# StarTuned®

Information for the Independent Mercedes-Benz Service Professional

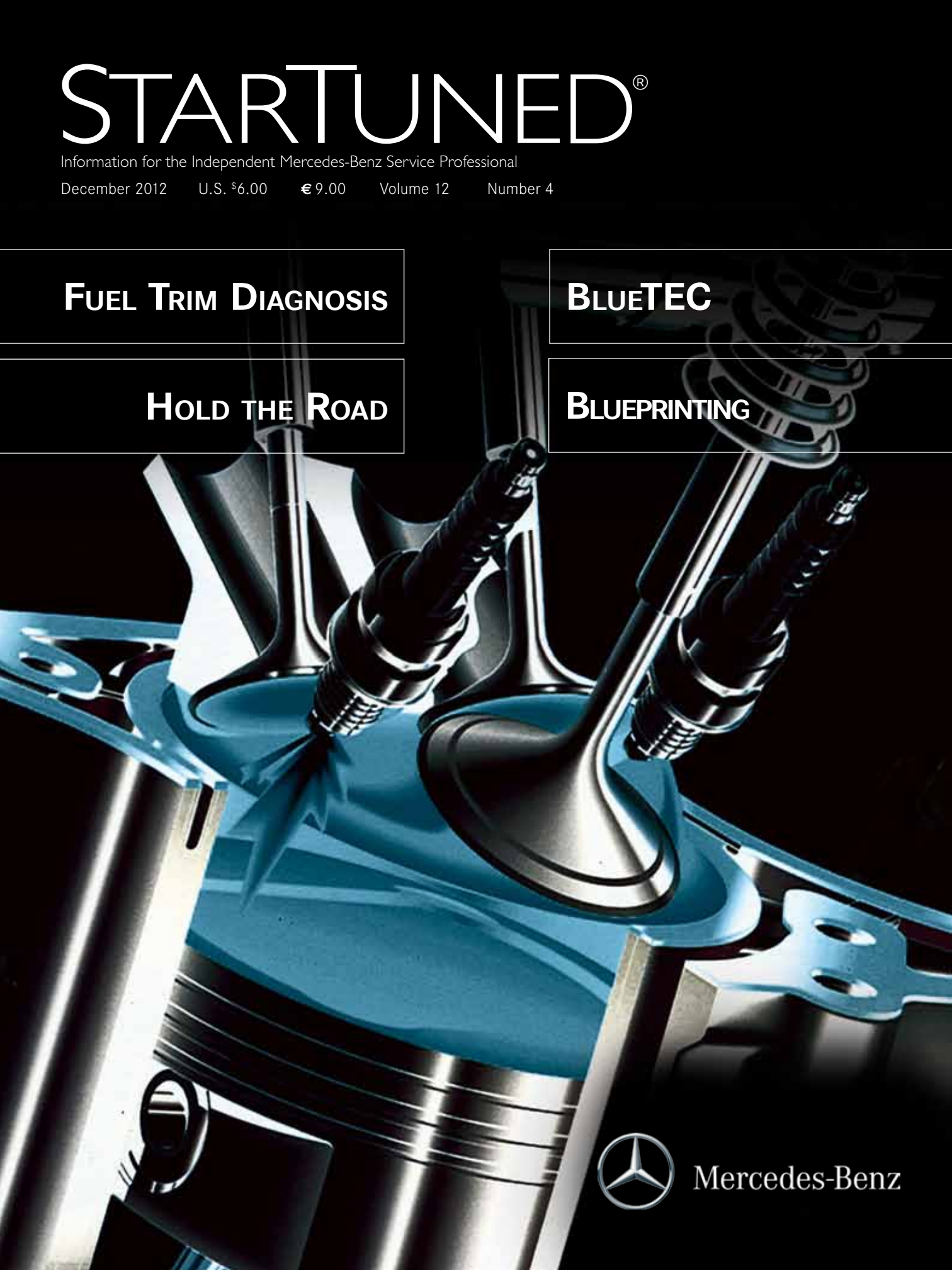
December 2012 U.S. $6.00 € 9.00 Volume 12 Number 4

## Fuel Trim Diagnosis

## BlueTEC

## Hold the Road

## Blueprinting



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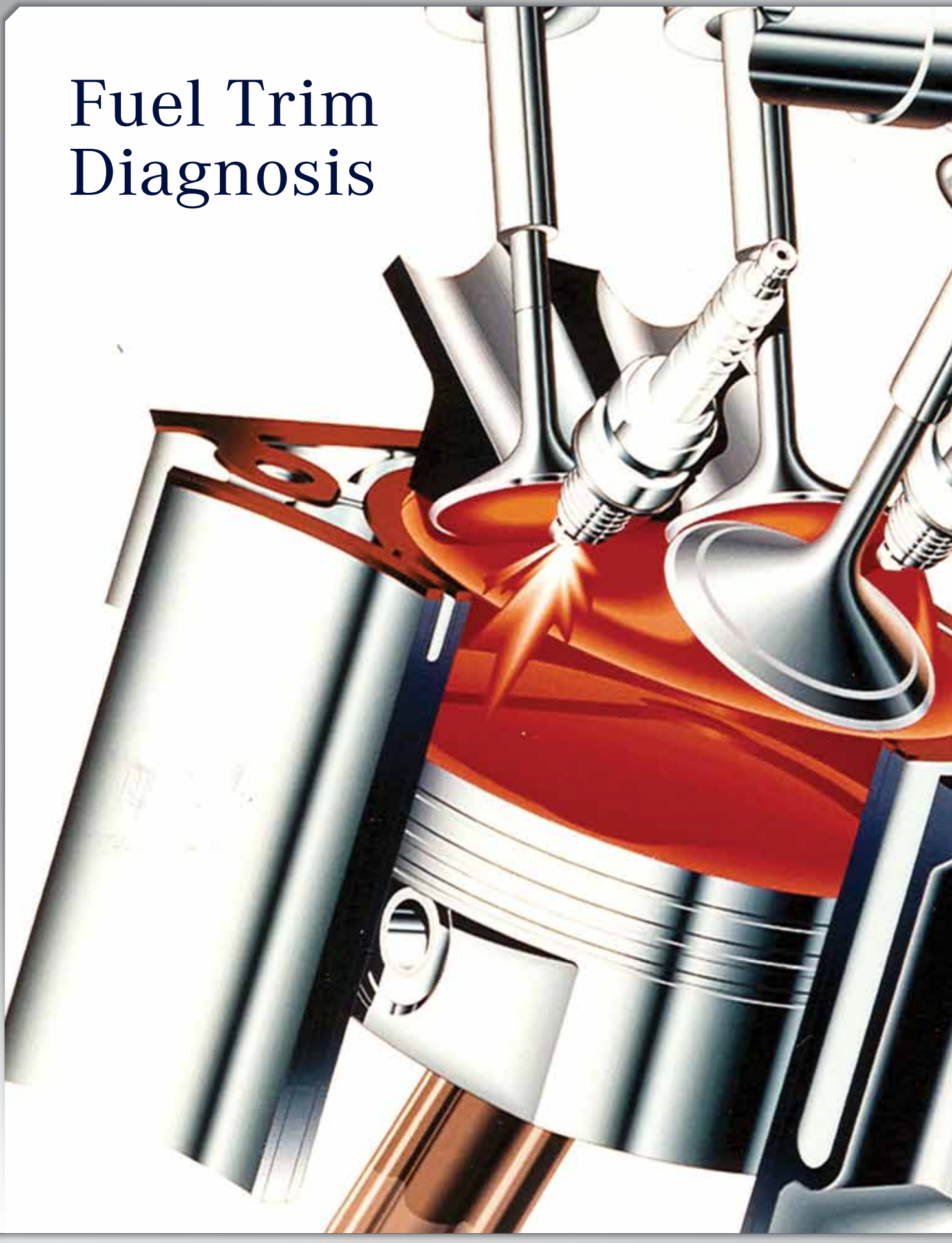
## In This Issue

# Fuel Trim Diagnosis



*"Self-adaptation" is how M-B refers to fuel trim and that's actually more descriptive. Regardless, understanding this electronic engine management feature will help you cure MIL-on complaints, failed emissions tests, etc.*

*Figure 1: Three valves and two plugs per cylinder help make the M112/M113 engine efficient and clean-running, but the A/F ratio has to be right.*

The dreaded "Check Engine" light. Commonly referred to as the CEL, but more accurately called the MIL (Malfunction Indicator Lamp), its illumination is a source of anxiety for the owner of the vehicle. No one wants to get stuck during a grocery run, or while commuting to work, and that light in the cluster brings up all kinds of troubling uncertainties. Do I have to take care of the problem right away? Is it going to be expensive to fix? Will my car ever run right again? For a technician, that indicator can also be a source of anxiety. Did I diagnose that fuel trim code properly? Have I replaced the right part? Is the light going to come on again? Here, we'll take a look at how to properly diagnose a fuel trim code on a Mercedes-Benz vehicle. If you fix it right the first time, there will be less anxiety for everyone involved and more profit for your shop.

## Continuous tune-up

Fuel trim is the fine tuning of the air/fuel ratio the engine control module (ME, or in standardized SAE J1930 terminology, PCM for Powertrain Control Module) does to compensate for any small deviations away from the ideal mixture. It is important that these calculations are as accurate as possible, to ensure a smooth running, smog-free engine.

How does the ME know how much fuel to inject? As you know, the basic formula for complete combustion calls for 14.7 parts of air to 1 part of fuel by weight, which is known as the stoichiometric ratio and is often represented by the Greek letter Lambda. In terms of fuel trim adjustments, ME will makes its calculations based on a post-combustion reading taken from the exhaust stream using the O2 sensors, or, in later models, A/F "wide-range" oxygen sensors. The amount the oxygen in the exhaust indicates whether the engine is running rich (too much fuel) or lean (not enough fuel). How can the readings be taken after combustion and still be used for calculating an accurate air/fuel mixture during combustion? This is a very important question.

## Pattern recognition

Fuel trim has to be thought of as an overall trend. The ME is not looking at each individual cylinder to make adjustments in fuel trim, but rather at the big picture. It will help to remember this during our diagnostic process. Also keep in mind that there is a limit to how much the ME can adapt. If you're old enough to remember carburetors, you could compare this to the limited idle mixture screws that were mandated in the 1970s to reduce exhaust emissions. Turning them in or out as far as they would go had only a small effect on the idle mixture, and couldn't make up for such things as a major vacuum leak, or a heavy float.

There's only so far the ME can adapt in either direction of increasing or decreasing injector pulse width, hence

fuel quantity, before it reaches its limits. For Mercedes-Benz, this is called Enrichment Limit, or Enleanment Limit. Although these values may be shown in different ways depending on the model, it is commonly displayed as a number between -1.000 and +1.000 when everything is okay, and outside of that range (in either direction) when something is wrong. The more positive the number, the more fuel ME is adding, and vice versa.

For the most accurate diagnosis, it helps to have the factory scan tool, which is called the Star Diagnosis System (SDS), or the Diagnostic Assistance System (DAS), or XENTRY for newer models (for the purposes of this article, we will be using DAS). Just having the tool is not enough, however. DAS will provide you with a whole lot of information, but it's up to you to decide what to do with it. For our example here we will be using a 2001 ML 320 with the V6 M112 engine. The M112 and its V8 sister the M113 share many design features: single overhead cams, three valves and two plugs per cylinder, sequential fuel injection under the control of ME SFI, and a Hot-Film Air Mass Sensor (also known as the MAF for Mass Air Flow). The M112/M113 engine family was standard in most Mercedes-Benz cars and SUVs from 1998-2006. Fuel trim fault codes are fairly common with these engines, so there's a good chance you will see one of these cases roll into you shop pretty soon.

Before we begin, let's mention that we are assuming the O2 sensors have been checked and are operating correctly. If you suspect a lazy or failing O2 sensor, DAS has some nice features that will help you determine if it (or they) need to be replaced (perhaps we will tackle that topic in a future article). For now, let's assume all these critical sensors are functioning properly.

## Out of range

Here's the scenario: A vehicle comes in with the MIL on. You do the basic scan for fault codes (short test) and you come up with what's highlighted in Figure 2.

