STARTUNED®

Information for the Independent Mercedes-Benz Service Professional

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TO OUR READERS:

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

Mercedes-Benz wants to present the information you need to know to diagnose and repair Mercedes-Benz vehicles accurately, quickly and the first time; text, graphics, 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: 1 800 225 6262, ext. 7112
e-mail: andrew.webb@mbusa.com

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

Editorial Director
Bob Freudenberger
bfreud@automotivedatamedia.com

Contributing Editor
Bob Chabot
bchabot@automotivedatamedia.com

Contributing Editor
Kerry Jonsson
kjonnson@automotivedatamedia.com

Contributing Editor
Tom Nash
tnash@automotivedatamedia.com

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

MBUSA Project Manager
Adam Green
adam.green@mbusa.com

Art Director & Circulation Mgr.
Christopher M. Ayers III
ayersc3@automotivedatamedia.com

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To locate a Mercedes-Benz dealer near you, go to **www.mbusa.com**.

Straight Talk:

Frame Realignment and Suspension Alignment Pose Unique Challenges

In America, we drive on 55- to 75-mph highways. In certain countries in Europe such as Germany, highway speeds are typically much higher, sometimes with no limit. Mercedes-Benz, a global automaker, therefore insists on adherence to strict frame and suspension alignment specifications, as even small deviations from these specs can compromise vehicle stability and occupant safety, especially when magnified by speed. For those who repair Mercedes-Benz vehicles, there is zero tolerance for anything less than using the best resources that the automaker provides.

Effective repair is rooted in accessing and using the most accurate collision service information, which is available at the Mercedes-Benz subscription-based startekinfo.com website. Facilities and technicians must also embrace industry-recognized training that raises technician competency to meet the repair challenges posed by

Images courtesy of Mercedes-Benz USA

new materials and inbound technology. In addition, the equipment and tools employed to must enable the safe and complete repair of any vehicle.

These three requirements enable a vehicle to be restored to the same safety ratings that the vehicle had pre-collision. Anything less is a disservice to the consumer, demonstrates a lack of professionalism, and puts the shop at risk of a charge of negligence.

Repair from the inside out

Mercedes-Benz requires that its dealer and independent collision repair facilities be certified by the automaker. In addition to Mercedes-Benz service/repair information, these certified facilities are required to employ factory-approved equipment, tools, and procedures. It should be noted that approved companies develop equipment and tools predicated on Mercedes-Benz repair information.

Examples include dedicated "jig and fixture" straightening benches, proprietary diagnostic tools (e.g. factory scan tool, Romess-Rogg inclinometer), based on collision repair procedures described in Mercedes-Benz Workshop Information System (WIS) guidelines at **www.startekinfo.com** (which provide jigs and mounting instruction, straightening guidance, bodywork repair data, diagrams, and documentation).

During manufacture, Mercedes-Benz vehicles are built using jig and fixture systems. Jigs are the key mounting points where a vehicle is attached to an automated assembly line, and also to a collision repair bench system, should a collision repair ever be necessary. Fixtures are measuring points that are used to provide a reference for the proper location of those key mounting points throughout a collision repair. In general, fixtures are not a point that is held and pulled against; rather, the fixture serves as a reference point for key location points to be pulled to before initiating further repairs.

Using dedicated bench systems during collision repair, such as those supplied by Celette Inc. (which is now part of the Azimuth Group) or Car Bench, helps Mercedes-Benz certified collision repair facilities precisely measure, control and monitor the repair. The vehicle must be mounted and securely fastened to the bench at points not affected by the collision using the straightening brackets and vehicle-defined mounting points. This allows dimensional variations in deformed or distorted parts to be recognized.

Key location mounting points can then be measured and repositioned in accordance with Mercedes-Benz specs and then locked down to prevent movement or damage during further repair. Whether a subframe element, suspension mounting point, safety system sensor, engine cradle, strut tower or some other vehicle element, only accurate positioning during the repair process can replicate the same dynamics obtained during manufacture.

