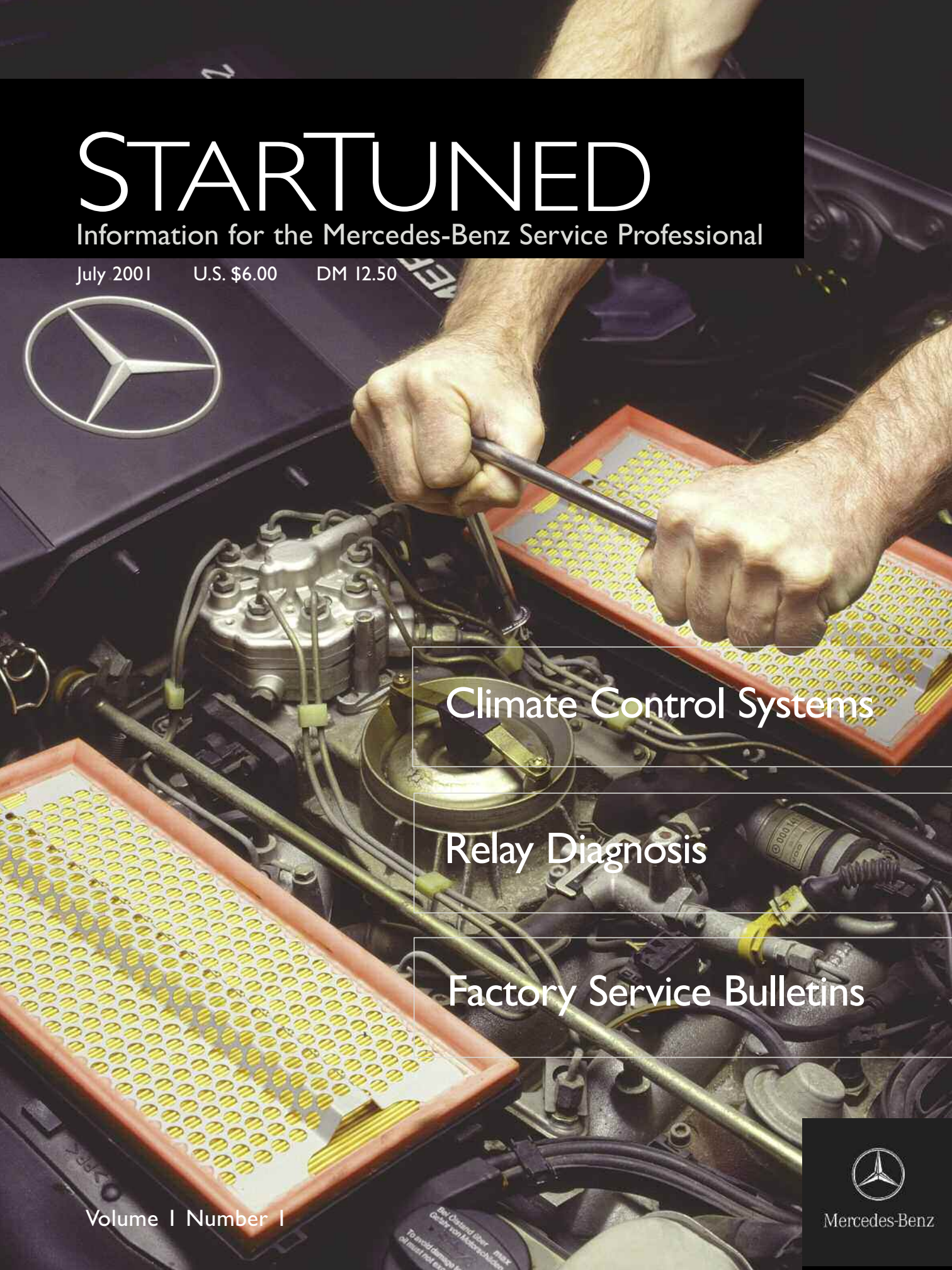

STARTUNED

Information for the Mercedes-Benz Service Professional

July 2001 U.S. $6.00 DM 12.50

Climate Control Systems

Relay Diagnosis

Factory Service Bulletins

Volume 1 Number 1

Mercedes-Benz

To our readers:

Welcome to the first issue of *StarTuned*, a new magazine for independent service technicians working on Mercedes-Benz vehicles. Mercedes-Benz both sponsors *StarTuned* and provides the information coming your way in each issue.

The worldwide carmaker wants to present what you need to know to diagnose and repair Mercedes-Benz cars accurately, quickly and the first time. Text, graphic, on-line and other internal information sources combine to make this possible.

Feature articles, derived from official company information sources, focus on being useful and interesting. Our digest of service bulletins will help you solve unanticipated problems quickly and expertly. Our list of Mercedes-Benz dealers can help you find original, Mercedes-Benz factory parts.

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

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Feature Articles

Departments

Mercedes-Benz

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Climate Control Systems

Dial in the degrees you want, and then just drive...

As one of the first automotive manufacturers offering a fully integrated vehicle heating and cooling system, properly described as an automatic climate-control system, Mercedes-Benz has used subsystem mechanisms very similar from one model to another for many model years. Virtually all of the company's recent cars use variations of this system, with the exception of some early 190's (Model 201).

This early model uses a temperature-setting wheel calibrated in centigrade; later versions use flip-flop centigrade/Fahrenheit selector buttons. This control tells the system what to pursue.

This automatic climate control system enables the driver to set the temperature in degrees with the adjustable wheel on the climate control panel (or with LED-setting buttons on some cars), and then he or she need do nothing more to keep the passenger compartment at the desired setting.

With the controls set to a specific temperature, the system works automatically, that is, it will either heat or air-condition until the temperature of the passenger compartment reaches the set temperature. If the passenger compartment is hot to begin with, the system will air-condition; if the compartment is cold, it will heat; if conditions change in the course of driving (going up or down a mountain, driving through changes in outside weather), the system will adjust what it's doing to maintain the temperature set.

Besides the temperature controls, the variety of duct outlets allow a wide range of different paths for the heated or cooled air to follow. If a motorist complains of insufficient heating or cooling, however, it is worthwhile confirming that he knows how to operate these ducts.

The system determines whether to engage the heating or cooling subsystems and to what extent from various temperature sensors inside and outside the car and in the engine. If the engine coolant is colder than the passenger compartment, the system waits after the driver first starts until the engine warms enough that air blown from the ducts is

somewhat warmer than the passenger compartment air. Once coolant temperature crosses that threshold, coolant circulates through the heater core, and the blower fan increases its speed. This continues until the interior of the car approaches the temperature set on the control panel. Then the system drops to a temperature-maintenance program, gradually reducing fan speed and setting the heater core to sustain the correct, desired temperature. The exact thresholds and measures to achieve them vary with the model and the year of manufacture, but all work in similar ways.

Before the system can control the monovalve, turn on the electric coolant pump and start the blower, it has to get a signal from the engine coolant temperature sensor that the coolant is warm enough to provide heat.

If the driver starts the engine under conditions requiring air conditioning, the compressor engages shortly after the engine idle stabilizes, and the climate control system works to drive the passenger compartment temperature down to the 'maintenance' threshold. The control unit cycles the compressor as needed to achieve the set temperature without freezing the air conditioner evaporator. The air conditioning system is an expansion-valve design.

Most Mercedes-Benz vehicles' air conditioning systems use a conventional sight-glass in the refrigerant line to determine when the proper charge level is achieved. With R134a, recall, you don't wait for the very last bubble to disappear.

The climate-control system is complicated only because the same controls determine the operation of both the heating and air conditioning systems; the individual subsystems are relatively clear and simple. Fan speed and air door position, as mentioned above, follow the system settings, though the driver can overrule the automatic functions and run the fan at a higher or lower speed as desired (perhaps to increase ventilation). Or he can close the vehicle against outside air in a stretch of very dusty or other undesirable atmosphere by pushing the recirculate button (later models include a cabin filter, cleaning all the entering air). The *recirculate* setting keeps the same air in the passenger compartment for about half an hour, until the system automatically disengages it. *Recirculate* allows maximum heating or cooling in the shortest period of time. It is less demanding to control the temperature of a fixed volume of air pumped round and round rather than constantly heating or cooling a new batch drawn in through the inlet. To protect the driver and passengers from any possible reduction in oxygen to breathe, the recirculate door function times out after some minutes. Its objective is to maximize heating or cooling for short periods or to seal the car for a limited travel distance; it does not hermetically seal the passenger compartment like a spacecraft or a submarine.

Later versions of the climate-control system allow different temperature settings for the driver and for the front passenger. In some luxury models, the rear-seat passengers have temperature controls as well. Obviously, these multiple-control variations employ more temperature sensors. Besides temperature inputs, blower speed also depends on vehicle speed: The faster you drive, the lower the voltage the control unit applies to the blower, depending more on ram-air with higher road speed.

Two significant components in the heating system are the "monovalve," an electrically pulsed water valve on the coolant return line, and the auxiliary electric coolant pump. By cycling this valve, the system can keep the heater core to a specific temperature rather than relying on whatever heat the engine coolant has. By pumping engine coolant through the heater core with the small electric pump, heating performance is constant even when the engine is running slowly or at idle. Systems with separately adjustable temperature for driver and front passenger have a more complex water valve to control the separate halves of the heater core. The more complex valve is called, not surprisingly, the "duovalve." Each of these water valves is spring-loaded open and closed electrically. Both of these components are simple 12-volt devices easily checked for normal operation in the ordinary ways of measuring continuity, power, ground and voltage drop.

Two electrical components play important and interconnected roles for heat and defrost. The auxiliary water pump, top, circulates coolant through the heater core as needed regardless of the circulation through the engine's main water pump. The monovalve, bottom, opens or closes the coolant's hydraulic circuit to and from the heater core.

