StarTuned®

Information for the Independent Mercedes-Benz Service Professional

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Inside:

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- Classic Cruise Control
- Stopping Wiper Streaking and Skipping
- No-Starts

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StarTuned®

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

Mercedes-Benz wants to present the information you need to know to diagnose and repair Mercedes-Benz vehicles accurately, quickly and the first time; text, graphics, online and other technical sources combine to make this possible.

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

Our digest of technical information can help you solve unanticipated problems quickly and expertly.

We want *StarTuned®* to be both helpful and informative, so please let us know just what kinds of features and other diagnostic services you'd like to see in it. We'll continue to bring you selected service bulletins from Mercedes-Benz and articles covering the different systems on these vehicles.

Send your suggestions, questions or comments to us at:

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Mercedes-Benz
The best or nothing.

Diesel Injectors

Mystery of the Black Death

Inspection, proactive service recommendations. What to expect? And, what about those glow plugs?

Sounds like a crime novel, doesn't it? Intrigue, mysterious plots and storyline twists reminds you of your favorite 'whodunnit!' Some of the vehicles you may see in your shop with this mysterious condition may indeed feel like a crime has been committed, especially when you are tasked with cleaning up the mess. A simple Google search for "black death" with regards to diesel injectors (not the plague) will ultimately turn up dozens of videos, blog posts, and other information on the problem. Not to worry though, with the right tools and information, plus a preventative approach, you can feel confident in servicing Mercedes-Benz diesel injectors.

The Evidence

The Black Death is a mechanical issue involving the vehicle's fuel injectors, specifically their seals. It is aptly named due to the thick, nasty black carbon buildup around the fuel injector. On a Sprinter you will find this under the plastic cover, sometimes filling up the whole cavity around the injectors. Since the injectors seat directly in the combustion chamber, the seals have a critical task of keeping the combustion gasses contained within the chamber. These leaks can arise from a few different causes including worn out, incorrect or improperly-installed seals. This black carbon deposit is extremely hard and at first glance you might think the engine is ready for the morgue! In some worst-case scenarios it may look like someone melted plastic, added roofing tar and poured it over the injector cavities.

Some of the supplies you'll need to re-seal the fuel injectors: Seals, hold-down bolts and injector grease.

Opposite Page: Cleaning the crud can be very time consuming!

Where It All Starts

Most of you are familiar with the diesel injector but let's take a closer look at the modern common rail injector and its history. The advance of the common rail system in particular gave engineers the freedom they needed to reduce exhaust emissions even further, and an added benefit of lowering engine noise. The particular design of common rail, with its injections of fuel as several pre-, main- and post-injections, allows the engine and the injection system to be matched to each other in the most efficient manner possible. In the common rail accumulator injection system, the generation of the injection pressure is separate from the injection itself. A high-pressure pump generates in an accumulator – the rail – a pressure of up to 1,600 bar (over 23,000 psi), as determined by the fuel system designer, independently of the engine speed and the quantity of fuel injected. The fuel is fed through rigid pipes to the injectors, which inject the correct amount of fuel in a fine spray directly into the combustion chambers. The CDI control unit controls perfectly all the injection parameters – such as the pressure in the rail and the timing and duration of injection – as well as performing other engine functions. The very first common rail system used in a production car was introduced by Mercedes-Benz in 1997 in their W202 models and had a control pressure of 1,350 bar. Injectors have come a long way since that introduction.

In its simplest form the common rail injector works like this: as high pressure fuel enters the injector, the pressure throughout the injector is equal. The injector solenoid is energized by the control unit, pulling the control plunger up. The control plunger releases a small amount of fuel and creates a pressure differential within the injector, causing the lower pintle to come off its seat. As the pintle moves upward, fuel is injected into

the cylinder. Injector solenoid current is then turned off, allowing the valve to reseat and stopping fuel flow.

A fairly obvious case of Black Death. Proper and timely service would have prevented this.

The newest technology goes beyond this. Delphi's Direct Acting CR system uses a patented direct-acting concept in which the injector needle is set in motion directly by a piezo-ceramic actuator instead of an electromechanical solenoid. The piezo-ceramic actuator directly operates the needle valve of the injector for initial lifts, such as those obtained in pilot injections, and a motion amplifier is used to help complete the lift for large injections. This enables the injector to spray fuel into the combustion chamber faster, with improved spray momentum and accuracy, and at higher pressures (up to 2,000 bar). It also provides extremely fast opening and closing of the needle valve, independent of injection pressure. With needle velocities exceeding 3 m/s (triple that of earlier systems), the direct acting injector allows seven (or more) injection events per engine cycle. In its heavy truck line, Mercedes-Benz has introduced the X-Pulse common rail injection system with pressure booster.

Regardless of the type of injector or system used, one thing is certain: you have to seal those combustion gases in. Any leaks past the injector causes combustion chamber residue to build up at the top of the injector. So it is important to know exactly how these injectors function, as you will be removing them in order to service the seals.

Look for the Signs

So how to tell if you have a leaking injector, and should we be replacing the seals proactively? The answer to the first question is look and listen. Sometimes a leaking injector will make a hissing or slight compression whistle or chuffing noise, especially under acceleration. This is the sound of combustion gasses leaking past the injector. Also removal of the plastic engine cover is needed to make a visual inspection. If the seals have been leaking for any amount of time you will see the evidence of the Black Death under the cover. If caught early enough it may merely be "wet" looking at the base of the injector(s). Sometimes this might only be oil from a leak or oil spill so you need to verify the leak. Some techs use a light soapy water spray while the engine is running to allow them to see if the escaping gasses blow bubbles. Also WD-40 is another product some techs use. The idea is to find a way to see if those gasses are bypassing the injector seals, which will be evident right at the base of the injector. Fluid at other parts of the injector, the rail connection and/or top nut may be indicators of the injector itself leaking.

Obviously if you have a severe case of black death you won't be able to see anything but the gooey mess (see photo). The injectors are not screwed in to the bores but rather clamped in under pressure which puts a crush on the copper seal. Over time, with expansion and contraction, normal wear begins to work on the copper seals and once the combustion seal is compromised there's no going back.

Should you be proactive and recommend to your customer to replace their injector seals? Absolutely! Most techs report seeing evidence of leaks anywhere from 60k to 100k miles. Certainly at first sign of leakage you should recommend immediate replacement of all the injector seals. This will save your customer cash in the long run and lots of headaches on your part if the repair is delayed. Your customer may want to talk you into just doing the one or two leakers but I guarantee they'll be back in a year with another leak saying, "didn't we already fix those?" The seals and bolts are not expensive.

The Procedure

You will want to consult the Workshop Information System (WIS), XENTRY or Startekinfo.com for the latest repair notes but replacement of the seals is fairly straightforward. Here is a tip that can save you some headaches: For most

jobs you obviously like to start with the engine cooled down, as it's easier and more comfortable to work on, but for servicing injectors you want that baby hot! Start by removing all the hold-down screws. These screws are long and torqued to yield, meaning they tend to seize in the head. Having the aluminum head nice and hot definitely makes the difference between snapping one off or having it come out straight away.

Heating the engine is the first thing to do after you remove the cover(s) to gain access. Then very carefully remove the fuel rail. Remember this is a high pressure system so take all the necessary precautions to keep yourself safe, including relieving pressure in the system. The engine needs to be off at least 30 seconds before cracking open the injector unions. Be sure to cap off the lines to prevent contamination.

The piezo injectors operate at a dangerous voltage level. Be sure the key is off and several feet from the vehicle (especially in KEYLESS-GO models). As a safety measure, disconnect the crankshaft position sensor. Disconnect and remove the fuel return lines and, with a twisting-pulling motion, remove the injector. If you have caught the vehicle in a state before the injector seal ring has failed for very long then this will work out pretty smoothly.

A severe case of Black Death. Removing the hardened carbon buildup is the first task.

If you're looking at a serious Black Death case then you are in for a bit more work. You or your service adviser will want to give the customer a heads up for what lies ahead. Anything from extra hours cleaning to a new cylinder head could be possible. Dissolving the crud can be a huge chore and sometimes some of the foam insulator is melted in with it. Some techs use acetone and or carb cleaner and let it sit overnight. Then using a steam cleaner you can remove much of the carbon. Also some techs have reported using a non-acidic oven cleaner to dissolve the crud. In extreme cases like the photo you will need to carefully chip away at the stuff before you do any of this. Using a shop vac you can remove the chunks you break loose.

After you have cleaned the engine enough to gain access to the injectors you can begin removing them. Remember a hot engine will aid in this, not only with the hold down bolts but with the injectors themselves. They will be really stuck in their bores from the carbon. It will be tricky to loosen them all while the engine is warm as each one will take some time. There are a number of special pullers available for removing stubborn injectors. Some use a slide hammer approach which can work well if you have enough overhead access. Sprinter models don't have enough room to use these though. Some use a cross bar approach which use the threaded portion of the injector top to pull the injector up. We've seen techs make their own puller with a piece of unistrut and some bolts from the hardware store. You will need a M14 X 1.5 pitch coupling nut to make this work, which may be hard to find. Except for the slide hammer procedure, a major drawback to these is they leverage against the valve cover which is fairly thin aluminum and can crack.

A typical injector puller set. Similar tools are available from several suppliers.

A slide hammer puller, here shown with a screw-on adaptor, works well if you have enough clearance.

Be prepared for this. If you have to use this extraction method on piezo injectors you'll need to replace them with new ones. A vehicle with 200k plus with really stuck injectors may warrant a new head.

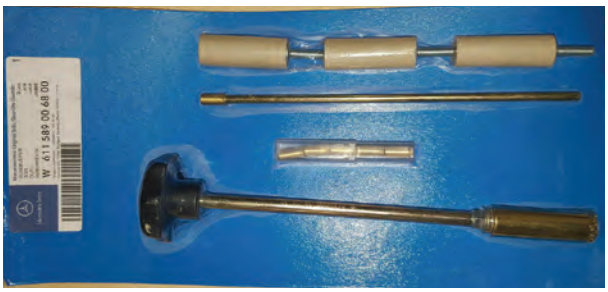
Installation

Ok you've gotten the injectors out, either the easy way or the hard way. If you are reusing the injectors make sure you mark them for replacement in the same cylinder. What's important next is making sure the bores are surgically clean and the injector seat face is perfect, otherwise you'll be doing this again too soon. Be sure to remove the seal ring from the injector well if it didn't come out with the injector. If not too soiled, clean the injector well with woolen brush W651 589 01 68 00. Use a clean, lift-free cloth to remove as much dirt as possible first. WIS advises that 'clean' bores don't need to be sealed against debris, but the brush set W611 589 00 68 00 comes with a brass plug just for that purpose, and you are well-advised to use it. Clean the seat face of the injector with a brass wire brush, being very careful not to contact the nozzle tip. Coat the injector thinly and evenly with a special grease available from Mercedes-Benz. Install the new seal and use new bolts for the tensioning clamps. We recommend cleaning and possibly chasing the hold-down bolt threads, being sure to blow out all debris from the holes: the hold-down bolts are torque-to-yield and you don't want any dirt interfering with your clamping force. A good practice when finished is to turn the engine over by hand to be sure nothing has entered the combustion chamber that could cause damage.

Reprogramming

If you have to replace the injectors, it is necessary to program the CDI engine control unit with the new injector quantity compensation codes, printed on the injector body. In Engine OM642, this is a seven-digit code. In other models, such as with OM651 engines, they have 20 to 24 characters (framed in red on the photograph).

Beware of cracking the cylinder head cover if you use it as leverage to pry against!



Clean the fuel injector bores using the proper tools.

Using a XENTRY or other factory-compatible scan tool proceed as follows:

1. Key on, engine stopped.
2. Battery voltage greater than 12 V.
3. Start the function.
4. A dialogue box will display the programmed injector codes, select "OK."
5. Select the injector to be programmed in the dialogue box then select "OK." If the injector code is correct, close the function.

6. Enter the new injector code in the dialogue box and then confirm by selecting “OK” to finish the programming sequence.
7. Repeat for all injectors.