For example, if bench measurement determined that these key location mounting points suffered no damage or displacement in the collision, then the

vehicle can be locked down to the bench before any subsequent repair procedures are performed. If any key location point was damaged or displaced during the collision, it can be moved to the proper position on the bench, using the fixture as a reference point. Once positioned properly, the vehicle can then be locked down and further repairs initiated.

If a frame element needs to be straightened and service information indicates that it can be pulled rather than replaced, bench equipment jigs can pull the component to its proper position using fixtures as reference points. Should a part have to be replaced, the fixtures that are located on the bench provide reference points for height, length and width that enable the repair technician to place the new part in its proper position relative to the rest of the vehicle.

Proprietary diagnostic tools are also essential to proper collision repair. The Mercedes-Benz Star Diagnosis System (SDS) tool must be used to fully reset, reinitialize, or reprogram sensors and modules where needed during the collision repair. For instance, recalibration of the steering angle sensor (a key element for electronic stability control) is now a crucial final step in a four-wheel alignment following a collision. Another tool is the Romess-Rogg CM-09606 inclinometer, which unlike other similar tools, is essential to measuring and adjusting ride height for all models.

Is anyone pulling new vehicles right today?

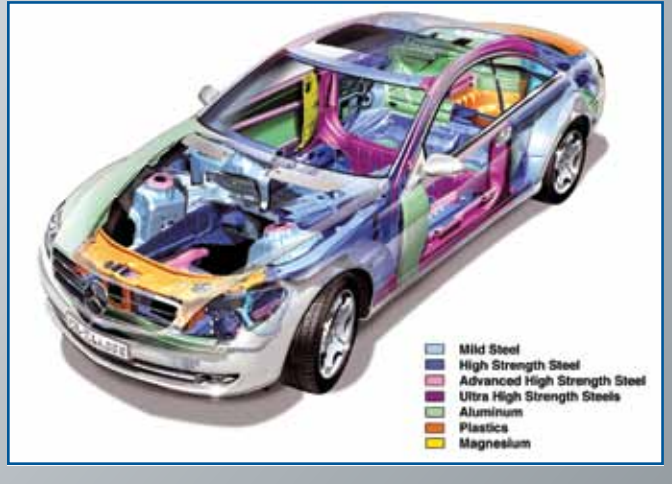
Fixtures have been around for 70 years or so, and were used mostly with mild steels during most of their history. But times are changing. The ramping up of innovations such as high-strength steels, aluminum, plastics, and carbon fiber composites poses numerous challenges to collision repair and to those who make straightening equipment.

Risk management has become an entrenched necessity. The influx of new vehicle technology has forced insurers and repair facilities to confirm repair via documentation, preferably in an automatic electronic form. This documentation provides a record of where that vehicle was before, during and after collision repair to confirm that proper realignment was achieved.

Vehicles are changing dramatically. For example, conventional fixture technology is a mechanical measuring system that locates specific, fixed points. Data cannot be documented and inputted

Tips for Straightening High Strength Steels

Mercedes-Benz vehicles are made with increasing amounts of high-strength steels (HSS) that offer increased strength, improved energy load path control and reduced curb weight. Here are three tips that facilities should be aware of:



- Technicians must use the most current service information to know where HSS is located to effect complete, safe repairs. Steel designs in some vehicles have been changed more than once in the course of a model year.
- Modern vehicles must be measured thoroughly when they've taken a hit. HSS will absorb and transfer energy around the passenger cabin. As a result, distortion and damage after an impact does not show up in traditional locations, but rather somewhere else.
- Higher-strength steels used today require more pressure at holding points to straighten. If too much pressure is applied at one centrally-located point it may tear or distort the metal when pulled, creating more. To prevent this damage, spread the total required pressure over multiple points and pull with simultaneous equalized pressures.

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electronically in an efficient manner throughout the repair process. To compensate, facilities may use an electronic measurement tool after repair, but these recording procedures are costly in terms of time.

Realignment equipment manufacturers are retooling in response to inbound materials, associated procedures, and time erosion during repair. Is anybody actually pulling new vehicles correctly?

