

STARTUNED®

Information for the Independent Mercedes-Benz Service Professional

March 2017

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INSIDE:

ALL CHARGED UP

MERCEDES-BENZ ELECTRICALLY-POWERED STEERING

MERCEDES-BENZ EXHAUST SYSTEM WORK

TRANSMISSION MAINTENANCE

Mercedes-Benz



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STARTUNED®

March 2017

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:

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Maintenance is the key to vehicle reliability, and is the bread-and-butter of the independent workshop. Most vehicle owners know to get their oil changed regularly – witness the growth of quick-lube joints – but what about that automatic transmission?

Editor's Note: In the December 2016 issue, we stated that "virtually any part is available to you" when discussing TRP parts, with a 'catch'. Another 'catch' we neglected to include is that electronic vehicle keys carry one additional requirement: The dealer must verify that the key operates properly in the vehicle. This means that you either need to bring the vehicle to the dealer, or have someone from the dealer travel to the vehicle, to insert and verify the key's operation.

[We apologize for this oversight.](#)

Visit us at our web site MBWholesaleParts.com to view past issues of *StarTuned*®, along with a wealth of information on Genuine Mercedes-Benz Parts.

Visit mbusa.com to locate a Mercedes-Benz dealer near you.

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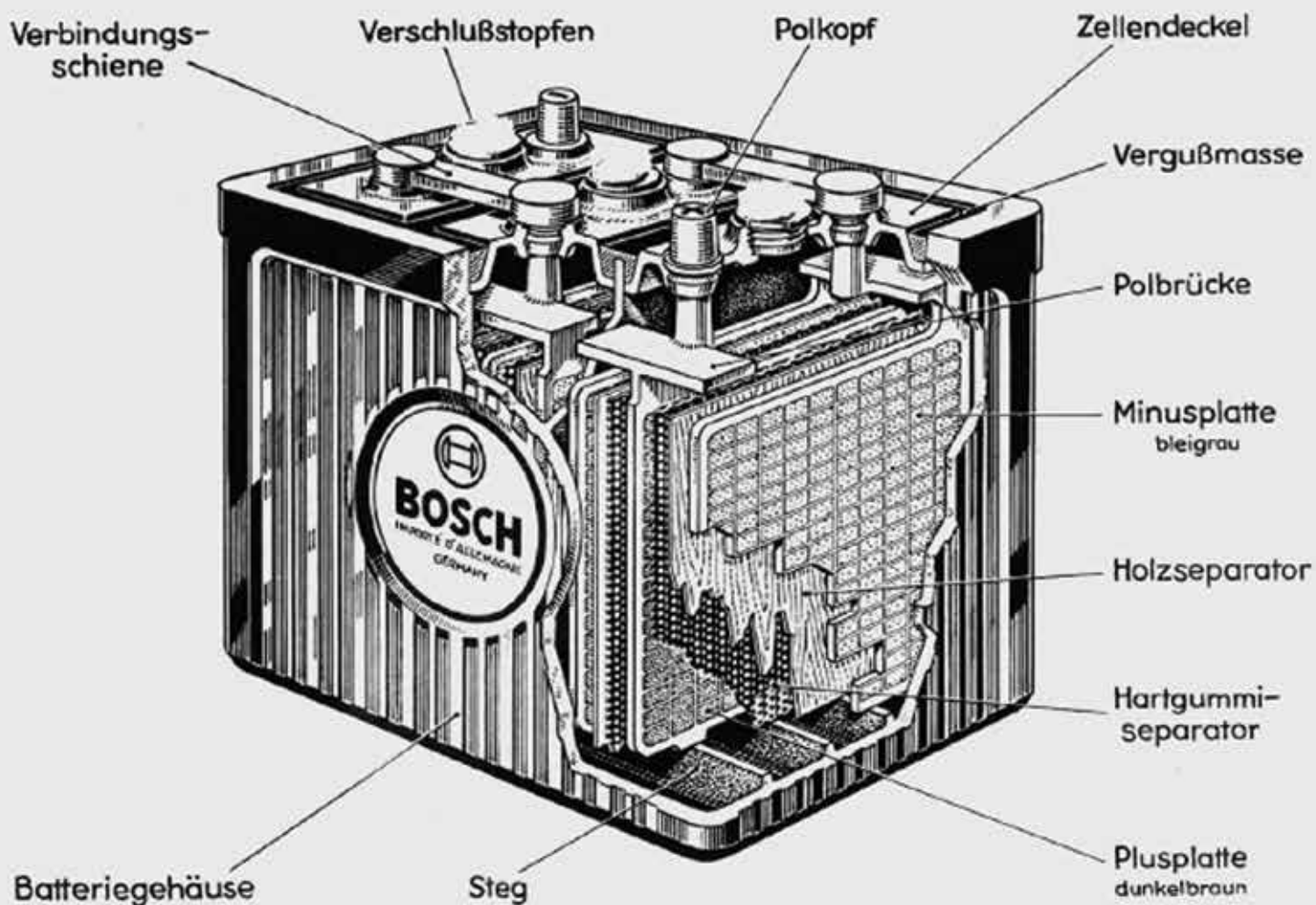


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All Charged Up

The design, operation, and diagnosis of charging systems and battery control modules, and a look at AC ripple and the problems it can cause



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

As far back as history records, man has endeavored to come up with ways to convert potential energy into kinetic energy. That is, energy which is stored by virtue of its configuration or position versus energy which is a body in motion. Early civilizations were primarily agrarian and the farmers would convert the grain that they stored (potential energy) into kinetic energy as they fed it to their animals to pull their plows and such. They would then raise crops to store, which then again became potential energy and the process started all over again. Fast forward to the modern day automobile and you find all kinds of potential energy and kinetic energy going on. We will primarily focus here on the battery, where energy is stored, the modern systems that charge them, and also troubleshooting.

Early batteries

It is not certain exactly when the first battery was conceived, but Allesandro Volta traditionally gets the credit. Archaeological digs have discovered devices that could possibly have been used to store electrical energy, but it was Volta's experiments in the late 1700s and early 1800s that paved the way for the modern battery. Volta discovered that certain fluids would generate a continuous flow of electricity when used as a conductor. This discovery led to the invention of the first voltaic cell. He also learned that he could increase the voltage output if he connected the cells in a series. Continuing in his experiments, he found that different metals have different electron affinities so that if he used silver and zinc immersed in electrolyte he would get different voltages than if he used lead and tin.

Lead acid batteries

Lead acid batteries are the oldest rechargeable batteries in existence, and the first manufactured for commercial use. Lead acid does not lend itself to fast charging, so finding the perfect voltage limit is critical. A high voltage (above 2.4V per cell) produces good battery performance, but shortens battery life due to corrosion on the positive plates. Conversely, a low voltage charge tends to promote sulfation of the negative plates. Arriving at the ideal charge rate is where modern charging equipment comes in, which we will discuss later in this article.

Lead acid batteries also do not lend themselves to deep cycling. A full discharge causes extra strain on the battery, and each cycle robs the battery of some service life, so keeping the battery charged up is critical to longevity. A typical sealed lead acid battery will survive approximately 200 to 300 discharge/charge cycles. Corrosion of the grid plates of the positive electrode is the primary reason for this relatively short cycle life.

Lead acid batteries have low energy density per unit of weight making them unsuitable for portable devices. Also, performance at low temperatures is diminished. On the plus side, the self-discharge rate is about 40% per year, which is among the best of all rechargeable batteries. By, Ni-Cad batteries self-



Nothing compares to a battery that bears the "Genuine Mercedes-Benz" label.



discharge this same amount in about three months.

Why AGM?

AGM (Absorbed Glass Mat) battery technology became popular in the 1980s to reduce weight and improve reliability. The sulfuric acid is absorbed by a very fine fiberglass mat, which in turn make the battery spill-proof. This also allows shipping without hazardous-material concerns. AGM batteries have very low internal resistance, can deliver high currents on demand, and offer a relatively long service life. AGMs are maintenance-free as well. Additional advantages of AGM batteries are a charge rate that is up to five times faster than that of the typical flooded lead acid battery, and the ability to survive deep cycling. These characteristics make it the ideal battery for today's high electrical load vehicles. AGM batteries do not like heat, though, which is why typical installations are in the trunk and not in the engine compartment.

What do the numbers mean?

CCA (Cold Cranking Amps) is a rating used in the battery industry to define a battery's ability to start an engine in low temperatures. Generally speaking, it is easier to start an engine in a warm environment than in a cold one. The rating refers to the number of amps a 12V battery can deliver at 0°F. for 30 seconds while maintaining a voltage of at least 7.2. The higher the CCA rating, the greater the starting power of the battery.

RC (Reserve Capacity) is a general indicator of how long a new, fully-charged battery can continue to operate essential accessories if

the vehicle's charging system fails. It identifies how many minutes the battery can deliver a constant current of 25 amps at 80°F. without falling below the minimum voltage (1.75V per cell) needed to keep your vehicle running.

Amp Hour or C20 is an indicator of how much energy is stored in a battery. It is the energy a battery can deliver continuously for 20 hours at 80°F. without falling below 10.5V.

First things first

In order to conduct a proper charging and battery systems test, we must first evaluate the battery's state of charge. Since the release of the model 204, it is now possible to evaluate the battery's state of charge via the IBS (Intelligent Battery Sensor) data stored in the SAM (Signal Acquisition Module), and the CAN bus keep-awake unit recognition in the CGW (Central Gate Way).

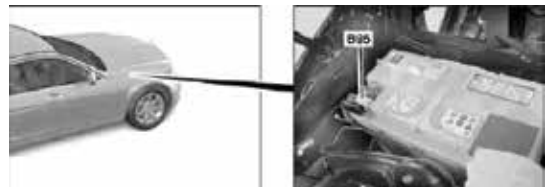
IBS design and function

The IBS is attached directly to the negative

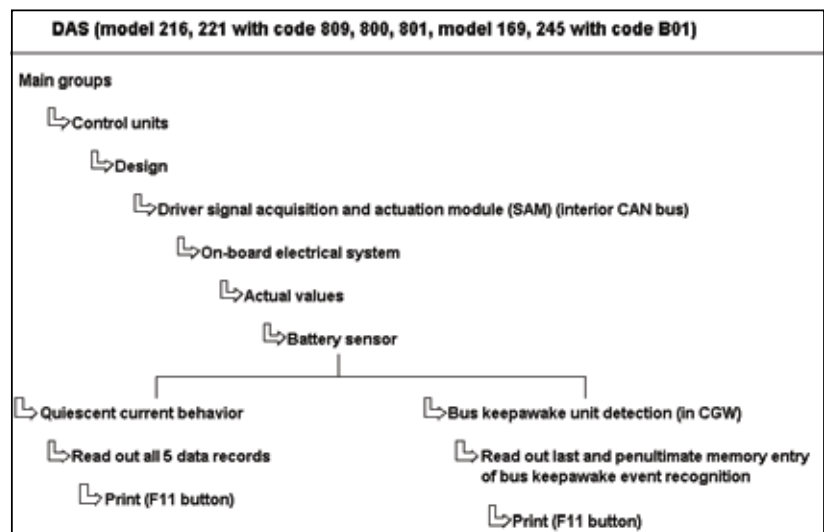
pole of the battery via the post terminal. Along with the terminal, the mechanical part of the battery sensor comprises a shunt and a ground pin. The shunt is attached to the vehicle's load path and is used as a measuring resistor to determine the current indirectly. On the ground pin, the existing ground cable can be conveniently attached. The electronics are located in a molded housing with a connector as an interface for energy management. It



Here's what the Intelligent Battery Sensor looks like...



...and here's where you'll find it.



You can get to the IBS data with these steps in DAS and XENTRY.

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- Wiring Diagrams
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records the voltage of the on-board electrical system battery and the on-board electrical systems' power consumption. These measurements are used by the battery sensor to calculate the internal resistance of the electrical system battery. A temperature sensor integrated into the battery sensor measures the temperature at the negative terminal. This is then used to calculate the inside temperature of the battery.

