

# STARTUNED®

Information for the Independent Mercedes-Benz Service Professional

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**BATTERY &  
CHARGING SYSTEM**

**NEW BLUE ANTI-FREEZE**

**THE BUS STOPS HERE**

**WIS  
FOR COLLISION REPAIR**



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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.

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: STARTUNED

One Mercedes Drive

Montvale, New Jersey 07645

Phone: 1 201.263.7284

E-mail: [Stefanie.A.Schweigler@mbusa.com](mailto:Stefanie.A.Schweigler@mbusa.com)

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### Group Publisher

Christopher M. Ayers, Jr.  
[cayers@automotivedatamedia.com](mailto:cayers@automotivedatamedia.com)

### Editorial Director

Bob Freudenberger  
[bfreud@automotivedatamedia.com](mailto:bfreud@automotivedatamedia.com)

### Contributing Editors

Bob Chabot  
[bchabot@automotivedatamedia.com](mailto:bchabot@automotivedatamedia.com)

Michael Klaas  
[mklaas@automotivedatamedia.com](mailto:mklaas@automotivedatamedia.com)

Tom Nash  
[tnash@automotivedatamedia.com](mailto:tnash@automotivedatamedia.com)

Frank Walker  
[fwalker@automotivedatamedia.com](mailto:fwalker@automotivedatamedia.com)

### Technical Advisor

Tim Amun

### MBUSA Technical Content Advisor

Donald Rotolo  
[Donald.Rotolo@mbusa.com](mailto:Donald.Rotolo@mbusa.com)

### MBUSA Project Manager

Stefanie Schweigler  
[stefanie.a.schweigler@mbusa.com](mailto:stefanie.a.schweigler@mbusa.com)

### Art Director & Circulation Mgr.

Christopher M. Ayers III  
[ayersc3@automotivedatamedia.com](mailto:ayersc3@automotivedatamedia.com)

Visit us at our web site

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## IN THIS ISSUE

### 4 FIRST THINGS FIRST: BASELINE THAT BATTERY AND CHARGING SYSTEM

Much of your electrical and electronic testing will be meaningless if you don't.

### 12 THE BUS STOPS HERE

Why CAN systems were adopted, High and Low, what a scan tool or scope can tell you, differentiating a bad module from a poor connection, and proper wiring/connector repairs.

### 22 WHY YOU SHOULD USE MERCEDES-BENZ'S NEW BLUE ANTI-FREEZE

There are many different antifreeze formulations out there in the wild and wooly real world, but for the Mercedes-Benz service specialist who cares about his customers there's only one real choice.

### 30 USING THE MERCEDES-BENZ WORKSHOP INFORMATION SYSTEM (WIS) IN COLLISION REPAIR

If collision repair of old was concerned with appearance, it is today far more about critical safety and reliability requirements. There is a vast amount of information available in WIS to help you straighten or replace, weld, bond, rivet, or otherwise fasten components back together in a manner that meets critical strength, durability, and safety requirements.

# First Things First: Baseline that Battery and Charging System



*Much of your electrical and electronic testing will be meaningless if you don't.*



It was many years ago when we first heard a veteran automotive service technician use the term “baselining” in regard to diagnosis. He was referring to the eminently sensible practice of making sure all the basics of vehicular motivation are in satisfactory operating condition before embarking on high-tech troubleshooting of a driveability or emissions problem. That meant giving everything involved a quick visual exam for obvious stuff like broken or disconnected wires, a loose or contaminated belt, leaky vacuum lines, a perforated duct downstream of the MAF, battery cable and clamp issues, etc. To take this further, you might pull the plugs for a compression test, or at least see what your vacuum and fuel pressure gauges tell you, then put your DMM across the battery to look for 12V+ with the engine off, and maybe 14V with it running. A few voltage-drop tests of the starting and charging systems wouldn't hurt, either.

Today, lots techs would disagree with all this traditional preparation, preferring instead to plug in a scan tool as a speedy first step. We see the point in this hurried modern world, but ignoring electrical baselining can send you off in a false troubleshooting direction, thus costing you way more time than a few simple tests would've taken.

### **BATTCHEM**

The prime mover of any automobile is, of course, the battery. Alas, most of us haven't retained our high-school chemistry, so perhaps a recap of lead-acid battery operation is in order, to which we'll add news on recent developments. The basic principle is that if two dissimilar metals are placed in an electrolyte that can attack them, voltage potential is created. Electrons will flow if a connection is made between the metals, and that's what electricity is.

In a wet cell, the metals are sponge lead (Pb) and lead peroxide (PbO<sub>2</sub>), and the electrolyte is dilute sulfuric acid (H<sub>2</sub>SO<sub>4</sub>). The reaction begins as sulfate (SO<sub>4</sub>) breaks away from the acid and unites with the lead of both the positive and negative plates to form lead sulfate (PbSO<sub>4</sub>). The oxygen (O<sub>2</sub>) is thereby liberated from the lead peroxide and joins with the hydrogen (H<sub>2</sub>) what's left over after the sulfate left the acid) to

produce ordinary water (H<sub>2</sub>O), which dilutes the electrolyte. Eventually, both the plates turn into lead sulfate, the electrolyte becomes very weak, and current stops flowing.

But reversibility is the wet cell's most important characteristic. When an outside power source pushes electrons through the cell in the opposite direction to that of discharge, sulfate separates from both plates to rejoin the hydrogen in the water, forming a new batch of sulfuric acid. The oxygen goes back to the positive plate to recreate lead peroxide, and the electrical potential is restored. If charging continues after all the sulfate has gone into the electrolyte, the water starts to decompose, releasing free hydrogen and oxygen, an explosive couple.

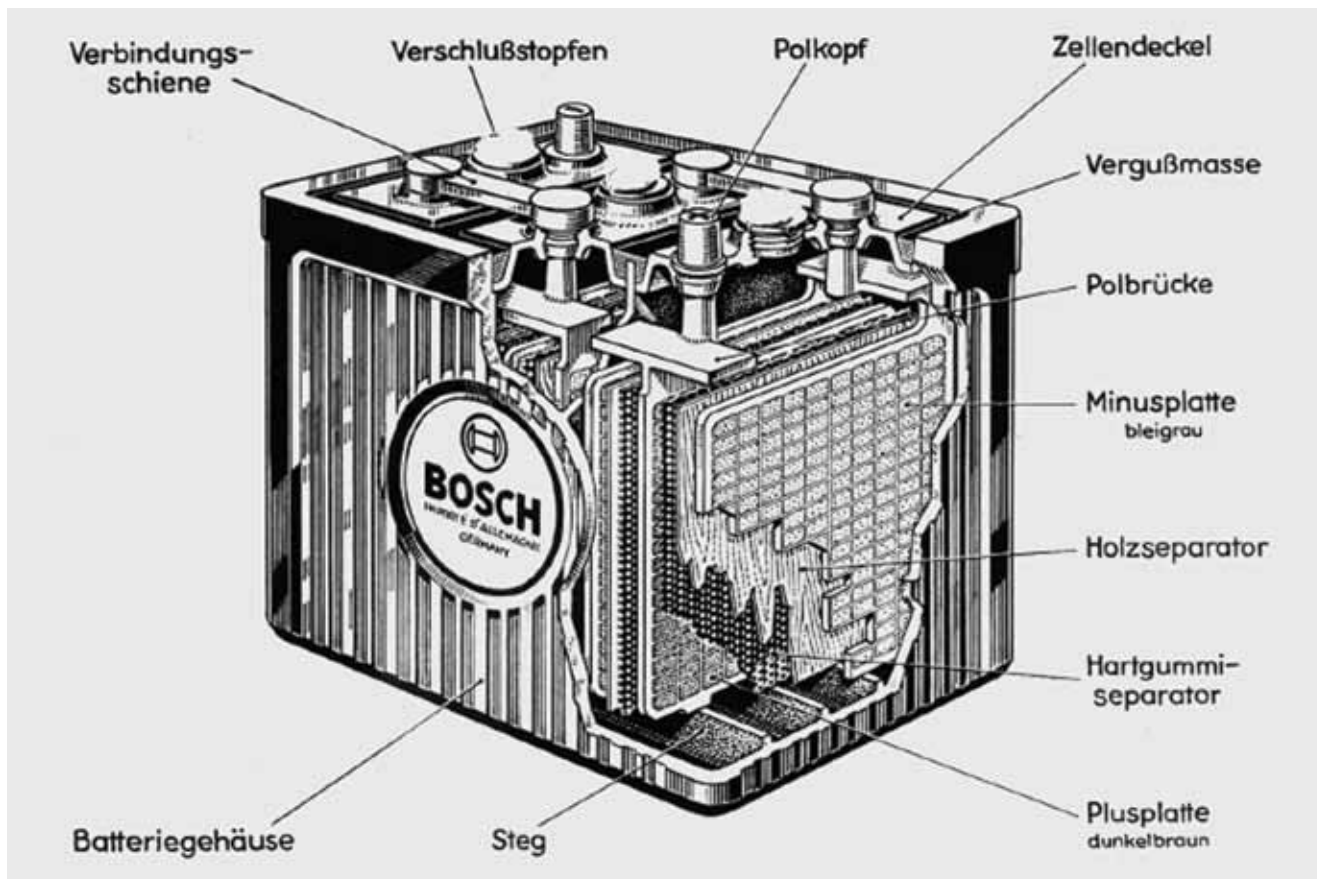
The traditional automotive battery has plates made of a combination of lead and antimony impregnated with the metals involved in the reaction. Numerous plates of each metal are interlaced within one cell, but whether two or a

dozen are used each cell produces a "pressure" of 2.1V. Six cells are connected in series to give the 12.6V almost all cars have needed since the 1950s.

