STARTUNED®

Information for the Independent Mercedes-Benz Service Professional

March 2008 U.S. $6.00 € 12.50

BlueTec

ABS/ESP

Aluminum Panels

Volume 8 Number 1

TO OUR READERS

Welcome to *StarTuned*, the magazine for independent service technicians working on Mercedes-Benz vehicles.
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Mercedes-Benz wants to present the information you need to know to diagnose and repair Mercedes-Benz cars accurately, quickly and the first time; text, graphics, on-line and other technical sources combine to make this possible. Feature articles, derived from approved company sources, focus on being useful and interesting.
Our digest of technical information can help you solve unanticipated problems quickly and expertly.
Our list of Mercedes-Benz dealers can help you find Genuine Mercedes-Benz Parts.
We want *StarTuned* to be both helpful and informative, so please let us know just what kinds of features and other diagnostic services you'd like to see in it. We'll continue to bring you selected service bulletins from Mercedes-Benz and articles covering the different systems on these vehicles.
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IN THIS ISSUE

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Mercedes-Benz

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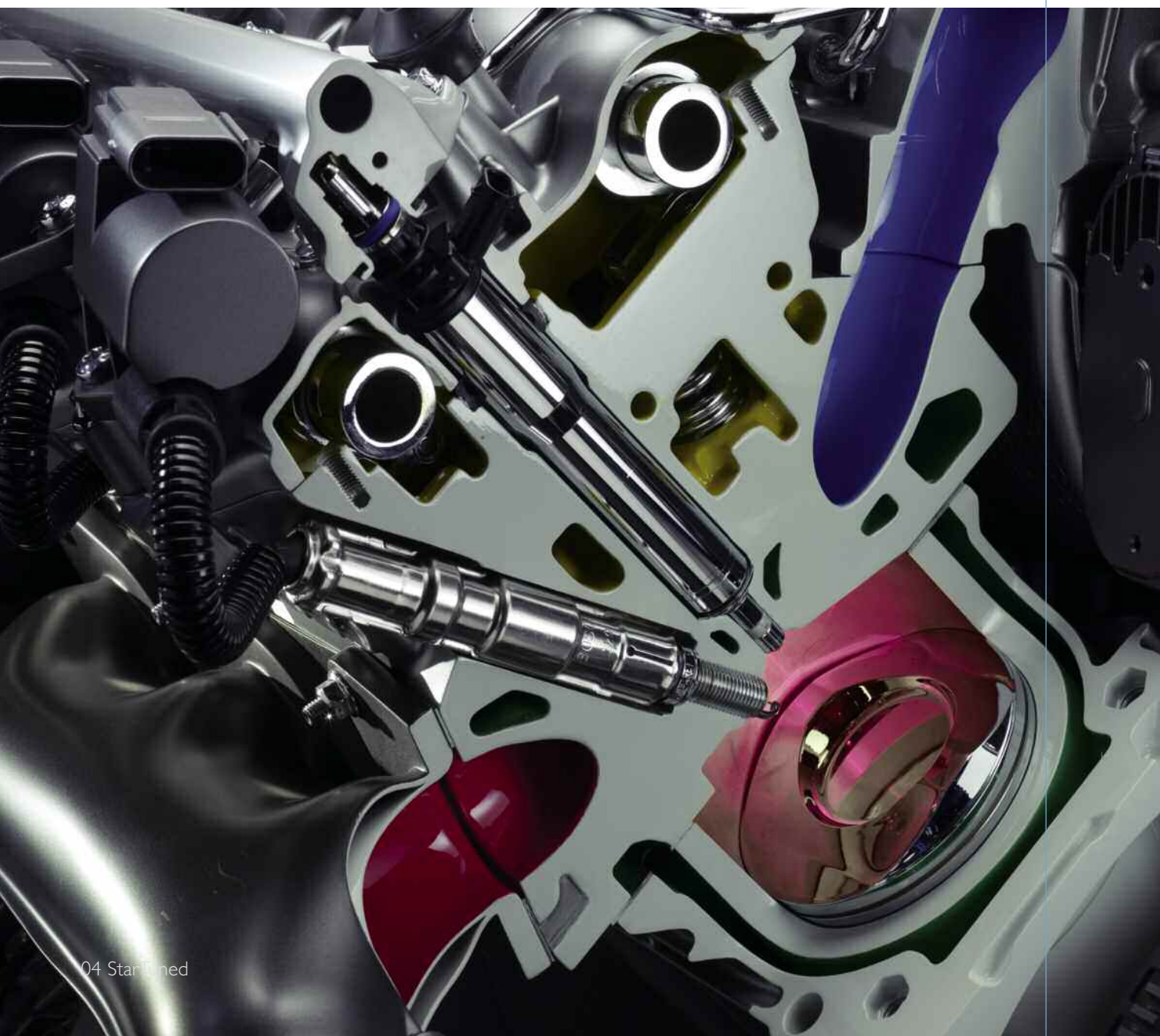
Mercedes-Benz BLUETEC



Diesel redux, thanks to intelligent engineering

Mercedes-Benz is leading automobile manufacturers in the re-introduction of diesel passenger vehicles to North America. First, the E320 CDI (W211) debuted in June, 2005 powered by the OM 648, an inline six-cylinder common-rail diesel equipped with a Diesel Oxidation Catalyst. In Model Year 2007, the OM 648 was replaced by the OM 642 V6, which first appeared in the E320 BLUETEC. This engine does not use the additive AdBlue®, but does use a Diesel Oxidation Catalyst, NOx Storage Catalyst, Diesel Particulate Filter (DPF) and a Selective Catalytic Reduction Catalyst (SCR). This is known as the Bin 8 diesel.

The OM 642 was also available in the GL, M- and R-Classes, but is not a BLUETEC as it is in the E-Class. This is a BIN 10 diesel. The vehicles were badged as 320 CDI, and have a DOC and DPF, but no SCR. They also require Ultra Low Sulfur fuel.

Cleaning up diesel emissions requires adopting a number of overlapping approaches. Extremely high levels of EGR combined with a reduced compression ratio curtails the production of N0x. A "regular" oxidizing catalyst combusts remaining hydrocarbons. A particulate filter traps soot. For Tier 2 Bin 5 vehicles, an SCR catalyst, combined with urea injection on the 2009 models, transforms oxides of nitrogen into elemental nitrogen and water. How does all this work, and what are the implications for the Independent Mercedes-Benz repair facility?

A new V-6 meets EPA Tier 2 Bin 5 "50-State" requirements.

The E320 went from an inline six to a V6 in 2007-2008.

Exhaust Gas Recirculation

Let's begin with EGR. Since EGR gases are oxygen poor, they're inert when it comes to combustion. Inert gas, by displacing the oxygen-rich air-fuel charge, keeps peak combustion temperatures down. This reduces the formation of NOx. Intercooling EGR gases makes them even more effective in controlling N0x production, especially when EGR flow rates of 30-50% are used.

As with gasoline engines, EGR gases tend to leave carbon deposits on everything they come into contact with. Cooling EGR aggravates the problem since it tends to precipitate out acidic compounds, which would otherwise remain in gaseous form. Mercedes-Benz's response is to use a corrosion-resistant stainless steel intercooler. Intercooling creates the additional issue of contributing to the total heat load a diesel engine must dissipate. Consequently, cleaning EGR passages, valves, and maintaining the optimum performance of cooling systems are likely to be important services for Independent Mercedes-Benz repair facilities.

The second issue associated with EGR and diesels is convincing EGR to flow into the intake manifold. There's little or no manifold vacuum to coax EGR gas out of the exhaust and into the intake. The solution Mercedes-Benz adopted is adding an ECM-controlled electric throttle in order to create manifold vacuum on demand. Intake manifolds exposed to high levels of EGR can be expected to foul, and cleaning may be occasionally required to keep these diesels at optimum performance – and prevent throttle valve actuators from sticking.

The new V6 is equipped with an EGR valve with a lift sensor, EGR intercooler, mass air flow sensor and throttle valve actuator. The cooled EGR gases are introduced after the throttle valve actuator. When EGR is active, the ECM knows the quantity of EGR entering the engine by the amount of lift measured by the sensor, and also knows how much fresh air is entering the engine from the mass air flow sensor. This helps in calculating the amount of fuel to be injected.

To determine DPF regeneration, the amount of backpressure before and after the DPF is measured by the differential pressure sensor. Regeneration can be spontaneous (if temperatures in the DPF reach burn-off), or triggered by the diesel ECM. Problems can arise if the vehicle is not driven for a sufficient amount of time to complete a successful regeneration. If this occurs several times, the DPF can be overloaded and the MIL will trigger. Using SDS, the technician can force regeneration to occur during a test drive.

Two variants of the BLUETEC technology were initially developed: the NAC+SCR system, which met Euro IV emissions standards and was good enough for 45 of the 50 US States (Tier 2 Bin 8), and the AdBlue® system, with urea injection (see sidebar). AdBlue® cars will be introduced in the 2009 model year and meet emissions requirements in all 50 states (Tier 2 Bin 5). Both

technologies demand the use of Ultra-Low Sulfur Diesel (ULSD) fuel, which became the standard at American pumps in 2005-2006.