The battery sensor provides the following electrical system values to the rear SAM control unit:

- Voltage
- The internal temperature of the battery

Using Xentry or other compatible scan tool, you can access not only the IBS data in the rear SAM, but you may also be able to identify the reason for the low state of charge in the battery. Below is just one of the menu options you'll find for diagnosing the battery.

If you have a case of a discharged battery/vehicle does not start complaint, you would read out the fault menu of the IBS. Say, the

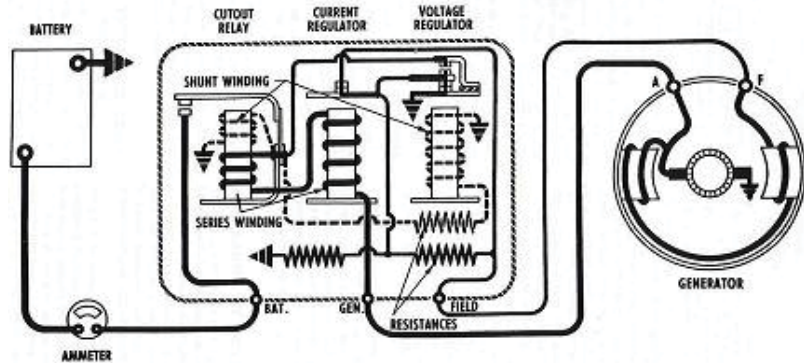
following entries are present:

- Power consumption of standing lights or parking lights
- Power consumption of low beams

You may have an indication of a faulty rotary light switch. If no other faults are found, then proceed to charging and testing the battery itself. The battery must be charged using an approved charger (see SSEP catalogue located under "MB Equipment" menu of STAR TekInfo).

A high quality diagnostic battery charger will determine the internal condition of a battery before attempting to apply a charge to it. The charger applies an AC signal at a known frequency across the

terminals and measures the internal conductance to determine battery health before attempting to charge. It is important to complete this step before moving on to testing the charging system of the vehicle. The battery should be fully charged up or replaced if it has been found to be faulty or your charging system data could give you faulty readouts. Correct charging of the on-board electrical system battery, starter battery, and buffer battery helps to ensure that the vehicle continues to start, functions properly, and has optimal battery life. The battery charging period depends on the charge level at the time. The battery is sufficiently charged when the



Not only did DC generators have little output at idle and slow speeds, they were mechanically complex. Look at all those segments in the commutator!



The alternator (or, AC generator) first appeared in about 1960 in plenty of time for the explosion in electrical accessories (courtesy Robert Bosch).

charging current reading is $< 25A$. Most modern computerized chargers will determine the correct charging time and rate and also tell you when the charge is complete.

The next step: converting mechanical energy into electrical energy

Now that you have verified a fully charged battery and located any possible sources of battery failure, it's time to check the charging system. As earlier discussed, we know that lead acid batteries do not like to be fully discharged so it's critical for battery life and the vehicle's reliability to have the charging system working properly.

The first electric generator was invented by Michael Faraday in 1831. This British chemist and physicist did extensive work in the field of electricity that paved the way for the inventions of the electric motor and transformer. Faraday discovered electromagnetic induction. He found that the electromagnetic effect a current has in one wire is able to generate electricity in another wire. Using this information, he learned how to produce a steady current. He connected two wires to a copper

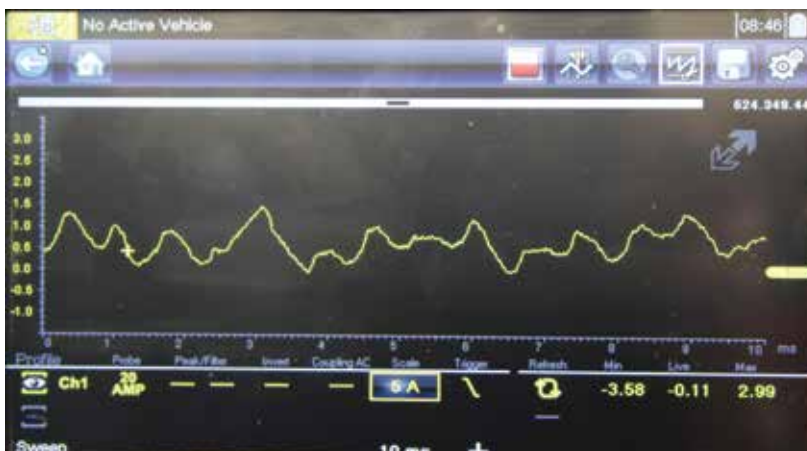
disc. He then maintained a steady current when he switched the disc back and forth between the two poles of a horseshoe magnet. Thus he made his first electric generator. Today's systems have come a long way from his first invention, but the principle is still the same: Use the mechanical power from the engine to drive the alternator to recharge the batteries and sustain the electrical load of the vehicle.

Early vehicles had charging systems that depended on DC generators. When the engine was running at low rpm, the generator had little or no output, and the battery provided all the energy needed for the electrical system. When vehicle speed reached about 20 mph, or engine rpm reached about 1,200, the generator would begin to charge, and this output would help the battery with some of the electrical load (this is known as the generator "cut-in" speed). At higher engine rpm of about 1,800, the generator was capable of providing all of the electrical current needed to run the accessories (of which there were very few in those days), as well as to recharge the battery as needed. Generators typically provided their maximum output at about 1,800

to 2,300 rpm of engine speed. The pulley diameter of a generator is designed so the engine will spin the generator at, or close to the rpm at which the generator operated most efficiently. This rpm was matched to the rpm at which the engine was expected to spend most of its time. A voltage regulator protected the system from overcharging by maintaining the optimum charge voltage. You can see drawbacks to this set-up, and with the advent of more electrical loads a more efficient system was needed.

Enter the alternator

Alternators have a great advantage over DC generators of not using a commutator, which makes them simpler, lighter, and more long-lived than their predecessors. The stronger construction of alternators allows them to turn at higher speed – typically twice engine rpm – improving output when the engine is idling. The availability of low-cost solid-state diodes from about 1960 allowed auto manufacturers to substitute alternators for DC generators. Automotive alternators use a set of rectifiers (diode bridge) to convert AC to DC. To provide direct current with low ripple, automotive alternators have a three-phase winding. There are typically three separate windings of wire in the stator that so that the AC current that is generated is slightly out of phase in each one. The peaks and valleys of the rising and falling current do not happen at the same time, rather they are staggered a bit. This increases and smooths the electrical output of the alternator much the same way that a 12-cylinder engine runs more smoothly than a four cylinder does – there are more power pulses happening in each revolution



AC in the DC is bad medicine that can mask real problems and make electronics go mad.

allowing more total power and better smoothness.

The process of rectifying the AC into DC is handled inside the alternator by something more advanced than a commutator: diodes. A diode is a solid state device that allows current to flow in one direction only – “solid state” means it does this without any mechanical or moving parts. It relies on the different electrical properties of the materials it is made of to act as a one-way valve for current. By arranging diodes so that current from each of the three stator wires is only allowed to pass in one direction, and by connecting the three outputs together, you get a reasonably smooth and stable DC output without any moving parts (this arrangement is typically manufactured as a single part and is referred to as the diode pack or diode trio). This lack of moving parts makes the alternator not only very reliable, but also comparatively inexpensive to build and repair.

Testing

Keep in mind that for some time Mercedes-Benz vehicles/engines have been equipped with alternators that communicate with the ME or CDI engine control computer via an interface. This results in changes to system diagnosis. When testing the alternator, a distinction is made between conventional alternators with terminal 61 without interface, and alternators with BSS interface or LIN interface. Using Xentry or other compatible scan tool, you will want to check control modules for related codes stored as well as freeze-frame data to help in your evaluation of the vehicle charging system. You can generally follow the on-screen instruction to complete testing. Steps will include (but not be limited to):

- Recording voltage output at idle and 2,500 rpm, both with and without electrical loads.
- Current output at same stated conditions
- Checking all wiring and connections at the battery and alternator.
- An alternator diode ripple test.

An analysis of diode ripple is important as excess ripple may mask a problem with otherwise proper output from the alternator. If only one or two diodes have failed, the alternator may still produce enough current to meet the vehicle’s electrical needs, but it may not be enough to keep up with higher loads or to maintain a full charge. This could cause the battery to run down over time.

Diode failures may also allow AC to leak into the electrical system. AC voltage creates electrical “noise” that can confuse electronic modules

and digital communications. A leaky diode also can allow current to drain out of the battery through the alternator when the vehicle is not being driven. If your testing proves that there’s an internal failure of the alternator, the repair is as simple as replacement – all the components are integrated into one unit.

Genuine Mercedes-Benz alternators are available either new or remanufactured, the latter having been thoroughly reconditioned and upgraded to the latest technical standards by the experts. The reconditioning process is subject to strict quality standards so that Mercedes-Benz reconditioned alternators offer the same quality as a new part, but at a significantly reduced price.

Be sure to verify your repair when complete so you can send your customer away all charged up! |



Genuine Mercedes-Benz remanufactured alternators are so carefully re-done that they're as good as new.



Don't let your customers get stranded. Test the battery.

Consumer Battery Mindset

- 77% of consumers wait until the battery fails to replace
- 74% choose another outlet for batteries