The mono- or duovalve and the electric coolant pump permit a feature you may not have seen before. There is, on most Mercedes-Benz cars, a climate-control button marked REST. This is the German word for residual heat, and it lets you continue to heat the passenger compartment for some time after the engine has been turned off – either thirty minutes or until the coolant temperature falls to a level where it can't convey any more heat. The electric coolant pump circulates warm coolant from the engine block to the heater core; the water valve remains open; and the blower continues to circulate air, including in the recirculate mode if that button is also pushed. This recovers heat that would otherwise just be lost to the ambient air, without the emissions consequences of leaving the engine idling.

Air conditioning subsystems have used R134a since concerns were first raised about the climatic effects of R12, but the different refrigerant systems work in the same way. Differences correspond to the different refrigerants' heat-transfer capacities and pressures. Observe all the standard precautions to detect and prevent contamination of the refrigerants, including the air conditioning oils specific to and compatible with each refrigerant, different service fittings and so on. Mercedes-Benz vehicles

Normal air conditioning service, such as checking pressures, evacuation and recharge can be done just as on any vehicle. The heating and air conditioning systems, while integrated by the system control unit, are mechanically independent.

include a sight glass on the receiver-drier to determine proper refrigerant charge. Keep in mind with R134a there will still be occasional bubbles in the refrigerant even at full charge if, as is likely, you perform air conditioning service in hot weather.

An Approach to Diagnosis

When diagnosing a complaint about the system, be clear how it should work in the first place. Does it heat but not cool, or cool but not heat, or neither? Does the fan blow, or blow but not at variable speeds? Does the vacuum system work the air doors correctly to correspond to the pushbuttons (Reminder: Diesel engines don't develop intake manifold vacuum naturally; they require separate vacuum pumps. So if a Diesel-engined car has no vacuum-door operation, check that vacuum pump first)? Does the system achieve the set temperature as tested with a thermometer? When you have the complaint and the circumstances under which the problem occurs clear and after you have confirmed *that* it happens, then consider from your understanding of *how* the system works what the possible causes of that problem could be. Testing is then the process of eliminating all of those possibilities but the right one, so you can make the correct repair.

Here's a good first step for any climate-control diagnosis (after confirming the customer's complaint, of course): Push the defroster button. The system assumes when you push that button, you want the windshield defrosted. *Now*. As long as the temperature is above freezing, the air conditioning compressor clutch engages; the monovalve stays open; the electric water pump runs; the air doors turn all flow to the windshield ducts; and the fan comes on full speed. Both heat and air conditioning systems work simultaneously. No other setting results in

such a busy set of operations in response, so you can check on heating and air conditioning at once. The evaporator condenses some moisture out of the defrost air; the heater core raises the temperature, thus lowering the humidity more. The resulting dry, warm air, blown hard across the windshield, evaporates any condensed moisture from the glass quickly. If everything turns on that's supposed to in *defrost*, whatever problem you're solving has to do with a temperature sensor or the air doors not involved. Naturally, you could still have ordinary problems, like leaves blocking the air intake or A/C condenser, restricted air or coolant flow through the heater core, road grit clogging the condensation drainpipe or an engine thermostat stuck open.

Let's start with how the climate-control system detects passenger compartment temperature. We'll take the 300E/124 as typical: A small grate next to the dome/courtesy light fits over a sensor that

At the lower left corner of the courtesy/dome light is a small grille behind which is the cabin temperature sensor. A tube from it leads behind the passenger side outlet duct, where a small air pump constantly draws fresh air through the tube and over the sensor.

changes its electrical resistance to correspond to the temperature of the air. A small tube at the sensor leads through the headliner and down the passenger-side A-pillar and behind the dashboard to a small electric fan that runs anytime the ignition is on. Its function is to circulate air past the sensor to make sure the reading accurately reflects the temperature in the passenger compartment. If there is reason to suspect that sensor is not functioning properly, compare its output with a temperature reading taken by an independent, accurate thermometer adjacent to the sensor's intake grille. This is also the position at which to take any temperature reading that will determine whether the system can achieve the set temperature determined by the temperature selector wheel on the dashboard panel.

Other sensors detect the engine coolant temperature – if the system is going to use engine coolant to heat the passenger compartment, it has to have information about how warm that is, what its thermal resources are – and the temperature in the heater core.

At the heart of the system is the climate control unit, directly behind the pushbuttons in the dashboard. This includes all the electronics for the system other than relays. It controls the interior temperature and blower speed (Important note: The control unit never applies more than about seven or eight volts to the blower, even for full speed fan operation. If you wire 12 volts to the blower motor directly, you could cause damage to it or to the blower-control resistors).

Heating Side

The system will not circulate warm engine coolant through the heater core unless the system settings and the engine coolant temperature call for it. The monovalve controls the flow of coolant through the heater core, and that valve in turn is controlled by a solenoid – actuated by the climate control system.

The M-B climate control system has included self-diagnostics since 1988. You need the factory impulse-counter tool or its equivalent to access that information. In the absence of the tool, it is not that difficult to check the components individually to determine what is going on. You can check visually, for example, to see whether the air conditioning

Mercedes-Benz usually includes a pair of auxillary fans for cooling the air conditioning condenser in front of the radiator. Relays control these fans and their speeds, in response to command signals from the control unit. These pusher fans mean the air conditioning system can work effectively even at low speeds in very hot weather.

The fuse and relay box for most Mercedes-Benz cars is on the driver's side in the engine compartment, sealed with spring clips. Fuses and relays are clearly identified by position and number; voltage and continuity measurements are convenient.

compressor engages or not; you can tell by touch or measurement whether coolant circulates through the heater tubes and core; you can check continuity and voltages of the electrical components with a good multimeter. For particularly difficult problems, complete information on any variation of the climate control system is available from Mercedes-Benz.

There is a strong tendency to assume that whatever has gone wrong must be something very complex because an automatic climate control system is complex. Not so. The Benz system is just as subject to blown fuses, air ducts or condensers plugged with leaf debris and the like as any other – just check the basic problems first.

SUBSYSTEM ACRONYMS

Some are English; some are German. We have them all (we think!).

Every carmaker uses various acronyms to describe different systems and equipment they install on their cars, and a company like Mercedes-Benz with a wide variety of different vehicles and options is certainly no exception. Their acronyms are complicated slightly because some of them are English acronyms while others use the original German alphabetic abbreviations, sometimes similar and sometimes not. *K*lopfsensor and *k*nock *s*ensor, thus, will get the same acronym, KS. But nothing will help you with ASD or FAN but a list. We have included some used on cars imported into the country privately.

Here are the major Mercedes-Benz acronyms and what they mean in English:

4MATIC	Automatically controlled four-wheel drive
A/C	Air Conditioning *(Automatic)*
A/C	Air Conditioning *(Tempmatic)*
AB	AirBag
ABS	Antilock Brake System
ABW	Distance Warning Device
ADA	Atmospheric Pressure-dependent Full-load Stop
ADM	Automatically Dimming Rearview Mirror
ADS	Adaptive Damping System
AG	Automatic Transmission
AKR	Antiknock Control
AIR	Secondary Air Injection
ALDA	Boost Pressure Aneroid Compensation
AP	Accelerator Pedal
ARA	Antijerk Control
ARF	Exhaust Gas Recirculation (EGR)
AS	Antenna System
ASD	Automatic Locking Differential
ASR	Acceleration Slip Control
AT	Automatic Transmission
ATA	Automatic Theft Alarm
BA	Backup Assist
BARO	Barometric Pressure (sensor)
BCAPC	Barometric Pressure – Charge Air Pressure Compensation
BDC	Bottom Dead Center

BM	Base Module
BPC	Barometric Pressure Compensation
CA	Closing Assist (e.g., for trunks and doors)
CAN	Controller Area Network
CC	Cruise Control *(Tempomat)*
CDC	CD Changer
CF	Convenience Feature (courtesy lights, etc.)
CFI	Continuous Fuel Injection System
CKA	Crankshaft Angle
CKP	Crankshaft Position
CL	Central Locking
CLUS	Instrument Cluster
CMP	Camshaft Position
CST	Cabriolet Soft Top
CTEL	Cellular Telephone
CTP	Closed Throttle Position
DI	Distributor Ignition System
DM	Diagnostic Module
DTC	Diagnostic Trouble Code
EA	Electronic Accelerator
EAG	Electronic Control for Automatic Transmission
ECL	Engine Coolant Level
ECT	Engine Coolant Temperature
EDR	Electronic Diesel Control
EDS	Electronic Diesel System
EDW	Antitheft Warning System
EFP	Electronic Accelerator Pedal
EGR	Exhaust Gas Recirculation
EIFI	Electronic Inline Fuel Injection
ELR	Electronic Idle Speed Control
ELV	Electric Steering Column Adjustment
EMSC	Electric Mirror, Steering Column Adjustment, Heated Mirrors
ESA	Electric Seat Adjustment
ESC	Electric Steering Column Adjustment
ESCM	Engine System Control Module
EATC	Electronic Automatic Transmission Control
ETC	Electronic Transmission Control
ETR	Emergency Tensioning Retractor
ETS	Electronic Traction System
EVAP	Evaporative Emission Control System
EZL	Electronic Ignition System
FAN	Horns (“Fanfare”)
FFS	Frame Floor System
FP	Fuel Pump
GDB	Controlled Differential Brake
GIM	Governor Impulse Method
GM	Base Module
GUS	Seatbelt Tensioner
GUB	Seat Belt Extender
HAL	Rear Axle Steering
HCS	Headlamp Cleaning System
HFM-SFI	HFM Sequential Multiport Fuel Injection/Ignition System
HFS	Hands-Free System
HHT	Hand-Held Tester
HPF	HydroPneumatic Suspension
HZS	Trunk Auxiliary Lock
HORN	HORN Signal System
HS	Heated Seats
IAT	Intake Air Temperature
IDC	In-Dash Controller
IFZ	Infrared Remote Control for Central Locking System
INFO	Information Center
IR	Infrared
IRCL	Infrared Remote Central Locking
ISC	Idle Speed Control

