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Information for the Independent Mercedes-Benz Service Professional

September 2004 U.S. $6.00 € 12.50

Brake Flushing

Radio Codes

Central Locking

Volume 4 Number 3

Mercedes-Benz

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Welcome to *StarTuned,* the magazine for independent service technicians working on Mercedes-Benz vehicles. Mercedes-Benz 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 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 original, 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.

Send your suggestions, questions or comments to us at:

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Mercedes-Benz

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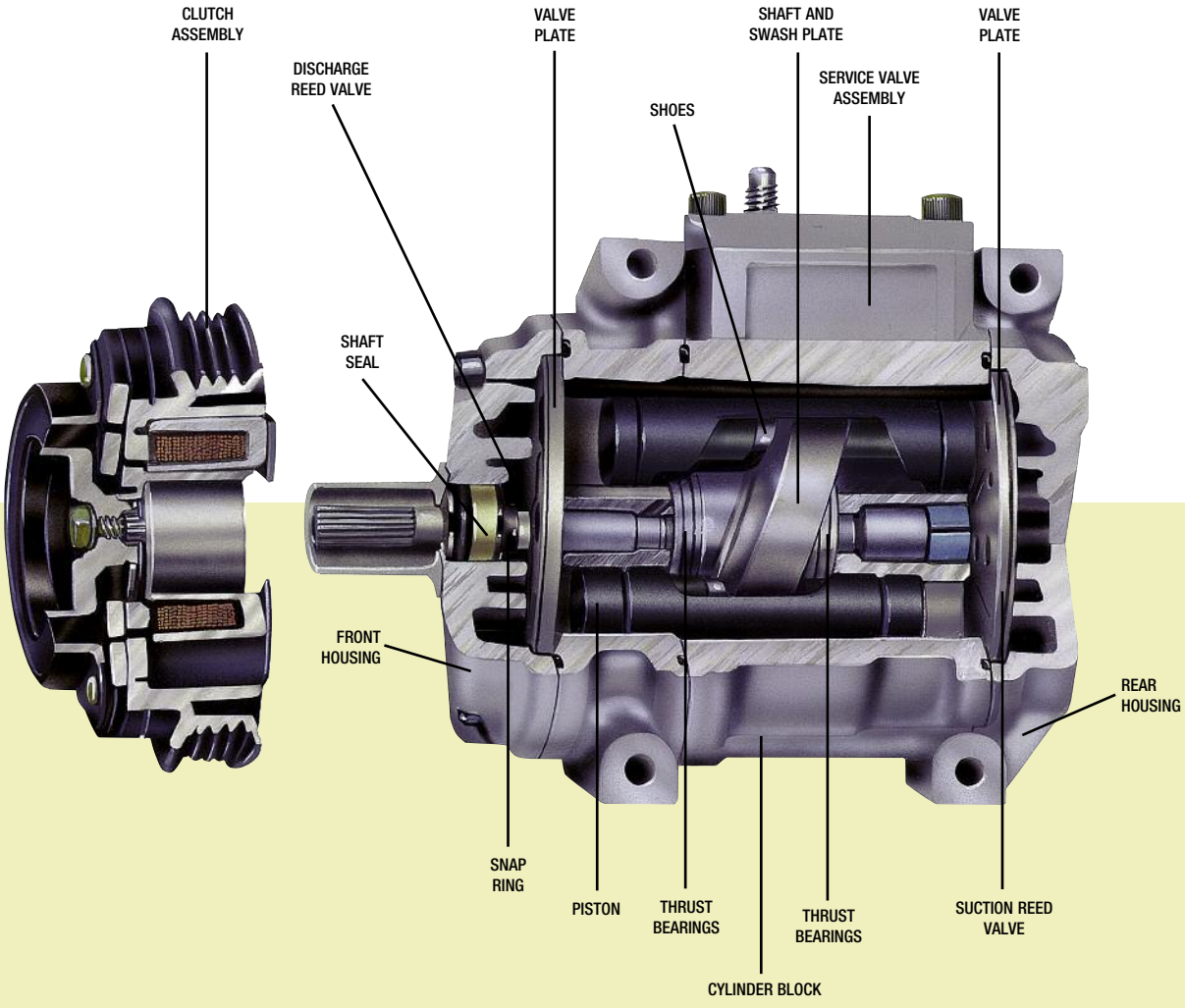

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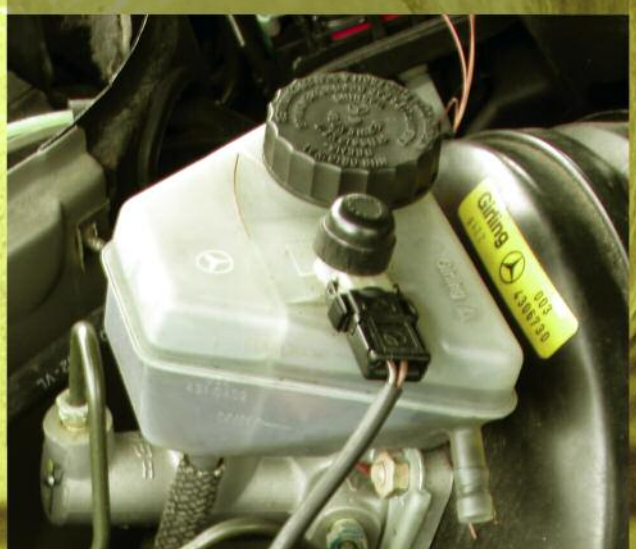
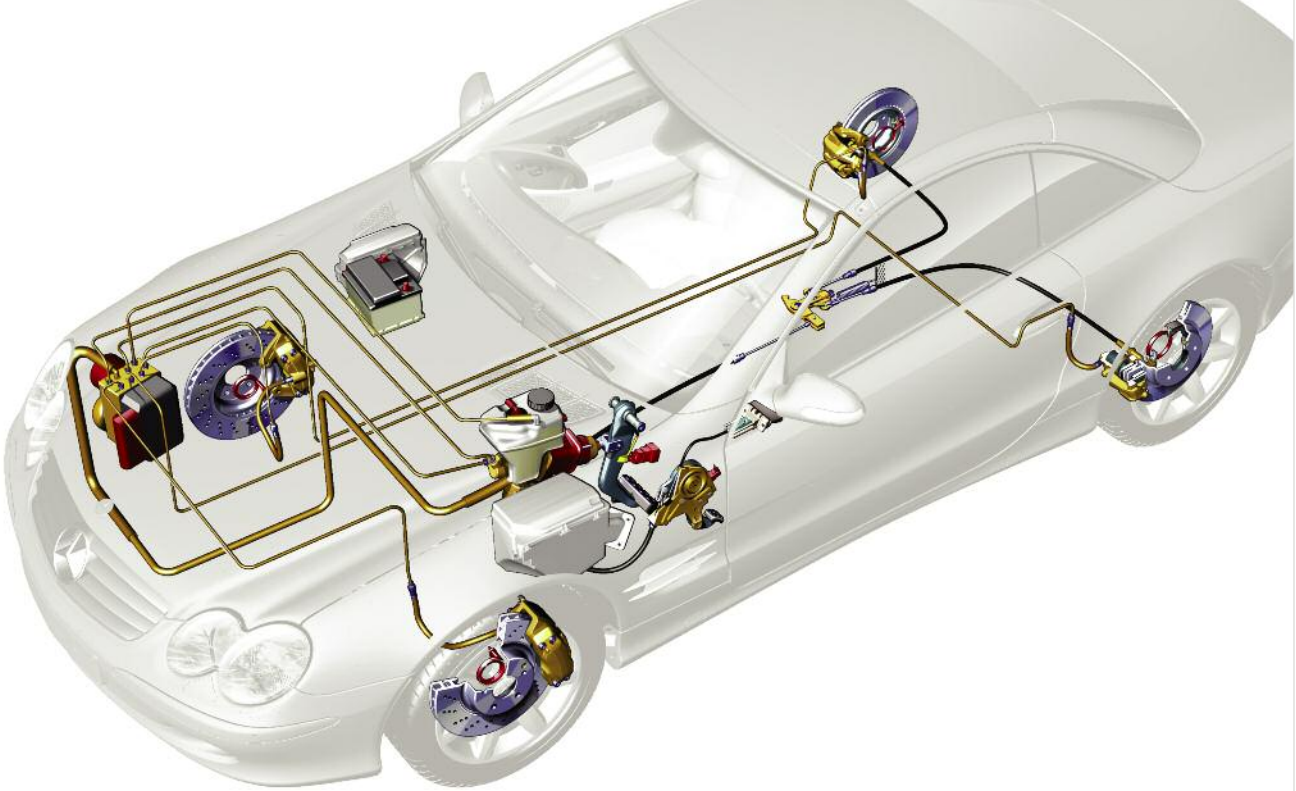
FLUID FLUSH

Before antilock brake systems, brake flushing was a simple, if widely ignored, maintenance procedure for most cars, including Mercedes-Benz.