In both systems, exhaust leaves the engine and passes through a Diesel Oxidation Catalyst (DOC), which "combusts" carbon monoxide and unburned hydrocarbons. Next is the NOx Absorber Catalyst, or NAC, which removes and traps oxides of nitrogen. During periods of lean operation, NOx is stored; under richer operating conditions (which can be created by manipulating the fuel injection) the NAC undergoes a regeneration process and releases a small amount of ammonia into the exhaust. The ammonia is stored downstream in the Selective Catalytic Reduction (SCR) catalyst, which uses it to further reduce NOx. Mercedes-Benz engineers had hoped to achieve 50-state emissions with NAC+SCR, however, barely missed. Hence, AdBlue®.

Oxidizing catalysts are nothing new, and should pose little or no service challenge for techs. Not so a diesel particulate filter (DPF). When sufficient particulate matter has accumulated in the DPF, and an increase in back pressure is detected, regeneration is called for. Regeneration involves boosting the temperature of the exhaust to the point where soot accumulated in the DPF gets incinerated into ash. Think of it as a self-cleaning oven.

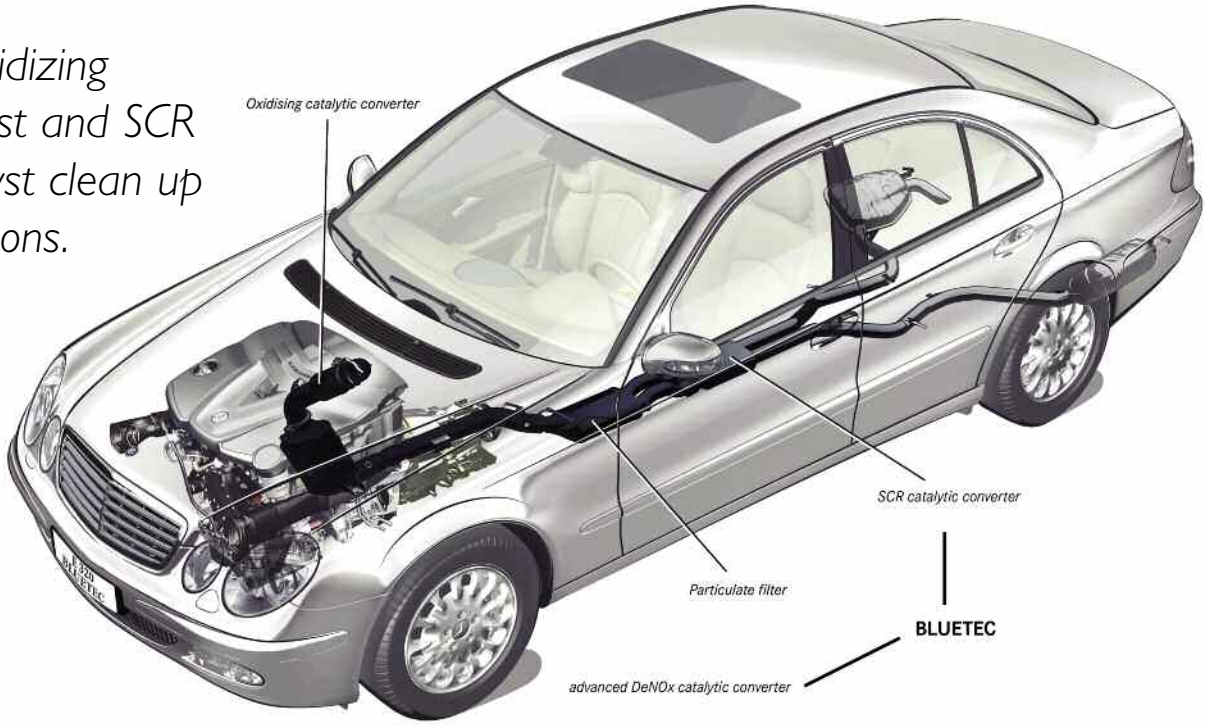
Exhaust temperatures are boosted by injection of additional fuel into the cylinders. The oxidizing catalyst will turn this overly-rich mixture into the extremely hot exhaust flow needed to regenerate the DPF. Ideally, regeneration should occur while driving at highway speeds so there is plenty of airflow around the DOC and DPF. That means little or no risk of igniting shrubbery or brush beneath the vehicle, nor of causing customer concerns. Regeneration should be totally transparent to the driver. However, a boosted idle speed or other alteration of engine "feel" may occur, causing driver concerns. Any sort of fuel or oil leak, such as a sticking injector or failed turbo seal could have extremely serious consequences at regeneration time. If a fuel injector is questionable, it should be replaced.

In order to detect backpressure across the DPF, measure temperatures, and inject urea into the SCR, pressure sensors and other items will have to be located directly in the exhaust stream, a necessarily hostile environment. Logically, these sensors should fail at about the same rate as oxygen sensors and DPF sensors on gasoline engines, and should trigger similar codes allowing ease of diagnosis.

Other BLUETEC issues independent repair shops may have to deal with include the use, or misuse, of biodiesel fuels. According to MBUSA, B5 biodiesel is approved for CDI diesel without

Intelligent glowplugs stabilize combustion.

An oxidizing catalyst and SCR Catalyst clean up emissions.



affecting the warranty. Biodiesel must adhere to ASTM D6751 and in addition have the necessary oxidation stability to prevent damage from deposits or corrosion. Whether or not all B5 biodiesel available at the pump meets these requirements is unclear, and this situation may confuse owners. A related requirement is the use of engine oil meeting American Petroleum Institute (API) rating CJ-4 to prevent ash from plugging the particulate trap.

Instant Start System

BLUETEC diesels incorporate an Instant Start System (ISS) with glow plugs that can reach operating temperatures in two seconds or less. At temperatures above five deg. F. no waiting is required before the engine can be cranked. The glow plugs are controlled by a module which may utilize them not only in starting situations, but whenever their use could stabilize combustion, such as in extended idling in extremely cold weather. For example, what's known as "post-glowing" will keep the glow plugs heated for a brief period after engine startup to achieve smoother operation and reduce emissions. A module, which communicates with the ECM, controls the current applied to each glow plug, and incorporates fail-safe features, such as short circuit detection.

The New V6

The 2007-2008 E320 BLUETEC boasts acceleration comparable to the gas-engined E350 six-cylinder a result of the diesel's whopping 388 lb. ft. of torque (as compared to 258 in the gas models). That figure is only three lb. ft. short of the E550 V8. It is a completely different engine from what's found in the 2006 E320 CDI, which sported an inline six.

The new 3.0-litre V6 diesel features four valves per cylinder. It is built on an aluminum block with cast-in steel cylinders, with an 83 mm bore and "undersquare" 92 mm stroke. A balance shaft located between the cylinder banks counter-rotates at the same speed as the crankshaft to smooth the V-6 out. Twin overhead camshafts in each cylinder bank operate the intake and exhaust valves, with the intake cams driven by a double chain that also drives the balance shaft. A gear on each intake cam, in turn, drives the exhaust cams.

Mercedes-Benz engineers found that throttling one of the two diesel intake ports on each cylinder at light loads added slight turbulence that helped optimize the combustion process and further reduce fuel consumption and exhaust emissions.

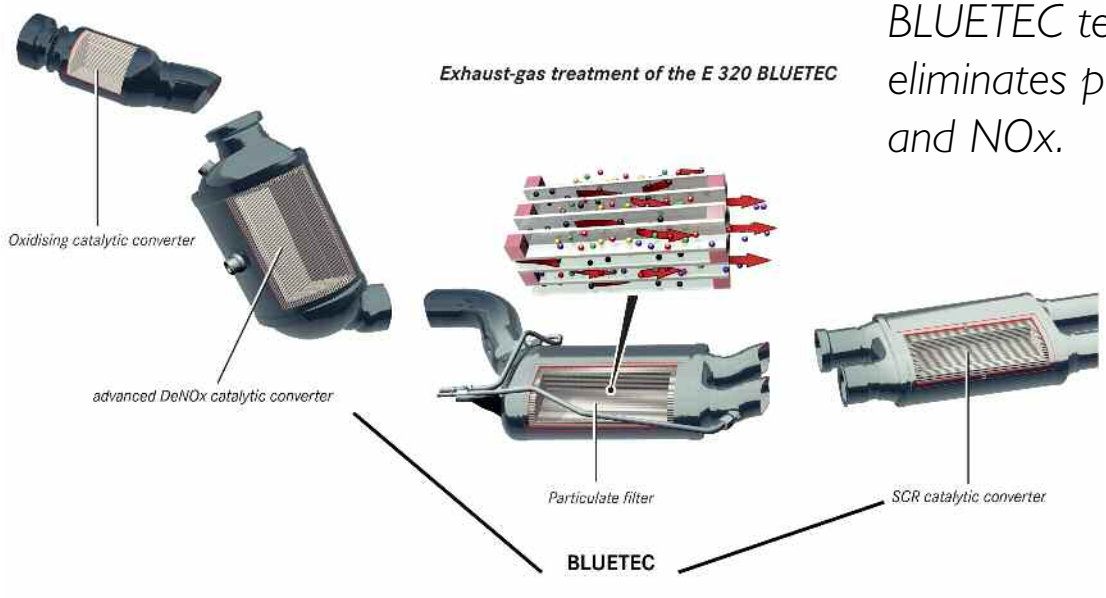
While many diesel engines have compression ratios higher than 20:1, Mercedes-Benz engineers found with the Garrett GT20V variable-geometry turbocharger, the engine is more efficient and produces less emissions utilizing a compression ratio of 16.5:1 (boost goes up to 29psi). The turbo uses a VNT (Variable Nozzle Turbine). The engine's electronics control the VNT's vanes to suit the load. The intake charge passes through an air-to-air intercooler lowering the air temperature by up to 150 deg. F. for increased charge density.

