StarTuned®

Information for the Independent Mercedes-Benz Service Professional

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On behalf of your local Mercedes-Benz dealer, we are proud to have produced *StarTuned* for Independent Mercedes-Benz technicians for 20 years!

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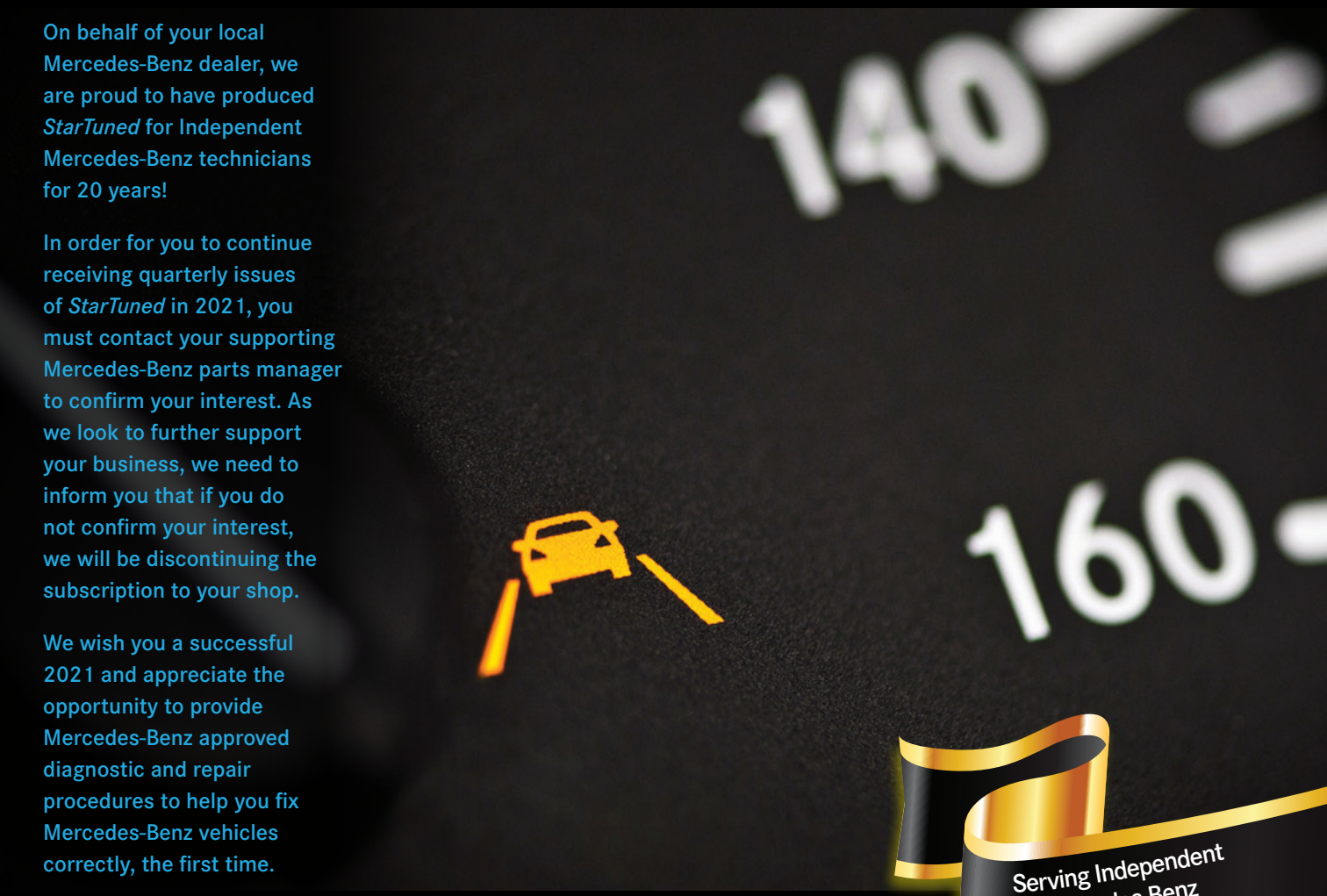
We wish you a successful 2021 and appreciate the opportunity to provide Mercedes-Benz approved diagnostic and repair procedures to help you fix Mercedes-Benz vehicles correctly, the first time.



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December 2020

StarTuned®

Celebrating 20 Years

We are pleased to be celebrating our 20th year in producing *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 aims to continue to present the information you need to know to diagnose and repair Mercedes-Benz vehicles accurately, quickly and the first time; text, graphics, online and other technical sources combine to make this possible.

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

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.

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In This Issue

Also Inside:

Mercedes-Benz
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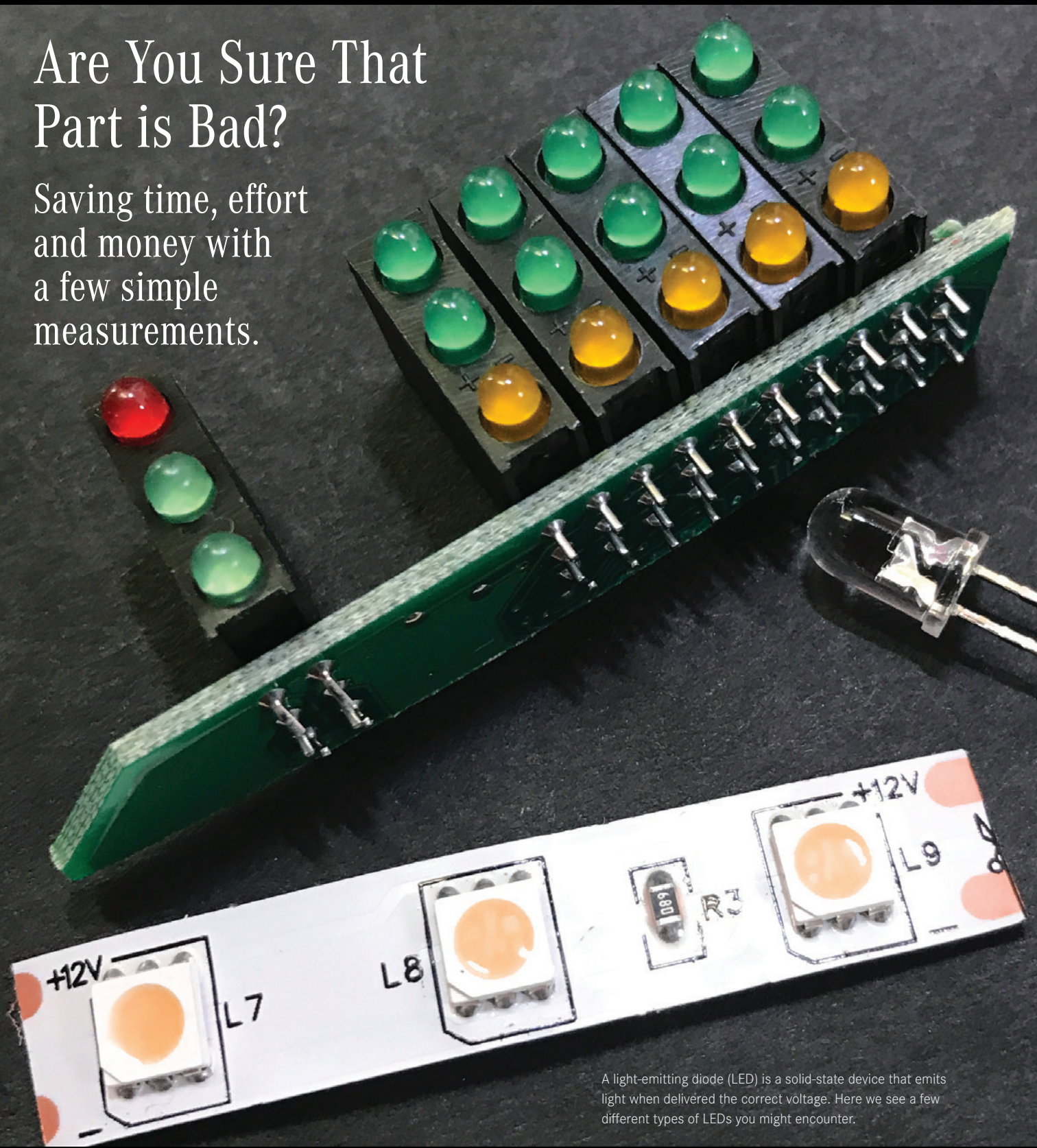
Are You Sure That Part is Bad?

Saving time, effort and money with a few simple measurements.



A light-emitting diode (LED) is a solid-state device that emits light when delivered the correct voltage. Here we see a few different types of LEDs you might encounter.

We've all had it happen: The Diagnostic Trouble Code (DTC) says it's that part, the symptoms point to that part too, but after installing a brand new one...still the same problem. Ugh!

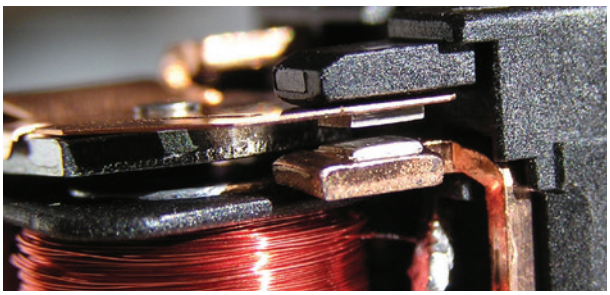
This article will take a close look at many of the most common electrical components we find in vehicles today and show how to test them to verify they really are faulty. We'll also share some resources from Mercedes-Benz you can use to find test values for more complex parts like sensors. After all, we always want to find the "smoking gun" to be sure the car is really repaired.

A vehicle is assembled from many electrical and electronic parts, and different vehicle models use different parts. However, all electrical parts can be broken down into one or more sub-types, and each of these sub-types can be tested in generally the same way. In other words, there are only a few ways of checking components: Master these techniques and you can test almost any component there is.

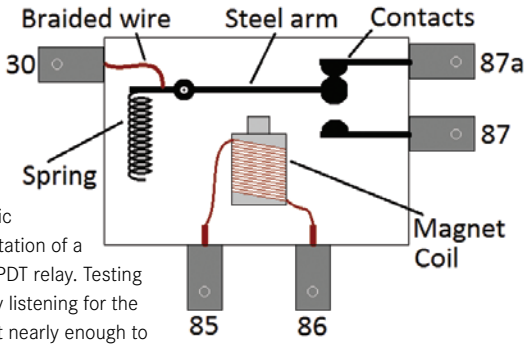
Contacts

Whether part of a switch or a relay, electrical contacts all perform the function of closing or opening a circuit path. The characteristics of a contact that we can test are resistance, isolation and timing.

Contact Resistance: To measure contact resistance, we use either the ohmmeter (for relatively low-current contacts) to directly measure contact resistance, or the voltmeter (for higher-current contacts) to measure voltage drop under load. It is possible for a contact to show a low resistance under the light load presented by an ohmmeter, but have excessive voltage drop under load.



The square electrical contacts of this relay do most of the hard work, but they are not the only thing that can go bad.



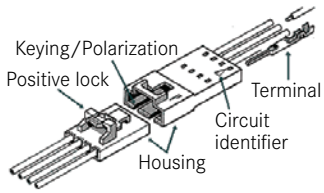
Schematic representation of a typical SPDT relay. Testing a relay by listening for the click isn't nearly enough to verify a good part.

Contact Isolation: To measure contact isolation, we use an ohmmeter. It is possible to use a high-voltage insulation resistance tester (a so-called MegOhmmeter) but this would be unusual in typical automotive testing. An exception would be in certain high voltage systems such as found in hybrid vehicles and electric vehicles, where it is important to verify that the insulation resistance meets safety specifications.

Contact Timing: Contact timing can be checked by ear or sight, and for critical or precise tests an oscilloscope can be used. Generally, there should be no significant delay between mechanical contact actuation and contact electrical closure.

Connectors

Connectors make it possible to disconnect electrical components from the wiring of a vehicle for maintenance or replacement, and allow for easier service by allowing one wiring harness to be separated from another. There are dozens of different connector types used by Mercedes-Benz, as you surely have learned.



Using the correct names when talking about a connector helps eliminate any confusion.

As with switch or relay contacts, the important features of an electrical connector are contact resistance (through the connector) and isolation (between connector pins). We are less concerned with switching timing since connectors are not used for this kind of function, but intermittent contact can cause all sorts of strange symptoms.

In the case of a connector, we measure the contacts using the same methods as for switch contacts. In the case of high-current connections, a few tenths of an Ohm of resistance can be a problem, so ideally we measure the voltage drop across the connector while under load. In general, more than a few tenths of a volt drop is cause for closer inspection.