Most modern Mercedes-Benz vehicles use an Absorbed Glass Mat (AGM) battery. The glass "fleece" absorbs the sulfuric acid while still allowing it to circulate for the chemical activity necessary. The advantages of AGM are increased service life, ability to withstand a deep discharge, and they won't spill sulfuric acid on the



*Except on the latest models with the "energy management" charging system, if you're seeing a reading this low across the battery with the engine running, you've found trouble.*



*Batteries have evolved a great deal since this old German specimen from Robert Bosch was state-of-the-art. Note that the plate separators are made of balsa wood.*

passengers in the event of a rollover. Since modern designs have moved the battery into the trunk and even the cabin, it has become critical to replace the battery with the proper non-spillable type.

## **No More Than 20**

By their nature, AGMs are susceptible to damage by overcharging. So, a 20A max automatic charger that carries Part Number 110-9420 is available from your local Mercedes-Benz dealer.

AGM or not, the diagnosis of batteries has evolved beyond hydrometers and traditional VATs. Mercedes-Benz recommends the use of the Midtronics 165-EXP-717 no-load battery tester, which gives you a definitive answer almost instantly, and is available from your local M-B dealer's parts department. You can still use your old VAT, but since it's hard to get a sample from an AGM for hydrometer testing, it's hard to feel confident in your findings.

Whenever your testing says the battery is beyond help, a Genuine Mercedes-Benz replacement is the best choice. Not only will it have been manufactured by companies such as Varta, which has been in business for over a century, but the warrantee is unimpeachable, and there will be no problem with installation.

*Mercedes-Benz has approved this sophisticated battery tester from Midtronics, which produces accurate results in no time and without applying a potentially-damaging load.*



## **CHARGE!**

A modern charging system is composed of an alternating current generator with a rotor comprising an electromagnetic coil wrapped around an iron core and enclosed in two six claw pole pieces. It receives regulated voltage through a pair of brushes that bear on slip rings, and this causes it to produce a magnetic field. An engine driven belt spins the rotor inside the stator (three coils wrapped on a ring), and this is where the current is induced.

But this set up produces AC, and automobiles need DC. So, the current must be rectified (that is, converted from AC to DC), and this is accomplished by six diodes, a negative and a positive for each stator coil, and three exciter diodes that supply the field with current once the engine is running. When the ignition is first switched on, field current comes from the battery through the charge indicator lamp.

Symptoms of charging system illness include a low or dead battery, or one that's cooked from overcharging, alternator noise, dim bulbs, and a charge indicator light that shines at the wrong time. Whenever you encounter a vehicle that exhibits any such failing, it only makes sense to check the simplest things first.

The belt, for instance. Suspect slippage if the trouble only occurs when it's raining, or at high speeds. Pop the hood and give the belt a yank and a look.



*That doesn't mean there's no place for your traditional VAT. The carbon-pile load can still give you useful information.*

Next, check for corroded battery terminals, broken wires, and big time shorts (we've seen several alternators in a row burn out on the same car because a missing grommet or a gap in insulation made them work themselves to death).

If you suspect that a short circuit or other draw is draining the battery, testing is not as simple as it was in the old days before CAN. Back then, you could just make sure all the accessories were off, including the courtesy lights, remove the negative cable from the battery, and connect a test light between the battery post and the cable clamp. If the light glowed, you'd remove fuses until it went out, which effectively isolated the leaky or hungry circuit.

Today, of course, there are different things to consider. First, never disconnect a battery unless you've got the radio security code handy. Second, it's best to use your DMM (Digital Multi-Meter) switched to mA to quantify the drain (it would have to be pretty bad to blow the meter's fuse). Connect the DMM before removing the clamp from the post so that the system is never completely deprived of voltage. A parasitic draw of 10 to 50 mA is generally considered the normal amount needed to maintain the electronic memories.

Then there are the CANs (Controller Area Networks) to keep in mind. When the ignition

key is switched off, either the EIS (Electronic Ignition Switch) or the CGM (Central Gateway Module) senses this and sends out signals to put the control modules on the CANs into a "sleep" or power-down mode. This can take a matter of minutes, so if you were to measure draw immediately after turning off the key, you'd see way more than the "normal" reading, and perhaps be thrown onto a fallacious diagnostic path, hunting for problems that don't really exist.

Remember, the traditional procedure of unplugging fuses to locate the draw may be augmented by unplugging control units from the CAN for the same purpose.

By the way, when the control units go to sleep, the CAN voltages change. CAN H drops to .025V and CAN L increases to 11V. The voltage may seem high, but the current draw is very low.

### WHERE DID THE PRESSURE GO?

The concept behind voltage drop testing is somewhat subtle, so lots of people don't really understand it. Any load in a circuit, whether intentional (an accessory) or unintentional (a bad connection), will use up voltage, and a measurement taken across that load reflects the amount. Where you can get confused is that you're in parallel along some segment of a circuit, and since you're used to looking for voltage between the feed side and ground, it seems sort of strange



*A genuine OEM replacement battery, such as this one from one of the oldest and most respected battery manufacturers in the world, will last far longer than what you'd get elsewhere. Note the Mercedes-Benz cable clamps, which are much more robust than those from other car makers.*



*A modern AC generator/alternator should last a long, long time, but typical failures are blown diodes and worn-out brushes.*





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that there'd be a reading in parallel. The thing to learn is that the load absorbs some voltage, so there'll be a difference between what's available on one side and the other. What you're reading is that difference.

Although resistance is stated in ohms, for most automotive work the best way to test for high resistance is with voltage, specifically "voltage drop." This is measured "across" each component, with the positive lead of your voltmeter on one connection of the component or length of wire, and the negative lead on the other. Make sure the negative lead is on the side that goes to ground. As we said, any load in a circuit, good (an accessory or wiring), or bad (poor connection), absorbs voltage. The measurement is the amount of voltage absorbed.

This also bears repeating: Where you can get confused is that your meter connections are in parallel to what you are measuring. Current is flowing through the component and through your meter at the same time. A high voltage drop reading means whatever you are measuring is absorbing a lot of voltage, leaving little for the rest of the circuit.

Switches, wiring, and other connections should have very little voltage drop because they're not supposed to absorb any voltage to speak of. If the reading is high, there's too much resistance. Devices, such as a light bulb, blower motor, etc., should absorb voltage. If there is only one device in a 12V circuit, the device should absorb all 12V, except for the small amount that may be lost in the wiring. If there are two devices, both the same size, each will absorb six volts.

A common question at this point is, "Why not simply switch my meter to ohms and measure resistance directly?" The best way to answer that is with a simple example of static vs. dynamic states. Suppose you have a #6 multi-strand wire between the battery negative post and a ground on the engine block, and the connections are perfectly clean. If you open the insulation and snip all but one tiny strand, then measure ohms, you'll see no resistance -- that single strand of copper will pass plenty of current to get the meter to read.

But what happens when you engage the dynamic state by trying to crank the engine? Well, there's no way that little electrical path will be able to pass hundreds of amps, and it'll burn itself open resulting in infinite resistance. It's no-load vs. load, what happens when a circuit is asked to actually operate. And the same applies even to small wires and connections.

## **DMM AND DSO**

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So, voltage drop testing is the only real-world way of looking for excessive resistance. As far as the equipment needed, the basic requirement is obviously the ability to measure small amounts of voltage. Before the advent of digital electronic devices, a low-reading analog voltmeter was all we had. Now, of course, the DMM is required. Its high input impedance (typically 10 megohms) protects fragile computer circuits and eliminates noise. Also, many versions with what's variously called the data record, dynamic recording or minimum-maximum feature will capture intermittent readings and rapidly changing values, and a change alert or alarm will chirp when wiggling wires alters the resistance.

A graphing multi-meter represents the next level, but there's something even better: a lab scope, also known as a DSO (Digital Storage Oscilloscope). You could call it a visual voltmeter, and it can be enlisted anywhere you would normally use a DMM. It allows you to see the invisible by displaying electrical phenomena as waveforms, and a fast sampling rate insures that you'll catch noise or glitches.

Once you understand the theory, the actual hands-on voltage drop test procedure is pretty easy. With a DMM, switch to the low volts or millivolts setting, and engage whatever data recording feature is present. Generally, you'll hook it up so the positive meter lead is attached to the part of the circuit nearest the battery plus terminal and the negative lead closest to the minus post (for engine-running tests you might clip the negative lead to the back of the alternator).

## **RIPPLE**

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Too much ripple in an alternator's output can cause electronic modules to misbehave, along with all sorts

of other “ghost” problems. Modules may reset, self-trigger, or misinterpret sensor readings when they’re not supplied with good, clean power, or are getting excessive EMI (electromagnetic interference).

Ripple voltage is the leakage of AC into the electrical system due to a faulty diode, winding, etc. While nobody worried too much about this in the past, the advent of computerized management made it important. After all, modern electronics need straight, pure DC or they’ll become unhinged and probably drive you crazy when you try to figure out what’s wrong.

There are several ways to ascertain the amount of ripple present. Modern VATs include a ripple measurement feature. Or, you can use your DMM (Digital Multi-Meter) across the battery terminals, and simply switch to the AC volts function.

### KEEP IN MIND . . .

Integrating the following points into your understanding will help you succeed in troubleshooting:

- As you’ll realize if you think about it for a minute, the rear half of the alternator case is really the central ground on any car when the engine’s running. For testing safety, just be sure to watch your hands and avoid those spinning cooling blades when you clip on your negative lead.



