StarTuned®

Information for the Independent Mercedes-Benz Service Professional

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Oil Puddles

ASR

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Mercedes-Benz

To Our Readers:

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 information sources combine to make this possible.

Feature articles, derived from approved company information sources, focus on being useful and interesting. Our digest of service bulletins 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 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 Mercedes-Benz and articles covering the different systems on these vehicles.

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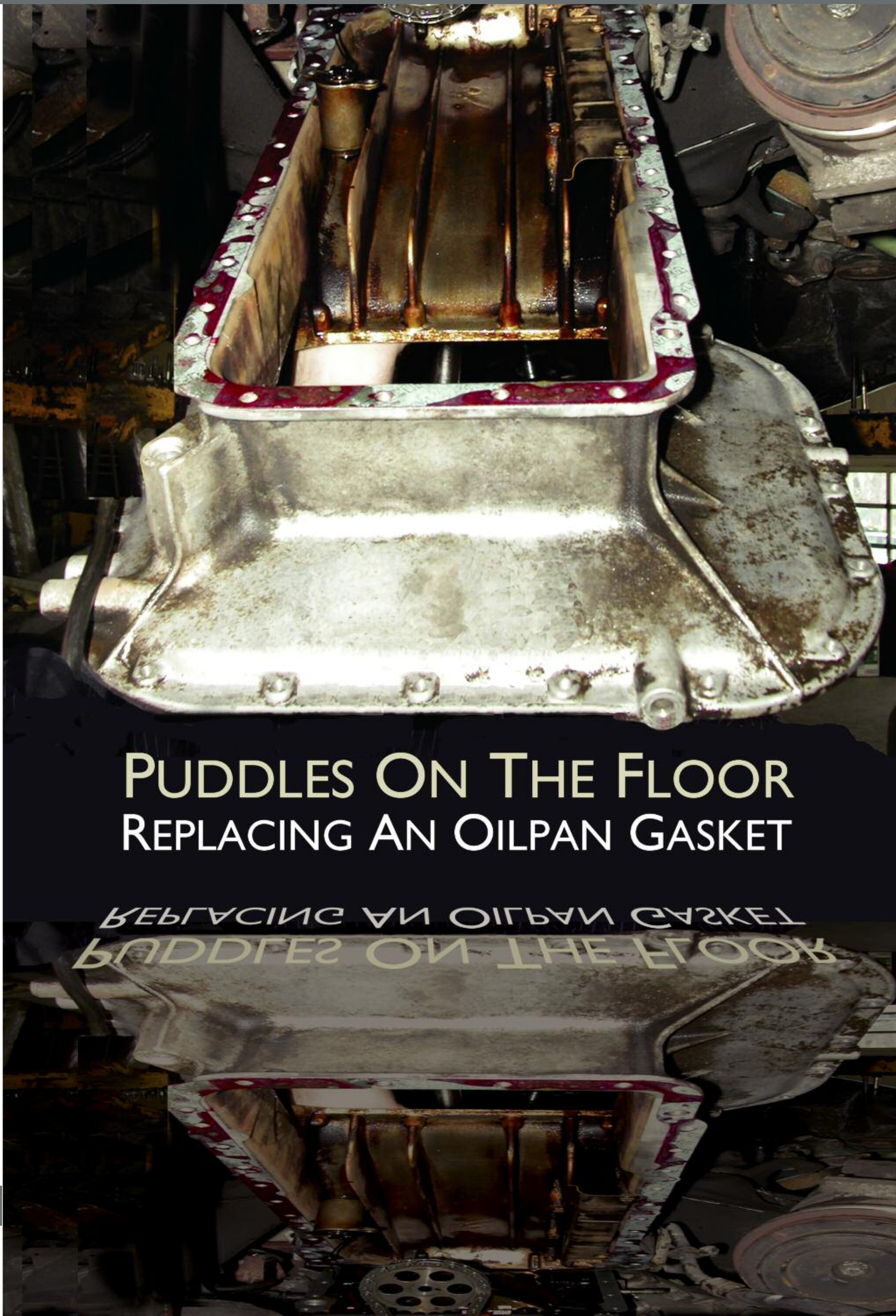
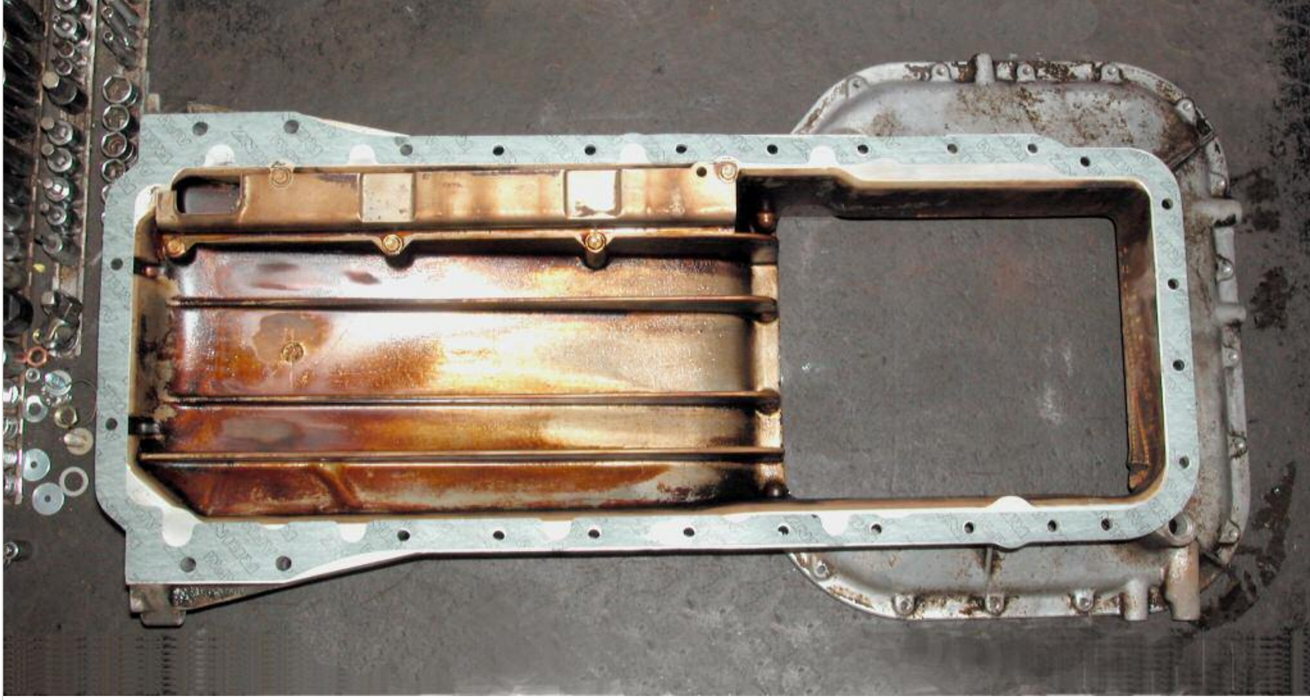


Puddles On The Floor
Replacing An Oilpan Gasket



No, the telltale dribbles of oil on the garage concrete wouldn't do at all. Maybe the owner might have been money ahead in the long run to just pour in more engine oil to offset the leak and sop the fluid up with oil-dry or cat-litter, but you weren't going to convince the fastidious owner of *this* 420 SEL (126) to do such a thing. The car might be a bit long in the tooth, but everything still worked, and it was still a pleasure to drive.