Use numbers and capital letters only. Only the following characters are valid: 0 1 2 3 4 5 6 7 8 9 A B C D E F G H J K L M N P R S T U W X Y Z (Note the missing letters I, O, Q and V, removed to ensure no confusion with digits).

The top of the injector will have the compensation code needed for programming. Genuine XENTRY units have a 2D QR code scanner (the black and white squares) to simplify entering the code.

A dialogue box will indicate if the programming sequence has succeeded or failed. If the function fails, check the test conditions and correct any faults found.

Glow Plugs

We won’t spend any time here on diagnosis of glow plugs, instead focusing mainly on replacement and problems that may arise with that. One important comment: Using an aftermarket scan tool can show false codes, so beware in such a case: Always verify any findings with a component test of each plug, the wiring, and the controller, regardless of which kind of scan tool you use. Your XENTRY Diagnosis system will guide you through these test steps.

Ceramic glow plugs are very sensitive to impact shocks which can cause invisible damage (hairline fractures) to the ceramic element and possibly lead to engine damage. Care in handling is of utmost importance, if you drop one, replace it! Be aware of poor packaging and only use original Mercedes-Benz glow plugs.

As with the recommendation on injector replacement, when changing glow plugs get the engine hot. Some can get stuck and you don’t want to have to try and remove a broken glow plug in the head. Warming the engine helps the head expand a bit and aids in loosening the plug. The service manual gives a recommendation to stop at 25 Nm if the plug won’t come loose. Usually it’s not the threaded portion that becomes lodged but the plug body itself. If you can just break it loose a tiny bit and spray some penetrating oil on it and then drive it for a good distance you may have success, and some technicians just start with the penetrating oil as a preventative measure. There are many tools available for removing a broken glow plug and repairing the cylinder head, but you really don’t want to go there if you don’t have to. Remember an ounce of prevention...

In the awful case where a glow plug breaks off inside the cylinder head, get a kit like this to ensure you don’t end up having to buy a new head. For some models Mercedes-Benz has a special tool set just for this purpose.

So there you have it. Every diesel that comes into your shop should be inspected for any injector seal leakage, since earlier action ends up being the best action. The Mercedes-Benz WIS has the right procedures for these jobs, but cleaning up after an injector leak takes time, patience, perseverance and plenty of solvent. And for glow plugs, while most of them come out without trouble, you just have to break one in the cylinder head to understand why you take the time to get the conditions as optimum as possible before starting.

The whole point is building your customer’s trust that you’ll always be looking for those little things that could end up as a big problem. Keep their cars happy, and they’ll be customers for life.

Mobil 1 and Mercedes-Benz Oil Offer

Product Name	Package Style	MBUSA Part #	Product Description	Recommended Consumer Application
MOBIL 1 0W-20	6X1 QUART	BQ1090242	Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance	Most vehicles that specify 0W-20 (newer Toyotas and Hondas), 5W-20 and certain hybrids
	DRUM 55 GAL	BQ1090241		
MOBIL 1 0W-30 AFE	6X1 QUART	BQ1090174	Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance	Most vehicles that specify 5W-30 or 10W-30
MOBIL 1 5W-20	6X1 QUART	BQ1090083	Advanced full synthetic formulation designed to meet the requirements of many newer vehicles including Hondas, Fords, Chryslers, and newer Toyotas	Vehicles that require 5W-20
	DRUM 55 GAL	BQ1090084		
MOBIL 1 5W-30	6X1 QUART	BQ1090250	Advanced full synthetic formula designed to meet the requirements of many domestic, including GM, and imported vehicles	Vehicles that require 5W-30. Corvette approved.
	DRUM 55 GAL	BQ1090249		
MOBIL 1 10W-30	6X1 QUART	BQ1090230	Advanced full synthetic formula designed for domestics and imports	Vehicles that require 5W-30 or 10W-30
MOBIL 1 15W-50	6X1 QUART	BQ1090231	Boosted, higher viscosity, advanced full synthetic formula designed for performance vehicles	HT / HS applications. Racing and Flat tappet applications
MOBIL 1 ESP X1 0W-30	6X1 QUART	BQ1090182	Advanced full synthetic formulas designed specifically for diesel passenger cars that have particulate filters	Low SPAsh. Available at most MB dealers.
	DRUM 55 GAL	BQ1090183		
	BULK	BQ1090184		
MOBIL 1 ESP 0W-30	6X1 QUART	BQ1090278	Advanced full synthetic engine oil designed to help provide exceptional cleaning power, wear protection and overall performance	Meets MB 229.52 specification. Low Sulfur and Phosphorous content
	DRUM 55 GAL	BQ1090279		
	BULK	BQ1090281		
MOBIL 1 ESP 5W-30	DRUM 55 GAL	BQ1090286	Advanced full synthetic motor oils are designed to help prolong the life and maintain the efficiency of emission systems in both diesel and gasoline-powered vehicles	Meets MB 229.52 specification. Fully compatible with passenger cars that have the latest diesel particulate filters (DPFs) and or those with gasoline catalytic converters (CATs)
	6X1 QUART	BQ1090273		
MOBIL 1 FORMULA M 5W-40	6X1 QUART	BQ1090213	Fully synthetic formulas designed specifically for gasoline passenger cars	Low SPAsh. Available at most MB dealers.
	DRUM 55 GAL	BQ1090240		
	BULK	BQ1090214		
MOBIL 1 FS 0W-40	6X1 QUART	BQ1090015	Fully synthetic formulation designed to meet the requirements of many European vehicles	Meets MB 229.5 specification along with many other European vehicle specifications, including Porsche A40. HT / TS applications.
	DRUM 55 GAL	BQ1090016		
	BULK	BQ1090010		
MOBIL 1 FS X2 5W-50	6X1 QUART	BQ1090211	Advanced full synthetic motor oils are designed with a proprietary blend of ultra-high-performance synthetic base stocks fortified with a precisely balanced component system	Suited for extreme driving conditions and motorsports applications.
MOBIL 1 SYNTHETIC ATF	6X1 QUART	BQ1090164	Multi-vehicle, fully synthetic fluid designed to meet the demanding requirements of modern passenger vehicles	Vehicles that require Dexron III, Ford Mercon and Mercon V performance levels
	DRUM 55 GAL	BQ1090163		
MERCEDES BENZ HIGH PERFORMANCE EO 229.5 0W-40	6X1 LITER	A000989810211BIBU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.5 specification	Mercedes-Benz engines that require 229.5 specification oil
	DRUM 208L	A000989810217BIBU		
MERCEDES BENZ GEO 229.5 5W-40	6X1 LITER	A000989790211BIFU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.5 specification	Mercedes-Benz engines that require 229.5 specification oil
	DRUM 208L	A000989790217BIFU		
	BULK	A00098790219BIFU		
MERCEDES BENZ GEO 229.52 5W-30	6X1 LITER	A000989800211BMEU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.52 specification	Mercedes-Benz engines that require 229.52 specification oil
	DRUM 208L	A000989800217BMEU		
	BULK	A000989800219BMEU		
MERCEDES BENZ GEO 229.6 5W-30	6X1 LITER	A000989820211BJEU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.6 specification	Mercedes-Benz engines that require 229.6 specification oil
	DRUM 208L	A000989800217BJEU		
MERCEDES BENZ GEO 229.71 0W-20	6X1 LITER	A000989830211BNXU	Fully synthetic formulas specifically designed for Mercedes-Benz engines that require the 229.71 specification	Mercedes-Benz engines that require 229.71 specification oil
MB GENUINE ATF FE 236.15	DRUM 208L	A000989270417BULU	Fully synthetic formulas specifically designed for Mercedes-Benz transmission that require the 236.15 specification	Please check owners manual to verify ATF specification requirement of the vehicle prior to ordering.
MB GENUINE ATF FE 236.17	12X1L	BQ1090287	Fully synthetic formulas specifically designed for Mercedes-Benz transmission that require the 236.17 specification	Please check owners manual to verify ATF specification requirement of the vehicle prior to ordering.

Product Name	Package Style	MBUSA Part #	Product Description	Recommended Consumer Application
MOBIL 1 SYN GEAR LUBE LS 75W-90	12X1 QUART	BQ1090085	Exceeds the most severe service requirements in both conventional and limited slip applications	Suitable for use in modern high performance automobiles like SUV's, vans and light duty trucks requiring an API SN / SM / SL / SJ
MOBIL SUPER 5W-20	6X1 QUART	BQ1090272	A synthetic blend motor oil recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks	Recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks
MOBIL SUPER 5W-30	6X1 QUART	BQ1090269	A synthetic blend motor oil recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks	Recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks
MOBIL SUPER 10W-30	6X1 QUART	BQ1090270	A synthetic blend motor oil recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks	Recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks
MOBIL SUPER 10W-40	6X1 QUART	BQ1090271	A synthetic blend motor oil recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks	Recommended by ExxonMobil for gasoline-filled automobiles and light-duty trucks
MOBIL SPECIAL 5W-20	6X1 QUART DRUM 55 GAL BULK	BQ1090226 BQ1090254 BQ1090251	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and DRUM 55 GAL BQ1090254 light duty trucks requiring API SN / SM / SL / SJ
MOBIL SPECIAL 5W-30	6X1 QUART DRUM 55 GAL BULK	BQ1090259 BQ1090258 BQ1090255	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and DRUM 55 GAL BQ1090254 light duty trucks requiring API SN / SM / SL / SJ
MOBIL SPECIAL 10W-30	6X1 QUART BULK 55 GAL BULK	BQ1090264 BQ1090263 BQ1090260	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring API SN / SM / SL / SJ
MOBIL SPECIAL 10W-40	6X1 QUART BULK 55 GAL BULK	BQ1090223 BQ1090268 BQ1090265	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring API SN / SM / SL / SJ
MOBIL SPECIAL 20W-50	DRUM 55 GAL	BQ109004664	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks where a higher viscosity API SN / SM / SL / SJ oil is preferred or recommended
MOBIL DELVAC 1 ESP 5W-40	JUG 4X1 GAL DRUM 55 GAL	BQ1090229 BQ1090233	Fully synthetic supreme performance heavy duty diesel engine oil that helps extend engine life while providing long drain capability and fuel economy for modern diesel engines operating in severe applications	Recommended for use in all super high performance diesel applications, including modern low emission engine designs with Exhaust Gas Recirculation (EGR)
MOBIL DELVAC 1300 SUP 15W-40 (CK-4)	6X1 QUART JUG 4X1 GAL DRUM 55 GAL BULK	BQ1090219 BQ1090220 BQ1090221 BQ1090053	Extra high performance diesel engine oils that help extend engine life in the most severe on and off-highway applications while delivering outstanding performance in modern, high-out-put, low-emission engines including those with Exhaust Gas Recirculation (EGR) and Aftertreatment Systems with Diesel Particulate Filers (DPFs) and Diesel Oxidation Catalysts (DOCs)	Specifically recommended for the latest low-emissions, high performance diesel applications equipped with after treatment systems using Diesel Particulate Fiilter (DPF) and Diesel Oxidation Catalyst (DOC) technologies
MOBIL ATF D/M	6X1 QUART DRUM 55 GAL BULK	BQ1090222 BQ1090274 BQ1090275	Provides excellent oxidation and friction stability, anti-wear properties and low-temperature fluidity desired for most automatic transmissions	Recommended by ExxonMobil for use in applications requiring: GM DEXRON® IIIH transmission fluid Ford MERCON® transmission fluid Allison C-4 transmission fluid
MOBIL ATF 134	DRUM 55 GAL	BQ1090166	Mobil ATF 134 is an extra high performance automatic transmission fluid formulated with selected HVI base oils	Recommended for use in Mercedes automatic gearboxes
MOBILGREASE XHP 222	CART 10X0.39KG/13.7OZ	BQ1090217	Formulated to provide excellent high temperature performance with superb adhesion, structural stability and resistance to water contamination	Recommended for industrial and marine applications, chassis components and farm equipment
MOBILUBE HD PLUS 80W-90	KEG 120 LB	BQ1090096	Extra high performance, automotive lubricant formulated from select base oils and an advanced additive system specifically for limited-slip differentials	Recommended for use in limited-slip differentials, exles, and final drives requiring API GL-5 level performance
DIESEL EXHAUST FLUID (AD BLUE)	JUG 4X0.5 GAL DRUM 208L	A0005830107 BQ1470002	Non-toxic solution that transforms harmful Nitrogen Oxide (NOx) emissions from diesel-powered vehicles into harmless water vapor and nitrogen	Recommended for use in Mercedes-Benz, Volkswagen, and VMW AdBlue (DEF) applications
MB POWER STEERING FLUID	6X1 QUART	BQ1460002	Automatic transmissions should be checked for proper fluid levels at regular intervals, and the fluid should be changed at manufacturer-recommended intervals	Recommended for use in Mercedes-Benz vehicles

Classic Cruise Control

Classic owners are passionate about their cars, and many can't live without their cruise control. Here's how to keep the Mercedes-Benz E-Tempomat system traveling down the road.