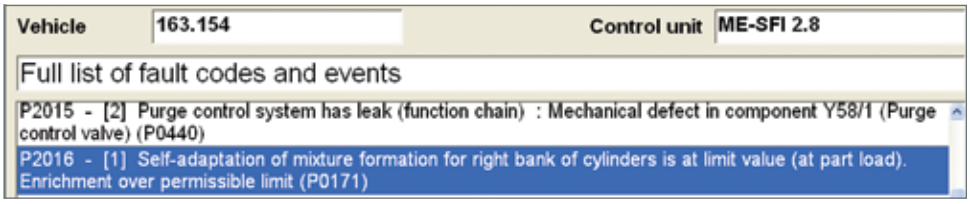



*Figure 2*

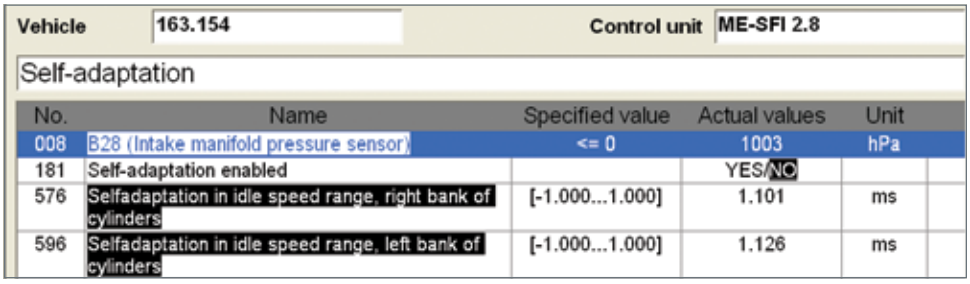



*Figure 3*

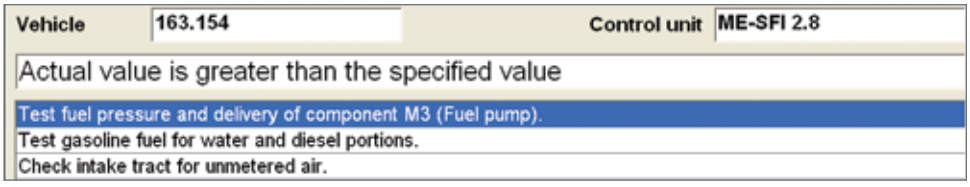



*Figure 4*

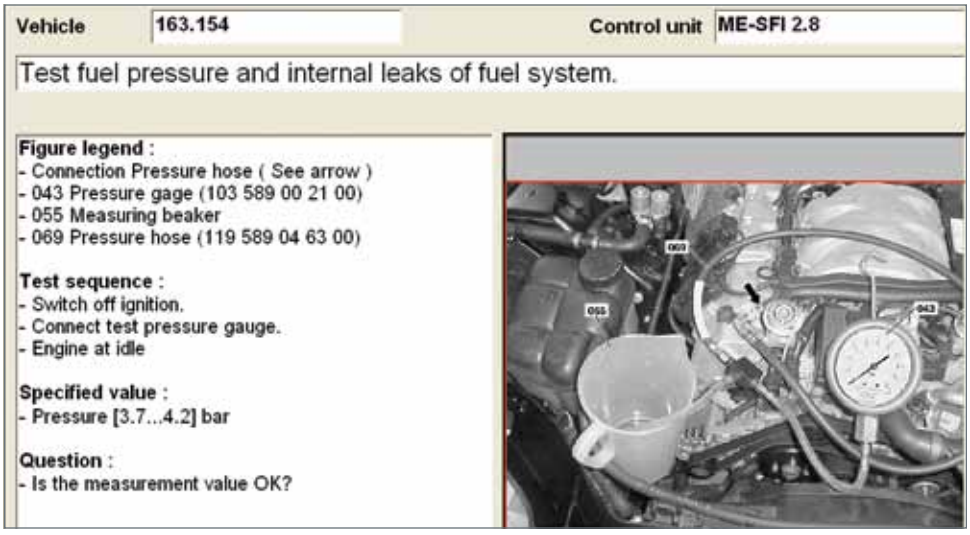



*Figure 5*

What does "Enrichment over permissible limit" mean exactly? Simply that the ME cannot increase the duration of the pulse width, hence the amount of fuel injected, any further. This is the most common fuel trim code in an M112/M113, enrichment over the limit either at idle speed or part throttle. So, we know the engine is running lean and the ME cannot add enough fuel to make it back to the 14.7:1 ratio (Figure 3).

Why is the ME adding so much fuel? DAS leads you down a diagnostic path starting with Figure 4.

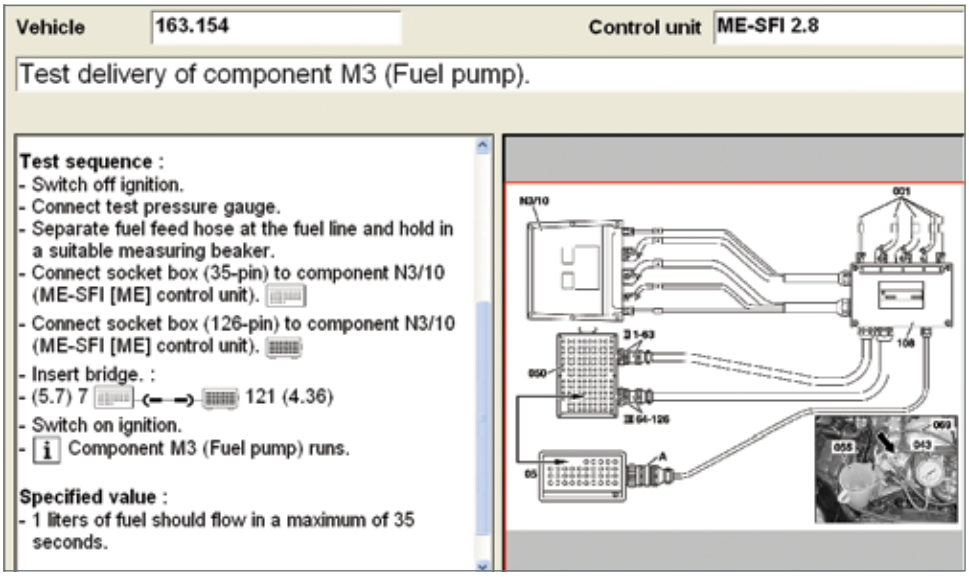



*Figure 6*

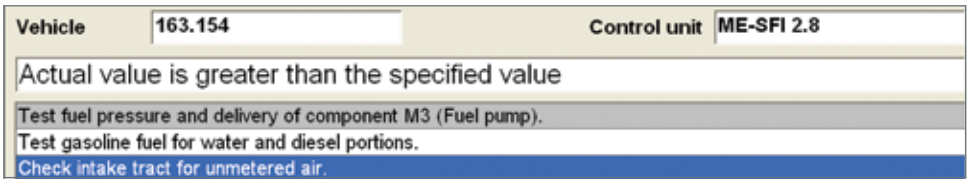



*Figure 7*

First, let's see if it's a fuel problem. Bear in mind that it's not enough just to check fuel pressure. Quantity matters as well. DAS first has you check for adequate fuel pressure and internal leaks (Figure 5).

## Bar and volume

Install a fuel pressure gauge and run the engine at idle. The pressure should be 3.7-4.2 Bar. Turn the engine off and leave gauge connected. After 30 minutes, the pressure in the rail should still be greater than 2.5 Bar. Anything lower than that might indicate a leaking injector (or, perhaps a leak upstream). In our case, the fuel pressure remained above 2.5 Bar, so we continued to follow the prescribed procedure (Figure 6).

Here DAS is having us check the amount of gasoline the fuel pump (M3) delivers. One liter should be delivered in less than 35 seconds. If not, check for restrictions in the fuel pump circuit such as a clogged filter or crimped line. We were getting more than a liter in 30 seconds, so we continued on the diagnostic path (Figure 7).

We knew there was no diesel or water in the fuel because we looked at the fuel sample taken on the previous test. At

*When the duct downstream of the Air Mass Sensor fails like this, it admits "false air."*

*Figure 8: Using your smoke machine is an easy way to find intake leaks.*

this point, DAS suspects unmetered air. In other words, air entering the intake tract downstream of the Air Mass Sensor, thus not measured by it, or accounted for by the ME. Two things are possible:

1. There is a leak in the duct between the Air Mass Sensor and the throttle body admitting "false air," or an ordinary vacuum leak in a hose or joint.

2. The Air Mass Sensor is not sending accurate signals to the ME.

How do you find out which? Smoke testing the intake and EVAP systems for any possible leaks is a good start. Once you are absolutely sure there are no intake leaks, then you can suspect the Air Mass sensor. How do you test it? DAS helps with that too. If there is no direct fault code for this crucial sensor, the easiest way to do this is to find the "List of possible tests" menu (Figure 9) inside the ME using DAS.

From there you can get to the screen where you can check the data from the Air Mass Sensor (Figure 10).

## Hot film

The important data here is the "HFM-SFI voltage." This is the signal back to ME that tells it just how much air is coming through the throttle body. An aside on how a Hot Film Air Mass Sensor works is appropriate here. Basically, a film element is heated to a given temperature inside the sensor housing. As air passes over this element, it has a cooling effect. The ME watches how much voltage is needed to maintain the calibrated temperature, and extrapolates from that and the intake air temperature

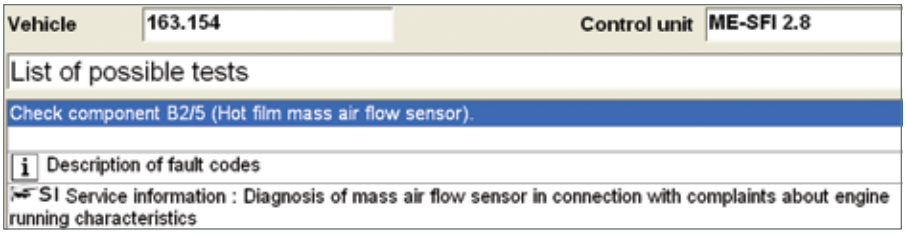



*Figure 9*

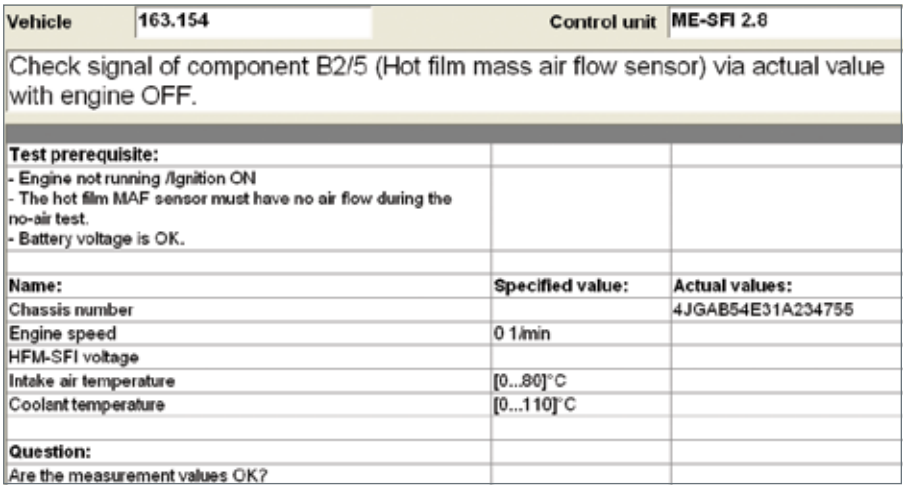



*Figure 10*

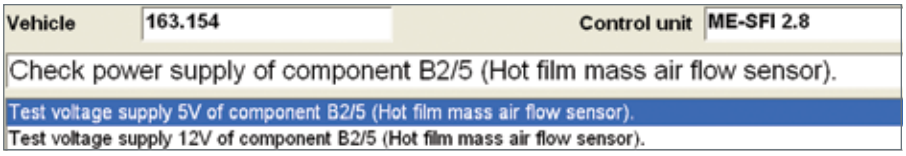



*Figure 11*

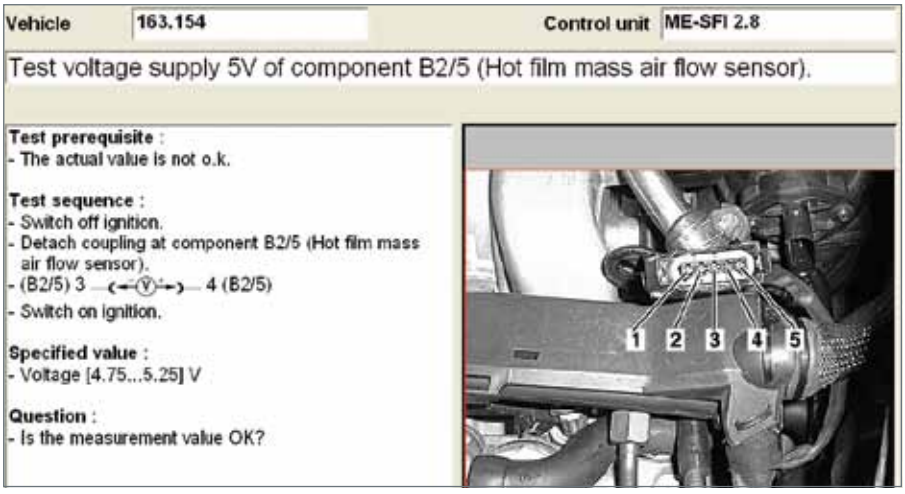



*Figure 12*

sensor signal the actual mass of the air entering the engine. This is a much more precise reading than could be obtained with an old-fashioned VAF (Vane Air Flow -- a flap rotating in the air flow and turning a variable resistor), which couldn't actually "weigh" the air.

If this voltage is off either in partial load or idle conditions, there will be a fault with self-adaptation. A problem with the Air Mass Sensor or its connections or wiring is probably the most common source of a fuel trim code in the M112/M113 engine, but how do we prove it? There are two voltages we must check first (Figure 11). DAS has us check the 5V reference and the 12V supply to the Air Mass Sensor (Figures 12 and 13).

If either of these voltages is off, there's a problem with the ME itself, or the wiring between the sensor and the ME. Chase this down. If both of these readings are good, either there's a bad contact in the connector to the sensor, or the sensor itself is faulty (you did positively rule out an air/vacuum leak, right?). A quick way to double-check this is to reset the adaptation data in the ME. First, clean the contacts in the Air Mass Sensor connector using the special electrical kit, or any good contact cleaner -- be careful because the contacts are tiny and delicate. Then, using DAS, access the ME's Adaptation Menu and select "Resetting of mixture adaptation" (Figure 14). Once you've reset the adaptation, everything goes back to the zero position (Figure 15).

Drive the car, or run it at idle. If the Air Mass Sensor is bad, you will almost immediately see the adaptation data creep back to the limit. If it does, you can feel confident about replacing the sensor (again, make sure you've ruled out air/vacuum leaks!). Protect the new one by making sure it stays clean -- install a new air filter element as well, and make sure there are no other contaminants getting into the intake tube.

While here we concentrated on a lean condition code, the same principles apply to a rich code, but instead of being paranoid about intake leaks, you would be trying to find where the extra fuel is coming from (bad/leaking injector?). Lean or rich, DAS gives you the information and the step-by-step procedures you need to find the fault. Happy hunting.