In addition, we must also look at the physical condition of the contacts: Are the contacts bent or malformed? Is there evidence of corrosion? Is the wire entering the contact properly crimped? Is there any physical damage to the connector housing or (if equipped) seal? Is the connector fully inserted and locked? Perform a careful inspection of the contacts, using a bright light and, if necessary, a magnifying glass. Often, connectors are buried in the car with difficult access, but it is important to get a good visual. We have resorted to using the shop's borescope in some cases.

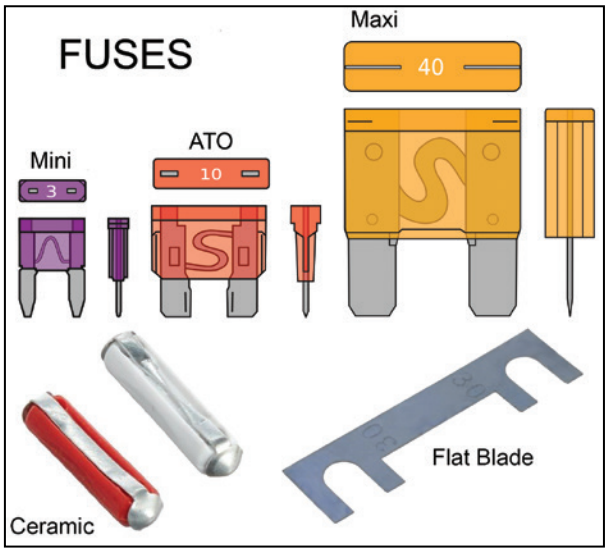
Fuses

Fuses protect electrical circuits from excessive current, and therefore from excessive heat build-up in wiring, connectors and other components.

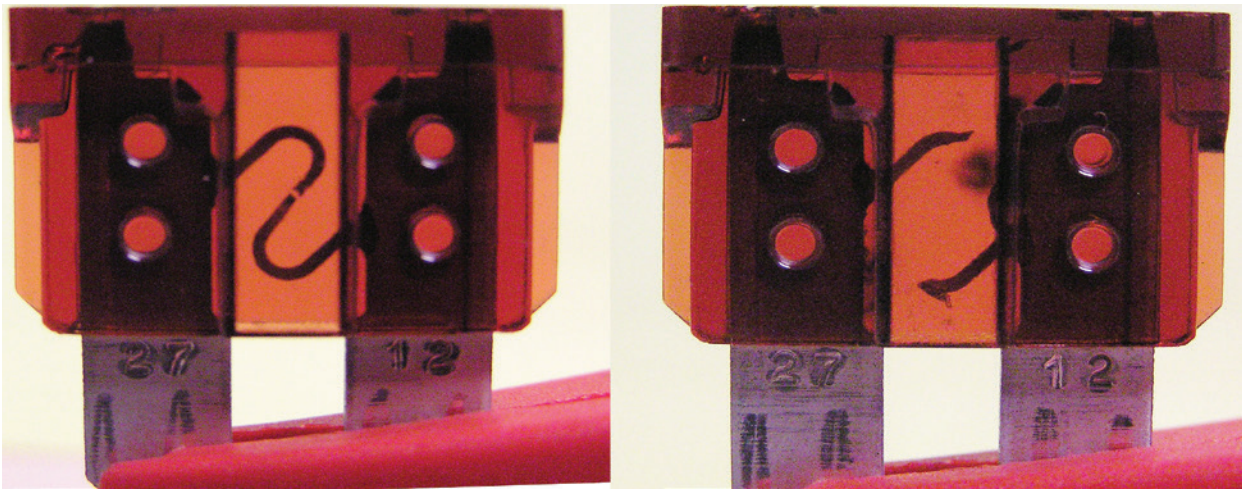
Fuses are a subset of contacts. Although fuses are not designed to open and close repeatedly, they act like closed contacts when they are not "blown" or open-circuited. Fuses are tested either with an ohmmeter (to verify continuity) or by measuring voltage drop across the fuse, which should only be millivolts. If you measure volts, the fuse is faulty. With fuses, it is also important to check for the following:

Fuse value: The fuse must have the specified value (in Amperes) to provide proper circuit protection. This is a safety item. Fuses are often color-coded as well as clearly marked with their rating. Always make sure the correct value fuse is being used, as verified on the wiring diagram or fuse card. Sometimes we have found the wrong value fuse installed.

Fuse type: The fuse must also be of the correct (physical) size and type, for example an ATO fuse with Nickel contacts or Silver contacts, designated with an N or S



Some different kinds of fuses found in Mercedes-Benz vehicles over the years. Modern models use primarily the Mini, ATO and Maxi fuses.



Every blown fuse tells a story. What stories do these two tell? See the text to find out.

on the fuse. Types must be exactly as specified and not mixed since this can cause contact corrosion.

Contact corrosion: When the metal of the fuse contacts have deposits on them, it often causes high contact resistance. This can lead to fuse heating and low circuit voltage.

Proper insertion: If the fuse isn't seated in its contacts well, it can cause high resistance.

If a fuse has blown, as shown in the near-by photo, look at it. A longer-time, moderate overcurrent often creates a small, sometimes difficult-to-see break in the fuse material, as seen on the left. Compare that with a shorter-time, high overcurrent which 'blows' the fuse visibly, as seen on the right. Knowing what kind of overcurrent a circuit with an open fuse may have faced will help in determining how to correct the fault.

Wires

Hundreds or thousands of feet of wire are used in modern Mercedes-Benz models, however much less than the number of functions in the vehicle would require if there were no networks (such as CAN) used in the vehicle. When checking wires, be sure to consider these points:

Check for continuity end-to-end. Note that this usually includes a connector on each end, and perhaps one or more connectors in-between, so be mindful that these also need to be checked. Always use the correct adapter from the electrical connection kit.

Check the wire's physical condition. You're looking for damage to the insulation or a connector, excessive bending, and for network wiring the evenness of the 'twists' in the wire pair. Also check that the harness is not placed in a position where it can be damaged.

Verify the wire's current-carrying capacity. Your ohmmeter may show continuity, but when carrying a few Amperes of current the resistance may be too high due to broken wire strands. As with connectors, check the voltage drop of the wire under load, it should be just a few tenths of a volt at most.

Although rare, remember the possibility of an improper wire repair or incorrect connector pin or socket placement. You never know who has been in there before you.

Lamps and Lighting

Incandescent light bulbs, invented in the early 19th century, are little more than a wire that glows white-hot, giving off light. Testing a light bulb is similar to testing a wire: If it has continuity it is essentially functional.

Some incandescent bulbs are filled with pressurized halogen, an inert gas. Halogen bulbs are different from regular incandescent bulbs in three important ways: First, they operate at a higher temperature, which improves efficiency but also increases the danger of being burned if you touch a hot light bulb. Second, they operate at a higher pressure, also for better efficiency. If the bulb breaks, the higher pressure may propel the bulb shards in a dangerous way.

The clear bulb is made of quartz (fused silica), which is tougher than regular glass but sensitive to any contamination (such as oil or grease from skin contact) that can allow localized heating and lead to shattering. For these reasons, halogen bulbs must be handled with greater care. Never touch a halogen bulb, always use a clean cloth or paper. If accidentally touched, wipe the bulb clean with isopropyl alcohol and clean cloth or paper.

A High-Intensity Gas Discharge (HID) Lamp, the so-called Xenon headlamps, do not contain a wire filament. Xenon lamps use the light from an electrical arc within a bulb filled with xenon gas. This type of bulb does not have a filament, and cannot be tested using continuity or any other means. The simplest option is to try a replacement lamp.

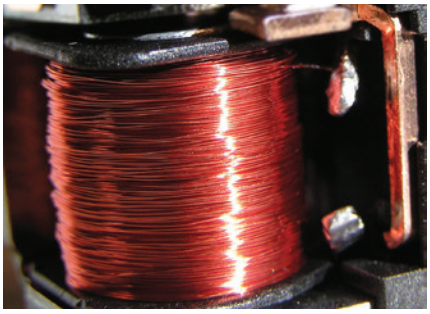
A high voltage is used to ignite the arc, which reduces (but is still dangerous) once the arc (which is a conductive plasma) is formed. Because xenon headlamps operate at high voltages, there is a risk of electrocution. Read and follow the safety information in WIS.

A Light-Emitting Diode (LED) is a semi-conductor diode that emits light. The electrons in the power source excite the atoms in the semiconductor to a point where they have excess energy. When that energy is released, it comes in the form of a photon, as light. Since an LED is a diode, it conducts electricity in only one direction. Unlike 'regular' diodes, the reverse voltage an LED can withstand is not very high, a few volts at most. To test an LED, apply the rated voltage (see below) of the correct polarity and see if it lights.

In automobiles, we do not see individual LEDs like those available at the electronics store (pictured on page 4), but instead complete assemblies set up for a 12 Volt

power supply. For low-power LEDs, this can be as simple as a few LEDs and a voltage-dropping resistor. For high-power LEDs, such as those used in headlights, an electronic LED controller is used to ensure the LEDs receive very precise power.

Halogen lamps don't use glass but fused quartz as the clear bulb envelope. Because of the intense heat, even the slightest contamination – such as a fingerprint - on the envelope is likely to cause it to shatter.



The wire coil of a relay forms an electromagnet that pulls the electrical contacts together. If the relay clicks, you know the coil is good.

The operating voltage of an LED is determined by its color: Red and orange LEDs operate at about 1.9 to 2.1 Volts, while white LEDs operate at around 3.5 Volts. Even a slight over-voltage – about double the operating voltage – will damage the LED.

The voltage-dropping resistor or electronic controller is essential for LED operation. Although 6 red LEDs in series will operate from 12 Volts, as the LEDs get warmer they will draw more current. This additional current increases the temperature further, and a cycle called "Thermal Runaway" begins, leading to LED failure. The resistor limits the voltage to each LED by dropping more voltage as the current increases (according to Ohm's Law), stopping thermal runaway.

Coils

Coils of many different types are used in automobiles. Most of us are familiar with ignition coils, which are in fact transformers, used to generate the high voltages needed for spark plugs to operate. Relays, solenoid valves, solenoid actuators and motors all use coils as well, and all have similar tests.

An electronic coil is simply a coil of wire, thus the name "coil." And, like wires, they are fairly simple to test (at least at the technical diagnosis level) with an Ohmmeter. In some cases, other testing such as current consumption or voltage drop may be helpful.

When an electrical current passes through a wire, it generates a magnetic field, just as a magnet passing a wire generates electrical current. If we make a coil of wire, the magnetic field is concentrated and can be used, for example, to move the magnetic 'armature' of a relay or solenoid valve. This allows us to use a relatively small current (through the relay's coil) to switch a much larger current (through the relay's contacts).

Although a modern ignition coil is indeed a coil of wire (two coils, actually, forming a transformer), because they contain electronics they cannot be tested except installed in the vehicle and by running the engine. Here, we use XENTRY Diagnostics and an engine scope to watch the secondary ignition pattern.

Sensors

Electronic systems in automobiles have a goal of making the vehicle better in some way: Better safety, better convenience, better efficiency, better comfort, and so on. In order to operate, systems often need to know the value of some physical quantity or another. For this we use Sensors.

Sensors can be used to measure most any physical quantity: Temperature, pressure, light, physical position, speed, and so on. While the specific theory of each sensor's operation can be a topic for an entire book, from the technician's point of view we are only concerned with one thing: Does the sensor accurately sense what it should?

This means we must know two things about the sensor to test it: What is it sensing, and How does it report its readings.

Most of the time, what the sensor is sensing is clear, but sometimes how it is sensing it is not as clear. Take a wheel speed sensor for example: It is supposedly sensing wheel speed, but what it is really sensing is 'teeth' passing the sensor. The difference is that looking at a moving wheel, you can see it has "speed" but you can't see that the spaces between the teeth are filled with debris, resulting in a wrong speed value.

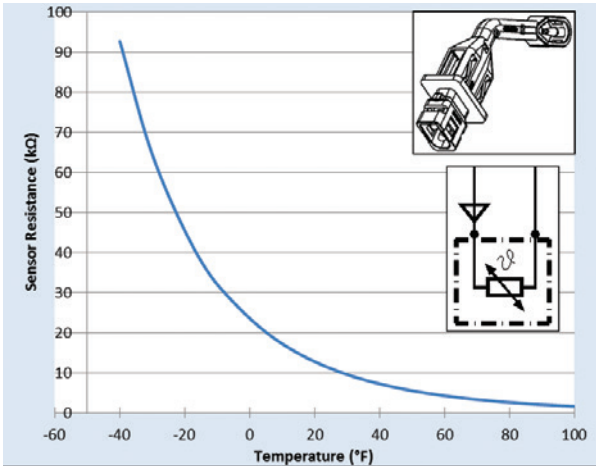
The point is, knowing exactly what a sensor is sensing (teeth) is important when deciding how to test it, while

knowing what parameter it is sensing (wheel speed) is important when deciding which sensor to test. Once the sensor to be tested is identified, you need to determine how these readings are reported back to the control unit, so you can measure it and decide if the sensor is sensing and reporting what actually exists.