The E320 BLUETEC uses the latest version of the Mercedes-Benz Common Rail Direct Injection (CDI) system, which keeps the fuel pressure at up to 23,000 psi. The BLUETEC V6 is fitted with piezoelectric injectors that work significantly faster than magnetic solenoid-based injectors, allowing up to five injection events per combustion event. So called "Pilot Injection" events reduce the noise (clatter) associated with diesels by slowing the rapid increase in pressure and temperature associated with a single injection event.

Impressions

So much for emissions, what about performance? As numerous automotive writers have commented, "This ain't your daddy's diesel." The gut-wrenching torque the new diesels are able to provide at low rpm make them as much of a performance option as an economy option in the minds of many. Turbocharging makes the new diesel engine just as fuel efficient as the full size hybrids offered by other manufacturers, especially during highway travel. Who would ever have used "diesel" in the same sentence as "sport", or "luxury"? Tire-burning torque, great fuel mileage, lack of smoke – will owners even be able to tell this is a diesel?

The answer is yes. On a cold morning, there will still be enough clatter to tell that this is a diesel engine. Windows shut, drivers will seldom pause to think, "I'm driving a diesel." As with all turbocharged engines, there may still be slight lag between stabbing the pedal and the vehicle launching. But according to many who have driven these cars, the "diesel disadvantages" have been minimized to the point where they are inconsequential – and more than made up for by the tremendous fuel economy these full size vehicles can deliver, as much as 36 mpg, highway.



BLUETEC technology eliminates particulates and NOx.

BLUETEC was originally a consortium of Mercedes-Benz, Volkswagen, BMW and Daimler-Chrysler.

Perhaps one of the most compelling arguments for "going diesel" with Mercedes-Benz is that unlike domestic manufacturers who were required to re-tool and build completely new engines and emissions systems in order to meet 50-state requirements, Mercedes-Benz's BLUETEC technology, including AdBlue®, is already in use in tens of thousands of commercial trucks in Europe. As a result, American consumers are not being asked to be guinea pigs for testing new emissions technologies – as the owners of some domestic diesel trucks appear to have been.

AdBlue®: What is it?

AdBlue® is the brand name for the Mercedes-Benz flavor of urea injection. Ammonia (NH3) created by the injection of liquid urea into the hot exhaust stream combines with NO and NOx to produce H2O and N2 – harmless water and elemental nitrogen (N2 makes up approximately 78% of the earth's atmosphere). Urea injection allows manufacturers to "virtually eliminate" all NOx produced by internal combustion engines.

The AdBlue® system places the diesel oxidation catalyst and particulate filter in a single "can." Ammonia is supplied by injecting a concentrated urea solution also called AdBlue® upstream of the SCR catalyst. The addition of ammonia enables the SCR catalyst to reduce NOx emissions to a level even lower than the NAC-SCR system. AdBlue® is carried in a heated on-board tank, which should be replenished whenever the car is serviced.

A gallon of AdBlue® fluid should last approximately 2,500 miles. Should a sensor detect a low level, a dash warning light will be illuminated, and other consequences may be added to the program. The EPA doesn't want diesel owners failing to refill it. The AdBlue® tank utilizes a special coupler that mates with the refill bottle, thus preventing filling errors.

BLUETEC is a Brand

A consortium of Mercedes-Benz, BMW, Daimler-Chrysler, and Volkswagen initially collaborated to create emissions control technologies for diesel engines in order to meet ever-tightening particulate and NOx standards, both in Europe and in North America. "BLUETEC" was the result. Of the original consortium members, Mercedes-Benz is the only manufacturer putting the BLUETEC badge on its vehicles equipped with this technology.

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"Get AGrip"

The ASR warning light will illuminate when the system is commanded not to function, either through the "ASR Off" switch, or if there is a fault in the system. When the light comes on while driving, it does not mean there is a DTC in the system. It means there is a problem with traction at that time.

Electronic driver aids have clearly helped reduce traffic incidents over the past decade, but they don't do much good when they're not working properly. Keeping our customers' Mercedes-Benz vehicles functioning in the safest possible manner should be our goal. So, here's how ABS/ASR and ESP systems work and how to repair them.

Anti-Lock Brake systems (ABS) have been around for decades. In a panic stop, the driver, not being properly trained, applies the brakes as hard as possible. This causes the brakes to overpower the grip between the tire and the pavement. The wheels are now locked and steering inputs prove futile. The driver has lost control of the vehicle.

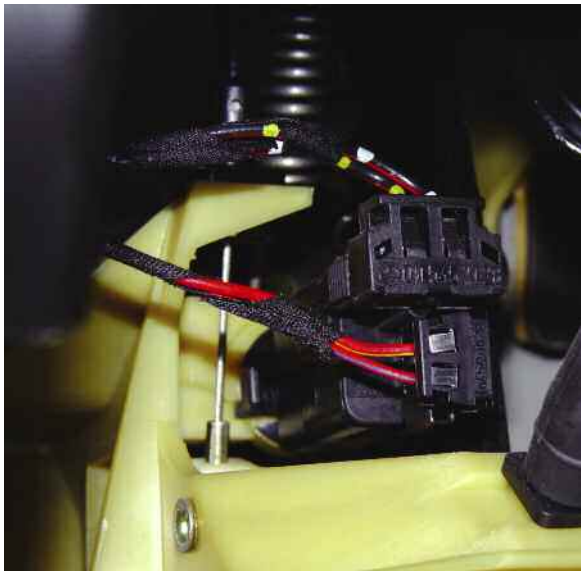
Using a computer's high-speed data processing capabilities, however, programming can reduce brake fluid pressure at individual wheels during a panic stop. This allows the tires to continue to rotate and retain grip. Since traction hasn't been lost, steering control is possible. The computer can reapply the brakes and continue the slowing-down process. This pattern occurs several times a second, gradually stopping the vehicle in a controlled manner.

As in the case of fuel injection, the computer can monitor sensor inputs, look at its pre-programmed set of responses, and manipulate output controls to further enhance the stopping ability of the vehicle. Since a computer can react to these changes quicker than any driver can, braking distances are reduced while steering control is maintained. Believe it or not, this simple explanation can be applied to even the most complicated integrated systems: inputs, logic, and outputs. Knowing how these function together will allow you to test them. This, coupled with an understanding of the computer's logic, lets you predict and test output controls.

The Power in Power Brakes

Before we get started on ABS/ASR/ESP, we should discuss BAS (Braking Assist System). This is the power in your power brakes. It is still vacuum assisted, but this simple system adds additional assist when needed. The brake booster is exposed to normal atmospheric pressure on both sides of a diaphragm with the engine off. When the engine is started, manifold vacuum is applied to both sides of the diaphragm. When the driver applies the brakes, atmospheric pressure is applied through a metered orifice to the brake pedal side of the diaphragm. This reduces vacuum to about 11 to 12 in. Hg. This differential in pressure forces the diaphragm to move in the direction of greater vacuum or lower pressure, which would be toward the master cylinder side of the booster. This is normal power assist.

Within a Mercedes-Benz booster with BAS there is a release switch and a solenoid valve. The switch indicates when the brake pedal is released. This switch input is sent to the BAS control unit (often mounted underneath the master cylinder). On later models with ASR or ESP, all of the control units are unified into one ESP/ASR/BAS control unit. Another input (either to BAS or ESP control systems) is the Membrane Travel Sensor. This monitors the position of the booster diaphragm. If it detects sudden movement of the membrane, it knows the brakes were applied suddenly. The solenoid valve (in the booster) is then opened allowing full atmospheric pressure into the brake pedal side of the brake booster. With full manifold vacuum on the master cylinder side of the diaphragm and full atmospheric pressure on the other side, the larger difference in pressure moves the diaphragm with greater force toward the master cylinder, thus increasing braking assist. On smaller engines such as in the SLK230, there is an additional vacuum pump to supply sufficient assist.



Here we have the dual output brake switch. One switch contact will be normally open (NO), and the other will be normally closed (NC). You can use the scan tool to watch this input, but a DMM will tell you if the switch contact is poor.