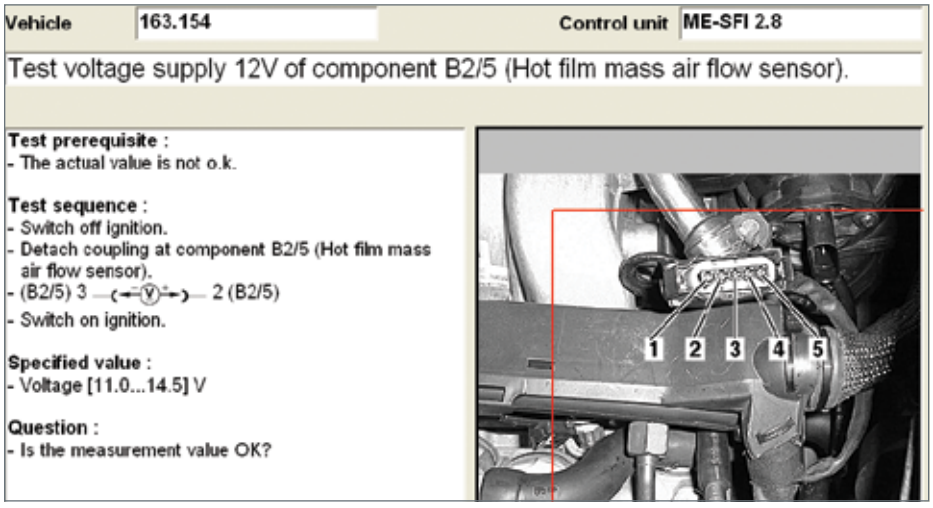



*Figure 13*

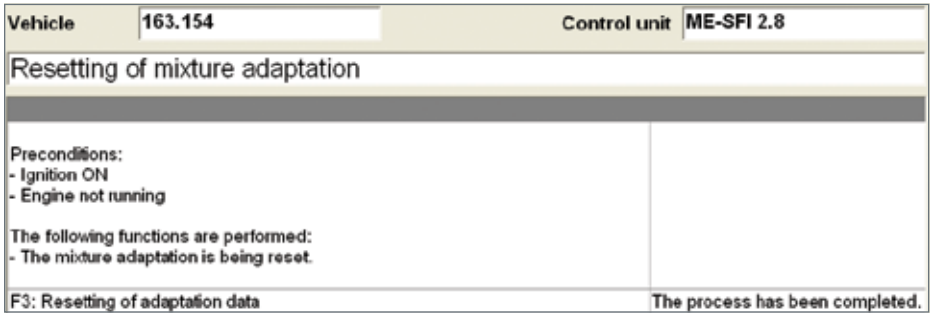



*Figure 14*

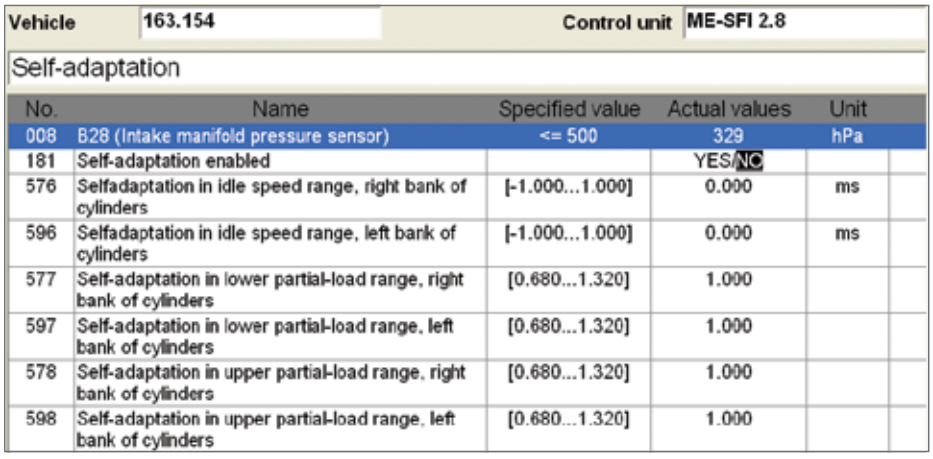
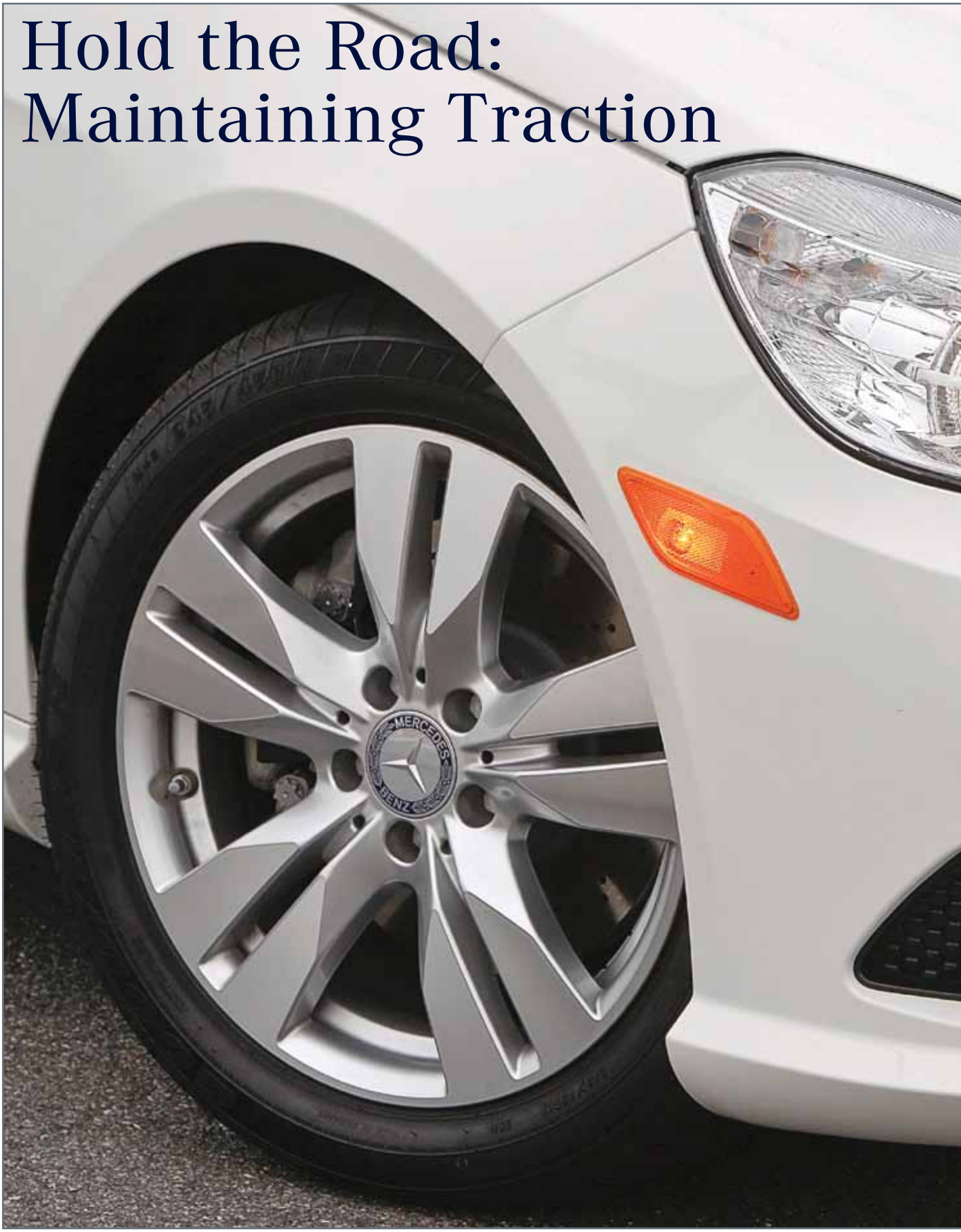



*Figure 15*

# Hold the Road: Maintaining Traction



*Traction Control isn't just a matter of using ABS to throw torque from one side to the other. It's an integrated system includingASR, BAS, ESP, and electronic throttle control, which all share data over a CAN. So,you've got to look at the big picture during diagnosis*

If you were to ask an engineer what the word "traction" means, you might get an answer like: "Traction is defined as a physical process in which a tangential force is transmitted across an interface between two bodies through dry friction or an intervening fluid film resulting in motion, stoppage or the transmission of power."[1] In layman's terms, this means the maximum amount of frictional force between two surfaces without slipping, in our case here the surfaces being the tires' tread and the road surface.

## 35 Years for ABS!

Over the years, Traction Control has evolved to include Throttle and Suspension Control. Traction Control's infancy was the Anti-Lock Brake System (ABS). ABS comprises wheel speed sensors and individual hydraulic solenoids that can apply, hold, and release pressure to each wheel individually. Believe it or not, the first vehicle to have ABS 2 (the original Mercedes-Benz version of ABS) was the 1978 S-Class. Systems more similar to what we have today didn't appear until 1985, but that's still 27 years ago.

Wheel speed sensors, by the way, have a function many people don't know about. Not only do wheel speed sensors provide information about wheel slippage, but they can also detect if the vehicle is riding on rough roads. Vibrations transmitted through the vehicle due to rough roads may have a negative impact on engine smoothness operation, which is why wheel speed signals from the traction control unit are sent via CAN to the ME, which uses this information and changes injection pulse to compensate for these irregularities to ultimately give uniform operation regardless of any driving condition.

## Not Just Dumb Limited-Slip

Automatic Slip Control (sometimes called ASR) was then installed on many vehicles. It goes far beyond the capabilities of an old-fashioned mechanical limited-slip differential by providing brake intervention at the rear driving wheels and combining it with engine torque control. This means that if one rear wheel is spinning,

### *ASR Intervention Sequence*

| | When 1 Wheel slips: | When 2 Wheels slip |
|---|---|---|
| Below 25mph | 1st: Brake applied<br>2nd: Torque reduced | 1st: Torque reduced<br>2nd: Brake applied |
| Above 25mph | 1st: Torque reduced<br>2nd: Brake applied | 1st: Torque reduced<br>2nd: Brake applied |
| In Turns, at 12mph to 75mph | 1st: Torque reduced<br>2nd: Brake applied<br>(With lower slip threshold) | 1st: Torque reduced<br>2nd: Brake applied |

*This ME Control Unit is located in the left front fuse box. When the fuse box lid is not securely fastened, it can allow water to get in. Pull the connectors and check for evidence of H2O.*

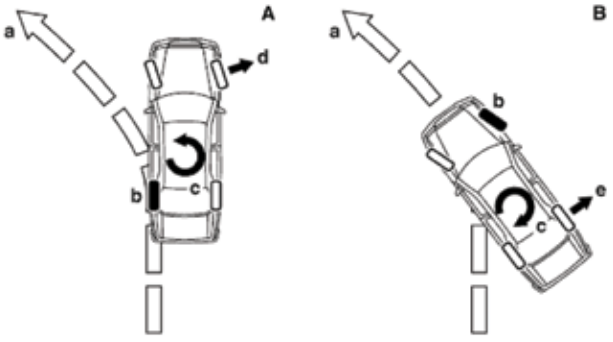
that wheel's brakes are applied, which sends the torque to the opposite wheel on the same axle through the differential (somewhat like an electronically-controlled version of the right and left brake pedals of a typical farm tractor, which can be manipulated by the driver to send power to one side or the other). If both wheels are spinning, a request is made via the engine Controller Area Network (CAN) bus to the Motor Electronics (ME) control unit to retard ignition timing and "relax" the throttle until traction is re-established. The only thing that was added to make this possible was programming in the ME Control Unit and a high-speed CAN line between the traction control unit and the ME.

Brake Assist System (BAS) was next on the scene. BAS provides maximum boost assist in an emergency situation by timing how quickly the brake pedal is applied. Thus, emergency stopping distances are shortened by initiating full braking faster than any driver can move his or her foot. This is achieved by the use of a BAS Membrane travel sensor (A7/7b1), BAS Release switch (A7/7s1), and BAS Solenoid valve (A7/7y1).

## Divine Intervention

The next ingenious evolutionary advance was the Electronic Stability Program (ESP). Working in concert with ABS, ASR, and BAS, ESP prevents over-steering and under-steering by applying the appropriate individual brakes to regain control of the vehicle. This is achieved by the ESP Control Module monitoring a lateral acceleration sensor, a yaw rate sensor, and a steering angle sensor, the signals from which allow the ESP Control Module to decide whether or not the vehicle is about to go into an uncontrolled skid. If its logic says it is, it applies whichever brakes are necessary to regain control and stabilize the vehicle. In essence, no matter how tight the turn you're making,

*Here is an example of an ESP Control Unit on a 2002 C-class. Aftermarket ignition components may not be as protected against causing high electromagnetic field (EMF) possibly damaging the ESP Control Units that are mounted on the hydraulic units.*




*This is how vehicle oversteering and understeering is corrected by the ESP Control Unit.*

or how fast you're going around a curve, or how far down you push the gas pedal, the vehicle will adjust the throttle and apply the brakes on its own to try to complete the handling maneuver safely. Of course, it can't change the laws of physics, but we've heard people who've experienced its beneficial effects describe it as "the hand of God." In other words, almost like divine intervention to prevent an accident.