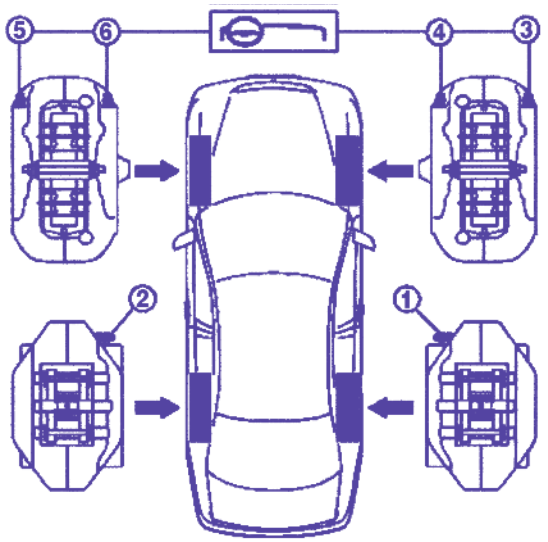
All hydraulic braking systems, from the oldest and simplest to the latest and most complex like this Sensotronic brake system from Mercedes-Benz shown in conceptual X-ray here, require the complete removal of all the air in the system to maintain hydraulic application force. They also all require periodic replacement of the fluid with new, both to remove any small debris that may accumulate and because the fluid itself changes boiling temperature over time.

Though everyone in the profession has long known that you should flush brake fluid at least every two years (ideally in the spring) to avoid moisture absorption, internal rust and a lower boiling point of the hydraulic fluid, few motorists agreed to the routine with that regularity. Most felt, as long as a dramatic brake failure or wheel lockup wasn't present, their worst concern might be the need to rebuild or replace a leaking caliper or wheel cylinder because of that internal rust.

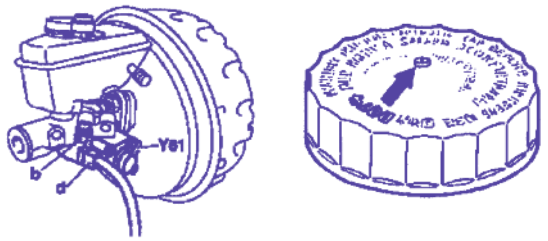
However, with ABS and even more so with later, comprehensive traction and stability control systems such as ASR and ESP, a car's brake plumbing includes electro-hydraulic units of intricate complexity and corresponding cost. Vehicle performance and safety standards of such subtlety and flexibility critically require control mechanisms of corresponding subtlety and flexibility. It’s bad enough if you have to replace one of these components because of damage from an accident, but much worse if you have to do so unnecessarily, only because someone deferred the inexpensive maintenance of a regular hydraulic fluid flush. Price one of these usually very long-lived components, and you won’t need further persuasion to flush the brake fluid as routine maintenance. If it were your car, you’d do it every time, every other year, no questions asked.

Traction controls, from the earliest and simplest in ABS to the latest and most complicated in ESP (except for early, all-hydraulic 4MATIC), involve hydraulic control units with valves, solenoids and hydraulic passages. As long as the brake fluid is uncontaminated with moisture, these control units can have an indefinitely long useful life. Let water in, and the car owner is quickly in the market for a replacement unit. The moisture allows internal corrosion and rust to form in the system, and there is no way to turn the clock back and remove it. Also, the ABS might not work when you need it, and there's the question of reduced brake fluid boiling temperatures (which we'll explain later), so this becomes an important safety issue

But there is a very economical way to avoid these problems: regular, timely brake fluid flushes. While this maintenance is not as sim-



Every vehicle has a proper bleeding sequence to insure removal of all entrained air in the system. For virtually every Mercedes-Benz, start at the bleeder farthest from the master cylinder and work back closer one bleeder at a time. Make sure each circuit is flushed and without any bubbles before moving on to the next.



The master cylinder comes first in every brake bleed – not necessarily to bleed it unless you've replaced it or opened the adjacent hydraulic lines, but to draw most of the old fluid out by vacuum and replace it with fresh. On many Mercedes-Benz brake systems, check the reservoir cap to confirm the vent is open.

ple as it once was, it is still relatively straightforward even for the most complex of Mercedes-Benz brake systems. Note, however, that for some of the very latest models, you cannot properly bleed the brake system without a special tool to actuate the traction control solenoids. This article contains no information about those systems. Once those cars are out of warranty, StarTuned will cover how to work on them.

Fluid Flush Step-by-Step

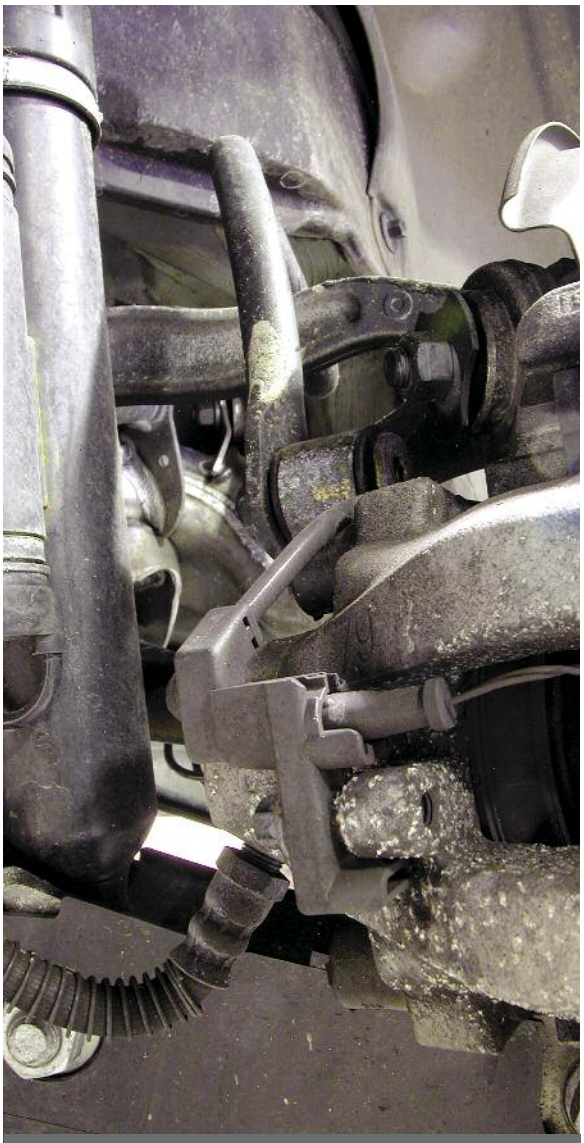
Flushing the fluid from a brake hydraulic system aims to replace all the old fluid with new, without introducing any air into the system. That last part can be a problem whenever you've opened the hydraulic system to replace something, say a brake hose or a caliper. We'll get to that in a moment.

Take care to have some water nearby whenever you're flushing or bleeding brakes. Water works quickly to remove spilled brake fluid and in particular to cancel its notorious hostility to paint. If you just wipe brake fluid off with a rag, the thin film that's left can still peel paint off the car later. Don't underestimate the importance of being ready to neutralize and remove brake fluid immediately: it would take the profits from many a brake flush to offset the cost of repainting a damaged hood or fender. Safe practice is always to use a hose over the end of each bleeder to direct the fluid into a container. Some still seeps around the threads, but that ooze doesn't spurt or gush and dribble down the side of the car.

Be alert to brake fluid's danger to your eyes, too. You already know how quickly it can turn the skin of your fingers to zombie claws. The lens of your eye has much less callous than any finger and can die immediately and permanently with a squirt of brake fluid. Use goggles, or, even better, a full-face shield, and don't be too lazy to hook up hoses to the bleeders and route them into a catch bottle, which you'll typically hang from a suspension or steering component.

The first step in any brake fluid flush is to draw most of the old fluid out of the master cylinder reservoir with some sort of vacuum device. You can even use an old suction-type turkey baster for the job (make absolutely certain that it's not contaminated with even a trace of oil, any other fluid, or dirt – just a drop of motor oil, or a fragment of debris, can ruin a hydraulic system), provided you label it so that there's no chance anybody will ever uses it for cooking again.

Clean the area around the master cylinder



The bleed sequence proper starts as far from the master cylinder as possible, at the right rear caliper on most cars. Once you have clear fluid flowing from this bleeder, with no bubbles, you have a solid hydraulic path all the way back to the master cylinder reservoir. Then, move to the left rear.

cap with a shop cloth before opening to keep any damaging particles from getting in, then draw the fluid down to just above the bottom of the reservoir, where the fluid enters the master cylinder piston. Why do this? Because the point of fluid-flush maintenance is to replace the old fluid with new, not just to cycle some fluid through the system. Remove as much of the old as possible as a preliminary, and you have that much less to flush through later. What 's more, since there's less of the old fluid in the reservoir to begin with, the new fluid gets less contaminated.

There is a certain proper sequence to follow in flushing brakes to get all the old fluid and air out, but if you understand the reason for that sequence, you don't have to memorize it and can flush or bleed brake systems on cars you've never seen before.

Fundamentally, you'll flush or bleed the point farthest from the reservoir first, the next farthest second and so on. The only exception to this is when you replace a master cylinder and are bleeding the system with the brake pedal rather than a pressure system. You'll have to bleed the master cylinder first to get a way to bleed the rest of the system. When you flush the farthest bleeder first – the right rear for most cars – consider what's happening: By the time you have clean, clear, new brake fluid flowing from that (with no bubbles), you have a complete hydraulic path of new fluid all the way back to the master cylinder reservoir. The only possible remaining locations for old fluid and air are in the branch circuits to the other wheels. Bubbles are not likely to float down in a hydraulic system. You can drive them down, of course, if there's no other way to get them out. But generally, a bubble will stay put or slowly rise. Once you flush a brake fluid hydraulic circuit and close the bleeder, though, no more air or old fluid can enter that circuit from upstream unless you push it down.