Temperature

The graph shows the resistance of a particular sensor, according to the temperature it is sensing. It has a Negative Thermal Coefficient (NTC), meaning that resistance decreases as temperature increases.

To test it, disconnect it and use an ohmmeter to measure resistance, and compare it to the actual temperature at the sensor, ideally at a few different temperatures. Ice in water is about 32 F and hot water from the sink is often around 120 F.



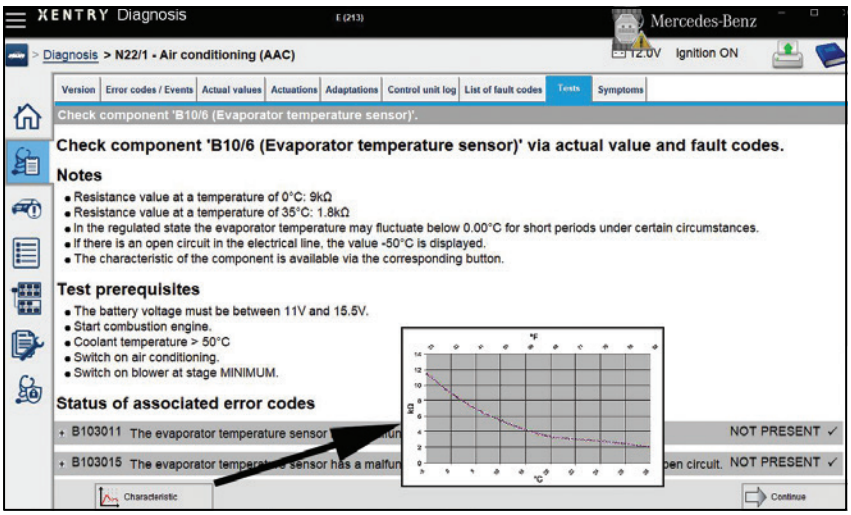
A typical temperature sensor, it's schematic symbol, and the characteristic NTC curve, showing how temperature changes affect the sensor's resistance.

Many sensors in newer vehicles are supplied with +5 Volts and return a signal that varies between around 0.5 to 4.5 volts. Note that some sensors have voltage outputs that are not referenced to ground but to +5 volt power. Measuring with your voltmeter with a ground reference will lead to major confusion, as the readings will be low and not make any sense. Always try using the +5 volt power supply as the reference to see if that makes a difference. Hall-effect sensors such as wheel speed sensors are one of the most common parts that use a +5 volt reference for the output signal.

Finding Test Values

When you need to know the test values for a sensor, use the following resources (listed in order of success):

1. XENTRY Diagnostics: Enter the control unit the sensor connects to and look for a guided test, which usually has the specific test values.
2. WIS: Find the Function Description (document type GF) for the system, which may include information on the sensor. Although WIS very rarely contains test values – this is exclusive to XENTRY Diagnosis – the function description can help you better understand the role the sensor plays overall.
3. Test a known good sensor, under conditions that are known (e.g., temperature, pressure, etc.) and compare readings.



A screen capture of a test step in XENTRY Diagnosis for an Evaporator Temperature Sensor. In addition to the specific test values given, clicking the "Characteristic" button displays the sensor curve (inset).

Conclusion

So there you have it: Even though that fault code says that Component XYZ is faulty, that "ain't necessarily so." Take a few extra seconds to actually test the component, verify that it really is faulty and see what that can tell you about the reason for failure. Understanding the component's function will definitely help you figure out how to test it, and with a few simple tests, virtually any electrical component can be verified good or bad, not only ensuring that the correct part is replaced, but saving you time and effort as well.

What About Vans?

Since 2006 more than 185,000 Sprinter and Metris vans have been delivered to destinations across the United States. Get to know the various models and their engines and transmissions.

When it comes to Mercedes-Benz Vans, most of us think of the classic and popular Sprinter vans but did you know that Mercedes-Benz came up with the idea of a van over a century ago? Mercedes-Benz recognized early on a need for a vehicle that could handle heavy hauling and serve all of industry. They invented the van and continued to develop it while becoming the standard for which others might follow. As the industrial age continued the need grew and soon Mercedes-Benz became the world's largest commercial vehicle manufacturer.

While most of you in the automotive industry will probably only service the smaller Sprinter models and the newest-of-the-fleet Metris van, it's good to know that Mercedes-Benz has raised the bar on innovation and technology. In this article we'll take a closer look at the various Sprinter models and systems over the years.

History

One of the earliest Benz delivery vans from 1896. The resemblance of the controls to those of the 1886 Patent Motorwagen is clear.

- 1896 The Benz Company invents the motorized van, dubbed a "combination delivery vehicle"
- 1929 Introduction of the Mercedes-Benz L 1000 Express van
- 1956 Mercedes-Benz introduces the L 319 and reinvents the light truck segment
- 1967 Mercedes-Benz introduces the new large-capacity van, the L 406 D
- 1977 Mercedes-Benz launches a new light van lineup internally called the TN or T1
- 1986 Mercedes-Benz presents its newest van, the T2.
- 1995 The first-generation Sprinter (Types 901-905, aka T1N) launches in Europe and wins "International Van of the Year"
- 2001 DaimlerChrysler Vans imports the first T1N Sprinters (Types 903 and 904) to the United States under the Freightliner badge
- 2006 The second-generation Sprinter (Type 906, aka NCV3) enters the European Market, and comes to the United States the next year.
- 2010 Daimler Vans USA first sells the Sprinter under the Mercedes-Benz name in the US market
- 2015 The midsize Mercedes-Benz Metris van enters the US market
- 2019 The third-generation Sprinter (Type 907, aka VS30) is launched worldwide

What's in Your Shop?

You'll note in the above history that the Mercedes-Benz Sprinter was first sold in the US market in 2010. You might be thinking "hey, we've been working on Sprinters before that!" and you would be correct. That's because they have been available here under various badges such as Dodge (Remember Daimler Chrysler?), and Freightliner. There have also been various conversion vans based on the Sprinter platform such as those by Winnebago.

Trying to cover all the variants in Sprinter models would be like trying to drink from a firehose! One actually has to consider almost a thousand different Sprinters, since nearly that many can be created simply from the different available offerings of wheelbases, lengths, heights, weights, body, engine, and transmission configurations. The Sprinter has been available in three wheelbases, four lengths for the cargo variants, with standard, high or super-high roof. It isn't simply restricted to modifications of the wheelbase: each particular wheelbase had its own specific matched overhang. The design reasoning was to engineer the most favorable advantages in terms of driving dynamics and weight proportion. We will however cover the different engine and drivetrains in the various models that you service.

Models and Years

The first generation North American Sprinter was launched in 2001 in the U.S. and was originally badged as a Freightliner. In 2003, DaimlerChrysler introduced

a Dodge branded version of the Sprinter to the North American market. It was identical to the Freightliner Trucks version except for minor styling details and badging. The Dodge Ram Van, which had used the same basic body and layout since the 1970s, was discontinued in 2003, with DaimlerChrysler choosing to replace it with the Sprinter. No reason to reinvent the wheel, the Sprinter platform was already a proven success.

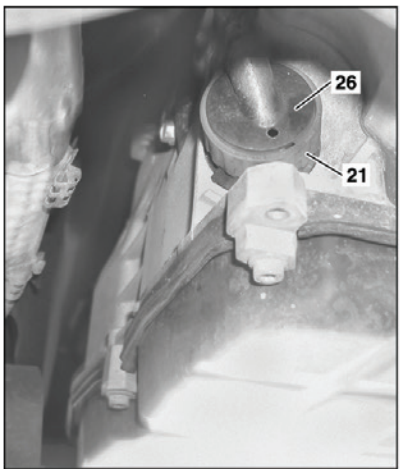
These models had the OM611 or the more common OM612 engines. The OM611 is a 2.0 liter inline 4 cylinder diesel engine and the OM612 is a 2.7 liter inline 5-cylinder Common Rail (CDI) in line overhead valve diesel engine. Featuring a cast iron block and aluminum cylinder head, it is also equipped with a turbo charger and intercooler, double overhead cams and four valves per cylinder. The Dodge versions can use the Chrysler DRBIII diagnostic platform as well as the Mercedes-Benz Star Diagnosis System (part of XENTRY Diagnosis) for scanning and diagnosis. There are also some aftermarket scan tools that can communicate with some or all of the control modules, although most cannot set adaptations or program control units.

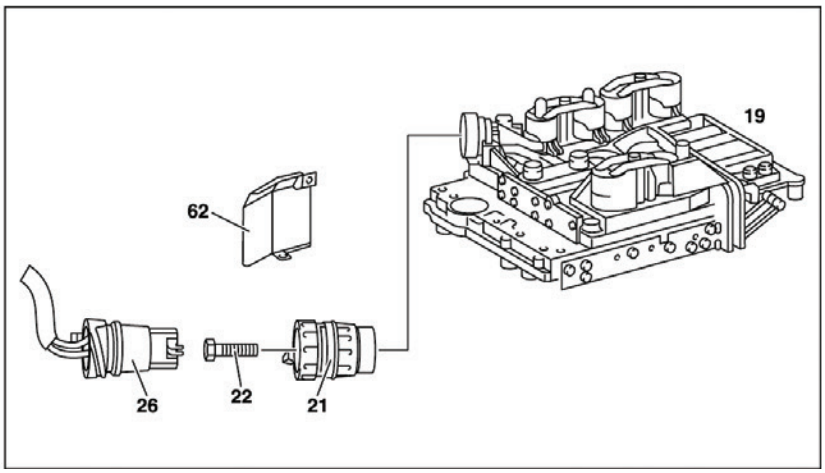
Sprinter vans were first imported under the Freightliner badge, later under Dodge and, of course, Mercedes-Benz.

The automatic transmission in these early models is the 722.6 NAG1 electronic transmission, known from the Mercedes-Benz passenger car line as of the late 1990s. An electronically controlled five-speed transmission with a lock-up torque converter, the NAG1 electronic transmission is a conventional transmission in that it uses hydraulically applied clutches to shift a planetary gear train. However, the electronic control system replaces many of the mechanical and hydraulic components used in conventional transmission valve bodies, with electronic solenoid valves directing the hydraulic fluid.

The ratios for the gear stages are obtained by 3 planetary gear sets. Fifth Gear is designed as an Overdrive with a high speed ratio. The electronic control system enables precise adaptation of pressures to the respective operating conditions and to the engine output during a

The electrical connector for the 722.6 NAG1 transmission has 13 pins.





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).

shift phase, which results in a significant improvement in shift quality.

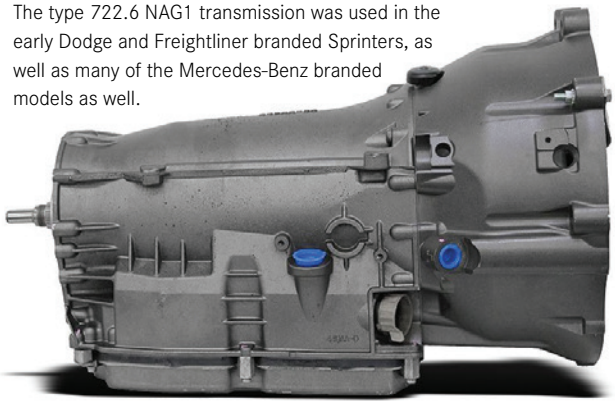
The NAG1 Transmission can be identified by the presence of a 13 pin electrical connector, with a bayonet lock on the front right side of the transmission oil pan. If the seal fails, a slow loss of transmission fluid can lead to shifting complaints, as well as stains on the parking lot. The O-rings are not available separately, so simply replace this part as a complete unit.

Early versions of the NAG1 in passenger cars have been known to suffer a conductor plate (the 'valve body' carrier in the oil pan) failure. Fault codes for the transmission, particularly the internal sensors, are typical, along with the transmission entering limp-mode, seemingly stuck in a lower gear.

Later 906 models, as well as the latest 907 Sprinter, have the NAG2 722.9 transmission installed. Again, this is well-known from the passenger car line. Check the March 2017 issue of *StarTuned* for information about this transmission.

Beginning with the 2006-07 model years Mercedes-Benz introduced the OM642 engine, a 3.0 liter V-6 diesel with aluminum block and heads, common rail direct injection and a variable nozzle turbocharger. The injection system operates at 1,600 bar (23,000 psi), while the compression ratio is 18.0:1. The engine features a counter-rotating balance shaft mounted between the cylinder banks to cancel the vibrations inherent to the 72 degree V6 design, and the crankpins are offset by 48 degrees to achieve even 120 degree firing intervals.