You'll find this same engine (116.96) in the 107 SL, but gasket replacement in that car is more work because access is tighter. You'll have to remove most of the front suspension on the roadster, for example. We were luckier having a 126 to repair. There are also minor layout and fastener differences between the older cast iron and the later aluminum versions of the 4.2-liter V8 engine. This one had an aluminum block.

Many of these engines use a two-piece oilpan, with a lower pan and second, smaller gasket just for the sump. Replacement of a leaking lower sump gasket is both easy and obvious, so you probably won't find one that leaks. The upper gasket is another story; it covers more than one separable metal part on the block, and it's significantly longer, so the chances of a leak are proportionately greater. While this gasket is harder to replace, there is also some safety factor involved since an oil leak high enough to come close to an exhaust pipe represents a small but real risk of fire. That gasket was where our 420 oozed, though onto the floor, not onto the sometimes-hot Y-pipe.

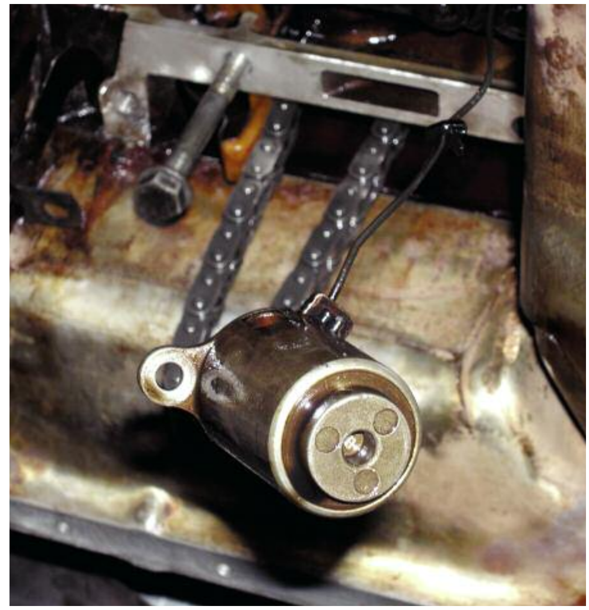
First, drain the oil from the sump. Take a close look at the drainplug and its sealing washer. These are not infinite-life components: The plug is not a short, fat bolt. It's made of softer metal than the oilpan threads so a stripped thread calls for a new plug rather than a new oilpan. The crush-washer distorts with each use and should be replaced before it starts to allow a leak. You certainly don't want to save a dollar or two in parts, only to have a continuing though smaller oil leak you have to explain later.

Pitch the old oil filter, too; this is probably going to be the most complete oil change in the useful life of the car, so don't leave any of the old stuff in the lubrication circuits. Once you have the lower sump pan and the filter off, it would be a good idea to leave a wide drainpan under the car and go do something else for about an hour. Oil is going to drip from every surface inside the crankcase about that long, and there's no sense catching any more of it than necessary on your head.

Put the sump pan in the parts washer for cleaning in the meantime. It's amazing to see how much oil stays at the bottom of the sump even with the plug out, amazing enough to make you realize the advantages of vacuuming oil out the dipstick tube in later cars. Even on an engine that's had careful, regular maintenance, oil changes at least as often as the book calls for, you'll find unappealing particulates on the bottom of the sump pan. That, of course, is the very point of having a sump pan, a place to collect the worst of the impurities in the fuel, any sludge formation from cold short-tripping and whatever else you don't want to recirculate through your engine's lubrication system.

There are three difficult steps to replacement of the upper pan gasket: removal of the oil pump, removal of the air conditioner and its bracket and finally, release and support the engine from above while you detach the pan itself and snake it out. The job is tight but possible: You don't need a double-jointed elbow or tentacles with tweezers for fingers. You don't need to lift the engine out of the car or lower the front suspension subframe from the 126 chassis.

The oil level sensor, a float in a container triggering a switch that works the dash light, bolts to the oil pump. It's important, working with the relatively robust and heavy components around the oil pump, crankshaft and oil pan, to be careful and gentle with the level sensor. You have to toggle for the moment from your heavy-duty, oil-and-steel mode to your more delicate electronic mode. As long as you're alert to its delicacy, you can leave the sensor hanging by its wire while you replace the gasket. It's not an eggshell, but it's not a hammerhead, either.



A chain from the crankshaft sprocket drives the oil pump, and the easiest way to get the pump and theoil level sensor out is to release the sprocket from the oil pump shaft first. This holds the sprocket fixed to the crankshaft while you loosen and then later tighten the nut while putting things back together, and it saves wrestling the pump around to disentangle the sprocket both out and back in. Just leave the sprocket hanging in the drivechain, if you want. There's enough room to pivot the pan around it.

There are a few ancillary components to separate. The AIR-injection pump and its brackets, on such vehicles as have them, can be loosened and slung from a wire in some handy position out of the way. Since you'll have to lift the engine above the subframe crossmember, you should unbolt either the fan shroud or the radiator fan itself so there's no plastic damage when you lift the engine. It's a reasonable precaution, to protect your fingers and whatnot, to put a 2x4 block between the engine and the subframe crossmember once there's enough space. This can prevent the engine shifting unexpectedly.

On either side of the engine, you'll find a small shock absorber/vibration damper that smoothes the torque production of the engine under low-speed loads. These need not be removed, but you should remove the nuts, brackets and rubber cushions on the lower ends of the shafts to allow the engine to rise beyond the range of the dampers. Immediately adjacent to each damper is the access bore for the

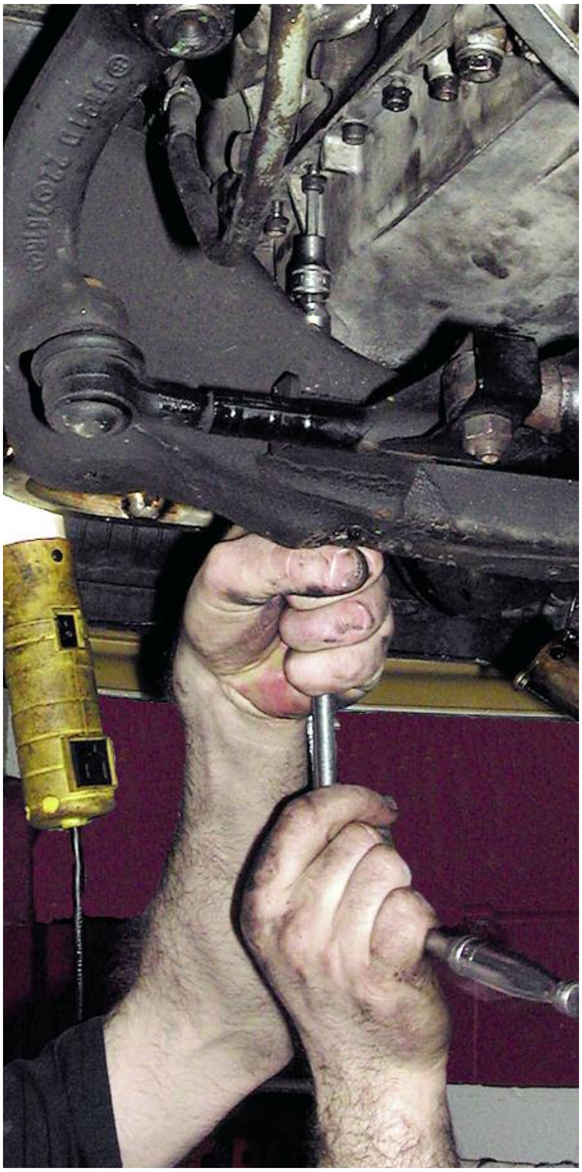
Inspect all the compressor fasteners carefully; there are many of them, and not all in obvious places.

engine mount bolt. Remove these bolts to allow sufficient vertical engine movement. When reassembling these dampers, don't go beyond a reasonable torque on the nuts. You want to compress the rubber washers, not crush them. Check carefully: This may be a good time for a replacement; after all, who will check them again over the next 100K? They should be snug, but not so tight as the nut atop a suspension shock absorber.