In the near future, vehicle realignment equipment will see a blending of current and emerging holding and pulling technologies. Some manufacturers suggest that dedicated bench equipment will yield to more universal equipment that will:

- Facilitate the holding and straightening of vehicles made of old or new materials.
- Incorporate automatic electronic measurement and documentation throughout the repair process to conserve time.
- Accommodate the safe and complete repair of multiple vehicle platforms, rather than being restricted to just a single platform.

Suspension alignment matters too

As vehicle suspensions have become complex, proper alignment, ride height, spring position, and wheel/tire condition are now critical to a vehicle's directional stability, response, cornering adhesion/balance, tire wear, fuel economy, and safety. Vehicles are also equipped with expensive high-quality tires and wheels, which have high replacement costs.

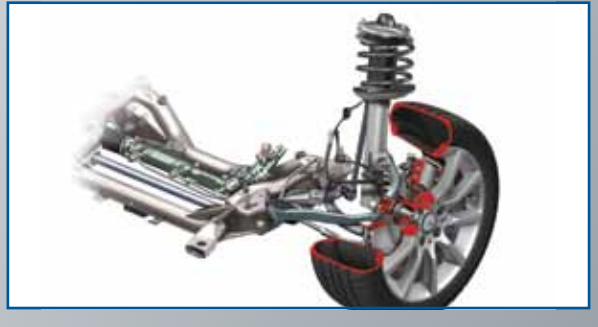
Mercedes-Benz requires four-wheel alignment on all of its models. To properly align a Mercedes-Benz suspension, technicians must use the approved equipment, tools, and procedures for any alignment procedure.

In the mechanical service world, basic maintenance-level wheel alignments resolve most problems. Minor adjustments to camber, caster, or toe are often enough; otherwise, the installation of repair bolts, parts, or kits will generally correct caster, camber, toe or the steering angle sensor angles that are within 0.25 to 0.50 degrees of specs.

Some techs assume that the included angle (IA), caster, and steering axis inclination (SAI) only need to be measured when components have been bent or damaged in a collision, but Mercedes-Benz requires that they be checked during every alignment, even if it is done as maintenance. This is because the latter

Suspension Alignment Diagnosis is a Lean Procedure

Taking 10 to 15 minutes to properly diagnose a car at the beginning of a suspension alignment allows a more definitive analysis, speeds the actual alignment process, and improves technician efficiency. For example, consider Mercedes-Benz models equipped with front MacPherson strut multilink suspensions. Alignment diagnostics training shows technicians that for this scenario, the set of values for camber, SAI, and IA will fit one of the lines in the table below. That narrows the search for cause(s) of an alignment problem. In some cases, the cause may require further bodyshop repair (e.g. bent frame).



Camber	SAI	IA	Then Check For:
Positive	Negative	OK	Bent lower control arm and frame
Positive	OK	Positive	Bent strut, knuckle and ball joint
Positive	Negative	Positive	Bent knuckle or ball joint ***AND*** bent lower control arm and frame
Negative	Positive	OK	Strut tower in at top
Negative	OK	Negative	Bent strut, knuckle or ball joint
Negative	Positive	Negative	Bent strut, knuckle or ball joint ***AND*** strut tower in at top

two are key pivot mounting points that actually hold the suspension to the vehicle.

During a suspension alignment, ride height adjustment procedures may require that a specified weight be placed inside the vehicle cabin to simulate a driver being in the vehicle, so that the alignment simulates the vehicle running at a typical curb height. In addition, proper ride height also determines spring position, which can also impact performance, comfort, and safety.

Use the Romess-Rogg electronic inclinometer to measure ride height via the position of the transverse links on front and rear axle drive shafts. Unlike other tools that are sometimes used for vehicles with conventional suspensions, the Romess-Rogg tool can handle models that are out of spec as well as those equipped with either an Airmatic air suspension or ABC hydraulic suspension. For example, Airmatic or ABC suspensions specify different ranges for the Romess inclination values, which allow a technician to then use the Mercedes-Benz SDS tool to raise or lower the car until it is in range and then calibrate the controller to accept that position as right. That's the difference being properly equipped makes.