KAF	Retractable Rear Headrests
KE	Electronic Gasoline Injection System (CIS-E)
KS	Knock Sensor
KSS	Knock Sensor System
LH	Hotwire or Hotfilm Air Mass System
LH-SFI	LH-Sequential Fuel Injection System
LLR	Idle Speed Control
LS	Loudspeaker System
MAF	Mass Airflow
MAP	Manifold Absolute Pressure
MAS	Engine Systems Control Unit
MG	Manual Transmission
MIL	Malfunction Indicator Lamp
MT	Manual Transmission
MVA	Manifold Vacuum Assist
O2S	Oxygen (O_2) Sensor
OBD	On-Board Diagnostics
OC	Oxidation Catalytic Converter
OSB	Orthopedic Seat Backrest
OT	Top Dead Center (TDC)
PEC	Pressurized Engine Control
PL	Power Locking
PML	Parameter Steering (Variable Assist)
PMP	Partial Intake Manifold Preheater
PNP	Park/Neutral Position
PS	Power Steering
PSE	Pneumatic System Equipment
RB	Roll Bar (or Antiroll Bar)
RD	Radio
REST	Residual Engine Heat Utilization
RHR	Retractable Rear Head Restraints
RHS	Rear Heated Seats
RPM	Revolutions Per Minute (engine or shaft speed)
RST	Roadster Soft Top
RTG	Retractable Trunk Lid Grip
SBE	Seat Belt Extender
SIH	Heated Seats
SLO	Starter Lockout
SMS	Service Microfiche System
SPS	Speed-Sensitive Power Steering
SR	Sliding/Pop-Up Roof
SRA	Headlamp Cleaning System
SRS	Supplemental Restraint System
SVS	Door and Trunk Closing Assist
TAF	Trunk Lid Auxiliary Fuse
TAV	Tank Aeration Valve
TB	Throttle Body
TC	Turbocharger
TCM	Transmission Control Module
TD	Speed Signal (Time Division), Electronic Ignition System
TDC	Top Dead Center
TIC	Transistorized Ignition Control
TN	Speed Signal, EZL/AKR Systems
TPC	Tire Pressure Control
TPM	Tire Pressure Monitoring
TRAP	Trap Oxidizer (for Diesel engines)
TRIP	Trip Computer, Tripmeter
TS	Towing Sensor
TSZ	Transistorized Ignition System
TVV	Tank Vent Valve
TWC	Three-Way Catalytic Converter
ÜRB	Rollover (Antirollover) Bar
UT	Bottom Dead Center (BDC)
VAF	Volume Airflow
VSS	Vehicle Speed Sensor
WOT	Wide-Open Throttle (full load)
ZV	Central Locking System

A Tale of Two Relays

Two little boxes a Mercedes-Benz carries, and what's inside.

Most Mercedes-Benz cars carry under their hoods a pair of relays not found on other cars, the overvoltage protection relay and the Klima relay. Both of them serve to protect different components of the fuel, ignition and climate control systems under various circumstances, and both of them play important roles in various other vehicle systems. These relays ordinarily function to toggle electric power to the engine systems control unit (MAS) and to the electronic ignition control unit (EZL), but in some cases of very high or sustained overcharge, reversed polarity and the like, they burn out themselves rather than conveying the high current to the control units. In those cases, of course, find the source of the spike first before replacing the sacrificed relay.

Overvoltage Protection Relay

The overvoltage protection relay, usually found with a red top and a fuse under the plastic cover, keeps voltage surges from damaging critical and sensitive ignition and fuel system components, particularly relays and modules. Voltage spikes can come from causes internal to the vehicle, such as a defective voltage regulator that full-fields the alternator's rotor windings, or from external sources, such as an attempted jump start from a vehicle with the wrong system voltage or a jump with reversed

The overvoltage protection relay, with its distinctive red cap and fuse, takes the hit if there's a voltage spike. But it shuts off the fuel or the spark or both when it does so. This should be your first check if a car has gone dead unexpectedly. Be sure to locate and repair the cause of the overvoltage before you finish the job.

If the air conditioning compressor won't engage beyond the first couple of turns when it first tries to connect, the problem may not be electrical at all. You may just have a loose drive belt, apparent to the Klima relay as a lack of correspondence between the compressor speed sensor signal and the crankshaft speed sensor. It disconnects the compressor to save the belt.

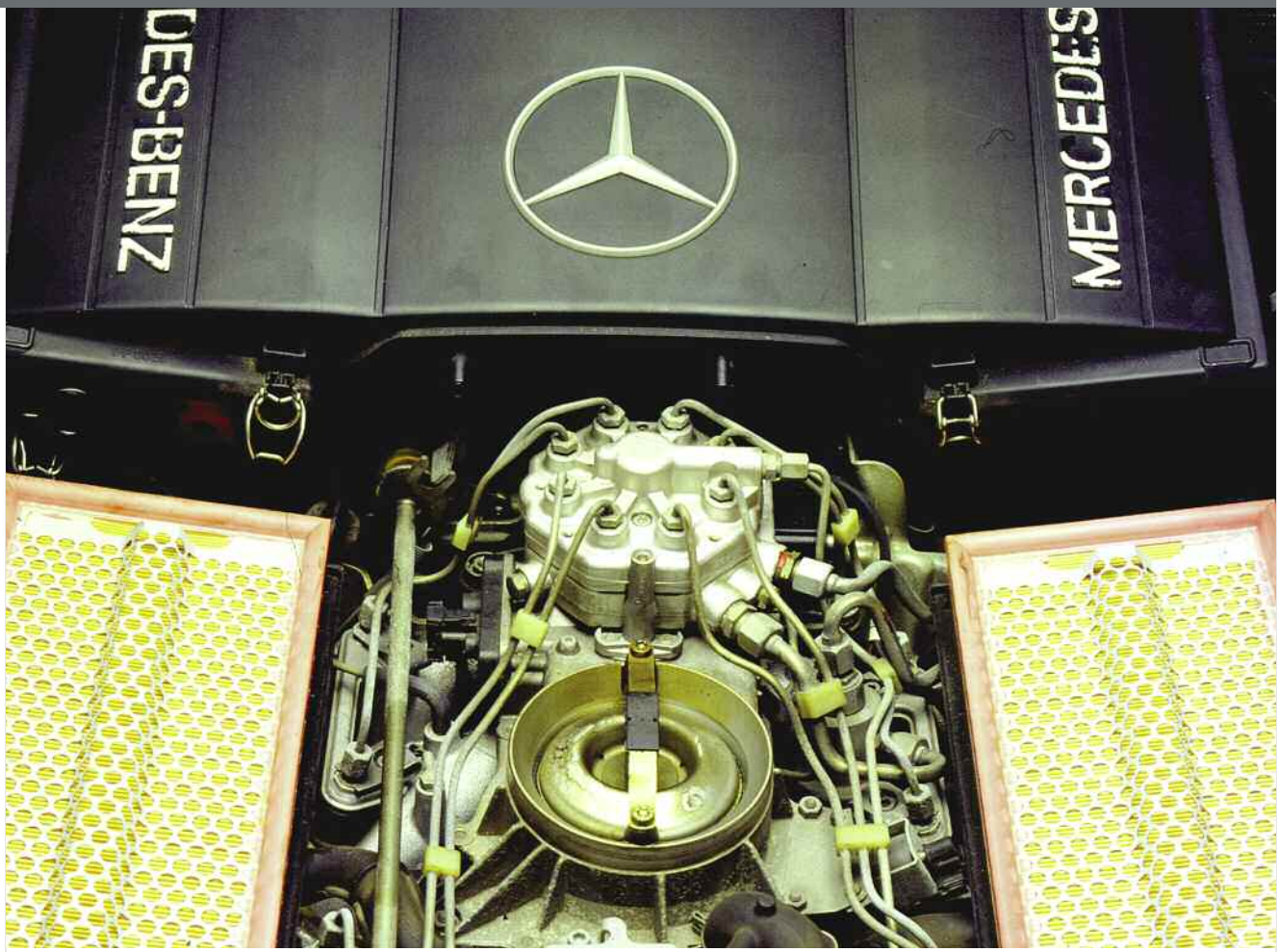
polarity. If you find a Mercedes-Benz with no spark or no fuel, before you begin lengthy diagnoses of those systems, check the fuse atop the overvoltage protection relay and the relay itself (which can have its contacts fused closed or its coils burned open by a sufficiently high overvoltage surge).

The Klima Relay

The Klima relay, marked with the word *Klima* somewhere among the numbers on the top, has inputs from the crankshaft position sensor and from the air conditioning compressor speed sensor, on the back end of the compressor crankshaft. If the ratio between these two signals falls outside the correct ratio determined by the relative pulley sizes, this relay disconnects power to the compressor clutch for the remainder of that trip. Why? Because if those signals don't correspond to that ratio, the discordance indicates the serpentine accessory drive belt is slipping, the clutch is slipping or the belt is broken. Since the accessory drive belt turns other components, including some like the water pump and alternator that are more important to the running of the vehicle than the air conditioning compressor, the Klima relay cuts the circuit to unload the compressor, relieve the load on the belt and, hopefully, avoid a broken or slipping drive belt and the various unhappy consequences that can have for the motorist. On most models, the Klima relay will reset for the next trip and will allow at least a momentary engagement of the air conditioner clutch to retest for belt slip. This initial re-engagement can provide you a diagnostic clue if you take the trouble to watch the compressor pulley just as someone turns on the air conditioning for the first time in a given startup.