If you haven't replaced this gasket before, what will give you more trouble than anything else is the air conditioner compressor and its bracket. There's nothing particularly tricky about it, just extensive. Why? The engine block generates a good deal of vibration; the air conditioner compressor does the same. The combination of the two vibration frequencies could loosen bolts or crack the support bracket. Such a result would be unacceptable, so the designers sketched out a compressor bracket so robust and held by so many fasteners the chances of resonance fracture are minimal.

The compressor bracket uses many bolts, not all of them the same size and not all of them in the same orientation because it must handle vibration and resonance stresses. Make sure you have them all out before you pry it loose, and make sure it's flush to the block and has all the bolts in place before you tighten them.

But don't make the mistake of prematurely supposing you've removed all the bolts and reaching for your long pry bar to pop loose the bracket. A good portion of this step in the job is careful eyeball- and finger-work, making sure there is not another bolt or two lurking around a corner in the shadows. These brackets are different for different model years, eventually changing from steel plate to machined castings. Inspect the bracket carefully and make sure all the bolts are in and tight when you reassemble things. Use an inspection mirror to make certain



the matching surfaces of the bracket and the block match for a proper fit. The best way to do this is to turn in each fastener finger-tight first and tighten all of them only once everything is in the proper place.

The dipstick tube is held at the upper oilpan and by a bracket higher on the engine. You'll find it simpler to release each point than try to worry the dipstick loose just at the bottom. While it's unlikely you'll be doing more than one 116/126-oilpan gasket job at a time, it's worth knowing that there are several different dipsticks and dipstick tubes for this engine, depending on the model year. Keep the original with the engine you're working on or there could be a problem getting and measuring the proper oil volume for the engine.

The main, upper section of the oil pan is held secure to the engine block with 28 Allen screws in two different sizes plus a couple that pitch in as bell-housing bolts. Most of them are directly accessible; a few require a U-joint between the socket and your extension. As with the compressor bracket, the best strategy is to carefully inspect that you have every single one out before you pop the pan loose from the block, breaking the hold of the gasket and the glue. When you're putting the pan back in place, put all of the fasteners in loose first and tighten them all in criss-cross patterns later. A major reason for starting all the pan screws first before you tighten any is to make sure the new gasket is in the correct position.

The old gasket failed right at the parting surface between the block and the rear cover. Proper positioning and the judicious use of seam sealer can reduce the chance of that happening to your work.

If you look carefully at the old gasket, the one with a crack that required the replacement work here, it looks likely that the gasket was pulled between the surfaces on either side of it. That stress, over many years and countless temperature cycles, allowed a crack to propagate from the inside to the outside, eventually forming a flowpath for the oil from the crankcase to the garage floor. To prevent that from happening to the gasket you install, make sure to put a bead of sealer at the parting surfaces where the block and the rear plate join, as well as the similar parting surfaces at the front of the engine where the timing cover meets the engine block. Besides sealing the joint more securely, this provides a small amount of variation in the location of the gasket, reducing chances of propagating another crack.

There are four parting surfaces between the block casting, the rear plate and the timing cover. If you put a small dollop of sealer right at the joint, the chances of heat cycles gradually cutting through the new gasket are lower.

We think of gaskets as bonehead parts, as nothing more than paper partitions that must exist because it's not economical to machine engine mating surfaces to perfect flatness. In unreflective moments, we may suppose that with a bit of time, a large-enough grocery bag, a ball-pein hammer and a Swiss Army knife we could make any gasket for any car.

And we could, if useful life played no role in our work. A head gasket made of newspaper might well last for hundreds of yards, perhaps a mile before the engine locked up. An oil pan gasket of the same wood-fibrous stuff might last even longer, ten or twenty times as far. Most of us, however, would like customers to get farther away than just out of sight of the shop before a gasket fails, in fact, we'd like that gasket to go undisturbed and fluid-tight to the landfill in ten or twenty years. To achieve that kind of useful life, you need the best gaskets available.

The odd thing is that neither parts cost nor availability plays much role here. The oil pan gasket we're talking about here retails to the motorist for under $15, and you surely get it from your Genuine Mercedes-Benz Parts source for less. The oil and the filter you'll replace in the course of the job cost much more than that. Is the factory part magical? Of course not, but it is certainly more than just satisfactory; it has passed more rigorous tests than you're likely to imagine for a gasket.

It isn't that the factory never makes a mistake or never builds a part that lasts shorter than forever. If they did, we'd all have to turn our hands to something else. When replacing this 420's oilpan, as the bolts for the oilpump came out, so did a few turns of aluminum thread from the block. The bolt had held securely for many years, but it surely wouldn't without those threads doing their part, so it was time for a dose of Helicoil. There may be some times and some positions on a car when you might be willing to risk not rethreading a stripped hole, but not for one of the two-and-only-two bolts holding the mating flange between the oil pump pressure output and the block gallery. If one of them loosened once you were finished, the engine would lose oil pressure at all speeds and sustain reduced useful life.

Some unwelcome spirals of metal, one of the pump fastener bolts brought out several rounds of block thread with it. The pump held until now, but it wouldn't again without a threaded insert.

If you're a regular reader of this magazine, you know the drill, of course. Carefully bore the hole out oversize but dead straight; retap it with the special tool; thread in the insert, and make sure you torque the bolt properly according to the specs. Many rethread inserts call for threadlocker between the outside threads of the insert and the metal of the casting. A rethreaded repair is actually stronger than the original metal because the insert thread spreads the load over a wider circle of the block casting, so if the job is done correctly there's nothing to worry about once the car leaves. Doing it correctly does take some care, though, particularly where there is an oil passage nearby. Make doubly sure there is no drilling or tapping chaff leftover in the hole. Blow it out with compressed air and then check it visually to confirm the hole is empty before going to each next step.

Putting the pan back up involves some additional steps. You'll recall the previous gasket split presumably because of tension pulling the edges of the gasket gradually apart. Three techniques can reduce the chance of that happening for a replacement: Grease the gasket with something that will allow it to find the proper micro-position later; daub with sealer the parting surfaces of the castings where the rear engine cover fit over the pan gasket (the very point where the crack started) to insure any subsequent movement of these plates can't start another gasket crack, and start all the pan attachment bolts before you tighten any of them, so you can draw the pan up against the block gradually and evenly, leaving no stress in the new gasket.