The ride height for all models — in or out of spec and regardless of suspension type — can be easily measured and adjusted by using the Romess-Rogg CM-09606 inclinometer. Other tools are limited to in-spec vehicles without air or hydraulic suspensions.

Clearly, no customer or facility wants post-collision repair handling problems, premature tire wear, or stability control problems, or the liability risk should another collision occur. So, shop owners must see that the approved service information is easily available to the technicians, and that they keep up to date on procedures, equipment, and suspension designs.

Never Repair a Mercedes-Benz Wheel

Wheels are designed to take an up and down pounding all day long, mile after mile. But they are not designed to take an impact – whether from the front or back, and especially from the side. In addition, wheels are manufactured from several heat-sensitive alloys – copper for flexiblilty, magnesium for durability and aluminum for lighter weight). When heat is applied, aluminum, for example, becomes malleable at only 200ºF. In addition, unseen microscopic fractures in a damaged wheel may compromise its integrity. At high speed or when cornering, any wheel failure could be catastrophic.

Power Plant

With all the modern conveniences found in Mercedes-Benz vehicles, it's no wonder they also have a technologically-advanced power distribution system. The Dual Battery system helps manage this symphony of electronics.

Technology does not come without consequences. Mercedes-Benz vehicles are some of the most technologically advanced on the planet. The features that separate them from ordinary vehicles are very often the computer systems that control almost everything from the powertrain and chassis to body and HVAC, and all of them require a stable source of electrical power. As this situation evolved, changes had to be made to the conventional charging and power supply systems to keep pace with electrical demands. What most people do not know about their charging systems is that not much charging is going on at idle. The alternator is simply not spinning fast enough to make any appreciable current. The real charging takes place on the highway. Even then it is more of a trickle charge than a big boost since much of what's generated is being used up by big consumers as you drive.

Generally, current draw is much less on a sunny day than on a cold night with rain when the blower motor, headlights, and wipers add to the load. The alternator has to supply stable current and voltage under these varying conditions, so Mercedes-Benz developed a dual-battery system that increases power storage capacity to provide a safety margin – one battery starts the engine and the other supplies

(Above) If you see a relatively large conventional lead acid battery (clear case), it is for starting. All jump starting should be done here, and you should load test it in the conventional way. This battery requires maintenance, so check the electrolyte level and specific gravity.

the rest of the vehicle. They can be isolated from each other when the extra capacity isn't needed, and combined under heavy electrical loads. Also, non-essential electrical consumers can be shut off if the total load exceeds the system's capabilities. As with any other feedback system, a control unit is necessary to monitor the electrical load and make the necessary changes, such as tapping into or isolating the additional battery.

There are two variations of the dual-battery system you will find on Mercedes-Benz vehicles. You can tell them apart by the size of the battery under the hood. The larger conventional lead-acid battery is on the late 1990s/early 2000s system. The smaller motorcycle-type battery is used on the early to late 2000s. The early system uses the conventional battery mainly for the starter if the other trunk-mounted battery is low. It can also supply current when vehicle demands are high. This is the only battery you should jump start the engine from. It is known as the "starter" battery and the red warning tag over the positive battery post lets

us know that. The larger battery mounted in the trunk is known as the "systems" battery. It supplies power to the accessory and ignition switch-on functions. You should never attempt the jump start the vehicle from this battery.

On the later system, a smaller (motorcycle-sized) battery is mounted underneath the cabin air filter. It is of the VRLA (Valve Regulated Lead Acid) type, and uses AGM (Active Glass Mat) construction. It is usually in a black case and the label identifies the battery type and specifications. This battery is a sealed unit, but if internal pressure increases to a predetermined point a relief valve opens. AGM batteries use absorbent glass mat to hold the electrolyte against the internal plates. They need to be charged at a very low level over long periods, or with the AGM settings on your charger. The larger systems battery found on both the older and newer variations are also of the VRLA type. This is one reason replacement batteries should be OEM from your Mercedes-Benz parts supplier. The rest of the system is designed to work with this type of battery, and any substitutions can lead to trouble codes and poor performance.