## Who Needs Mechanical Linkage?

A necessary component of maintaining traction is the modern throttle control system. The Electronic Accelerator is basically a drive-by-wire technology where

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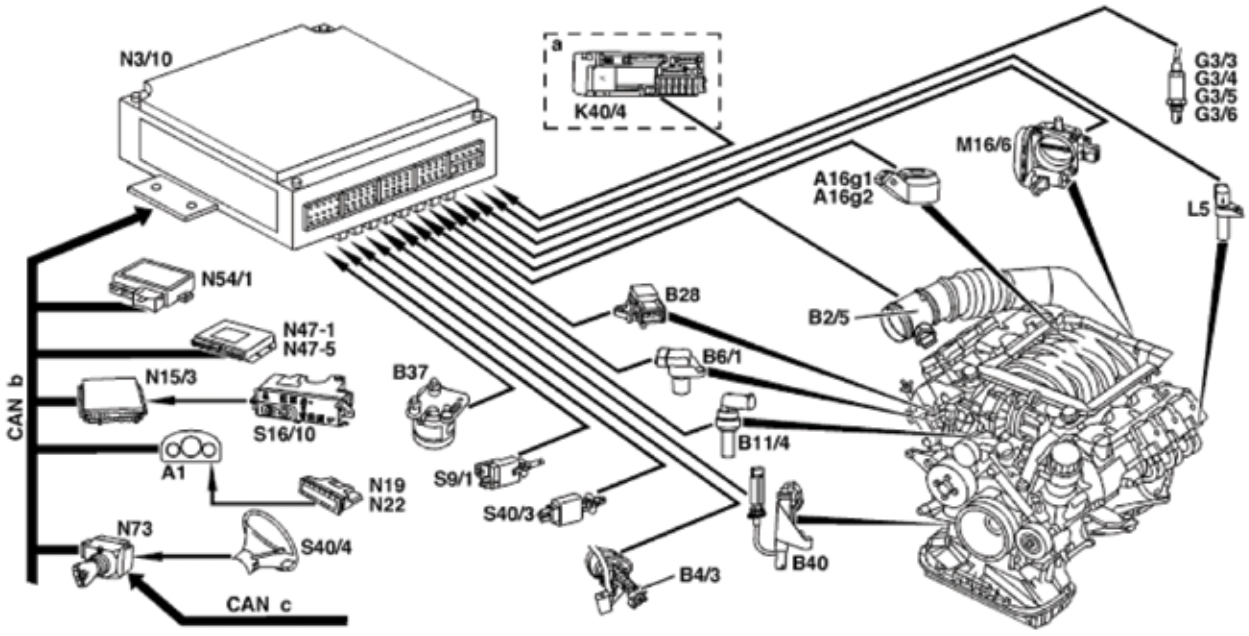
| | | | |
|---|---|---|---|
| GF07.61-P-0001-06A | Motor electronics (ME-SFI) fuel injection and ignition system control unit input signals | | GF |

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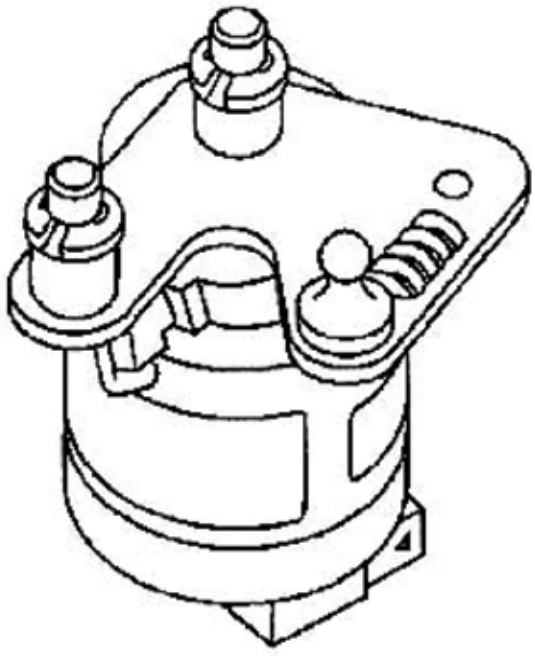
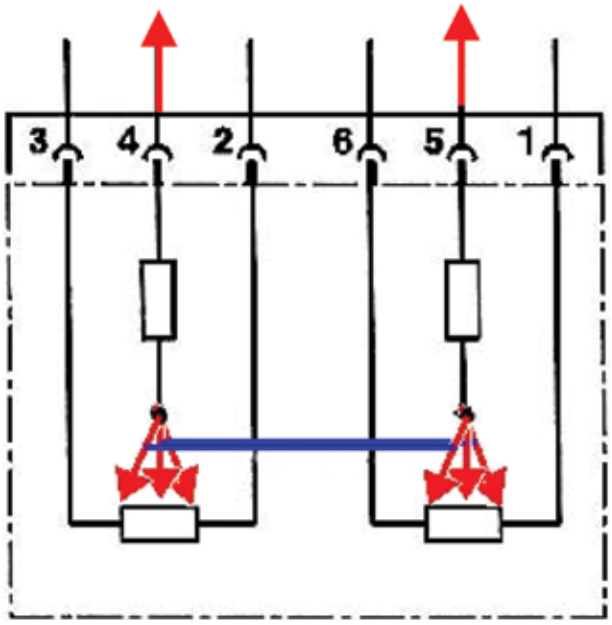
*All of these sensor inputs help the ME Control Unit maintain throttle control.*






*The redundant potentiometers of the Electronic Accelerator cross-check the accuracy of the measurements. If one contradicts the other, the ME will put the vehicle into "throttle limp" mode.*

the driver is not in direct mechanical control of the position of the throttle plate. Many people were horrified when they first heard of this concept -- "Will the car run amok if there's an electronic glitch?" It turns out that's not possible because there are redundant potentiometers in both the B37 sensor (Accelerator Position Sensor) and M16 (Throttle Actuator) to cross-check the accuracy of the measurements. If one of these measurements contradicts the other, the ME will put the vehicle into "throttle limp" (limited acceleration) to allow it to be driven, albeit at a low level of performance, to the nearest repair shop. The input from the B37 sensor is just that, an input, and does not open the throttle actuator. Ultimately, it is the programming in the ME that will receive the input and decide how far to open the throttle as long as there is no over-ride from the traction control module. Throttle Control, which is a part of the ME Control Unit, goes hand in hand with traction control due to the fact that if there is no "true" contact with the road, what is the point of sending more torque to the wheels? You're not going anywhere anyway. The ME reduces engine torque when it receives implausible or incorrect wheel speed signals that indicate wheel slippage to aid in regaining traction.

*If the Electronic Acclerator sensor has any corrosion issues, your testing may indicate that it is out of specifications.*

## Stiff or Stiffer?

The latest developments in suspension technology integrate traction control as well as throttle control. Systems like Active Body Control (ABC), which is an active hydraulic suspension, and Airmatic, which is an active air suspension both adjust the suspension to any driving condition to keep the vehicle level. This is achieved by receiving ride height and body acceleration inputs as well as wheel speed, wheel rotation, tire pressure, and brake torque signal inputs from the ESP Control Unit to make adjustments that produce harder or softer dampening to conform to any driving style or situation. These signals are transmitted from the traction and throttle control units via a high speed CAN bus at a data transfer rate of 500 kB/S (kilobytes per second).

## Info Sharing

Diagnosing integrated functions of traction, throttle, and suspension can be complex because the processed information is shared not only with the module that it is hard-wired to, but with all the other modules relying on that information also. That's why having a factory-compatible scan tool that has the ability to communicate with all the modules on the vehicle is so important. If you only can communicate with one or maybe two of the many different modules on the CAN bus, the faults in these modules may indicate to you that you may have a failure somewhere else. If you look at what malfunction lights are on as well as what driving characteristics are impaired, it may lead you in an entirely different direction.

The most common of these failures is the dreaded ABS light "Visit Workshop." Your scan tool shows a P1999 code in the ME Control Unit stating: "P1999 [8] 'Rough road detection signal" (arrived at by comparing wheel speeds). If you only have a scan tool that will communicate with the ME Control Unit, you would automatically think that one of the wheel speed sensors has failed. Without having the ability to look at the "Actual Values" in the Traction Control Unit to monitor the live status of the sensor, your next plan of attack would probably be comparing the resistance values of each sensor with an ohmmeter. If the ohmmeter reads approximately the same side-to-side, you may take another tack, switch your DMM (Digital Multi-Meter) to read AC voltage, and spin the tire. Again, if the readings are pretty much the same on both sides, now what? This proves that even if you apply experienced trouble-shooting logic, you can very quickly go down the wrong path and waste valuable time.

## The Genuine Article

That's why it's essential to get a factory scan tool that can communicate and access the faults in all modules to paint a better picture as to what is going

# The Advantages of Genuine Mercedes-Benz Reman


## Quality, Reliability and Value

Reman A/C Compressors are not rebuilt or refurbished, they are brought back to the exact Mercedes-Benz approved specifications and tolerances, thus ensuring optimal performance.

Additionally, these units come preassembled with the clutch attached, so a technician can get right to installing the entire assembly, saving time and money.

By using Genuine Mercedes-Benz Remanufactured Compressors, you could save 40% or more when compared to the cost of new. And like all of our remanufactured parts, it's covered by the Mercedes-Benz limited parts warranty.


Genuine Remanufactured installed.
Problem solved!

For more information, visit **www.mbwholesaleparts.com**.

# GENUINE MERCEDES-BENZ REMAN A/C COMPRESSORS

| MODEL YEAR | VEHICLE MODEL | REMAN PART NUMBER |
|---|---|---|
| 1984-1992 | 190D2.2 | A000230121180 |
| 1984-2002 | 260E, 190D2.5, 300TD, 300D, 300CE, SL500 | A000230241180 |
| 1986-1991 | 420SEL, 560SEC/SEL, 560SL | A000230251180 |
| 1986-1995 | 190/300 series, E300D | A000230111180 |
| 1986-2002 | 300E, 300CE, 600SL, SL600 | A000230051180 |
| 1990-2002 | 500SL, SL500 | A000230061180 |
| 1992-1993 | 500SEL | A119230111180 |
| 1992-1995 | 400SE, 400SEL, 500SEC, S420, S500 | A119230001180 |
| 1992-1999 | 600SEL, S320, S600, 300SEL | A000230171180 |
| 1992-1999 | 300SE, 600SEC, S600, S320, CL600 | A000230221180 |
| 1992-2004 | CL500, 300/400/500 series, S/SLK/C/CLK/ E-Class | A000230701180 |
| 1994-2000 | C220, C280, C36 AMG | A000230131180 |
| 1998-2005 | ML320, ML430, ML55 AMG | A000230681180 |
| 1998-2010 | ML500, ML350 | A001230281180 |
| 1998-2010 | ML350, ML500, E500, SL500, C/CL/S/G-Class | A000230901180 |

| MODEL YEAR | VEHICLE MODEL | REMAN PART NUMBER |
|---|---|---|
| 2000-2006 | CL600, CL65 AMG, S65 AMG, S600 | A001230011180 |
| 2000-2009 | E320, S350 | A000230911180 |
| 2002-2007 | C32 AMG | A000230781180 |
| 2002-2007 | C230 CL 1.8 | A000230971180 |
| 2002-2010 | CLK-Class, C55 AMG, SLK55 AMG | A001230191180 |
| 2003-2009 | CLK500 | A001230161180 |
| 2003-2010 | SL55 AMG | A001230021180 |
| 2003-2010 | E55 AMG, E320, E500, CLS500 | A001230121180 |
| 2003-2010 | E-Class, CLS55 AMG, CLS550 | A001230141180 |
| 2003-2010 | SL550 | A001230551180 |
| 2005-2010 | SLK280, SLK300, SLK350 | A001230541180 |
| 2006-2010 | R350, R500, ML350, ML500, ML550, GL450, GL550 | A001230871180 |
| 2006-2010 | R350, R500, ML350, ML500, ML550, GL450, GL550 | A002230521180 |
| 2009-2010 | C300, C350 | A001230501180 |
| 2010 | GLK350 | A002230311180 |
| 2010 | E350, E550 | A002230381180 |

*Made with the same OE components as original factory parts

*Assembled to original Mercedes-Benz specifications

*Results: Mercedes-Benz Quality, Reliability and Value

Remanufactured for Mercedes-Benz by

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on with the vehicle. If the suspension module, which also gets inputs from the ESP traction control unit, is displaying problems with communication from the ESP, you need to follow the evidence and start investigating what's happening. Can communication be established with the traction control unit? Are there powers/grounds missing to the control unit? If powers/grounds pass a load test, but no communication can be established, is the CAN bus corroded at the unit, or does the vehicle have coding errors?

You can always hook up a scope or graphing multimeter to the CAN bus and see if the pattern looks acceptable. Unfortunately, this won't tell you if there is missing information on the CAN bus. You could have a perfectly fine CAN bus, but only a scan tool will be able to read the information and tell you what is missing.

Another question to be asked is, does the vehicle know how to communicate with the ESP traction control unit? If the "coding" is not correct in the Central Gateway Module (CGW) or Electronic Ignition Switch (EIS) as to what kind of traction control is present, or what modification year it was produced in, the vehicle may not know how to identify or recognize the signal on the CAN bus, even though it is present. For the most part, control units need to be told exactly what kind of vehicle they are installed in. Not only for the sake of that particular unit, but for all the other units relying on the information that it gives. A factory scan tool will give you the ability to read and change coding in all modules that require coding.