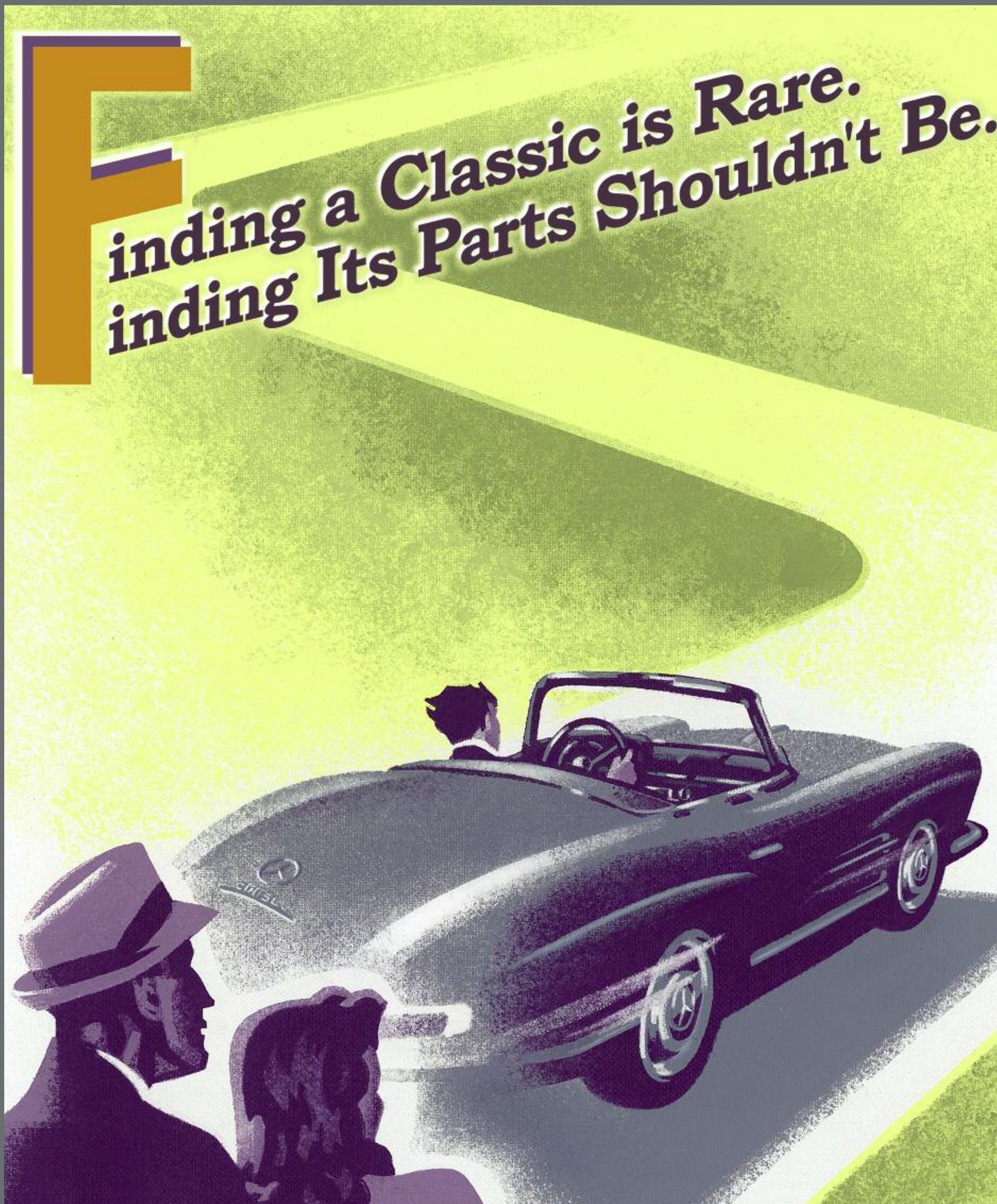
Be careful tapping a new bore in aluminum. It's particularly important to keep the tap exactly square with the surface, which can be more difficult in an awkward position. Clean and oil the tap repeatedly, and blow all the chaff from the hole.

Refill the crankcase with oil and prime the filter. Because so much oil drained from the engine, it will almost certainly need more before you release the car to the customer, but don't fill it above the fill line in anticipation of this.

Disable the ignition before you crank the car for the first time after the pan gasket replacement. In fact, it would not be a bad idea to remove all the spark plugs also. The object is to reduce the wear on the bearings, which will have only the residual oil until the oil pump picks up the fresh lubricant and pressurizes the system. This step is not strictly necessary, but you'd probably do it if the car were yours, and that's the way your customer would probably choose, even for a few more labor dollars on the bill. You won't have to pack the oil pump with grease since it rides submerged in the oil, so there should be no need to prime it.

With the upper pan retightened, torque the pump and the oil level sensor to specifications, being careful to route the sensor wire correctly.

Lubricating the new gasket on the pan before installation allows slight adjustments once it's in place without damage to the gasket.



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ASR

Second Part of Our Series on Traction Control

With all the power of the 6-liter V12 on our cover, just what happens if the driver goes pedal-to-metal from a standstill with one drivewheel in the wet grass? With ASR and the later Mercedes-Benz traction control systems, the car drives off just about normally.

Walking as if on an imaginary oiled tightrope but in reality along a black-ice-crusted Ohio road, I held out my gloved hands to break the fall I expected any moment. A cold misting rain had started the night before, only to freeze hard and then shiver down to a feathery snow, still drifting across the fields and roads early the next day, leaving every surface treacherous at every footstep. The snow blanket muffled all the morning sounds but the squeak of the dry snow and crinkle-crack of the ice sheet under my boots. But my cautious footfalls suddenly gave way to a quick, iron-shod clop-clop-clop climbing the hill behind me. Deep, steady breaths blew from barrel-sized lungs like exhaust from a steam locomotive, and the thin sound of four skinny, metal-band 'tires' on spoked wooden wheels, skittered along the ice-speckled road behind the trotting horse. Inside the closed black buggy, calm voices prattled of pies and quilts, soft voices in a 17th Century Swiss-German, a dialect paradoxically reminiscent of the Swabian-German spoken today by many Mercedes-Benz engineers. And just as paradoxically that frigid winter's day, the red-bordered orange warning triangle behind the buggy flagged the fastest vehicle on the road.

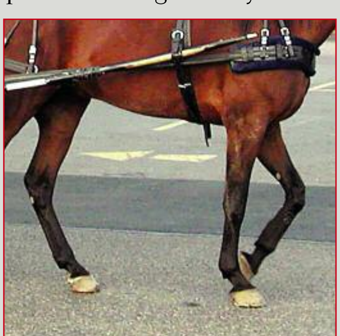
This area of eastern Ohio is the largest Amish/Mennonite settlement in the world. Many families have lived here since the 1820's and still work their farms with Belgian and Haflinger draft horses and use trotters to pull their buggies. Most 'pet' horses, I guess, are skittish, prancing sprinters, anxious for every second's attention from their owners. But an Amish road horse is a self-possessed, steady marathoner, holding a fast, energy-efficient trot, satisfied to put in a hard day's work and then return to its barnstall. In four hours, it can jog a buggy up and down hills for fifty miles, and once tied to the hitching post, its pulse and breathing drop to normal in about a minute. Then, after the family visits with friends or strikes a shrewd bargain at a farm auction, their horse trots the buggy back home in an equal timespace.

Actually, the Amish aren't 'old-fashioned' at all. Instead, they consciously choose technology, old or new, to suit their larger purposes. They use candles and lanterns rather than electric lights not because they like their houses dark, but because independence from the power grid blocks the stultifying brainwash from The Tube. They use the Post Office rather than the telephone because they want communication, but not interruption. They use horses and buggies instead of cars because they want control over

their travel, not because they want to go slow. They choose their life and all the details and elements in it because they intend to keep their families intact and independent, as they have for centuries. You don't buy their values? So? Those weren't for sale like the pies and quilts, anyway.Amish buggy horses are marathon athletes, strong, tireless and fit. Calculate the work they do at a steady run, and it factors out to six or eight horsepower. They carry no lard on their bones and have a reaction speed and precision that makes them a living model of what a traction control system can be.

Specifically for our purposes here, the Amish don't keep their beautifully fit horses as luxury pets, but as rock-reliable transportation. A good part of that reliability comes from the horse's instinctual traction control. This brings us back to our business here at StarTuned and to yours in your workbay, understanding vehicle technology so we can diagnose and correct automotive problems. A Mercedes-Benz traction control system doesn't work by instinct, of course, but from careful plan. But the strategy and tactics for retaining traction are interestingly similar for both horse and car.