*Ripple is AC in the DC, and it can cause modules to misbehave, among other things. Modern VATs detect it instantly.*

- For a century or so, the rule of thumb for the max limit of V-drop across any connection was .2V (or, 200 mV), but that’s not good enough anymore. Today, there shouldn’t be more than half that per individual wire, ground, connection, or switch (add them up for the maximum allowable in a particular circuit). Or, you could use the following upper limits: 200mV for a stretch of wire or cable, 300mV for a switch, 100mV for a ground, and 50mV for a sensor connection.
- The last ditch procedure of jumping a fuse with a wire (or, in the old days of ceramic fuses, a sawed-off bolt) to find a short has burned lots of cars to the ground. Use a relay type short finder.
- Wires shouldn’t get hot. You’ve got a problem.
- Ampacity is the safe carrying capacity of a wire in amperes. Doubling the amperes without increasing the wire diameter increases heat four times. The potential energy that each electron loses by traveling through the voltage drop is left in the conductor in the form of heat.
- The thicker the wire, the smaller its gauge number.
- Multi strand wire can carry more current for the same diameter than solid, single strand wire. It’s also much better at surviving the stress of flexing.
- Although it may seem like a good idea, don’t use ordinary RTV silicone to coat or insulate splices. The acetic acid solvent eats copper wire.
- A typical DMM measures resistance by passing a known current through the circuit or component, gauging the voltage drop, then calculating the ohms present using Ohm’s Law: ohms equal volts divided by amperes.
- In the real estate business, there’s an old saying about the three most important things that determine the value of a property: location, location, location. In automotive diagnosis, we’ve come to the conclusion that a similar statement should be etched in the mind of everybody who works on cars. What’s crucial here are basics, basics, basics. Taking it one step further into electrical troubleshooting, and you could phrase it grounds, grounds, grounds. |

# The Bus Stops Here

*Why CAN systems were adopted, High and Low, what a scan tool or scope can tell you, differentiating a bad module from a poor connection, and proper wiring/connector repairs*





All of us by now have probably experienced the frustration of having to diagnose an elusive Controller Area Network (CAN) system problem. This experience can often make technicians examine their motives for staying in this ever-changing industry. If, however, you have a firm understanding of the CAN concept and follow some logical steps whenever you are presented with these issues, they can become a very satisfying part of your career.

The reason why every automobile manufacturer has adopted the technology of networking is because with so many on-board computers it would not be cost-effective or package-efficient to connect them all together with individual wires -- the harnesses would be as thick as your arm, which would not only present routing and space problems, but would also add weight. Take traction control, for example. It requires inputs from other control units (i.e., ME, ESP, ETC, IC, suspension, to name a few). Having to wire each control unit so that it gets, say, wheel speed data would be redundant when there's already a wire that has the information being sent from the wheel speed sensor to ESP. Being able to "share" this information on the CAN system with multiple control units at the same time at a high-speed data transfer rate makes the most sense.

### **HIGH AND LOW, FAST AND SLOW(ER)**

Two-wire signaling operates on two different voltages. CAN High will operate at a certain voltage and digital signals will rise, while CAN Low also operates at a certain voltage and digital signals will drop. The Engine CAN, Chassis CAN, Front End CAN, Telematics CAN, etc. all function at 500 kilobits per second, and the Interior CAN runs at 125 kb/s (83.3 kbits/s in some older models). There are also several LIN (Local Interconnect Network) buses that run at 20 kbits/s.

LIN systems are single-wire bi-directional communication data buses that are being used in more and more applications, such as wipers, climate control, and window switch operation. Their signals are very similar to those of a CAN. The only differences are that there is just one signal, and the speed is slower. LIN systems have a single master controller ECU, which is tied to a

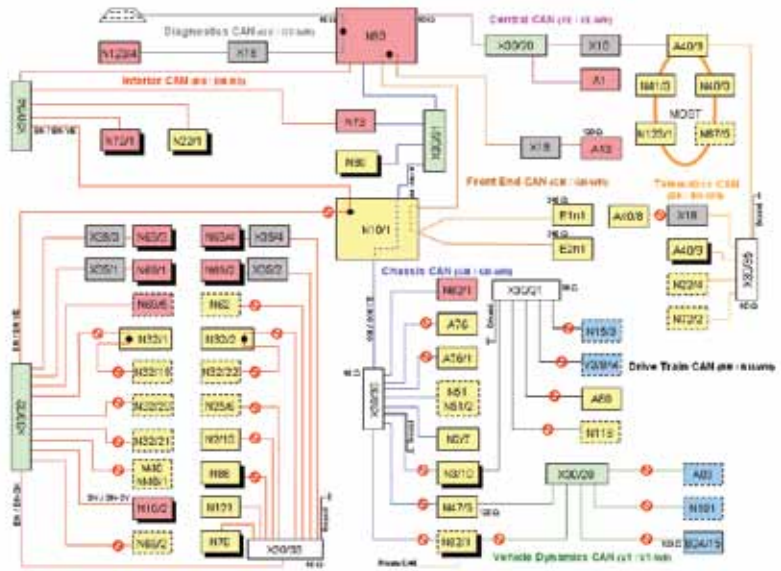
CAN and has up to 16 slave computer actuators. LIN is a low-cost alternative to low-speed CAN networking.

### MASTER OF MANY CANS

Throughout the years with its different models, Mercedes-Benz has used various CAN systems. This concept was first made practical in 1983 by Robert Bosch GmbH. Mercedes-Benz recognized its value early on, and was the first auto maker to introduce a CAN system in its vehicles. In 1991, the 140 model S-Class started this trend in inter-system communication. Today on the newest vehicles, there may be as many as eight different CAN systems -- Diagnostic CAN, Central CAN, Interior CAN, Front End CAN, Telematics CAN, Chassis CAN, Drive Train CAN, and Vehicle Dynamics CAN. The reason for adding more and more CAN systems is because the existing ones would have been overloaded and unreliable. There are limits to the amount of information that can pass through a CAN bus before the network runs out of time slots for new messages. The use of so many control modules (now typically totaling over 50) and numerous sensors all communicating on CANs drives the need for updating and “growing” the infrastructure.

With so many computers on a network, there needs to be a ‘master’ or ‘overseer’ in charge. Depending on the model, this manager is either called the Central Gateway Module (CGW), or the Electronic Ignition Switch (EIS). Researching the vehicle you are working on will be needed to verify which is present. The EIS has typically been in charge from the late 1990s to the early 2000s until the introduction of the CGW. The functions of the CGW are to hold variant coding (model series, national version), be the gateway for all CAN busses connected directly to it, control all maintenance processing, monitor specified/actual CAN configuration, and monitor CAN bus idle (the function that tracks what is keeping a bus awake).

It should be obvious that performing any CAN diagnosis on one of today’s sophisticated



520 JA 1.1 CAN Diagnosis (GibsonM, PageE, Cookson) 02-13-06

Full graphical representation of the 221-model CAN bus networks on the entire vehicle (courtesy MBUSA).



Central Gateway Module location (courtesy MBUSA).

vehicles will be expedited through the use of the factory DAS/XENTRY tool. Having the ability to communicate with the master gateway can be very helpful when troubleshooting CAN faults without hooking up directly to the bus. That said, however, 99% of the real-world problems you’ll encounter are due to what’s called “physical layer faults.” In other words, damaged wires or connectors, resistances from corrosion at connections and grounds, improper voltages, and any other “mechanical” (as opposed to internal electronic) shortcomings in the network. These



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are all things that can be observed directly through careful visual inspection and electrical measurements. As a very helpful MBUSA engineer tells StarTuned, “What we’re teaching technicians is that XENTRY is not necessarily needed -- only a meter, a wiring diagram, and a brain.”

## **VOLTS, OHMS, AND PATTERNS**

So, when attempting to troubleshoot any CAN failure, other equipment besides a factory scan tool will help. First, a Digital Multi-Meter (DMM) can be used to detect CAN operating voltages. If the reading is out of specification, you can then test to see if the CAN wires are shorted to positive, ground, or each other. Second, an oscilloscope is useful for analyzing the CAN signal pattern. A dual-trace lab scope is best to monitor both the CAN High and Low simultaneously to see whether or not the information matches, and that there are no voltage spikes, drop-offs, or abnormalities -- you should be seeing a clean on/off square-wave

pattern. Last, but not least, the tool that everyone should have to make diagnosing CAN systems easier while preventing damage to the electrical connectors is the Mercedes-Benz Electrical Test Kit Adapter Set, Part Number 220 589 00 99 00. It makes life a whole lot simpler to be able to tap into the separate networks with the exact harness adapters. With these tools, and the knowledge of how CAN works, you will be well on your way to diagnosing any type of CAN issue.

## **KNOWLEDGE IS POWER**

Knowing how the CAN system is integrated into the vehicle you’re working on is Step #1. Without this knowledge, the scope of the problem will be a mystery. The research needed will include acquiring a map of the networked CAN system, and the locations of all the CAN bus connectors and control units. As we said, having a DAS/Xentry tool available is also critical. If you do not have these ingredients, diagnosing a CAN failure can be futile.

Let’s use a CAN issue on a 2008 GL 450 as an example. You don’t know the history of the vehicle, but you do know that the vehicle came to your shop “on the hook” and won’t start. You attach your scan tool and perform a “quick test.” You determine that there is no communication with N80-Steering Column Module (SCM), N3/10-ME Control Unit (ME-SFI), Y3/8-Electro-hydraulic Control Unit (VGS), A80-Intelligent Servo Module (Direct Select), N47-5-Traction Control Unit (ESP), N51-Suspension Control Unit (Airmatic), N2/7-Restraint System Control Unit (SRS), N71-Headlamp Range Adjustment Module, and A76 and A76/1-Left and Right Emergency Tensioning Retractors (ETR).