The ESP, ASR and BAS Lights Are All On!

Of course, the BAS system will not work if there is a failure with a component such as the release switch, the solenoid valve or the membrane travel sensor. Other outside influences such as the brake switch (not present on the very latest models) can set a code and turn on all of these warning lights. The brake switch on a Mercedes-Benz is a double-throw switch. It has one set of contacts that are normally open (NO) and another that is normally closed (NC). These switch contacts reverse position when the brakes are applied.

Scan data can be used to monitor these switch inputs. To test these switches directly you will probably have to look in multiple diagrams. One brake switch contact could be connected to various control units, such as the illumination module for brake light activation, and the other switch contact could be connected to the Electronic Traction Support module (ETS) on vehicles with four-wheel drive. They could also go directly to the ESP/ASR/BAS module, so make sure you know the system you are working on. One easy way to check which systems are in a particular vehicle is to simply look for the various warning lights coming on in the instrument

Since the control unit is so easy to get to, you can measure the resistance of the wheel speed sensors right from the connector. This not only checks the sensor resistance, but it also checks the wiring. This testing does not apply to Active Wheel Speed sensors.

cluster during the key-on bulb check. In later models, the brake switch input is normally sent to the ESP/ASR/BAS module and is communicated to other control units through the CAN.

The Essence of ABS, ASR, and ESP

Some of the most critical components in any of these systems are the wheel speed sensors. They often double as the vehicle speed sensor input and their signals are transferred to the other control units through the CAN. Wheel speed sensors live in a harsh environment. Mounted on the wheel spindle, they are exposed to high temperatures, moisture, road salt and debris, and brake dust. They are AC pulse generators, so when scoped they produce an AC sine wave. This AC sine wave indicates the speed of the wheel. If the frequency of the sine wave increases, then the wheel has picked up speed. If it decreases, then the wheel is being slowed down.

Some models such as the C- and CL-Class in 2001 and the S-Class in 2000 started using what is called an active wheel speed sensor. This has no reluctor or tone wheel, instead using magnets in the wheel seal (be gentle with them during service) to cause magnetic switching and generate a DC square wave. With any of these sensors at each wheel the ABS control unit can determine if any wheel(s) are slowing down faster than any of the other wheel(s) while under braking. This would indicate different wheel speeds, which means some of them are losing traction. The ABS control unit can then isolate the ones that are "locking up," and reduce and apply

A more accurate way to test a wheel speed sensor is to check how much AC voltage it generates while spinning the wheel. Here, 1V AC is being produced by spinning the wheel by hand. Once again, this does not apply to Active Wheel Speed sensors.

brake pressure as necessary to bring the vehicle to a controlled stop.

A second step in assisting the driver is through ASR. If the wheel speed sensors can determine if one or more wheels are slowing down too fast, then it stands to reason that a computer could determine if the wheel was accelerating faster than the others, otherwise known as wheel slip. In the event of this phenomenon, the ASR module can isolate the brake fluid circuit and apply brake pressure (stored in the system) to the wheel(s) that is/are slipping. This is roughly the same action as an ABS stop, but this time the brake is not depressed and the vehicle is accelerating. This is never more evident than when accelerating or decelerating in snow.

Mercedes-Benz has addressed this problem with Electronic Traction Support. This system can detect wheel slippage between the two driven wheels and apply the brake to provide even power distribution. In addition to brake application, the ASR unit can convey to the ME (Motor Electronics) to close the throttle. This is referred to as Engine Torque Reduction (ETR). The ME

This control unit is one of many on the powertrain CAN. This ASR control unit has traction control, but in this '97 S320 does not have ESP. Notice how easy it is to perform electrical testing at this unit. Under "Diagnostics," you're given the pin voltages to test for.

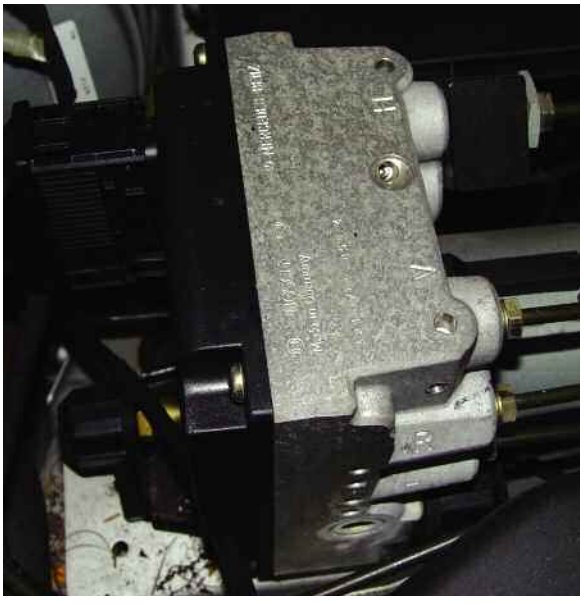
control unit can either retard timing, or close the throttle plate to reduce power output. In the case of deceleration, if the ASR control unit detects a difference in rear wheel speed compared to vehicle speed it can request the ME control to open the throttle to reduce engine braking. This is referred to as EBR, or Engine Braking Regulation. As you can see, with the integration of all these systems CAN communication is critical to keeping those warning lights off, so an advanced scan tool such as the Mercedes-Benz Compact III would be a tremendous advantage in this area of diagnosis. Keep in mind there is also an ASR "Off" switch. Switching the system off may help you isolate the cause of problem.

As mentioned earlier, monitoring wheel speed is critical to these systems functioning properly. You need to know how to test these sensors. One of the first steps you should take is to scan the computer for codes. Mercedes-Benz electronic control systems are capable of detecting many abnormalities even if they are minor enough not to warrant illuminating the warning lights. Another step in the diagnostic process is,

through our scan tool, monitoring the wheel speed sensors. Of course, during any test drive be mindful of safety, especially while evaluating scan data. It's best to have someone else drive while you monitor data; perhaps the customer could drive while he or she is explaining to you what he or she feels while driving the vehicle. The scan tool is also useful for checking various switch inputs such as the brake and release switches. If you get to a point where the scan tool has given you all the direction it can, you may have to electrically test each component.

As already mentioned, Mercedes-Benz vehicles will either have AC pulse generators for wheel speed sensors, or Active Wheel Speed sensors, which generate a DC square wave. Even though it's a square wave, the principle remains the same. The faster the wave, the faster the wheel is traveling and visa versa. With the AC wheel speed sensors you can start off with a resistance test to make sure you do not have a shorted sensor, but it is best to monitor AC voltage while spinning the wheel by hand. Each wheel should produce a similar AC voltage – between .5 and

One way to determine what variations are on the system you are working on is to look at the warning lights during a bulb check. You can see that this vehicle has BAS, ESP (which means it has ASR also) and ETS. If these lights stay on with the engine running, you definitely have a fault in the system.



Although you see a control unit-type plug, it is only for the hydraulic solenoid assembly. This component houses the brake fluid control solenoids. The unit that controls the hydraulic assembly is mounted elsewhere.

1.5V, depending on how fast you're spinning them. Sensors may have different resistances and AC voltage output, so it's best to compare one side of the vehicle to the other. In the case of the active wheel speed sensor, a graphing multi-meter or lab scope will illustrate the wave pattern. If this is not available to you, a DMM capable of DC V, Duty Cycle and Frequency will allow you to monitor the consistency of the signal. If you detect the DC voltage dropping out, the duty cycle changing significantly, or the frequency changing rapidly, you probably have a bad sensor. Keep in mind that these are three-wire sensors that have a five-volt reference and a ground as well as a signal line.

Things Are Getting Out Of Control!

To further enhance driver control, ESP was introduced to coordinate the multiple electronic control units. The BAS, ABS, ASR, and EBR make up the ESP system. These systems work together to assist the driver in maintaining control of the vehicle in low-traction conditions. There are a

(Continued on page 20)

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Compressor with Clutch Conversion

PART NUMBER	MODELS	YEAR
A 000 230 05 11 80	260E 300CE 300E/TE 300SE/ SEL 300SL 350SD 350SDL E320 SL320 SL600	1987-1989 1988-1993 1986-1993 1988-1991 1990-1993 1991 1990-1991 1994-1995 1994-1997 1996-1997
A 000 230 06 11 80	400E/ 500E 500SL E420 E500 SL500	1992-1993 1990-1993 1994-1995 1994 1994-1999
A 000 230 11 11 80	190D 190DT/ 300DT/ TDT 190E 260E 300CE 300D 300E 300SE 300SEL/ TE E300D	1986-1989 1987 1985-1993 1987-1989 1988-1989 1987-1993 1986-1992 1988-1992 1988-1991 1995
A 000 230 13 11 80	C220/ C280 C36 AMG	1994-1995 1995
A 000 230 17 11 80	300SD 300SE/ 600SEC 600SEL S320/ S350D S420 S600	1992-1993 1993 1992-1993 1994-1995 1997-1999 1994-1996
A 000 230 22 11 80	CL600 S320 S350D S600	1998-1999 1995-1999 1995 1996-1999
A 000 230 24 11 80	190D 190DT/ 300D/ DT/ TDT 190E 260E 300CE 300E 300SE 300SDL 300SEL/ TE	1986-1989 1987 1985-1993 1987-1989 1988-1989 1986-1992 1988-1992 1986-1987 1988-1991
A 000 230 25 11 80	420SEL/ 560SEC/ SEL 560SL	1986-1991 1986-1989
A 119 230 00 11 80	400SE 400SEL/ 500SEC 500SEL S420/ 500	1992 1993 1992-1993 1994-1995
A 000 230 70 11 80	C280/C43 AMG CLK320 CLK430 CLK55 AMG/ML320 E320 E430/E55 AMG ML430 ML55 AMG SLK230/SLK320	1998–2000 1998–2003 1999–2003 2001–2002 1998–2002 2000–2002 1999–2001 2000 2001–2004
A 001 230 02 11 80	CL500 CL55 AMG S430 S500 S55 AMG	2001–2003 2001–2002 2002–2003 2002–2003 2002–2003