The early system (with the conventional starter battery) has a Vehicle Power Supply control module. It manages the charging of both batteries with two relays. One is the cut off relay, and the second is called the isolation relay. The cut off relay disconnects the starter battery from the rest of the charging system when it is in the relaxed state. When the systems battery drops below 10.8 volts, the cut off relay is energized and the starter battery voltage is added to the overall system. It is also energized to allow the charging system to charge the starter battery. The isolation relay is normally closed and

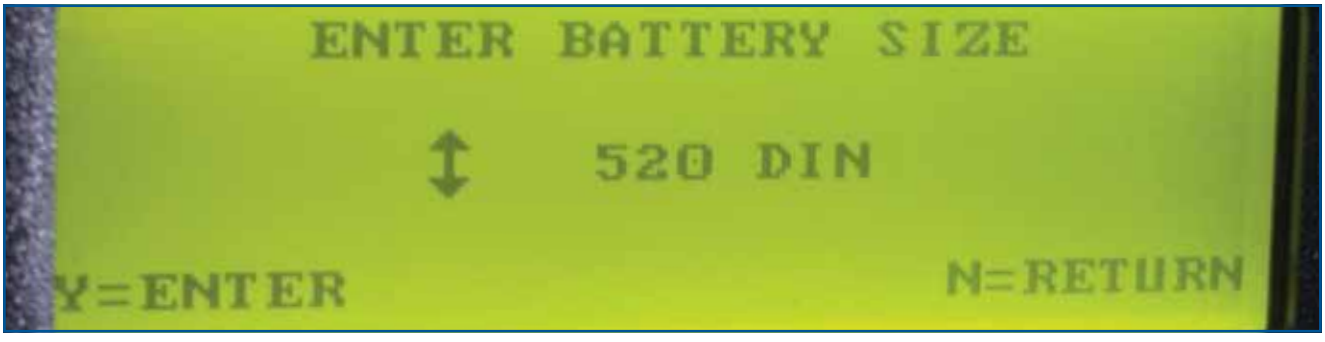
Don't discard the systems battery's positive post cover as it carries the warning not to jump start the vehicle from this post. Also, these VRLA/AGM batteries should not be charged as you would a conventional unit. Use low current over a longer period of time, or simply use a charger specifically designed to handle AGMs.

At the base of the windshield under a protective cover is the auxiliary relay. This connects the auxiliary batter to the system either to supply voltage or receive charging current for the auxiliary battery.

provides voltage to the accessory power sockets. When voltage is low, the relay is energized opening the voltage supply circuit to the accessory sockets. Through CAN messages to the SAM module, other accessory consumers such as seat heaters are shut off to reduce the electrical load.

The later system works slightly differently. The under-hood battery is an auxiliary battery, not a starter battery. A Battery Control Module (BCM) monitors the available battery voltage at start up and during heavy electrical loads. It is critical that you do not connect vehicle accessories directly to this battery as the BCM will not measure these electrical loads. Always attach accessories through one of the fuse circuits in the pre-fuse boxes. The control unit still controls two relays. The cut off relay still interrupts electrical consumers if battery voltage is too low, but now we have the auxiliary battery relay that simply adds an additional power source to meet the demands of the vehicle. You can look at data with your SDS since the control modules are integrated into the car's CAN network. Remember, substitute batteries were not made to work with the vehicle's battery control units and you may set codes or cause premature failures. To test these VRLA batteries you will need a tester with an appropriate setting. The Miditronics 717 is one tool that Mercedes-Benz approves for testing these batteries. Knowing how a system works and properly repairing it properly is what Mercedes-Benz wants for your customers and your business.

Read the label on the battery and you may see some ratings you are not used to. For instance, Ah stands for Ampere Hours and DIN is Deutsches Industrie Norm, the European equivalent of SAE. You are probably accustomed to looking for the cold cranking amp reading. This is one difficulty in finding a non-OEM replacement.



When using an AGM battery tester, you will have to enter the specifications of the battery. You may have to change the units you are measuring with to make sure the tester performs the correct test.