Next, you move on to the left rear, the next farthest wheel and caliper from the master cylinder. If you flushed the right rear properly, the only possible place for old fluid and air in the left circuit is from the juncture block to the bleeder, so that should be a straightforward piece of work.

When you move to the front axle, bleed the right caliper first, since it's slightly farther from the master cylinder. Front brakes do more of the braking than rears and those wheels encounter more road debris, so check the condition of the brake rotor, pads, hydraulic hoses and metal lines, and all the surrounding hardware for security. While you're in place, make sure all the suspension and steering parts are functional and check for any fluid leaks from the coolant, lubrication or power steering systems.

Why Flush Brakes?

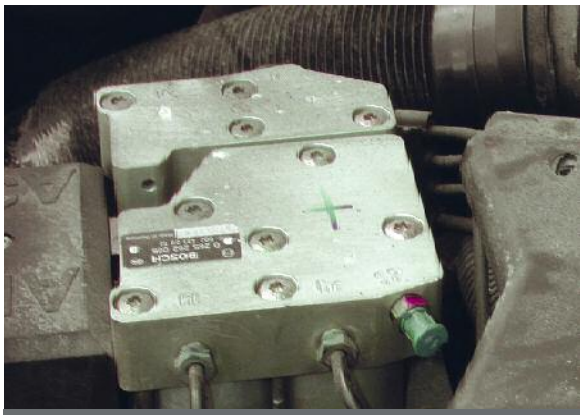
"If stuff ain't broke yet, don't fix it" has been a mantra of traditional mechanical wisdom forever.

And like most gnarled chunks of traditional wisdom, a crackpot mantra at that, even if "everyone knows it." Would you defer oil changes until an engine throws a rod, since there "ain't nothin' broke yet?" Without maintenance, there will be damage soon enough. Would you wait to check and correct tire inflation until a tire turns to ragged black strings around a smoking wheel? For that matter, would you wait until the fuel tank runs empty to fill up? Rational maintenance is "fixing stuff before it breaks."

For most people, whatever they say otherwise about acceleration and performance, what really counts for the most important dimension of automotive performance is dependable, useful life, durability. You can't have that by waiting for something to fail and then replacing that piece; you can't have it by not "fixin' what ain't broke " until something is. The none-too-mysterious, none-too-dramatic non-secret of vehicle durability (assuming good engineering design and construction in the first place) is intelligent, attentive, regular inspection and maintenance.

To make a Benz last, you don't have to change the oil every Saturday morning, but you should change it before the car goes beyond the prescribed mileage limit or the recommendations of the oil maintenance reminder program. The lubricant properties of engine oil fall off rapidly after that time-point. You do have to look closely at all the vehicle components while you're doing routine work, because that's the only way you'll spot a leaking shock absorber, a worn ball joint, a split suspension bushing or a cracked exhaust hanger before it becomes a "drop everything," "right-now" problem –or worse still, a road-side breakdown or even an accident.

The main reason brake flushing falls into this routine-maintenance category is that brake fluid is hygroscopic: It draws moisture out of thin air. Since there's no visible change, this is very hard to believe unless you were to test it –but just take our word for it rather than run the actual test, which is dangerous since the fluid is flammable and could (with some difficulty – its flashpoint is high) catch fire under extreme conditions. To reiterate: DO NOT ACTUALLY PERFORM THE THEORETICAL TEST WE ARE ABOUT TO DESCRIBE AS IT WOULD PROPOSE A FIRE HAZARD. JUST USE YOUR IMAGINATION.



Although we aren't covering ASR or ESP in this article, if you see a unit anything like this, you can eliminate some old fluid by doing the following: Look for the outlet marked "SP." Sometimes, as here, it ends in a stub; sometimes there's a pipe. In either case, set up a drain tobe to vent the fluid into a container (it will come out with considerable force and speed). Loosen the fitting and start the engine. The ASR/ESP pump comes on and forces fluid through the valve block. When there are no bubbles, close the outlet and once the pump stops turn the engine off. Top up the master cylinder reservoir and check the brakes for reliable function. You're done flushing brakes for this car for a couple of years.

Here 's how to run the test in your mind as a thought experiment: Imagine that you've got a cup or so of leftover new brake fluid (you don't save it, of course, because you use a fresh, unopened new bottle for each job unless you have one of those special, sealed-pressure flushing machines or bleeders – a very worthwhile purchase, indeed), and you pour it into a beaker over heat and measure its boiling temperature. Good quality brake fluid boils somewhere between 500 and 600 degrees Fahrenheit. That's pretty toasty, but the friction

surfaces of brake disks and pads get very much hotter, conducting much of their heat through the piston and caliper to the fluid.

Now, suppose you left the rest of your sample in the bottle, open or cap-ajar, for a week or so (if you ever actually leave brake fluid around for any reason, put it out of the way so there'll be no paint or other damage if someone bumps it over), and then imagine repeating the conceptual boiling-point test. The fluid would look identical. But it would start to bubble at just above 300 degrees. What happened over that week or so? The hydraulic fluid absorbed moisture from the air, and it only needs to absorb about three percent of its volume to drop the boiling point several hundred degrees. The now-dissolved water begins the lower-temperature boil. The same absorption occurs (unavoidably but much more slowly) in the brake system, drawing moisture around the piston seals and reservoir cap. It can happen very quickly, however, if a car in the work bay sits with the cap open for any appreciable amount of time on a humid day.

Bleed the front calipers next, keeping in mind that some late-model cars have more than one bleeder on the front calipers. While you're at work, carefully inspect pads, hardware and nearby suspension components. Don't wait for something to break.

So? Big deal. What's the difference? Who cooks brake fluid in a pot? Wrong questions! Ask instead, what boils brake fluid in a car and what happens then? Let's go back to the hot friction surfaces of the pads and disks, the source of all the heat. The heat travels, mostly by conduction, but partly by radiation, to the calipers and the brake fluid inside them.

Let's suppose the brake fluid temperature exceeds its boiling temperature in a caliper during an extended, hard brake application, say down a long mountain slope. What happens? The surprising answer is, at first, nothing. Brake fluid, like all fluids, has a boiling point at a specific pressure. When you boiled the sample in a pot, the ambient pressure was ordinary atmospheric, about 14.5 psi or 1,000 mBar, at sea level. We speak of water boiling at 212 degrees, but that's at the same sea-level atmospheric pressure.

What is the boiling point of water in a pressure cooker? It depends how much pressure there is. For reasons of safety (we don 't want scalding steam bombs exploding in kitchens), most pressure cookers release steam at 15 or 20 psi above ambient atmospheric. The water in them boils at perhaps 250 or 260 degrees. But at 240 degrees under the same pressure, it's not boiling. In fact, pressure and temperature correspond directly up to the temperature/pressure at which the safety release weight starts to dance on a plume of steam. Use a heavier weight, get a higher temperature. And vice-versa. That's why people at the top of the Rockies have to use pressure cookers to cook potatoes – their water boils at about 185 because of the low atmospheric pressure present at their altitude, but potatoes take hours to soften at that temperature.

What would happen if you were foolhardy enough to release the pressure with the water at, say, 240? (DO NOT ACTUALLY TRY THIS – IT IS ANOTHER THOUGHT EXPERIMENT). Suddenly it boils furiously – explodes, actually. That sudden, superheated steam release would be a very dangerous experiment, one to avoid strenuously because of the serious risk of scalding. You wouldn't be able to re-cap the steam blast without burning your hand. Let us repeat: All of our steam pressure comments here are about thought-experiments – don't actually run them yourself. Superheated steam can cause much more tissue damage much faster than open flame.

A pressure canner with the weight removed from the steam vent boils water at 212 degrees at sea level. Put the weight on, and the boiling point rises to about 240 degrees. Add some extra weight (the 2000 Sacagawea dollar), and the temperature rises to perhaps 250. With the still heavier 1884 Liberty dollar, the temperature must rise to above 260 before the pressure (and thus the boiling point) rises high enough to lift the weight and vent the steam. You'll notice, we didn't actually tamper with an active steam-pressure safety release because that would be dangerous. Neither should you. The point is the correspondence between boil-point temperature and vapor pressure. This correspondence is just as true for brake fluid in a brake caliper as for water in a pressure canner, but at higher numbers.

Now think about the hot brake fluid in the caliper during a sustained, hard brake application. Let's assume the temperature also goes above the fluid's boiling point at atmospheric pressure – let 's even assume it goes far above. But the fluid in that caliper just then is most certainly not at ambient, atmospheric pressure; it could be as much as 1,500 psi higher, not just the dozen or so psi you can get in the canning pot with Sacagawea or Lady Liberty jiggling on the steam weight. It all depends how hard the driver can press the brake pedal. Brake fluid doesn't boil at that high pressure. But next, the driver reduces or releases pedal pressure, or he attempts to pump the pedal, or the ABS cycles the pressure down to prevent an imminent wheel lockup. You see what must necessarily happen. Now, at the exact moment of pressure release, brake fluid in the caliper boils furiously. The boiled fluid blasts back through the lines toward the master cylinder. Now the caliper and adjacent brake lines change from an incompressible hydraulic system to a spongy pneumatic one. Now, instead of the tons of clamping force you could apply hydraulically between pads and caliper, you can only deliver pneumatic ounces. Now you've effectively lost most braking power and can't slow the car. Now, you have serious brake failure that can only correct itself when the system cools.