INTRODUCING: NEW APPLICATIONS

PART NUMBER	MODELS	YEAR
A000 230 91 11 80	C240/C320/S430 S500/CL500/CLK320	2004
A001 230 12 11 80	E320/E500	2003-2006
	CLS500	2006+
A001 230 28 11 80	ML350/ML500/ML55AMG	2003+
	G500/G55 (NOT G55K)	2003+
A001 230 68 11 80	ML320/ML430	UP TO 2000
A000 230 90 11 80	S55AMG/CL55AMG	2003-2005
	C240/C320	UP TO 2003
	CLK320	2003
A000 230 78 11 80	C32AMG KOMPRESSOR	2002-2004
A000 230 97 11 80	C230K M271 (VIN RANGE SPECIFIC)	2004
A001 230 01 11 80	S600/CL600	2001+
	S65AMG/CL65AMG	2005+
A001 230 14 11 80	E55AMG	2004-2006
	CLS55AMG	2006
	E350/E550	2007
	CLS550	2007
	E320CDI	2005-2006
A001 230 19 11 80	CLK550	2007
	CLK55AMG	2003+
	SLK55AMG	2005+
	C55AMG	2005+
A001 230 55 11 80	C230K M271 (VIN RANGE SPECIFIC)	2004

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Mercedes-Benz

few more components added to ESP to monitor the vehicle dynamics. The first one we will discuss is the Steering Angle sensor. This is often mounted in the steering wheel switch housing. The ESP control unit uses this sensor to compare to the front wheel speeds to verify traction is being maintained. It is a photo-electric sensor that generates a square wave. The shutter wheel that blocks and unblocks the light beam is in a specific pattern, so it is not an even and consistent square wave that you might be familiar with from a camshaft position sensor, or something along those lines.

What is more important is if you replace the sensor or battery power goes dead, you will have to re-initialize the sensor. You can do this with the aid of a factory-specific scan tool, or by slowly rotating the steering wheel lock-to-lock with the weight of the car on the tires and the engine running. There is also a pressure switch mounted in the hydraulic unit. It is a three-wire sensor with a reference, signal and ground. The signal is an analog voltage. This sensor detects brake fluid pressure in the hydraulic unit. Pressure and return pumps in the hydraulic unit create pressure that the ASR system may need to apply to a caliper. Remember, this is for controlling wheel speed under acceleration, not braking.

Other sensors found in the ESP system would be just as at home in an aircraft as an automobile. They are the Lateral Acceleration Sensor and the Yaw Rate Sensor. The Lateral Acceleration Sensor measures the speed of the change in direction of the vehicle. It is a three-wire sensor and has a five-volt reference and a ground, as well as a signal wire. If this sensor needs to be replaced, it must be adapted with a factory specific scan tool. The Yaw Rate Sensor detects the speed of body roll. This is difficult to monitor and is also best diagnosed with a factory-specific scan tool. A problem here could cause the SRS warning lamp to illuminate. You can monitor this signal wire for an analog voltage signal while driving the vehicle through turns. All these inputs go to the ESP control unit, so scan data could make your life a lot easier.

Inputs,...Control Units,... What's Next?

As mentioned earlier, no matter how complicated the system, it's just a matter of monitoring computer inputs, knowledge of computer operation, and, finally, predicting and monitoring computer-controlled outputs. We discussed how critical CAN communication is, and checking for codes in all related systems will help direct you to the system at fault. For example, if there is a problem with the Electronic Accelerator, it will turn on the MIL and the ESP system will be disabled since it cannot shut the throttle when it needs to. It's always a good idea to check all the control units in the powertrain CAN for codes. When dealing with BAS/ASR/ESP, you need to know that the computer controls solenoids to redirect brake fluid pressure according to what is desired. Mercedes-Benz uses Hold, Release and Pressure Apply solenoids in the hydraulic unit.

When dealing with codes, you are usually looking at a wiring problem, or sticking/faulty solenoids that are all incorporated into the hydraulic unit. As well as using resistance checks to test, we can also activate solenoids (preferably through a scan tool) and monitor the current relative to the voltage change.

Overview

We hope you have learned what input sensors are involved in BAS/ASR/ESP. Checking for codes in all Engine CAN control units will give you a diagnostic direction. Monitoring these inputs in scan data can help you quickly determine what system you should be testing. After pulling up a wiring diagram, you can now directly check sensor inputs and monitor computer-controlled outputs that did not respond properly during scan tool testing. This all leads to the isolation and conclusion of a successful diagnosis, no matter how complicated the system. We can all consider this a job well done.

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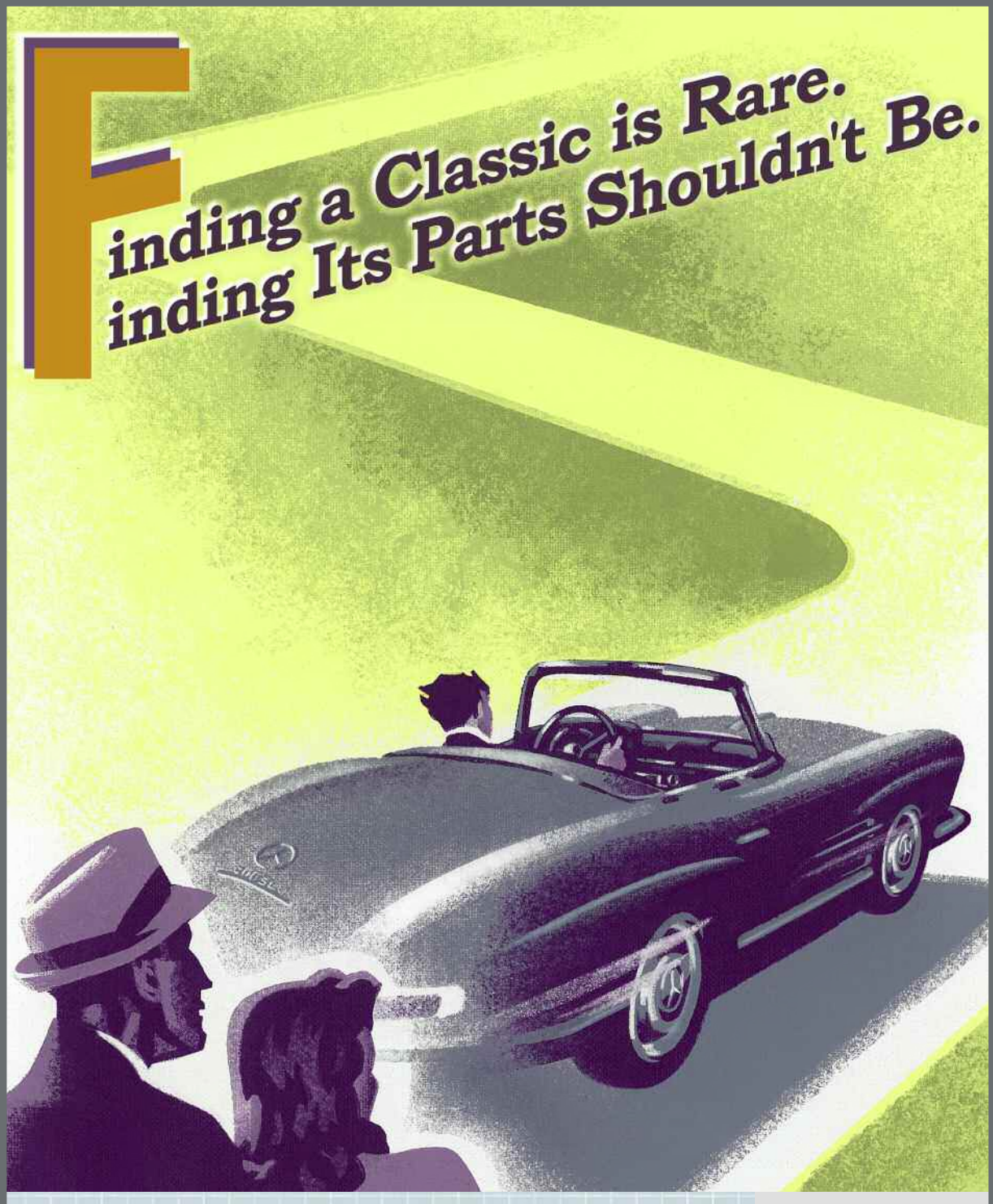