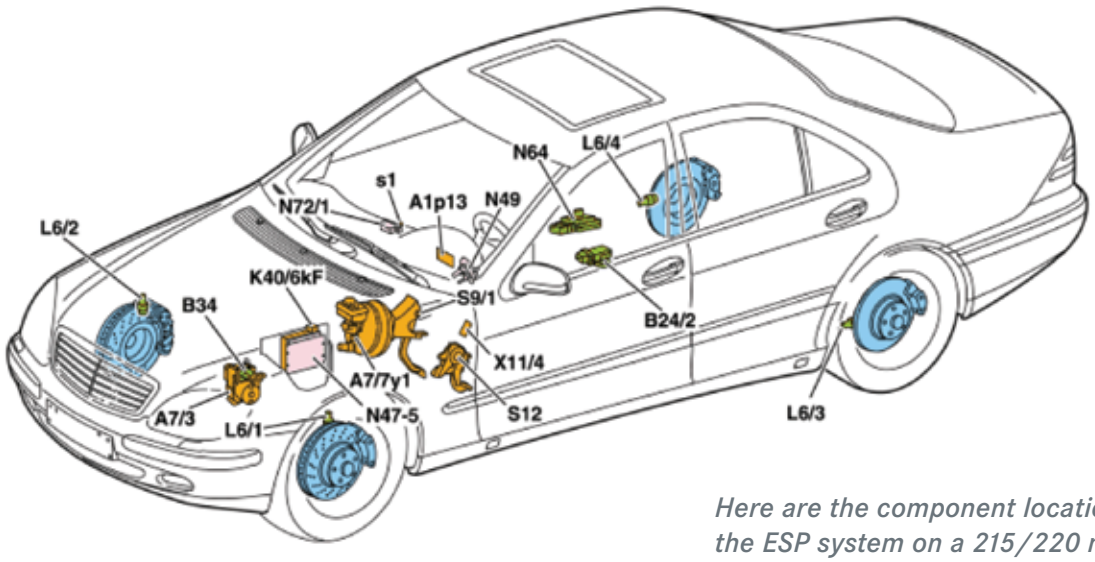
When all avenues have been looked at and no other explanation can be deduced other than a traction

| SA codes | |
|---|---|
| 055 | YEAR OF MODIFICATION 04/2 |
| 130A | LEATHER "TWIN" |
| 213 | PARAMETRIC-STEERING |
| 232 | GARAGE DOOR OPENER WITH 284 - 390 MHZ FREQUENCY |
| 242 | FRONT SEAT RH ELECTRIC ADJUSTABLE WITH MEMORY |
| 249 | INSIDE AND OUTSIDE MIRROR AUTOMATIC DIMMING |
| 264 | LICENSE PLATE ATTACHMENT AMERICA |
| 265 | LINES-NO.PLATE DISCONTINUED |
| 275 | MEMORY PACKAGE (DRIVER SEAT, STRG. COL., MIRROR) |

| SA codes | |
|---|---|
| 763 | FUNKFERNBEDIENUNG MIT PANIC-SCHALTER (315MHZ) |
| 805 | YEAR OF MODIFICATION |
| 819 | CD-WECHSLER |
| 875 | SCHEIBENWASCHANLAGE BEHEIZT |
| 910 | HIGH CAPACITY ALTERNATOR |
| 915 | FUEL TANK WITH LARGER CAPACITY |
| 919 | AIRCON COOLING POWER PACKAGE |
| 955 | AUSSTATTUNGSPAKET ELEGANCE |
| 986 | IDENTIFICATION NUMBER (VIN-NO.) |

*Version coding the modification year correctly is vital to how the vehicle communicates on the CAN bus. Always verify that the option codes listed on the vehicle data label match what the vehicle is coded to have.*

| | | | |
|---|---|---|---|
| GF42.45-P-0001-03F | Electronic stability program (ESP), location of electrical components | Models 215, 220 | GF |




*Here are the component locations for the ESP system on a 215/220 model.*

control module failure, it's time for replacement, which will again need to be programmed by a factory compatible scan tool. Not only coding, but performing a recalibration of the ESP sensors will need to be done.

As you can see, when dealing with the most sophisticated cars in the world complex situations are apt to arise. That's why it's so important to have the real Mercedes-Benz scan tool. Aftermarket units will take you part of the way, but they simply haven't got the dedicated capabilities you need for complete diagnosis of M-B vehicles.

It's reassuring to know that Mercedes-Benz has always focused on safety as the Number One priority when designing and building motor vehicles. In doing so, the company has continually set the bar higher and higher for industry standards.

[1]Mechanical Wear Fundamentals and Testing by Raymond George Bayer

## Mercedes-Benz Traction and Braking Advances

### ABS
### –Anti-lock Brake System

*ABS modulates the brake pressure to prevent the wheels from locking up during braking in order to maintain directional control. Introduced in MY1985.*

### 4MATIC
### –Automatic Four Wheel Drive

*4MATIC uses a transfer case to distribute power to all four wheels. The traction control system is used to determine wheel slip and the 4MATIC system hydraulically applies clutches in the differential and transfer case to direct the power to the wheels with traction. Introduced in the 124 series in MY1987.*

### ASD
### –Automatic Locking Differential

*ASD consists of hydraulic clutches on the differential that are applied to match the rear wheel speeds when the ABS sensors detect a spinning wheel. Introduced in MY1991.*

### ABS/ASR
### –Anti-lock brakes with Anti Slip Control

*ASR uses the traction system to apply pressure to the brake caliper of the spinning rear wheel during acceleration. If both rear wheels are spinning, engine torque is reduced. Introduced in MY1991.*

### ETS
### –Electronic Traction System

*Replaced the Automatic Locking Differential (ASD) option. Using the ABS components, brake pressure is applied to a spinning wheel during acceleration. Introduced in MY1995.*

### ESP
### –Electronic Stability Program

*ESP includes ABS, ETS and ASR functions, plus it detects directional instability (oversteer and understeer) in the vehicle and uses the brake and throttle control to help keep the car going in the "right" direction. Introduced in MY1996.*

### 4ETS
### –Four Wheel Electronic Traction System

*A four-wheel-drive system that uses the ABS/ESP components to apply brake pressure to any spinning wheel (or wheels, maximum of three) during acceleration. Integrated with 4MATIC, it falls under that name on today's passenger cars. Introduced in MY1998.*

### BAS
### –Brake Assist System

*BAS monitors brake pedal application speed, and if an emergency situation is calculated, maximum brake boost is provided. Introduced in MY1998.*

### SBC
### –Sensotronic Brake Control

*This "brake-by-wire" electro-hydraulic system includes ABS, Brake Assist and ESP functions. Electronics replace many conventional mechanical components, including the brake booster. Introduced in MY2003.*

# Mercedes-Benz Mobil1

| Product Name | Part Number | Quantity | Product Description | Recommended Consumer Applications |
|---|---|---|---|---|
| Mercedes-Benz SPEC. | | | | |
| Mobil 1 Formula M 5W-40 | BtQ 1 09 0144 | Bulk - No Equipment | Fully synthetic formulas designed specifically for gasoline passenger cars | Low SPAsh. Available at most MB dealers |
| | BQ 1 09 0162 | 6/1 Quart Cases | | |
| | BQ 1 09 0151 | 55 Gallon Drum | | |
| Mobil 1 0W-40 | BQ 1 09 0010 | Bulk - No Equipment | Fully synthetic formulation designed to meet the requirements of many European vehicles | Porsche A40. Many European vehicles. HT/TS applications. |
| | BQ 1 09 0015 | 6/1 Quart Cases | | |
| | BQ 1 09 0016 | 55 Gallon Drum | | |
| Mobil 1 ESP Formula M 5W-40 | BQ 1 09 0135 | Bulk - No Equipment | Advanced full synthetic formulas designed specifically for diesel passenger cars that have particulate filters | Low SPAsh. Available at most MB dealers |
| | BQ 1 09 0142 | 6/1 Quart Cases | | |
| | BQ 1 09 0143 | 55 Gallon Drum | | |
| Mobil 1 5W-50 | BQ 1 09 0133 | 16 Gallon Keg | Higher viscosity, advanced full synthetic formula designed for performance vehicles | Porsche A40. HT/HS applications. |
| | BQ 1 09 0134 | 6/1 Quart Cases | | |
| Mobil ATF 134 | BQ 1 09 0166 | 55 Gallon Drum | Extra high performance automatic transmission fluid formulated with selected HVI base oils | Recommended for use in Mercedes-Benz automatic gearboxes |
| Mobil 1 ESP Formula MB 5W-30 | BQ 1 09 0165 | 12x1 Liter Cases | Advanced full synthetic formulas designed specifically for passenger car diesels that have particulate filters | Low SPAsh. Available at most MB dealers. |
| AdBlue® 1/2 Gal. | A 000 583 0107 | 1/2 Gallon Bottle | Non-toxic solution that transforms harmful Nitrogen Oxide (NOx) emissions from diesel-powered vehicles into harmless water vapor and nitrogen | Recommended for use in Mercedes-Benz, Volkswagen + BMW AdBlue® (DEF) applications |
| Diesel Exhaust Fluid 55 Gal | BQ 1 47 0002 | 55 Gallon Drum | | |
| Mobil 1 5W-30 | BQ 1 09 0017 | 6/1 Quart Cases | Advanced full synthetic formulation designed to meet the requirements of many domestic, including GM, and imported vehicles | Vehicles that require 5W-30. Corvette approved. |
| | BQ 1 09 0018 | 55 Gallon Drum | | |
| Mobil 1 10W-30 | BQ 1 09 0019 | 6/1 Quart Cases | Advanced full synthetic formula designed for domestics and imports | Vehicles that require 5W-30 or 10W-30 |
| | BQ 1 09 0020 | 16 Gallon Keg | | |
| | BQ 1 09 0021 | 55 Gallon Drum | | |
| Mobil 1 5W-20 | BQ 1 09 0083 | 6/1 Quart Cases | Advanced full synthetic formulation designed to meet the requirements of many newer vehicles including Hondas, Fords, Chryslers, and newer Toyotas | Vehicles that require 5W-20 |
| | BQ 1 09 0084 | 55 Gallon Drum | | |
| Mobil 1 0W-20 AFE | BQ 1 09 0169 | 6/1 Quart Cases | Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance | Most vehicles that specify 0W-20 (newer Toyotas and Hondas), 5W-20 and certain hybrids |
| | BQ 1 09 0168 | 55 Gallon Drum | | |
| Mobil 1 0W-30 AFE | BQ 1 09 0174 | 6/1 Quart Cases | Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance | Most vehicles that specify 5W-30 or 10W-30 |
| Mobil 1 Synthetic ATF | BQ 1 09 0164 | 6/1 Quart Cases | Multi-vehicle, fully synthetic fluid designed to meet the demanding requirements of modern passenger vehicles | Vehicles that require Dexron III, Ford Mercon and Mercon V performance levels |
| | BQ 1 09 0163 | 55 Gallon Drum | | |
| Mobil 1 15W-50 | BQ 1 09 0023 | 55 Gallon Drum | Boosted, higher viscosity, advanced full synthetic formula designed for performance vehicles | HT/HS applications. Racing and Flat tappet applications |
| Mobil 1 Gear Oil (Mobil 1 Gear Lube 75W-90) | BQ 1 09 0085 | 12/1 Quart Cases | Exceeds the most severe service requirements in both conventional and limited slip applications | SUITABLE for use in modern high performance automobiles like SUV's, Vans and Light duty trucks requiring API GL-5 level performance |
| Mobil Special 5W-30 | BQ 1 09 002464 | Bulk - No Equipment | Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions | Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ |
| | BQ 1 09 0171 | 12/1 Quart Cases | | |
| | BQ 1 09 003064 | 55 Gallon Drum | | |

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

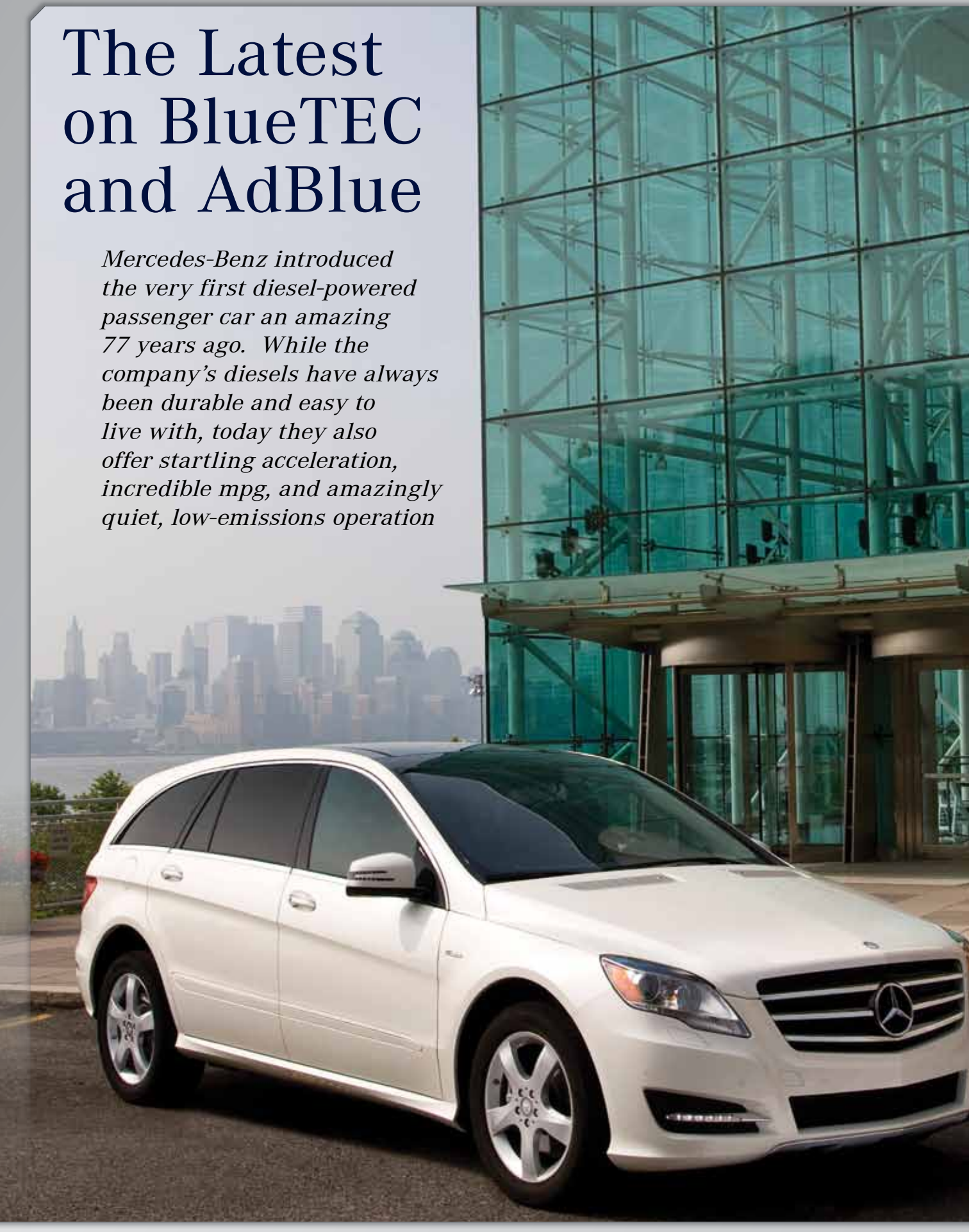
That's why Mercedes-Benz and Mobil 1 have partnered to offer an unbeatable combination of total engine performance and driving luxury.