In later vehicle systems, the work of the Klima relay is part of the various tasks of the MAS control unit. Besides its responsibility for fuel and ignition circuits, it also cycles the air conditioning compressor or, as does the Klima relay, shuts it off entirely if the shaft speeds do not correspond.

In later models, the function of the Klima relay is assigned to the updated MAS control unit, essentially a complex relay providing power to the fuel pump, ignition system and other critical components. Like the Klima relay, it compares rpm between the compressor and the engine crankshaft and disconnects the clutch if they don't match correctly. The MAS unit, however, controls many other electrical and electronic functions, which we'll cover another time.



No Start Diagnosis

Fire, fuel or pressure. Find what's failed fast.

The same sorts of problems – spark, fuel, compression, timing – can keep a Mercedes-Benz engine from starting as any other. You check for many of them in similar ways to other engines, and some tests are M-B-specific.

One problem happens with a new owner, perhaps of a used car. Some carmakers calibrate their fuel gauges to read full for the first fifty miles after a fill-up, and to read empty when they still have another three or four gallons left. Not so Mercedes-Benz. When you drive away from the gas station pump, the needle starts down. When the needle reaches the bottom, the engine stops. The moral of this story: Even if a motorist tells you there's fuel in a tank that reads very low or against the peg, pour in another gallon or so just as insurance. Two dollars' worth of liquid diagnosis can sometimes save hours of work you'll never recoup if it turns out the car was just out of fuel. Note: a Diesel engine often requires bleeding the air manually from the injector lines while cranking before the engine can start, if the driver has run the vehicle so low on fuel the pickup starts drawing in air.

Even with a full tank, though, you can still find fuel problems. All of the cars we're considering for this article are fuel-injected (the last Mercedes-Benz imported into the United States with a carburetor was long ago), and fuel injection systems work by pressure and volume. The CIS and CIS-E systems work when the electric fuel pump raises the pressure of the fuel in the lines enough that it forces its way past the spring-loaded mechanical valves at the

For many years, all the way up to this 1992 model, Mercedes-Benz used increasingly complex versions of the Bosch CIS-E fuel injection system, with continuous injection and a fuel distributor as here.

tip of each of the fuel injectors. Either hydraulic problems forcing the fuel through the filter and lines or electrical problems delivering current to and from the fuel pump can reduce the fuel injected enough to hamper running or prevent the engine from starting. That being said, the originally all-mechanical CIS-E system became so increasingly electrical and electronic that one of its final versions, like the 500 SL (129) in some of our photographs, has almost as many potentiometers and electrical actuators as the fully electronic systems that followed.

Except for fuel pump circuit failures, most no-starts will have neither spark nor fuel. The reason for this design, of course, is to minimize hydrocarbon emissions: If for any reason the fuel doesn't or can't ignite for lack of spark, you don't want to inject it at all because there's practically no exhaust dirtier than exhaust during a no-start crank. For each of the fuel and ignition systems found on these cars, the crankshaft position sensor plays a central role. With the CIS and CIS-E systems on the earlier cars, that signal must reach the control unit with a certain minimum frequency (corresponding to about 400 rpm on most engines, too low for idle, too fast for cranking) for the computer to keep the fuel pump energized. With the later versions, you need that signal *and* the camshaft signal to sequence the fuel injection. Because of its importance for both ignition and fuel injection, a quick check of the crankshaft signal is a reasonable first diagnostic inspection. The crankshaft position sensor is adjacent to the flywheel, on the back of the engine next to the bellhousing. Keep in mind that both the amplitude (voltage) and the frequency of the signal are critical to reaching the control unit's recognition threshold. The computer won't respond to an rpm signal pulse much below 1.1 volt (alternating current).

But if you find a no-start and smell gasoline, what could that mean? First, check the plugs to see whether they're wet with fuel. If they are, of course, the engine is flooded and won't start for that reason. However, merely drying the plugs off and re-cranking probably won't work satisfactorily. If the system delivers fuel even when the engine won't start, check for spark at the plugs. A defective coil, coil wire, distributor rotor, cap or plug wires could intercept the spark after the control unit has already concluded spark is on its way. Then the fuel pump will

The ignition module is responsible for triggering the coil, that is, interrupting the ground circuit so the electromagnetic field collapses and generates the high-voltage secondary spark. Check your service information to see just what information in the form of voltages you should find on the module's terminals, because this varies by model and by year.

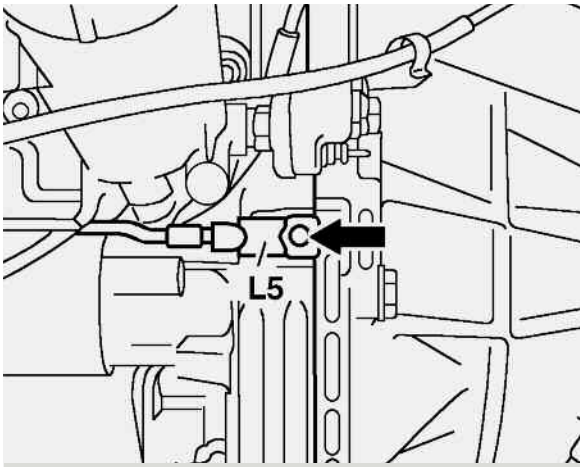
This cover protects the ignition coil from the elements, but also can form a path for a carbon track. When you check the coil for continuity and physical damage, make sure to inspect the coil cover as well.

continue to pressurize the fuel, for two seconds, and the injectors can flood the plug electrodes, even within the two seconds the pump waits for a crank signal. On the electronic systems, a coolant temperature sensor that reports a very low temperature can have the same effect because it can so richen the fuel mixture that the plugs foul.

The 300 E in the photos uses a distributor on the front of the camshaft and a remote ignition coil to provide ignition to each of the six cylinders. Most of the possible no-starts result from some easily discovered open or short in the primary or secondary ignition system. If there's no spark at a plug, see whether there's spark at the distributor coil wire. If there is, your problem is in the cap, rotor or wires. If there's not, check for spark at the coil tower. If there is, you've found an open-circuited coil wire. Check for voltage at the coil primary and for the normally cycled ground on the other side.

None of this should be surprising, but people sometimes forget that all gasoline engines work essentially the same way because they all depend on the chemistry of the same gasoline and oxygen.

Some no-starts are by design: The antitheft/central locking system will prevent the engine from starting without the right key. Occasionally these systems get overenthusiastic, and their control units (on the right side in the trunk) intermittently prevent starting even with the right key. You'll understand why we won't provide detailed information about how to bypass the central locking or antitheft systems here. However, you may run across this sce-



If the crankshaft position sensor fails, mounted at the flywheel, you'll have neither spark nor fuel.

Spark must travel through the same sorts of circuits on a Mercedes-Benz as on any other vehicle. Check the wires for continuity, inspect the cap and rotor for carbon tracks, cracks and even carbon-button failure.

Mercedes-Benz vehicles have a formidable array of control units, not just in the front compartment shown here but in many other places in the vehicle. Many control units, however, does not mean the problem is in a control unit. Before pursuing the most complex possible diagnosis, check the fundamentals – fuel, spark, compression and timing – for proper operation.

nario: On most models with antitheft/central locking systems, if you close and lock the trunk with the key while the driver's door is open, that is ajar, the starter will not work again until you operate the driver's door lock with the key (door closed) to reset the system. If you don't know this, you could spend a long time chasing nonexistent problems.

Similarly, a surge intercepted by the overvoltage protection relay (see the article on that relay in this issue, p.11) can keep an engine from starting. Rather than allow an overvoltage spike to destroy expensive control units in the car, the overvoltage protection relay disconnects the fuel pump and/or the ignition module to protect them from a runaway alternator or other such problem. Of course, merely replacing the fuse in the overvoltage protection relay or the relay itself will not permanently solve the problem until you locate and correct the source of the voltage spike.

Some no-starts arise from the design, but not according to plan. A no-start in the early Fall on an older car with CIS-E and a cold-start injector could come from water in the cold start injector line if there has been a problem with fuel quality. Over the summer, the water has plenty of time to separate out and even to form rust. Obviously, that's not a problem until you need the cold-start injector squirt to get the engine going.

Diesel No-Starts (and a No-Stop)

For a combination of historical and technical reasons, Mercedes-Benz has emphasized Diesel engined cars for many years. No discussion of Mercedes no-starts can leave out the Diesels, thus. Diesel engine no-starts most frequently fall into two categories: fuel delivery problems or glow-plug problems. Fuel problems can be anything from a pickup line leaking air before the pump to defective injectors or pump. Glow plugs can surprise you – on many cars, *all* the glow plugs must work, or the engine can't start cold. The high compression of the Diesel engine (21 to 1) can slow the crank so much with even one missed power stroke, you won't have the combination of crank speed and temperature required to start the engine.

The Diesel compression-ignition system also requires a functional glow plug controller, the relay/module that calculates the glow plug on-time from the temperature of the engine coolant. On the older Diesel engines, you may find just the opposite problem – the engine won't shut off – if the vacuum pump (for the brake booster, heater doors and injection pump shutdown diaphragm) or its check valve fails. These engines included a conspicuous engine shut-off lever, visible even to the mechanically unsophisticated as soon as the hood was open.