How does the Amish farmer's horse keep its traction? If you watch closely as a horse and buggy pass on an ice-covered road (or if you'll take my word for it), you can see what the traction-control engineers plan and design for: systems that sense every incip-



ient traction loss and recover it immediately by reducing the directional load at that spacetime point and by transferring the load to another ground contact a moment later. When its hoof strikes the road, the horse instantly feels whether that foot remains where planted or slips to one side, back or forward. If it slips at all – if there's traction loss – the horse immediately corrects for it by reducing the directional load on that leg to restore traction and by transferring the load to whichever of the following hooves do find traction. The horse can do this, and we cannot, because it has four legs, just as a car has four wheels.

You can literally see the technique underway because you can see the horse release tension in this or that leg muscle, halting the slip at that hoof. I don't know how the pavement friction of a farrier's nailed iron horseshoe compares to a tiremaker's grooved rubber treadpatch, but it surely doesn't have better grip. So the horse's neurological traction control must work with multiple sensory feedbacks all in an eyeblink, and with flawless motor coordination among all four legs.

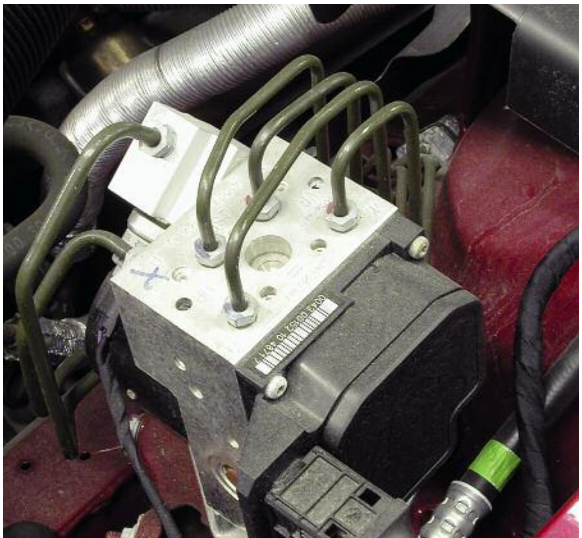
That way the passengers in the black buggy can largely ignore details of the road and concentrate on their family conversations or on peering out the window or on snoozing in the seat, none of them anxious in the least about keeping on the road or getting home safely. They know their horse's perceptions are the equine traction control system's fast sensors, and its muscles the powerful actuators.

Come to that, its navigation and suspension systems do amazing things, too, things automotive engineers hope to achieve years from now. An

Amish horse, sensing frequent need to accommodate slipping hooves, will slow imperceptibly, just enough to drop safely within the hoof-traction envelope, as if a car's flashing ASR warning triangle imperceptibly lowered the vehicle speed automatically, whether the driver knew it or not. Besides, how many cars know the way home from town or automatically slow for railroad tracks? How many know to trot faster when Amos is at the reins or slow down for Rebeccah or rattle and bounce along the washboard ruts when there are squealing children aboard? We see the beginnings of this with adaptive cruise control, slowing when another vehicle blocks the lane but resuming the set speed once the road is clear, but there's still room for development. Don't rule any of those things out for future systems!

With such an effective traction control system at the front of the buggy, the Amish family can occupy their attention with more interesting pastimes than just operating a vehicle. Some of them can peer out the back window to monitor the suspicious behavior of 'Englisch' (i.e., non-Amish) photographers.

ASR – *AntriebSchlupfRegelung* Controlling drivewheel slip



The hydraulic control unit for ASR (or here for ESP) straddles the lines between the brake master cylinder and the four brake calipers. Current versions use two-position solenoid valves to direct the hydraulic pressure; older versions used three-position solenoids.

The ASR system on Mercedes-Benz cars imported to the US first appeared on the 124, 126, 129 and 201 and went through three revisions since the introduction, the last for model year 1995. All the ASR systems imported officially to North America were of the second or later versions. In Europe there was an early, original ASR briefly available only on the 126 from late 1987 to 1989, using separate hydraulic units for ASR and ABS. You might find an example of this early version in a 'grey-market' car, one privately imported, not through the carmaker's American division. There were even rarer and earlier versions going back to 1981, we read. Each ASR version imported here by Mercedes-Benz itself shares hydraulic units with ABS. The most common version, ASR V, was built on everything with ASR since model year 1995.

ASR is the next logical step after ABS, the subject of our main feature in the last issue of *StarTuned.* Just as ABS retains steering and directional control while maximizing braking effectiveness by pulsing specific brakes off if the connection between tirepatch and road starts to slip, ASR retains driving and acceleration force when the corresponding drivewheel slip begins. ABS pulses brake pressure down and off; ASR pulses brake pressure up and on, both to retain traction under different circumstances. ASR also can close or sometimes open the throttle more or less than the driver signals with the accelerator pedal, all to retain drivewheel traction.

In the last issue of *StarTuned* we mentioned these traction constants: First, the slip of the treadpatch against the pavement can't go beyond a certain low (single-digit-percent) threshold, or the tire loses its grip on the road completely, and that slipping wheel contributes nothing further to acceleration, braking or steering. Second, the rear wheels must stay 'glued' to the pavement longer than the fronts, or the car spins first sideways and then around, losing all directional control. While a slipping tire contributes nothing to directional control, it still holds the car off the ground, of course, the pneumatic tire's original purpose (at least until the heat of sliding friction blows the tire).

The business of keeping a specific wheel firmly attached to the road is fundamentally the tiremaker's stock in trade, but the carmaker can optimize this for a particular car by building steering, suspension and traction-control systems that react quickly to changes at each wheel and execute well-thought-out programs to maximize the traction objectives for the vehicle.

Just as with ABS, the ASR operating strategy is not simply to maximize traction under all circumstances. Directional stability and steering control take precedence, if they would be compromised by an ASR activation. How could that happen? Well, suppose a driver were close to WOT in a turn. Under the right circumstances, the inside wheel, lightened somewhat of its load by the centrifugal weight shift, could begin to slip under the drive torque. If the ASR system merely applied the brake at that wheel enough to slow it to the traction-retention speed, that could leave enough engine torque left over, torque now available through the open differential to the other, loaded drivewheel, to suddenly break its connection with the pavement. Now instead of a mere acceleration-traction slip, the driver would have to deal with a rear end instantly coming around, racing the front of the car for the guardrail you hope is out there.

For that matter, there are limits to desirable traction for any vehicle. Which would you rather have, a gradual slide of the car once you get to the extremes of a turn and the limits of tire adhesion, or so much traction that the car rolls over, instead? That answer is obvious, but the answer to every other conceivable traction questions is not necessarily so obvious.

Yes, Mercedes-Benz traction-control systems are complicated, but not just because the engineers like complexity (though they do, of course). But instead, because many of the problems the system sets out to solve are themselves so complex.