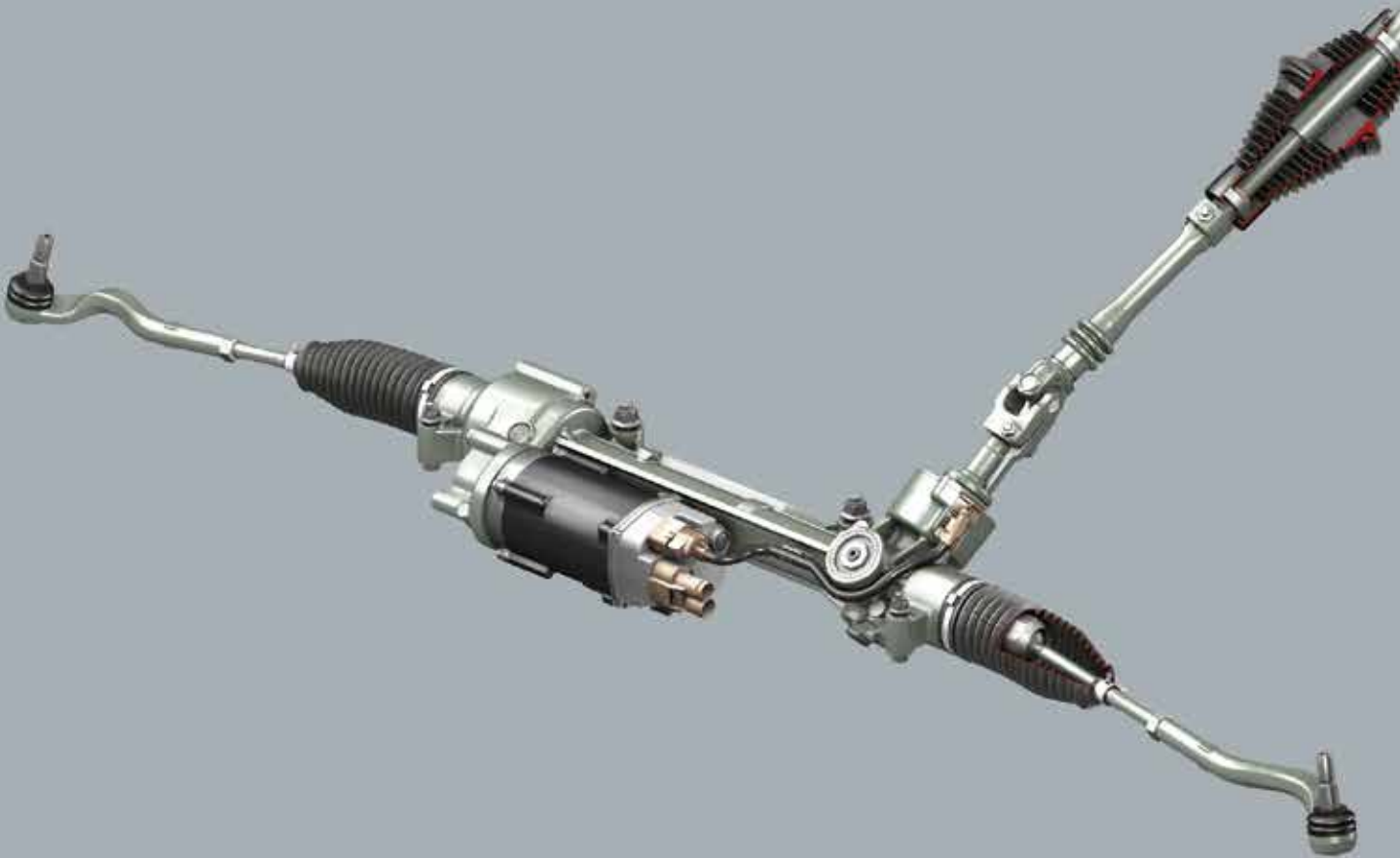
Proactive Battery Testing

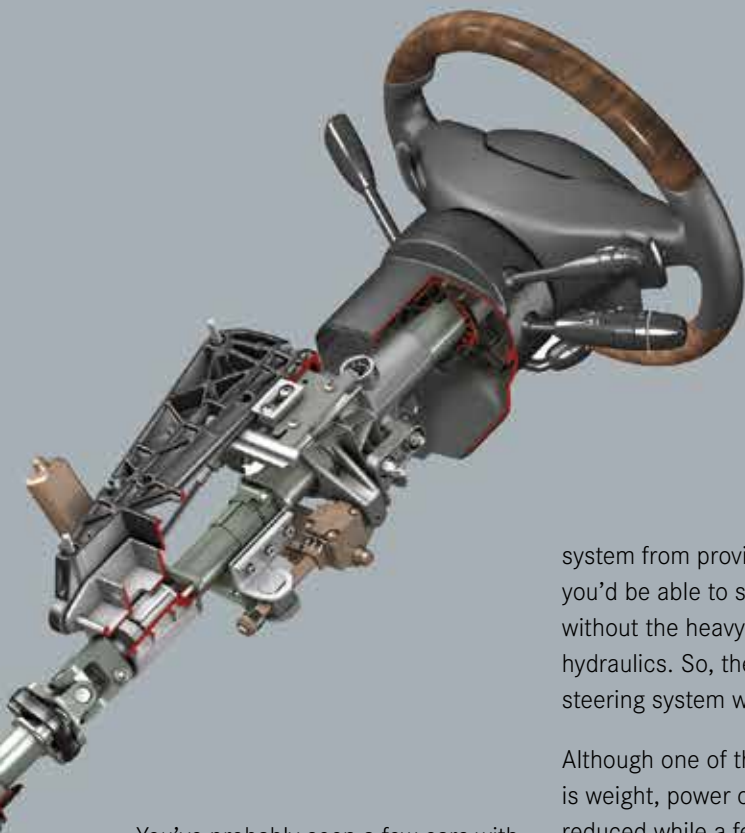
- 95% of your current customers are willing to have a battery test
- 84% will proactively replace a battery if the test shows it will fail soon

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Mercedes-Benz Electrically-Powered Steering





You've probably seen a few cars with electric power steering pass through your shop by now. Introduced in 2011 with the CLS (218) model, virtually every new Mercedes-Benz model that's appeared since then has this innovative system. In this article, we'll explain how it works and offer some tips for when something's not quite right.

Why go electric?

Daimler engineers needed a way to get rid of the power steering pump. It steals energy from the engine, hurting fuel economy, and takes up precious room at the front of the engine. It wouldn't hurt to get rid of power steering fluid, along with the weight, plumbing, and potential leaks involved. Also, if a road hazard, accident, or fire should prevent the

system from providing assistance, you'd be able to steer the vehicle without the heavy resistance of hydraulics. So, the electric power steering system was developed.

Although one of the main advantages is weight, power consumption is reduced while a few valuable new features become possible: When the engine is stopped under ECO Start/Stop operation, the power steering boost remains available. With the new Assist Systems from Mercedes-Benz, sub-systems like Steer Assist (which helps the driver make the right steering choices during critical maneuvers) and DISTRONIC PLUS (a portion of which can actually steer the car for a brief while) become possible. If the car encounters an uneven road surface (say, due to highway construction), the electric power steering system can apply a small steering force to help counteract any negative influences, as well as to counteract similar forces when braking hard. All this means the car is more predictable, easier, and safer to drive.

You also get an enhanced steering feel, which can be carefully controlled by the design engineers instead of being left to chance by the vagaries of an electro-hydraulic design. This really comes in handy in the AMG models, where the steering feel can be changed in software instead of hardware. Plus, the steering wheel return-to-center is power-assisted, no longer dependent upon the front end's caster to deliver this important necessity. Not to mention the Parking Assist system, which parks the car automatically, both parallel and perpendicular. These are all features Mercedes-Benz customers want and deserve.

How it works

The entire steering rack is self-contained, composed of the mechanical parts, a powerful electric motor, and the control unit. An Input Torque Sensor detects the steering shaft input torque from the driver, and the control unit calculates the electric power needed to drive the electric motor to assist the steering rack's side-to-side movement.

The system is in operation when Circuit 15 (ignition) is on, the engine speed is greater than 400 rpm, and vehicle speed is above zero. The torque sensor, along with the steering wheel's steering angle sensor (which also delivers steering speed) is used to determine the steering needs.



The torque sensor is found on the input shaft, well-protected against the steering housing. The input shaft passes through the torque sensor and ends inside the housing, with a pinion gear connected to the steering rack, providing a backup way of steering the vehicle, albeit without power assist, if there is some kind of system or electrical fault.

To steer the car, the control unit powers the electric motor, which transmits its rotation using a toothed belt to a recirculating ball nut. As the nut turns, the ball bearings inside drive the screw thread cut into the rack, moving it side to side with very low friction. The friction is so low, in fact, that you can push the rack side-to-side by hand if necessary (back-driving the motor) as long as Circuit 15 is off. This ability to move is necessary for the backup steering function to operate.

There's also a data network connection to the steering control unit. Not only does this allow for steering requests from other vehicle systems (ESP, Parking Assist, and DISTRONIC, for example), it allows for diagnostics, using your XENTRY machine. Note that generic aftermarket diagnosis scan tools do not usually have capabilities beyond drivetrain systems.

If the engine is off, or the vehicle stopped, there is no power assist. In vehicles equipped with ECO Start/Stop,

the power steering assistance remains active (but at a reduced level) even if the vehicle is not moving, provided the engine was stopped by the ECO Start/Stop function.

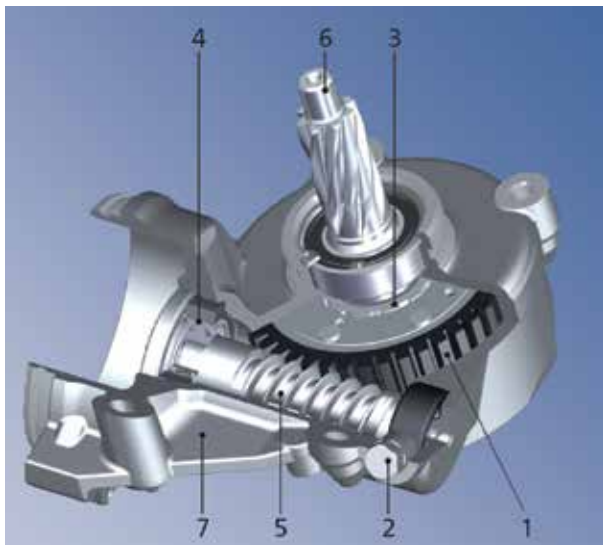
Spare Parts

If we take a look at the Electronic Parts Catalog, we see that none of the internal components of the steering gear are available. It is only replaceable as a complete unit, but it is offered as both brand-new and remanufactured. The rebuilt units can save your customer about \$1,000 as compared to the new, and, as with all Genuine Mercedes-Benz Parts, they both carry the same one-year unlimited mileage replacement warranty.

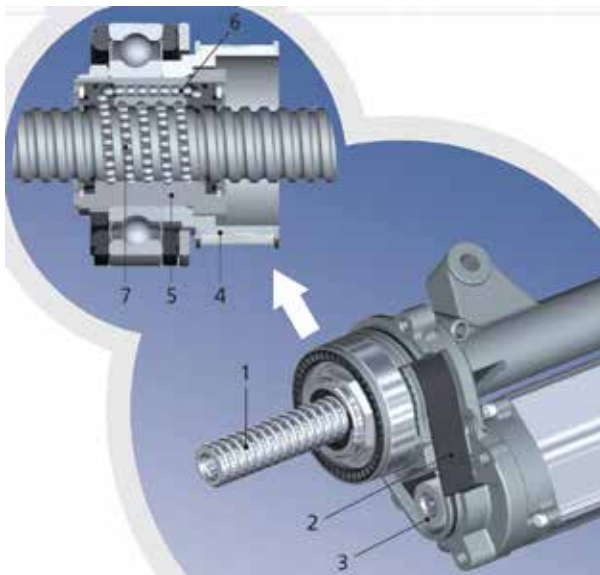
When the system was first introduced, some technicians expressed their concerns about the toothed belt, figuring it was going to wear and fail, resulting in high costs for what is essentially a low-dollar part. Over the years, these fears were proved to be unfounded. This kind of belt has been used by other industries for many years without any problems.

Maintenance

Unlike the power steering systems we've known since forever, there are no hydraulic components. The steering power boost is delivered by an electric motor instead. And, also unlike previous systems, electric power steering



The driver's steering force enters through the steering column drive pinion (6) and is sensed by the torque sensor (3). The worm gear (5), which is part of the steering rack, is then driven side-to-side via an electric motor (not shown) managed by a control unit according to the torque sensor input. If the electrical system fails, the helical gear (1) drives the worm gear (5) and thus the steering rack directly. Image Credit: ZF Lenksysteme



The steering rack (1) is driven by the electric motor shaft (3) via a toothed belt (2) and pulley (4). The recirculating ball nut (5) moves the rack side to side with very low friction as the ball bearings (7) move along the screw thread cut into the rack. The bearings are recirculated through channel (6) continuously. The nut only rotates, it does not move side-to-side. Image Credit: ZF Lenksysteme



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is maintenance-free. Indeed, the only replaceable parts in the system are the inner tie rod ends and their boots.

That doesn't mean nothing will ever need attention, however. Although in practice the system has shown itself to be extremely reliable, as with any mechanical system things may wear and need replacement.

In early versions of the electric power steering system, the case was equipped with an automatic water drain valve. The valve has a water-soluble "pill," which dissolves when in contact with water, allowing spring pressure to open the valve and release any water trapped within the housing.

If you get a car with electric power steering in your shop, always check for a water drain valve. If one is present, inspect it. If it has opened, it must be replaced, ideally along with a careful inspection to identify the source of the water entry – most often the rubber boots surrounding each tie rod.

If you do find an open water drain valve, be sure to check the toothed rack for corrosion and, depending on the severity, consider replacing the steering rack. Check the Workshop Information System (WIS) document AR46.20-P-0005EW for the detailed inspection and replacement procedure and tightening torque for the drain valve. The valve carries part number A218 461 00 02 and is readily available.

If you don't find the water valve on the steering rack housing, don't panic: Later system versions eliminated this drain valve around 2014, since water sealing was found to

be a non-issue. In its place, you'll find a flattish spot on the housing, marking the low spot when it's installed.