While most of your shop's daily work is probably on newer Mercedes-Benz models, there are many customers with classic models, and their cars still need regular service and maintenance. With that in mind, *StarTuned* plans to deliver a series of occasional articles on some of the classic systems used in these older models. Today, we will explore the E-Tempomat cruise control system used in vehicles from the mid-1980s until the early 1990s.

The E-Tempomat cruise control system we'll focus on is installed in later-productioon S-Class model 126 vehicles, but the same basic system was also installed in the SL (107), E-Class (124) and 190-series (201) models. You can tell if it's an E-Tempomat system by the components: The throttle is actuated by an electric motor, and the cruise control amplifier has 14 pins. Earlier cruise control systems used pneumatic throttle actuation and a 10-pin amplifier, while later systems used the Electronic Accelerator system which is a part of the traction control system.

The system works by measuring vehicle speed and actuating the throttle linkage to increase or decrease engine output. Many customers love their cruise control, using it as an easy way to control vehicle speed, reducing both fuel consumption and the possibility of a speeding ticket. Not just for long highway cruises, even the daily commute is made easier, allowing the driver to focus on tasks other than speed control, which research shows also helps make for safer driving by reducing critical workload.

The Driver's View

Mercedes-Benz uses a unique lever mounted on the steering column to control the system. Tipping the 4-way lever upwards sets the desired speed, or increases the set speed by a small increment. Tipping the lever down also sets the speed, or decreases the set speed by a small amount. Exactly how much the speed is increased or decreased depends on the E-Tempomat version, but it is generally either about 1 MPH or 1 km/h. Holding the lever either up or down increases or decreases the vehicle speed at a set rate, although on a downhill slope the speed may not decrease as quickly. Pulling the lever towards the driver resumes a previously-set speed, while pushing the lever away from the driver switches the system off. Other ways to switch the system off include tapping the brakes, pressing the clutch pedal (in manual-transmission vehicles), or if the system detects an unreasonable deceleration (about 1.5 m/s^2). The system cannot be activated below about 40 km/h (25 MPH).

If the driver overrides the set speed by pressing the accelerator, for example when passing, upon releasing the pedal the vehicle will coast down and resume the set speed. It is important to avoid shifting into neutral in an automatic transmission vehicle, as this will cause the engine to rev up to the over-rev limiter setting. The set speed is erased when the ignition is switched off.

Originally, the E-Tempomat control amplifier was a purely analog circuit, with a different part number for each vehicle. The plastic connector end was coded by color, and the part number is stamped on the housing. Since vehicles have different power-to-weight ratios, a different reaction by the amplifier is needed – for example, a 190D 2.2 needs to approach the throttle more aggressively when the speed drops, while the same reaction in a 560SL might be a little scary. Later versions, including the replacements available today, were digitally controlled, and a coding plug was attached to the amplifier to set the specific throttle response and other parameters.

The unique and iconic cruise control switch, located on the steering column, makes operating the system easier for the driver.

Components

The system consists of only four components: The amplifier (or control unit), the actuator motor, the speed sensor and the control switch.

There are also several other related components, like the throttle linkage, that can be relevant in a diagnosis. Let's look at these components in detail.

As mentioned previously, the control switch is a 4-position switch. Looking at the wiring diagram for a 1988 560SEL, we see that each of the three switches – one for up/down motion and two for forward/backward motion – have two actuated positions and an 'at rest' position. With Pin 2 on the switch connector as the common for all switches, accelerate/set has continuity to Pin 4, and decelerate/set has continuity to Pin 3, when the switch lever is actuated appropriately. For the resume function, continuity is to pin 5 when actuated. Pin 1 has continuity in both the resume and resting positions, and loses continuity in the off position.

Using your ohmmeter, you can verify that all the switches are switching when they are supposed to, and by actuating them several times (including with more and less force) you can check for intermittent contacts. Because the switch's connector contacts (down in the steering column) can also contribute to the problem, you might consider also measuring the switch values directly at the amplifier plug.

The speed sensor is very simple. In a 126 the electronic speedometer has a connection on the back that sends out pulses that correspond to vehicle speed. Compare that to the 124 or 201, which have a speedometer cable running from the transmission to the back of the mechanical speedometer: There is an inductive sensor on the back of the speedometer that sends out the pulses. The pulses vary in frequency depending on the vehicle, but a couple of pulses per (rear) wheel revolution should be expected. Although an oscilloscope would be ideal to monitor these pulses, your voltmeter will do just fine. Just note that the rear wheels need to be spinning a couple of revolutions per second to get a good reading. The inductive sensor is no longer available; a Hall-effect version must be retrofitted as a replacement.

The actuator, on the other hand, is not so simple. It contains a motor to move the throttle, a two-track variable resistor to track the position of the output lever, and a clutch to engage or disengage the motor from the output lever. Testing is possible with a Mercedes-Benz special tool, W126 589 05 21 00. However, many of the symptoms will clearly indicate if the actuator itself needs to be replaced, and we'll look at some diagnosis steps we can take in a moment. In any case, avoid opening the actuator, as might never work right again. There is a security pin on the actuator housing, which must be broken to open it. The image here is just to satisfy your curiosity.

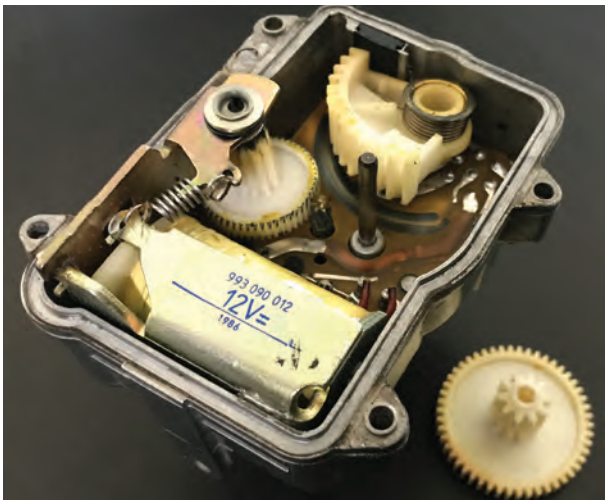
The cruise control amplifier, as an electronic control unit, cannot be tested directly, but we can easily say that if all of the inputs and outputs to the unit are correct, either the system is operating correctly or the amplifier needs to be replaced. The unit only has 14 pins, so it is fairly quick and easy to check every one of them and come to a conclusion. We'll get into the details when we talk about diagnosis.

Other Related Systems

One of the most important of the related systems is the brake light circuit. Power is fed to the brake light switch, which is on the brake pedal lever, and when the brake pedal is pressed, the switch closes and powers the brake lights. The E-Tempomat system detects this and disengages the system in two ways: The amplifier is switched off and the actuator clutch is disengaged.

The electronic sensor used to generate the cruise control's vehicle speed signal in vehicles equipped with a mechanical speedometer. The inductive version shown has been replaced by an electronic version using a hall-effect sensor.

Pin 8 of the cruise control amplifier is



The insides of a cruise control actuator. At front is the clutch solenoid, and top center is the two-track position-feedback potentiometer (curved black lines). The gear between the clutch and the output segment gear is removed for clarity.

the “Disengage” circuit, and needs to sense a ground to allow the amplifier to function. It gets this ground thorough the cold filament of the brake light bulbs. In a 1988 560SEL, for example, the output of the brake light switch connects to junction point X21/2 (behind the instrument cluster), which delivers power to the brake light bulbs after passing through the exterior lamp failure monitoring unit N7. If all brake light bulbs are burned out or disconnected, the lack of a ground through the bulb filaments will prevent the system from engaging.

In a similar way, the clutch inside the throttle actuator gets power from the amplifier, but relies upon the same brake light circuit ground (through the cold bulb filaments) to operate, so if the ground is removed (by switching the brake lights on) the actuator clutch disengages instantly. Also note that other systems, notably ABS and the Anti-Theft Alarm, also connect to the brake light circuit, but rarely cause problems with cruise control.

Both the brake light switch and the cruise control system get power from Fuse 9, so a fuse failure ensures the system cannot operate. The system ground (at W1) is connected to amplifier Pin 12 and (originally in production) Pin 14. Note that in vehicles where Pin 14 is connected to ground, the new digital amplifier won’t work. At the time, there was a Dealer Technical Bulletin explaining the issue, but that document is no longer available. The solution is to remove Pin 14 completely, leaving that connector hole empty.

An mentioned, vehicle speed is a series of pulses, with increasing frequency indicating increasing speed. In Mercedes-Benz vehicles with a mechanical speedometer cable, there is a sensor on the back of the speedometer that generates these pulses, while in electronic speedometer models the speedo re-forms the pulses received from the inductive sensor at the transmission output shaft. In either case, the speed signal is received by the cruise control amplifier on Pin 11. Since several other systems use the vehicle speed signal – CIS-E engine control, fuel pump relay, air conditioning and radio to name a few – there will be other systems affected if the vehicle speed signal is faulty.

The upper arrow points to the vehicle speed signal output connector from the speedometer, the lower arrow points to the connector block for that signal.

Diagnosis

As mentioned previously, the actuation switch has four inputs to the amplifier, on Pins 2, 3, 4 and 6. The connections to the actuator are on Pins 5, 7, 9, 10 and 13. Pin 5 is the actuator clutch power output mentioned before, while Pins 7 and 10 control the actuator motor. The voltage on these two pins varies both in magnitude and polarity, since the DC motor used to actuate the throttle needs to be able to run in both directions and at variable speed. Pins 9 and 13 are the throttle-position sensor power source and returned position voltage, respectively. The position sensor, which is a high-reliability potentiometer, is grounded at W1 along with the amplifier.

That covers all 14 pins of the amplifier, and diagnosis is as simple as taking 14 readings (and 2 of them are grounds!). But as we mentioned, there are other components related to this system which may need to be checked as well.

One frequently-heard complaint is a ticking or clicking sound coming from the actuator, along with the complaint that cruise control is inoperative. This is a symptom of a problem with the feedback potentiometer, where the amplifier believes (inaccurately) the throttle position is too high, causing the amplifier to run the actuator motor in an attempt to bring the throttle linkage to idle position. The clicking is the ratchet in the actuator clutch, since the actuator motor is also disengaged in this situation. This symptom is often caused by a poor ground to the actuator at Pin 1 of the actuator connector, located in the engine compartment.

Because of the position of Pin 1 in the connector, and the silver-plated brass material originally used for the female electrical contact, this contact can become slightly enlarged and allow the ground to be lost. When this happens, the sensor floats at the supply voltage, which would be an (incorrect) indication of full throttle. This may

The 8-pole electrical connector (here seen unplugged) for the cruise control actuator is found next to the round diagnosis connector in this 1988 300SE.

Removing the connector cover in this close-up view of the cruise control actuator plug lets us see the wire colors.

Three contacts (A003 545 26 26): one brand new, one properly soldered, and one cold-soldered. The cold-soldered contact is likely to fail if not re-soldered correctly.

happen only intermittently, particularly after the engine compartment gets hot. The solution is the replace the female contact with an improved version (the only type available today) made of Beryllium-copper, which does not become malformed easily. Simply solder in all new female contacts using the latest version (A003 545 26 26).