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


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

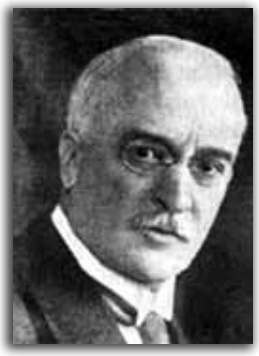
# The Latest on BlueTEC and AdBlue

*Mercedes-Benz introduced the very first diesel-powered passenger car an amazing 77 years ago. While the company's diesels have always been durable and easy to live with, today they also offer startling acceleration, incredible mpg, and amazingly quiet, low-emissions operation*



# BLUETEC

Almost 30 years ago, a Mercedes-Benz engineer asked a group of automotive technical journalists if General Motors had ruined the market for diesels in the United States with the debacle of the Oldsmobile 5.7L, which tended to come apart before it got to 50,000 miles. The answer was yes, with one notable exception: Mercedes-Benz. That company's diesels were relatively smooth and quiet, and some specimens covered a million miles of real estate without major engine work. True, they lacked the sprightly performance of their gasoline-burning counterparts, and gave off an aroma that made you think of a bus station, but their dependability, durability, and miserly fuel consumption garnered a cult following and fairly decent sales figures.



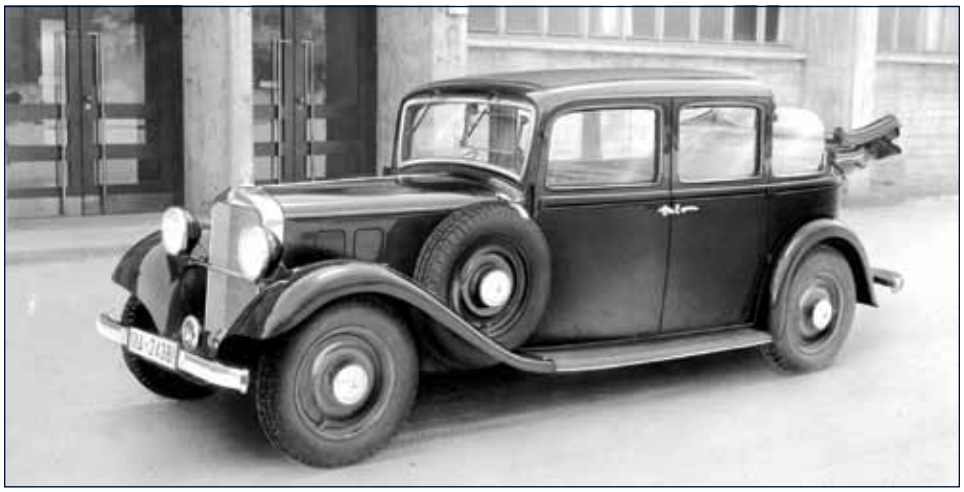
*Rudolf Christian Karl Diesel, 1858-1913*

## Technological Light Years

How far we've come. Today's Mercedes-Benz BlueTEC common-rail direct injection diesel engines provide incredible torque and acceleration (two characteristics especially desired by American drivers), superior fuel efficiency, and exhaust so clean it could hardly have been imagined just a few years ago -- no more watery eyes and offended noses.

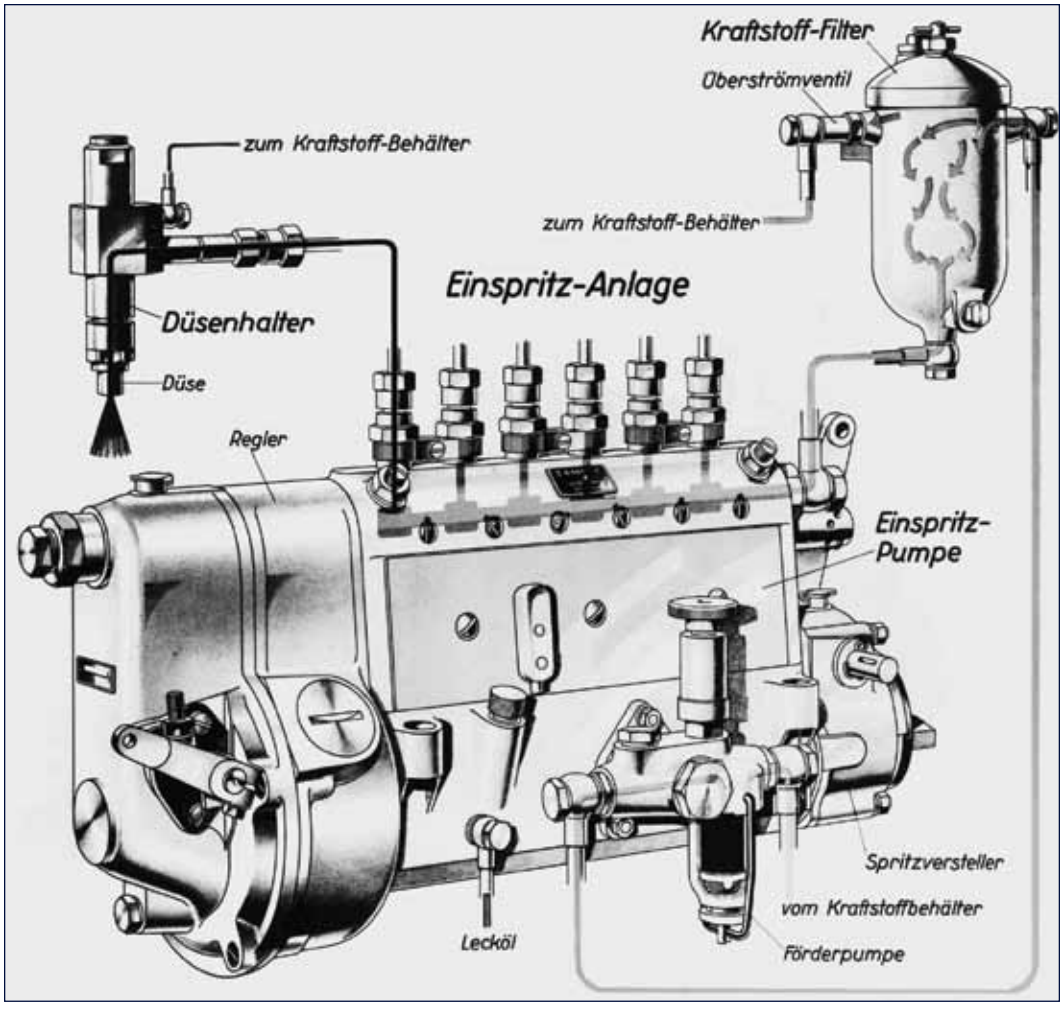
These salubrious developments are a result of collaboration between Mercedes-Benz and Robert Bosch AG, both companies with long, illustrious histories. The world's first diesel passenger car was the 1936 M-B 260D, and Bosch has been manufacturing diesel injection pumps since 1920.

The big news now on BlueTEC is the introduction of incredibly powerful, efficient, and clean four-cylinder engines. Already for sale in Europe, they'll be in the U.S. soon, albeit with slightly less horsepower (you'd never notice the difference) because of our country's stricter emissions regulations.



*Mercedes-Benz introduced the world's first passenger-car diesel in 1936, the 260D.*

*Robert Bosch collaborated with Mercedes-Benz in the development of BlueTEC technology. The company started manufacturing diesel injection pumps for commercial vehicles in 1920.*




## Torque Galore

The lineup of current non-U.S.A. models is nothing if not impressive. Take the GLK 250 BlueTEC 4MATIC for example. It has the most powerful four-cylinder diesel of any SUV worldwide. With its common-rail direct-injection, it's rated at 204 hp and, get this, 369 ft. lbs. of torque from a mere 2.14L (190 hp and 369 ft. lbs. in American trim). When this engine arrives here in appropriate models, all that torque should make its performance especially appealing to American drivers, who tend to like flexible power.

Equally important is its extreme frugality: up to 38.6 mpg (or, 6.1L per 100km if you prefer metric). CO2 emissions stand at 159-169 grams per kilometer, and it complies with U.S. BIN-5 emissions regulations.

The GLK 200 and GLK 220 CDI BlueEFFICIENCY models with six-speed manual transmission are even more fuel-efficient at almost 43 mpg, and emit only143 to 147 grams CO2/km.

If you should opt for the GLK 350 CDI 4MATIC BlueEFFICIENCY V6 model, you'll be rewarded with a truly-brutal 457 ft. lbs. and 240 hp of twist along with 34 mpg. Or, a 35 hp increase on 17% less diesel compared to the previous V6.

*U.S. GLK-Class SUVs will get three terrific BlueTEC diesels, with the first arriving in 2013. The powerful, yet miserly, fours are the biggest news.*

## Package Efficiency

The excellent fuel economy of all GLK diesel models is achieved through a comprehensive package of BlueEFFICIENCY measures, as well as state-of-the-art engine technology. In addition to the ECO start/stop function that's standard, these measures include the seven-speed 7G-TRONIC PLUS automatic transmission, low-friction axle drives, electric power steering, and tires with low rolling resistance.

To single out one of these, the 7G-TRONIC PLUS, which is standard on all 4MATIC models of the GLK-Class, boasts extremely low converter slip and optimized efficiency. A central role is played by the new torsion damper, which effectively eliminates torsional eccentricities and vibrations in the transmission. The lower the rpm and the lower the number of cylinders, the more severe these can be. This results in a conflict of aims between comfort and fuel-efficient operation. Mercedes-Benz developers resolved this by using what is known as a twin-turbine damper, which is also fitted with a centrifugal pendulum on the diesel models. Depending on the rpm, this moves the centre of mass and allows comfortable operation even in the most economical operating range. Furthermore, the optimized damping allows a marked reduction in the slip of the torque converter lockup clutch even under low loads, which also contributes to fuel savings. This technology also allows an even faster response to driver commands via the accelerator pedal. Friction-optimised bearings and new transmission oil thermal management help reduce fuel consumption, too.

## Less Squeeze & More EGR

As far as engine technology is concerned, these amazing enhancements to power, efficiency, and clean running have their foundation in numerous engineering features, not just BlueTEC per se. For example, NOx emissions have always been a problem with diesels because their super compression ratios result in the high peak combustion temperatures that produce oxides of nitrogen. So, M-B first reduced the "squeeze" ratio. A typical diesel might have a ratio of 20:1, or higher, but Mercedes-Benz found that with the BlueTEC's Garrett turbocharger, the engine is cleaner and more fuel efficient with a ratio of 16.5:1. The vanes of the VNT (Variable Nozzle Turbine) are controlled by the CDI module according to load, and the air-to-air intercooler can take up to 150 deg. F. out of the intake charge.

Other important anti-NOx strategies were to increase EGR flow rates to unusual levels -- up to 50%! -- and intercooling this inert gas to make it even more effective at keeping those peak temps down.

You may think that EGR and diesels can never work well together because there isn't enough intake manifold vacuum to draw in any appreciable volume of exhaust gas. Normally, that would be true, but Mercedes-Benz engineers came up with a logical solution: a throttle controlled by the CDI module to produce the required amount of vacuum whenever needed.

Of course, these engines rely on the most highly-evolved version of the Mercedes-Benz Common Rail Direct Injection (CDI) system, which can produce fuel pressures approaching 30,000 psi. The highly-engineered injectors are faster than ever before, and the latest versions can handle an astonishing number of injection events per combustion cycle. This ability spreads out the introduction of fuel into the cylinder even more than previous versions could, which reduces the violence of the combustion event, thus enhancing smoothness and practically eliminating diesel clatter.

## Aftermath

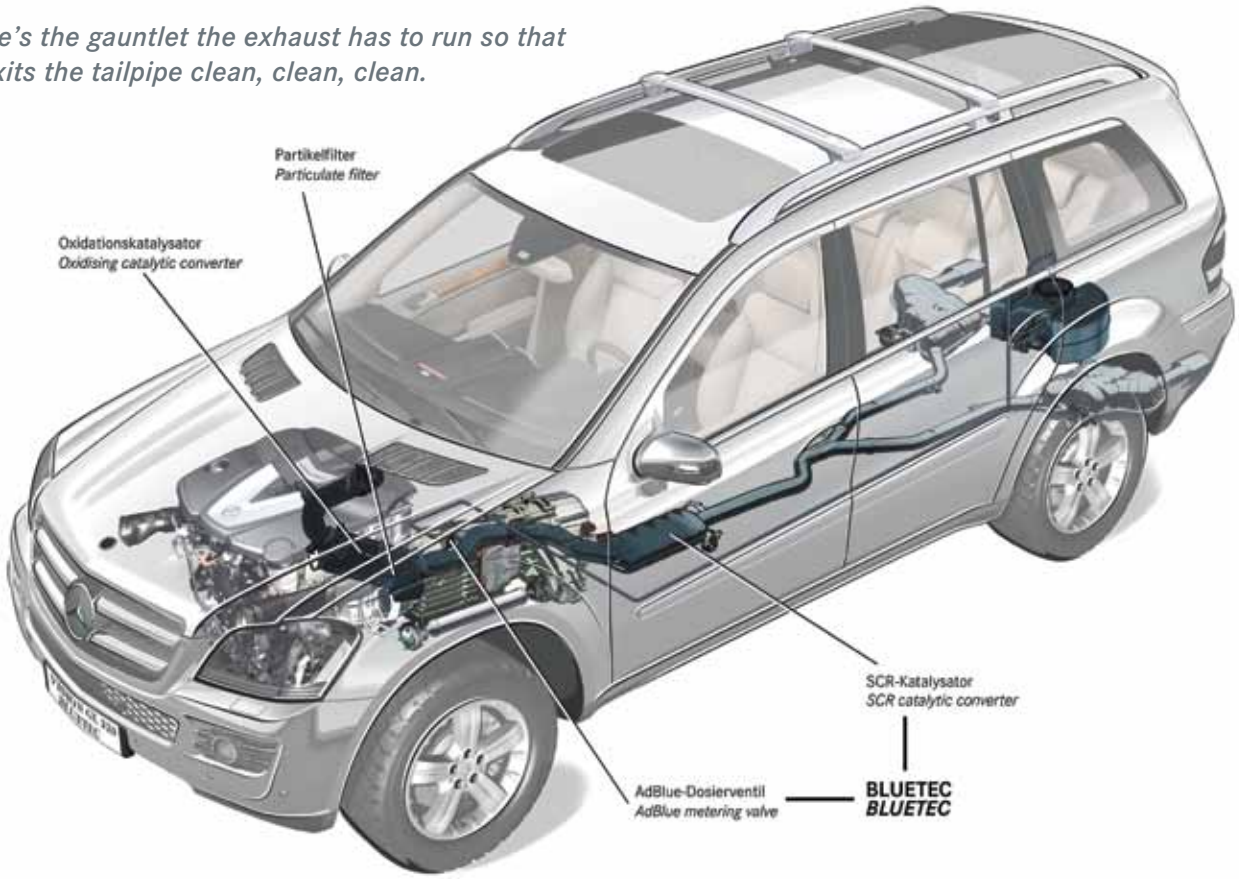
Some of the most interesting aspects of BlueTEC are downstream of the exhaust manifold. The mostly-spent gases pass through a Diesel Oxidation Catalyst (DOC), which burns up carbon monoxide and hydrocarbons -- the basic concept has been around for decades with gasoline-burning engines. Contained in the same "can" is the Diesel Particulate Filter (DPF), which is a different thing altogether. It actually collects the particles that the EPA has determined are harmful to human health. What happens when it fills up like your vacuum cleaner bag? No, you don't change it. The CDI module detects the rise in backpressure and goes into regeneration mode. That is, it raises the temperature of the exhaust enough to incinerate the soot so that it blows through as dry ash. It's sort of like a self-cleaning oven. So that you don't melt the asphalt in your driveway, regen is performed at cruising speeds.