Fuel pumps and fuel filters may be the most common long-range problem. These are finite-life components and require replacement sometime during the useful life of the vehicle. Check for power and ground to the pump before condemning it, of course. And remember a fuel pump can run without necessarily producing the pressure or volume required to power the engine. On vehicles with in-tank fuel pumps, it is usually a good idea to clean out the fuel tank at the same time you have it down. There is inevitably a certain amount of grit and dirt that finds its way in over the course of a hundred thousand miles. That grit and rust debris are frequently what cause the fuel pump check valve to lose its seal, allowing pressure bleed-down when the engine is shut off. That can result in long cranking or even in vapor lock if underhood temperatures stay high enough.

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Parts News

Cabin Filters

Current Mercedes-Benz models use cabin filters, sometimes two in series, to clean the incoming air to the passenger compartment. When there are two cabin filters, the first is an electrostatic particulate filter to catch dust and pollen, and the second is an activated charcoal filter to remove vapors. Each vehicle owner's manual lists the corresponding replacement interval, though under particularly dusty (or malodorous) conditions it may be advisable to replace them after a shorter interval.

Failure to replace the filters can reduce the volume of fresh air drawn into the car. In extreme cases, it could even contribute to the overheat-failure of the blower motor since that is cooled by the incoming air.

Models 129 and 124 carry the dust filter under the hood. Model 140 has both dust and charcoal filters under the hood, and some 140s require drawing a vacuum on the rubber bead around the filter to extract it from the housing. Model 202 has a dust filter under the dash, and the 210 and 220 have both filters under the dash. Model 208 has a combination dust/charcoal filter under the dash. Model 203 has a dust filter under the hood and a charcoal filter under the dash.

Replace the electrostatic dust filters every 15,000 miles on 1997 and older cars. The change interval goes to 25,000 miles for 1998 and later. Charcoal filters should be replaced every 45,000 miles up to 1997 and every 60,000 after that.

Batteries

It's neither convenient nor economical to wait until failure before replacing a battery. But there are more factors in selecting a battery for a car than the size of the case and orientation of the positive and negative terminals. The extent of the warranty generally corresponds to the overall quality of the battery, but the performance specifications are the most critical details. The only performance specifications to use for comparison are *CCA* and *RC*. CCA (cold cranking amps), defined by the Battery Council International as "the number of amps a lead-acid battery at 0°F (-17.8°C) can deliver for 30 seconds and maintain at least 1.2 volts per cell" (7.2 volts for a 12-volt lead-acid battery), reflects the battery's ability to start an engine under low-temperature conditions. RC (reserve capacity), BCI defined as "the number of minutes a new, fully-charged battery at 80°F (27°C) can be discharged at 25 amps and maintain a voltage equal to or higher than 1.75 volts per cell" (10.5 volts for a 12-volt battery), represents the time the battery will continue to operate essential accessories in the event of a charging system failure.

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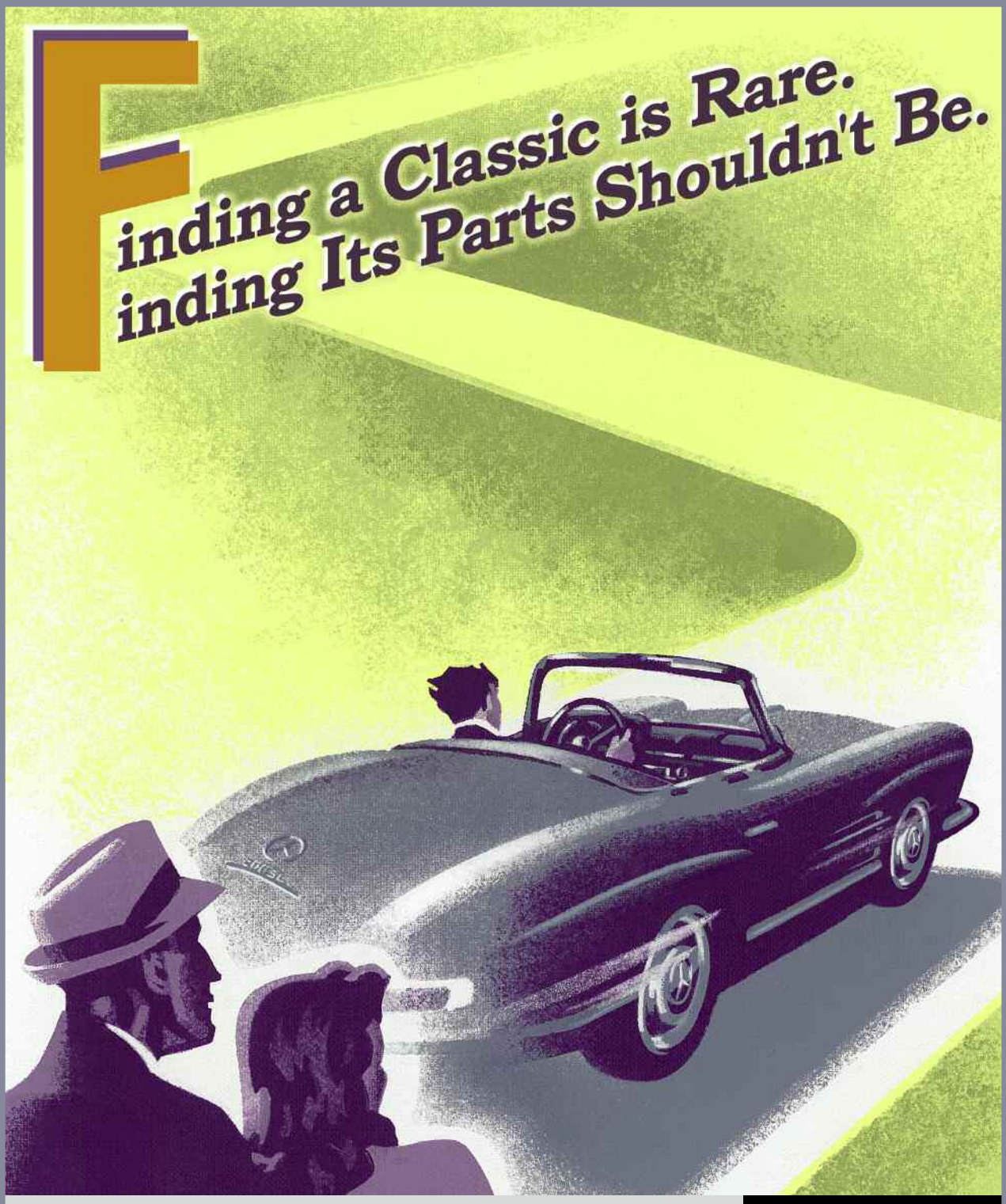

Relive the good ol' days. Mercedes-Benz makes it easier to find classic car parts. When you call 1-866-MBCLASSIC, Mercedes-Benz works to track down the genuine Mercedes-Benz classic part you need. So you can be sure of one thing: they really do still make 'em like they used to. **Genuine Mercedes-Benz Parts**

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FACTORY SERVICE BULLETINS

These suggestions and solutions for technical problems come from service bulletins published by Mercedes-Benz, selected and adapted for independent repair shops.

Fuel Pump Noises

Suspicious noises from fuel pumps usually fall into one of two categories: humming or whirring, depending on the frequency of the sound. A humming noise frequently occurs when the fuel line drums against a body panel or clamp, either from misrouting, backpressure from a clogged fuel distributor internal filter or a defective fuel pump. The higher frequency whirring sound more often comes from a defective fuel pump itself, though sometimes dirt and rust deposits in the tank can contribute to the problem as well.

07.3-87011

Snapping or binding in rear axle when cornering or parking, all models with ASD

ASD is the automatic locking differential system, and a resistance to different wheelspeeds is an inherent part of the design. If, however, the binding or snapping is too strong for the motorist, this can be remedied by removing one friction plate per side from the differential clutch packs and replacing it with a special steel plate kit, part no. 140 350 64 23. To do this, you must remove the differential

assembly entirely, open the housing and exchange the friction discs for the steel plates.

AF35.41-U-3100DA

Unsteady or erratic speedometer needle, Models 124 and 201

A wobbly needle is probably the result of an interference problem in the speedometer cable or in the speedometer itself. Reroute the cable correctly or replace the cable if needed. Lubricating a speedometer cable will *always* result in failure of the speedometer, so do not attempt that 'repair.'

If you're not certain how to proceed, read the Service microfiche for Electrical system I, Models 124 or 201, Group 54, Jobs 54-245 and 54-250. Detailed service information is available from MBUSA.

AF54.30-U-2100AV

Engine stalling, all engines with CIS-E

An engine that suddenly stalls but can restart after a short time or that sometimes stalls during coasting can have a variety of different problems, and careful checks are necessary to determine the cause. First, check the connections to the ignition coil, seeing that they're tight and electrically secure. Check the TD (crankshaft position) sensor signal wire for intermittent ground contact at the diagnostic socket, at the tachometer, at the connector for the fuel pump and at the A/C compressor cutout relay.

As you go through the electrical connections, check each one with a meter for voltage drop and for resistance. Check the sockets for the fuel pump relay and overload protection relay in particular, pinching widened sockets back together to form a more secure connection. At the fuel pump and A/C compressor cutout relay, check also for evidence of moisture and corrosion. As needed, clean socket connectors or replace defective or intermittent relays. At the crankshaft position sensor, perform the additional test of moving the harness around while monitoring continuity at the terminal ends.

If the car has engine type 103, check the distributor rotor and cap, being certain to remove the rotor and inspect the lower side for evidence of burn-through, cracks or other damage.

Most affected vehicles employ a deceleration fuel shutoff strategy to control emissions and save fuel, but if the electrohydraulic actuator (EHA) shuts off the fuel at the wrong time or fails to resume fuel delivery, this can cause stalling.