Optionally available was the M272, a 3.5-liter V-6 gasoline engine, also well-known from the passenger car line. All M272 engines have aluminum blocks with a 90° V-angle with silicon/aluminum lined cylinders.



The type 722.6 NAG1 transmission was used in the early Dodge and Freightliner branded Sprinters, as well as many of the Mercedes-Benz branded models as well.

The aluminum DOHC cylinder heads have 4 valves per cylinder, forged steel connecting rods, one-piece cast crankshaft, iron-coated aluminum pistons and a magnesium intake manifold. A dual-length variable length intake manifold is fitted to optimize engine flexibility. Those of you that have serviced this engine will recognize this is an area of concern in the higher mileage vehicles: Intake runner valves can get stuck and break, resulting in multiple codes and power loss complaints.

With the introduction of the Mercedes-Benz branded Sprinter in 2010 some improvements also came with the OM642 engine. In some heavy vehicle applications, Mercedes-Benz' BlueTec AdBlue urea injection is utilized for NOx reduction. In lighter vehicle applications, a NOx storage catalyst captures nitrous oxides, which are periodically purged or broken down by running the engine slightly rich. A Diesel Particulate Filter (DPF) lowers soot, making this engine ULEV certified. The 906 model continued with the 722.6 NAG1 automatic transmission as described above, but changed over to the 722.9 7G-TRONIC in model year 2014, when the OM651 diesel was introduced.

Maintenance

Early models may or may not have the ASSYST Maintenance Computer which can aid you in determining the service intervals. In equipped vehicles, the next maintenance service is indicated in the multi-function display with the wrench icon symbol and a displayed distance or time. A single wrench icon indicates that an Oil Service (Service A) is necessary, while a double-wrench icon indicates that a Maintenance Service (Service B) is necessary. If the display shows the time remaining instead of distance, a clock symbol will also appear in the multi-function display.

Be sure to reset the service indicator after an oil service and/or maintenance service has been performed: In Model 903/904: Turn the key to position 2 and press "mi" (or "km") button twice. Turn the key to position 0. Hold down the "mi" (or "km") button and turn the key to position 2, wait about 10 seconds for the reset confirmation tone, then release the button. Consulting the maintenance schedule and details in the Workshop Information System (WIS) will be important as with all models in determining the best possible care for your customer's vehicle.

A typical maintenance schedule for the early Dodge-branded Sprinter looks like this:

Maintenance Booklet

Active Service System (ASSYST)

General notes

Your Sprinter is equipped with the **Active Service System (ASSYST).** The maintenance computer tracks distance driven and the time elapsed since your last service. The maintenance service is shown in the multifunction display in the instrument cluster.

Approximately one month before the maintenance service is due, the multifunction display shows a message. It indicates when the next maintenance service is due in miles or days.

The icons or letters on the service indicator show the type of service that is due.

or A Oil Service Plus

or B Maintenance service

The ASSYST system helps you understand which service is needed. The maintenance symbols are a single or double wrench icon.

An Oil Service is fairly simple:

- Oil change and filter replacement
- ASSYST maintenance computer reset
- Check power steering fluid. If low, trace and correct cause.
- Replace fuel filter (OM611 only)

A Maintenance Service is somewhat more involved; here is a summary only:

- Oil Service
- Function check of the horn, MILs and warning lamps, parking brake and exterior lighting
- Check for leaks and damage, especially belts, hoses and wiring, and suspension and drivetrain rubber
- Check fluid levels, correct as necessary (Coolant, brakes, washer system, etc.). If low, find and correct. Replace brake fluid every 2 years.
- Replace fuel filter, check engine air filter and replace if necessary (at least every 3 years)

Chassis and body

- Trailer coupling (if factory-installed): Check operation, play and retaining fixtures
- Secondary rubber springs: Visual check
- Tire pressures: Correct as necessary, including spare tire
- Check thickness of brake pads
- Check condition of steering mechanism
- Heating/ventilation dust filter renewal

Additionally, the maintenance schedule calls for renewal of the automatic transmission fluid and filter once only at 80,000 miles. In our shop, considering that most customers expect to run their van for a half million miles or more, we advise our customers that even though Mercedes-Benz recommends only the single oil and filter change, the overall cost of this service is inexpensive compared to a new unit, and so suggest they get the oil and filter changed around every 50K-80K or so.

Later models including the Mercedes-Benz branded Sprinter have the ASSYST or FSS system, which is helpful in providing the proper maintenance. These later models use the classic Service A and B schedule as prescribed by Mercedes-Benz. In these models, the transmission fluid intervals have been updated to every 75K miles. Important as with all Mercedes-Benz products is to use the exact fluid called for in the specifications for the model you are working on. Your local Mercedes-Benz parts dealer will stock the proper fluid and many can sell it to you in bulk if you have a large container.

And, as always: Check the relevant service literature and WIS for the details of the exact model you have in your shop. There are simply too many to cover them all here.

Common Repair Items

Early 903/904 models:

Crank no start: These vans are older now and many are very high mileage so you will begin to see aging fuel systems starting to fail. If you suspect a fuel problem you will need to do a complete fuel system test, including fuel rail pressure and voltage, as well as line pressure from the intake pump to the filter, and test all the injectors for return flow.

Power loss, under-boost codes: This is often caused by a failed turbocharger resonator (also called intake silencer).

A failed part we have seen is this intake silencer or turbocharger resonator. This is an improved later version.

Door handle and latch problems: As stated earlier, many

of these models are fleet vehicles and worked hard, doors being opened and closed many times in one day. Careful inspection is the key to finding worn components.

Door handles, sliding door hardware, and latches get high wear especially on fleet vehicles. Check carefully for wear, replace as necessary.

906 models:

NOx system failures: Symptoms may include no start no crank. The fuse for the NOx AdBlue system can blow. Fault codes 155700, U029D and U029E may be present. A complete and careful inspection of wiring for the exhaust sensors along the exhaust system is required. Service bulletin LI49.10-N-059066 deals with this.

EGR failures: Engine DTCs 150200 (The upper limit value of component HFM-SFI has been exceeded), and 14CF00 (Component Y27/17 EGR positioner was temporarily sluggish) which is sometimes called position control deviation. Repairs can include possible EGR valve replacement and/or EGR cooler cleaning or replacement. Many power loss issues and Mass Air Flow sensor codes can be due to air leakage in the intake system. Consult service bulletin S-B-07.07/83 which can help guide in the repair. It is important to note that with all HFM-SFI codes the adaptation values will have to be reset.

Glow plugs: As with passenger cars, these are a common service item. They are in a hostile environment and will eventually wear out. When one goes, the others are not far behind, so try to convince your customer the benefit of changing them all when one or more fails. Be extremely careful when changing them, as breaking one of these off in the cylinder head will ruin your day. Consult the article on Black Death from the September 2020 issue of *StarTuned*.

Fuel Injector Seals: Speaking of Black Death, be sure to check the fuel injectors at every service, and if ANY signs of seal failure are present, replace all the seals immediately. The parts and labor are very inexpensive if you catch this early enough.

No start no crank issues: Possible failure of the anti-theft immobilizer system or key. This system is responsible for recognizing the proper programmed key to start the

Beware the PSM

Don't Get Burned!

The vans world is very different from that of passenger cars. A car buyer might customize their vehicle with snazzy rims or a pair of fuzzy dice, but a van buyer might customize it with emergency lights and siren, a full kitchen and bath, or even a small but efficient machine shop. To allow such a wide range of upfitting, Mercedes-Benz offers an optional control module named the Programmable Special Module, or PSM.

The PSM is an optional module, generally mounted under the driver's seat, that allows upfitters (like Winnebago or FedEx) to interface with almost every vehicle system using software, helping avoid safety issues or inadvertent damage to the vehicle's base electrical system. It contains a powerful micro-computer and several input/output channels, along with a CAN Bus interface and an extensive library of logic functions that can be used to control add-on systems or create new functions using existing systems. For example, an ambulance upfitter might add emergency lights and program the PSM to operate them properly. Or another upfitter might program the headlamps to switch on if the wipers are switched on, a driver law in several states. Different models and years have different PSMs with different capabilities; as you can imagine, newer models are more advanced.

Few upfitters have the expertise (and are granted access) to correctly write a program for a PSM. The majority rely on a special factory support team for their programs. Even with some advanced computer programming knowledge, it would be a grave error for someone to try to change this programming without very specialized training and tools. That being said, it is almost too easy to accidentally erase the PSM's programming, and impossible to get it back without getting the upfitter involved. No matter what, you'd be looking at several days down time.

So, it is not just a best practice but almost a mandatory move to always copy the PSM programming into XENTRY Diagnostics every time you work on a van that has a PSM. This is part of the procedure if you are going to replace the PSM (i.e. transfer programming from old to new part), but other operations (most notably flashing the PSM firmware) can erase the custom program. So, if you are doing anything anywhere near the PSM, be sure you know who the upfitter is, how to contact their technical team, and have a copy of the original programming from the PSM safely stored in XENTRY. This isn't a job for an aftermarket scan tool, at least none that we know of. If in doubt, get your local dealer involved to store a copy, even if it's only 'just in case.' Better safe than sorry. |

vehicle. You will need a factory scan tool to diagnose and repair failures in this system. Since Theft-Relevant Parts (TRP) are involved, plan extra time and prepare the needed owner documentation your dealer will need to see.

Newer Models

The Metris van, launched in the USA in 2015, is known as the Vito in the rest of the world. Although it has its own unique chassis, virtually all of the systems are carry-overs from the passenger car world. The passenger version is positioned as a people-carrier and not a luxury van. Equipped exclusively with a 4-cylinder turbocharged gasoline engine and 7-speed electronic transmission, it boasts a flexible configuration and segment-leading features.

The newest Sprinter, Type 907, features an optimized powertrain: Diesel or gasoline engines couples with the either the 9G-TRONIC Automatic Transmission (725.0, 9-speed) or 7G-TRONIC PLUS Automatic Transmission (722.9, 7-speed). The 9-speed automatic torque converter transmission is a first in the large van segment, with gear ranges graduated to give an optimum balance between low fuel consumption and superior handling. Other virtues include a low noise level and a high level of ride comfort. Also built in is the ability to change the current shift profile manually with steering wheel shift paddles.

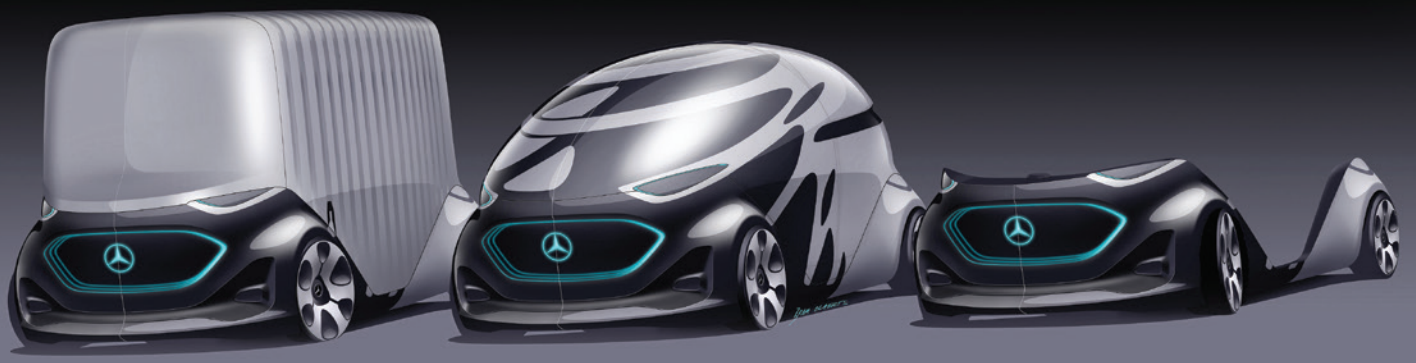
The wave of the future: The new Sprinter (Type 907) fitted as an all-electric version.

The 3.0 liter V-6 diesel engine has continued to undergo refinement and remains the only six-cylinder in the large van segment. A new 2.0 liter gasoline engine, also featured in the mid-size Metris, is a turbocharged 4-cylinder, direct injection gasoline engine with a 7-speed transmission.

Service Opportunities

With so many Mercedes-Benz vans on the market, if you service Mercedes-Benz automobiles already, you should consider taking on the van market as well. Other than the obvious body differences, you will find most of the van systems and components to be nearly the same as found in passenger cars. Many smaller companies use them in the service industry and your Mercedes-Benz Vans dealer keeps a full inventory of parts for servicing them.

The mid-size addition to the van fleet: The Metris van.