– Continued on page 18

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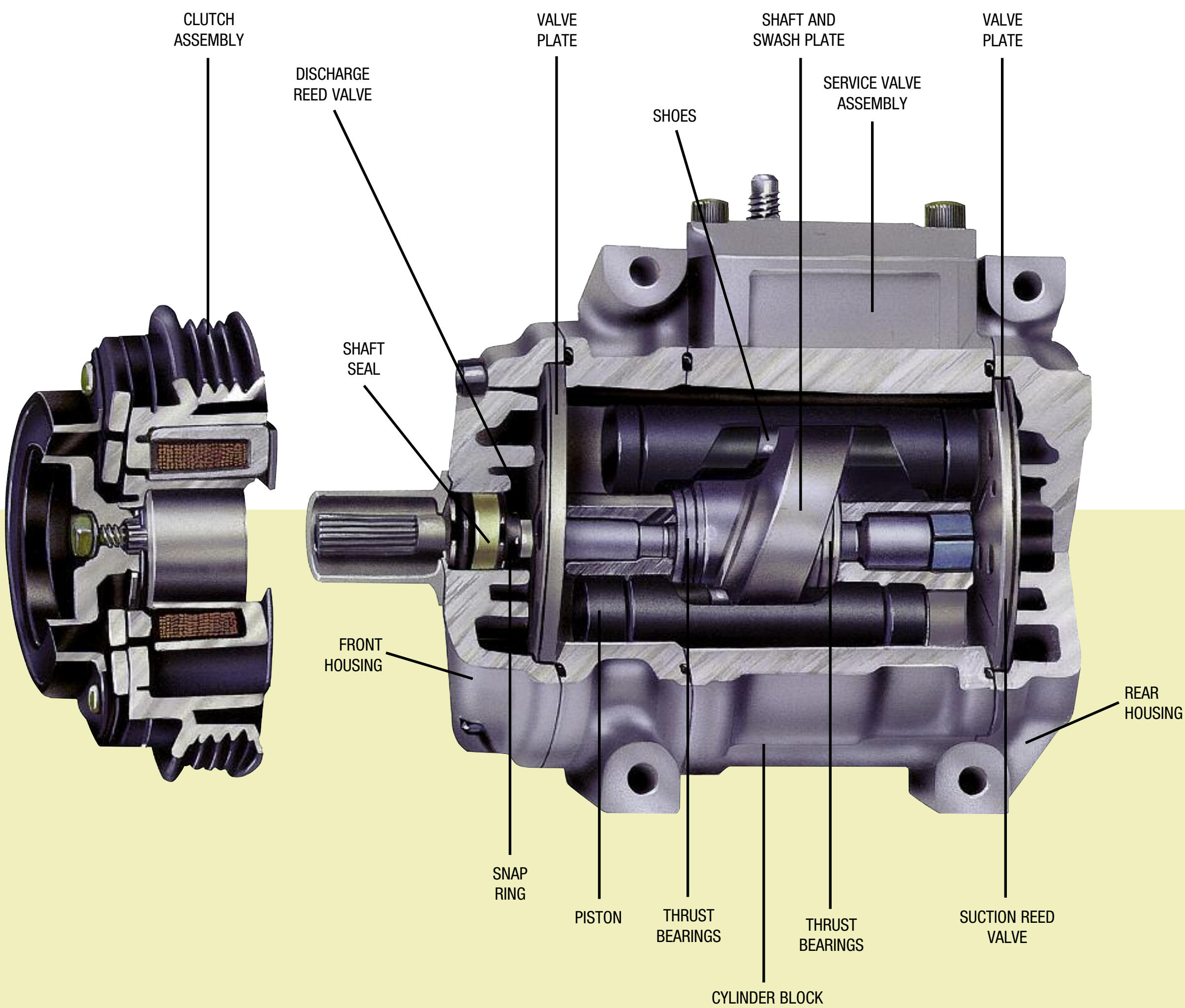

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Mercedes-Benz Genuine Remanufactured Parts

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The Amish farmer's buggy horse, finding several hooves slipping in sequence, corrects for the slip and/or reduces speed, but it uses the entire equine neurological system to do this, a system far more complex than any vehicle wiring harness. As it pe forms similarly complex traction-retention tactics, the Mercedes-Benz ASR system flashes the warning light in the dash to signal a heads-up to the driver. Except in political-ideology fantasies, there are few simple solutions to complicated problems.

The warning lamps come on as a bulb check when first starting. Then the warning triangle in the speedometer comes on to signal ASR activation. If the motorist toggles the snow-chain switch, the warning light stays on, flashing when wheelslip conditions occur.

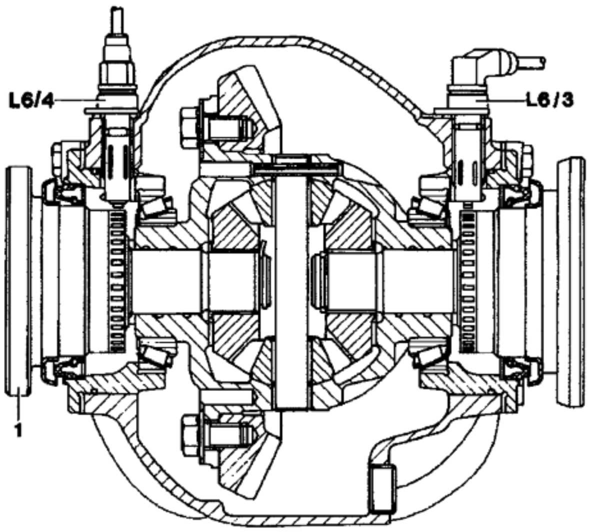
ASR begins as does ABS with the wheelspeed sensors, except that ASR requires individual wheelspeed sensors for the drivewheels, while as you'll recall from our article on ABS a single differential sensor works for the braking system. Additional inputs come from the brakelight switch and the parking brake switch (because you want to toggle ASR off under any and all braking conditions) and over the data bus from the engine controls. The system includes the control unit, in the control unit compartment by the bulkhead on most cars, and the hydraulic unit, mounted in the front left area of the engine compartment in most vehicles.

The electronic control unit connects to all the sensors and all the actuators through the harness, as well as to the voltage supply, usually through the overvoltage protection relay (some are different, though). The hydraulic control unit has six hydraulic lines, two from the master cylinder and one to each of the wheel cylinders. It also houses the electric motor and hydraulic pump to provide pressurized brake fluid in sufficient quantity to actuate drivewheel brakes as needed. Power for the electronic control unit comes through the overvoltage protection relay.

All the traction-control systems function to begin with from the wheelspeed sensors input data. ASR uses sensors for both rear wheels, not just one at the differential, because it must identify which rear wheel slips to apply braking to the slipping wheel. The sensors are essentially the same inductive pickups used for all traction-control systems.

ASR is integrated with ABS, so in important respects they're one system. However, it is possible for ASR to fail in a way that leaves ABS fully functional. The contrary is not possible, though. Anything that disables ABS also disables ASR. This results from the structure of the two related systems: ABS is fundamental; its sensors form the core, and its actuators can reduce the pressure applied at any brake caliper depending on conditions. If something in the pressurizing system fails, that could leave ABS unaffected, while it disables ASR. The MIL for each system reflects this: The ASR MIL can come on alone; the ABS only in company with ASR.

ASR application strategy changes through three phases. Straight ahead, up to a speed of 40 km/h (25mph), the system will first apply a brake to a slipping drivewheel. If two drivewheels slip, it will apply both brakes. If there is still drivewheel slip, the system will reduce engine torque output until the slip ends. The system determines there is slip by comparing the drivewheel speed as reported by the drivewheel speed sensors with the front, driven wheelspeed sensors. If the first are turning faster than the second by a certain percent, that represents drivewheel slip, and the system begins its countermeasures.



Since it controls individual drivewheels, ASR requires individual wheelspeed sensors for each of the rear wheels. Early systems fit the sensors in the differential on either output flange; later versions carry the sensor through each wheel's backing plate.