Diagnosis

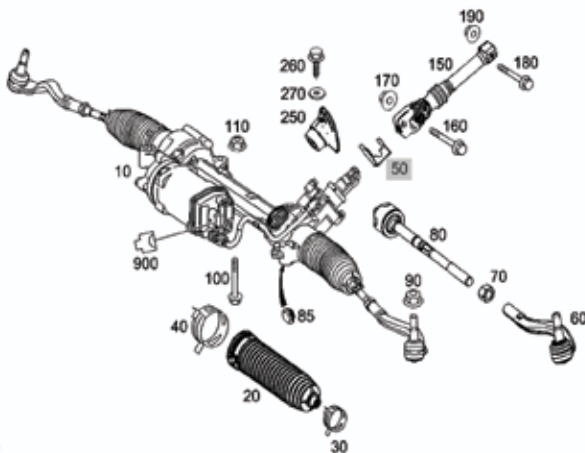
If the electronic control unit detects a fault, it sends a message to the driver via the Instrument Cluster: "Power Steering Defective! Service Required!" Using XENTRY, you can view the basics, including fault codes and actual values, but the bottom line is that there are no replaceable parts inside, so unless the fault is related to an external influence – CAN Bus faults, power and ground, or the like – there's little else to do.

Repair work

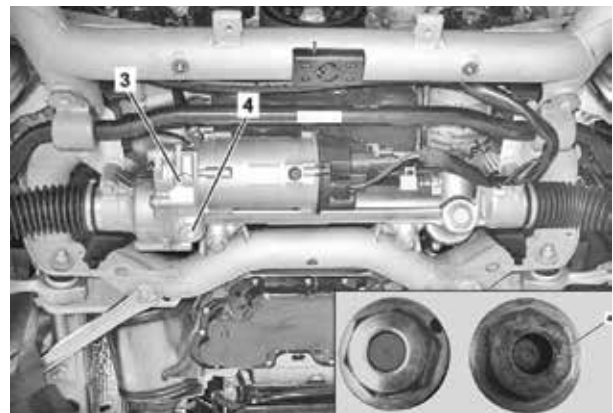
As these vehicles age, you may start to see worn inner tie rod ends. These are found within the rubber bellows boots at each end of the steering rack. If a bellows is torn or damaged, not only must it be replaced, but the dust and dirt has probably caused some damage to the inner tie rod end.

To replace it, remove the boot using your click-clip pliers, counter-hold the shaft while you loosen and unscrew the nut holding the tie rod in place. Replace the parts as needed, then tighten the nut to the specified torque to ensure proper operation. You can find the specs in WIS. Reinstall the boot and clamps and perform a complete wheel alignment.

Of course, replacing the outer tie rod ends is much simpler, since the entire part is exposed. Do check the work instructions in WIS, however, since there is a



The electric steering rack (10) can only be replaced as an assembly, but it is available as a remanufactured part for a considerable cost savings. Note that the tie rod ends (80, inner and 60, outer) are also available as spare parts, along with the rubber boot (20).



Early versions of the electric steering systems are equipped with a water drain valve. In the inset image at the bottom, on the left is a new valve, on the right is one that has opened due to water within the electric steering case. Always look for the valve (4), which is found at the lowest point of the main steering gear housing. If you find one that has opened it must be replaced along with whatever's letting the water in. Refer to WIS for details.

special tool used to separate the tie rod end cone from the steering knuckle that will save you time and grief.

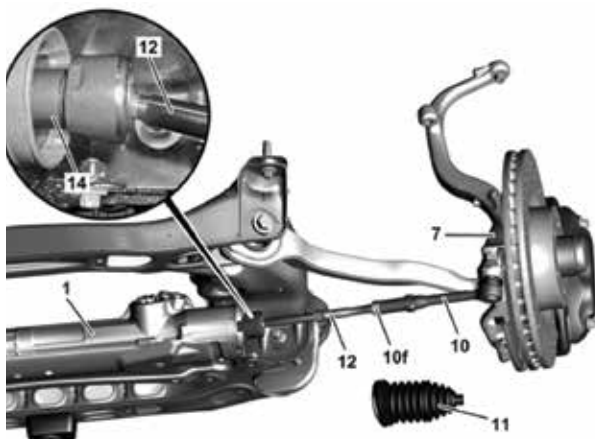
If you have to replace the entire steering rack, be sure to follow the WIS work instructions carefully. Some of the Mercedes-Benz special tools, particularly the pullers for the tie rod ends and steering knuckle bolts, make the job so much easier than using a pickle fork or hammer that buying them for even a single job is well worth it for the time savings, doubly so if you accidentally damage any of these parts.

There are several “gotchas” in the job, such as replacing all the single-use fasteners and maintaining steering shaft alignment, and the special two-stage bolt tightening sequence that is critical to follow for the bolts in this safety-related system. Several of the steps in the work instruction vary depending on which model you’re working on. There is simply no substitute for having the work instructions right there to guide you.

Noises

The power steering rack itself is rarely the cause of any strange noises, but you can hear a slight motor hum and whine under the right conditions. It is unlikely your customer will complain of this, however. Instead, you will be faced with the other usual suspects: ball joints, tie rods, and so on.

The first step when trying to diagnose any noise complaint is to duplicate the problem. After all, until you can make it happen, how can you be sure you’ve made it go away? StarTuned has covered the diagnostic process



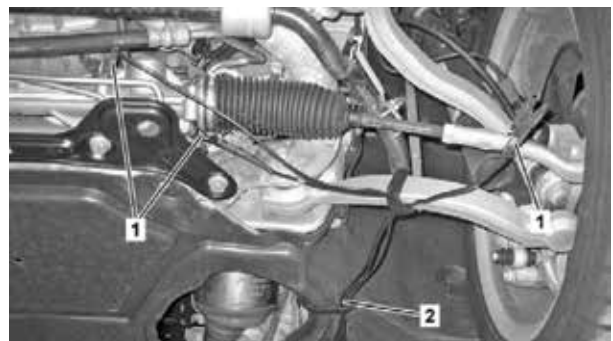
Both the inner and outer tie rod ends are replaceable, as are the inner flexible boots. If the boot (11) has failed, it may allow water and dirt to enter the steering housing, leading to early failure. For the inner joint, hold the steering rack shaft (14) while unscrewing the holding nut.

in previous issues, so we won’t repeat it here, but duplicating the problem is a point worth repeating.

Mercedes-Benz recommends a noise diagnosis system, similar to the well-known Chassis Ears, from Gayle Technologies, available on the open market for about \$550. This system is also recommended by a few other manufacturers, and its value extends beyond chassis noises. To use it, you clip, clamp, tape, or otherwise fasten microphones to the chassis near the suspected source of the noise, then have a colleague drive while you listen. Just make sure you don’t restrict the movement of the chassis or steering, which could break your microphone or even cause an accident. Same with driving with the headphones on: You’re risking too much, so just don’t.

Some of the tips from Mercedes-Benz include comparing left and right sides of the same component. The tool supports several microphones, so this can all be done with a single test drive. Avoid the urge to spray silicone onto the offending spot: It will mask the noise for a little while, but your customer won’t be happy when the noise comes back. For temporary troubleshooting, lubrication with water might be helpful, but ultimately a noise is trying to tell you something’s wrong, so replace whatever it is.

While the basic idea of steering hasn’t changed in over 130 years, now you’re informed about the modern electric steering system. Although problems are rare, between Mercedes-Benz’s remanufactured parts program and the Workshop information System there’s nothing on the electric steering system you can’t handle. |



When trying to diagnose noises from the steering and suspension, clamp-on microphones really help to pinpoint the source. Here we see three clamp-on microphones (1) and the associated wiring (2), carefully routed to avoid affecting any chassis or steering movements and preventing any damage to the wiring or microphones. Listening and driving is a two-person job.



Performance. Reliability. Success.

With our competitively priced Genuine Remanufactured Parts, you no longer have to settle for anything less than Mercedes-Benz quality. But that's just part of the story. You see, our AIRMATIC® struts, catalytic converters, turbochargers and steering racks all carry a 24-month, no mileage-restriction warranty. So our parts are not only a great deal. They're a great value. And since they're genuine Mercedes-Benz, you can have confidence they'll last, and so will your relationship with your customers.

Mercedes-Benz

The best or nothing.



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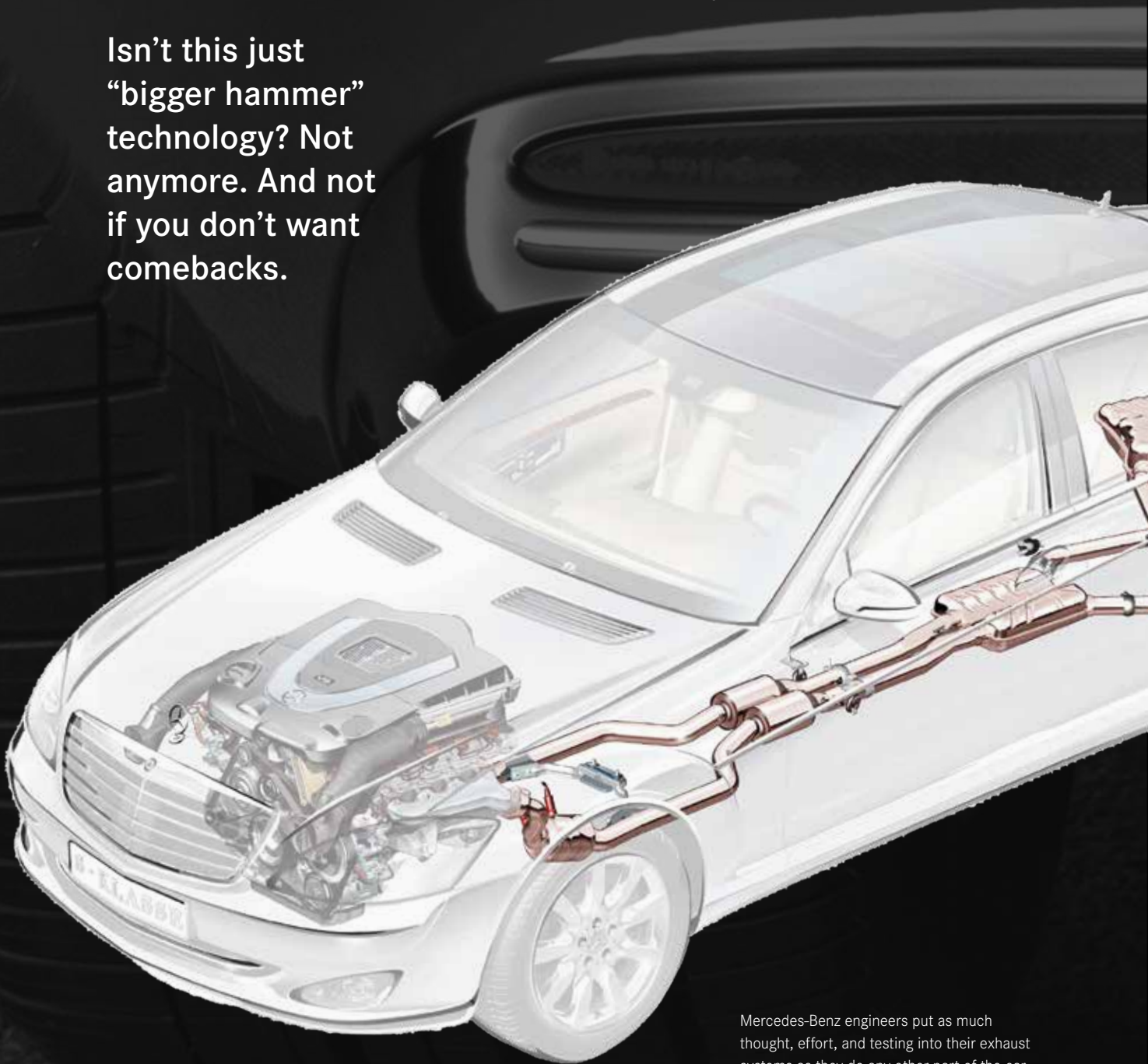


One remanufactured engine pulls the plug on climate-damaging CO₂ and saves 447 days of power for one laptop.