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3. Test all other critical components.
4. Replace components that do not meet specs.
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Rebuilt Process (Typical Aftermarket)

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2. Replace damaged part with non-OE part and clean.
3. Re-assemble, test and box.

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Cat Got Your Tongue?

With very few exceptions, the catalytic converter has been on every gasoline-burning car sold in the U.S. since 1975. Over those 36 years, we've sometimes seen them clog and lower engine performance, or lose their efficiency, setting codes and/or preventing a vehicle from passing an emissions test. Here's how to make sure that cat's really dead before replacing it.

To start the catalytic process, fresh oxygen-rich air is injected into the exhaust stream during engine warm-up for approximately two minutes. Combined with the rich mixture of a cold engine, this gets the converter hot enough to initiate the oxidation process quickly.

The goals engine designers strive for are basically maximum fuel mileage, minimum emissions, and performance that makes the vehicle fun to drive, but trade-offs must be made to achieve them simultaneously. When the catalytic converter was first adopted, critics warned that this restriction in the exhaust stream would decrease fuel mileage and horsepower, but just the opposite happened. Since the engines of cat-equipped vehicles could have much more efficient calibrations than the previous "leaner and later" emissions-reducing strategies and still meet regulations, performance and driveability actually improved markedly.

At about the same time, many high-population states and municipalities started emissions inspection programs to verify that vehicles were not gross polluters. These tests took a diluted sample at the tailpipe and measured percentages, parts per million, or grams per mile of HC, CO, and NOx directly. Since 1996, of course, we've had an OBD II monitor that tests the efficiency of the catalytic converter by means of oxygen or A/F sensors both upstream and downstream of the converter, and the diagnostics in the PCM (Powertrain Control Module).

Capacity

What's actually being tested here is the cat's ability to store and release the oxygen needed to complete its reactions. If the engine's air/fuel ratio is rich for too long, the stored oxygen can be used up, and this situation is called catalyst "punch through." So, the PCM compares the activity of the upstream HEGO or A/F sensor to that of the one downstream. A good cat will have large oxygen storage capacity, so it will absorb fluctuations in the oxygen content of the exhaust, somewhat as an electrical capacitor smoothes voltage variations.

The PCM expects to see a big difference between the amount of voltage change activity in the upstream sensor and the one downstream. If, instead, it sees that the ratio between the two is close to one, the catalyst fails its monitor.

Construction

The core of a catalytic converter is a ceramic honeycomb substrate that maximizes the surface area that comes into contact with the exhaust gasses. It has a "washcoat" that contains the catalytic material. The irregular surface created by the washcoat further increases the area, which gives the converter the maximum chance to burn up the HC and CO, and break down the NOx, in the exhaust. Expensive "noble" metals are suspended in the washcoat, chiefly platinum, palladium, rhodium, and cerium.

And here is where a big difference in quality between OEM units and aftermarket replacements

makes itself known. To keep materials costs down, non-OEM units use as little of those metals as possible, and we've seen where they often don't last even a year, or can't pass the monitor or a emissions test when new. There are often complications with the physical installation, too.

Vehicle	203.064	Control unit	ME-SFI 2.8	
Self-adaptation				
No	Name	Specified value	Actual values	Unit
008	B28 (Intake manifold pressure sensor)	<= 500	335	hPa
181	Self-adaptation enabled		YES/NO	
576	Selfadaptation in idle speed range, right bank of cylinders	[-1.000...1.000]	0.368	ms
596	Selfadaptation in idle speed range, left bank of cylinders	[-1.000...1.000]	0.362	ms
577	Self-adaptation in lower partial-load range, right bank of cylinders	[0.680...1.320]	1.000	
597	Self-adaptation in lower partial-load range, left bank of cylinders	[0.680...1.320]	1.000	
578	Self-adaptation in upper partial-load range, right bank of cylinders	[0.680...1.320]	1.000	
598	Self-adaptation in upper partial-load range, left bank of cylinders	[0.680...1.320]	1.000	

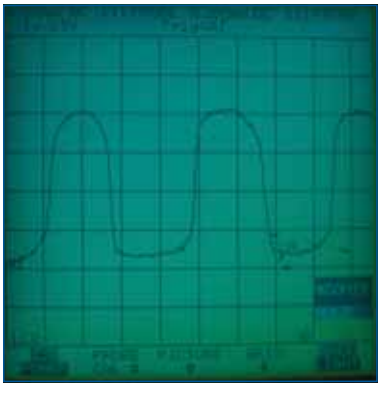
Always look at fuel trims first. You may find a fuel control issue that is adding to the problem. Exhaust leaks can also contribute to the setting of a P0420, P0430.