All of these modules are on the Engine CAN. The two modules that have not been mentioned that are also on the same CAN bus are A1-Instrument Cluster (IC), and N73-Electronic Ignition Switch (EIS). These modules still have the ability to communicate because they are also tied into the interior CAN bus. The modules that you can communicate with on the Engine CAN (CGW, EIS, IC) all have communication codes pertaining to the problem. CGW has current and stored Code 9003 (“Coding of control module N93



*This Mercedes-Benz Electrical Test Kit Adapter Set is essential in not only ensuring good contact, but it also avoids the damage to the factory harness that might be caused by jamming an unsuitable object into the connectors when testing.*



Central Gateway Control Unit is faulty”). This merely indicates that specified and actual values do not match. You can verify this by looking at the specified/actual values in the Systems Diagnosis.” EIS has event codes 9008 and 9009 (“No CAN message was received from control unit A80 Intelligent Servo Module for DIRECT SELECT”). IC has current and stored code 9100 (“The instrument cluster no longer transmits over the engine CAN databus. Status ‘CAN bus OFF’”). These are all clues to what’s going on and further CAN investigation into “the big picture” needs to be performed.

## ENGINE (CAN) C

Researching the wiring schematic, you will find that all of these modules are connected to the X30/19 Passenger-side voltage distributor Engine (CAN) C connector located at the passenger-side front kick panel. Once that’s located, you can break out your handy Mercedes-Benz Electrical Test Kit Adapter Set and use the proper CAN test connectors to gain seamless access to the network. No need for paperclips, or, even harsher yet, insulation-piercing tools (which can lead to further CAN issues down the road if the holes are left exposed).

Install the Engine CAN C test connector to access the CAN High/Low resistance value. Your resistance value across the CAN High and Low should be approximately 60 ohms with the key off (CAN asleep). This value is actually acceptable

for all networks because of the terminating resistors in the modules and CAN bus connectors. Terminating resistors were added to the CAN bus to help suppress interference noise and eliminate mirror messaging (basically, to act as a filter by cleaning the communication line).

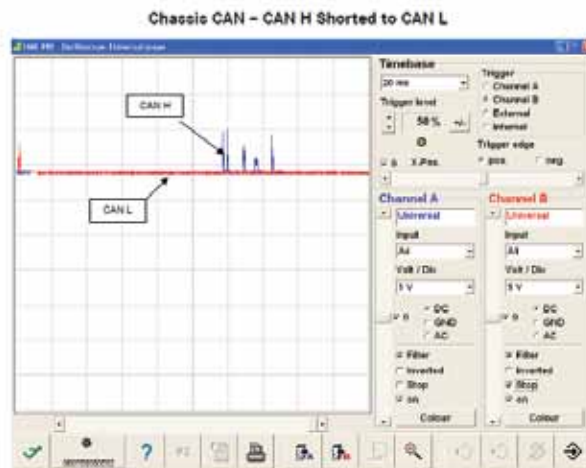
If a higher resistance reading is found, it indicates that a module is not communicating on the bus, or is not “on-line.” If a lower resistance is found, it may indicate that the bus is shorted. For a shorted CAN High or CAN Low to ground, test the resistance of each circuit to ground. The CAN that is shorted will read 0 ohms. For a shorted CAN High or CAN Low to positive, you cannot check resistance to positive to determine which CAN is shorted because both circuits have voltage. You will have to look at the scope patterns to determine which circuit is shorted. Any loss of signal from a short will bring the bus down.



*Circled are the terminating resistors that suppress interference noise. Whenever you encounter a CAN problem, always take the covers off the bus connectors to check for corrosion. If the carpet is wet, there’s a good chance that corrosion is present (courtesy MBUSA).*



*Engine CAN connector location (courtesy MBUSA).*



*This is an example of a shorted CAN High and Low scope pattern (courtesy MBUSA).*

# The Advantages of Genuine Mercedes-Benz Reman



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# GENUINE MERCEDES-BENZ REMAN A/C COMPRESSORS

MODEL YEAR	VEHICLE MODEL	REMAN PART NUMBER
1984-1992	190D2.2	A000230121180
1984-2002	260E, 190D2.5, 300TD, 300D, 300CE, SL500	A000230241180
1986-1991	420SEL, 560SEC/SEL, 560SL	A000230251180
1986-1995	190/300 series, E300D	A000230111180
1986-2002	300E, 300CE, 600SL, SL600	A000230051180
1990-2002	500SL, SL500	A000230061180
1992-1993	500SEL	A119230111180
1992-1999	600SEL, S320, S600, 300SEL	A000230171180
1992-1999	300SE, 600SEC, S600, S320, CL600	A000230221180
1992-2004	CL500, 300/400/500 series, S/SLK/C/CLK/E-Class	A000230701180
1994-2000	C220, C280, C36 AMG	A000230131180
1998-2005	ML320, ML430, ML55 AMG	A000230681180
1998-2010	ML500, ML350	A001230281180
1998-2010	ML350, ML500, E500, SL500, C/CL/S/G-Class	A000230901180
2000-2006	CL600, CL65 AMG, S65 AMG, S600	A001230011180

MODEL YEAR	VEHICLE MODEL	REMAN PART NUMBER
2000-2009	E320, S350	A000230911180
2002-2007	C32 AMG	A000230781180
2002-2007	C230 CL 1.8	A000230971180
2002-2010	CLK-Class, C55 AMG, SLK55 AMG	A001230191180
2003-2009	CLK500	A001230161180
2003-2010	SL55 AMG	A001230021180
2003-2010	E55 AMG, E320, E500, CLS500	A001230121180
2003-2010	E-Class, CLS55 AMG, CLS550	A001230141180
2003-2010	SL550, C230, C180, C200, CLK200	A001230551180
2005-2010	SLK280, SLK300, SLK350	A001230541180
2006-2010	R350, R500, ML350, ML500, ML550, GL450, GL550	A001230871180
2006-2010	R350, R500, ML350, ML500, ML550, GL450, GL550	A002230521180
2009-2010	C300, C350	A001230501180
2010	GLK350, E250CDI, SLK250, CLS250	A002230311180
2010	E350, E550	A002230381180



\*Made with the same OE components as original factory parts

\*Assembled to original Mercedes-Benz specifications

\*Results: Mercedes-Benz Quality, Reliability and Value

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## MIRROR IMAGE?

If resistance is okay, the next plan of attack is using the oscilloscope. With a dual-channel scope, measuring the CAN High and Low simultaneously will allow you to determine whether or not the signals are an exact image of each other, or if only one signal has an issue. When looking at the pattern, as with any digital square wave, signs of a sinusoidal waveform, or voltage spikes are bad.

Likewise, having incorrect CAN baseline voltages indicates trouble. When testing any CAN system, knowing what the correct baseline voltages are is important. In the case of the GL 450, the Engine CAN C voltages should be approximately 2.6V on the High side, and approximately 2.4V on the Low side when the system is awake. Asleep, these voltages will be approximately 0V.

Once a faulty signal pattern is identified, disconnecting the CAN bus wires one at a time at the X30/19 connector will should be performed. This will help identify the faulty module that's causing incorrect signals on the bus. You may now notice that all the CAN wires are not marked or identified in any way as to where they go or what module they are wired to. This is not an issue for anyone who has the factory scan tool that can communicate with all the modules in the vehicle. Simply leave the CAN wire disconnected and perform a "quick test." The module that you just disconnected from the bus should have an

"!" next to it. Any module that has this symbol assigned to it cannot communicate with the vehicle. This may mean that the communication link has been severed, the module itself is faulty, or powers/grounds are not present. If a module does not have power, ground, and a good CAN line, there is no way that it can function.

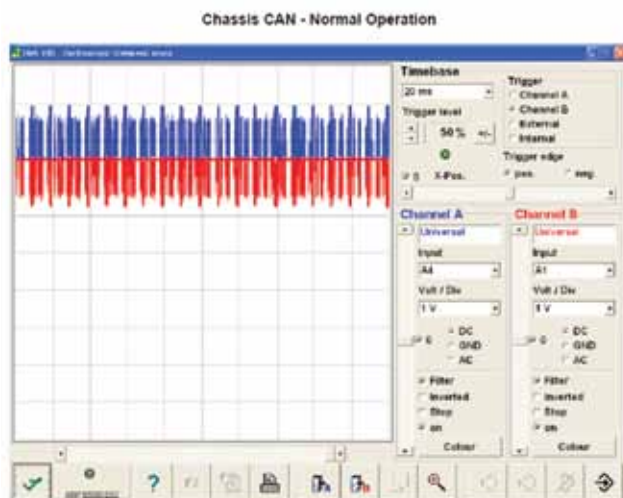
## REMOVED FROM THE EQUATION

In this case, the N71-Headlamp Range Adjustment Module was the module causing the signal pattern to be corrupt, and when it was disconnected, the signal pattern looked "clean." After performing the "quick test," the N71 also had an "!" next to it. But not so fast! The N71 module itself has a single bus wire going to each Left and Right Headlamp Range Adjustment Power Module (E1n3 and E2n3), which could cause the same scenario as a bad module. In this particular case, removing the connection from each headlight one at a time revealed that the Right Front Headlamp Range Adjustment Power Module was the culprit that was causing "everyone" on the CAN bus, including yourself, a headache.

While replacing the faulty module with a new part from your nearest Mercedes-Benz dealer's Parts Department, you may notice that not only was there physical damage to the module (most likely from a collision in the vehicle's history), but that the connector does not look too great, either. There are good ways and bad ways to repair connectors, but when it comes to vital communication wires such as those at CAN connectors, it is best to follow the Mercedes-Benz recommendations for repair. You know the saying, "When in Rome, do as the Romans do."

## NO-OHM REPAIRS

If new terminals need to be crimped onto the CAN bus, there are important rules to be followed. For crimping a joint, which is both electrically and structurally sound, you must pay attention to the following: wire cross-section, contact, the correct crimp tool and wire stripper, and tool adjustment. Crimping can be a delicate business. There should be no excess wire outside the crimp, or an excess of space inside, nor should the crimp claws touch the bottom of the wire so that it is bowed. The wires should be snugly enclosed in the casing.



Here is an example of a normal CAN High and Low scope pattern (courtesy MBUSA).