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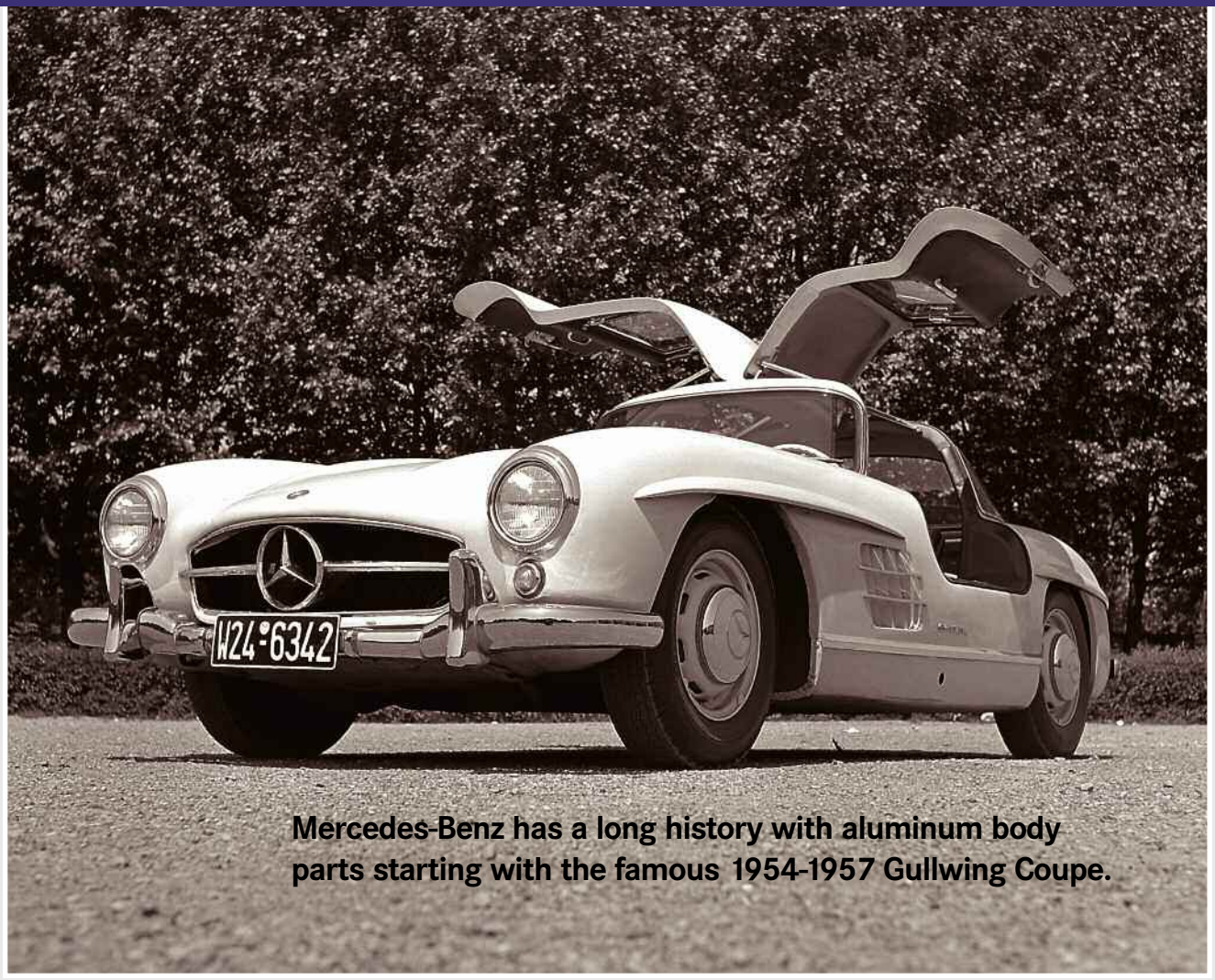
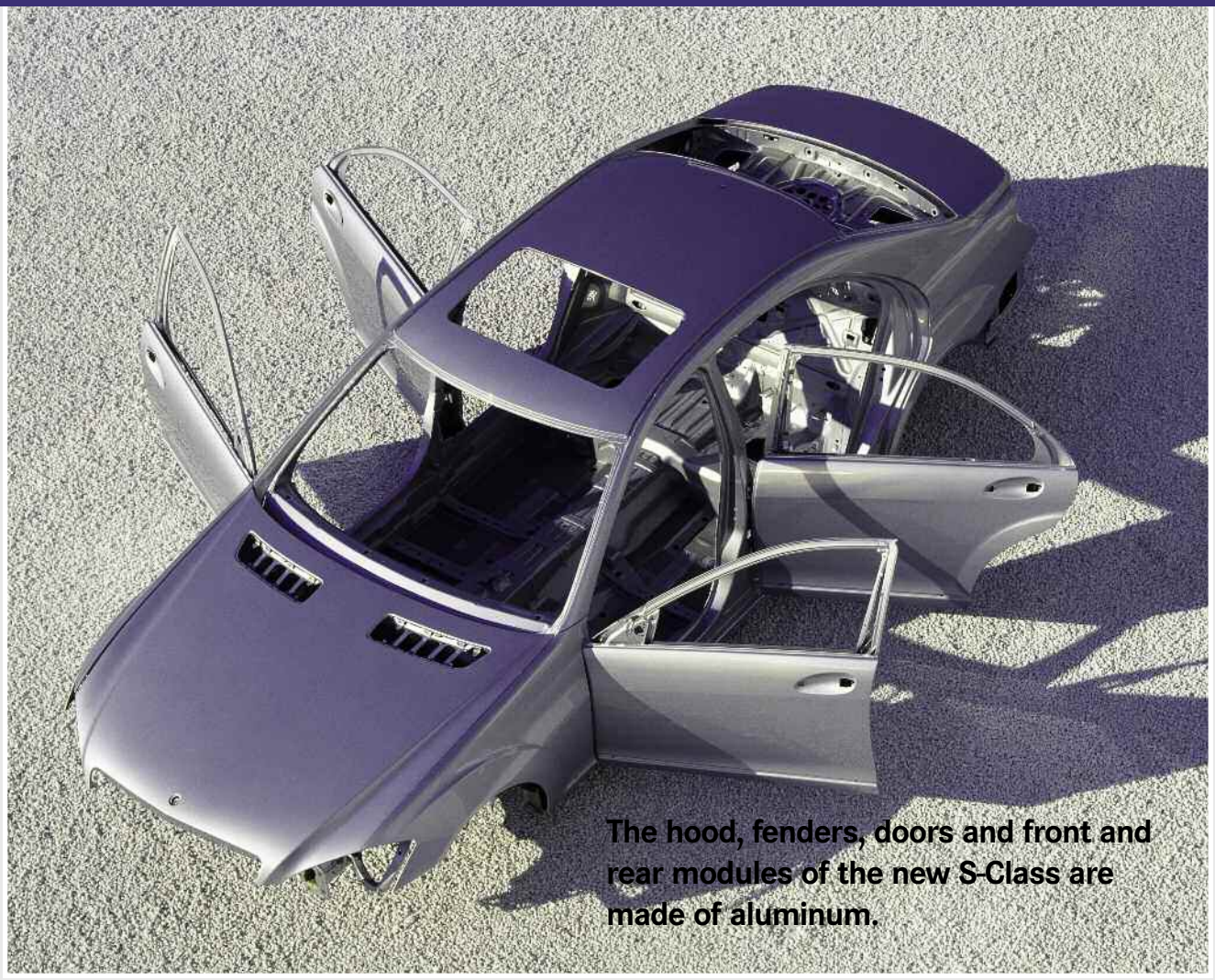


Mercedes-Benz has a long history with aluminum body parts starting with the famous 1954-1957 Gullwing Coupe.

Beauty is Only Skin Deep: Working With Aluminum Panels



The hood, fenders, doors and front and rear modules of the new S-Class are made of aluminum.

The quest for reduced weight has led auto manufacturers to the use of aluminum, and Mercedes-Benz has been in the forefront of this trend for decades. While these changes make for lighter body construction they also lead to challenges in auto body repair. Here's a look at the ups and downs of this miracle metal.

Some believe strict government regulations regarding raising fuel economy and safety standards force manufacturers to change materials and designs. Others believe this is simply evolution of the breed. Whichever you believe, the use of aluminum body panels is becoming more and more prevalent.