Mercedes-Benz Exhaust System Work

Isn't this just
"bigger hammer"
technology? Not
anymore. And not
if you don't want
comebacks.



Mercedes-Benz engineers put as much thought, effort, and testing into their exhaust systems as they do any other part of the car. And when they focus on keeping the price highly competitive, everyone wins. That's why it makes sense to use only Genuine Mercedes-Benz parts.

How much can one write about exhaust systems that you, as an independent shop owner, don't already know? Quite a bit, as it turns out.



If you're buying exhaust components anywhere but from a Mercedes-Benz dealer, you may be doing both your customers and yourself a disfavor. One can argue that the aftermarket systems save money, but do they really?

Extra hour?

The first thing you need to consider is fit. Although the aftermarket can deliver exhaust systems that are close in dimensions, only a genuine

Mercedes-Benz exhaust system is guaranteed to be a perfect fit, regardless of model or year. This saves you time from having to use brutal and barbaric methods to make things go together and line up properly. Is it really in your customer's best interest to save \$100 on a pipe that takes an extra hour to install?

Even small amounts of misalignment in an exhaust system can be a problem. Unexpected stresses on the pipes and hangers can not only cause gas-tight joints to loosen, but they can promote vibrations and resonances in the vehicle, leading to odd noises that can be difficult to track down. Sure, the 240D owner might not be able to hear these things (or even care), but the modern E-Class owner spent enough on the car to want it to be right. And, for your reputation's sake, don't you, too?

Decades of life

Then there's longevity. Take a look at the original component you're removing from your customer's car. How old is it, and why did it fail? Obvious problems like accident damage from driving over something, which dents or badly scrapes the pipe, can lead to premature failure. But typically an exhaust system might be 20 years old or more before it fails to the point of needing replacement. On the other hand, we've see

aftermarket pipes rust through in as little as a few years. The customers thought they were saving money, but, sadly, no.

Then there are repairs. We've had cars come in with "Franken-systems" welded together with too-small pipes and "used" catalysts, and the customer never had a clue as to why his or her Mercedes-Benz didn't have the pep it used to have. The welds are always the weak point, where the pipe starts to corrode until, one day, it completely lets loose. It may be hard to tell a customer he or she needs a complete new exhaust system, everything from the manifold back, since the only thing readily visible – the tailpipe – looks shiny and new.

Rebuilt cats

It does get easier to deliver this news, though, when you find out that Mercedes-Benz now offers most catalysts as "rebuilt" units. Of course, in following with emissions laws, the catalysts themselves are not actually re-used, but there is a core value associated with these "reman" units that ends up bringing the cost down to a very competitive point. You see, catalysts contain a small amount of platinum, which until recently was more expensive per ounce than gold. Rather than have you sell the used cats on the free market, Mercedes-Benz offers a generous allowance for their return.

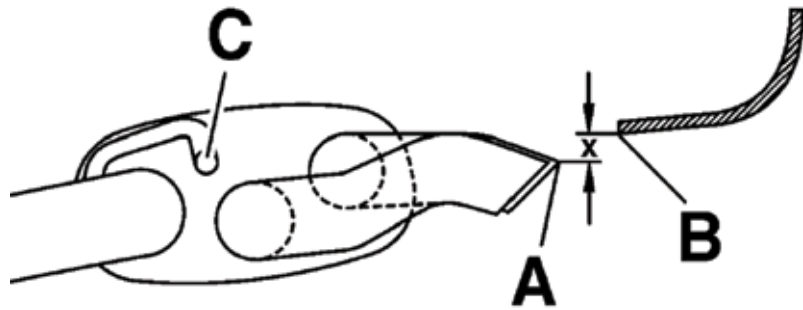


Then there's the rest of the system, the parts that more often need replacement. Catalysts often last the life of the vehicle, but pipes and mufflers tend to go after a long time, particularly in the salt-in-winter states. As we mentioned, perhaps you can save enough for a fast food meal on some parts, but Mercedes-Benz has some attractive prices for exhaust systems. And, don't forget the hangers, gaskets, and bolts in that equation. We're not going to claim the Genuine Mercedes-Benz parts are less expensive, but let's face it: Quality always costs a little more. That's why your customers drive what they drive, right?

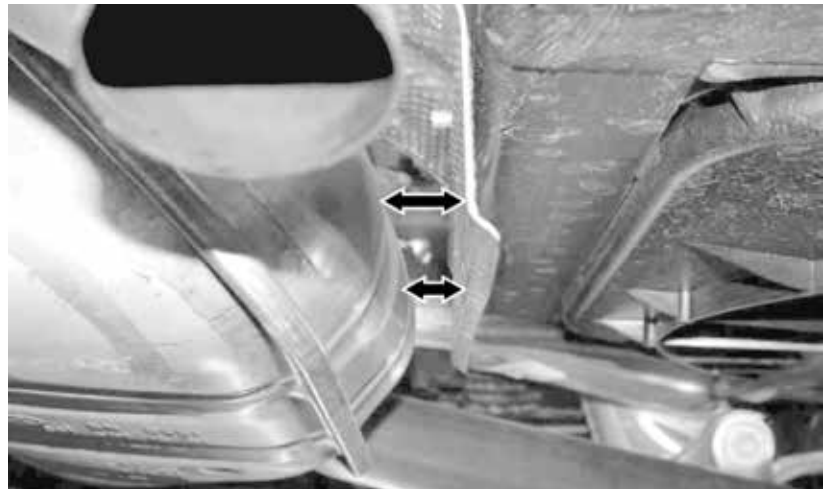
Hard life

Let's get down to brass tacks, and take a look at the exhaust system for a 1997 E420, for example. This car is about 20 years old, spent its life in Michigan, and it wouldn't be considered unusual to find the exhaust system in need of replacement. To simplify the job, we decided to replace everything from the catalytic converters back: pipes, mufflers, hangers and hardware. On the lift, it means loosening four bolts from the dual catalytic converter pipes, releasing the rubber hangers, and dropping the whole system in under five minutes.

The new system is reassembled on the car, front to rear, and all of the fasteners are left little more than finger tight. We backed the car out of the work stall, let it run for a few minutes just to warm up the pipes, and then put it back on the lift to snug up the fasteners. We didn't want to get the pipes too hot to touch, just enough to put them a little into their warm expansion zone, halfway between cold and normal operation. By doing this,



Are you sure that aftermarket exhaust system will line up as perfectly as a Genuine Mercedes-Benz part? The exhaust tips (A) must have a certain minimum clearance (X) from the rear bumper cover (B). Using a low-quality exhaust system or even an aftermarket rubber hanger at (C) could cause the bumper to overheat and melt, resulting in an angry customer and a new bumper at your expense. Avoid it altogether by using the real thing, at prices that may surprise you.



Aftermarket systems aren't always bent to the same specifications as the original. Maintaining proper clearance (arrows) from heat shields and other body components is critical for avoiding noises and possible overheating.

With the Genuine Mercedes-Benz exhaust system, replacement was as simple as the four bolts (47) at the rear of the catalytic converter pipes (5, 8). The whole system came down off the rubber hangers in one piece, and went back on just as easily, lining up with the catalytic converters perfectly. The time saved (and blood pressure reduced) when everything goes together perfectly by design is considerable, especially when the parts are about the same price as multi-piece, ill-fitting aftermarket components.

we are trying to minimize stresses on the system, which can lead to unwanted noises, harmonics and vibrations – and possible failures from damage to aluminized coatings.

Although we buy our parts from the local dealer, and so are unfamiliar with the pricing and availability of non-Mercedes-Benz parts, we went online to compare. One well-known aftermarket exhaust company's website tried to sell us the exhaust system for a six-cylinder station wagon, despite carefully specifying an E420 sedan. After that eye-opener, we decided to use the Mercedes-Benz Electronic Parts Catalog, included with our STAR TekInfo subscription, to find the real "right part," which ended up being A210 490 2721. Web sites varied in price from \$880 down to \$485, plus shipping.

One company that sells a replacement system has split the main pipe into two parts, adding a joint to what is originally a single-piece unit (of course, using this will require you to buy the same brand as a replacement when this one fails, since the Genuine parts will no longer fit). Their price for both halves comes out to about \$420, not including mounting hardware. The list price on the Genuine Mercedes-Benz part is \$570, but, of course, we get a generous discount from our dealer, since we're one of his best customers. Let's just say that when all is said and done, the genuine system was actually less expensive than the online "bargains."

Big savings

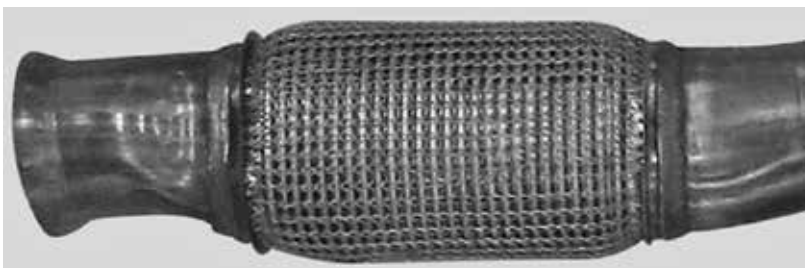
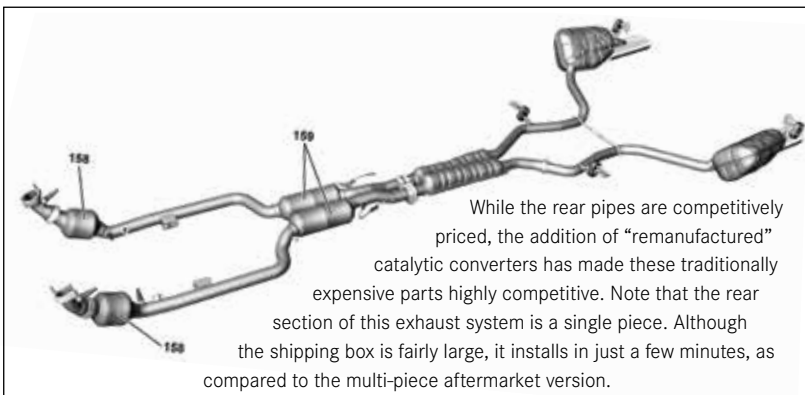
Now let's just pretend we also needed both catalyts, which are

called "front" exhaust pipes in the EPC. The two pipes are A210 490 4419 and A210 490 4519, with a full list price of \$1,350 and \$1,200, respectively. Adding the "80" suffix for a remanufactured unit, we find the list price, after returning the core, drops to about \$600 and \$400, respectively, with our dealer's generous discount, or about \$1,000 for the pair. Going online, we found prices for the 4419 ranging from \$495 to over \$1,200, and the 4519 ranged from \$730 to just over \$1,000.

The sensible conclusion is that the aftermarket doesn't know about Mercedes-Benz pricing, particularly when the core value is included. The bottom line is that this E420 customer, had she needed the entire system including catalyts, could have saved around \$1,100 by insisting on Genuine Mercedes-Benz parts, and we'd save the extra hour of pain-in-the-neck making things fit together caused by the aftermarket parts.

Hmm, maybe we're dumb, but that seems like a pretty strong case to us. That being said, we're not unaware of local sellers offering these items at slightly lower prices, but they usually end up awfully close to the dealer's price. I can't say what you'll decide, but just having the right parts that are priced right, fit perfectly and go in so smoothly, last a long time, and which we can happily tell our customers are genuine Mercedes-Benz parts, well, that's a really easy sell for us.