The following methods of wiring harness repair have been approved by Mercedes-Benz: crimping using the special Raychem tool, Raychem soldering using special solder connectors and heated with a heat gun and special reflector to 400 deg. C., a combination of a Raychem repair

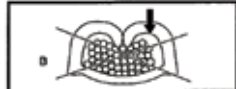
method and cable tail repair (as in prefabricated cable tail wiring harness kits), soldering (using commercial solder for repairing connectors only), rapid connection technology using special rapid-connection wire blocks available in 2-, 4-, and 6-wire versions (not permissible for CAN lines), and flat conductor pliers using special crimp contacts. Note that rapid blocks should never be used outside of the vehicle's interior because they're not waterproof.

## Repairing wiring harness by crimping

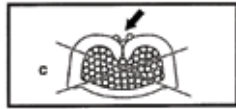
**A** Correct crimp joint



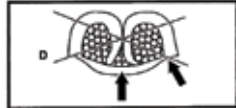
**B** Incorrect crimp joint



**C** Incorrect crimp joint



**D** Incorrect crimp joint



Acceptable and non-acceptable connector crimps (courtesy MBUSA).

As you can see, in the end both the problem and the solution make perfect sense, but when you don't have a plan of attack for CAN issues, confusion can settle in quickly. Year-to-year, or model-to-model, some Mercedes-Benz vehicles may have similar control modules, but how they are networked is the key to understanding and diagnosing CAN failures. Having the right tools and accurate resources is also imperative. The success rate of going in blindly is not nearly as high as you will achieve by doing a little research beforehand, which will improve both your income and your reputation. |

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# Why You Should Use Mercedes-Benz's New Blue Anti-Freeze

*There are many different antifreeze formulations out there in the wild and woolly real world, but for the Mercedes-Benz service specialist who cares about his customers there's only one real choice.*

*The current blue-dyed formula carries the part number BQ 1 03 0004, which is also designated as G48. It only comes full-strength, not pre-diluted. The previous yellow-tinted antifreeze is no longer available.*



“One size fits all” generic antifreezes that claim to meet every automaker’s specs aren’t what Mercedes-Benz engineers had in mind when they designed the company’s cooling systems. Whenever you see the word “compatible” on a jug no matter how reputable the brand, remember that that doesn’t mean equal protection. All it signifies is that no “battleground” issues (somewhat similar to harmful drug interactions) that can quickly cause metal damage have shown up in laboratory tests.

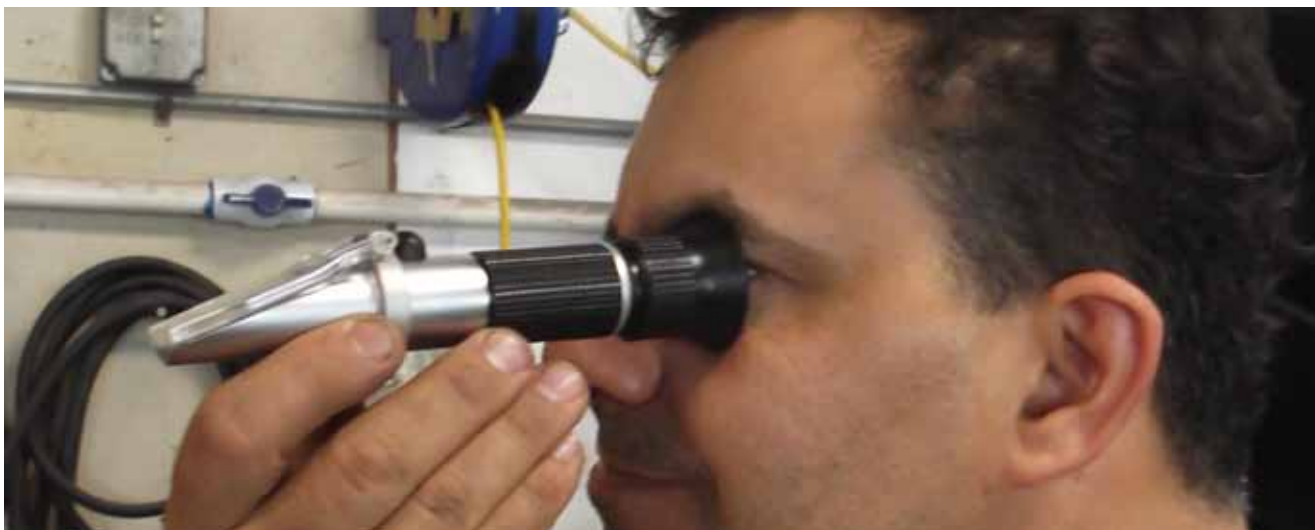
As a preliminary, we should mention that all original equipment antifreezes and most aftermarket brands are 93-95% ethylene glycol and diethylene glycol, 3-5% rust/corrosion inhibitors, plus about 2-3% water and/or solvent (required to keep the rust/corrosion inhibitors in solution), and a leak-trace dye. A few aftermarket antifreezes are made with propylene glycol, which is promoted as less toxic, but which is not quite as effective at freeze protection.

### **GREEN, YELLOW, BLUE**

A look at the evolution of Mercedes-Benz “Anticorrosion/Antifreeze AGENT” (as it says on the label) will give you a better understanding of what you should use either for a simple topping up after replacing a hose or water pump, or for a complete flush and refill service. In the U.S., the cooling systems of all domestic cars and many

imports used “conventional green” since the inception of “permanent” antifreeze, as opposed to the plain alcohol that had been employed previously to prevent cracked blocks (it tended to boil off). The inhibitors in this obsolete mixture are sodium silicate and phosphate, both proven protectors for aluminum, benzoate and borate for broad-range metal protection, and triazole for old-fashioned copper-brass, plus an inhibitor that keeps cast iron from rusting (not much of that to be found in engines anymore). It worked pretty well, but had to be flushed out and replaced every couple of years.

Mercedes-Benz, on the other hand, has for many decades filled its systems with the yellow antifreeze you’re surely familiar with ((Part Number Q 103 0002, spec sheet number 325.0, and designated G05). The jug states that it contains ethylene glycol, diethylene glycol, sodium tetraborate, sodium benzoate, corrosion inhibitors, defoamers, silicates, and dyes. This has shown to be an excellent product, and it qualifies as a HOAT (Hybrid Organic Acid Technology), though light on organic acids. Instead of the phosphate corrosion inhibitors some manufacturers add to their antifreeze, which can lead to harmful deposits in the cooling system, Mercedes-Benz opted for silicates. These give immediate corrosion protection, whereas with pure OATs considerable



*If a cooling system has been topped up with plain water to compensate for a slow leak, or when a part was replaced, obviously the concentration of antifreeze and its important inhibitors will be too low. So, always check it during routine maintenance, preferably with a refractometer.*

time is required before a coating is established (5,000 miles is typically quoted). Silicates are also the best defense against what's called "water pump cavitation erosion-corrosion." The only negative characteristic we know of about them is that they can drop out of solution over a shorter time than would qualify for the "long-life" classification that was becoming all the rage.

Mercedes-Benz adopted an ingenious and unique answer to this problem that allowed the 15-year/150,000-mile change interval to be recommended starting in 2002: a packet of silicate gel built into the coolant overflow tank. Somewhat similar to the little envelopes of silica that are used in the packaging of various products as a desiccant, it serves as means of continuous rejuvenation of the corrosion-protection qualities of the antifreeze. Laboratory tests have shown that even up to 15 years, most of the inhibitor remains in the gel, still available to add protection.

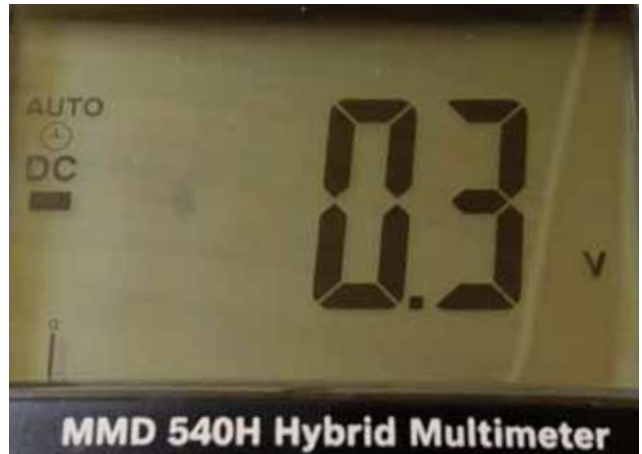
### **BETTER YET**

About five years ago, Mercedes-Benz started the switch from the G05 used for as long as most of us can remember to the blue-dyed HOAT (Hybrid Organic Acid Technology) G48, Part Number BQ 103 0004. The Tuscaloosa plant adopted it in 2010, and by 2012 MBUSA aftersales offered nothing else. The only significance of the color is to differentiate one formulation from the other.

The new blue product is slightly different in that it adds more organic acid, along with its basic silicate additive. It's a worthwhile evolutionary improvement, but is still rated as having a 15 year/150,000 mile life (that's not long enough?). There's no better protection from corrosion, erosion, deposits, and gelling.

According to the label, it contains ethylene glycol, diethylene glycol, sebacic acid, sodium hydroxide, 2-ethylhexanoic acid, corrosion inhibitors, defoamers, silicates, dyes, and a bittering agent. Its ASTM spec is D3306.

Fortunately, the yellow-dyed G05 formula is 100% compatible with the pretty new blue stuff. So, if you replace a water pump, hose, or a head gasket, you don't have to do a complete coolant flush and replace. Certainly, it would be a good



*Any voltage reading between the coolant and ground means that electrolysis has started, which can result in expensive damage. Flush and refill with the right stuff.*



*The new Mercedes-Benz Genuine "Anticorrosion/Antifreeze AGENT" is dyed a pretty blue color.*

idea to broach this sensible maintenance practice to your customers, but it's not absolutely necessary.