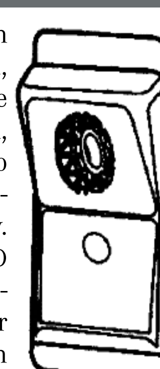
Above the speed of 40 km/h (25 mph), the system reverses the sequence of countermeasures. First it reduces engine torque output; then it applies braking force to a slipping wheel. The reason for the difference is to maximize traction up to 40 km/h (25 mph) and to maximize directional control above that speed. The third ASR phase is in turns above 12 mph. In this phase the threshold for wheelspeed differences is greater, as you'd expect, but the drivewheel slip countermeasure strategy is exactly the same as in the second phase, drive torque reduction first, brake application second.

The reasons for preferring traction over stability for the lower vehicle speeds is that getting stuck is more likely and spinning out of control is less so, and vice-versa for the higher speeds and turns. An added benefit for the higher speeds is that engine torque reduction can occur much faster than brake application. While it does take some time to close a throttle, actual torque reduction can occur with the next power stroke by retarding the spark advance. The control units are internally much faster than any mechanical events in the engine, so they can finish their calculations and exchange information between power strokes, even at relatively high engine speeds. Since all of the vehicles with ASR also employ the electronic accelerator ('drive-by-wire'), the system quickly reduces the throttle setting as well, but this obviously can't occur as quickly as spark retard for the next power stroke.

Besides the wheelspeed sensors, ASR has input also from a number of switches. The brake and parking brake switches disengage any ASR action with the slightest movement of the brake pedal. After all, you don't want drivewheel traction control if you're trying to stop or park.

The electronic control unit for most ASR systems resides in the compartment on the passenger side of the bulkhead in most vehicles. Electronic control units are generally very reliable components, so if your diagnosis points toward one, be sure to inspect the wiring harness throughout the traction control system, not excluding the connection pins. Impact damage where the harness runs along the lower edge of the fender or corrosion damage from saltwater, leaked or spilled vehicle fluids, can all result in problems that mimic control unit failures.

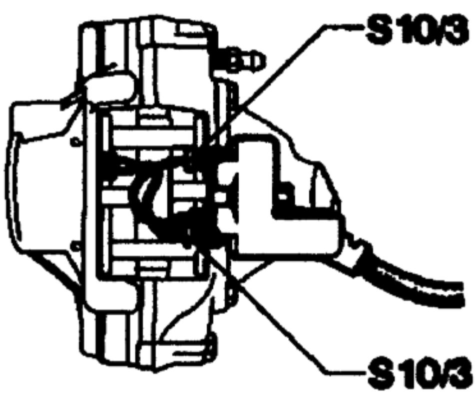
The system includes a snowchain switch on the dashboard. If toggled, this switch disengages the engine torque reduction function of ASR, but not brake activation. It also selects slightly higher slip thresholds after a fractional-second delay. When the switch is pressed, the LED in the switch comes on. If the vehicle accelerates beyond the upper speed threshold for the snowchain function (about 40 mph), the



subprogram shuts off. On later versions, the warning triangle in the center of the speedometer comes on and begins to flash under circumstances when the system would have engaged the engine torque reduction if the switch had not been on. Brake activation works normally throughout the event, except for the extended spin threshold. The reason for this curious exception to ASR operation is to allow the drivewheels to spin to some extent in deep snow, mud, gravel and the like. Under some conditions like these, tires with snowchains (or sometimes just tires alone) can profitably mill away at the snow or mud to let the vehicle get underway.

Keep in mind with all Mercedes-Benz traction control systems employing wheelspeed sensors that you should install snow chains on *all four* wheels, not just the drivewheels. Otherwise the system can set a sensor fault and toggle itself automatically off.

Because ASR actively employs the drivewheel brakes, cars with that system have rear brake wear sensors except for the first year for the option. Early systems use four wear sensors; later versions use one. These wear sensors can trigger the brake lining warning, but they won't set codes or disengage the ASR system itself, even if pad wear is excessive.



Rear pad wear sensors are necessary with ASR because a driver who frequently calls on the traction control feature has to consume brake pads faster than a more conservative motorist. Later versions have only one sensor.

Early versions of ASR depend on the pressure reservoir for the brake pressure required for brake activation. Later versions employ a pump of greater capacity and do without the reservoir. The pressure reservoir is behind the trim panel on the driver's side fender. A pressure sensor switch turns on the pump when the reservoir needs recharged.

There are actually three pumps with two electric motors. Both motors and thus all three pumps run at the same time. One pump, often identified as M15 in

All of the traction control systems employ electric motor pumps to build the brake fluid pressure required to activate the brakes during ASR activations.

the carmaker's technical literature, is the pressurizing pump. This pump can be in the lower trim panel with the reservoir or near the master cylinder. It builds ASR system pressure up to 1.8 to 11 bar. The second, the return/charge pump in the hydraulic control unit is two pumps in one (the charge portion being reduction geared for higher pressure). That second pump provides return fluid flow for ABS events as well.

ASR uses the same three pressure modes as does ABS: pressure buildup, pressure holding, pressure reduction. The major difference is that in ASR the brake fluid pressure can be greater than what flows from the master cylinder when the control unit directs pressure to specific wheel calipers.

The pressure reservoir uses a spool-shaped piston in a cylinder (See the diagram on page 25). Nitrogen gas at about 100 bar forms the initial charge. You may recall in the last *StarTuned* we pooh-poohed the idea of using nitrogen to inflate tires because the likelihood of significant moisture in a tire is so low. The nitrogen gas chamber of the pressure reservoir, however, is another matter. It would be unreasonable to take even the slightest risk of allowing trace moisture – and thus rust – anywhere inside the brake system's hydraulic system.

A hydraulic test of the system checks the pumps and the pressure reservoir. Use only a pressure gauge employed only for brake pressure measurements, specifically not a Diesel injection pressure gauge. The very last thing you want any trace of in a brake system is mineral oil. First, release the pressure in the reservoir as described in our sidebar on brake bleeding (page 25). Then monitor the pressure increase. The charging pump should build somewhere between 1.8 and 11 bar. That may seem like a wide threshold, but the purpose of this gerotor pump is to supply volume, not pressure, so the specifications are right. Then observe the pressure buildup in the reservoir. If there is no pressure buildup or if it takes longer than 60 seconds, you have a pump that is not performing satisfactorily. If the pressure reservoir is defective, either the pressure rises quickly to 50 bar and then slowly up to the maximum or quickly and constantly up to maximum.

The working pressures for the system, the points at which the dual pump (a 'quill' pump familiar from ABS) should turn on and turn off, are approximately 160 and 180 bar, requiring about 30 to 50 seconds for the recharge. It may seem odd to have such high pressures since they are seldom or never applied to a brake caliper, but because of the incompressibility of brake fluid (of fluids in general, in fact) pressure application is nearly immediate when a solenoid in the control unit changes state. Not much actual fluid flow is required for the activation, so what the system really needs to store is pressure – hence the 180 bar.

ASR also employs the engine management system to retain torque. Early systems control only the throttle position; later versions (from ASR III on) can retard spark as well. Obviously, this means we're talking about cars with one or another form of drive-by-wire, so the ASR unit can send instructions to the engine management computer to close the throttle. The telescoping rod in the linkage to the accelerator pedal accommodates any difference between what the driver wants the car to do and what the traction conditions allow. Ordinarily, if there is a disabling fault in the electronic accelerator system, that will also disengage the ASR, triggering both warning lamps.

The very earliest ASR systems had no self-diagnostic capacity, so if there was something wrong with the mechanism you had to test individual components mechanically, hydraulically or electrically.

After that you can extract trouble codes with the impulse counter, Hand-Held Tester or the equivalent. Keep in mind, as always, that trouble codes point to suspect circuits, not components. If you just replace the part corresponding to the code, you'll replace some functional elements.

Thanks to the parts and service crew at Mercedes-Benz of Bedford (Ohio) for their cooperation in these and many earlier photos.