Unfortunately, that may not happen in time to avoid an impact. If you still have half a mountain to descend without brakes, you may tragically discover the control limits of engine braking and steering traction alone. Now the economy and convenience of skipping a regular brake fluid flush may not loom so large.

Let's put the question more precisely: What is the dynamic difference between a hydraulic and a pneumatic system? Don't be misled thinking about air brakes on big trucks, which are technically, of course, pneumatic, but in a substantially different sense. Those brakes use huge pressure diaphragms – half a square foot or more, not the inch or two square at the typical brake caliper. And they don't use a few ounces of applied pressure, but as much as 120 psi. And they don't apply that pressure directly to the friction surfaces; instead, they push levers that rotate cams that, in turn, pivot the shoes – all of this with mechanical advantage compounded multiple times by leverage at each juncture. So, truck pneumatic airbrakes can apply many tons of force between shoes and drums.

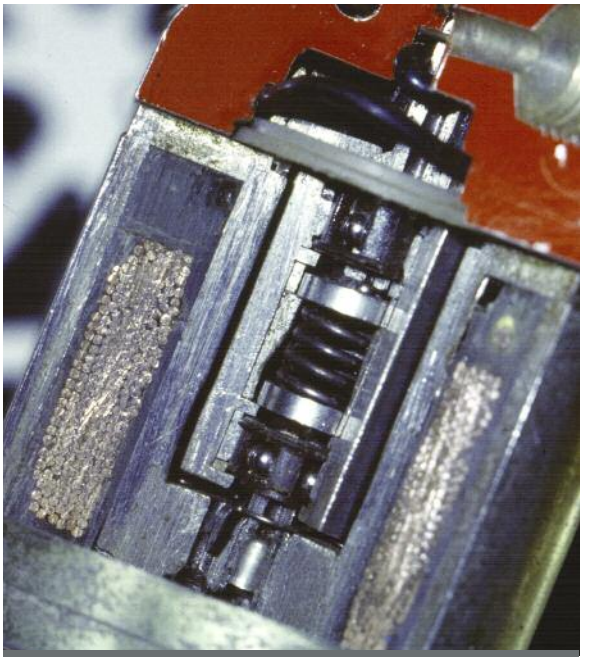
But a car with hydraulic brakes overheated to the vapor point can barely apply the brakes at all, with mere ounces of clamping force, not even enough to resist turning a wheel by hand. The pedal will sink to the floor alarmingly, and you'd have to pump it frantically to re-pressurize the system above the boiling point again. That is serious brake failure. We flush the brake system every other year with fresh fluid so we can read about that kind of bone-chilling occurrence rather than experience it ourselves.

Let's consider the simplest possible hydraulic circuit: a piston, a tube and another identical piston at the other end, all filled with fluid. Push the drive piston an inch, and the driven piston moves an exactly corresponding inch. Or does it? What if there's a load or some other resistance at the driven piston? Well, that resistance will be equal at the drive piston, so it will resist drive-piston movement in exact proportion to the resistance at the driven. If the driven piston encounters an immovable object halfway through its travel, so does the drive piston, and it stops. This relationship endures perfectly up to the limits of the tube's and piston seals' capacity to hold pressure, and the resistance corresponds to the relative surface of the working hydraulic face of each piston (so a drive piston one-inch square can push a two-inch driven piston half its travel distance with twice its own force, or a half-inch driven piston twice its travel distance with half its own force).

So how much pressure can an inch of drive piston travel build? It could be thousands of psi, if there is sufficient resistance and the system can hold it. A hydraulic system is almost as rigidly mechanical as if the pistons were either end of the same steel rod. Think diesel injection lines, which routinely transmit pressures of several thousand psi.

Now consider a pneumatic system, exactly the same plumbing as before, but the tube and working volume of the pistons are full of a gas instead of a fluid. The fundamental difference is this: A gas is compressible; a fluid is not. A fluid can carry pressure hydraulically, of course, but it does not itself compress. Do not mistake the capacity to carry pressure with compressible – the hydraulic fluid has the first without the second; the pneumatic gas has both, but not in a parallel way.

How does this apply to a brake system and fluid flushes? The brake system is, of course, hydraulic. But if nobody flushes the fluid, it eventually absorbs enough moisture through the piston seals and master cylinder cap to boil at 300 degrees. The brakes can reach that temperature quickly in a hard deceleration, and if they do, they'll boil the fluid in the caliper into vapor. A sealed system with both fluid and vapor in it is essentially pneumatic, because the vapor has the critical property of compressibility.



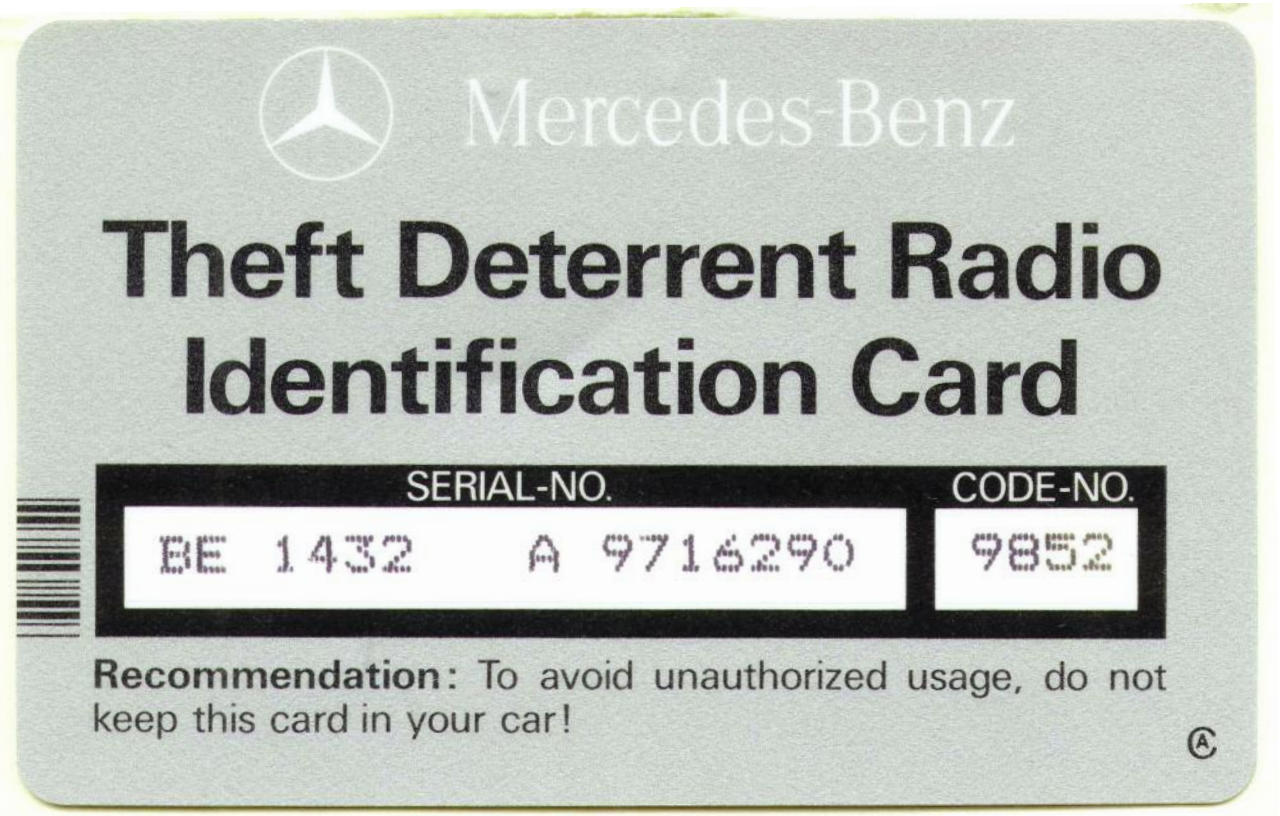
The sophisticated electronics of ABS won't be able to do their job if the tiny hydraulic passages and the electro-hydraulic components are gummed up.

What happens then is an effective reduction of pressure at the calipers. The length of the bore limits master cylinder travel, and if there is suddenly a lot of vapor in the system at the calipers, it is impossible to increase or even sustain the clamping pressure at the pads without pumping.

So, flush the brakes by the recommended schedule. In the case of Mercedes-Benz, that's every two years in the spring. Not only does the motorist save the cost of a hydraulic control unit, he or she may still be alive next time to have the job done again. And the next time someone tells you "Don't fix it if it ain't broke," point him or her to a mangled wreck. That could be the result of his or her suggestion,whether he or she understands it or not. Don't wait until "somethin's broke." You, not the motorist, are the professional who knows what to do. Tell your customers what's needed, and expect them to take what you say seriously.