Before the next exhaust system job, give your dealer a call and see what he's offering. You might be surprised. |



The flexible sections of Genuine Mercedes-Benz pipes are reinforced for extreme durability. Others just fold up some steel and figure it'll last long enough. Even if the fit and durability were the same – do you believe they are? – aftermarket parts are not as much of a bargain as you thought. Just compare between your aftermarket supplier and your local dealer to see what we mean, and let your customer reap the benefits.

Mercedes-Benz Mobil 1

Product Name	Part Number	Quantity	Product Description	Recommended Consumer App.
Mercedes-Benz SPEC.				
Mobil 1 Formula M 5W-40	BQ 1 09 0197	Bulk - No Equipment	Fully synthetic formulas designed specifically for gasoline passenger cars	Low SPASh. Available at most M-B dealers
	BQ 1 09 0195	6/1 Quart Cases		
	BQ 1 09 0196	55 Gallon Drum		
Genuine Mercedes-Benz Oil MB 229.5 Specification SAE 5W-40	A0009898301USB6	6x1 Quart Cases	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.5 Specification	Mercedes-Benz Engines that require 229.5 Specification Oil
	A0009898301USB8	55 Gallon Drum		
	A0009898301USB9	Bulk - No Equipment		
Mobil 1 0W-40	BQ 1 09 0010	Bulk - No Equipment	Fully synthetic formulation designed to meet the requirements of many European vehicles	Porsche A40. Many European vehicles. HT/TS applications.
	BQ 1 09 0015	6/1 Quart Cases		
	BQ 1 09 0016	55 Gallon Drum		
Mobil 1 ESP X1 0W-30	BQ 1 09 0184	Bulk - No Equipment	Advanced full synthetic formulas designed specifically for diesel passenger cars that have particulate filters	Low SPASh. Available at most MB dealers
	BQ 1 09 0182	6/1 Quart Cases		
	BQ 1 09 0183	55 Gallon Drum		
Genuine Mercedes-Benz Oil MB 229.52 Specification SAE 5W-30	A0019893701USA9	Bulk - No Equipment	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.51 and 229.52 Specification requirements	Mercedes-Benz Engines that require 229.51 Specification Oil
	A0019893701USA6	6x1 Quart Cases		
	A0019893701USA8	55 Gallon Drum		
Mobil 1 5W-50	BQ 1 09 0133	16 Gallon Keg	Higher viscosity, advanced full synthetic formula designed for performance vehicles	Porsche A40. HT/HS applications.
	BQ 1 09 0194	6/1 Quart Cases		
Mobil ATF 134	BQ 1 09 0166	55 Gallon Drum	Extra high performance automatic transmission fluid formulated with selected HVI base oils	Recommended for use in Mercedes-Benz automatic gearboxes
M-B Genuine ATF 134FE	A0019897703USA8	55 Gallon Drum		
Mobil 1 ESP Formula MB 5W-30	BQ 1 09 0165	12x1 Liter Cases	Advanced full synthetic formulas designed specifically for passenger car diesels that have particulate filters	Low SPASh. Available at most MB dealers.
AdBlue® 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
	BQ 1 09 0022	6/1 Quart Cases		
Mobil 1 Gear Oil (Mobil 1 Gear Lube 75W-90)	BQ 1 09 0085	12/1 Quart Cases	Exceeds the most severe service requirements in both conventional and limited slip applications	SUITABLE for use in modern high performance automobiles like SUV's, Vans and Light duty trucks requiring API GL-5 level performance

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 App.
Mercedes-Benz SPEC.				
Mobil Special 5W-30	BQ 1 09 002464	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ
	BQ 1 09 0171	12/1 Quart Cases		
	BQ 1 09 003064	55 Gallon Drum		
Mobil Special 10W-30	BQ 1 09 003164	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ
	BQ 1 09 0172	12/1 Quart Cases		
	BQ 1 09 003764	55 Gallon Drum		
Mobil Special 10W-40	BQ 1 09 003864	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks where a higher viscosity API SN/SMSL/SJ oil is preferred or recommended
	BQ 1 09 0173	12/1 Quart Cases		
	BQ 1 09 004464	55 Gallon Drum		
Mobil Special 5W-20	BQ 1 09 012464	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ
	BQ 1 09 0170	12/1 Quart Cases		
	BQ 1 09 013264	55 Gallon Drum		
Mobil Special 20W-50	BQ 1 09 004664	55 Gallon Drum	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks where a higher viscosity API SN/SMSL/SJ oil is preferred or recommended
Mobil Delvac 1300 Super 15W40	BQ 1 09 0053	Bulk - No Equipment	Extra high performance diesel engine oils that help extend engine life in the most severe on and off-highway applications while delivering outstanding performance in modern, high-output, low-emission engines including those with Exhaust Gas Recirculation (EGR) and After-treatment Systems with Diesel Particulate Filters (DPFs) and Diesel Oxidation Catalysts (DOCs)	Specifically recommended for the latest low-emissions, high performance diesel applications equipped with aftertreatment systems using Diesel Particulate Filter (DPF) and Diesel Oxidation Catalyst (DOC) technologies
	BQ 1 09 0058	12/1 Quart Cases		
	BQ 1 09 0059	4/1 Gallon Cases		
	BQ 1 09 0060	55 Gallon Drum		
	BQ 1 09 0179	6/1 Quart Cases		
Mobil Delvac 1300 Super 10W30	BQ 1 09 0086	Bulk - No Equipment		
Mobil Delvac 1 5W40	BQ 1 09 0051	4/1 Gallon Cases	Fully synthetic supreme performance heavy duty diesel engine oil that helps extend engine life while providing long drain capability and fuel economy for modern diesel engines operating in severe applications	Recommended for use in all super high performance diesel applications, including modern low emission engine designs with Exhaust Gas Recirculation (EGR)
	BQ 1 09 0052	55 Gallon Drum		
Mobil Grease XHP 222	BQ 1 09 0078	60/14 oz Cartridge	Formulated to provide excellent high temperature performance with superb adhesion, structural stability and resistance to water contamination	Recommended for industrial and marine applications, chassis components and farm equipment
	BQ 1 09 0079	120 lb Keg		
	BQ 1 09 0080	400 lb Drum		
	BQ 1 09 0098	40/14 oz Cartridge		
Mobil Lube HD Plus 80W90	BQ 1 09 0096	120 lb Keg	Extra high performance, automotive lubricant formulated from select base oils and an advanced additive system specifically for limited-slip differentials	Recommended for use in limited-slip differentials, axles, and final drives requiring API GL-5 level performance
	BQ 1 09 0097	400 lb Drum		

AMG

Half a Century of Success with Mercedes-Benz

AMG – these three letters stand worldwide for supreme automotive performance, exclusivity, efficiency, and highly-dynamic driving pleasure. In 2017, the company founded by Hans-Werner Aufrecht and Erhard Melcher is celebrating its 50th anniversary. In the course of this half-century, Mercedes-Benz-AMG has recorded numerous successes in motor sports, and through the development of unique road-going vehicles has repeatedly underlined its position as a highly-successful sports car and performance brand. Today, AMG is a wholly-owned subsidiary of Daimler AG.

In this anniversary year, Mercedes-Benz-AMG will carry on the exceptional success story of what began as a two-man company. For each of the now 1,500 employees, the focus will be on the brand promise of “Driving Performance,” which unites the core strengths of AMG: cutting-edge technology and a passion for dynamic, emotively-appealing products. The company from Affalterbach stands for outstanding engine expertise, including not only development, but also the “one man, one engine” philosophy, which means that each engine is hand-crafted by one builder. With the biggest strategic

model initiative in the company’s history, AMG heads into this anniversary year with record figures.

With 99,235 vehicles delivered in 2016, the success story of Mercedes-Benz’s sports car and performance brand reached a new level – unit sales have more than tripled since 2013. This was made possible by the development of performance models that are in greater demand than ever before. Yet the strategic broadening of the portfolio in recent years has also led to the successful development of new groups of customers. So, the company’s global success is not solely based on the popular eight-cylinder models of the 63 series. The compact 45 series, along with the wide range of the 43 series, are finding favor with many customers.

“We’re on the road to worldwide success with our strategic portfolio expansion and can look back on a sensational year. The 63-Series models still constitute our core product line, and they continue to delight auto enthusiasts around the world. In addition, our AMG GT series, which was developed entirely in-house, is now available as a broad-based family, with which we have impressively demonstrated our expertise as a sports car brand. At the same time, our broad portfolio

puts us in the perfect position for further sustained growth,” says Tobias Moers, Chairman of the Board of Management of Mercedes-Benz-AMG GmbH.

New customers

2016 saw ten new models being added – performance-minded customers are able to choose from over 50 models. In each category, AMG is offering the most powerful standard-production four-cylinder compact to the sportily-elegant S 65 with its superior 12-cylinder engine, and from “saloons” and estates in many different output classes, to a broad range of SUVs and coupés, to cabriolets and variously-configured roadsters. The available technology ranges from optimized rear-wheel drive to state-of-the-art all-wheel drive, as well as from dual-clutch transmissions to a sporty nine-gear automatic transmission.

At the same time, the sports car and performance brand has won entirely new groups of customers with its recently launched 43 series models with their powerful and efficient six-cylinder engine. Other hallmarks of the 43 series derivatives include special transmission tuning with shorter shift times as well as AMG-specific axle designs and suspensions, and powerful brake components.

With the Mercedes-AMG GT series, the company is once again underlining its status as a highly

dynamic sports car brand. Following the SLS AMG, the GT models are the second sports car family to be developed entirely in-house. The front mid-engine concept with transaxle and the lightweight aluminum construction form the basis for a dynamic driving experience. In 2016, AMG added fascinating models to the GT family in the form of the GT R and the GT Roadster and the GT C Roadster variants. The coupé is also available in the anniversary year with the same next-level performance and technology. It is positioned as the Edition 50 special model.

Hypercar with Formula 1 technology

Mercedes-Benz-AMG is setting a further landmark in 2017 by giving a peek into future performance in the form of a street-legal hypercar. Offering unadulterated Formula 1 technology for the road, the hypercar is thus the first commercially-available vehicle with an F1 hybrid powertrain. With a system output of over 1,000 hp and four-wheel drive with all-electric front axle, it marks



the pinnacle of what is currently technologically feasible.

For maximum efficiency, AMG has equipped the V8 engine in the performance saloon with the Cylinder Management cylinder deactivation system. In addition, all-wheel drive as well as an optimized transmission that includes a coasting function provide exemplary low fuel consumption and emissions.

Competence center for V8 development

Affalterbach is home to AMG hand-crafted V8 engine building. Four-cylinder in-line engines are produced in Kölleda, and V12s in Mannheim. Each engine is hand-assembled by a single builder at these sites according to the “one man, one engine” philosophy, and is provided with a badge bearing the mechanically-reproduced signature of the relevant technician.

Mercedes-AMG is today responsible for the development not only of the new eight-cylinder family of the Mercedes-Benz brand, but also of the AMG V8 engines. The first standard-production vehicle to be fitted with a V8 engine developed in Affalterbach was the G 500, which

celebrated its market launch in September 2015. The V8 engine for the upcoming new S-Class was also developed in Affalterbach.