Mercedes-Benz Vision URBANETIC More than a self-driving vehicle

A revolutionary new mobility concept, the Vision URBANETIC platform from Mercedes-Benz Vans is much more than all-electric, self-driving vehicle. Fully networked with its surroundings, it not only analyzes current needs to develop optimal solutions, but also learning from them to help anticipate future needs. For instance, the overall system can use the data captured by the vehicle control center – which collates and analyzes needs – to identify a crowd of people gathering in a certain area. It can send vehicles there to quickly and efficiently satisfy the increased demand. The system can react flexibly and is not based on rigid routes or fixed timetables.

To meet the goal of a holistic system solution for urban mobility, the vision URBANETIC (rhymes with "energetic") features switchable bodies that can accommodate people or cargo as needed. At the time of announcement, planned are a people-mover body for up to 12 passengers, and a cargo body with a 12 foot (3.7 meter) load space. The modules are switched either automatically or manually, with the automated process taking just a few minutes.

Thanks to fully automated driverless operation, operating costs fall significantly with Vision URBANETIC. Plus, with the exception of charging times for the battery-electric drive and maintenance periods, each vehicle can be in use around the clock, 365 days a year. It means, for example, profitable operation of local public transport solutions which would not be commercially viable with a driver. Likewise, the concept provides an answer to an ever- increasing demand in areas such as the logistics sector – a lack of drivers.

Vision URBANETIC's electric drive delivers zero-local-emissions mobility, thus making it the perfect vehicle for city centers and areas subject to legal access restrictions. The virtually noiseless electric drive also presents new options for late or night-time deliveries and thus offers major commercial potential.

The absence of a driver's cab frees up space for interior design. Steering wheel, pedals, dashboard and the entire cockpit are things of the past. The space can instead be used for additional passengers or higher goods volume.

Many people still view autonomous vehicles with the certain degree of skepticism. To address this, Vision URBANETIC adopts a new approach, particularly with its people-mover body. The vehicle uses multiple cameras and sensor systems to observe its surroundings in their entirety and communicates actively with them. For example, it uses the large-format display on the front of the vehicle to inform pedestrians crossing the street that it has noticed them. Another example is digital shadowing around the side door. Several hundred light units display the contours of approaching individuals along the sides, signaling to them that the Vision URBANETIC has noticed them.

While the Vision URBANETIC remains a concept vehicle, it is a serious endeavor that is a clear indication of the vision of future mobility at Daimler. |

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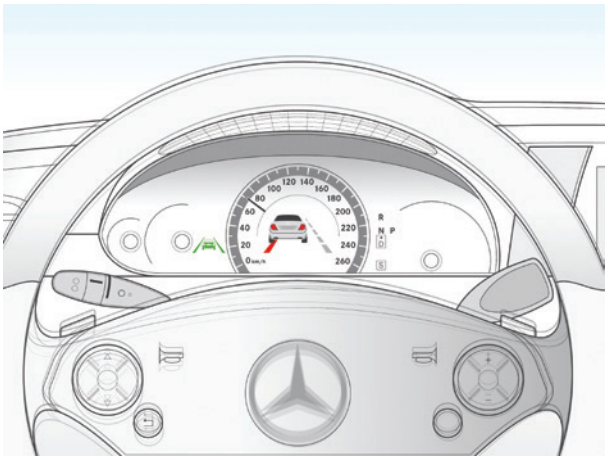
One remanufactured engine pulls the plug on climate-damaging CO_2 and saves 447 days of power for one laptop.

Understanding Mercedes-Benz Lane Keeping Assist

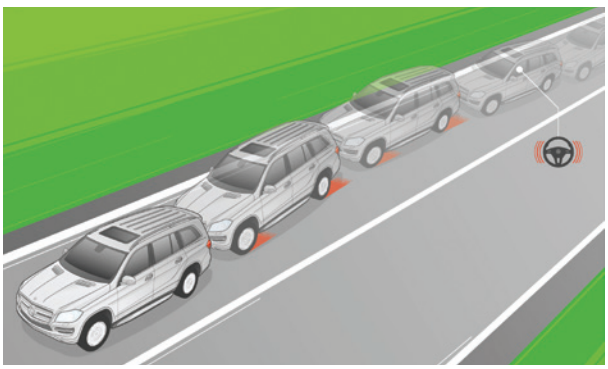
Understanding how steering, Electronic Stability Program, acceleration, braking, camera and radar sensors interact in the Mercedes-Benz Active Lane Keeping Assist program can help you maintain system reliability.

It would be a shame if this beautiful 2021 GLA 35 crossed the lane markings unintentionally, so Lane Keeping Assist technology is on the job.

Mercedes-Benz offers two systems to help inattentive drivers stay safely inside the lane markings as they drive. A base Lane Keeping Assist provides warnings if the vehicle begins to wander across a lane marking line. Advanced Active Lane Keeping Assist amps up this functionality by adding the ability for the system control unit to take over braking and nudge the vehicle back to safety inside the lane markings.



Active Lane Keeping Assist vibrates the steering wheel (that's not a blurry illustration, folks) to alert the driver of lane drift, simulating road-edge rumble strips. If the driver does not respond, Active Lane Keeping Assist applies corrective braking (indicated by the red icon on the instrument cluster) to help pull the vehicle back into the lane.

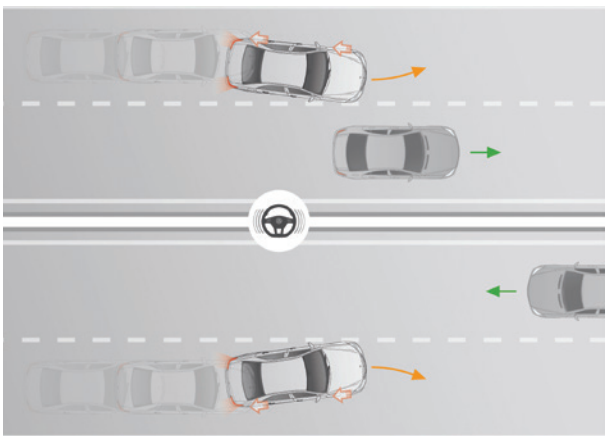


Active Lane Keeping Assist first vibrates the steering wheel, then waits for a driver response. If the turn signal is not activated for the direction in which the vehicle is traveling, or the car does not turn back into its lane, Active Lane Keeping Assist initiates braking on the wheels opposite the direction of travel (red under tires, illustrated here on a 2013 GL-Class). This corrective braking pulls the vehicle back into its lane.

Both Lane Keeping Assist systems use a forward-facing camera to monitor the direction in which the vehicle is headed and compare that to lane markings. Both systems assess driver behavior and issue warnings if the vehicle begins to wander over a lane marking unintentionally. Both consider accelerating, braking, use of turn signals, or certain other behavior as indicators that the driver is aware and in control, and thus the lane change is intentional and no warning is necessary.

The base Lane Keeping Assist offers warnings that consist of visual alerts in the instrument cluster and mirrors, plus vibrating the steering wheel to yank the driver's attention back to the position of the vehicle in the driving lane. The Active Lane Keeping Assist system adds a radar sensor mounted behind the rear bumper. This wide-angle radar sensor provides a signal to the multifunction camera control unit when they detect an object in the area immediately behind or to the near left or right of the vehicle.

If the vehicle begins to cross the lane markings without the use of turn signals or other indications of driver intent, Active Lane Keeping Assist takes over.



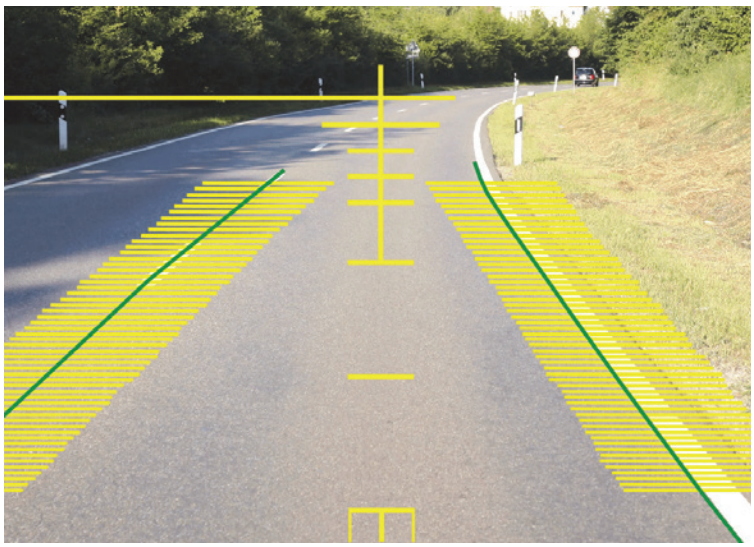
Active Lane Keeping Assist features both a front-facing camera and rear-facing radar sensors. It can detect traffic all around the vehicle. In addition to seeing the start of lane departure, the technology also detects vehicles in neighboring lanes, oncoming traffic, and cars approaching from the rear. Active Lane Keeping Assist initiates corrective braking independent of driver input, if necessary.

Instrument cluster messages let the driver know when the Lane Keeping Assist system is active, as shown here on the 2013 and up Sprinter.

An orange triangular icon pops up on the appropriate side mirror to help alert the driver where not to go.

Independent of the driver, the multifunction camera control unit actuates braking at the appropriate wheel or wheels to pull the vehicle back into the original lane.

Mercedes-Benz vehicles with Lane Keeping Assist include the 2014-2020 CLA-Class, 2011-2019 B-Class MPV, and 2014-2020 B-Class EV. Models with Active Lane Keeping Assist include the 2015 and newer C-Class, E-Class and S-Class, 2012-2019 GLE SUV and Coupe, 2010-2017 CLS, and more.



The multifunction camera and radar sensor system control unit each collect data on the lane markings separately, then combine their analyses to determine the relative position of the vehicle in the lane. The system cannot function where lane markings are absent or visibility is obscured.

The Lane Keeping Assist function detects unintended driving across road lane markings and issues a haptic warning to the driver by generating vibrations on the steering wheel. The driver can choose from two different operating modes. Standard Mode sets sensitivity thresholds to issue warnings earlier and more frequently. Adaptive Mode generates warnings later and less often.

Lane Keeping Assist includes driver behavior in its calculus on whether to issue a warning. If Lane Keeping Assist sees steering wheel movement, braking, turn signal operation, or acceleration activities during the time a lane change is occurring, the system declines to issue a warning. The same is true if the driver changes lanes while also engaging in sharp or high-speed cornering in a curve. Lane Keeping Assist operates only at vehicle speeds above about 37 MPH (60 km/h).

Weather and Road Conditions Can Hinder Functionality

Movement across lanes is monitored by the multifunction camera. Lane markings must offer high enough contrast with the road surface to allow optical pick up by the camera.

Several environmental factors can cause Lane Keeping Assist operating difficulties. If lane markings are in poor condition or not present, cameras or sensors cannot collect accurate data to determine the vehicle location relative to lane edges. Heavy rain or fog can reduce the ability of cameras to see where the vehicle is in the lane.

The multifunction camera is mounted on the top center of the front windshield. In addition to collecting visual information about lane markings, it functions as a central processor for all Lane Keeping Assist inputs and outputs.

Snow, dirt or leaves on road surfaces can obscure lane markings. Ice, snow or debris covering the camera lens or sensors can render them inoperative. Excessive glare from the sun can temporarily blind a camera and diminish Lane Keeping Assist functionality. Incomplete or unclear construction site markings also increase the likelihood of Lane Keeping Assist errors.

Many LKA Components

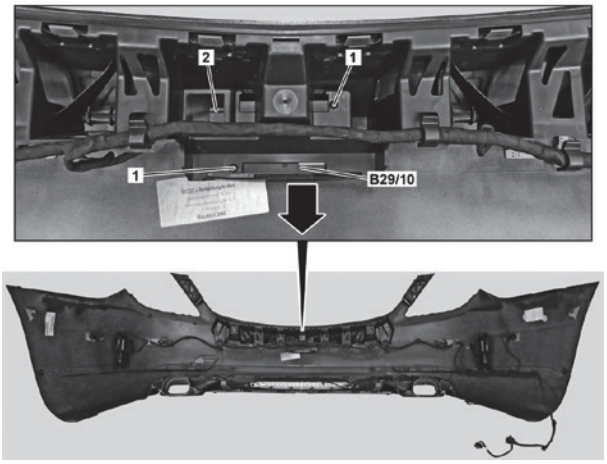
Lane Keeping Assist functionality requires more than just a camera and sensor. Both the active and base Lane Keeping Assist systems include many components that share data used to maintain proper functionality.

For example, assessment of driver intent involves information from the accelerator pedal position sensor, steering angle sensor, lateral and longitudinal acceleration sensors and related control modules. Lane Keeping Assist activation is speed-dependent, and the steering wheel haptic (vibration) warning increases or decreases to compensate for speed-related road noise, so input from wheel speed sensors and braking are critical.