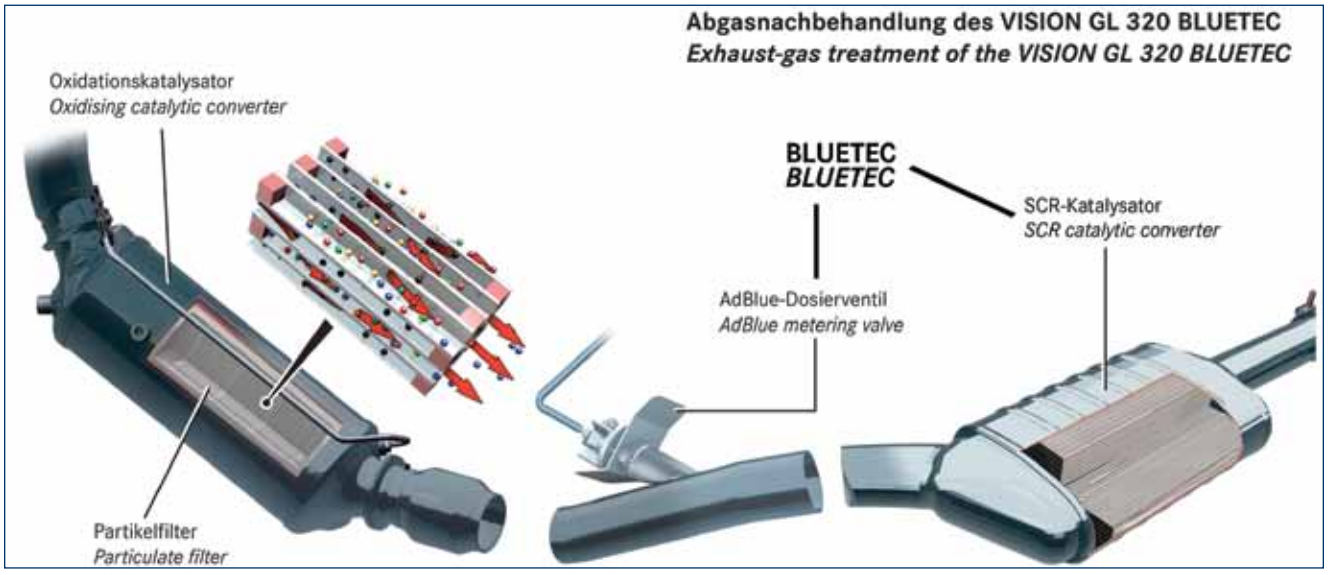
The NOx Absorber Catalyst (NAC) stores oxides of nitrogen during periods of lean operation. Then, under richer conditions (which the CDI module can create through altering injector "on" time), the NAC goes through a regeneration process, and also releases a small amount of ammonia into the exhaust stream. The ammonia is stored downstream in the Selective Catalytic Reduction (SCR) catalyst, which uses it to further reduce NOx. It's not enough, however, to meet all the latest standards, so AdBlue was introduced in 2008 to make up the difference. It is injected upstream of the SCR.

AdBlue is a registered trademark of the German Association of the Automotive Industry (Verbrand der Automobileindustrie, VdA) for its urea exhaust additive, or DEF (Diesel Exhaust Fluid), that's needed to get NOx emissions within mandated limits. NH3, more commonly known as ammonia, is created by the injection of liquid urea into the hot exhaust upstream of the SCR cat. It combines with NO and N0x to produce

H20 and N2 – harmless water and nitrogen (N2 makes up approximately 78% of the earth's atmosphere). AdBlue is carried in a heated tank, which should be replenished when the car is serviced. If this isn't done and the tank runs low, a warning light will flash on, and the engine will eventually fail to start.

*Here's the gauntlet the exhaust has to run so that it exits the tailpipe clean, clean, clean.*




*Here, note that the DOC and the DPF are contained in the same can, and where the AdBlue is injected.*

## Working on Them

Early BlueTECs are finding their way into your bays by now, so here are some service issues you should bear in mind:

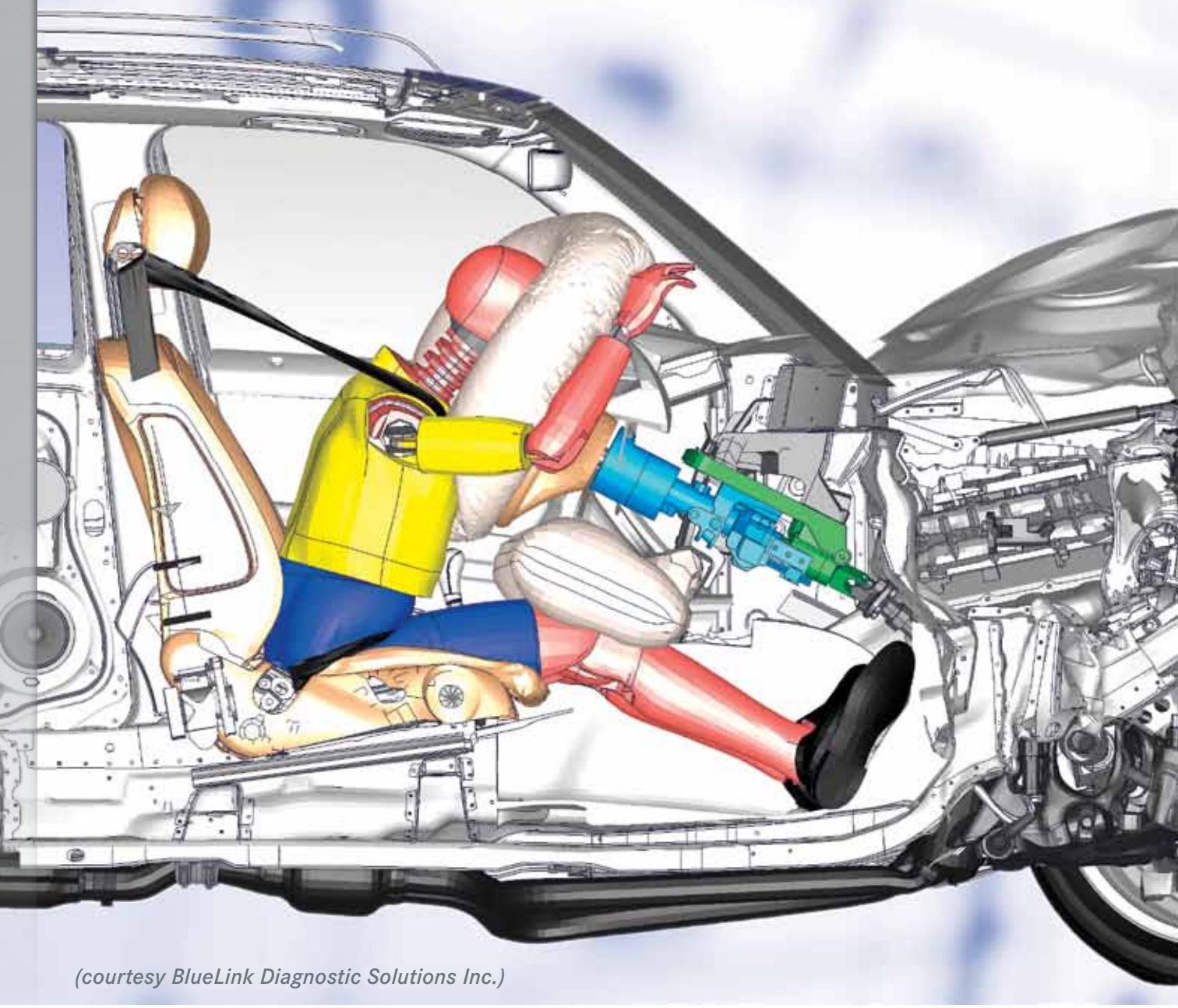
- This bundle of technologies requires Ultra-Low Sulfur Diesel (ULSD) fuel. While that became the standard in the U.S. six years ago, there is biodiesel to consider. B5 biodiesel is approved for these engines in levels up to 5%, but it must meet ASTM D6751 and have sufficient oxidation stability to prevent deposits or corrosion.


*Each gallon of Genuine Mercedes-Benz AdBlue fluid should last up to 2,500 miles (how's that for mpg?).*

- Recirculated exhaust gases create carbon deposits, and cooling them only makes this situation worse. So, you will probably be cleaning EGR passages and valves, and intake manifolds and throttles often. Your customers will thank you.
- Intercooling adds to the heat load the engine must dissipate, so keep that engine coolant and the cooling system in good shape using genuine Mercedes-Benz antifreeze and parts.
- Use only engine oil that meets or exceeds American Petroleum Institute (API) rating CJ-4 to help prevent ash from plugging the particulate trap.
- A sticking injector that admits extra fuel into a cylinder can result in damage during DPF regeneration as the unit may get dangerously hot. A leaky turbo shaft oil seal can do the same thing.

# Blueprinting for Success

*Sound planning is the key to efficient, complete and safe collision repair*



*(courtesy BlueLink Diagnostic Solutions Inc.)*

If you added up all the efficiencies the application of lean, up-to-date procedures and associated efficient products in a body shop operation promise, vehicles would be fixed seemingly before you even put in any effort. Unlike that fantasy, the reality is that there is no perfect process or repair facility.

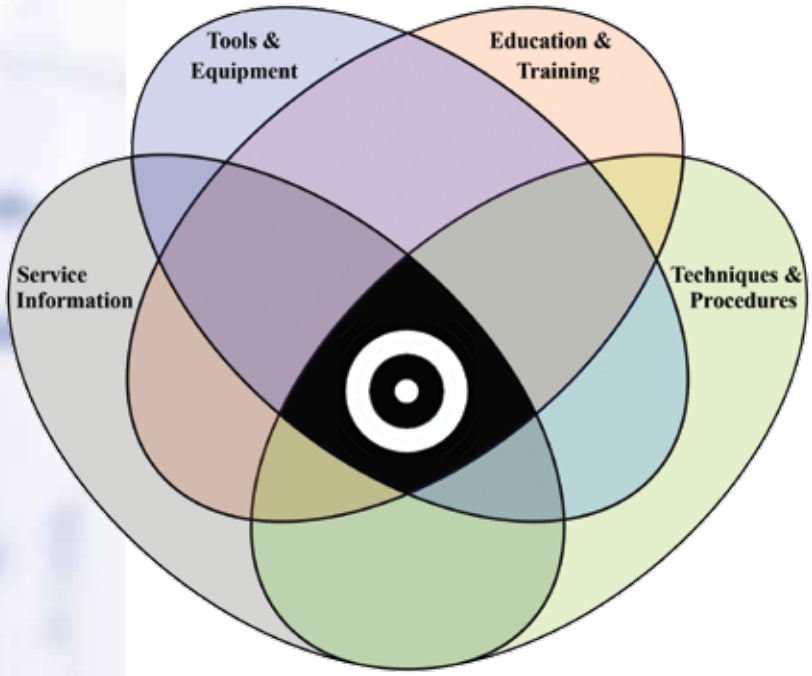
In these fast-changing times in the collision repair world, the technological curve is shifting ever forward and upward, led by automakers such as Mercedes-Benz (MBUSA). To survive and flourish, breaking from long-held collision repair paradigms and practices is no longer optional. Developing a good repair plan before ever starting the repair — a practice know as blueprinting — is essential to performing a safe, complete, and efficient repair.

## Design a complete and thorough repair plan methodology

In the past, estimates drove the collision repair process. That is no longer the case today; Increasing complexity is the new norm. Body shops must be aware of inbound change and develop the capability of handling innovative materials used in the mix to manufacture vehicles, as well as the associated repair procedures and emerging interactive electronic systems — such as integrated safety systems, electronic steering and suspensions, and body controls sensors — that are often located in impact crush zones. In addition to cognizance, access to the resources necessary for modern collision repair is required before ever touching a vehicle.

Ongoing change is reflected in ever-evolving service/repair information, developments in repair procedures, and requirements for new, often specialized tools and equipment — sometimes more than once for vehicles in any model year. Think of blueprinting collision repair as a systematic approach to continually identifying and removing the waste from the system, be it time, money, or other resources.