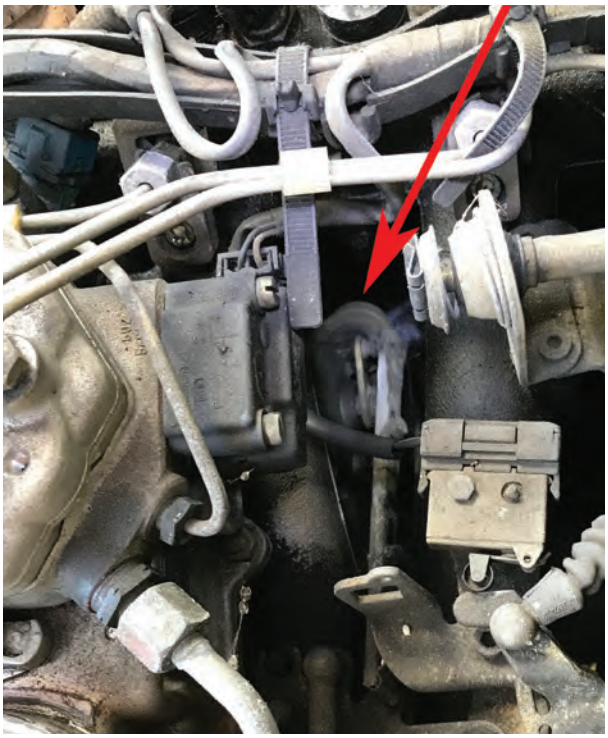
Another complaint we've heard is that the cruise control system operates more-or less fine, but tends to 'hunt', or constantly change throttle position from a little too much to a little too little, almost continuously while in operation. Found especially in higher-mileage vehicles, this is a clear symptom of a worn feedback potentiometer in the actuator. What happens is that the potentiometer resistance surface eventually wears out in just one small spot, and the only solution is a new actuator.

This symptom can also be caused by a sticking throttle linkage. Clean and lubricate, and verify the correct adjustment as explained in STAR TekInfo in the Legacy Microfiche: The topic of Cruise Control is found in Volume 2. Scroll to the bottom to find cruise control info for your particular model. Download and open this PDF conversion of the microfiche and check the index (at the end of the document) for the adjustment procedure applying to your specific model and year.

In some models, a mild hunting while traveling downhill can be caused by the deceleration fuel shutoff system. With fuel shut off, the engine braking can be enough to slow the car enough to need some throttle. This resumption of fuel injection can be felt by sensitive drivers. The Legacy Microfiche (in STAR TekInfo as explained above) explains in topic 30-576 how to install a relay and harness to address this complaint.

In the digital cruise control amplifier, Mercedes-Benz decided to use a so-called Reference Resistor to set the characteristics of the amplifier, allowing a single part number amplifier to be used in several different models. When replacing an analog-type amplifier, be sure to also order the correct reference resistor or the system won't work. If you are replacing a digital amplifier, you should swap the reference resistor over to the new amplifier. Test values can be found in the legacy microfiche as explained above.

So now we know how this relatively simple system operates, from both the customer's view and as a system. We have looked at each of the four major components and a few related systems and learned how they function and how they can be tested. We also became aware of a



The arrow points to the cruise control actuator, buried beneath the CIS-E fuel distributor in this 1988 300SE. Some of the throttle linkage is also visible. Be sure the linkage points are properly lubricated.

A few different reference resistors (coding plugs) that are used with the digital cruise control amplifier to match the system characteristics to the vehicle.

few Service Information bulletins with useful information for this convenience system. And finally we learned about a few of the more common complaints, learned their likely causes and how to correct them.

Again, while these older models probably don't make up the bulk of your customer base, we all know just how enthusiastic and passionate these classic-model owners can be. Your efforts at keeping their "baby" operating as designed will be appreciated by your customers, and likely profitable for you. Now you know everything you need to know about the Mercedes-Benz E-Tempomat cruise control system to keep the cruise control system, and your customers, happy.

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

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Oh, Behave! Stopping Mercedes-Benz Wiper Streaking and Skipping

Debris, contaminants, or an incorrect angle of contact with the glass can cause wiper blades to squeak, judder, and leave streaks. Here's how to stop it all.

The 2017 Mercedes-Benz AMG GLE43 SUV wiper system can handle any weather.

There are several types of windshield wiper performance complaints that require different factory-recommended repair solutions. Issues include wiper blades squeaking or shuddering, leaving streaks, pulling water back from the A-pillar area during the downward stroke, and other complications related to poor contact between the rubber edge and the windshield.

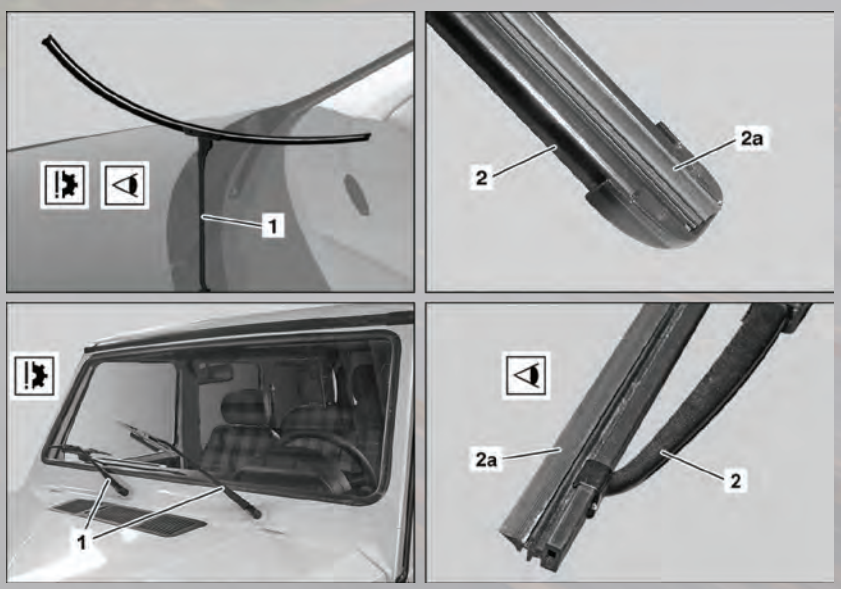
Although the snow shown here is on the decklid of this 2021 AMG GLE 53 Coupe, the owner of this vehicle should de-ice the windshield before using the wipers, to avoid potentially damaging the rubber blade edges.

Causes may include worn or damaged blades, contaminants on the windshield, or wiper arms that rest against the glass at an angle outside of the factory tolerance when measured in specific positions. These problems can happen in any Mercedes-Benz model.

Start with the blades

Actually, safety first: Be sure the ignition is off and the key well-secured away from the car, at least 3 feet away (such as on top of your toolbox). Serious injury/dismemberment can occur if ignition can be switched on while technicians are working on the system. That being said: Wiper blades are wear parts and subject to natural aging and use-related damage. Wiper shuddering and skipping across the windshield often results from blades that have been damaged or deformed, or from contaminant films on the glass. Dirt particles, grains of sand, insect parts, or other debris damages wiper edges. Using the wipers on an icy morning without first de-icing the glass can permanently abrade the rubber and cause it to leave streaks.

Look for bent or damaged wiper arms. Press down on the arms near where the ends attach to the rotating shaft, feeling for broken or loose fittings. Replace any damaged components.



Some Mercedes-Benz wiper arms (1) feature a one-piece wiper blade (2) design (top image) that must be replaced as a complete assembly. Others use a blade on which the technician may replace the rubber insert (2a) separately (bottom image), or install a new complete assembly.

Lift the wiper arms off of the windshield. Wipe the rubber edge with a clean, dry cloth. Run your finger along the wiper's edge to check for damage. If you feel any rough texture to the rubber surface, replace the blade.

Check the rubber insert for hardening, cracks, wear, and correct seating in the blade guides and end caps. If you find problems, replace either the rubber insert if available separately or the entire blade, depending on the wiper type.

Standard Mercedes-Benz replacement wiper blades are equipped with a sensor dot, which turns yellow after several month's exposure to the weather, indicating the wiper should be replaced. StarParts blades are also available for price-sensitive customers, but these do not include the sensor dot.

Blade lifecycle

Keeping the windshield clean can improve wiper performance and help prolong wiper life. Long stretches of lying unused can allow wiper blades to become deformed or deteriorated, much like tires can develop soft spots or dry rot after lengthy intervals between uses. Due to wear, damage, or natural aging, encourage your customers to replace their wiper blades twice a year.

Contaminated windshield

Inspect the windshield to first rule out stone chipped areas and other defects. Then check for contamination by spraying the glass evenly with water. If the water wets and runs down the windshield uniformly, as opposed to beading up or channeling, there is no contamination.

Differences in friction between contaminated and clear areas or wet and dry spots cause the blades to vibrate against the glass and squeak. Contaminants that contribute to these problems include wax, silicone-based washer fluid, water-repellent coatings, atmospheric fallout and residues from a car wash or appearance treatment.

Water that is not draining evenly off of the windshield looks like separate rope strands running down. Wherever water beads up and drains like little rivulets, that portion of the glass likely contains a film of residual contaminants. Clean the windshield with Mercedes-Benz Car Washing Agent A000 986 40 71. If moisture continues beading anywhere, re-clean that area.

Lift the wiper arm away from the glass during windshield cleaning. Do not clean the wiper blades, as the concentrated cleaning agent may harm the factory coating on the blades.

If streaking, skipping, or noises continue occurring after cleaning the windshield, it is time to check the wiper blade angle of incidence.

Wiper arm angle

The angle at which the wiper blade contacts the windshield must be slightly off of perpendicular to provide good wiping performance. An incorrect angle of incidence of the wiper arms to the windshield can prevent the rubber lip of the wiper insert from flipping over when the arm reverses direction. Not flipping at the appropriate time causes the wiper blade to shudder and skip.

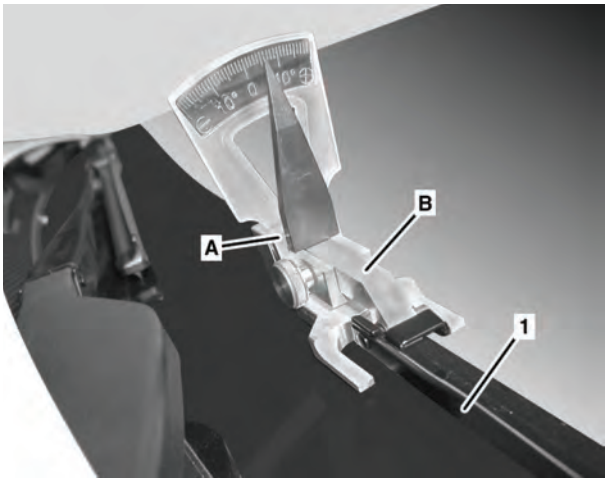
The range for the angle of incidence is approximately three to four degrees for most Mercedes-Benz vehicles and may vary by model. For example, the angle of incidence must fall within 2 to 6 degrees for some AMG GTS coupes (Model R190), or 3 to 7 degrees for other models such as the 2010 and newer E 350 (W212) and CLS coupe (C218).

Setting the wiper at the correct offset within this narrow window helps ensure not only good wiping performance, but also low blade wear, reduced noise, and no skipping as the blade moves across the windshield.