The multifunction camera is also a control unit responsible for collecting and interpreting all lane keeping system inputs as well as generating appropriate outputs and actuation commands. However, work through any trouble codes you find for these related components before you consider replacing the multifunction camera.

Lane Keeping Assist – Key System Components

- Multifunction camera
- Steering wheel vibration motor
- Electronic Stability Program control unit



The radar sensor is mounted in the rear bumper in S-Class models up to 2018 equipped with Active Lane Keeping Assist. Expansion rivets (number 1 in this image) hold the sensor (B29/10) in place. Replace these rivets if damaged.

This wiring harness from a 2012-2019 GLE-Class Coupe has chafing damage from rubbing against a nearby component or bracket.

- Steering angle sensor
- Steering column module control unit
- Steering wheel electronics

Active Lane Keeping Assist

All of the above, plus additional key components:

- Yaw rate sensor
- Video and radar sensor system
- Regenerative braking system control unit (electric/hybrid vehicle)

When you find a trouble code that relates to a power supply problem, you'll trace it on the wiring diagram to the components to test. Before condemning costly components, inspect for loose wires, corroded or damaged connectors or other wiring issues that can cause opens or shorts in a circuit.

A Temporary Hiccup

Infrequent sensor malfunction may be frightening to the driver who has become accustomed to relying on Lane Keeping Assist. But the good thing is that fear brought the vehicle in so you could identify any real problems. Something no more critical than a temporary hiccup is probably resolved by the simple act of starting the car to drive to the repair facility.

Even when a Lane Keeping Assist error message pops up more often than the occasional weird glitch, the cause could be minor. Something as simple as dirt or ice blocking the lens of the multifunction camera or radar sensor could lead to a system error. On vehicles with Active Lane Keeping Assist, the radar sensors could be disrupted by interference from an external transmitter such as a cell phone or other nearby device using Bluetooth. A quick cleaning of the camera lens or radar sensor, and shutting down or removing the Bluetooth device from the vehicle often clears up those types of problems.

Faulty Sensor Hardware

A warning light that comes on every time the vehicle starts indicates a more serious issue. Check the fuse and, if used, relay for that circuit. On the 2013 C-Class, E-Class, CLA-Class, CLS-Class and other models built between November 2012 and September 2013 for example, the micro-relays in the fuse and relay boxes in the engine compartment or rear compartment may have a malfunction and not close correctly. Just hearing the relay click isn't enough: Be sure to test the relay properly as explained elsewhere in this issue of *StarTuned*. This fault can disrupt data communication to and from not only the driver SAM (signal acquisition and actuation module) and engine control units, but also control units for Lane Keeping Assist, DISTRONIC and other key systems. Refer to XENTRY Tips document LI54.15-P-057373 for details.

If it is not the fuse or relay, normal wear and tear could have brought the sensor to the end of its useful life. Corrosion on connectors and harnesses may prevent or weaken voltage signal transmission. Any Lane Keeping Assist component or its wiring may have developed a short or other electrical fault.

Moisture Contamination

The number one and more likely cause of radar sensor failure is moisture contamination. If the customer explained that the problem started after a heavy rain, or occurs each time it rains, water may be entering the radar sensor housing. Remove the sensor from the rear bumper and check for evidence of moisture. If there is no corrosion, clean and reinstall the sensor and ensure that it is properly sealed in its housing.

Moisture could also seep into the video and radar sensor control unit, located under the carpet in the front passenger footwell, and disrupt input and output signals to and from the control unit and key system components. Lift up the carpets and underlay to look for signs of liquid.

Steering Wheel Vibration Motor Failure

In the event of unintended lane departure, the multifunction camera control unit commands the steering wheel electronics to actuate the vibration motor in the steering wheel. The vibration motor receives 12 volts for approximately 3 seconds to generate warning pulses, designed to simulate the vibration from road-edge rumble strips, that the driver can feel through the wheel. If the vibration motor is faulty or the current fails to reach it, the system cannot create that haptic warning.

In such a case, the system displays a "Lane Keeping Assist Not Available" message in the instrument cluster. Do not mistake this for the "Active Lane Keeping Assist Currently Unavailable" message. Active Lane Keeping Assist drops out in some instances, due not to hardware faults, but rather to environmental conditions reducing visibility of lane markings. No repair is required: Active Lane Keeping Assist returns to normal operation once weather or road conditions allow lane markings to be visible again.

Use Mercedes-Benz XENTRY Diagnostics to actuate and test the vibration motor. If your diagnostic steps confirm that the vibration motor is not functioning, replace it. In most models the motor is available separately, but certain AMG models will need a new steering wheel if the motor fails.

If the vibration motor is functional, trace the power flow to and from the steering wheel electronics (N135 in the wiring diagram). Test for an open, short, or loose or

Lane Keeping Assist is ready for action when the system icon turns green. Here, the yellow icon indicates the system is active but not yet ready to issue warnings, for example the vehicle has not yet exceeded the lower speed threshold.

damaged connector. If there are no wiring problems, you may need to replace the steering wheel electronics unit.

The three bolts holding the steering wheel electronics unit in place are thread-forming type. They must be torqued to 7 Nm. If you cannot reach 7 Nm tightening torque, replace the steering wheel, using new thread-forming bolts. Refer to Mercedes-Benz XENTRY Tips document LI46.10-P-065829 for additional repair procedure details.

Multifunction Camera Failure

In 2015 to 2016 C-Class (W205, multiple body styles), S-Class (V222 4-door sedan, C217 2-door coupe), and GLC-Class (X253/C253 crossover SUV) vehicles equipped with a stereo multifunction camera, the error message "Active Lane Keeping Assist Inoperative" (code 238) may appear in the instrument cluster. The cause is a glitch in the stereo multifunction camera control unit (A40/13) software. When the problem occurs the camera control unit stores diagnostic trouble code P180504. This DTC notes that hardware-monitoring algorithms have detected an internal fault in the control unit.

Mercedes-Benz resolved this issue by developing new software for the multifunction camera control unit. The optimized software is available via XENTRY Diagnostics updates or in DVD materials published beginning in May 2016. Refer to Mercedes-Benz XENTRY Tips document LI54.00-P-064149 for additional repair procedure details

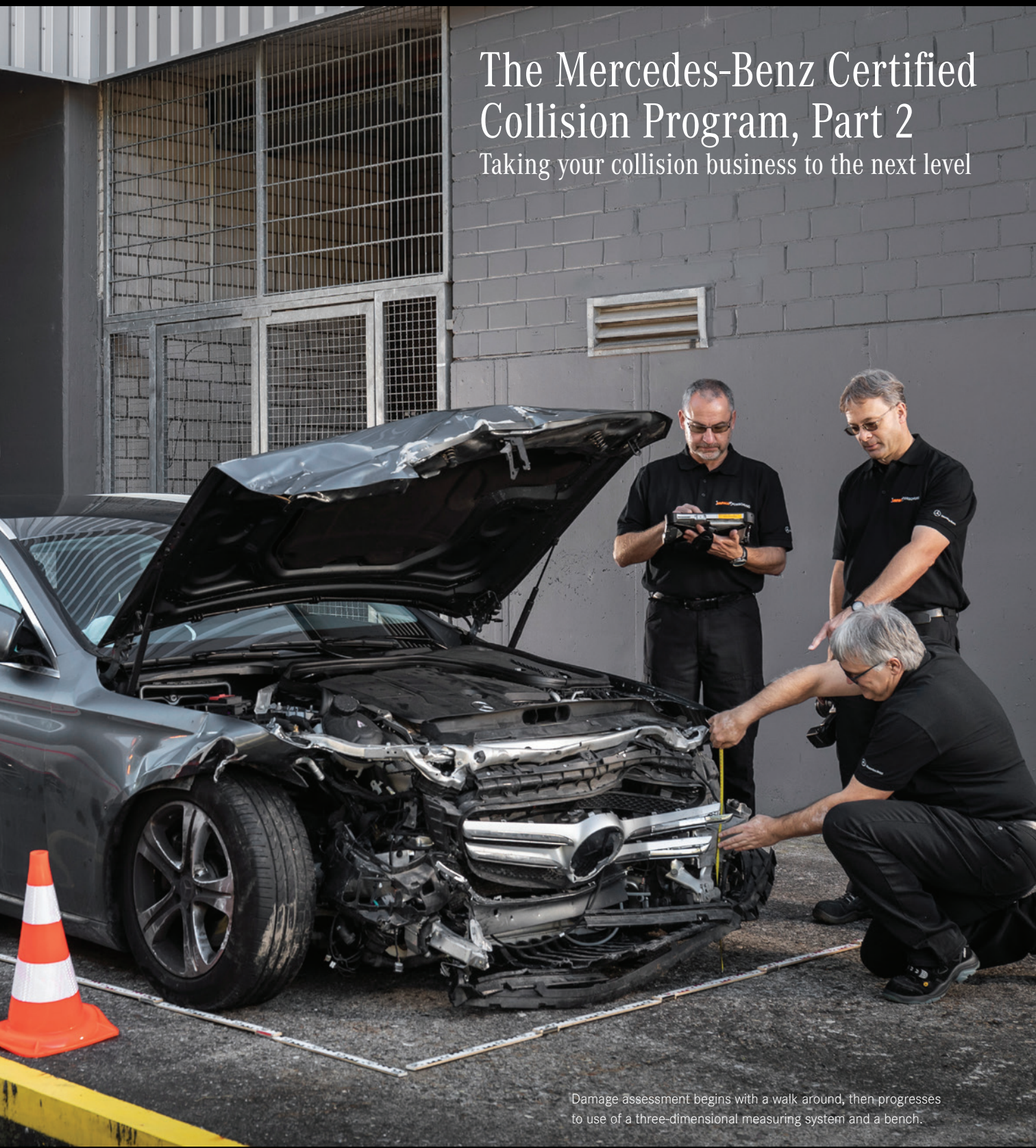
Fault Code U11A600

The fault code U11A600 "Communication with the radar sensor system control unit has a malfunction" may be stored in the steering control unit (N68 in the wiring diagram). This code applies to the 2014-2017 electric drive B-Class (B250e) with Active Lane Keeping Assist. Mercedes-Benz has issued a XENTRY Tips document (LI46.35-P-069432) explaining that the code is the result of an error in the XENTRY Diagnostics software. There is no steering fault related to this error message. The fault code and message can be ignored.

So there you have it: This important safety system rarely has trouble, but when it does, you now know how to approach a diagnosis and repair. Lane Keeping Assist: It's multifaceted, but not complicated.

The Mercedes-Benz Certified Collision Program, Part 2

Taking your collision business to the next level



Damage assessment begins with a walk around, then progresses to use of a three-dimensional measuring system and a bench.

Editor's note: This is the second of a three-part article about the Mercedes-Benz collision repair certification program, developed through conversations with three Mercedes-Benz USA Certified Collision Center instructors. Special thanks to Kevin King, Technical Collision Instructor & Welding Inspector; Clint Allen, Collision and Technical Trainer, both teaching at the Mercedes-Benz Learning & Performance Center in Grapevine, Texas; and Bob Laurino, Collision and Technical Trainer at the Learning & Performance Center in Robbinsville, New Jersey.

Last time in *StarTuned*, we discussed the benefits to the independent collision center of becoming a Mercedes-Benz Certified Collision Center. Not just the powerful marketing of the whole Mercedes-Benz organization to drive traffic to your shop; not just access to the right tools, equipment and information to make each repair perfect and more profitable; and not even access to factory training to improve cycle times and quality (not to mention the excellent morale found in well-trained shops): just the prestige alone of being able to put the Star on your wall tells your customers that your shop is the best of the best.

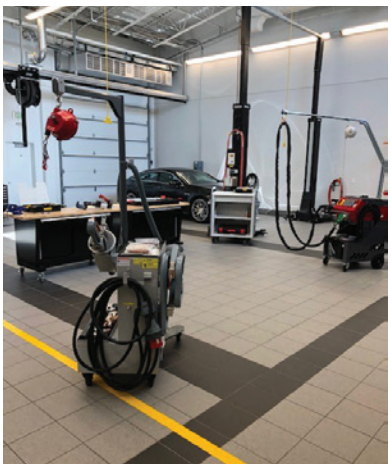
In this issue of *StarTuned*, we'll discuss the three tiers of certification: What they mean, what kinds of vehicles are included, the various requirements, and how to get the process started. And for that, the place to start is Base Certification.

Base Certification Tier

All collision repair facilities must meet Base level requirements in order to be in the Mercedes-Benz certification program. Body shops that have been using OEM repair information and providing quality service to their market are already in the right frame of mind for meeting the Mercedes-Benz technician training objectives, tool and equipment requirements, facility image, and customer comfort guidelines.