LOCKED RADIO

Oops!
You pulled the battery cable without attaching a battery backup, and you just know you're going to see the "CODE" message on the radio panel when you reconnect.



Better hope that customer has the code information, such as this card, in his or her papers somewhere. If not, you'll need to present proof of who actually owns the car and your own credentials before the company will release the unlock sequence.

Well, there's good news and bad news. First, none of the radios Mercedes-Benz has used for years will lose their station settings from a power interrupt, so the customer won't have to tune or seek until he finds his favorite disk jockeys, classical music stations, or talk shows, then reset those buttons. But no matter how fast you might be at realizing what you've done and slapping that cable back on the terminal, you're going to have to reset the code. This function occurs in milliseconds. Rumors you may have heard about internal batteries or lingering capacitance holding this useful feature at bay for any length of time at all are simply false. You'll have to just accept it, then follow through with what must be done to make that radio operational again.

The radio will inform you of your mistake with the alarm display, "CODE." After you're done slapping your forehead, what do you do to set things right and stay in your patron's good graces? Well, resetting the radio is done in different ways for the various audio systems found in Mercedes-Benz cars, and here's the information you'll need to perform the procedure on some common models.

One note up front: Carmakers first installed radio anti-theft systems to thwart felons and bandits who ripped radios from cars, leaving gaping holes in ruined dashboards. With anti-theft systems, this enterprise fails because such a filch renders the radio useless, and although junkies may wallow in delusion with the shrieking gibbers, drug pushers and fencers of stolen property do not. No way they're going to pay anything for even the most upscale unit if it can't be used because the thief neglected to get the code card along with it (that's why M-B advises that the card should not be kept in the glove compartment, although after the owner takes it out and puts it somewhere among his or her other papers, there's a good chance that he or she won't be able to find it again, human nature being what it is). Nothing in this article serves to get around that anti-theft feature. If you don't have the specific radio code for this vehicle, either from the car owner's records or directly from Mercedes-Benz's C.A.C.

(Customer Assistance Center), you won ’t find it here, either, or any way to work around it.

If your customer doesn’t have the radio-code information, you’ll find that the company's representatives will want a fair amount of proof of who owns the car and who is doing the work before they’ll release the unlock sequence. In some cases, MBUSA may require that you take the car to a dealership to confirm all the vehicle information first. Considering that the whole point of this system is to make things inconvenient, if not impossible, for thieves, you can understand why.

Mercedes-Benz builds cars, not radios, so there are different radios in different cars, depending on the model year, the accessory choices and so on. Different radios use different release code procedures, so make sure you know which radio you have before you start. You won’t destroy the radio by punching the code in the wrong way, but you could trigger a second level of defense, requiring a longer or shorter wait depending on how often you’ve flubbed the procedure. This second level of defense could require leaving the radio turned on (but non-functionally locked) for as long as 24 hours. The point, again, is to discourage and dishearten those who believe in helping themselves to others' property.

Unlocking the CODE

Start with the model year in our boxes below. Make sure the radio faceplate in our line drawing corresponds to the radio in the car, and follow the instructions exactly. Many different radios use slightly different unlocking procedures, and you must use the exactly correct one for that radio.

For earlier models, you may recall that there were some "gray-market" cars with European radios, none of which is included here. For them, you’ll have to go to your local dealer (who may not be entirely ecstatic about the job, either). The first generation of anti-theft radios to appear in Mercedes-Benz cars were the Beckers used from 1986 to 1989. If one of these early units requires digital unlocking, you’ll definitely have to take it to an M-B dealer because a physical electronic key is required to unlock them, and these keys are not generally available.

Radios from different suppliers have different release code procedures. If you try the wrong one, you might trigger a second level of defence, which may entail a long wait.

Avoiding the situation

Of course, you'd be better off if you didn't cause this sometimes-frustrating glitch in the first place. So, whenever you're about to disconnect a Benz's battery for whatever reason, stop and think. All you have to do is attach an auxiliary power source to the cables. We used to keep a small motorcycle battery around for the purpose, but now we just use our portable jump-start box. There's even a special tool available called a "Memory Retainer." By the way, if you plug the auxiliary into the cigarette lighter, remember that you'll have to leave the key on to keep Circuit 15 alive.

Procedures for Selected Models

As of Model Year 1999, Becker Accessory Radio

Recording Sequence:

1. Turn ignition key to position 2.
2. Turn radio ON. "CODE" appears on the display followed by four stars.
3. Enter first digit of anti-theft code from CODE card. The first star will disappear. Enter the remaining three digits. Each successive star will disappear as the code is entered.
4. The radio will resume normal operation if the code was entered correctly.
5. If an incorrect code has been entered, "CODE" and four stars will reappear on the display. The correct code must be entered.

If Unsuccessful:

6. If three unsuccessful attempts are made and "WAIT" appears on panel, the radio must be left ON until "CODE" and four stars appear. This will take 60 minutes.
7. Once "CODE" and four stars appear, continue with step 3.

Up to Model Year 1999 Model 163 Premium Radio

Recording Sequence:

1. Turn ignition key to position 2.
2. Turn radio ON. "CODE" appears on the display.
3. Enter first digit of anti-theft code from CODE card. "CODE" will disappear and the entered digit will appear followed by four dashes. Enter the remaining four digits.
4. Press the < or > button to confirm code. Radio will resume normal operation.
5. If an incorrect code has been entered and confirmed, "CODE" will reappear on the display. The correct code must be entered.

If Unsuccessful:

6. If three unsuccessful attempts are made and "WAIT" appears on panel, the radio must be left ON until "CODE" appears. This will take 10 minutes. If three more unsuccessful attempts are made and "WAIT" appears on panel, the radio must be left ON until "CODE" appears, which will take 60 minutes.
7. Once "CODE" appears, continue with step 3.

As of Model Year 1994, Alpine & Becker

Recording Sequence:

1. Turn ignition key to position 2.
2. Turn radio ON. "CODE" appears on the display.
3. Enter first digit of anti-theft code from CODE card. "CODE" will disappear and the entered digit will appear followed by four dashes.
4. The next digit to be entered flashes. When all five digits are entered, the first digit flashes again. Verify that the correct code is on the display. If a wrong digit was entered, re-enter complete code until correct code is displayed.
5. Press SC, Seek or Tune button to confirm code. The radio will resume normal operation.

If Unsuccessful:

6. If "WAIT" appears on panel, the radio must be left ON until "CODE" appears. This will take either 10 minutes or 24 hours depending upon the number of attempts made.
7. Once "CODE" appears, continue with step 3.

As of Model Year 1991 Alpine Radios

Recording Sequence:

1. Turn ignition key to position 2.
2. Turn radio ON. "CODE" appears on the display.
3. Enter first digit of anti-theft code from CODE card. "CODE" will disappear and the entered digit will flash on the display panel.
4. Enter remaining three digits (total of four digits). Verify that the correct code is flashing on the panel. If wrong digit was entered, re-enter code until correct code is displayed.
5. Press button "*" to complete the sequence. Radio will beep and resume normal operation.

If Unsuccessful:

6. If "HOLD" appears on panel, the radio must be left ON until "CODE" appears. This may take either 15 minutes, or 24 hours depending upon the number of unsuccessful attempts made.
7. Once "CODE" appears, continue with step 3.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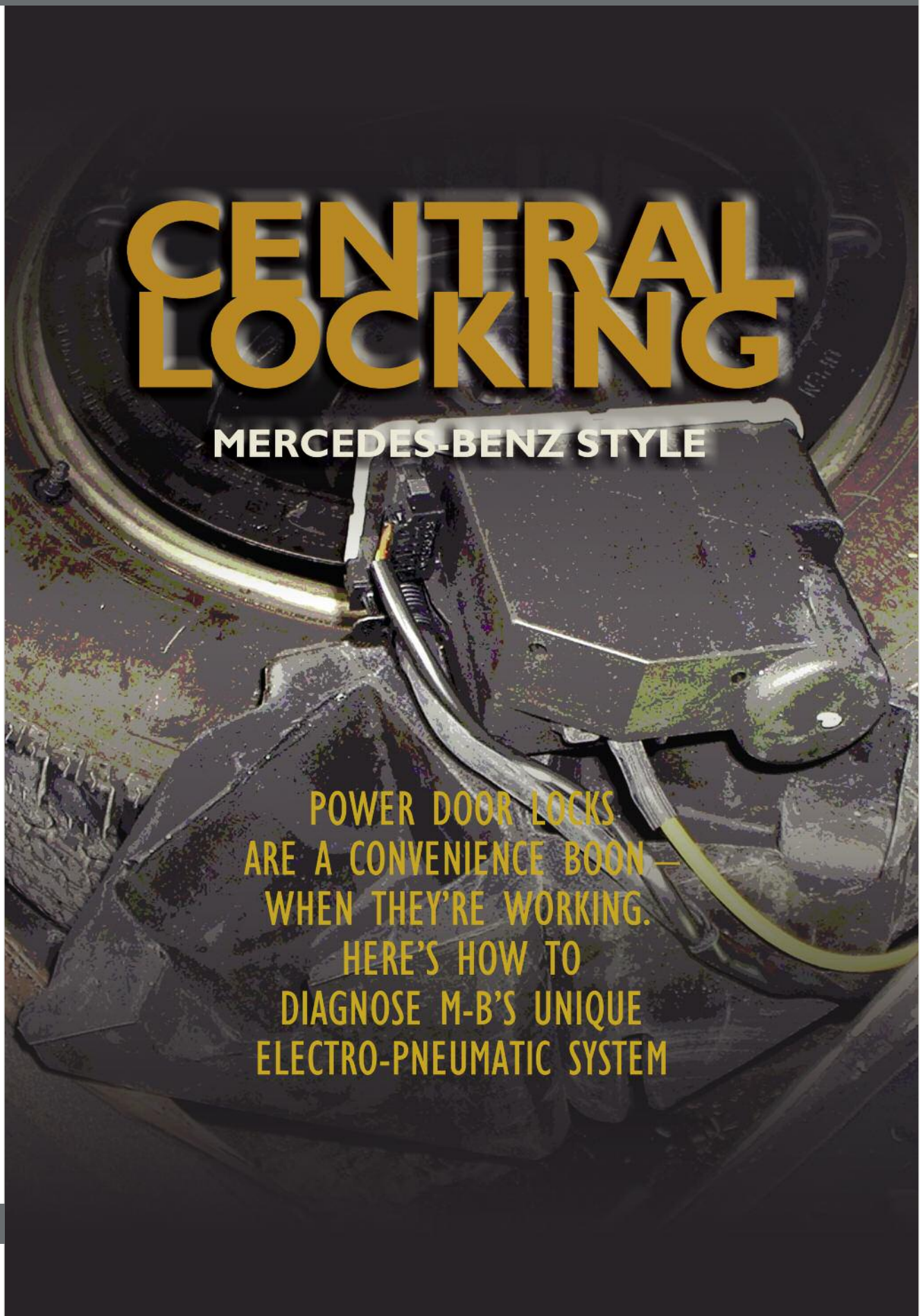