Mercedes-Benz is very familiar with the use of aluminum body panels dating all the way back to the early 1950s and the 300SL "Gullwing" coupe. This historic vehicle either came with aluminum hood, doors and trunk, or an all-aluminum outer skin! An overall lighter vehicle improves performance, fuel economy, and reduces strain on stressed components. Another benefit of aluminum is how well it yields to manufacturing processes. It can be cast, extruded, or rolled into sheets, the most popular use. While these benefits are tangible and real they do complicate the issue when accident damage occurs and body work becomes necessary. In order to maintain the Mercedes-Benz sound and stable body structure and sufficient corrosion resistance, proper body work techniques need to be followed. Here we will review proper structural body repair techniques that Mercedes-Benz owners require for their vehicles.

Aluminum and its characteristics

Why Aluminum? Aluminum is roughly one third as dense as steel. However, in order to maintain comparable strength to steel structures only about a 40% weight reduction is acceptable. Aluminum is also a great conductor of electricity, and on vehicle bodies it doubles as a ground path for the ever-increasing electronics on luxury vehicles – it is one of the most cost-effective choices. Aluminum by itself, while being lightweight, is not sufficiently strong for automotive applications. While aluminum alloys often have sufficient tensile and yield strengths, an alloy must be formed to provide the necessary stiffness strength. Aluminum alloys are made by adding other metals and elements such as copper, magnesium, manganese, silicone and zinc. Different blends are used to create different characteristics. For instance, a 2000 series aluminum alloy uses more copper. This makes the panel strong, workable and easier to stamp. A 3000 series alloy uses manganese and is still workable, but also stronger. A 4000 series alloy has a lower melting point, so it is mainly used for welding. The 5000 series alloys are blended with magnesium so they are corrosion resistant as well as being stronger. In addition to inner and outer paneling, this alloy can also be used for structural components in the frame, as well as welding wire. A 6000 series alloy adds silicone to the 5000 series so there is some additional strength. Finally, the 7000 alloys add zinc, which makes the alloy strong and is primarily used in structural members such as bumpers and bumper reinforcements.

Aluminum alloys are basically split into two groups, heat treatable and non-heat treatable. The 3000, 4000 and 5000 series are non-heat treatable. This means you cannot strengthen them with heat; however, they will harden by working them. If you need to, you can anneal them with heat. Keep in mind, these alloys will not show signs of excessive temperature.

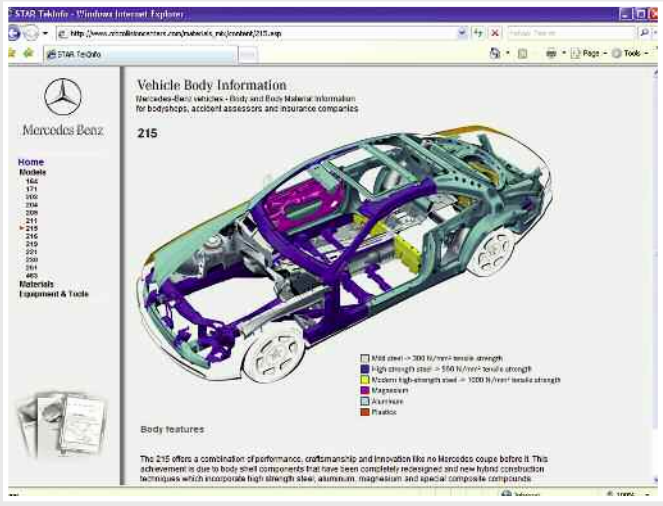
Heat reactive crayons should be used to give an indication of how hot the metal gets as you're annealing. Remember, the more heat cycles you put the metal through, the weaker it will become. The 2000, 6000 and 7000 alloys will strengthen with work hardening and some even with heat. They are also annealed with heat, but once again be careful of the lower melting points.

These characteristics become important when heat is to be used in straightening the aluminum panel. The damaged portion of a panel is stronger than the rest due to the work hardening of the metal. If you attempt to pull out the dent, the surrounding non-damaged areas will be affected and warp. You should heat the damaged area to soften the metal and make it easier to work with. "Heat-shrinking" is a process that uses heat to expand the aluminum around the dent. If done properly, this should force the metal back into the more natural shape it had before the dent was created. Heat is also a recommended method for softening up bonding adhesives used to join aluminum panels, but more on this later. Of course, in more severe hits heat shrinking will not be possible and the panel will have to be replaced. Mercedes-Benz's modular design of its vehicles allows dissimilar metals to be bonded or riveted together to form an overall stronger structure yet.

Preparing for an aluminum repair

During the aluminum panel stamping process, water-soluble dry-type film lubricants and water-free dry-type film lubricants are used. While these protect the metal during forming, they do need to be removed before any welding or painting takes place. Aluminum also has an oxide layer on the surface that naturally forms a corrosion-resistant surface. This must also be removed with solvents to allow for welding and paint preparation.

Not only does the aluminum panel have to be clean, but your work area must be also. This is one of the more critical steps in the process, but it is often treated as the boring task left to the apprentice. While working on aluminum panels, steel contamination from the previous job, or from the job the next bay over, can cause paint



MBUSA offers a website for approved Mercedes-Benz Certified Collision Repair Facilities. On this site, you can access specific information on materials used by Mercedes-Benz and how they recommend that the material be secured.

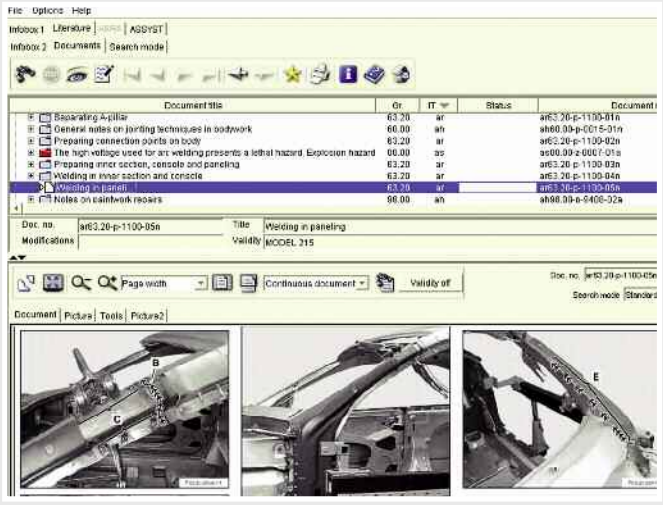
problems. Little dots protruding out of the paint are caused by the two dissimilar metals reacting. There is nothing less profitable than having to do a paint job all over again. For this reason it is required that your body technician keep all the tools dedicated to aluminum repair completely separate from those used for steel. Also a special work area is required, which must be set off from the rest of the shop by either walls or floor-to-ceiling curtains. This will reduce the possibility of steel (or other material) contamination.

Additional measures we can take to ensure both the health of the technician and the quality of the work is to provide proper safety attire and to remove contaminants and aluminum chips with the use of a vacuum evacuation system. Aluminum chips are explosive and pose a significant heath hazard. Other steps include covering the entire vehicle except the portion being worked on. Aluminum panels should be inspected for cracks before and after any repairs are performed. The surface can be inspected by using color dyes that remain on the panel surface and will normally seek out “channels” that are created by cracking. Careful inspection should be done after the dye is used as some cracking may not be visible to the naked eye. Never allow the dye to dry in the crack – be sure to clean the panel before this occurs. Note: Cracks may also appear as pores, crow's feet, or bull’s eyes.

Working with the metal

While aluminum is not as malleable as steel, dents may be removed from a panel when metal stressing is limited, or the actual disfiguration is minimal and not deep. Similar to steel, the technician should take notice of the low and high points of the dent, then commence with repair. If it is determined that the dent is too distressed, the panel should be replaced. Unlike steel, the technician should begin in the middle of the dent and work outward. As is done in "paintless" dent repair, the technician should “press” the dent out by applying a small amount of pressure against the damaged area. It is required that wooden, plastic or aluminum hammers be used should the need arise, and that any tools with sharp edges be avoided. Care should be given not to “stretch” the panel highly as that may cause it to crack or become brittle.

Once the technician has determined that the dent is relieved, it is time to "draw in" the aluminum. Before continuing, the technician should clean the surface of all contaminants.



At www.startekinfo.com you can access recommended body repair procedures. These include a list of recommended tools, step-by-step instructions, and required materials such as seam sealers, adhesives, etc.

Heating the area with a "neutral" welding flame while staying within the 300 to 850 deg. F. range (using a heat crayon at the outer edges of the repair area will assist in maintaining the proper temperature), then allowing it to cool quickly will assist in drawing the panel in. Heating the panel will allow the aluminum to resume its original shape; however, it is important to keep the heat limited to the repair area. This process should be repeated quickly and as needed to match the panel characteristics properly.