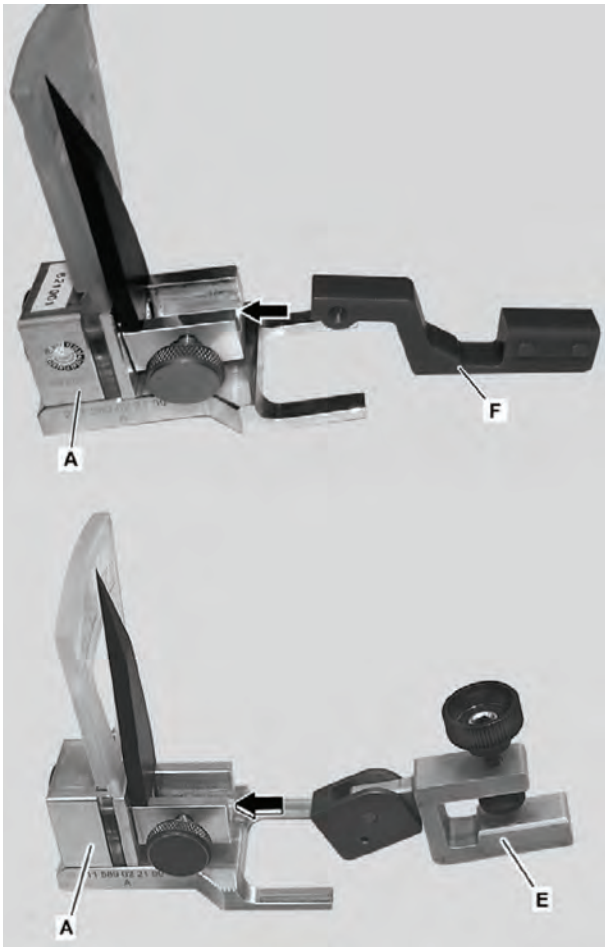
Measure the wiper blade Angle of Incidence

Before adjusting the wiper arm you must check to confirm that the angle of incidence is outside of the factory-specified tolerance.

Use the Angle Adjustment Tool Set (Mercedes-Benz part number W211 589 02 21 00) to check wipers. The set includes an angle gauge (known as a Goniometer) and two alternative adapters. The angle gauge measures the actual angle at which the wiper arm holds the blade against the glass when parked or in the reversing position. The adapter holds the arm in place during measurement.



Use the angle gauge with the blade removed from the wiper arm. Attach the adapter (B) to the angle gauge (A) and slide both onto the wiper arm (1). This image shows measurement on a C-Class (W204) sedan with the wiper arm in the park position at the base of the windshield. Check WIS for the details of other models.



Different wiper designs require alternative versions of the adapter to connect the angle gauge to the wiper arm. For models 117, 156, 176 and 246 one adapter (part number W211 589 00 21 00, "F" in the top image) is used for model year 2015 and later, and the other (part number W205 589 05 21 00, "E" in the bottom image) is for model years up to 2015.

The exact wiper arm adjustment procedure varies by model. Here we see the driver (1) and passenger (2) arms in the specified positions ("A" is 60-mm and "B" is 330-mm), shown for the wiper angle of incidence measurement on a C-Class (204) sedan.

Different adapters and blade angles may be required on various years of the same vehicle model. Before checking and adjusting the wiper arm position, refer to the Mercedes-Benz WIS for adapter details and angle of incidence specifications by vehicle model and year.

Checking the angle of incidence is simple and quick. You remove the wiper blade, insert the wiper arm into the adapter and angle gauge, place the assembly against the windshield, and record the angle measurement.

The procedure may differ in minor ways by model. For example, which adapter to use and whether to place the wiper arm in the park, center, reversing, or some combination of positions during measurement could each differ depending on the model and year. The arm is parked when it is at the base of the windshield. The wiper is in the reversing position when it is at the end of its wiping path and ready to swing back down the windshield.

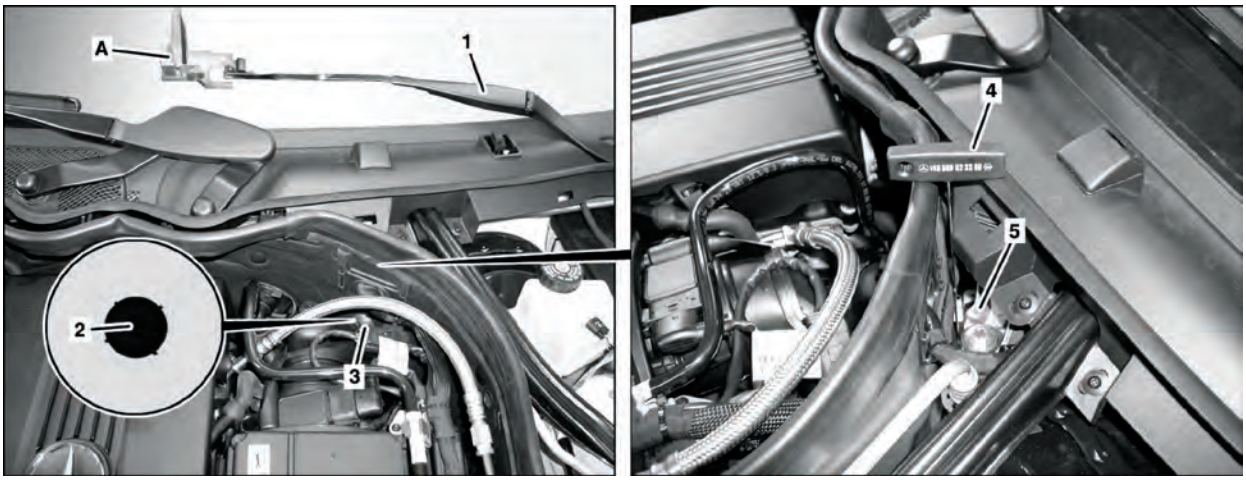
Different wiper positions for angle measurement

There are two primary methods of adjusting the wiper arm angle of incidence. Under certain conditions, you can adjust an individual arm at the windshield. Alternatively, if both arms are out of specification by the same amount and in the same direction, you need to reposition the wiper system unit under the hood.

You determine which adjustment method to use by measuring the angle with the wiper arm placed in two different positions. Depending on the vehicle model, the two positions are either the park and reversing position, or the park and center position.

Most Mercedes-Benz chassis designs introduced to the US market from 2006 to the present measure the angle of incidence with the wiper arm in the park and reversing positions. Examples include the 2006 and up B-Class (246), 2008-2014 C-Class sedan and wagon (W204/S204), 2012-2015 C-Class coupe (C204), 2010-2016 E-Class (212), 2014-to-present GLA (X156), 2013-to-present S-Class sedan (222), and 2011-2018 CLS-Class (218).

Older models featuring body styles marketed in the US up until the early 2000s often used park and center positions for measuring the angle of incidence. Examples include the 1994-2000 first-generation C-Class (W202), 1997-2003 CLK coupe (C208) and convertible (A208), and the 1996-2002 E-Class (210).

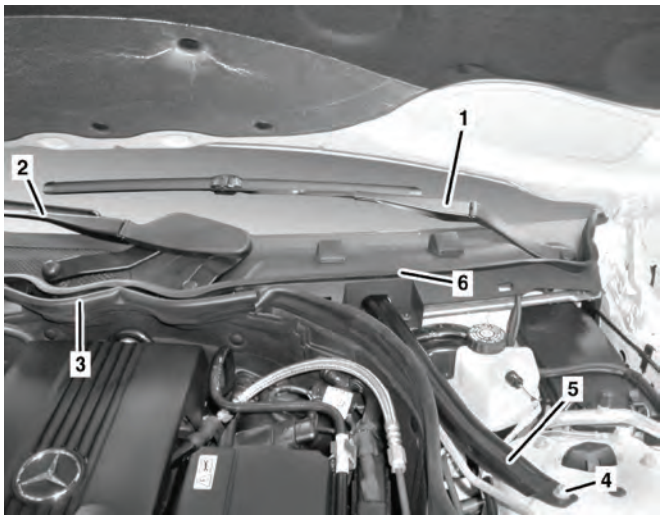


The image on the left shows the measurement tool (A) mounted to the wiper arm (1) on a Mercedes-Benz C-Class (W204). If both the driver and passenger side wiper angles are out of specification in the same direction, adjust the linkage through the windshield wiper system (5 in the close-up image on the right) under the hood. Loosen the screw (3) beneath cover (2), then adjust the wipers by moving the windshield wiper system using the extraction hook (4) until the angle gauge shows the correct value. The screw cover (2) is a discontinued part on the C-Class, and need not be replaced after repair to the system.

Reference points for comparison

Once you have measured the angle, which factory specifications you compare your findings against may also differ based on model and year. The arm angle on the 2014-2019 CLA (C117) and GLA (X156), and the B-Class (W246) ranges from +4.0 to +5.0 degrees for the driver's side wiper in the park position. On the 2008-2014 C-Class (204) sedan and coupe, 2011-2018 CLS (C218), and 2010-2016 E-Class (W212) sedans, the angle range is slightly wider – from +3.0 to +7.0 degrees for driver's side wiper measured in the park position.

Whether you measure the wiper arm in the park or reversing position can also affect the choice of which angle of incidence you use as a reference point for comparing the measured values. For example, while the angle on the 2010-2016 E-Class sedan (W212) and Coupe (C207) each range from +3.0 to +7.0 degrees for driver's side wiper measured in the park position, the range for the same wiper measured in reversing position is -1.2 to -5.2 degrees. The angle of incidence may also differ for the driver and passenger side wipers on some models. Refer to WIS for application-specific instructions and angle of incidence tolerance ranges.



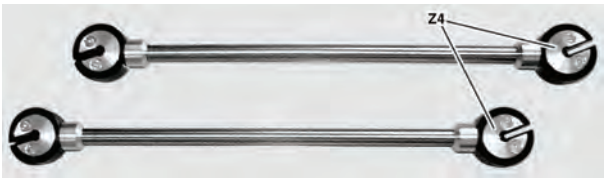
If only one wiper arm is out of specification, or both are off but in different directions, you can adjust each arm (1 and 2 in the above image) individually. Use the adjuster tools on each arm at the specified position (park, center, or reverse) on the windshield. If both arms are out of specification in the same direction and by a similar amount, the wiper system unit (not shown) located under the water collector tray (6) at the base of the windshield may have shifted position. A support beam (5) bolted (4) to the driver's side front suspension strut tower helps stabilize the wiper system unit.

Measurement results determine adjustment options

Depending on the measurement findings, the repair can often be accomplished by adjusting only the wiper arm.

On pre-2003 models for which you measure the angle of incidence in both the park and center positions, adjust the arm if the center measurement does not meet the factory specification.

If the angle of incidence on these older vehicle models exceeds the tolerance range when measured in the park position, adjust the wiper system unit under the hood. On 2003 and newer models you adjust the underhood wiper



The Mercedes-Benz adjustment toolset includes two adjustment levers that feature slotted heads to grip and twist the wiper arm back into the specified shape.

With the wiper in the recommended position (at the base of the windshield for the C-Class shown in this image) and the angle gauge (A) and adapter (B) mounted on the arm, place both adjustment levers (Z4) as far apart as possible on the wiper arm. Hold the lever that is farthest away from the angle gauge steady. Rotate the adjustment lever that is close to the angle gauge until you have twisted the wiper arm by approximately the amount of that arm's deviation from the factory-specified tolerance limit. Note: Even though you perform this procedure with the arm in the park position, you twist the lever until the angle gauge changes in an amount equal to the deviation that you measured with the arm at its reversing position.

system unit only if both the driver and passenger side wiper angles are off-specification in the same direction when measured in the parked position.

After adjusting the unit, check wiper arm angles again. In rare instances, you may have to fine-tune the adjustment of an individual arm after correcting the position of the wiper system unit.

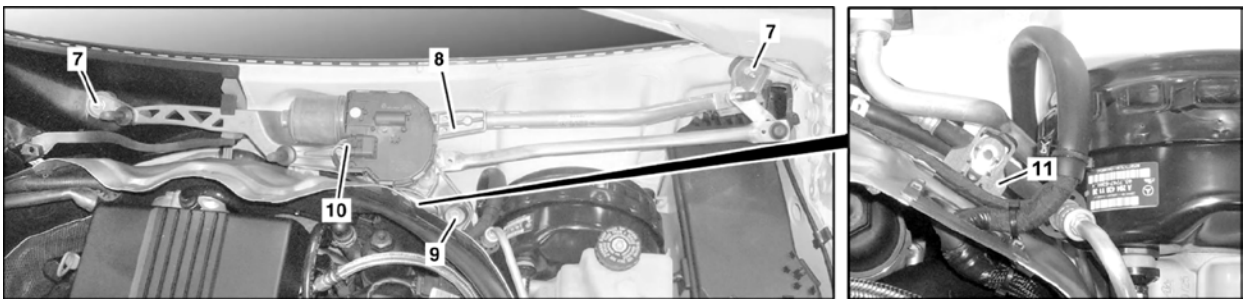
For Model 210 E-Class sedans, Model 202 C-Class sedans and Model 208 CLK coupes, equipped with the innovative single-arm wiper system, you check the wiper arm angle of incidence with the arm in the center and park positions. If, when measured in the center position, the test value falls outside of factory specifications you should adjust the wiper arm only, unless the arm angle value exceeds the tolerance range when measured in the park position, in which case the entire system gets adjusted. This system's adjustment is a little more complicated, so refer to the WIS instructions.