Will adding blue to yellow make a horrible-looking muddy mess in the radiator's filler neck? Not really. According to basic color theory, the primary colors yellow and blue when blended in equal proportions produce green. Not a problem, and that's what you should expect.

The new M-B antifreeze is even longer-lasting than that which you've been using for many years.





While the previous formula qualified as a HOAT, the new one is more so with additional organic acids that assure even better protection.

According to basic color theory, mixing the new blue with the previous yellow-tinted formula in equal proportions will produce a nice green. They are completely compatible.



Embrace it, and be happy that the cost isn't much more (the same as that of the previous yellow) than if you had substituted some dubious generic that claims to meet M-B specs.

Given the "green" age we're now living in, you might have suspected that there's an environmental component to the industry-wide switch to long-life antifreeze, and you'd be right. In Europe and the U.S., the concern is that do-it-yourselfers typically just dump old coolant down the drain, or even right on the ground, which

contaminates the water table. So, the longer it can be kept in service, the less of it will find its way into the environment.

### MORE ON PHOSPHATES

We mentioned phosphates above, and that brings up two additional points. First, this form of protection, which is especially popular among Asian car makers, doesn't react well with the minerals found in hard water, tending to form heavy deposits that can limit, or even block, coolant flow through small passages. Mercedes-Benz made the decision to go with silicates partially because its vehicles are sold worldwide, and there's no telling what the qualities of local water might be everywhere.

Second, you might be thinking that it's okay to use any antifreeze in a Mercedes-Benz as long as it doesn't contain phosphates, a pure OAT, for instance. Think again. The factory fill will have established a specific type of corrosion protection mechanism. A different type of inhibitor package will not continue with that form of protection and might even cancel it out. Another problem with

pure OATs, by the way, that most technicians who work on domestic cars are familiar with, is that they only offer protection to surfaces that are continuously immersed. If the coolant level should ever be allowed to drop, truly catastrophic corrosion will begin very quickly. Silicates, on the other hand, “paint” all those vulnerable interior surfaces with a long-lasting coating that works even if air is present.

### **APPROVED, BUT NOT PRACTICAL**

Over the years, Mercedes-Benz has tested many high-quality brands of antifreeze to find out which ones can be classified as Factory Approved Service Products, but looking at the list of similar silicated HOATs might give you a chuckle. Where are you going to find Fricofin Kühlerfrostschutz (made in Germany), Agip Antifreeze Plus (Italy), Dragon Power Coolant (S. Korea), or Behran Zagros (Iran)?

Doesn't it make more sense to just buy genuine M-B antifreeze from the dealer where you make most of your parts purchases? The somewhat higher price than that of a questionable generic makes next to no difference in the overall cost of vehicle ownership, and may, in fact, head off very expensive repairs.

As the company's service literature states, “Failure to use M-B Anti-corrosion/Antifreeze may result in a significantly shortened service life. While there may be a number of products available which will provide the required protection, all such products have not been tested for Mercedes-Benz vehicles.”

### **H2O PLUS?**

Everybody in the auto service business should be giving more thought to the other component of coolant: water. Mercedes-Benz service info states that antifreeze should be blended with water “that is not too hard.” That's not very specific, so we here at StarTuned believe an explanation is in order.

First, “hardness” refers to the water's content of mineral and metallic particles, primarily calcium and magnesium, but also iron. The measurement scale starts at 17 parts per million, and any number over 120 ppm is considered hard, but wells in some areas of the country yield up to 850 ppm!



*Is tap water okay for the 50/50 blend? Most regions in the U.S. have “hard” water, meaning it contains mineral and metallic particles, primarily calcium and magnesium, to the tune of 120 ppm and up. Also, particularly in the South, many municipalities add so much chlorine to city water that you can smell it. In either case, you're asking for problems in the long term.*



*You can differentiate yourself from your competitors by advertising that you use only distilled or de-ionized water (at maybe \$1 per car) and genuine Mercedes-Benz antifreeze in cooling systems.*

Even though silicated HOAT is much better at tolerating these particles than other types of antifreeze, they still amount to contamination.

Also, in many places city water contains so much chlorine you can smell it. Using it in a cooling system would be introducing an unwanted reactant.

So, we suggest that unless you have a water softener, you purchase distilled or de-ionized H<sub>2</sub>O to make the mix. This is actually a good way to take your shop's reputation to the next level and differentiate yourself from your competitors at practically no cost. Advertise that you use nothing but distilled water and genuine original-equipment Mercedes-Benz antifreeze in the cars you service.

## POINTS

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We'll conclude with some random, but important, points:

- Symptoms of a neglected cooling system today may include a MIL-On, and the OBD II Code P0128, which indicates a failure to reach normal operating temperature in a specified time.
- We hope you realize that Mercedes-Benz's incredible long-life service interval is predicated on a properly maintained system. If the coolant mix is kept at 50/50 (at least -- you can go somewhat higher in antifreeze concentration), and the level is never allowed to fall, they apply. If not, there are no guarantees that damage won't result. If you change to an antifreeze with inhibitors that provide a different type of protection (such as phosphates or organic acids), continued protection may be compromised.
- Then there's the case of the second cooling system. The Mercedes-Benz 6L V12 Bi-Turbo has a separate circuit for its twin turbochargers. Although the engines themselves carry the 15/150 service interval, the second system should be flushed and refilled every four years.
- If you're ever tempted to top off the system with an antifreeze that has some other type of inhibitor package than that

of the Mercedes-Benz factory fill, resist. If it uses phosphates or OAT, you'll lose the benefit of the silica gel packet. Under severe conditions, such as a low antifreeze concentration, there might not be enough of the needed additives to prevent corrosion. To put it another way, you're contaminating the factory fill. Neither inhibitor package may be strong enough to provide its specific type of protection.

- Generic antifreeze producers may claim that if you drain the cooling system, you avoid any performance issues when you switch coolants. That's not necessarily true with a Mercedes-Benz. Specific silicate protection has been established, and the system is designed for continued refreshment from the silicate packet. Further, it's difficult to completely drain the system, although use of good coolant exchange equipment should remove maybe 90% of the old stuff.
- By volume, a 50% concentration of genuine Mercedes-Benz antifreeze will keep the icebergs away down to -35 deg. F. A higher concentration is only necessary if the ambient temperatures are even lower. Going to 55% gives you -49 deg. F. If you live where it gets colder than that, move.
- Although one engineer has told us that you can go as high as 70/30, Mercedes-Benz service literature states that a concentration of more than 55% antifreeze should not be used as the maximum freeze protection has already been reached.
- Higher concentrations impair heat transfer.
- It wouldn't hurt to read what <http://bevo.mercedes-benz.com> says about coolant, and fluids in general. For English, go to the link at the very bottom of the page.
- Pure OATs are so potentially troublesome that one major producer found itself in trouble with the FTC over its advertising claim that its antifreeze was "universal" and could be safely used in any make vehicle. So, "Big Name" doesn't necessarily mean "reputable." |

# Mercedes-Benz Mobil1

Product Name	Part Number	Quantity	Product Description	Recommended Consumer Applications
Mercedes-Benz SPEC.				
Mobil 1 Formula M 5W-40	BtQ 1 09 0144	Bulk - No Equipment	Fully synthetic formulas designed specifically for gasoline passenger cars	Low SPAsh. Available at most MB dealers
	BQ 1 09 0162	6/1 Quart Cases		
	BQ 1 09 0151	55 Gallon Drum		
Genuine Mercedes-Benz Oil MB 229.5 Specification SAE 5W-30	A0009898301USA6	12x1 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
	A0009898301USA8	55 Gallon Drum		
	A0009898301USA9	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 Formula M 5W-40	BQ 1 09 0135	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 0142	6/1 Quart Cases		
	BQ 1 09 0143	55 Gallon Drum		
Genuine Mercedes-Benz Oil MB 229.51 Specification SAE 5W-30	A0009899701USA6	12x1 Quart Cases	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.51 Specification	Mercedes-Benz Engines that require 229.51 Specification Oil
	A0009899701USA8	55 Gallon Drum		
	A0009899701USA9	Bulk - No Equipment		
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 0134	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
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® 1/2 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
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

Mercedes-Benz automobiles are designed to perform on the most challenging roads and conditions. Shouldn't the oil used in Mercedes-Benz engines do the same? We think so.

That's why Mercedes-Benz and Mobil 1 have partnered to offer an unbeatable combination of total engine performance and driving luxury.

Please have a look at our oil portfolio which is available through your local Mercedes-Benz dealer. Our dealers are able to offer you a wide variety of oil grades at competitive prices.