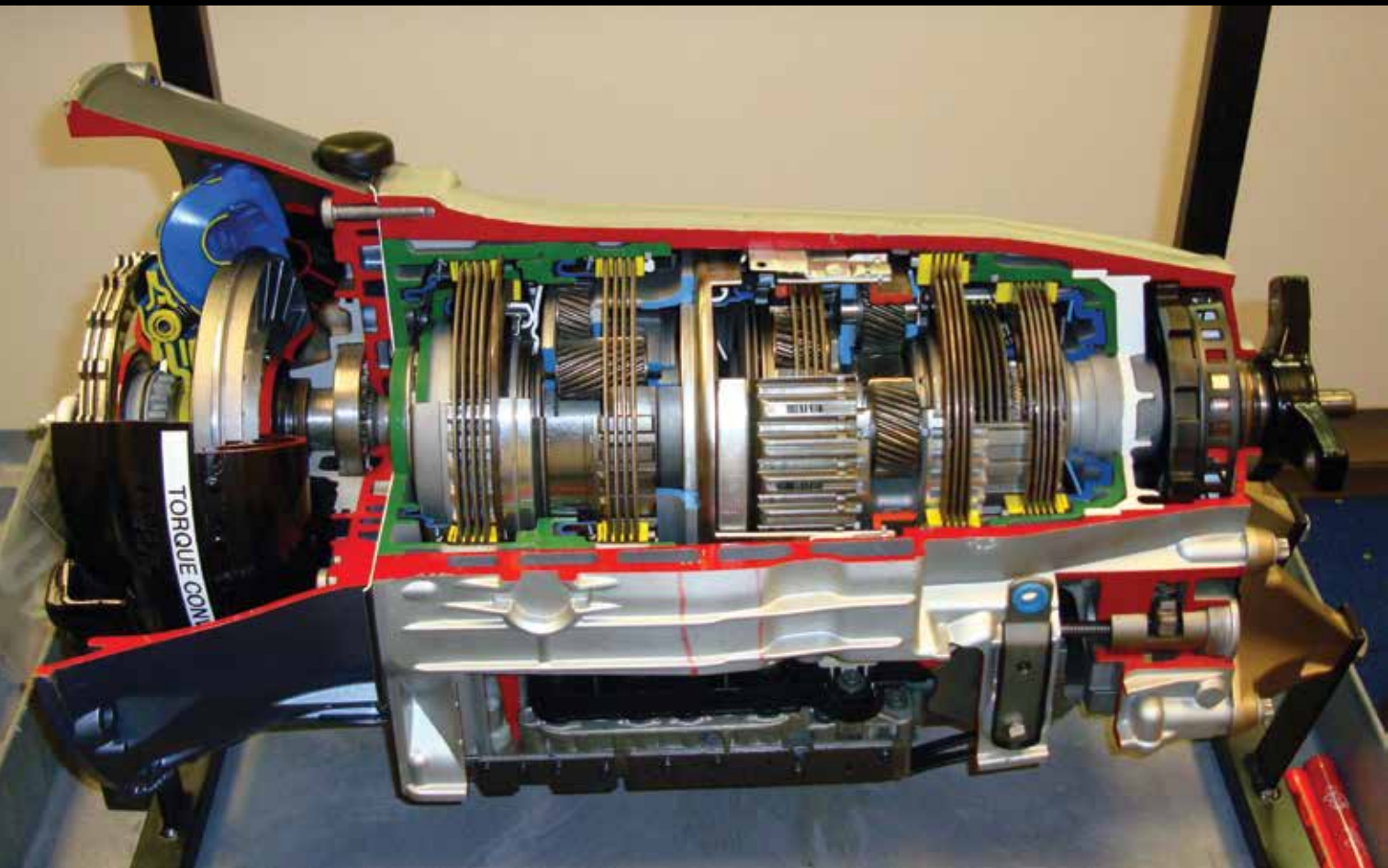
Milestones in the history of AMG

The company, founded by Hans-Werner Aufrecht and Erhard Melcher, has been fulfilling the dreams of performance enthusiasts for 50 years. The pair set up their first workshop in an old mill in 1967 as an “engineering office and design and testing center for the development of racing engines.” In 1971, the AMG 300 SEL 6.8L of “Aufrecht and Melcher, Großaspach” – AMG – claimed victory out of the blue in its class and took second place overall in the 24-hour race at the Circuit de Spa-Francorchamps. Another milestone was the all-new cylinder head with cutting-edge valve technology, developed by Melcher.

Collaboration with Mercedes-Benz began in 1990. The C 36 AMG, launched in 1993, was the first vehicle on the market to result from this collaboration with Daimler-Benz. In 2005, Mercedes-AMG became a wholly-owned subsidiary of Daimler-AG, and 2009 saw the introduction of the Mercedes-Benz SLS AMG, the first vehicle to be developed entirely by Mercedes-Benz-AMG. |

Transmission Maintenance

Maintenance is the key to vehicle reliability, and is the bread-and-butter of the independent workshop. Most vehicle owners know to get their oil changed regularly – witness the growth of quick-lube joints – but what about that automatic transmission?



The maintenance sheets for newer Mercedes-Benz vehicles show a transmission oil and filter change once at about 35,000 to 40,000 miles. The reasoning is that any contamination from wear during this initial break-in period will have stabilized and been caught by then, so by performing a maintenance service, the trans should be good from there on. And, if you trust that those German engineers know what they're doing, it is.

Additional maintenance isn't harmful, may possibly be beneficial, but definitely isn't on the maintenance schedule published by Mercedes-Benz. Yet, most customers will request it, and even agree to it when asked, because, well, a few dollars

now might prevent something vastly more expensive down the road.

Let's take a look at three modern Mercedes-Benz automatic transmissions and the details of their needs.

NAG

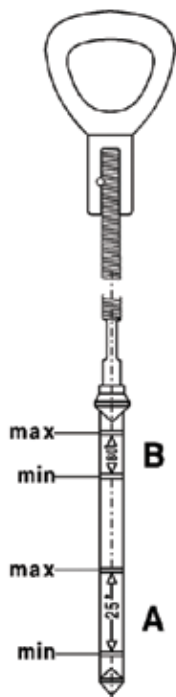
First, we have the venerable 722.6 "NAG" (New Automatic Gearbox), a five-speed fully-electronic transmission introduced in the mid 1990s with the 210 E-Class chassis. In Model Year 2004 the 722.9 "NAG2" was introduced in vehicles equipped with non-turbo M113 V-8 engines, adding two additional forward gears for a total of seven speeds. Recently, the 725.0 "NAG3" was launched, a 9-speed entry in the race for fuel efficiency.

722.6

When the 722.6 NAG1 transmission was introduced, it was a technological breakthrough: Far fewer parts, fully-electronic, and far more reliable and smooth than anything before possible, even considering the very refined 722.3 hydraulically-controlled predecessor. But for service shops, the biggest thing was the new transmission oil: ATF Dexron III was out, and this new synthetic stuff, at a considerably higher price, was in. Some tried using Dexron III, either to save money, or through ignorance or error, and found that not only did the 722.6 not like it at all, bad things happened fairly soon. A spate of transmission replacements was the result, often paid for by the shop owner.

Several other features were introduced here, including a lock-up torque converter, the deletion of a transmission oil dipstick (use special tool W140 589 15 21 00 to check the fluid level), a seal for the dipstick tube covering, and a new oil pan and its bolts, which are sensitive to over-tightening.

One service issue seen often on the 722.6 is the so-called "pilot bushing", which is the electrical connector located in the front right of the transmission just above the pan. Early versions of this component had O-rings, which tended to leak — slowly, over time.



Regular transmission fluid maintenance is much more expensive with synthetic ATF than it was with conventional Dexron, but transmission work is much more expensive, too. The visual comparison of clean to dirty ATF as seen on this flush machine is a powerful customer pleaser.

Left: In the NAG1 (722.6) transmission, the dipstick was eliminated, but by using special tool W140 589 15 21 00 you can check the oil level using the dipstick tube. Later generations eliminated the dipstick tube as well.

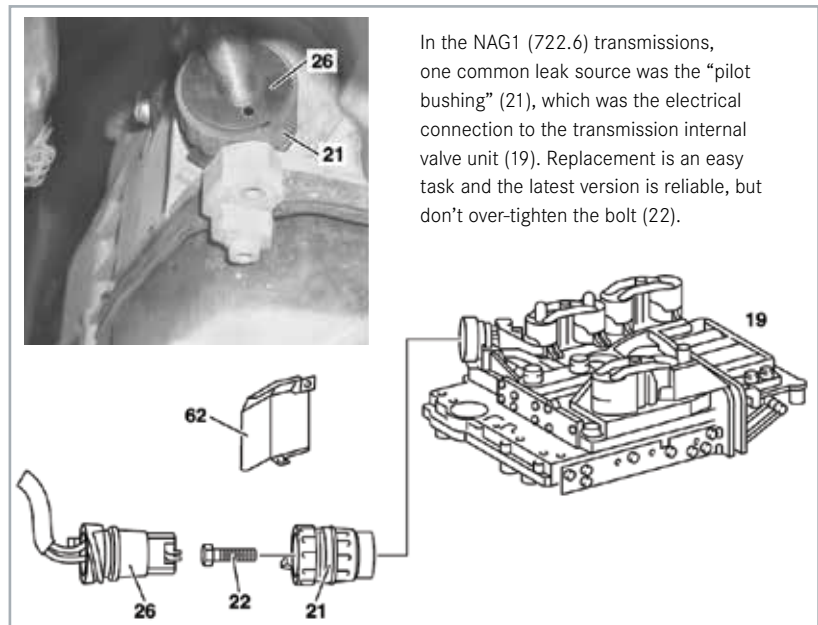


This slow drip would often not be addressed by the customer until it was almost too late, with slipping shifts and eventual loss of power transmission entirely. The solution is to replace the entire part, and to be sure to tighten the single central bolt holding it in place carefully to specification, a downright miniscule 2.5 Nm, which really is just finger-tight. But don't trust your fingers: Use a good micro-torque wrench, or risk a repeat failure. The modern version of this part is quite reliable.

Before we discuss maintenance, it is a well-known rule that automatic transmission work always requires the utmost cleanliness. Even the smallest dirt particles in the hydraulic components can lead to malfunctions and a total failure of the transmission. Always clean the work area thoroughly before removing any fasteners, covers or plugs.

Maintenance is straightforward in this model. Start by warming the transmission to 176 deg. F., clean the area to keep road dirt out, and drain out the oil pan using the drain plug (replace the copper seal washer upon installation, and observe the tightening torque). Then remove the oil pan, but be careful, since there's usually still some oil left in it. Check the pan for the presence of a magnet (if not installed put one in – they're inexpensive from your dealer) and clean any debris out. Pull out the old filter and replace it, then reinstall the pan with a new gasket (lightly lubricated with new oil). Again, observe the pan bolt torque religiously or it'll come back to bite you.

Now, flush out the old oil. WIS has two documents, one for shops equipped with a transmission flushing machine,



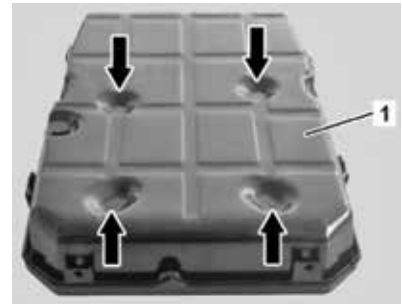
In the NAG1 (722.6) transmissions, one common leak source was the “pilot bushing” (21), which was the electrical connection to the transmission internal valve unit (19). Replacement is an easy task and the latest version is reliable, but don't over-tighten the bolt (22).

and one for those without. For the ‘without’ version you'll need about 14 liters of approved transmission fluid to complete the process. If you have a transmission flush machine, follow the manufacturer's instructions for how much fluid to use. Just don't mix the special synthetic Mercedes-Benz fluid with standard fluid. Check and correct the fluid level through the dipstick tube as necessary, and the oil and filter change is done.

A word about the transmission fluid: The original 722.6 fluid is no longer sold, having been replaced by the fluid used in early versions of the 722.9 transmission. This fluid carries Mercedes-Benz specification 236.14, is also known as ATF134, is colored red, and can be ordered from your local dealer under part number A001 989 68 03. Don't confuse this with the newer fluids, which are blue or gold in color. We'll discuss this further in a moment.