Whereas estimating focused on determining damage, blueprinting is more encompassing; it is about building a thorough and complete repair plan from the get-go, before technicians begin their work. Similar to building a house, a quality and mistake-free collision repair blueprint is essential. Preparing that blueprint requires the completion of a number of key steps before repair actually begins.




*Blueprinting is the process of bringing all the necessary resources together to build a complete collision repair plan that minimizes wasted time and resources that would otherwise result (ManicMedia LLC).*

These include:

- Understanding collision repair theory for older and newer M-B models — Whoever inspects the vehicle and prepares the collision repair blueprint must have an expert understanding of past, current, and incoming M-B vehicles. This professional must also be cognizant of the material mix and technologies within the vehicle, and be able to access service/repair information and other resources to perform a complete repair. Today, more than ever, experience matters. Have a skilled repair-planning technician enter relevant info directly into a repair plan, then make sure that someone verifies that this plan meets the requirements of your insurer.
- Performing a visual inspection for apparent and suspected hidden damage — New vehicles behave differently from their predecessors in a collision. A visual inspection might only show some tell-tale signs of damage. Using a knowledgeable, seasoned technician here can be critical to identifying suspect areas of hidden damage. Many of the new materials used in late-model M-B vehicle construction don't behave as materials of the past did. Even in a close visual inspection, damage can be missed. Traditional gap analysis (e.g. door to fender, door to hood, door to quarter) might only show some minor signs, but not reveal the full extent of the damage. For example, rear-end damage may result from a front-end collision that transferred much of the impact forces around the central cabin structure to the rear rails. In other cases, shifts of the advanced construction materials may not even be discernable to the eye.
- Measuring to identify and document damage, including hidden damage — You simply don't see damage the way you used to. Nor does damage from an impact in one area show up where it used to. Methodically disassemble the vehicle and measure along the way to arrive at a complete understanding of the damage before writing the estimate. Measure the vehicle front-to-back, side-to-side, top-to-bottom, even when damage appears limited to one side or end. Use M-B-approved equipment and tools that provide a range of electronic measuring options. Stay current with cost-effective innovations that can both help identify hidden damage and verify repairs. But like any new tool or piece of equipment, it isn't enough to purchase it. Ensure your supplier provides training in the tool's or equipment's use. Proper measurement not only makes the identification of damage possible, it also facilitates documentation and eases approval for recommended repairs from your customers, whether insurers or car owners.
- Referring to M-B service/repair information for vehicle data, as well as recommended repair and replace guidelines and procedures — The failure to consider MBUSA service/repair information before preparing a collision repair plan can doom the repair to failure downstream, or costly reworks. More on this later.
- Conducting a damage analysis to identify and describe all damage — Once the vehicle has been measured, prepare a thoroughly-documented damage analysis. This is more than a structural assessment. Insurance covers both structural and mechanical damage sustained in an accident that needs repairs. Blueprint for both structural and mechanical repairs. For instance, involve your paint specialist at this stage to be fully aware of whether certain fillers, paints, blending, or other procedures will be necessary. Other examples include a part that isn't there in time, a missing one-time fastener like a fender bolt or clip, or finding something on the tail-end of a repair that was not identified in the measuring process. Clearly, the lack of a complete damage analysis can interrupt your shop flow, increase vehicle "touch" time downstream and create unnecessary waste.
- Writing a repair plan that identifies all steps in the repair process — Eliminating potential bottlenecks once repairs begin should be paramount in writing up the repair plan for a vehicle. Know and document how the vehicle needs to be set up to properly pull where necessary. Have a full description for all the parts needed (e.g. specialized one-time clips or rivets required) to help eliminate omissions when ordering parts. If specialized welds or other procedures are required, document those as well. In essence, avoid ambiguity because it leads to omissions.
- Getting customer approval (be it the insurer or owner) — Ignorance or lack of foresight are not excuses an insurer or car owner will accept. Think of waste as anything that a customer is not prepared to pay for, be it an insurer or a car owner. Examples include time, materials, and more. Think of these as items that add cost, but not value to a repair. When seeking approval to proceed, "no surprises" should be your goal. For instance, documentation should note suspect areas and account for the possibility of supplements. Identifying the full extent of damage before getting

insurer approval, rather than piece-mealing post-estimate discoveries later, solidifies relationships with both insurers and car owners.

- Ordering structural and mechanical parts and supplies — Once the repair plan is approved, order the necessary parts and supplies. Ensure all the parts are present before you begin work on the vehicle, or know with certainty that if you start sooner with structural parts, required rebuild parts (such as taillights, radar sensors, and cameras) will arrive before being needed. In addition, use carts and keep the necessary replacement parts organized in a consistent manner so that repair technicians can focus on repairs rather than on searching for elusive pieces.
- Scheduling the vehicle for repair — It's all about creating a good repair flow. Good repair planning ensures that technicians do not have any gaps in their time working on a vehicle — no stoppages, delays, or reworks occur once a vehicle repair is started. Some shops only have one frame rack. If a shop has more than one, be sure to designate the right machine for the vehicle. In addition, a sound repair plan will ensure no delays occur once a vehicle is mounted on a rack. Likewise, blueprinting properly will ensure time and resources in a paint booth aren't wasted.
- Verify continued safety -- Mercedes-Benz spends a great deal of time and money crash testing recommended repairs. So, your blueprint should include verifying that your work fits all the criteria needed for the safety of the vehicle in possible future collisions.

To help the industry understand and implement blueprinting, I-CAR (the Inter-Industry Conference on Auto Collision Repair) has developed a brand-new Blueprinting Process and Damage Discovery course, which was debuted in October, 2012. "The course provides dealer and independent collisions professionals with an understanding of the definition of the blueprinting process and how it can help improve repair quality through a standardized approach to collision repair planning," said Jason Bartanen, technical training director for I-CAR.

Classroom time is limited, so that more interactive training is provided on a shop's floor — including a number of demonstrations, quick checks and blueprinting implementation tips — which leads participants beyond the disassembly of damaged parts to help them uncover hidden damage that can impact the repair process. "What makes this new blueprinting course relevant and authentic is I-CAR's ability to deliver the training at any collision facility," Bartenan continued.

"For example, we could deliver the course at a Mercedes-Benz dealer-owned collision repair or sponsored facility. Using StarTekInfo.com service information, as well as MBUSA-approved equipment, tools, supplies and other resources, the course will help train participants in blueprinting by providing the knowledge and a number of live demonstrations on actual Mercedes-Benz vehicles provided by the host facility."

## Employ the power of MBUSA service information

If you're not looking up OEM information and repair procedures for every vehicle when preparing a collision repair plan, you're probably already making mistakes. Given the ever-increasing complexity of modern vehicles, service/repair information changes often. This cannot be stressed enough. That's why you need repair information online, rather than a quarterly CD or software updates you have to seek out.

Whether your facility provides both collision and associated mechanical repairs, or it sublets mechanical repairs to a dealership or an independent shop, genuine and current MBUSA service/repair information is not only essential, it must be reviewed up front for all repairs associated with a collision and incorporated into the plan.

Everyone in your shop — from the shop manager to the estimator to the technician — should have easy access to and be able to utilize the MBUSA


*Models can change year-to-year, and even mid-year. Make access to genuine and current MBUSA service information a mandatory early step (www.startekinfo.com). It will help identify the types and location of various metals, whether there are reinforcing, but different, metals behind structures, and whether specialized adhesives or other new materials (e.g. carbon fiber) are present. In addition, specific repair procedures, lists of required parts, required welding procedures, and other information will help ensure a complete repair plan is used (courtesy MBUSA).*

service information website, notably WIS (Workshop Information System) where the real meat is available. From the beginning to the end of the repair process, including finished product quality assurance checks, each person involved in a vehicle's restoration to pre-collision status should be proficient in using WIS.

Some may question the need for everyone to employ service information, but consider just how much more efficient your team could be when, before they begin their tasks, they review a vehicle's structural composition and components, pertinent technical service bulletins and recalls, technical safety information, required tools and equipment, and other important repair information.

This strategy might cost a little implementation time, but as your team gains confidence using the service information system, the gains realized will be well worth the investment. Once proficient, a facility's staff should be able to:

- Minimize costly vehicle defects and returns.
- Prepare more accurate estimates with fewer supplements.
- Document and verify proof of repair for insurers and car owners.
- Increase employee safety.
- Decrease production time with the foreknowledge of required parts, materials, techniques, equipment and tools.
- Improve management of liability issues.
- Realize better customer satisfaction index scores (CSI) scores by providing on-time and complete repairs.

Granted, not every service information system is perfect. There are bound to be bona fide information gaps — times when a team member will be unable to locate the necessary data to complete work. However, when everyone on the repair team is using this critical tool proficiently, what appears to be a gap sometimes can be merely a few more clicks away, demonstrated by a co-worker or manager who has previously encountered a similar situation.

When authentic gaps are identified in M-B service information, it's imperative to contact MBUSA. Not only can your team obtain the necessary information, the gap will be corrected for future use by everyone. Another avenue that independent and dealer-owned collision shops can use to resolve information gaps is to file a "Service Information Request" with the National Automotive Service Task Force (NASTF) at www.nastf.org.

## Implementing blueprinting requires a determined, open-minded resolve

Having a plan is one thing; implementing it is another. Optimizing a vehicle's flow through a body shop's repair process requires planning to minimize, if not eliminate, bottlenecks. On a larger scale, consider whether your shop layout creates bottlenecks. Are their changes you can make that would facilitate a smooth flow of vehicles through the repair process? If so, make the ones you can afford to now, and work toward making others that improve shop flow over time.

Then look at specific areas of the work environment with an open eye to removing waste from shop processes and procedures. Are there ways to streamline and reduce waste? While not every inefficient or unpleasant task can be removed during a repair, unnecessary wastes of time and resources not only cut into the shop's profitability, but create a more stressful and frustrating work environment for everyone.

This evaluation should be a work-in-progress within the business, and it should include the entire staff. Unless everyone has a stake and a say in procedure and process changes, you have little chance of creating a sustainable environment of best practices. Here are seven areas that you and your employees should examine:

- Transportation — The moving of vehicles, tools, parts, and equipment within your work environment.
- Inventory — Parts and repair materials impact each person's time available to work each day. How can you improve the flow of parts, as well as an inventory of employee time, expected versus actual?
- Motion — Similar to transportation, but it's a closer examination of each person's need to move and the necessity of these movements.
- Waiting — Downtime and non-productive time periods for any reason affect cycle time. Consider how you can optimize getting work approvals, tool and equipment sharing, and parts deliveries, handling incorrect or incomplete orders, etc.

*Many collision facilities are not aware that when authentic service information gaps are identified, it is imperative to contact MBUSA. Not only can your team obtain the necessary information, the gap can be corrected for future use by everyone. Another avenue that independent and dealer-owned collision shops can use to resolve information gaps is to file a "Service Information Request" with the NASTF. To do so, copy www.nastf.org/i4a/pages/index.cfm?pageid=3290 into your Web browser (courtesy NASTF).*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- Over-processing – Avoid completing work ahead of schedule if it causes other projects on deadline to be sidelined.
- Over-production – Avoid completing work that is unauthorized, unsold, or unnecessary.
- Defects –Avoiding mistakes, miscommunications, substandard or incorrect work, and comebacks all fall into this category. Think about how this kind of waste can be reduced.
- Safety – A safe work environment is critical, but also consider losses caused by injuries that happen outside of the work day and injuries that occur over time as a result of the work (i.e., hearing loss, repetitive motion, exposure). For example, do technicians work at a comfortable level, or on the floor?

Blueprinting enables a collision facility to become a leaner, more efficient operation. Eliminating wastes within your work environment, as well as within the processes and procedures you employ, should be done uniformly and consistently by each team member. When you establish a common ground, resistance to change is more easily overcome by the entire staff.

One means of leveraging blueprinting to become a leaner work environment is to integrate principles known as the "5S's" into your repair planning. These five principles are:

- **Sort** – Reduce clutter and unnecessary items in work areas. Rank each tool and piece of equipment by how often it is used.
- **Set in order** – Determine critical resources needed for a job and evaluate an appropriate location for each.
- **Shine** – Work areas, tools, equipment, and other resources need to be maintained. Clean each item regularly, noting service, repair, or replacement of resources when necessary.
- **Standardize** – Look for easy ways to create consistency, and create standard operating procedures.
- **Sustain** – Ensure all team members get the chance to provide input to changes in the work environment, processes, and procedures. Create a culture that encourages innovation within the workplace.

*Copy www.youtube.com/watch?v=NtMdhlHEx28&feature=g-all-u into your computer's Web browser to see what shop owners, technicians, and other staff have to say about blueprinting. For more information, visit the I-CAR website: www.i-car.com (courtesy I-CAR).*

These may appear to be lofty goals, but if changes are developed with buy-in from the team and implemented incrementally over time, you have a better chance of sustaining these changes. It takes a great deal of hard work to overcome old habits. Remember to give your team the space and authority to incorporate change in a consistent manner across your entire operation, thus giving them the keys to attaining personal success.

One final note: You will encounter processes and procedures that can't be altered, for whatever reason. Remember to accept them with grace, and turn your attention and energy to the items that you have control over.

## One-Stop Shop For Auto Body Repair

European Auto Tech is located in the Dallas-Fort Worth metroplex. The organization has several mechanical repair facilities and a central MBUSA Certified Collision Center that is equipped with current MBUSA-approved repair technology, and employs technicians who have been trained by MBUSA and I-CAR.

"For owners of Mercedes-Benz vehicles, our auto body specialists can make collision mishaps a distant memory. We offer a lifetime warranty on all our auto body repairs. That means paint will be an identical match, body panels will be a perfect fit and the vehicle will be aligned the way it was before your accident. In addition, if a customer's vehicle needs mechanical repair as a result of an accident, our staff of MBUSA-certified technicians provides a complete range of electronic diagnostics and services necessary to discover and remedy any issues."

# the NET

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