohrmann

How would you describe the ideal parts support person? Well, you'd certainly want a "car guy or girl" who speaks the language and understands vehicular technology. You'd want an industry person who understands the needs of the aftermarket. And you'd want a shrewd businessperson who appreciates the need for near-instantaneous availability of quality replacement parts at competitive pricing.

That would describe Bill Mohrmann.

Bill comes from a background that includes after-sales positions with other European and Asian auto makers as well as an aftermarket supplier of parts for various European marques. Most importantly, he has spent the last 20+ years in various wholesale parts positions with Mercedes-Benz.

During his more than two decades with the company he has touched on virtually all the disciplines you would associate with a highly-qualified wholesale parts specialist – distribution, marketing, pricing, training, technical support, customer relations, parts ordering, inventory control, and more.

Savvy shop owners know that, in order to stay current, productive, and profitable, learning can never stop. That's why Bill is a champion of making technical service information available to wholesale parts customers. He encourages shops to take advantage of MBUSA's technical library available to shops on a subscription basis, as well as publications like the one you're reading right now – StarTuned.

Bill strongly supports MBUSA's partnership with OEConnection and their CollisionLink and RepairLink ordering platforms, where shops can enjoy spot discounts that match, or come close to matching, the pricing of aftermarket parts, and without sacrificing quality. Many of the Mercedes-Benz dealerships in the northeast participate in these two platforms.

All in all, isn't Bill the kind of guy you want looking out for your parts purchases?

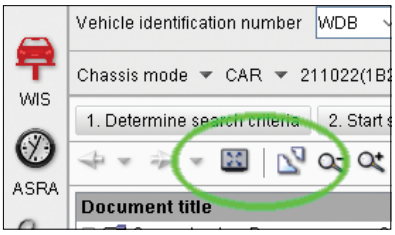
We certainly think so... |

(with the choices of any, all, exact, and none), but remember you are looking only in the document titles, so it goes a lot faster.

Then there is the Additional Search, allowing searches by seldom-used things like option (SA) code, ASRA operation number, and "Top News." In the interest of time, we won't explain all these here, but urge you to play with them so you can see what they do.

One really handy feature is the direct document number entry. Each document has a unique number, such as AR20.10-P-2455GZA, which happens to be "Test coolant thermostat" for engine 272 and 273. In this example, the AR is the document type, 20.10 is the group and sub-group number, P is for the authoring unit (Passenger Cars in this case; you may also see U for USA-developed documents, as well as other letters on occasion), the specific document number (2455), and the applicability code (GZA, which will be found at the end of many other documents applying to M272/M273).

What this all means is that if you know the document number, perhaps from a service bulletin or other document, just type (or paste) it in. No need for uppercase letters or punctuation – it'll find it regardless. Try it by typing in "ar2010p2455gza" (without the quotes). We use this a lot.



To hide the document results window and maximize the document itself, use the 'maximize' button (circled, at left) or the tear-off button (at right). You can also press the F9 or F12 button instead of clicking the icon to get the same result.

When you are in a document, you will almost always find links to other relevant documents. Red links lead to another document, while blue links are at a different spot in the same document. Grey links lead to documents that don't apply to the specified VIN.

At times it can get frustrating to follow the links down what seems like a tunnel maze of documents, sometimes leading you in circles, particularly on complex jobs. The trick we've found is to remain focused on the original, main document and just go down those links with a purpose. The navigation arrows in WIS will always lead you back up to the last document you saw, eventually back to the main document. Sometimes we'll print out the main document so we can remember where we are in the process as we follow a string of links to find some tidbit of information.

When you're in a document, pay attention to all the details of each step. Again, the Swabians don't waste words. You might be sent to the instructions to remove & reinstall the center console when all you need to do is loosen the ashtray, but they'll tell you that first if you take a look.

If you use the full-text search options carefully, you can produce a search as narrow or broad as you like. Although the full-text search is a powerful tool, it can take a minute or two to complete.

When you get down to it, WIS isn't all that difficult to use. Sure, you might get a little lost following document links, but you can always get back. We've even resorted to pressing F9 to bring back the document search window to re-open the original document on occasion. But after a few month's daily use, most of the regular jobs were easy to find, and the really odd jobs only took maybe a minute to hunt down.