722.9

The NAG2 transmission completely eliminated the dipstick tube, and is



In 2010, the design of the oil pan of the NAG2 (722.9) was changed, indicating the need for a different fluid and overflow tube. Here we see the “newer” version pan, which has deeper oval indentations (arrows) and a green overflow pipe (visible with the drain plug removed). The side of the pan is flat, unlike the older version pan, which has a noticeable angled chamfer. Be sure to follow the WIS instructions for the version you're working on.

filled from below. This is simple if you have a filling pump (with the correct adapter), and darn near impossible if you don't.

As before, after cleaning the area to avoid any road crud from getting in, we start by draining out the oil pan: Remove the drain screw and pry off the overflow tube (inside the pan) with special tool ‘Drift’ W722 589 03 15 00, allowing the oil to drain out. At the same time, drain the torque

	236.14 (Red, ATF134) A001 989 68 03	236.15 (Blue, ATF134- FE) A001 989 77 03 or 78 03	236.17 (Gold) A002 989 06 03
722.6 (NAG1)	OK		
722.9 (NAG2) Up To S/N 2834526	OK		
722.9 (NAG2) As Of S/N 2834527 with engine 113, 152, 156, 157, 275 and 279		OK	
722.9 (NAG2) As Of S/N 2834527 with engine other than 113, 152, 156, 157, 275 and 279		OK	OK
725.0 (NAG3)			OK

Using the correct transmission oil is critical, and none of the electronic transmissions can use Dexron III. Also note that these fluids cannot be mixed and are not interchangeable.

converter – the 722.6 generally didn't have a drain plug on the torque converter, which is why we used such an elaborate procedure and 14 liters of fluid; the 722.9 has a drain, so use it, then reinstall the plug with a new seal ring.

With the oil out, remove the pan, again carefully since there may be some oil left in there. Pull out the old filter and install the new. Clean out the pan (and magnet) carefully and install a new overflow tube of the same color (using the wrong one will under- or over-fill the transmission, and may be a source of problems). Searching for the tube part number in the EPC by VIN helps get this correct. Since the bolts holding the pan in place are aluminum stretch bolts, it is absolutely mandatory that they be replaced. The pan gasket, too, of course.

To fill the transmission with fluid, mount the adapter to the drain opening and connect your trans oil pump. Now pump six liters into the transmission. Be sure to use the correct fluid – more on that in just a moment. Leave the pump connected.

Start the engine and bring the transmission oil up to temperature. The exact temperature depends on the vehicle: With a chamfered oil pan the spec is 113 deg. F.,



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and without a chamfered oil pan the spec is 95 deg. F. in the model we checked, and if the car has an auxiliary transmission oil cooler the oil must reach 194 deg. F. before the oil starts flowing through it. In every case, you should follow the WIS instructions for the specific vehicle you're working on to be sure. Use XENTRY to measure the oil temperature, and never "power-brake" the transmission to increase the oil temperature. Instead, hold the throttle at about 2,500 rpm with the transmission in Park.

Switch off the engine and re-verify the transmission fluid temperature. If it's too hot (i.e., you heated up the oil because of the auxiliary oil cooler), shut off the engine and let it cool down. When it's correct, start the engine and add either four liters (if the torque converter was drained) or two liters (if the torque converter was not drained) to the transmission using the oil pump. Shift through P-R-N-D several times with the vehicle completely stationary (brakes on) and the engine at idle. Shift into P.

Verify yet again the correct temperature and, if it is correct, remove the pump and adapter and let any excess oil drain out. It is essential that the engine be at idle, and the transmission fluid is not hotter than the specification. It may be necessary to switch off the engine and let things cool down before removing the pump and adapter. Let excess oil drain until only drops come out, then install the drain plug with a new seal washer.

Temperature

Why the obsession with temperature? Seriously, it was checked at least three times! We do this because of

the very high sensitivity of the special transmission fluid to temperature. Its volume changes significantly with temperature, and if you perform the last step (letting it drain from the overflow tube until it drips) at the wrong temperature, you can be certain that the transmission oil level will not be correct. Do we have to explain what happens when there is too little or too much fluid in an automatic transmission? This is a circumstance best avoided.

Transmission Oil

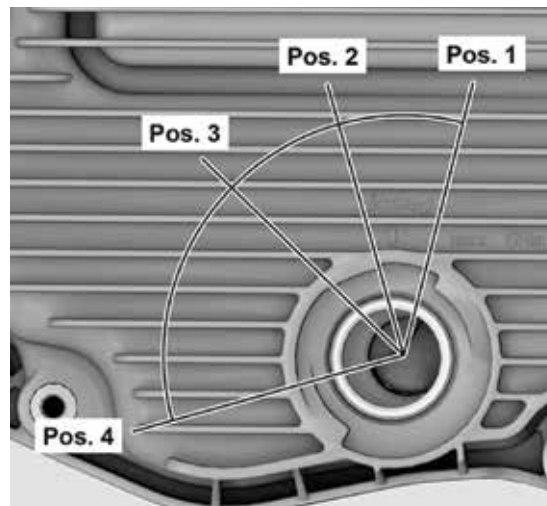
We've mentioned it already, but what you need to know about transmission oil when dealing with 722.6 and later transmissions is shown in the chart. The original 722.6 oil, which is no longer sold, was replaced by the "early, red" 722.9 transmission oil. Later, the oil switched to blue, and then gold. None of these oils are interchangeable, and they must never be mixed.



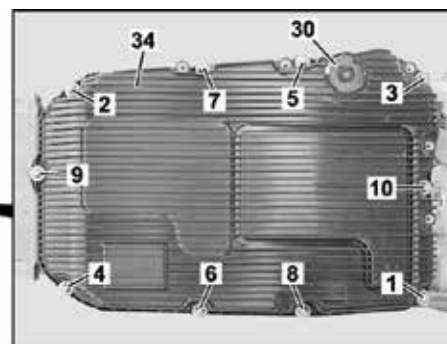
725.0 NAG3

The NAG3, introduced only recently, is a nine-speed fully-electronic transmission. As with the NAG2, there is no external control unit, and be aware that there are two versions: up to the end of Model Year 2014, and as of Model Year 2015. These differ slightly in how they're drained and refilled.

Replacing the transmission oil and filter is similar to the procedure in the 722.9 in that you start by draining the pan and torque



The quick-release coupling as of Model Year 2015 has a valve with four positions: Position 1 is for adding oil, Position 2 is not used in the USA, Position 3 is for adjusting the oil level (see text) and Position 4 is for draining out the oil completely.



In the 725.0 NAG3, the filters (32) are part of the oil pan (34), so you have to replace the whole assembly. Not only must you use the correct torque, but as with cylinder head gaskets, you must tighten the bolts in sequence (1 through 10) in two stages. WIS covers the details nicely. You can also see the quick-release coupling (30) in this photo.



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converter. In early versions of the NAG3, an overflow tube and bayonet coupling (a quarter-turn drain plug) are installed, and the procedure is much like the NAG2 mentioned above. As of Model Year 2015, the NAG3 is equipped with a Quick-Release coupling that has four distinct positions as shown. Use the oil thrower from assembly tool W725 589 02 90 00 to release the quick-release coupler, then use the wrench to turn the coupler so the wing on the tool is in Position 4, allowing the oil to drain. Also drain the torque converter, and keep track of the quantity drained from both the pan and the converter for refilling.

Once the oil is drained, the oil pan is removed. In this transmission, the pan and filters are a single assembly. Replace the entire oil pan with the filters. Additionally, the ten screws holding in the oil pan must be replaced, since they are stretch bolts. When installing the new pan, not only must you observe the proper torque, but also the proper torque sequence (1 through 10) as shown in the image. It goes without saying that utmost cleanliness is to be observed, and you need a new pan gasket, too. Start by torquing all bolts to 4 Nm (which is not a lot of torque), and then repeat the sequence with a 90 degree (1/4 turn) final tightening. Of course,

check in WIS that these values are correct for the vehicle you're working on.

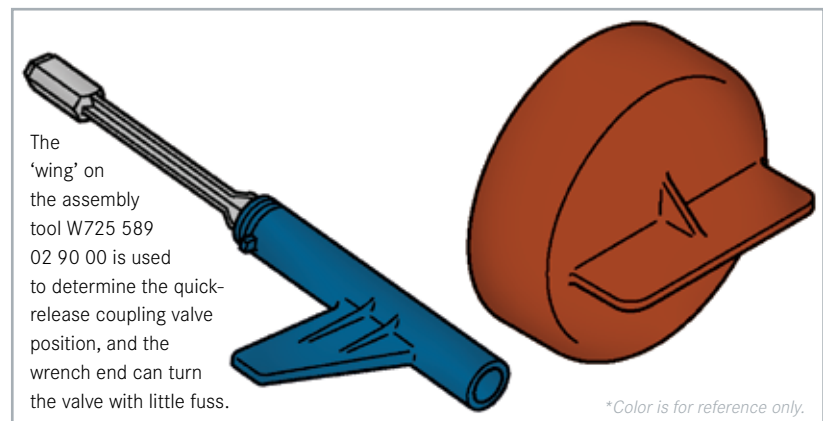
To fill the transmission with fluid, connect the adapter W725 589 00 90 00 to the filling pump (set to not more than 2 Bar/29 PSI to avoid damaging the pan), and attach the adapter to the transmission. For an oil pump, WIS suggests using Pump W000 588 06 82 00, but we couldn't verify USA availability, so check with your dealership for what they're using. Pump in the same amount you drained, plus one-half liter additional, of the correct fluid (Specification 236.17, colored gold).

Disconnect the filling adapter and install the quick-release coupling. Using XENTRY, determine the oil temperature using the "adjust oil level" procedure. With the oil temperature less than the specified value (letting it cool off if necessary),

remove the quick-release coupling and, using the wrench end of assembly tool W725 589 02 90 00, turn the valve inside so the wing on the tool points to Position 1.

Start the engine and warm the oil as specified, and when the exact temperature is reached turn the valve to Position 3. Let the oil drain until it becomes a thin stream (more than just dripping) and the oil reaches one deg. C higher. Turn the valve back to Position 1, reinstall the quick-release coupling, and switch off the engine.

That covers the basic maintenance of the NAG1, NAG2 and NAG3 automatic transmissions. In a future issue, we'll discuss some of the unique maintenance needs of the 7G-DCT dual-clutch transmission first introduced in the CLA (117) model. |



Vehicle (As Of Model year 2015)	Fill temperature (do not exceed)	Turn to 'Position 3' at...	Valve to position 1 when thin stream AND this temperature is reached
205, 207, 213, 217, 218, 222, 231, 253 (Not all have 725.0 NAG3)	95°F	102°F	104°F
166, 292	131°F	138°F	140°F

Temperature limits in NAG3 transmissions as of Model year 2015. The temperature is read using XENTRY in the "Adjust oil level" procedure. The temperatures are critical to ensure the proper oil level, so don't take any shortcuts here. As always, verify the values expected in WIS for your specific vehicle.

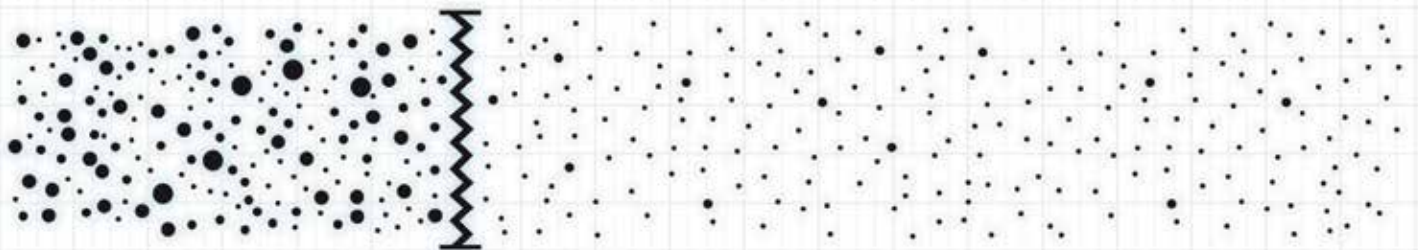
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