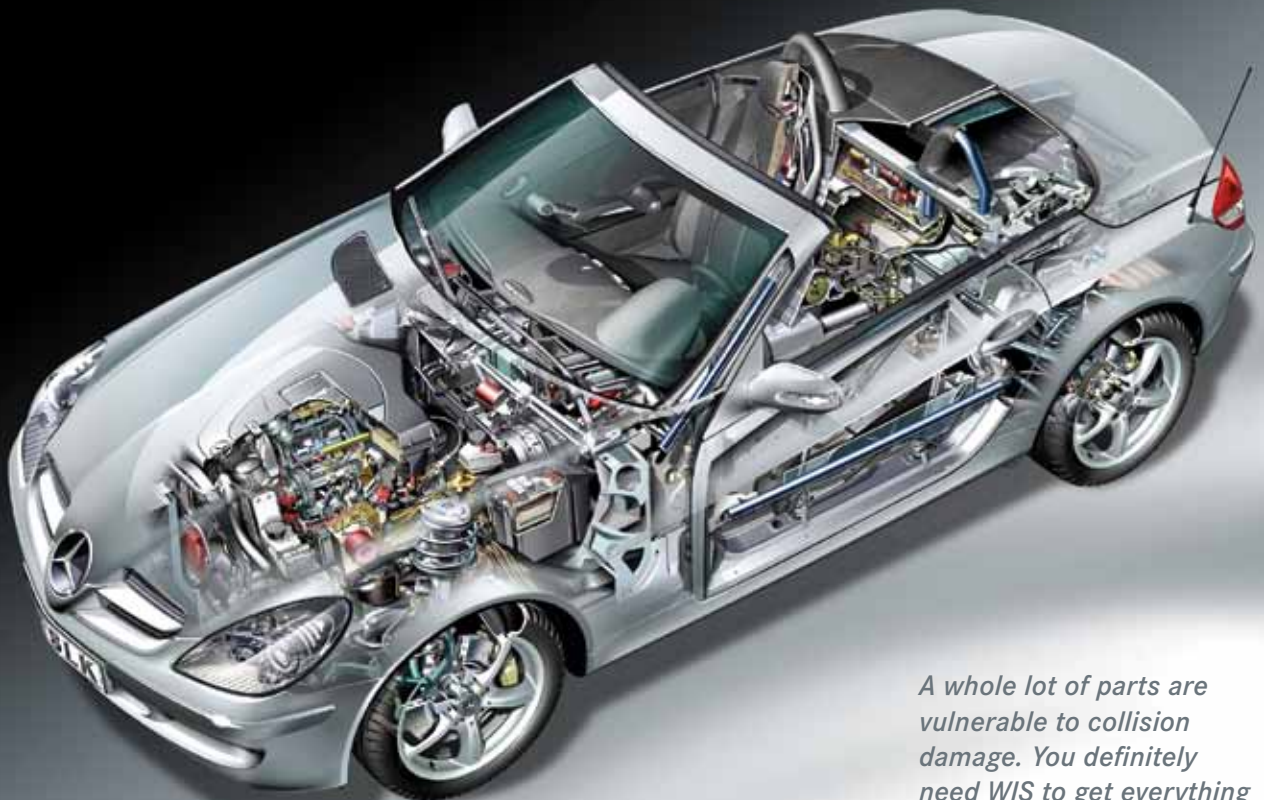


Product Name	Part Number	Quantity	Product Description	Recommended Consumer Applications
Mercedes-Benz SPEC.				
Mobil 1 Gear Oil (Mobil 1 Gear Lube 75W-90)	BQ 1 09 0085	12/1 Quart Cases	Exceeds the most severe service requirements in both conventional and limited slip applications	SUITABLE for use in modern high performance automobiles like SUV's, Vans and Light duty trucks requiring API GL-5 level performance
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
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 Aftertreatment 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		
Delvac 1300 Super 10W30	BQ 1 09 0086	Bulk - No Equipment		
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 the Mercedes-Benz Workshop Information System (WIS) in Collision Repair

*WIS is a cornucopia of information that no collision repair service provider should be without. If collision repair of old was concerned with appearance, it is today far more about critical safety and reliability requirements. There is a vast amount of information available in WIS to help you straighten or replace, weld, bond, rivet, or otherwise fasten components back together in a manner that meets critical strength, durability, and safety requirements.*

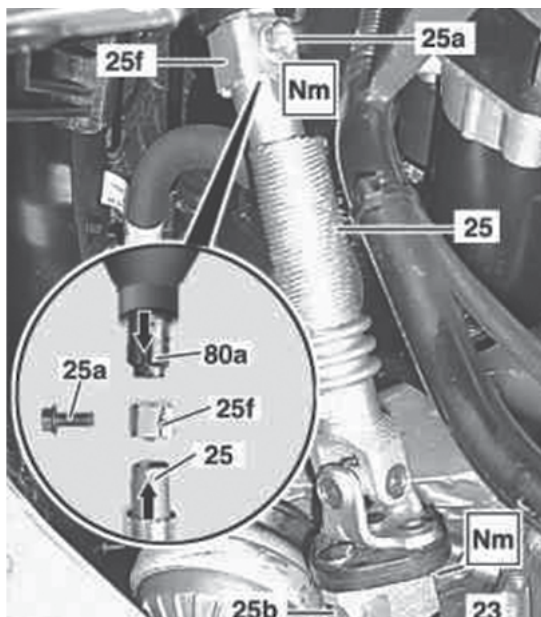
*Of course, WIS also includes everything you need for making mechanical repairs, including TSBs, wiring diagrams, diagnostic training, hardware and performance specifications, and much more.*



*A whole lot of parts are vulnerable to collision damage. You definitely need WIS to get everything back together right.*

You understand that there is no substitute for accurate repair information, or you wouldn't be reading StarTuned. You also know from experience that with the high-tech requirements and variety of today's automotive materials and technology, many repairs are application-specific.

Back when everything was made of the same type of steel, a good understanding of conventional welding may have gotten you through much of your day. Today's Ultra High-Strength Steel requires a different bonding process than even High Strength steel, and fastening either type may differ from the process required for joining aluminum. Squeeze-Type Resistance Spot Welding (STRSW), and use of adhesive combined with rivet bonding are two methods approved for selected Mercedes-Benz vehicles. However, various M-B models may modify these procedures to account for different joint strength specifications, corrosion protection requirements, materials compatibility, and other concerns.



*A pre-set fracture point on the control valve (23) of the rack-and-pinion steering assembly may have been weakened if the front axle has been damaged in an accident. The lower steering shaft (80a) is sensitive to lateral forces. A self-locking nut (25f) that connects the steering column (25) to the lower steering shaft (80a) is not repairable. WIS instructions require replacement of the entire steering gear assembly if the front axle has been damaged.*

When you subscribe to the Mercedes-Benz StarTekInfo repair information website, you also get access to WIS. You'll have at your fingertips detailed information about every repair, for every Mercedes-Benz vehicle, from 1985 to the most recently published model year documents.

## **FRESH INFORMATION IS BETTER**

Mercedes-Benz updates WIS regularly with new procedures that improve repair reliability, enhance performance, or reduce labor time. WIS procedures are also crash tested for safety. You'll see new repairs first if you're using WIS. When you successfully repair vehicles that other collision service providers cannot handle, you'll also get more word-of-mouth referrals.

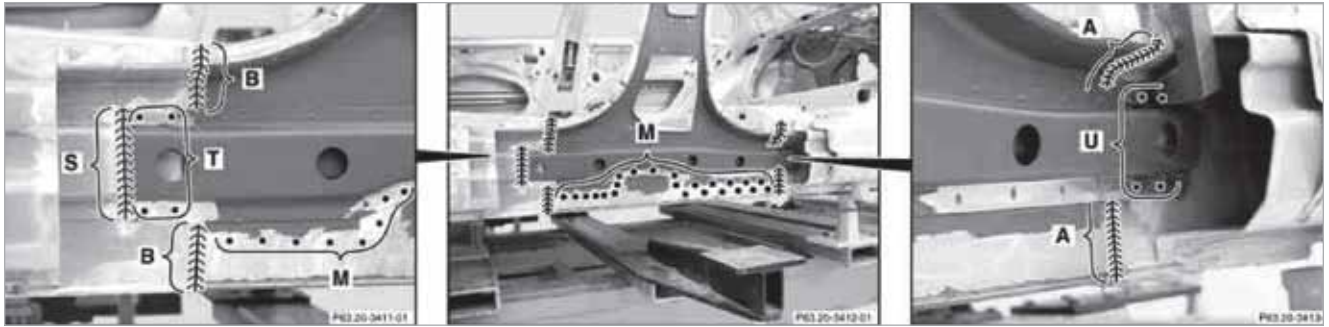
For example, WIS now requires technicians to replace the entire steering gear assembly if the front axle has been damaged in an accident. This critical safety information is linked to the front axle repair procedure document in WIS.

Another example might be the major changes in the B-Pillar replacement procedures for Mercedes-Benz E-Class models. Beginning with the 2003 E-Class, M-B requires that technicians use special procedures when working on the Ultra-High-Strength steel in the B-Pillar.

High heat welding would weaken the boron steel in the B-Pillar. Ultra-High-Strength steel is also less workable than other steels, so attempts to straighten large bends will likely result in cracks in the part. Mercedes-Benz recommends straightening only for minor dent areas.

New procedures specify lower heat, more concentrated application of heat in smaller weld areas for shorter amounts of time, and a spot weld test on the old panel to determine the welding settings that will result in the recommended weld nugget size for the actual repair on the replacement panel.

Documents in WIS spell out the exact temperatures for different High-Strength-Steel welding procedures, the Mercedes-Benz approved adhesives and rivets, the special cutting tools required, and the locations where MIG welding is acceptable.



*WIS documents often include images showing exactly where to perform the repair being presented. Images above show SG-welding (areas A, B and S), and RP-welding (areas M, T and U) used in replacement of an inner B-Pillar.*

Mercedes-Benz adds Technical Service Bulletins and other documents presenting improved components, updated procedures, or new tools to WIS whenever they are created. You'll see vehicle-specific information as soon as it comes out from Mercedes-Benz, rather than having to wait for updates from other information providers.

Work with the confidence that your repairs are based on procedures, components, and tools that are field-tested and OE-proven, not tips from some unknown bulletin board commenter. With your subscription you'll have unlimited access to that repair data 24 hours a day. In short, you'll always find the freshest, most accurate repair information in WIS.

As a subscriber, you can print most documents that you find in WIS. You can also save bookmarks, including keywords and notes to help remind you why you thought a given document was worth marking as a keeper.

## **How to WIS**

WIS works only on a PC, not a MAC, and only with Internet Explorer, not other browsers such as Firefox or Google Chrome. In the Internet Explorer browser, type [www.startekinfo.com](http://www.startekinfo.com) to get started.