Check the EHA to determine this.

If no other cause becomes evident, on model 124.201 only, install a modified component compartment cover (see SI 54/48; 62/18, March 1988).

If the problem is most pronounced when coasting down from a higher speed, check that the speedometer is sending a signal to the CIS-E control unit. This precaution applies to vehicles with one of the following CIS-E control units:

006 545 02 32,
006 545 14 32,
006 545 77 32,
006 545 79 32,
007 545 14 32 or
007 545 15 32.

For each, connect a voltmeter to the CIS-E control unit plug, between socket 6 and ground. The specific test follows:

- For Model 124.201 – Push the car forward and backward. The result should be between zero and 9 volts and changing. Repeat the test measuring the voltage directly at the Hall-effect speed sensor and again at the wire from the sensor to connector X26, socket 11. Check plug connection X53/5 for intermittent contact.
- For Model 107.126 – Drive the car on a dynamometer or roadtest it. The value at 25 mph should be above 1.0 volt. Check the wire from the electronic speedometer to connector X26, socket 6.
- For all vehicles with deceleration fuel shutoff – check the electrohydraulic correction element and replace it if needed.

AF07.32-U-6702A

Arrhythmic Noise, Warm Idle, Engines 103 and 104

An erratic noise similar to a slipping belt, a noise increasing as the engine temperature rises to normal may be caused by a defective timing belt tensioner if the spill valve for the hydraulic tensioner becomes defective. Replace the tensioner complete except for the end piece.

AF05.10-U-1450GG

Central locking system problem, SL/129

Occasionally it becomes impossible to unlock or lock the driver's door using a key at the front passenger door, the trunk lock or the infrared remote control system. Check whether a door panel screw has damaged the switch and working element in the driver's door. This problem can also affect the passenger's door. When replacing the damaged strip, use a special metal strip, part no. 129 805 00 97 with attachment screws 3 mm shorter, part no. 007981 00457.

AF80.20-U-6094A

No EHA ratio adjustment and CEL on, all CIS-E engines

This unwanted new problem can be very irritating right after you've done some other job the car badly needed, not infrequently exhaust work. Here's how to solve the problem the repair caused: The most probable cause of the problem is an intermittent or permanently nonfunctional oxygen sensor. Test for that by monitoring the oxygen sensor signal while driving (steady speed, engine at normal operating temperature, etc). Make sure the intake and exhaust systems are tightly bolted to the cylinder head and engine block. Make sure all negative electrical connections, as well as the manifold and flange bolts are tight and electrically conductive. Loosen and then retighten the oxygen sensor to be sure there's electrical conductivity through the exhaust system. If you're in doubt about these procedures, read the technical literature for removal and installation of the exhaust system before you tighten the manifold bolts.

Next check the coaxial cable between the oxygen sensor plug (G3/2x2) and the CIS-E control unit pin 8 is not shorted to ground. Do this by unplugging the control unit and checking the resistance between socket 7 and socket 8. You should find a resistance above 10 kOhm, i.e., infinite. Otherwise replace the corresponding section of the engine harness.

Another possibility is a loose connection or intermittent connection at the connector sleeve Z, a solder joint in the harness, in the CIS-E control unit connector. In that case, you can merely open the plug and resolder the connection at connector sleeve Z on socket 7. Mercedes-Benz recommends checking Diagnostic Manual Volume 2, Engine 102 (available from the company): Tests GE-04.01 and GE-04.05, tests GE-07.01 and GE-07.05. For engines 116 and 117, tests GE 08.01 and GE-08 .05.

AF07.32-U-6000A

Rumbling or droning when cornering, Model 124.2*xx* with engine 103

A possible cause for a rumbling or droning sound when the car takes a corner comes from a misadjusted engine mount or stop, in particular a collapsed rear engine mount.

AF28.00-U-1100BA

Alternator Whine, all models

Besides the obvious causes, such as worn bearings or damaged pulleys, alternator whine can come from two other causes. At low temperatures, the acoustics of the fan can allow the sound at 3000 rpm. In that case, no corrective measures are necessary. In other cases, the magnetic field of the alternator can cause a whining sound most noticeable at about 700 rpm if there are enough electrical consumers turned on to increase the field saturation to a high level. In the latter case, check that the battery is fully charged, recharging as needed. If the sound continues even with normal charging loads, replace the alternator.

AF15.40-U-1000AG

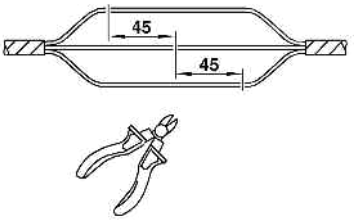
Engine dies in gear, S-class/140 with engines 104*xxx*, 119*xxx* or 120*xxx x*2

Moisture or corrosion in the connector between the starter lockout switch and the transmission wiring harness can introduce enough resistance that the engine dies when shifted into gear or when parking. When such corrosion is found, replace both the starter lockout switch and the transmission wiring harness.

AF15.40-U-1000AG

Splicing wiring harnesses

When repairing multistranded wiring harnesses with soldered terminal sleeves, expose the damaged area at an accessible point and cut off the defective section. Separate the conductors in the harness and stagger the connecting points by approximately 45 mm. This reduces the chance of a subsequent short through the splices.



Cut the new harness to fit, matching the old part but allowing an additional 50-mm on each wire for creating loops for the cable. Strip the insulation from the last 15-mm of each wire. Use a terminal sleeve that fits the cross-sectional dimension of the wires joined, and turn the sleeve fully onto the wires. Heat the sleeve with a hot-air gun to about 400 degrees C until the soldered ring detaches and the sheathing moves cleanly around the cable. Stagger the sleeves on a multiple-splice repair and wrap the harness with the appropriate protective insulating tape.

AR54.18-P-0100-02A

Steering rattle at full lock, Models 124, 129 and 140

A modified pressure plate in the power steering pump, found only in LuK PS pumps built between July and August, 1992 (production codes 20G to 23G) allows this problem. While many of these were replaced under warranty, the fix for any remaining is the installation of either a ZF power steering pump or a pump from LuK not made during the period affected.

AF46.30-U-1400BG

Water in headlights or turn signals, all models

Moisture can get into headlights and other lights by two means, leaks or condensation. It's important to distinguish which problem you have because there is no way to correct for condensation in the lamps – it's a natural phenomenon when the surfaces fall below a certain temperature under the right conditions of humidity. Leaks, however, can be located and repaired after performing a water spray test. Ordinarily there will either be a visible crack or you can identify the gasket you need to replace. If no water enters the lamp during your spray test, the moisture is from condensation, and no repair is necessary (or for that matter, possible).

AF82.10-U-4041AU

Engine surge in cruise control during 'decel,' Engine 102.96/98, 103

If a vehicle with either the 102 or 103 engine surges while the cruise control lever is held in the 'decel' position, shortening the connecting rod to the cruise control actuator by 2 – 3 mm (2 – 3 turns) from the slack position should correct the problem.

AF30.21-U-9100AG

Low-speed brake vibration, Models 124.226/230/290

A vibration under light braking in a curve just after starting from a stop and having reached a speed of 6 - 12 mph, may come from air in the transfer case hydraulic system. To bleed the air from this system, remove the hydraulic lines AV and ZS at the transfer case and place the ends in a catch basin. Run the engine and drain the hydraulic oil until it flows free of air bubbles. Finally, correct the hydraulic oil level in the 4-MATIC reservoir.

A second possible cause of this problem is incorrect initial pressure of the multiple-disc clutch AV in the transfer case. Its pressure should measure 1.20 to 1.30 bar.

Finally, the multi-disc clutch AV may have the wrong frictional forces, either because of worn parts or because of the wrong fluid. Replacing the oil in the transfer case with special ATF fluid, part no. 001 989 07 03 and briefly driving the vehicle in tight-radius right and left turns to circulate the new fluid to the clutch surfaces should correct the problem.