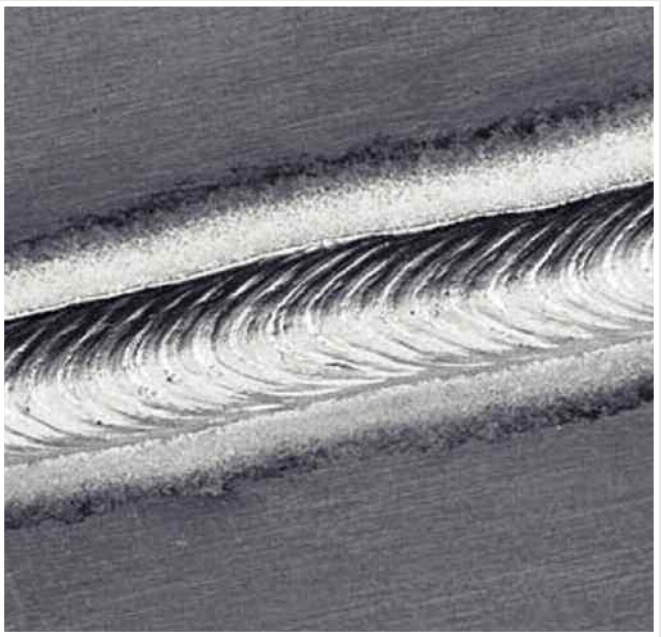
Re-sculpting the panels is a much bigger challenge than it is with its steel counterparts. Unlike steel, aluminum panels need to be heated before repairs can begin. The panel should be brought to between 475 and 575 deg. F. and then be worked by lightly hitting the panel with a plastic, wooden or aluminum hammer. Focus should remain on maintaining these temperatures during the repair to avoid the panel becoming "springy," deforming, or cracking. Since aluminum will tear quickly when the work area is crumpled or wadded, it is highly likely that the panel will need replacement rather than repair. Do not attempt reshaping of any die-cast panels.

Finally, always remember to do a post inspection of repaired panel(s) for any cracking.

Welding aluminum

Two possible methods of securing aluminum body parts are MIG welding and riveting. There are pros and cons to both. To prepare the surface for welding, solvents must first be used to remove any production lubricant as well as the oxide layer. Welding technology has evolved over the past few decades to allow for more intricate designs in the manufacturing process. Manufacturers have moved away from resistance spot welding. Aluminum being a much better conductor of electricity does not have enough resistance to build up the heat necessary to weld the parts together, so more current would be required.

Gas metal arc welding, MIG in particular, is a superior method for joining aluminum, but even this procedure has its drawbacks. The heat required to weld aluminum can cause distortion just outside of the weld seam, particularly with thin sheets. Reducing current moves us closer to "Short Circuiting Arc Transfer", which often leads to poor welds. Spray transfer is the preferred process when welding aluminum, but the amperage required is still too high and causes distortion and fatigue. New welding technology is available to address this need. Originally pulsed arc welding could reduce overall current, yet still maintain spray transfer. Today computers control inverter-based welders that can pulse a lot faster and easily control overall current. Experienced aluminum welders are hard to come by, so alternatives are needed.

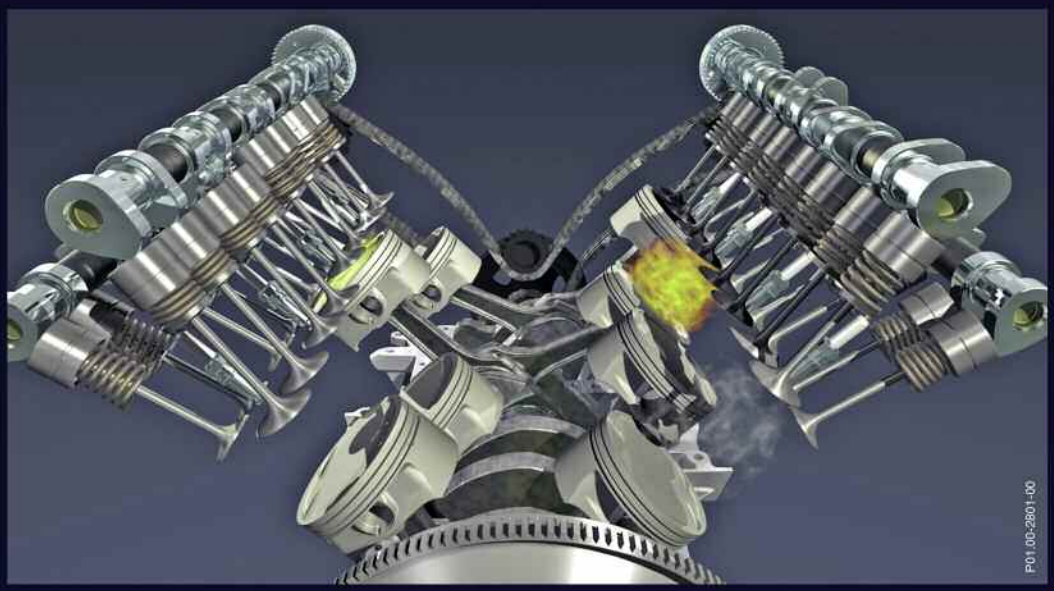


This weld was made with a new type of inverter welder. These welders use computers to control pulsed current, in the thousands of cycles, allowing for precise control of current, which keeps the high heat that can deform panels manageable.

Rivets

The other preferred method of mounting body panels is the rivet. Testing performed by Mercedes-Benz has resulted in riveted panels

FIRE...



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This is a steel-to-steel application rivet. The serrations in the body help the rivet to deform in a specific pattern.

This is a special Usibor rivet provided by Mercedes-Benz. These are intended for High-Strength steel applications.

providing the same security and strength as in the vehicle's original design. Mercedes-Benz actually prefers blind rivets over spot and plug welds on certain models. Rivets eliminate the deformation caused by the heat of welding.

How will you know when to apply this? All this information is available with a paid subscription to www.startekinfo.com. This is the Mercedes-Benz service information website. Under the heading WIS-net, you will find body repair information specific to your vehicle. When dealing with riveting aluminum panels uses aluminum-bodied rivets to prevent dissimilar metals from reacting and promoting corrosion.

Another component of rivet bonding is adhesives. Mercedes-Benz recommends the use of adhesives between aluminum (and steel) plates to reduce noise and increase strength. Remember to rivet in a different area rather than right where there was a plug or spot weld. The weld compromised the strength of the metal, so new metal will be more predictable and secure. Chamfer or deburr all drilled rivet holes on both sides of each panel to be joined to ensure the anti-corrosion coating is not scratched off. Another tip to prevent corrosion is to eliminate moisture at the rivet point. Mercedes-Benz wants a zinc paint, Part Number A000 986 34 42 to be applied to all naked metal surfaces before securing panels. However, this “weld-through” primer is not recommended for MIG welding. Finally, seal the seam with a Mercedes-Benz-approved seam sealer, and finish up with an approved wax-based anti-corrosion compound.

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Engine Performance Complaint from "False Air"

Model 203.040/740

If you receive customer reports in the above model of the engine vibrating, rpm fluctuations at idle or poor accelerator response with codes P2020 (P0172), P2046, P201C or P201A in the engine control unit, please perform the below procedure. The partial load breathing towards intake manifold hose, cylinder crankcase breathing hose or the non-return valve to nozzle hose may be torn at the connection to the crankcase. Air will bypass the air mass sensor, i.e. unmeasured air will enter the intake, causing the engine to run lean.

Remedy:

1. Remove compressor (supercharger). Refer to WIS document AR09.50-P-4705QK.
2. Remove and inspect the partial load breathing towards intake manifold hose, cylinder crankcase breathing hose and the non-return valve to nozzle hose for crankcase ventilation. If damaged, replace as needed. Refer to Figure 1 for details.
3. Install compressor (supercharger). Refer to WIS document AR09.50-P-4705QK.

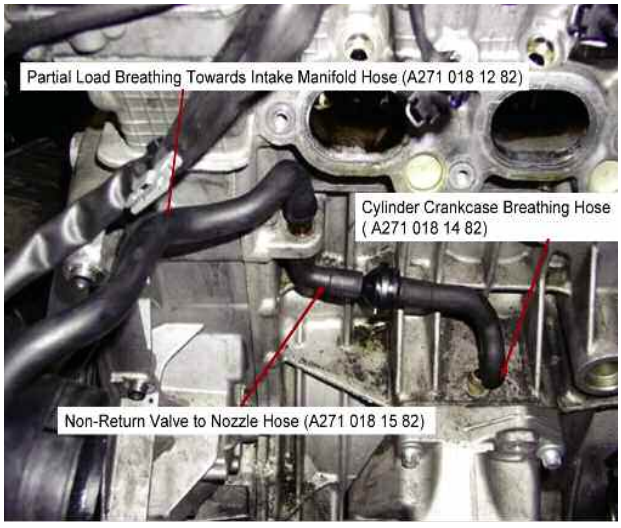

Figure 1

Note:

- Use "click clamp" as specified in parts information for securing hose.
- Ensure that clamp is positioned as close to the end of the hose and fastened tightly.

Parts Information

Quantity	Part Name	Part Number
1	Click Clamp	A005 997 49 90
As needed	Partial Load Breathing Towards Intake Manifold Hose	A271 018 12 82
As needed	Cylinder Crankcase Breathing Hose	A271 018 14 82
As needed	Non-Return Valve to Nozzle Hose	A271 018 15 82

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Napleton's Autowerks
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Knauz Continental Autos
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Chambers Motorcars of Boston
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