CENTRAL LOCKING

MERCEDES-BENZ STYLE

POWER DOOR LOCKS ARE A CONVENIENCE BOON – WHEN THEY'RE WORKING. HERE'S HOW TO DIAGNOSE M-B'S UNIQUE ELECTRO-PNEUMATIC SYSTEM

The pump may be found in the spare tire well, as in this specimen, under the back seat, or in the engine compartment. Note the single yellow vacuum/pressure line and the insulating foam casing.

When central locking was first introduced it was one of those, "Why didn't I think of that?" moments. It sure beats walking around the car key in hand, or stretching awkwardly from the driver's seat to push all those buttons down. So, this feature has been standard equipment on all Mercedes-Benz models sold in the U.S. for decades.

M-B, as you should know by now, took a different tack from other automakers for this system early on. Instead of using solenoids or electric motors to snap those locks, the company's engineers decided it was better to do the job pneumatically – more force, no unpleasant noise, great durability. That, however, presents us in the independent auto repair business with a new set of diagnostic issues, and if we're going to be a one-stop car-care center for our patrons who own Mercedes-Benz vehicles, we need to understand how these systems work and how to diagnose and fix them.

Since about 1986, most M-B cars have had what's called the "multi-point" system. If you're not sure what you're dealing with, go to the passenger's door and unlock. If all the other doors do the same, you've got multi-point. If not, either you're working on a car with the older single-point system (which unlocks only from the driver's door), or there's a problem. But since you've been presented with a complaint about this feature, you may be unable to get any action out of it whatsoever. That means you've got to dig deeper.

Componentry

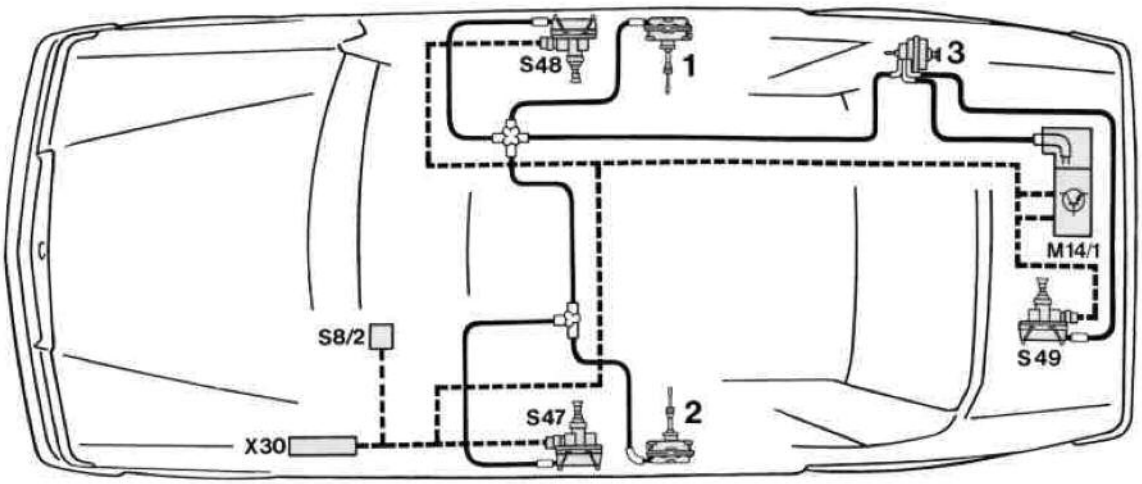
You need to understand the components and operation of a typical system before you can proceed (reading the owner's manual will give you an idea of how it's supposed to work from the customer's point of view). First, there's the pump, which supplies both the vacuum (for locking) and pressure (for unlocking) the system depends upon. This may be located in the spare tire well, under the back seat, or perhaps in the engine compartment on older models. If it's not in the engine compartment, it'll be encapsulated in foam. It has two electrical connectors, one round and the other flat.

The pump should produce .5 Bar (7 psi) within two or three seconds. Pressure in the system is relieved in 15 to 20 seconds after the pump stops. If there's a heavy leak, the electronics that control it switch it off in 25 to 60 seconds. From about 1983 onward, the change from vacuum to pressure is accomplished by electrically reversing the rotation of the motor – negative control voltage for vacuum, positive for pressure. Previously, this had been done by means of a switching valve.

Next, actuation units (which M-B calls "operating elements") are present at all the doors, the trunk lid and the gas cap flap. These are simple diaphragm-type pneumatic devices with linkage rods. All are very similar, but the ones for the doors are all black, while those for the trunk and filler flap are painted different colors on their upper portions. One yellow plastic line connects them to the pump.

There's an electrical switch in the driver's door that controls the action of the pump, and one of the functions of the ignition switch is to assure that the doors can't be locked while the key is in place. In the multi-point system, the passenger's door and trunk elements also have switches.

Typical Mercedes-Benz Central Locking Schematic



1	Element, rear door right (sedan only)	S47	Control and working element, front door left
2	Element, rear door left (sedan only)	S48	Control and working element, front door right
3	Element, tank flap	S49	Control and working element, trunk lid lock
M14/1	Supply pump central locking system	X30	Connector block for optional electrical equipment
S8/2	Warning buzzer contact lighting/central locking system	- - - -	Electrical cable
		-----	Pneumatic pipe

The interaction between central locking and the alarm system is quite complex and would fit better into an article on the latter. All we'll say here is that if the vehicle has an EDW Alarm system, you can disconnect the intermediate plug of the EDW cable harness from the connector (M14/1x2, or M14/2x2) and connect the central locking cable harness directly to the supply pump. If central locking works okay now, it's time to delve into the EDW.

Leaker?

There are three types of possible problems: Pneumatic, mechanical, and electrical. Where the first is concerned, the most probable malfunction is, you guessed it, a leak, which is probably in the diaphragm of an operating element, or at a line connection. Those plastic lines themselves are pretty tough, but still a possibility.

To find out whether or not a leak is indeed present, disconnect a line and use a manually-operated test pump, such as a Mighty Vac, to draw a vacuum and see if it holds. At 300 mbars (9 in. Hg), you should see less than a 30 mbar drop in the gauge in one minute.

The operating elements are all pretty much the same. You screw the rod in or out to achieve the proper length.

But vacuum doesn't necessarily tell the whole story. Sometimes a circuit that holds vacuum won't hold pressure. So, pump it up to 600 mbars (9 psi) and make sure it doesn't lose more than 30 mbars in a minute.

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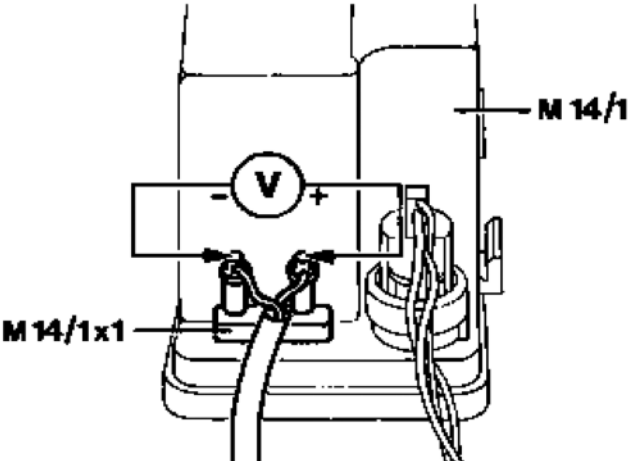
Watch the gauge for a minute to determine if there's a leak. Finding it is the big problem.