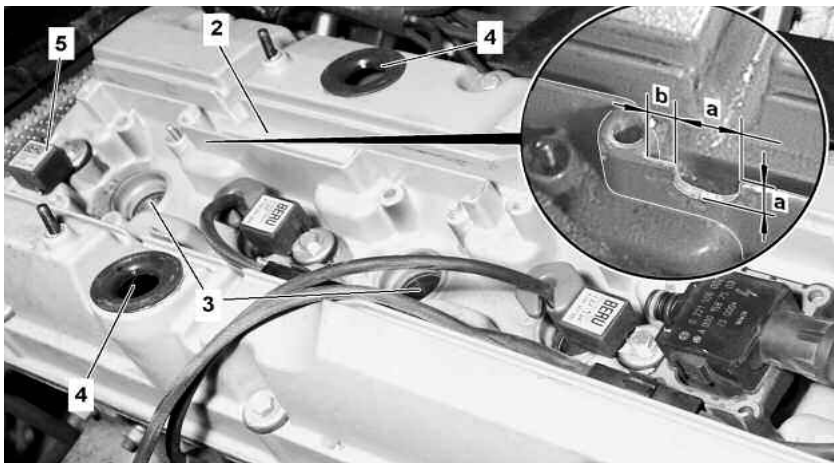
AF28.70-U-3103AV

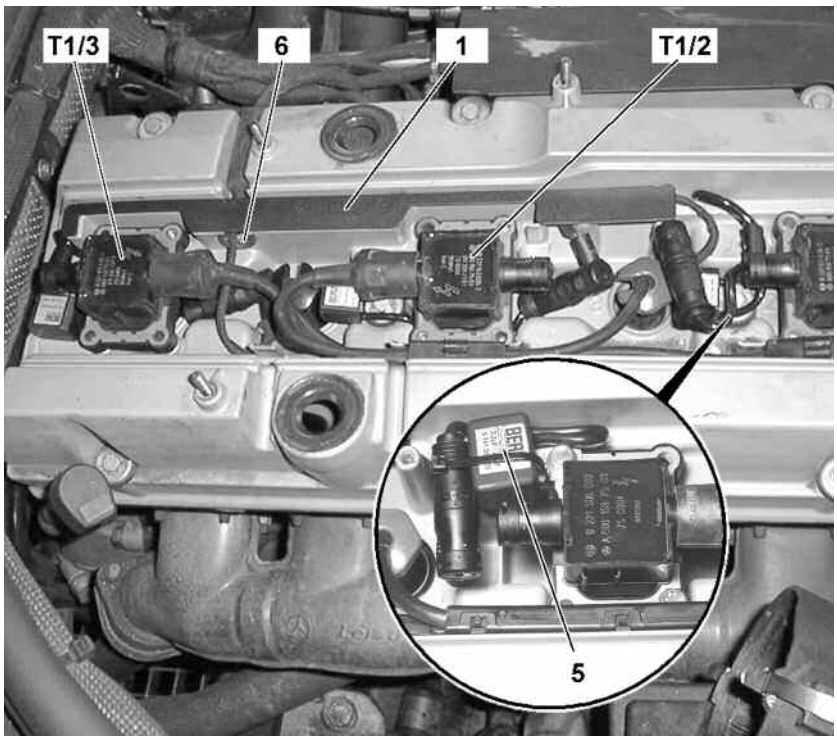
Installing interference suppression filters, engine 104

Sometimes the only way to quiet a radio is with ignition suppression capacitors or filters. To install ignition interference suppression filters, first remove the intake air pipe and the ignition wire shaft cover. Then remove the ignition coils T1/2 and T1/3. Next remove cover 1 and remove the wires from the cable shaft (2). Plug the openings in the valve cover (3 and 4), before you cut out sections in the cable shaft wall. Dimension *a* is 10 mm; dimension *b* is 7 mm. Install the interference suppressors (5).

Re-install the ignition coils and connect the interference suppressors in the circuit 1 feed lines for the ignition coils. Route the electrical lead for ignition coil T1/3 through the cutout you made with a protective sleeve. Make sure the leads for the interference suppressors for both coil T1/2 and T1/3 are below the ignition coils, but do not pinch the wires. Finally, reinstall the cover, the ignition cable shaft cover and the air intake pipe.

AF07.61-U-1300-01A





Cruise control surging downhill, Engine 103

If the car surges or jerks coasting downhill under cruise control, this may be a problem with the deceleration fuel shutoff system. You can confirm this by disconnecting the idle speed microswitch and test driving the vehicle. If the problem is gone, the cause is the fuel shutoff. Unfortunately, you can't leave the switch disconnected because that disables the deceleration fuel shutoff and will put the vehicle out of compliance with federal emissions laws. While testing continues on countermeasures, on many affected vehicles it seems shortening the cruise control rod can reduce the problem.

AF30.21-U-9101AG

No start below -5 degrees C, Engines 104.942/992 up to 3/31/94 in Model 124

Sometimes this problem comes along with code 440a, cruise control, or code 471a, ASR. The original HFM-SFI control module software set the fuel mixture too rich at very cold temperatures, flooding the engine. The software was changed after 8/94. Replacing the module is the repair.

AF07.51-U-6430DA

Surge at idle or no start, Model 124 with engine 104.942/992

This problem may also occur with code 440a, cruise control, and with code 471a, ASR. Check fuse no. 7. If it is burned out, replace it with a 16-amp fuse and make a written note at the fuse box that fuse 7 should be rated at 16 amps thereafter. It may also be necessary to replace the HFM-SFI control module if the one installed is earlier than software status that displays 05/93 in the handheld tester readout.

If fuse 6 is burned out, replace it with an 8-amp fuse. Check whether harness connections are reversed for fuses 6 and 7 and correct if necessary.

AF07.51-U-6400DA

Oil leaks from rear of oil pan

Sometimes there is insufficient clamping force between the rear section of the oil pan and the lower casting of the engine block. But you can t just crank down harder on the fasteners because they have a specific torque assigned to them for proper force without stretching or distorting. If you find a vehicle with oil seepage at the back of the engine as shown here and your customer wants to correct the situation, besides replacing the oil pan gasket with a new one, apply Loctite 5900 sealer in the area in the photo, the back section of the mating surfaces between the pan and the block. Follow the original torque specifications in your service material for the fasteners, however, when completing the repair.

AF01.40-U-4041EU

Battery discharge, sometimes fast, Model 124

If a microswitch in the front door or trunk locks sticks open or the wire to the microswitch shorts to circuit 31, this condition can activate the convenience control unit, which controls the central locking system. Current draw with the vehicle unlocked is between 200 and 800 mA. But if the driver locks the vehicle with the central locking system, the current draw at fuse G or H is between 15 and 20 amps. After the temperature switches in the power window motors trip, this current draw falls to about 200 mA.

To check for this, unplug connector D on the convenience control unit under the left rear seat. Measure the resistance between socket 4 of connector D and circuit 31 (ground). That value should be more than 20 kOhms; in short, there should be no continuity. If your ohmmeter test displays lower resistance than that, disconnect the connectors to the trunk and door microswitches one at a time. If you get the correct resistance with one of them disconnected, that switch is defective. While you check it, it may prove necessary to replace the lock as well.

AF82.40-U-6002A

No central locking from front passenger's door, Models 124 and 201

If the central locking system does not work and if no malfunction appears after you perform the central locking system test described in the Diagnostic Manual, replace the central locking pneumatic pump with the version designed for the station wagon. If necessary, you can make the central locking system work for a short time by resetting the fault recognition circuit. To do so, disconnect power from the pump for at least ten seconds.

AF80.20-U-6095B

Numbers and More Numbers

The Mercedes-Benz Vehicle Type, Parts, Service Groups and Information Classifications

If you're a relative newcomer to working on Mercedes-Benz vehicles, you may be surprised at how many numbers you run into. Besides the fact that the company uses numbers for the sales descriptions of their cars, unlike most domestic or Asian carmakers, these sales numbers are not even the 'real' numbers! What's more, everything else also fits into a numbering system that gradually developed over time to encompass everything on the vehicles, one that includes within the system provision for classifying vehicle technologies not yet invented.

First are the car model numbers. These correspond to the chassis/frame construction of the vehicle, not the sales number. The sales number usually, though not always, reflects in a stylized way the displacement of the engine in liters. Since the same engines are often used in different body styles, you can find more than one kind of vehicle with, say, the number 300 in its sales designation. On the following page are the service group and parts classifications. Every part and every piece of service information fits here in the parts bin or the service literature under that number.

Models Previously in Production

Model 107, the SL two-seat sports car, dates from 1971 to 1989.

Model 116, a large sedan, dates from late 1972 to 1980.

Model 123, a medium sedan, dates from 1976 to 1985. There were station wagon models as well.

Model 124, a medium sedan/coupe, successor to the 123, began in 1985 until 1995. There are station wagon 124's as well.

Model 126, a large sedan, successor to the 116, dates from 1979 to 1991

The two-seat **129 SL**, successor to the 107, began in 1989 and is still built.

The **model 140**, a large sedan/coupe, also called the S-class, began in 1991 until 1999.

Model 201, the smallest sedan, began in 1982 and continued to 1993.

Model 202, sometimes called the C-class, began in 1992 until 2000.

Models Currently in Production

Model 170 was introduced in 1998 as a two-seat convertible with a retractable hardtop.

Model 163 was introduced in 1997. Built in the US, it is the first MBUSA SUV.

In 2001, **Model 202** was replaced by model 203, also available as a coupe.

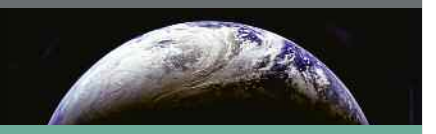
Model 208 was introduced in 1998 as a two-door coupe or convertible.

Model 215 was introduced in 2000 as a hardtop coupe with an all-aluminum body.

Model 220 was introduced in 1999 as a 2000-year model.

Number	Contents
01	Maintenance, service, technical data, General descriptions, Operating instructions, General considerations concerning service products (fluids, etc.) Jacking, towing, laying-up of vehicle
02	Engine, removal and installation, Crankcase, cylinder head, engine breathing
03	Crankshaft assembly
05	Engine timing, valves
07	Diesel injection system, Carburetor system, Mechanically and mechanically/electronically controlled gasoline injection system, Electronically controlled gasoline injection system
09	Air cleaner, intake air preheater, exhaust gas turbocharger
13	Air compressor, belt drives, Intake manifold, exhaust manifold, exhaust brake, emission control system
15	Electrical system, engine (ignition system, preheating system, starter, alternator)
18	Engine lubrication, engine oil cooler
20	Engine cooling system, coolant hoses, radiator
22	Engine mounts
25	Clutch
26	Manual transmission, power takeoffs
27	Automatic transmission
28	Transfer case (4MATIC)
29	Pedals
30	Throttle control, cruise control systems (*Tempomat*)
31	Frame, trailer operation
32	Suspension
33	Front axle