To ensure the correct angle of incidence, replace wipers with only genuine Mercedes-Benz blades.

Prevent scratching or shattering the windshield by placing a clean shop rag or other suitable aid between the arm and the glass whenever the wiper blade (or the angle gauge) is not mounted on the arm.

If you must remove or disassemble the wiper system, do so without changing the position of the mounting bracket when reinstalling the unit at the partition wall. This applies to the C-Class (204), E-Class (207/212), and CLS (218). Changing the location of the bracket will cause the contact pressure of the arms to fall outside of the factory specification and reduce the effectiveness of the wiping function.

Clean, smooth, and set at the correct angle to the windshield. See, you can make wiper blades behave.



The wiper system unit (8 in the image above) links to both the driver and passenger wiper arms under the hood. Lifting and repositioning the wiper system adjusts the angle of incidence of both the driver and passenger wiper arms simultaneously and by the same amount.

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Accurate repairs, reduced cycle time, and effortless marketing

Keeping this 2020 AMG GT beautiful is a labor of love best performed by a Mercedes-Benz Certified Collision Center.

Editor's note: This is the first of a three-part article about the Mercedes-Benz collision repair certification program. All content in this article was developed through conversations with three Mercedes-Benz Certified Collision Program instructors: Kevin King, Technical Collision Instructor & Welding Inspector and Clint Allen, Collision and Technical Trainer, both teaching in the Mercedes-Benz Learning & Performance Center in Grapevine, Texas; and Bob Laurino, Collision and Technical Trainer in the Learning & Performance Center in Robbinsville, New Jersey. We thank them for their kind efforts and time.

Participation in the Mercedes-Benz Certified Collision Program tells potential customers that your repair facility lives up to the brand's promise of offering "the best or nothing." Meeting the program performance standards results in higher productivity, fewer comebacks, and greater profitability. And providing access to OEM repair information and training not only makes it all possible, but also shows your technicians and staff that you value their contributions and are investing in their success.

Today, there are about 350 facilities in the U.S. and Canada certified to perform collision repair on Mercedes-Benz vehicles, and about three-quarters of them are independent body shops. To ensure that their vehicle owners can easily find quality collision repair providers, Mercedes-Benz wants more independents to join the certification program. Is your shop up for the challenge?

Benefits to the Shop

Competitive advantage

Despite their goal of increasing the number of certified collision centers, Mercedes-Benz USA (MBUSA) isn't interested in having a shop on every corner. This means that, if approved, your shop could be the only one in a given market, although large markets might have a few. An important factor in shop approval is the number of vehicles in operation in the area, to help ensure you won't see a Mercedes-Benz Certified Collision Center every other mile on your street.

Because of the safety implications of an improper structural aluminum repair, certain aluminum structural repair parts are only available to Elite-level Certified Collision Centers. Even an Authorized Mercedes-Benz dealer can't get these parts unless they are Elite certified. So customers need your shop not only for its expertise but its access to the repair parts required.

The biggest competitive advantage may be the peace of mind the Mercedes-Benz certification gives potential customers. "As far as the prospect driving by knows, a body shop is a body shop," said Clint Allen, Collision and Technical Trainer in the Mercedes-Benz Learning & Performance Center (LPC) in Grapevine, Texas. "One may have made a commitment to have the right tools, equipment and properly trained staff. Mercedes-Benz

helps promote the certified body shop advantages of factory-trained technicians, following manufacturer-approved repair procedures, and using the latest tools, equipment and OEM materials."

"Mercedes-Benz certification offers a significant amount of prestige to your collision repair facility," said Kevin King, Technical Collision Instructor and Welding Inspector at the Mercedes-Benz LPC in Grapevine, Texas. "Regardless of what brand of vehicle they drive, when a prospect brings their vehicle to your body shop and notices several premium Mercedes-Benz vehicles that have been repaired, it boosts their comfort level with the decision to come to you."

Shop locator assistance

Mercedes-Benz actively markets its certified collision centers through various channels. One such support channel is referrals from your sponsoring Mercedes-Benz dealer: Customers needing repairs, small and large, are sent your way. The Mercedes-Benz Customer Assistance Center (CAC) is another major source of referrals: Eligible Roadside Assistance program customers can get towed to the nearest Mercedes-Benz dealership or certified collision center. "The CAC staff functions as an immediate shop locator assistant by offering, over the phone, referrals to a qualified nearby Mercedes-Benz certified body shop," said Allen. "If the customer has the ability to visit MBcollisioncenters.com, the website shows your shop name and location on a Google Maps screen showing near-by certified facilities."

Customers can request assistance to address minor damage by calling the CAC, or using Mercedes me, a telematics app on their smartphone (subscription required). If the collision is severe enough to deploy an airbag, the SOS feature in the vehicle can summon emergency assistance, according to Allen. If the customer chooses, the Mercedes-Benz agent can also suggest a nearby certified collision center and arrange for towing if necessary.

Reduced cycle time

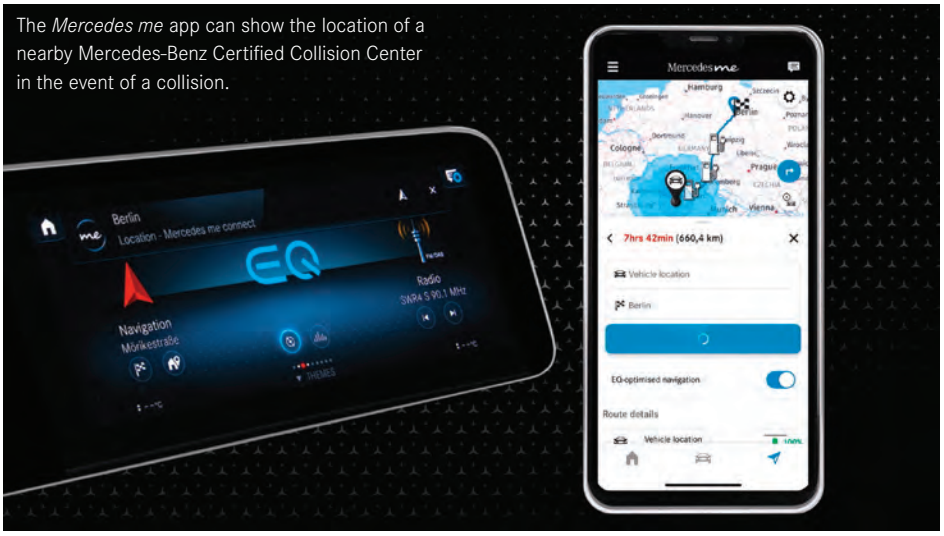
"Good training teaches technicians to find the correct repair documents quickly, interpret and effectively use that information in blueprinting, perform repairs efficiently, and avoid errors that typically trip the less skilled technician," said Bob Laurino, Collision & Technical Trainer at the LPC in Robbinsville, NJ. "The feedback I receive during visits to certified facilities is that after their technicians complete Mercedes-Benz factory training, they experience higher vehicle throughput and increased profitability."

"Shop owners tell us that the number one thing they gain from having their technicians factory-trained on proper repair techniques is dramatically reduced cycle times for collision repairs on Mercedes-Benz vehicles," echoed King. "Their technicians generate a lot of sales revenue, and vehicle-specific, state-of-the-art training makes them even more productive."

Instructor-led, hands-on training

You won't, thank goodness, assign an inexperienced technician to perform a frame rail repair. "We teach that technician what it takes and have him or her actually perform the repair," said Allen. "Now that technician has experience and the shop didn't risk repair comebacks or a potential safety issue. It's a big benefit to the technician, the shop, the customer, and to Mercedes-Benz."

Class sizes are limited, allowing instructors to fine-tune their teaching to the needs of each student. For the structural aluminum welding classes, the arriving technicians have varying welding knowledge and skill. Although the curriculum is challenging,



The *Mercedes me* app can show the location of a nearby Mercedes-Benz Certified Collision Center in the event of a collision.

the instructors work to ensure that before heading home each class participant can produce strong welds in a variety of metals and joint designs. "Our students retain and improve their welding skills thanks to the repetition of classwork and weld testing built into the three certification stages," said King. "The failure rate at the two-year recertification stage is currently zero."

State-of-the-art equipment training

Another big benefit of hands-on training is exposure to tools and equipment that the technicians may have never used. "Mercedes-Benz has a number of approved welders on our approved list – we have three of them in our training facility," said Laurino. "The technicians may already own one, and will often ask to use one of the others during our training exercises. I let them use the one they want. I show them its features and capabilities, and answer as many questions as I can. They love having a chance to play with a tool they don't have at their shop."

OEM repair information

Certified shops get access to the Mercedes-Benz online WIS. There, technicians can find all of the information needed to perform factory-approved repairs on Mercedes-Benz vehicles. Searches are VIN-based, which allows WIS to serve up repair procedures and guidance specific to the vehicle model, year, and system or component being repaired. The database is updated in real time as vehicle materials, technology, and repair procedures change, making WIS your most up-to-date, accurate source possible for Mercedes-Benz repair information.

The Mercedes-Benz front crash module bolts onto the upper and lower frame rails (longitudinal members) on this 2010 GL 450. Mercedes-Benz Base certification training teaches the proper procedures for sectioning or replacing the structural components.

Certified shops also enjoy access to the Mercedes-Benz video training system. Step-by-step video demonstrations often help to clarify written instructions. Videos cover procedures such as removing and replacing a windshield, taking off a door panel, and many other topics. "Taking a couple of minutes to see the job actually being done helps technicians approach the job confidently, and results in fewer 'gotchas' and higher productivity," said Allen.

Auto-generated parts job list

Certified shops have access to the XENTRY Parts Information catalog and the very popular Mercedes-Benz Parts Job Program. Input the VIN and the planned repair, and the Parts Job Program generates an accurate, complete list of all parts needed, including quantities. No more work delays due to waiting for supplement approvals.

Certification Tiers

There are three certification tiers: Base, which includes repairs to nearly all Mercedes-Benz vehicles; Elite, which adds models with structural aluminum components; and Commercial, which adds the Sprinter and Metris commercial van models to the mix. We'll get into the details of these tiers in the next issue of StarTuned.

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.

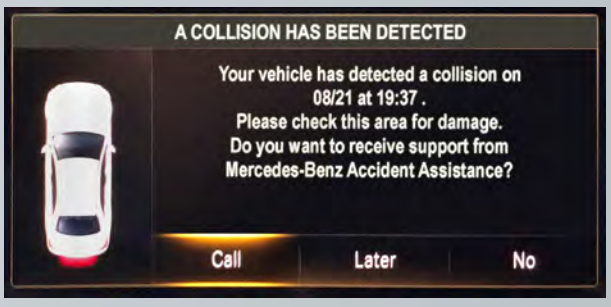
Are you in? Being one of the elite (pun intended) few will benefit your shop, your customers, and Mercedes-Benz. Win-Win!

Parking lot ding? Your car knows and can tell you.

We've all seen it and possibly even experienced it: You return to your car in the parking lot and find, to your dismay, someone had a minor collision with it and left the scene, leaving you to deal with the damage. Well, those days are over now that the *Mercedes me* app is around: One of the settings can notify the driver immediately when it detects a collision with their parked vehicle. (This feature is new, built into some models now, and will expand across the entire model line.)