The real value is in the information it contains, which is kept up-to-date every month. In fact, the WIS version you use online is the exact same one used by dealers worldwide, running on massive servers at Daimler's European Data Center, so you can be certain that it gets updated the minute the next update is released. Indeed, in almost any search, you can see the little icon indicating a new or updated document, proof positive that you can't get better information about Mercedes-Benz from anyone but Mercedes-Benz.

Every document in WIS has a unique number. While you can probably guess at the meaning of most of it, only the "2455" is assigned essentially at random.

Why you need XENTRY

Want to know why you need the sophisticated XENTRY diagnostic and service package from Mercedes-Benz?

Here's the short answer: So you can perform virtually every diagnostic, service, and programming task that a dealership can perform.

OK, here's the longer answer...

XENTRY is the comprehensive hardware and software package created by Mercedes-Benz specifically for independent repair shops that service a large number of Mercedes-Benz vehicles. It allows service providers to perform nearly every diagnostic and flashing procedure that can be performed by dealership service departments. The only tasks reserved for dealerships are the programming of keys and similar proprietary security-related services.

The XENTRY package incorporates the three steps needed in service Mercedes-Benz vehicles – vehicle identification, diagnostics, and programming/reprogramming/software updates. XENTRY covers the vehicles you're most likely to see in your service bays, essentially all Mercedes-Benz vehicles from the 2008 model year to present, plus many of the systems found in vehicles dating back to the mid-1990s.

Complete service information, data, diagnostic, service/repair, and reprogramming information is provided on vehicle mechanical systems, including gasoline and diesel engines, transmissions (including electronic selector modules), and all traction, braking, stability control, and active body control suspension systems, including ESP, ASR, ETS, ABS, BAS, and SBC.

Also covered are all of the electronics and vehicle safety and convenience systems. They include the instrument cluster, Parktronic, Keyless Go, tire pressure control, drive authorization system, signal acquisition modules (SAM), and the electronic ignition system (EIS). In addition, XENTRY provides diagnostic and repair information on all of the various body control modules used over the years, including ACP, UCP, LCP, SCM, SKF, KFB, RCM, and DCM.

Obviously the first step in preparation for diagnosing, repairing, or updating software is to properly and precisely identify the vehicle you're working on. XENTRY quickly and accurately helps you identify the vehicle's VIN and build model number, and with that information you can access, and record, all of the specifics of the vehicle.

Once you've properly identified the vehicle you're working on, including details on specific systems, XENTRY will provide you with all the same diagnostic procedures that are available to dealership technicians. XENTRY will also provide data points that you can record and save, or print out for future reference.

Once you've identified and corrected the issues that you and XENTRY have identified, you can use XENTRY to perform post-repair quality control checks to confirm that the repair you've effected has been successful in correcting the known fault.

With XENTRY you can re-program existing components, including installing updated software as it becomes available. You can also program new components following replacement.