Number	Contents
35	Rear axle, trailing axle
40	Wheels, chassis alignment
41	Driveshaft and U-joints
42	Brakes – hydraulic and mechanical system
43	Brakes – pneumatic and auxiliary brakes
46	Steering
47	Fuel system
49	Exhaust system, heat shields
54	Electrical system, equipment and instruments
55	Auxiliary drives, hydraulic and articulated systems
58	Tools, test instruments, equipment
60	Body, general
61	Undercarriage
62	Front end and firewall
63	Side walls (body)
64	Rear bulkhead and rear end
65	Roof
67	Glass and windows
68	Interior equipment
72	Doors
77	Slide roof (sun roof), top, luggage racks
80	Central locking system, convenience hydraulics, electrical system, body, radio, windshield washer, light range regulator
83	Climate control
86	Emergency equipment, sanitary equipment, kitchen
88	Attachments, outside flaps
91	Seats, cots, restraint systems
94	Body noises, sound insulation
97	Body sealing, anticorrosion protection
98	Paintwork
99	Technical literature, validity list, administration



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McConnell Automotive Corporation
334-476-4141

Montgomery
Jack Ingram Motors, Inc.
334-277-5700

Tuscaloosa
Leigh Automotive
205-556-1111

Alaska

Anchorage
Mercedes-Benz of Anchorage
907-277-3383

Fairbanks
A & B Auto, Inc.
907-456-6161

Arizona

Phoenix
Phoenix Motor Company
602-264-4791

Scottsdale
Schumacher European
480-991-1155

Tucson
Mercedes-Benz of Tucson
520-886-1311

Arkansas

Fayetteville
Jones Motorcars, Inc.
501-521-7281

Little Rock
Riverside Motors, Inc.
501-666-9457

California

Anaheim
Caliber Motors, Inc.
714-777-1900

Bakersfield
Mercedes-Benz of Bakersfield
661-836-3737

Belmont
Autobahn Motors
650-637-2333

Beverly Hills
Beverly Hills, Ltd.
310-659-2980

Buena Park
House of Imports
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Calabasas
Calabasas Motorcars, Inc.
818-591-2377

Carlsbad
Hoehn Motors, Inc.
760-438-4454

Chico
Courtesy Motors Auto Center, Inc.
530-893-1300

Encino
Auto Stiegler, Inc.
818-788-0234

Escondido
Mercedes-Benz of Escondido
760-745-5000

Fremont
Claridge's Ltd.
510-623-1111

Fresno
Herwaldt Motors
559-438-0300

Glendale
Calstar Motors, Inc.
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Laguna Niguel
Mercedes-Benz of Laguna Niguel
949-347-3700

La Jolla
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858-454-7137

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Mercedes-Benz of Long Beach
562-426-7301

Los Angeles
Downtown L.A. Motors
213-748-8951

Modesto
Modesto European
209-522-8100

Monterey
Stahl Motor Company, Inc.
831-375-2456

Newport Beach
Fletcher Jones Motor Cars, Inc.
949-718-3000

Oakland
Mercedes-Benz of Oakland
510-832-6030

Palm Springs
Mercedes-Benz of Palm Springs
760-328-6525

Palo Alto
Park Avenue Motors
650-494-0311

Pasadena
Rusnak/Pasadena
626-795-8004

Pleasanton
Mercedes-Benz of Pleasanton
925-463-2525

Riverside
Walter's Auto Sales & Service, Inc.
909-688-3332

Rocklin
Van Housen Motors
916-924-8000

Sacramento
Mercedes-Benz of Sacramento
916-924-8000

San Diego
Mercedes-Benz of San Diego
858-279-7202

San Francisco
Mercedes-Benz of San Francisco
415-673-2000

San Jose
Smythe European, Inc.
408-983-5200

San Luis Obispo
Kimball Motor Company
805-543-5752

San Rafael
R.A.B. Motors, Inc.
415-454-0582

Santa Barbara
Cutter Motors
805-682-2000

Santa Monica
W.I. Simonson, Inc.
310-829-4511

Santa Rosa
Smothers European
707-542-4810

Stockton
Berberian European Motors
209-944-5511

Thousand Oaks
Silver Star A.G. Ltd.
805-371-5400

Torrance
Mercedes-Benz of South Bay
310-534-3333

Van Nuys
Keyes European
818-997-8700

West Covina
Penske Motorcars
626-859-1200

Walnut Creek
Stead Motors of Walnut Creek
510-937-1655

Colorado

Colorado Springs
Phil Long European Imports L.L.C.
719-575-7950

Denver
Murray Motor Imports Company
303-759-3400

Littleton
Mercedes-Benz of Littleton
303-738-7700

Connecticut

Fairfield
Mercedes-Benz of Fairfield
203-368-6725

Greenwich
Mercedes-Benz of Greenwich
203-869-2850

Hartford
New Country Motor Cars, Inc.
860-522-6134

New London
Carriage House of New London, Inc.
860-447-3361

North Haven
Mercedes-Benz of North Haven
203-239-1313

Delaware

Milford
I.G. Burton & Company, Inc.
302-424-3042

Wilmington
Wilmington Motor Cars, Inc.
302-995-2211

Florida

Clearwater
Lokey Motor Company
727-530-1661

Coral Gables
Bill Ussery Motors, Inc.
305-445-8593

Daytona Beach
Mercedes-Benz of Daytona Beach
904-274-4775

Ft. Lauderdale
Mercedes-Benz of Fort Lauderdale
954-462-4381

Ft. Myers
Mercedes-Benz of Fort Meyers
941-433-8300

Ft. Pierce
Coggin Motor Mall
561-466-7000

Ft. Walton Beach
Quality Imports, Inc.
850-863-2161

Gainesville
Kraft Motorcar Co., Inc.
352-332-7571

Jacksonville
Brumos Motor Cars, Inc.
904-724-1080

Lakeland
Robert G. Waters, Inc.
863-688-8111

Maitland
Mercedes-Benz of Orlando
407-645-4222

Melbourne
Continental Motorcars, Inc.
321-956-0600

Miami
Mercedes-Benz of Miami
305-919-8000

Naples
Regency Autohaus, Inc.
941-643-5006

Pensacola
Centennial Imports, Inc.
850-432-9903

Pompano Beach
Autohaus Pompano
954-943-5000

Sarasota
Glauser, Inc.
941-923-3441

St. Petersburg
Crown Eurocars, Inc.
727-526-3738

Tallahassee
Capital Eurocars, Inc.
850-574-3777

Tampa
Mercedes-Benz of Tampa
813-870-0010

West Palm Beach
Mercedes-Benz of Palm Beach
561-689-6363

Guam

Tamuning
Atkins Kroll, Inc.
671-646-2360

Georgia

Albany
Hentschel Motorcars, Inc.
912-883-2040

Athens
Mercedes-Benz of Athens
706-549-6600

Atlanta
Carriage House Imports, Inc.
770-964-1600

Atlanta
RBM of Atlanta, Inc.
770-390-0700

Augusta
Rader, Inc.
706-860-1111

Columbus
Columbus Motor Company
706-327-3636

Decatur
Atlanta Classic Cars, Inc.
404-296-1313

Macon
Jackson Automotive Group, Inc.
912-477-4858

Savannah
Critz, Inc.
912-354-7000

Hawaii

Hilo
Theo Davies Euromotors, Ltd.
808-961-6087

Kailua-Kona
Theo Davies Euromotors, Ltd.
808-329-7616

Honolulu
Theo Davies Euromotors, Ltd.
808-592-5600

Idaho

Boise
Lyle Pearson Company, Inc.
208-377-3900

Pocatello
Park Price Motor Company
208-232-1062

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Mark Motors, Inc.
847-259-4455

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Motor Werks of Barrington
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Napleton's Autowerks
815-933-8221

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Sullivan-Parkhill Imports, Inc.
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Loeber Motors, Inc.
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Sawyer Auto Imports, Inc.
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Lake Bluff
Knauz Continental Autos, Inc.
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Lincolnwood
Loeber Motors, Inc.
847-675-1000

Loves Park
Napleton's Autowerks, Inc.
815- 636-6600

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Foley-Sweitzer Motor Sales, Inc.
618-997-1313

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Mercedes-Benz of Naperville
630-305-4560

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Sud's Motor Car Company, Inc.
309-454-1101

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Autohaus on Edens, Inc.
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Mercedes-Benz of Orland Park
708-460-0400

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Mid/Town Imports Incorporated
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Isringhausen Imports, Inc.
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D-Patrick, Inc.
812-473-6500

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Highland
Terry Shaver Imports, Inc.
219-924-2400

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765-448-4582

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219-272-0990

Iowa

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Areson Motors
319-849-1233

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319-388-8610

Des Moines
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Aristocrat Motors
913-677-3300

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Sunflower Motors, Inc.
785-266-8480

Wichita
Scholfield Auto Plaza, L.L.C.
316-688-5000

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Sim Fryson Motor Co., Inc.
606-329-2288

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270-745-0001

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606-268-1150

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Tafel Motors, Inc.
502-896-4411

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Walker Automotive
318-445-6421

Baton Rouge
Audubon Imports
225-296-7290

Lafayette
Moss Motors
337-235-9086

Metairie
Benson Motor Company
504-456-3727

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318-212-1212

Maine

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207-941-1017

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Performance Motors
207-781-3207

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Grand Blanc Motorcars, Ltd.
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Orrin B. Hayes, Inc.
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Williams Auto World
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Mercedes-Benz of Novi
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Terry Feldmann's Imports, Inc.
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Maplewood Imports
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Sears Imported Autos, Inc.
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Bert Allen Imports
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Higginbotham Automobiles, L.L.C.
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Creve Coeur
Plaza Motor Company
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Husker Auto Group. Inc.
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Premier Motorcars of Nebraska
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609-825-7070

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Intercar, Inc.
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Prestige Motors, Inc.
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908-964-4000

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609-645-9000

New Mexico

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505-821-4000

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212-629-1600

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315-475-7933

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Bend
Dave Holt, Inc.
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Mercedes-Benz of Houston North
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Classic-Tyler Motors, Inc.
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