At least half of your total staff, with a minimum of five, must have Base certification training, with at least one person certified in each of the job areas of Manager/Estimator, Body Repair Technician and Refinish Technician. Your employee's job code – assigned by Mercedes-Benz according to their job function – allows them to access online and in-person training.

Online courses focus on basic information, such as an introduction to a particular model type and the location and function of major components and systems. Averaging about a half-hour or less, these courses allow the employee



Mercedes-Benz Learning and Performance Centers in Texas and New Jersey are fully-equipped to ensure the highest quality training.

Technicians remove and replace bumpers and` other components in the hands-on non-structural collision repair class.

to take them at their own convenience, and save time needed for other topics when they arrive at a Mercedes-Benz learning & Performance Center to participate in Instructor-Led Training (ILT).

A typical ILT is two days, with about half the time in the classroom and the rest of the time spent in the workshop, actually performing the repairs. Available training courses include collision damage assessment, general body repair, bonding and joining techniques, the use of the Mercedes-Benz Workshop Information System (WIS) and structural heavy damage repair, as well as platform-specific classes. ILT classes are offered at Mercedes-Benz training facilities near Dallas, Texas and Trenton, New Jersey.

The aluminum-intensive R231 Chassis SL500 has extruded aluminum frame rails and longitudinal members, cast aluminum door sills, wheel wells, firewall, and strut towers, and aluminum sheet metal body panels. Some aluminum parts, including portions of the frame rail and the friction-stir-welded plate floor, can be installed only during vehicle production. The only non-aluminum structural component is the steel windshield frame.

More than half the time in an Instructor-Led Training class is hands-on, and that reinforces the theory covered in the online and classroom training. “Technicians tell us they love the hands-on aspect of our classes,” said Bob Laurino, Collision and Technical Trainer at the LPC in Robbinsville, New Jersey. “They like going through the adhesive bonding procedures, working with the rivet gun, doing welding exercises, and so on. The work flow in the shop keeps them interested.”

There is also training for estimators, collision managers and facility owners. Mercedes-Benz has structured its certification program to provide assistance to facilities in conducting the Key Performance Indicator (KPI) analysis, business performance reporting and customer satisfaction tracking that helps businesses thrive.

In addition to employee training, Base certification also has specific requirements for shop equipment, customer comfort, shop appearance and processes. Your assigned third-party certification team will guide you through the process.

Elite Certification Tier

Certain Mercedes-Benz models have significant structural aluminum content, and shops wishing to be certified for these vehicles must attain the Elite certification level, as an additional step to the Base level. This requires not only a dedicated aluminum-only workspace, but specialized training and equipment as well.

Only collision facilities with Elite certification can purchase most aluminum structural repair parts. Not even a dealer can buy these without this certification. Models with structural aluminum include the SLS, GT and newer SL and S-Class. Of course, non-structural aluminum parts, such as a hood or fender, are not restricted from sale. The structural component sales restriction helps ensure that repairs are made properly, maintaining the vehicle’s integrity and safety characteristics.

As for training, attaining the Elite level requires at least one technician to pass an intensive two-week hands-on aluminum welding course. Welds are destructively tested, and those who don’t pass the course must repeat it. And, in the two-week period, a lot of welds are made.

Maintaining Elite status requires attending a two-day semi-annual welding re-check course, and completing recertification in a three-day welding update course every other year.

Commercial Certification Tier

To achieve Commercial certification the facility must first meet Base level requirements. Once they’ve become Base certified, they attain Commercial certification by acquiring technician training and equipment for repair of Mercedes-Benz Sprinter and Metris vans. The equipment requirement includes a spray booth with a minimum of

twelve feet of interior clearance, a heavy-duty chassis bench, and a lift that can accommodate commercial vans, along with other tools for heavy-duty vehicle repair.

Becoming Mercedes-Benz Certified

Dealer-owned and independent body shops can earn Mercedes-Benz collision repair facility certification. Independent shops must be sponsored by a Mercedes-Benz dealer. Finding a dealer willing to sponsor your shop as a program participant is the easier part, because every Mercedes-Benz new car dealer that does not already operate or partner with a body shop wants to find the best place to refer their customers that are in need of collision repair. Proving that your facility is best-positioned to provide safe, reliable, quality collision repairs can be a bit more involved.

After an initial agreement of a dealer to consider sponsorship, the body shop will be contacted by a 3rd party representative to set up the certification audit process on behalf of MBUSA. Both independent and dealer-owned body shops must meet all equipment requirements, have a facility that meets quality and customer comfort standards, complete at least two instructor-led training (ILT) courses (plus additional online classes) per year, and apply for recertification every two years.

In the next issue of *StarTuned*, we'll take a closer look at Mercedes-Benz training, arguably one of the most valuable benefits of collision center certification.

Get Certified!

To learn more about the program, or to apply to become a Mercedes-Benz Certified Collision Center, go to mbcollisioncenters.com and scroll down to the link "Become a Certified Collision Center." Once there you will find links to answers about a variety of questions, including a list of required tools and equipment, a document containing the standards by which repair facilities, technicians, and staff are evaluated, a brochure that provides an overview of the entire program, and a program application form.

Are you in? Being one of the elite (pun intended) few will benefit your shop, your customers, and Mercedes-Benz. Win-Win!

You'll need a spray booth with a high ceiling clearance in order to refinish Sprinter vans. This van is so tall it could trim low-hanging branches from trees.

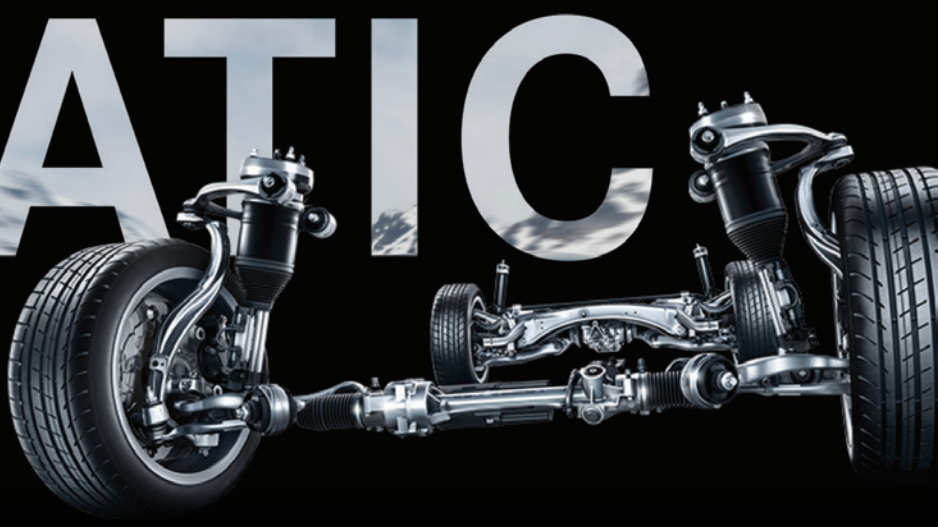
Mercedes-Benz Sprinter vans have driver assist technologies, including Lane Keeping Assist as shown here on this 2019 Sprinter.

Breaking News:

Car-O-Liner straightening benches added to approved equipment list

Mercedes-Benz USA recently announced the addition of Car-O-Liner straightening benches to the list of approved collision center equipment. With the addition of BenchRack BR5500 and BR6300 benches combined with EVO fixture sets and the Car-O-Tronic® Vision2 X3 measuring system, now Mercedes-Benz Certified Collision Centers have three equipment vendors (including Car Bench and Celette) to choose from for their straightening bench systems. Complete details on the entire Certified Collision Center program, including approved equipment, can be found at www.mbcollisioncenters.com/become-collision-center.

4MATIC Evolution



Introduced over three decades ago, this feature has gone through several generations. Do you understand how to handle them all?

In the 1980s the automotive industry saw the beginning of a huge surge in the demand, research and development of automobiles and SUVs that could provide better traction, slip control and all around safety in various driving conditions. 4WD signified a lifestyle that could take the owner almost anywhere, even though soccer moms were destined to drive them in the world of concrete and freeways, shopping centers and big box stores. These were labeled with various descriptions such as 4 wheel drive, all-wheel drive, and limited slip drive among others. While there is no universally accepted set of terminology that describes the various designs and functions, the terms used by various manufacturers will often reflect marketing rather than significant technical differences or actual engineering considerations between systems. There is an international standard J1952 that recommends only the term “all-wheel drive” with additional sub classifications that cover all types of AWD/4WD/4x4 systems found on production vehicles.

Early 80s production 4-wheel drive systems had their issues however. Germany's *Auto Motor und Sport*, a serious automotive magazine, carried out comparative tests on the early Audi Quattro that showed that its four-wheel drive gave no advantage in terms of road-holding on wet, dry, or snow-covered surfaces and virtually no protection against hydroplaning or loss of control on black ice, and no reduction in braking distances. But four-wheel drive did improve grip - the ability to move away from rest and accelerate - quite substantially, because the engine's torque is split into four smaller units rather than two big ones and is fed through four tires rather than just two. The advantage is most noticeable on snow or wet surfaces, and even more so with a powerful engine. Since antilock braking characteristics had not yet been put into production vehicles, this again turned in to a huge disadvantage when descending a snow-covered slope - exactly the occasion many people saw as the justification for purchase of a four-wheel drive car. Also, this is one reason why Mercedes-Benz waited until they had it right before introducing 4MATIC.

Long before the eighties Mercedes-Benz was at work developing and refining 4-wheel or all-wheel drive. Paul Daimler, the son of the company's founder, came up with the first designs featuring all-wheel drive possibly as early as 1903. In 1907, the "Dernburg-Wagen,"

Most 4MATIC models will have this badge. Some early models didn't, but customers can ask to have one installed.

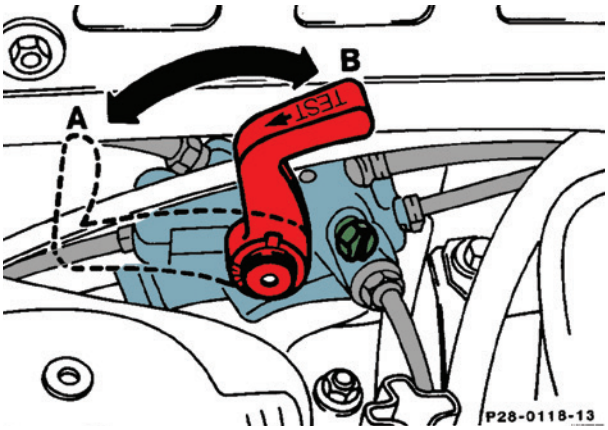
as it was known, was produced for driving in Africa. Although built on the basis of a truck, it was designed as a passenger car, making it the forefather of today's cars with 4MATIC drive. The first ever all-wheel drive passenger car from Mercedes-Benz was the W124 E-Class model series, whose 4MATIC versions made their debut in 1985 at the IAA International Motor Show in Frankfurt. The 4MATIC system entered production in the W124 model series in 1987.

This first generation 4MATIC system was originally an electronically controlled system with automatically engaging four-wheel drive. The system employed locking central and rear differentials to provide additional traction in slippery conditions. The center differential, actually a transfer case, contains two clutches. Each hydraulically enabled clutch is controlled separately to allow for three modes of operation: Conventional two-wheel drive, where the rear wheels receive 100% of engine torque; four-wheel drive with either a 50:50 torque split; or a 35:65 torque split front/rear.

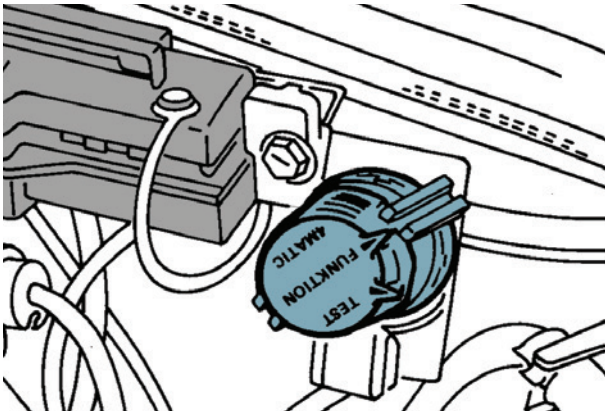
The rear differential lock introduced the automatic locking differential system ASD, which can engage to help fight rear wheel slip. Due to safety and stability concerns there is no front differential lock.

4MATIC uses wheel speed inputs from the Anti-lock Braking System ABS, along with a steering wheel angle sensor, to decide when to engage. 4MATIC is disengaged automatically if the service brakes are applied.

Two model 124 (E-Class) variants of the first-generation 4MATIC system were produced: the first system (from start of production until approximately April 1991) used a mechanical lever (red, above right front wheel well) to disconnect the system hydraulics, while the second system variant use an electrical switch (near the X11/4 diagnostic connector near the battery) to remove power from the system. In test mode, the later variant allows the self-leveling system to continue operation. In 1993, the multi-plate clutch transfer case was discontinued.