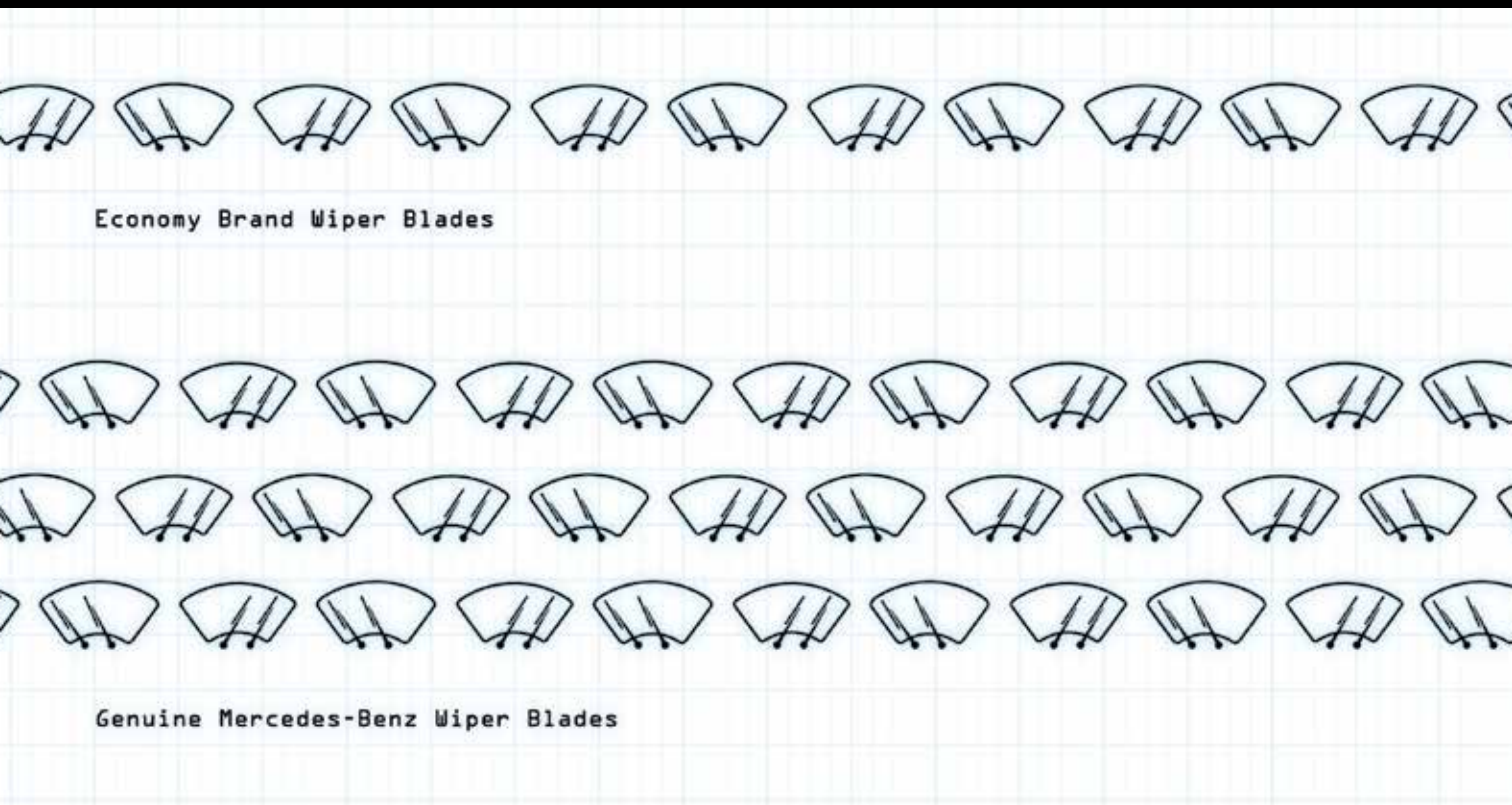
The newest-generation XENTRY system includes all the features you need to thoroughly diagnose and repair Mercedes-Benz vehicles. Those features include the Diagnostic Assistance System (commonly referred to as DAS), the Workshop Information System (WIS), Electronic Parts Cataloging (EPC), STARUTILITIES (incorporating movement management system and self-test), and the clever and innovative Benz Disassembly System that uses video lessons to show precisely how to remove individual components.

XENTRY only requires the operator to log on once and enter the vehicle's VIN just once. Then the technician can switch easily among multiple applications, confident that XENTRY will "share" data, including changes in settings, among the various applications running.

The Guided Fault Finding feature in XENTRY is surely the most comprehensive approach to diagnostics and repairs. However XENTRY also offers a useful and informative Quick Test that can be run first.

XENTRY can be licensed, and the fee includes up to five software updates in a year's time. After that, operators can renew software updating on a daily or annual basis. Purchase agreements are available on-line at www.StarTekInfo.com.

PartsPro



Some think all wiper blades are the same. This will make it clear.

Genuine Mercedes-Benz Wiper Blades can provide up to 800,000 more wiping cycles than ordinary blades*. Not to mention that every blade has a precise curvature unique to each model, and most have a maintenance indicator on the tip that shows when replacement is necessary. A clear advantage – at a competitive price. This is why you should choose Genuine Mercedes-Benz Wiper Blades. **Contact an authorized Mercedes-Benz dealer or learn more at www.mbwholesaleparts.com.**

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*As compared to economy wiper blades using durability test #PN 103713, which tests wiper durability through 1.5 million wiping cycles.

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