With the key out of the ignition, look and listen while you slowly push the driver's lock button down.

Okay, suppose there's leakage. How do you find out where it is exactly? The logical first step is a visual exam of all the lines and connections you can see. If nothing's obvious so far, start disconnecting lines at the pump and doing your vacuum/pressure tests, and work your way toward the doors, trunk and gas cap flap. Nobody wants to remove a door panel unnecessarily, but you may need to do so. Plug the element end of the line. If vacuum and pressure hold now, the diaphragm in the operating element is the culprit. Connect your test pump to it directly to make absolutely sure.



1. Check voltage supply of the supply pump.

2. Connect digital multimeter.

3. Lock and unlock central locking system with key.

4. Then reinstall copling housing.

Nominal value: battery voltage>10V

Mechanical problems come down to maladjustment of the length of the rods, perhaps due to a faulty previous repair, and to binding. In the former case, follow the factory recommendations for rod length. In the latter, bend the rod and lubricate the joints according to common sense. Remember to re-adjust the rod length when you've got everything moving unhindered.

Flow of electrons

If you suspect an electrical glitch, the first thing to do is to listen for the pump to run (come to think of it, using your sense of hearing will help you locate the pump in the first place in cases where you're not sure where to look). With the key out of the ignition switch, slowly press the driver's door lock and you should hear the pump. No? Then examine the fuse (typically #15, but check the fuse box chart).

If that's okay, unplug the pump's flat connector (M14/1x1), remove the connector housing, push the terminals back on the pump pins and check for voltage between the terminals (the brown wire is ground) while you lock and unlock the system. If you don't get at least 10V, go to the wiring diagram to track down the impediment to electron flow. If you've found sufficient voltage, but the pump still doesn't

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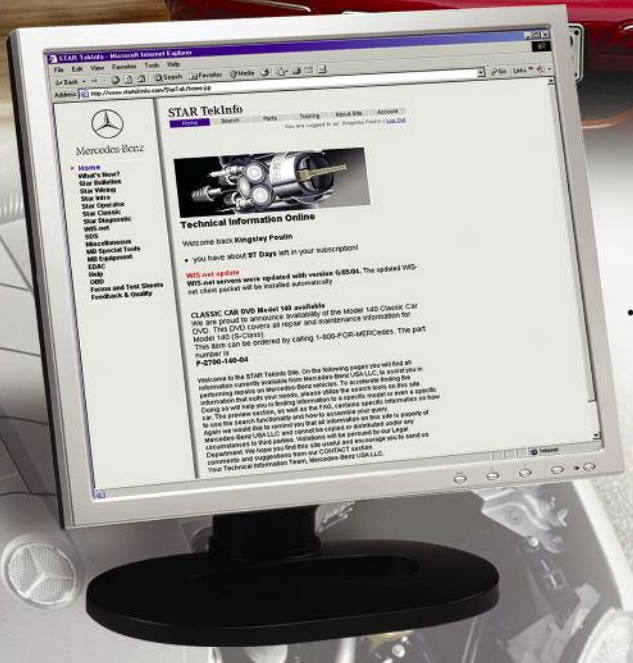

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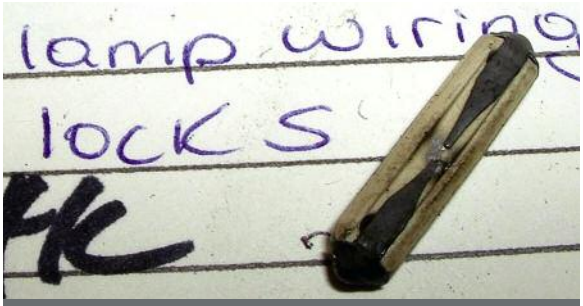


This one was easy: Fuse #15 was blown, which kept the pump from running.]

run, it's probably worn out. By the way, pumps with a black cover are not interchangeable with those that have a white cover.

If M14/x1 has a third pin, the car is probably equipped with orthopedic seats. The third pin is Circuit 15 to control that function.

Finally, the round connector carries the switch signals from the three controlling elements (front doors and trunk) to the pump. Look for a change from ground to 12V as you move the actuator from unlocked to locked for each of the three pins.

Keyless Go System and Infrared "SmartKey"

You walk up to your locked car, pull the door handle, and the car unlocks. Key still in a pocket or purse, you sit down in the driver's seat, press the brake pedal, touch the top of the shift lever, and the engine starts! Science fiction? It might seem so, but it's a real-life option on some Mercedes-Benz models. Starting in 2004, Keyless Go is available on S-Class, CL-Class, SL-Class, E-Class, and CLK-Class.

Low-power radio transceivers in the doors sense the presence of the SmartKey in the driver's pocket or purse and allow the doors to unlock when a button on the door handle is touched. Without a key of any sort in the ignition slot, the engine burbles to life whenever a button on top of the shift lever is pushed. For safety reasons, the brake pedal must be depressed with the shift lever in Park for the engine to start.

Most other Mercedes-Benz cars get the standard-issue SmartKey – the industry's first fully electronic key system. Gone is the conventional mechanical ignition key, in favor of a fully electronic key that is integrated into the remote locking unit. There's no metal key which could be illegally copied and, as a result, no way to unlock the steering column or start the engine without the owner's remote unit. Since a family can make use of multiple keys for the same car, SmartKey even memorizes the last seat position, climate control and mirror settings selected.

The driver operates SmartKey in exactly the same fashion as a conventional system. The unlock button on the remote unit unlocks the door, and the Smartkey fits into the ignition switch and is twisted. As the driver turns the key, infrared data is exchanged. If the correct code is sent back, the steering column is unlocked, the ignition circuit is switched on and the starter operates. As a double security measure, the system changes codes each time the car is started. Also, the driver need only "bump" the key to the start position. The starter is disengaged at the precise moment the engine fires, preventing the ring starter gears from potentially gnashing.

Hidden inside the SmartKey unit is a small conventional key that can be detached to lock the glove box and trunk securely, then pocketed before handing the remote to a valet. The metal key also unlocks the door if the battery in the remote fails, and since data exchange from the car works even when the SmartKey battery is dead, the car can still be started with the remote unit.

WATERING HOLE

The ocean may've been the cradle of life, but water is still not at all welcome in some places, such as inside a car. There, it'll not only contribute to a musty smell, it can also cause subtle and not-so-subtle problems in electrical systems. If it's not absolutely pure, it's a pretty good conductor itself, but worse than that is the fact that it promotes corrosion in any connection and even down inside the insulation of all those myriad wires.

You're starting to see where we're going with this? How about strange malfunctions in the central locking system and the anti-theft alarm (ATA) of SLK models? The uninvited moisture has a way of penetrating the electrical connectors at the pump, migrating along the wires or the pneumatic line. This raises havoc and causes consternation among technicians presented with complaints about glitches in these two security-related systems.

So, before you go crazy following wiring diagrams and trying to outguess the electronic logic, do a simple visual exam – as they say in the medical profession, look for horses before you look for zebras. If you find H2O at the pump, pull the harness connectors and see if the terminals are wet and/or corroded. Clean them thoroughly, or replace the metal contacts. A moisture-dispersing spray will help. Chances are good this will be the fix.

But how is the water getting into the trunk where it doesn't belong? In other words, you've got to locate the leak. First, perform a water penetration test using a garden hose. In the SLK, a possible entrance point is the rear seal of the Vario roof. Water penetrates from under the seal and over the metal fold into the trunk, then drips onto the trim and runs along the longitudinal member and the cables into the pump's connector. The seal has an elastic sealant (except for over the metal fold). This might not be sufficient. The seal or the metal fold may be too small, or maybe the metal fold is wavy (the seal can't compensate for the waves).

Another potential leak point is between the Vario roof rear lower seal the trunk seal on the quarter panel (they cross over each other). Perhaps the shell of the vehicle is not within the specified dimensions in this area (especially the metal fold for the trunk seal) so that the seal "tips" to the side when the trunk lid is closed. Or maybe the seal for the roof or the trunk is not within specs.

There is also the possibility of leaks at the water drain hose of the rear fender. The water runs between the seal and the body cutout because there is not enough clearance for the seal. This may be the result of the seal not been snapped into place properly. Or, perhaps the cutout isn't within the specified dimensions, or the seal groove is too big.

Regardless, fix the leak, then install the repair wiring harness (Part Number A170 540 35 09) and rotate the pump 180° from its original position – refer to WIS document AR80.20-P-2710G. This lengthens the lines and forms a loop so that the water that would otherwise run down the lines will now drip off at the lowest point of the loop.

For parts, you'll need:

-20 Raychem connectors (green), A001 546 99 41

-2 Raychem connectors (red), A002 546 00 41

-1 Raychem connector (blue), A002 546 01 41

-1 Tape, A006 989 94 85

-2 Hose, A007 997 61 82

-1 Repair wiring harness, A170 540 35 09

-1 Foam housing for the pump, A170 800 02 35

So, as is so often the case, the problem with these high-tech systems isn't the high-tech part at all, but something simple. You've just got to know what to look for.