Different from Automatic Collision Notification, which makes an SOS call for emergency services when it detects a significant accident, the Parking Damage Detection feature in the *Mercedes me* app can be set to provide immediate notification of even a minor parking lot mishap, giving you time to get back to your car and assess the situation. Combined with the Theft Notification feature, you'll know right away if something happens while you're not around, including minor collisions, alarm system triggering, and any attempts at towing. The customer can also control the interior protection and towing detection from their phone or smart device, and can cancel an activated alarm remotely.

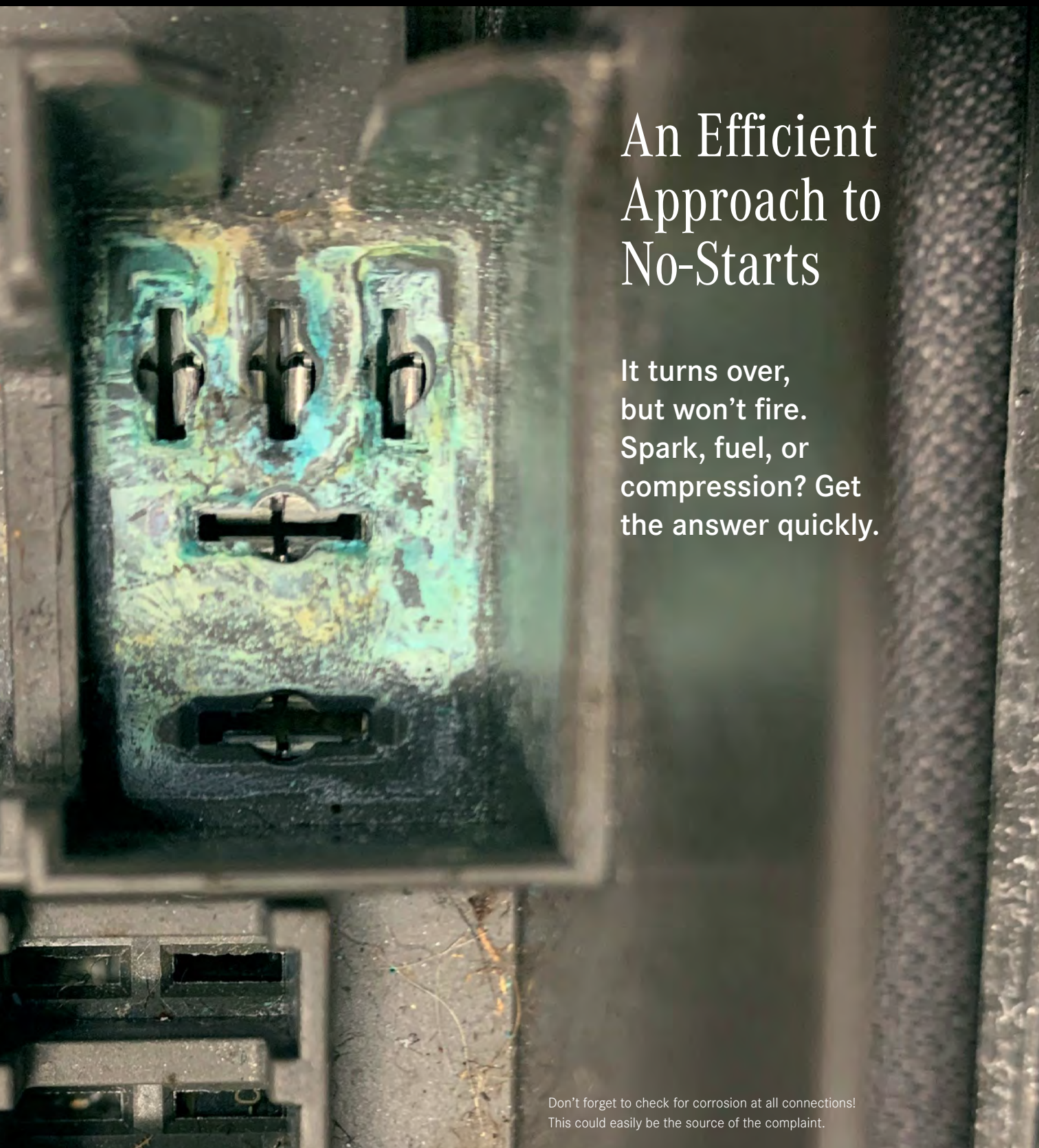
What is important for an independent workshop like yours is to understand that the system also sets a message in the instrument cluster, visible at startup, advising the driver that an incident was detected since the vehicle was parked. Your customer may not know about this feature, and become concerned by the message. Now you can reassure them that their vehicle is only telling them that something happened while they were away. In such a case, the *Mercedes me* app also offers additional information and assistance on their smartphone if there is possible damage.



Your customers depend on your shop to keep their most valuable asset, their car, operating safely and reliably. Stay informed of new features and systems to offer competent and timely advice when your customers need it most.

An Efficient Approach to No-Starts

It turns over, but won't fire. Spark, fuel, or compression? Get the answer quickly.



Don't forget to check for corrosion at all connections! This could easily be the source of the complaint.

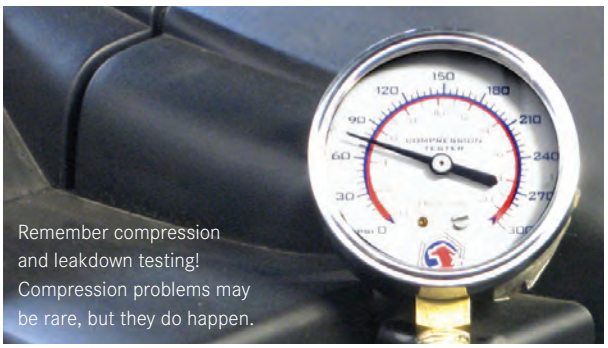
So where to start with no starts? This scenario is often described as a Crank, No-Start. Well, the best start is with a good question and answer session with the customer, especially if the problem is intermittent. It may only occur when hot, after sitting in the grocery store parking lot. Maybe it is only first thing in the morning. The important thing is to get as many details about the customer's concern as possible in order to correctly diagnose and solve the problem.

Your customer might not be able top describe the symptom accurately, so it is really important to listen carefully and ask careful questions to identify the complaint. Often a married couple will have two completely different descriptions of what's going on and you have the makings of a great comedy scene. This is where good questioning and listening skills come into play as part of the diagnosis.

Strategy Based Diagnostics

We've touched on this concept before, but whenever discussing any diagnosis – and no-starts are no exception – we find it useful to have a brief refresher on the concepts. A good technician combines experience, system knowledge, observations and test data along with manufacturer literature to develop some theories and then prove or disprove each one.

Always start by verifying the complaint. Skipping this step will have you chasing your tail by trying to fix a problem different from what exists in the vehicle. Once confirmed, get out your most powerful diagnosis tool: your brain.



Remember compression and leakdown testing! Compression problems may be rare, but they do happen.

The basic idea is to identify every component that could possibly affect the system, and then look for which one(s) are not operating properly. Use the Mercedes-Benz STAR TekInfo or WIS wiring diagrams and system function descriptions if necessary. With a list in hand, check the easiest-to-check components first, and move on to the more difficult items if necessary. For example, a quick check of the fuel gauge reading could save a lot of time if the tank is empty.

Once your tests have identified a possible cause, you can start making repairs. If that doesn't address the complaint, pick up where you left off, as it is not impossible to find two different causes for a particular complaint. Hopefully, in the end you have not only corrected the complaint, but you've given some thought to why that part failed in the first place, and taken actions to prevent it where possible.

In a crank, no-start situation, here is a basic list of components and systems that are involved. We will have a closer look at each of these:

- Battery
- Wiring
- Control Modules & Relays
- Ignition Components
- Engine sensors
- Fuses
- Security/Anti-Theft
- Fuel Supply
- Engine Compression

Spark, Fuel, or Compression?

With only these three things needed for an engine to run, it sounds like it would be easy to narrow it down, but as we all know the details get complicated. If all three happen at the right time, the engine will start. Being able to test for all of these is important, but modern engine control systems have a wealth of self-diagnostics that can really help point us in a direction. And don't limit yourself to the engine module: Related systems can also cause problems. Of course, diesel engines only need fuel and compression, 33 percent easier!

Quick Test

After verifying the customer concern, (or maybe not, sometimes it starts right up!) a complete scan of the

vehicle is in order. Using your XENTRY Diagnostics system or compatible scan tool, make a note of any codes stored in the various modules. Compare similar codes (i.e. voltage codes) and incorporate that into your diagnostic strategy. Remember when using any scan tool you need to supply robust power to the vehicle. Allowing low voltage during diagnostics can cause problems, which could have you chasing ghosts. Even worse is a power drop during programming, which can possibly cause module damage. Mercedes-Benz recommends a dedicated automotive power supply with protection circuitry, capable of more than 30 amps at battery voltage.

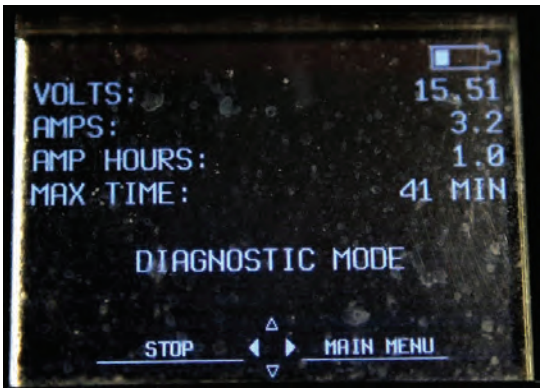
Battery

You may wonder why you need to check the battery – after all, it cranks, right? Yes, well, the real question is how low does the system voltage drop during the high load from the starter motor? A weak battery might allow system voltage to drop too far, but be barely noticeable when checking cranking speed by ear.

Mercedes-Benz batteries are generally either AGM (absorbed glass mat) or conventional (flooded) lead acid. Some newer models, including Hybrids, may have exotic Lithium-Ion batteries or even multiple batteries. Later models tend to have AGM almost exclusively, especially if they are found in the passenger compartment or trunk as opposed to under the hood. WARNING: Only specifically-trained personnel should service batteries rated above 12 volts. Some batteries have lethal voltages! This article doesn't cover these specialty systems.

Dual-battery systems range from a tiny 1.2 Ah secondary battery (used to ensure the transmission can always be shifted into Park) to a relatively large (about 50 Ah) auxiliary battery used to run vehicle systems when the ECO Start-Stop system has switched off the engine. Use a high-quality battery tester to check all the batteries in the car, paying particular attention to the one that runs the starter. Mercedes-Benz recommends the Midtronics line of testers (see mbusassep.com for recommended equipment) but there are many high-quality testers on the market. Pick a reputable brand to be sure.

If the battery needs to be charged, it is a best practice to disconnect the battery from the vehicle. In two-battery systems, charge both batteries. When working on electrical systems, be sure that all batteries are disconnected by their ground terminal, otherwise a short-circuit hazard may exist. Accidentally shorting a wrench between a live power source and ground will definitely make for an exciting day, and not in a good way.



A high-quality battery tester with a diagnostic function is a critical tool for today's modern batteries.

Mercedes-Benz recommends Midtronics battery testers, not only for their accuracy, but for their clear and definitive test results.

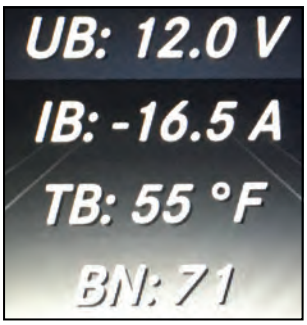
As a quick check, you can read the battery voltage using a voltmeter or, in many models, directly on the instrument cluster, as described in WIS document AR54.10-P-1132A. A battery should be charged if the measured voltage drops below 12.2 V. A good tester will tell you if the battery needs to be charged and retested. Some testers have a mode of diagnostic charge. This mode charges and tests the battery at the same time to give a very accurate analysis of its condition.

Check the Fuses!