Mercedes-Benz does not engage in this type of cost-cutting with its genuine replacement catalytic converters, choosing instead to supply units that meet as-new standards of performance, durability, and fit. Such adherence to quality will not only help you avoid comebacks and dissatisfied customers, but also make your job easier.

Feline fatalities

Mercedes-Benz catalytic converters are engineered to last for the life of the vehicle, so make sure you answer two questions accurately before you replace one. First, has it really failed, or is some other problem reducing its efficiency and causing a code to set? Second, if it is indeed ruined, what condition caused its destruction?

Cat failures start with the obvious: mechanical damage such as a shattered substrate (does it rattle when you hit it with the heel of your hand?), or perhaps corrosion or metal fatigue in a very old unit, Next, there's lack of catalytic action, which may be due to contamination of the metallic elements from oil burning, an internal-engine coolant leak, or silicone from non-sensor-safe RTV. Or, in the case of the oxidation section, insufficient fresh air whether or not an air-injection system is present. For the reduction section, poor catalysis may be due to an air/fuel ratio that's not being held at stoichiometry (14.7:1 air to fuel by weight) because of some electronic engine management problem. Finally, there's melt-down and clogging, which is typically caused by overheating from misfiring or continuous running in open loop.



When using the O2 or A/F sensors to evaluate the functioning of the converter, you're obviously assuming that the sensors are good. Shown is an O2 sensor switching rich to lean at about 800mv at a rate of one switch per second.

The most common DTCs (Diagnostic Trouble Codes) are P0422 and P0432, which indicate that efficiency is below specs for banks #1 and #2, respectively, on a "V"-type engine. But the presence of codes doesn't necessarily mean the cat is wrecked, or even significantly degraded, so it behooves you to do further testing.

A false converter DTC is often the result of a slight misfire that's below the misfire monitor's reporting threshold. This may add enough extra gasoline to the exhaust stream to exceed the cat's oxygen storage capacity, thus making the signal from the downstream sensor jagged enough to set a code.

If you've invested in an SDS, under actual values you can evaluate the engine's "smooth running" to isolate any problem cylinders. Check the spark

plugs and compression of any indicated. The next thing to look at is fuel adaptations of the misbehaving bank. If the mixtures are too lean or too rich, the PCM will compensate. If the adaptation limits are reached, you should get fuel trim codes, but you may see cat efficiency codes first. Try to correct any fuel trim issues to get the adaptation number as close to 0.0 as possible. Also "smoke" test the exhaust to make sure you don't have any air leaks. False air can change O2 or A/F sensor readings and lead to converter efficiency codes.

Also, you can use your SDS to monitor catalytic converter operation. You can plot the oxygen sensor voltage scan data in the "Lambda" values. Front O2 sensors will switch above and below .5V with a normal mixture. At idle, you will also see the rear sensors toggle in a similar fashion. The converter has not "lit off," so you will see little to no change from front to rear readings. Bring the rpm up to a steady 2,000 and wait. If the cat is working, you should see the rear sensor signal start to stabilize . Of course, here we are relying on properly-functioning sensors. You should also verify that the O2 sensor heater has a 12V supply and is properly grounded. You can also easily measure the heater element's amp draw.

Plugged

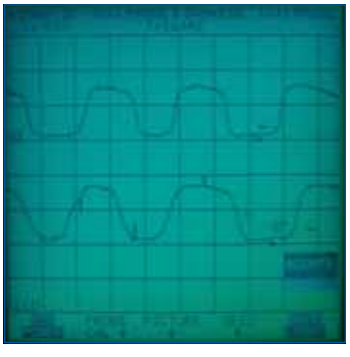
The symptoms of a clogged catalyst are usually anemic power, poor fuel mileage, and, in serious cases, backfiring through the intake.