The hydraulic test lever used in the first version of 4MATIC is bolted to the right front wheelhouse. Pushing the lever forward to position "A" disables the 4MATIC hydraulic system.



The electrical test switch used in the second version of 4MATIC is found at the right rear of the engine compartment, near the X11/4 diagnostic connector.

Second Generation

4MATIC was reintroduced with the 210 (E-Class) in model year 1997 as a second-generation system. The new 4MATIC was now a full time all-wheel drive system with a single-stage transfer case providing a front-rear torque split of 35:65. Traction control is achieved using the Electronic Traction System (ETS), which employs the ABS system (with additional valves) to monitor and then partially brake any wheel which loses traction, simulating a limited-slip differential. This much simpler system, removing the need for a multi-disk clutch in the differential, is also featured in the M-Class SUV.

Third Generation

Since 2008, some versions of 4MATIC have provided true AWD where the system is permanently active. Sophisticated engine management and ABS systems control the amount of torque transferred to each wheel, allowing the system to be effective at any speed. From

The transfer case assembly for an ML model

March 2008, Mercedes-Benz also began to offer the CL-Class luxury coupe (C 216) with all-wheel drive in the CL 500 4MATIC model. At its heart is the 7G-TRONIC seven-speed automatic transmission, which had been specially developed for all-wheel drive models and has a transfer case with a center differential lock incorporated into it. It splits the drive torque between the front and rear axle in the ratio 45:55. The newly-developed multi-plate clutch at the center differential transmits the engine's power to all four wheels with a basic locking effect of 50 Newton meters between the front and rear axle. This results in even better start-off characteristics and handling stability on slippery surfaces. At the same time, the all-wheel drive system is exceptionally efficient: the CL 500 4MATIC consumes no more fuel than the corresponding rear-wheel drive model.

Fourth Generation

In model year 2010 MBUSA launched what is now the fourth generation of 4MATIC with the new E-Class (type 212), featured in the E350 and E550 sedans.

In 2016, Mercedes-Benz introduced a new 4WD system called 4MATIC +. This system can send 100 percent of the available engine torque to either the front or rear axles.

In the fifth-generation E-Class an additional setting was introduced in the E63 S AMG model that disconnects the front axle from the powertrain, effectively turning it into a rear wheel drive automobile. This has become known as "Drift Mode."

Of course, each 4MATIC generation has several unique characteristics and functions that space doesn't allow us to describe here. Be sure to check the Mercedes-Benz

Workshop Information System (WIS) and other service literature for all the specifics of the vehicle you're working on.

Service and Maintenance: Early Versions:

Maintaining and servicing these early models is fairly straightforward, simply follow the recommended maintenance schedules and intervals. Pay particular attention to the correct fluids and additives called for in transmissions, transfer cases and differentials. The maintenance system sheet for these models call for transmission fluid and filter change at 30k mile intervals. The transfer case and rear differential fluids should have been changed at the initial (1,000 mile) inspection service, after that they are considered "lifetime fill."

While Mercedes-Benz engineers surely know what is best for their vehicles, we often hear customers questioning the lifetime fill designation. Indeed, our take (especially in

The modified Specifications for Operating Fluids are available in the table, the corresponding BB documents are in WIS or the BeVo Portal on the internet at: bevo.mercedes-benz.com for viewing.

	ATF 134 BeVo 236.14	FE-AFT 134 BeVo 236.15	ATF D97 BeVo 236.16	DCT ATF BeVo 236.21
Oil Color	Red	Blue	Gold	Gold
Part Number	A001 989 68 03	A001 989 78 03	A 001 989 92 03	A 001 989 85 03
5-Speed Automatic Transmission 722.6	X			
7-Speed Automatic Transmission 722.9 before production number 23834526	X			
7-Speed Automatic Transmission 722.9 after production number 23834526 with engines 113, 152, 156, 157, 275, 279		X		
7-Speed Automatic Transmission 722.9 after production number 23834526 without engines 113, 152, 156, 157, 275, 279		X	X	
7-Speed Automatic Transmission Hybrid 724.2			X	
9-Speed Automatic Transmission 725.0			X	
7-Speed Dual-clutch Automatic Transmission 724.0				X

Here is a handy chart to identify which type of automatic transmission fluid to use.

Passenger car, sheets 235.0 to 235.74 Major assembly	SAE grade	Sheet no. 235 .0	.3	.7	.10	.15	.61	.62	.74
Front axle (4MATIC)	85W-90, 90	○							●
Rear axle model 163									●
Rear axle model 164 with rear wheel drive (4 X2)						●			
Rear axle model 251 with rear wheel drive (4 X2)							●		
Rear axle model 117, 156, 176, 246 4MATIC (4 X4)								●	
Rear axle (standard differential)	75W-85, 85W-90, 90	○		●					
Rear axle with AMG differential lock Model 230.479 Model 204.077/277, 211.076/077/276/277, 219.376/377, 230.470/472/474 with code 471/P30 Model 171.473, 203.076/276, 209.377/477 Model 172.475, 231.474/479, 463.270/271/272/273	75W-140						●		
Rear axle with differential lock model 164, 199	75W-85					●			
Differential with limited slip	75W-85, 85W-90			●					
Manual steering	85W-90, 90	●							
Manual transmission as of transmission sequence number 7 340 241 (717.4 and 716.6)	75W-80W				●				
Manual transmission SG 150/180 (716.5)	75W-80W				●				
Manual transmission NMT 270, 370/400			●						
Manual transmission 700.7 (Citan)					●				

Consult the proper maintenance chart for your specific model, this is for an early version. Also available online, simply search for "MB Bevo," the Mercedes-Benz service fluids website.

these older vehicles) is that a fluid change can't hurt, especially when comparing the cost to that of a replacement unit. At the very least, check the cleanliness of the fluid and replace it if soiled.

The ASD-equipped rear differential should have an information plate attached. The fluid should be checked at every other lubrication service and changed at the discretion of the technician thereafter. Take into consideration the type of driving and the conditions and be proactive. You'll not be doing your customer any favors by waiting until the fluid is black and full of shiny particles.

Be sure to check for cracks and loose bolts at the flex coupler, a sure cause for vibrations! Look closely and you'll see that this disk is cracked and needs replacement.

As these models will undoubtedly have plenty of miles on them, some particular issues may arise. One is addressed in a XENTRY TIPS document LI28.00-P-060078, which references a noise in the drivetrain and diagnosis. The complaint is a humming, howling, or droning noise from drivetrain which is caused by overlaid vibrations excited by the engine, suspension and drive train.

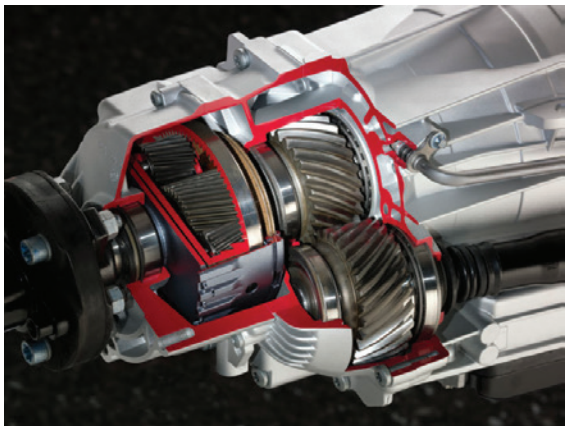
First, address the front engine mounts:

1. Visually inspect the positions of the front engine mounts. They must be correctly seated in the engine support. (Obviously be sure they are not worn out!).
2. Unscrew the engine mount bolts. The thread in the engine mount must line up with the hole in the integral carrier.
3. If this is not the case, lift the engine/transmission assembly approx. 10 mm and lower it again. Again: The threads in the engine mount must line up with the holes in the integral carrier.
4. If the bolt is out of alignment, slacken the upper threaded connection of the engine mount on the engine support and position both engine mounts so that the thread in the engine mount lines up with the hole in the integral carrier.
5. Tighten the lower mounting bolts to the specified torque, lower the engine onto the engine mounts and tighten the bolts to the specified torque.

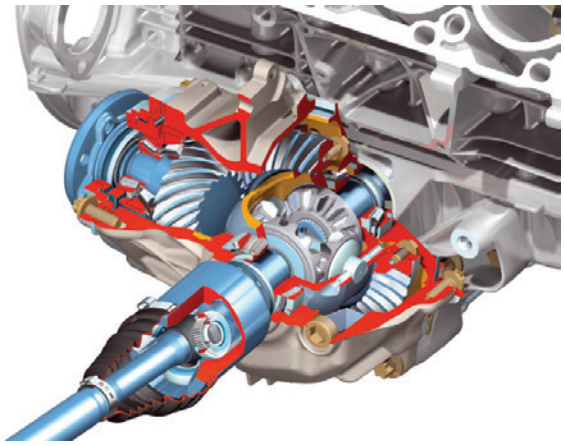
Next, un-stress the rear engine mount:

1. Unscrew the bolted connection between the rear engine mount and engine support.
2. Detach the exhaust system transmission bracket at the exhaust system pipe and in the area of the engine support, and look for stresses (e.g. exhaust system slipping upwards). Relieve any stresses found.
3. Raise the engine/transmission assembly in the area of the transmission so that the rear engine mount lifts off the engine support. Then lower the rear engine mount back onto the engine support. The threads in the engine mount must line up with the holes in the engine support (in the same way as the front engine mounts). If this is not the case, continue with step 4.
4. Unscrew the rear engine support mounting bolts on the body and align the rear engine support in the longitudinal and transverse directions so that the holes in the engine support and engine mount line up. Then tighten the bolts to the specified torque in the following sequence: a) Engine support to body b) Engine mount to engine support c) Exhaust system transmission bracket in area of rear engine mount and on exhaust system pipe. The transmission bracket in the area of the exhaust system pipe fastening bolt must not be tilted and must not rub.

Don't forget the propeller shaft! On older vehicles noises can be attributed to shaft assembly wear and tear. Inspect the flexible couplings for cracks and missing or loose bolts. Also check the carrier for alignment, loosen and readjust if necessary. Some techs will try a



A cutaway of a newer transfer case/transmission unit. Note the simplicity of using helical spur gears to transmit engine torque forward.



The extremely compact S-Class front differential unit. Note how the left axle shaft runs through a channel in the engine oil sump.

realignment of the flange by rotating 90 or 120 degrees depending a three or four leg flange.

Servicing Later Models

On later generations there have been many advancements, in particular in the sophistication of the electronics. You must have the proper diagnostic equipment if you intend to do any type of troubleshooting. A XENTRY Diagnostics system or factory compatible scan tool is paramount for this type of work.

The transfer case in these models is attached directly to the automatic transmission, without an intermediate flange, forming a single drive unit with the engine and front axle gear. The transfer case does not have any hydraulic or mechanical differential locks which in turn reduces the weight significantly. An important repair note in servicing these units is when filling the transfer case (either when changing the fluid or replacing the transfer case unit) be sure to fill the transmission to the bottom of the filler opening, test drive the vehicle and then recheck and top up as necessary. The reason is, the chamber in the front housing section of the transfer case where the planetary gear is located is supplied with oil only when the transfer case is in operation. Don't neglect this step or you will run the risk of having an inadequate fluid level.

The newer the model you are servicing, the more important it will be to consult the proper workshop literature in regards to servicing transmissions and differentials in a 4MATIC model. This is evident for example in Star Bulletin S-B-00.20/102a, which explains that in the specified models, the ASSYST system does not indicate rear differential fluid changes. The bulletin provides additional details on when and with which fluid the service should be carried out. Missing something like this might cause you to miss not just the need for maintenance, but a chance to sell that maintenance to your customer. In some ways, a WIS subscription can help pay for itself.

The Latest Generation and What the Future Holds

In the S-Class 4MATIC models, the torque to the driven front wheels is provided via a transfer case which requires no additional installation space as it is integrated in the 7G-TRONIC automatic transmission. From there, a driveshaft supplies the power to the front axle. From the front differential, power is transmitted to the front left axle shaft using an intermediate shaft running through an encapsulated shaft channel in the engine oil sump.

The transfer case has an extremely compact design. Mercedes-Benz engineers dispensed with one complete gear stage and, by integrating the rear universal joint in the output gear, it is possible for the drive shaft to the front differential to run very close to the automatic transmission. With these design changes there is no need to have floor design changes as compared to conventional rear wheel drive models.

The Mercedes-Benz all-wheel drive line-up currently encompasses dozens of passenger car models across nearly every model series. Besides the many SUV models, each of the sedan, coupe and wagon variants generally include a 4MATIC version. With all these models on the road you should be well versed in the various phases of 4MATIC as you will be servicing them for years to come.

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