This step is often overlooked, but remember to start with the basics. Before moving on to more complicated theories check the fuses – all the fuses – as there may be three or more fuse boxes, and fuse cards are often simplified as to what fuse protects what. It is frustrating to find your concern was a supposedly unrelated fuse. If using the XENTRY Diagnostics system the integrated test routines will often direct you to a specific fuse depending upon the complaint.

Fuel Pressure

Of course, you have verified the car has some fuel in it. But is enough fuel being delivered? A scenario: The 2010 C300 quick test turns up codes for possible faulty fuel pump or communication codes with fuel pump control unit. You can hear the pump running briefly when cycling the key. The fuel pump (M3) is actuated via the fuel pump control unit (N118), which in turn is controlled by the ME-SFI control unit. The pump draws fuel through an integrated strainer. Check the 20 amp fuse #42 at the rear SAM and 7.5 amp fuse #4 in the front SAM, testing both sides of each fuse for power. At the fuel pump control unit, verify Circuit 30 (constant battery power) on connector 1 Pin 1 (Red/Green wire) and Circuit 15 (key-on power) on connector 2 Pin 5 (Pink/White wire). Check for a good ground on connector 1 Pin 2 (Brown wire).



As a quick check, the battery voltage can offer a peek at the battery's condition. Note that voltage doesn't necessarily indicate battery condition, only state of charge.

Be sure to use a voltage drop test when checking powers and grounds. Wires carrying current always have inherent resistance to current flow. Voltage drop is defined as the amount of voltage loss that occurs through all or part of a circuit due to that resistance. While a voltage drop at a component is expected – this is what powers the component – drops in the supply and ground lines can indicate a problem.

One of the rare instances where a modern test light might be useful is testing fuses. Be sure to check both sides!

To check for voltage drop in a circuit, connect your voltmeter between the battery positive pole and the device's power input (such as the fuel pump). Energize the circuit and read the voltage drop. Repeat between the battery ground and the component ground. Much higher than about 0.6 volts and your component could be suffering undervoltage, so you'll need to trace the wiring to find the cause of the excessive voltage drop.

At normal output, the fuel pump in this model will deliver approximately 85-90 psi. Compare your gauge measurement with the sensor value shown by your scan tool. Low fuel pressure can indicate a clogged fuel filter or damaged fuel line, or possibly the fuel pump itself has worn and needs replacement. Be sure to check for damaged wires at the pump and correct or replace as needed.

Communication Errors

In some E-Class (211) models, communications error codes in the Central Gateway (CGW), or a control unit not responding to the quick test, can be an indication of a CAN Bus problem. If a system is not receiving the messages it needs because of a CAN fault, a no-start condition is possible. Locate the CAN Bus wiring for the Engine CAN (green & green/white) and Body CAN (brown & brown/red) on the Central Gateway Module (CGW).

Be sure to verify that the fuel pressure delivered by the pump is within specifications, and it agrees with the sensor reading.

Using a voltmeter (or an oscilloscope if you have one) you can check the Bus voltages. Normal DC voltages (to ground) for Engine CAN are 2.6 volts (CAN-H) and 2.4 volts (CAN-L), and for body CAN are about 4.5 volts (H) and 0.65 volts (L), both with the ignition on.

CAN Bus testing is a process of elimination. If any voltage is incorrect, disconnect and reconnect connectors from the CAN Bus voltage distributors one at a time until the problem disappears – the disconnected branch is the problem. Good indicators of CAN Bus problems include a component failing to respond to a quick test, a "display defective" message on the instrument cluster, and several control units showing communications codes. CAN Bus voltage distributor locations are specified in STAR Finder and WIS.

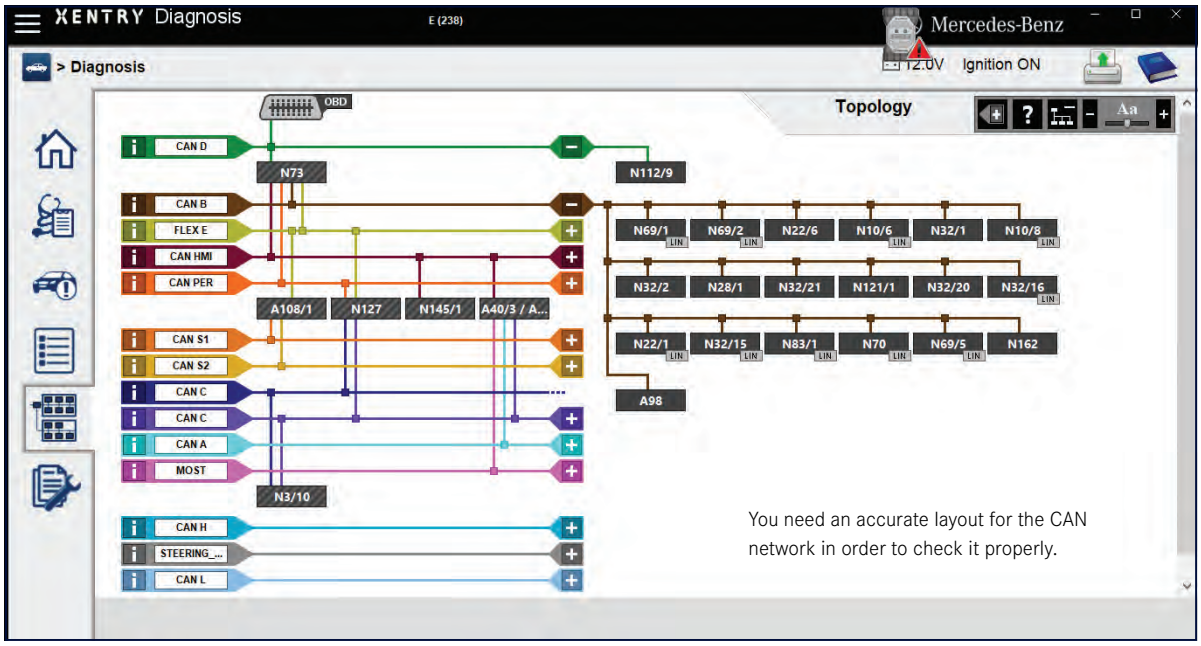
Let's take another example: A W204 C300 with the fault code "No Controller Area Network (CAN) message was received from control unit N118 fuel pump control module." A test procedure in this instance might be to access the control unit (beneath the right rear seat) to test power and ground and CAN Bus voltages. If you have an oscilloscope, check the CAN Bus signal pattern for distortions. Issues with the CAN voltage distributor X30/21 have been found on this particular model: Remove the voltage distributor and inspect it for corrosion, possibly caused by clogged cowl or evaporator drains.

No Spark

Rarely will you get this symptom by itself, it will usually be accompanied by a no fuel pressure symptom as well. The exception would be in much older models where the fuel and spark management systems are separate. If you do need to do a pinpoint test to check for ignition spark, it is important to take some precautions to protect the control unit. According to Mercedes-Benz WIS document AH15-10-P-0002-01D you should never check spark by trying to jump the coil output terminal to ground. For field testing it is recommended to use a spark plug attached to a good engine ground and the coil boot to check for evidence of spark, while taking precautions against accidentally igniting anything. In coil-on-plug engines, use the inexpensive ignition testing adapter (See WIS or ask your Mercedes-Benz dealer) to check the ignition pattern.

The typical ME-SFI ignition system consists of:

- Knock sensors
- Mass Air Flow (MAF) sensor
- Camshaft position sensor(s)
- Coolant temperature sensor
- Accelerator pedal sensor
- Crankshaft position senor
- Throttle valve actuator
- ME-SFI engine control unit
- ETC (transmission) control unit
- Spark plugs and ignition coils
- A 16- or 38-pole Diagnostic connector

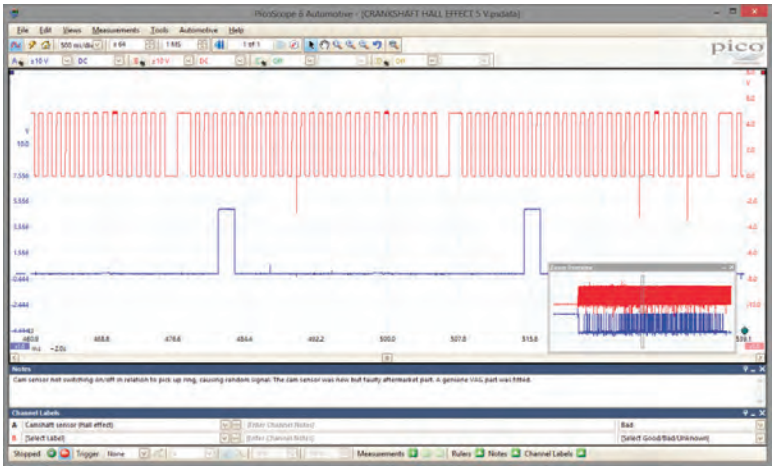


Sensors

A generic code of P0336 or specific codes of 0117, 0119, and 0120 on a C230 (203 chassis) typically indicates a fault in the tooth count or wiring of the crank sensor. Observe your scan tool and monitor the engine RPM while cranking. If no RPM is detected, the crank sensor or wiring may be faulty. Check the three pins on the connector: Pin 1 is ground, Pin 2 is signal, and Pin 3 is the 5-volt reference. If Pins 1 and 3 are correct, reconnect the sensor and check Pin 2. The waveform from the crank sensor while cranking should be a 5 volt square wave.

If you are working on a Mercedes-Benz 203 chassis, the front and rear edges of the segmented teeth will produce an alternating voltage which will look like a pulsed sine wave. The higher the engine speed, the higher the voltage. The permanent magnet located in one segment of the flywheel causes a change in the signal which is used for detecting the respective ignition circuit. The failure of the crank sensor is keenly associated with intermittent no-starts: When the sensor gets hot, the sensor can open internally and fail to produce voltage. As it cools down, it starts working again. We've seen this issue in several models over the years. Keep in mind the type of sensor you're monitoring, as not all have this type of pattern. Always good to consult the manufacturer's specifications.

If indeed you do find a faulty sensor, a relearn is required on the new-style hall-effect sensors. If vehicle does not start, P0336 code may get re-flagged as a result, even if there is nothing wrong with the sensor. Look for a re-initialization icon on your scan tool on the control unit adaptations menu.



A Hall-effect crankshaft position sensor typically has an output waveform that looks like this.

Sometimes you may have what seems like a flooded condition. You may smell fuel when cranking or are able to start the vehicle in clear-flood mode. Black smoke may be emitted upon start up. You might have pulled a spark plug for inspection and found the electrode to be all full of black soot. These are possible indications of a faulty engine coolant temperature sensor. Sometimes this will not set a code unless the sensor goes so far out of range that the processor deems it implausible. A sensor that tells the ME control unit that the temperature is -40 degrees will cause the injection of too much fuel, thereby causing the flooding problem.

Anti-theft Systems

As mentioned, if the immobilizer anti-theft system is not operating properly, the engine will crank but fail to start, or in some cases crank for just a brief moment. In newer models, the engine won't crank at all if the immobilizer is active, sometimes not letting the key turn.

While complete diagnosis of a Drive Authorization System (DAS) concern is well beyond the scope of this article, reading the fault codes will bring you a long way towards identifying the cause. In general, if the DAS system doesn't recognize the vehicle key as valid – bad key, bad transponder coil, mis-matched control unit, or some other fault – a DTC will be set. As always, your XENTRY Diagnostics machine will walk you through the test procedures, or you can check in the Diagnostic Manuals found on STAR TekInfo.

So there you have it: Using a structured approach to a crank, no-start complaint, during which you consider all of the possible components and systems, will lead you to a firm conclusion. While checking the easiest items first, don't stop until you've found the root cause. Staying well-organized will keep you from getting confused or lost, instead your careful notes on tests performed and results observed can be used later to verify your findings.

Not every problem can be solved quickly, but there are only so many parts in a car, and eventually you will find the one that needs your attention. Use your expertise, collect data in a logical way, and consult the myriad resources that Mercedes-Benz offers to successfully remedy that no-start condition.

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