STARTUNED

PARTS NEWS

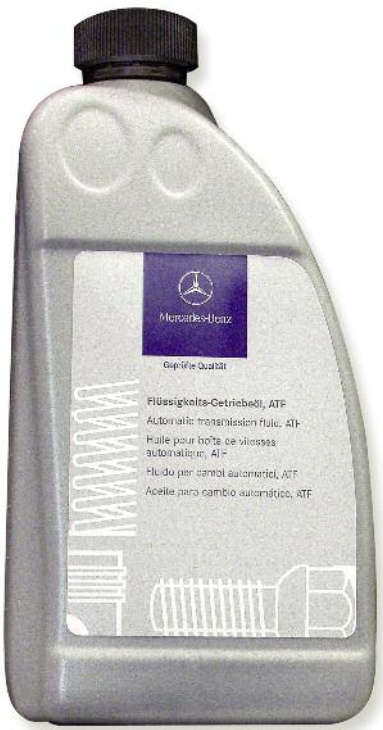
BODY TRIM

Some body parts, like this trunk surround trim, could probably be plastic-welded if cracked or gouged, but you'll never get them to look or work they way they did originally. It is surprising how much perceived difference there can be, especially in an area you see or touch frequently, between a repair that just functions and a repair that restores the fit and feel the vehicle had in the first place. 'Original Parts' and 'Proven Quality' are what the words on the box mean, and those are the real standards. Such parts are seldom prohibitively expensive, even for vehicles built in limited numbers some time ago. It's always good practice to check with your genuine Mercedes-Benz parts supplier for availability and cost. You may not be too amazed to find how quickly they can deliver specific components to your shop, but you could be surprised to find how competitive that delivery is.

FLUIDS

There are some supplies like the automatic transmission fluid pictured, or power steering fluid, antifreeze and others, supplies you can find someone ready to sell you by the tankcar-load at about the price of bottled water and with the claim of OEM-equivalent quality. And it's true Mercedes-Benz does not refine their own ATF or power steering oil, nor do they blend their antifreeze.

So what are you getting with oils and fluids from Mercedes-Benz? You're getting our skills and experience testing these products and our required manufacturing standards for the finished chemicals. The blenders and refiners do not want to lose the Mercedes-Benz label on the bottle in a random test, so they see to it that all of the fluids meet those stringent Mercedes-Benz standards.



StarTuned

Factory Service Bulletins

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

E-Class engine performance problems/Check Engine Light with Code(s) P03xx

If you encounter an E-Class vehicle (W210) with a complaint of engine misfire/lack of performance with a low fuel level (below approximately one-quarter tank) and/or "Check Engine Light" (MIL) activated with code(s) P03XX (misfire detection), a possible cause is a lack of fuel supply due to an obstructed opening to the fuel pump in the splash bowl. If the tank level at the time of misfire was low, it is possible that the condition was caused by insufficient fuel entering the splash bowl, thus failing to feed the fuel pump. This is probably due to foreign material blocking the fuel supply hole. During a low fuel level condition, fuel enters only through the supply hole at the bottom of the splash bowl.

Perform the following procedure:

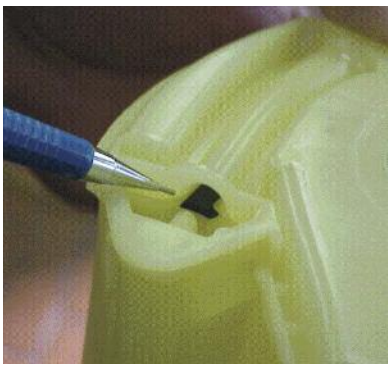
1. Ensure all related systems are working and within specifications – repair as necessary.

2. With your scan tool, check the freeze frame for "fuel tank level." Write down the freeze frame data and clear OBD memory.

3. Lower the fuel level in the tank to approximately the same level or lower than indicated in the freeze frame.

4. Try to duplicate the condition as far as load and rpm are con cerned as indicated on the freeze frame and see if the engine misfires and a code is set.

5. Connect a fuel pressure gauge and drive the car with high load/rpm while monitoring the fuel pressure. It should remain constant.



Note: Make sure the codes are stored with fuel level at one-quarter tank or below (see freeze frame data) , i.e. below the top of the upper splash bowl rim, and that no fuel can enter the splash bowl from the top opening. If the misfire can be duplicated and/or misfire code(s) are set again during the procedure in Step 4 and 5, or fuel pressure starts to fluctuate during procedure in step 4, replace the fuel tank. If, on the other hand, during Step 4 no misfire is observed and/or no misfire code is set, and the fuel pressure remains stable during Step 5, the cause for the customer complaint is something other than described above and needs to be further diagnosed.

E420 Engine Does Not Reach Full Power in High Temperature Conditions

If a 119.985 engine is not producing full power when the ambient temperature is over 86 deg. F. (30 deg. C), the elbow from the air intake at the radiator grill may be partially collapsing during full acceleration from idle. Install improved intake elbow, part number A210 528 07 04.

Flywheel Sensor Problems on 1997 Models with M104 Engine

Hard starting, rough idle, lack of performance/misfire, and/or engine not revving higher than 2,500 rpm may be caused by corrosion or water in the plug of the flywheel sensor. This condition may set DTCs relating to flywheel sensor or misfire. Replace the flywheel sensor and plug.

Squeaking Steering Column in E320 and E430

If you encounter complaints of squeaking noises from the steering column, verify the noise with the engine off and the weight off the front wheels to eliminate any hydraulic noises from the pump and rack. Locate the source of the noise. If it is coming from the sealing boot between the firewall and the steering shaft, the boot should be replaced with Part Number A210 462 10 96 and be lubricated with the improved grease Part Number A001 989 84 51 10.

Note: For all other E models, do not replace the boot. Simply lubricate the existing boot with the

improved grease on both sealing surfaces inside and outside the front bulkhead.

M137 Engine Running Complaints With Blue Smoke and/or Hydrocarbon Odors During First Start Up

Engine running complaints/misfire in conjunction with blue smoke and hydrocarbon odors for several seconds during first start-up, and/or an excessive amount of standing oil in the intake manifold with an M137 engine may be due to a PCV (positive crankcase ventilation) System intake assembly (front cover, right cylinder head) oil condensation drain that is clogged with oil sludge.

Remove and disassemble the front cover assembly of the right cylinder head (refer to WIS document AR01.30-P-5700L, up to and including step number 14). Inspect the oil condensation drain for clogging and clean out the oil sludge blocking the drain. Reassemble and reinstall the front cover assembly of the right cylinder head.

Note: When performing oil and filter change, be sure not to overfill the crankcase. Refer to the Approved Service Products Booklet for approved engine oils.

Water Pump Leaking on All M- and G-Class Models with 112 or 113 Engine

If you receive a customer complaint of the water pump leaking on any vehicle with either the 112 or the 113 engine, replace the water pump only if it is clearly visible that coolant drips continuously from the vent hole.

Traces of coolant residue and wetness (formation of droplets) at the vent hole of the water pump are normal and therefore are not considered "leakage." Water pump replacements under such conditions are therefore not justified.

A small amount of coolant in the groove of the pump seal is required for lubrication of the pump. Coolant droplets forming at the vent hole dry up and leave a distinct residue due to the high content of solid matter in the coolant (6g/100cc). This is particularly obvious on vehicles used for short distance driving with the engine being started and stopped frequently.

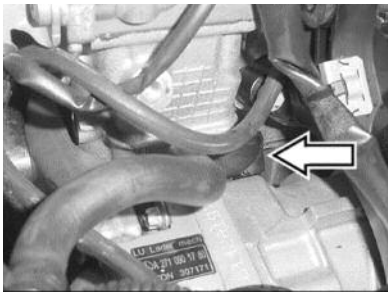
In a warranty situation, water pumps returned for leaking coolant will be checked very carefully and warranty claims might be debited if a pump is found to be in acceptable working order.

C230CL 1.8 Kompressor Engine Performance Complaint

Engine vibration, rpm fluctuations at idle, or poor accelerator response along with codes P2020 (P0172), P2046, P201C or P201A may be caused by a tear in the partial load vent hose at the connection to the crankcase. Air will bypass the mass air sensor – i.e. unmeasured air will enter the intake – causing the engine to run lean.

The remedy:

1. Remove the supercharger. Refer to WIS document AR09.50-P-4705QK.



2. Remove and install partial load vent hose for crankcase ventilation.

3. Install the supercharger according to the WIS document above.

Note: Use a "click clamp" as specified in parts information for securing hose. Ensure that the clamp is positioned as close to the end of the hose as possible and fastened tight.

Parts Information:

Click Clamp, A005 997 49 90

Partial Load Vent Hose, A271 018 04 82

A/C Compressor Switches On Frequently

Models C, E, CL, S, SL

If the air conditioning compressor as well as the mirror heaters switch on with an increased frequency, replace the multifunction sensor for the activated charcoal filter. The increased frequency of operation is a result of an incorrectly calibrated Convenience Automatic Air Conditioning multifunction sensor sending erroneous values over the CAN bus.

C Models with CODE (581b): Install AR83.40-P-6730P multifunction sensor.

CL and S Models: Install AR83.40-P-6730M multifunction sensor.

E Models with CODE (581a): Install AR83.40-P-6730T Convenience Automatic Air Conditioning multifunction sensor.

SL Models: Install AR83.40-P-6730R multifunction sensor.

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