In the left column, click on "Subscribe" and follow the instructions that pop up. Once you are subscribed, enter your User ID and Password in the boxes on the Welcome screen, and then click "Go."

If your computer doesn't already have it, you may need to download a special applet called "Java Runtime Environment" (it's free).

On the StarTekInfo.com home page, click on "Tech Requirements" in the left column. Go to the "Software Requirements" section and click on "Installation Instructions." Under the "Application to be installed" table, click on "Java Runtime Environment." A new window entitled "Installing JAVA Web Start" will open. Follow the instructions, and then restart your browser and log in to StarTekInfo.com. A new window will pop up and allow you to start WIS.

## **THE VIN IS THE THING**

It pays to identify a specific vehicle before you search for anything in WIS. This allows WIS to filter out many documents that are not applicable to the vehicle for which you seek information, thus saving you time.

Of course, if you already know the document number, you can enter that and skip all of the vehicle identification data entry.

Mercedes identifies vehicles by class, model, chassis, and engine. The fastest way to help WIS target the vehicle you are working on is to enter a VIN at the top of the WIS Home page. WIS will automatically fill in the details of class, model, chassis, and engine type.

If you don't have the VIN, you can still set up the search in WIS. At the top of the WIS Home page, click the "Display Model Designation" icon (looks like two gears).

Let's walk through the steps. With the Display Model Designation window open, select "Car" as the Vehicle Type. A list of all M-B passenger car models will populate the "Model" box.



You can get a shorter list to start from if you know the chassis designation of the model you want to know about. For example, if you enter “WDB” in the VIN prefix box and “203” in the second VIN box, WIS will open a window listing only recent model year (2000 and up) C-class cars (C240, C320, etc).

Scroll down and select the model name. WIS will place the model number in the “Model Designation” box.

If there is more than one version of this vehicle, you’ll have to select the correct model name again in the “Sales Designation” column. This time, WIS will be a bit more helpful and place both the name and the Engine Number in the model description box.

The last thing to select is the “Major Assembly” type. From among the choices WIS has found, select the appropriate type. Once WIS has identified the model, chassis designation, engine type and other data about the vehicle, you can begin defining the information you want to find.

## START WITH THE VEHICLE DATA CARD

The Data Card tells you the exact model name, an identification number that includes both the VIN prefix and the remainder of the VIN, the paint code, engine number, transmission number, and other component/accessory codes.

All of this data can help narrow the search field so you don’t waste time scrolling through options that are not related to the vehicle you are repairing. The Data Card icon (a car in front of a piece of paper) in the upper right of the WIS home page becomes active once the VIN is entered.

## WIS LOVES GROUPS

All components and repair information in WIS are organized in a group number system. On the left side of the screen is a list of all main groups.

For example, you’ll find information about the frame floor system, substructure frame, lower engine compartment paneling, and more in the “Substructure” group. Information about door pillars, outer longitudinal members, side wall components, and more is in the “Side Wall” group.

Want to know about the headlamp cleaning system? Find it in the “Electrical System, Body” group.

AH60.00-P-0024-01N	General information on repair of vehicles with ultra-strength steels.	Failure to observe instructions when straightening/repairing, separating, preparing adhesive points, joining/connecting, resistance spot welding, MIG welding, MIG brazing can lead to considerable damage to ultra-strength steels and their joints.	②
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**MODEL 117, 166, 176, 197, 204, 207, 212, 216, 218, 221, 231, 242, 246**

### Straightening/repairing ultra-high-strength steels

#### Straightening work

- Do not heat above 300 °C.
- Use commercially available pulling tool to planish the side longitudinal member, for example. Observe welding suitability resistance when installing pulling adapter (e.g. shim) on ultra high-strength steels.
- Straightening work on ultra high-strength steels can only be accomplished in the event of minor damage (dents).

#### Cutting ultra-high-strength steels

##### Heating gluing points

- The maximum permissible temperature for heating the flange connection to be loosened is 200 °C.
- The ideal temperature for loosening the flange, e.g. with a chisel, is approx. 100 to 120 °C.
- Do not heat adhesive connections that consist of 3 sheets of metal to temperatures exceeding 200 °C to preserve the connection without permanent damage.
- After the component has cooled down, the adhesive resumes its original strength.
- We recommend a hot air gun as heat source.
- Drill out spot welds with special drill bits (see GOTIS).
- Mill spot welds with special spot weld milling cutters (see GOTIS).
- Cut with Ø 30 mm cutting disks (see GOTIS).
- Use suitable machines for individual tools (see GOTIS).

#### Snap-out test on sample panel (old part) on ultra high-strength steels to determine the optimal welding parameter setting

- Determine suitable welding parameters on sample panel (to be removed from old part) in combination with approved spot welders. By completing spot-weld specimen (with adhesive) and performing snap-out test with measuring weld nugget diameter using formula  $4 \times \sqrt{t}$  (t = panel thickness).
- Weld nugget diameter (a) should be at least 5 mm. ⓘ Take adhesive from glue cartridge without mixing tube (mix manually).

- Drill rivet holes with special drill bits (see GOTIS).

#### Prepare gluing points

- ② The detailed work description included with glue set must be strictly observed. Otherwise adhesion problems may occur.

#### ⓘ Observe pretreatment of bonding surfaces.

#### Joining/connecting ultra-high-strength steels

##### Rivet joints

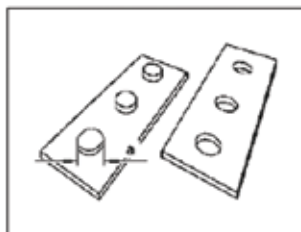
- When processing ultra-high-strength materials, use only high-strength rivets approved by Daimler AG.
- For this purpose, a riveter with increased draw-off strength is required (see GOTIS).

##### Resistance spot welding

- The spot welding tongs (inverter technology) to be used must be approved for these materials (see GOTIS).
- The extension of the electrode arms is limited to the short standard electrode.
- To determine the optimum welding parameter setting and the electrode pressure, perform a snap-out test on a sample plate before performing resistance spot welding on the vehicle (see following picture).
- Only this ensures optimum welds.

##### MIG soldering

- ⓘ MIG soldering is only permitted on repair points specified in the Workshop Information System (WIS).



*WIS also provides general guidelines for working with Ultra High-Strength Steel as a related document when you open any repair instruction that applies to an Ultra High-Strength steel part. You'll need to check yes to "Functions, as-built configurations" as a selection in either the "Repair" or the "Diagnosis" section of the "Information Types" menu before you start the search.*

Click on a group and it expands into a list of subgroups. Once you've narrowed down to the desired topic, you're ready to tell WIS what types of information you need. Move over to the "Information Types" window on the right side of the WIS home page and select the information types you want.

While first learning how to use WIS, keep a broad range of information types selected. For example, you'll find within the "Repair" and the "Diagnosis" sections an information type entitled "Functions, as-built configurations". Select it and you'll often find general how-to tips that make it easier to understand the reasons behind the recommended procedure for the repair you seek.

Click on "Start Search" and WIS will present a list of any available documents. To save time, look in the "Validity" box under the title. There may be a description of the models, years, and engine range covered in the document. Review this and you won't have to open every document to screen out those that are not applicable to your vehicle year and model.

Double-click on a title and the document will open in the bottom half of the screen. There may be links to additional documents on the right side of the page.

Links that are color-coded red point to a document that is also applicable to the vehicle. They may help you find extra explanations, or associated work that must be completed as part of the original repair for which you began this search.

Once you've found a document that is directly applicable to the vehicle and repair you want to know about, you can narrow your search. You'll know the main group and subgroup in which the document is located, so you can deselect all subgroups except the one in which the document resides.

You also now know the Information Type of the document, so you can deselect all other information types.

Now, when you click on the "Start Search" button, you will see fewer search results, and they



*This photo shows how to align the rack-and-pinion steering coupling to the control valve housing. It is part of a separate document that is linked to the instructions for replacing the steering gear assembly.*

will all be relevant to the vehicle and repair for which you searched.

Here's a tip from a friend at MBUSA that applies generally to WIS: After opening a document, there's an icon that looks like a computer screen with four arrows pointing outwards. This maximizes the document on the screen. Click it a second time to see the search results again. "Trust me, this is helpful," he says.

In Greek mythology, the Cornucopia, or Horn of Plenty, is described as a horn of the goat that suckled Zeus, the father of the gods. The Horn of Plenty becomes full of whatever its owner wants. Mercedes-Benz has designed its Workshop Information System to function as an automotive repair Horn of Plenty.

### **WIS FROM M-B, NOT eBAY**

Avoid offers to purchase used or sale-priced WIS DVDs. You'll need a user ID and password, which are available only with a subscription, to get into the online site. We love eBay, but it won't help you with WIS. |

# the **NET**

Sourcing Mercedes-Benz  
Repair and Parts Information

The screenshot shows the Mercedes-Benz Wholesale Parts website. At the top left is the Mercedes-Benz logo and the text "Mercedes-Benz". To the right, the page title "Mercedes-Benz Wholesale Parts" is displayed. Below the title is a navigation menu with links: Home, What's New, Certified Collision Program, Remanufactured Parts, Accessories, Service Parts, and Find a Dealer. The main content area features a large image of a car engine. On the left side of this image, there is a text block titled "The Advantages of Genuine Mercedes-Benz Parts" with a list of benefits: Value, Quality, Fit, Performance, Warranty, Service, and Experience. A quote states: "Every single part - down to the last nut, bolt and gasket - has been designed to the specifications of each particular vehicle. No compromises accepted." Below this list is a red button labeled "Tech Support" with sub-links for "Repair Information" and "STAR TekInfo". At the bottom of the main content area are three red buttons: "Price Updates", "Tools and Links", and "Order Parts Online". The footer contains the copyright notice "© 2012 Mercedes-Benz USA, LLC" and a link for "Limited Warranty | Contact Us".



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