The easiest test for plugging is done with a vacuum gauge. Note the reading at idle, then hold rpm at 2,500. The needle will drop when you first open the throttle, then stabilize. If the reading then starts to fall, excessive backpressure is the probable cause.

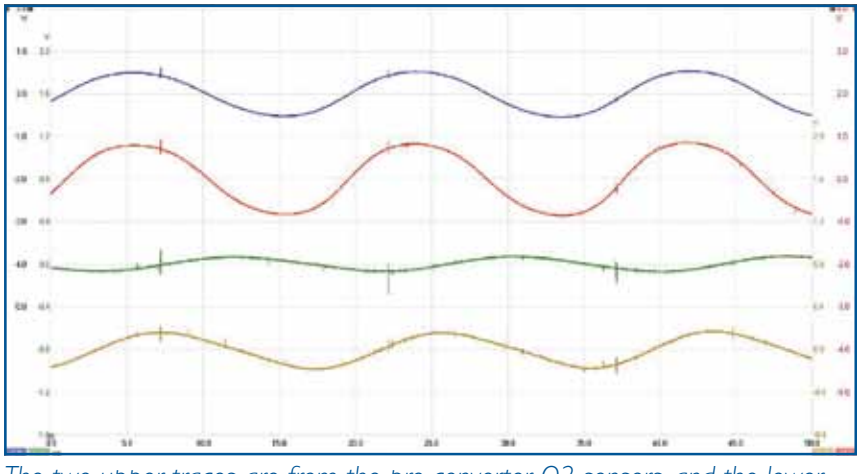
But don't stop there. The next step is to check backpressure directly. If the vehicle has air injection, disconnect the check valve from the distribution manifold, and plug in a pressure gauge (you want one with a low scale). Or, remove the upstream O2 or A/F sensor and take your reading at its hole in the manifold. Check the specs for the car at hand, but if you see over 1.25 psi at idle, or more than three psi at 2,000 rpm, there's a restriction in the exhaust system.

There's yet another direct means: Remove the converter and shine a light through it. You should be able to see breakage and meltdown. If there are too many bends in the pipes for a clear view, put your shop vac in its blow mode and use a tapered adapter to force those CFM through the unit. If you hear the sound of the vacuum's motor change, flow is being strangled.

One final note: If the vehicle is still under the federally-mandated eight year or 80,000 mile emissions warranty and hasn't been abused or tampered with, the cat is definitely covered. While sending your customer back to the dealership will mean losing the work, it will make you a hero.



You can compare the front and rear O2 sensor signal voltages, as we are here. This was taken with the engine in the warm-up phase and at idle. The catalytic converter has not reached operating temperature, so they are both about the same.



The two upper traces are from the pre-converter O2 sensors, and the lower traces are post converter. Bank #1 is the upper trace and bank #2 is the lower. Bank #2s cat is apparently struggling to clean up the exhaust.

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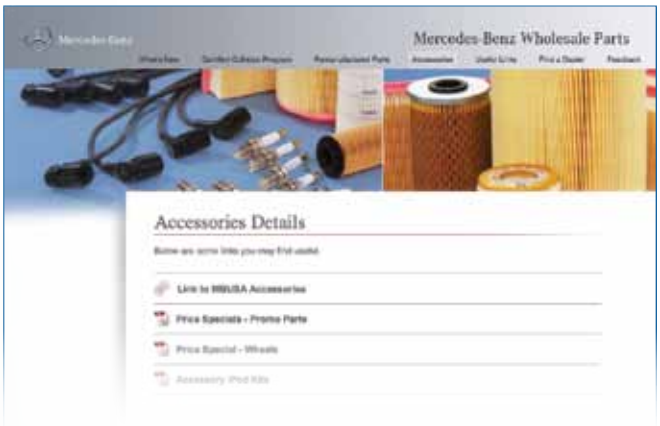

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