German-English Alphabet Soup

With all the traction-control acronyms, it's easy to confuse the corresponding but different Mercedes-Benz traction-control systems. Where available, we've included the German-language description, but we should tell you that, while German does make long compound words by joining several shorter words together, it does not capitalize, boldface or italicize individual letters in the middle of words – we've done that here just to highlight where the acronym comes from. Sometimes, too, the official translation is not a literal one; sometimes there's more than one official translation, depending on how many cooks were stirring the soup. Finally, Mercedes-Benz sometimes uses an English name for a system even in the original German technical information. Ah well, cut 'em some slack – they've only been at this for 117 years or so.

Some non-traction-control subsystems, like the speed-sensitive power steering on Model 140, also fall under the traction-control system purview because the sensors and microprocessors are already there, so a cost-savings results from including them. For that matter, once everything connects to everything else on a data bus, there's really only one system, anyway, whether you're talking about the radio or the turn signals or the ignition timing or the courtesy lights.

ABS ***(AntiBlockierSystem)*** prevents wheel lockup during braking. This retains steering and directional stability while optimizing braking performance. ABS works by reducing or releasing brake hydraulic pressure at the wheels once the system recognizes the beginning of lockup. In most circumstances, ABS increases the effective braking performance (that is, reduces the braking distance), but not in all: It retains steering and directional stability first and only then improves braking. Read your last issue of *StarTuned* for much more on ABS.

ASR ***(AntriebSchlupfRegelung)*** prevents drivewheel slip during acceleration. Preventing drivewheel slip also retains steering and directional stability while optimizing acceleration traction. ASR works by either braking slipping drivewheels or reducing engine output torque, depending on the circumstances. ASR can get you going on a very slippery surface when no amount of delicate work with the accelerator coupled with brake-pedal feathering to control wheelspin will do the job. But it's not magic. The facts of physics still control the extent of movement: If you're floating on the bellypan in gumbo mud and spinning your drivewheels in cloudy swampwater, you're probably going to stay there until the tow truck arrives, ASR or no.

BAS, the brake assist system, is related to the traction control systems proper but is somewhat different. Through a sensor that reports the speed of brake pedal movement (actually the speed of the vacuum booster diaphragm movement), its control unit identifies emergency braking situations and, by venting atmospheric pressure to the rear of the booster diaphragm, applies full braking power immediately in such circumstances. This system was developed after Mercedes-Benz researchers discovered that in most such stopping emergencies people apply the brakes quickly enough, but too tentatively, with insufficient force, as though fearing to lock the wheels up. With an ABS system, of course, you're not going to lock up the wheels by stamping on the pedal, so an emergency situation calls for full-force-braking from the very first instant to reduce vehicle speed as quickly as possible, beginning as far from the location of potential impact as possible. Traction control comes into play with the now almost routine prevention of brake lockup through the ABS system. BAS exploits the safety margin of ABS when it senses the emergency stop and applies full braking at once. Depending on the vehicle speed, traction conditions and so on, this can shave as much as 30 feet off the braking distance to a standstill. In many emergencies, that could mean no accident would occur at all. In others, it means the force of the impact is much lower.

EBR or MSR ***(MotorSchubRegelung),*** Engine braking control, prevents wheelslip at the drivewheels caused by engine braking under deceleration. You sometimes find this system described as "overrun control." The major purpose of this part of ASR or ESP is to retain steering and directional stability when the driver lifts a foot off the accelerator pedal in a fast turn, though it also works to prevent deceleration drivewheel slip (and thus retain directional stability) in a straight line. EBR works by opening the throttle when engine braking threatens to make a drivewheel slip in a turn. For most Mercedes-Benz vehicles, that throttle opening by EBR/MSR is limited to 17 or 18 degrees of throttle opening, more than enough to reduce the deceleration vacuum and increase the engine torque output sufficiently to let the wheels grip the pavement. On Diesel engines, the engine braking control subsystem increases the amount of fuel injected, though you'll recall from our previous articles on Diesel engines that there is not much inherent engine braking in a Diesel engine since there are no significant pumping losses, the source of engine braking. In reverse gear, below 20 km/h or if the transmission control system fails, engine-braking control shuts off.

ASD ***(Automatisches SperrDifferential)*** prevents or reduces drivewheel slip by locking the differential so the axles turn at the same speed. This relatively infrequent option appeared mostly on smaller gasoline engines and Diesels before ASR, ESP and later traction-control systems. ASD does not include any special measures to prevent the simultaneous slip of both drivewheels, though the physics of friction and the limits of the available torque from the smaller engines help in that respect.

4MATIC is the first of the all-wheel-drive systems, connecting all of the wheels together with front and rear drivetrains connected through a transfer case. 4MATIC prevents drivewheel slip by selectively locking rear or center differentials to direct engine torque to the wheels with the most traction. The system also unlocks all the differentials for ABS operation, to prevent one wheel with traction from forcing another without to slip through the locked differential they share. Again, the system provides an impressive increase in traction.

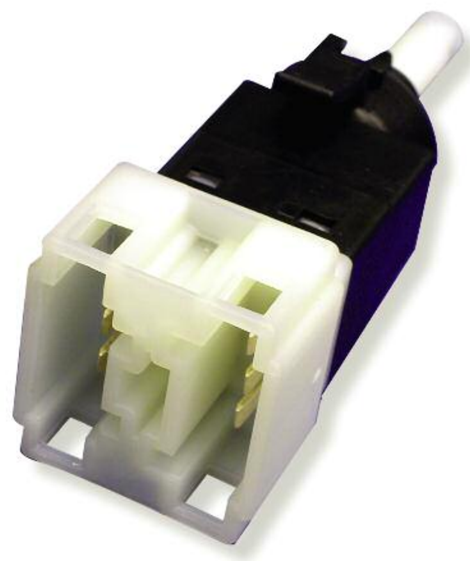
ETS ***(Elektronisches TraktionSystem/*****electronic traction system)** and 4ETS systems are the successors of ASD and 4MATIC, achieving through selective brake applications the same effects as differential lockup in ASD and in 4MATIC. All-wheel-drive, of course, maximizes traction up to the limits of the tires' physical adhesion to the pavement during acceleration. Instead of achieving drivewheel traction by locking the differential, however, it works by braking the slipping wheel. This amounts to achieving the same level of control at significantly lower production cost, and avoids the need for the now-redundant differential lockup clutches and hydraulic system.

ESP ***(Elektronisches StabilitätsProgram/*****electronic stability program)** is the latest and most complex of the Mercedes-Benz traction control systems, though there are more and even subtler systems in the pipeline. Its function is to prevent loss of traction from over- or understeering. With additional sensors to report yaw movement and lateral acceleration and through control of individual wheel brakes as well as engine torque output through the electronic accelerator system ('drive-by-wire'), ESP keeps the vehicle going or turning in the direction the driver indicates with the steering wheel, up to the limits of tire adhesion. If the front wheels slip sideways, the ESP system brakes the rear wheel opposite the slip; if the rear wheels slip sideways, ESP brakes the front wheel toward the slip. In each case, the ESP braking works the way right and left handbrakes do on a bulldozer or tank, pivoting the vehicle toward the braked side. With ESP, we're getting very close to the limits of what kinds of traction controls are even possible. Further developments will surely involve radar-like sensors of surrounding objects and systems that may even overrule the driver's input in the interests of safety and stability.

PARTS NEWS

BRAKE SWITCH

At one time, a brake switch only served to turn on the brake lights when the driver pressed the stop pedal. Since the car's electronics are now all one system, the brake switch has a much more complex role to play and more detailed ways of playing it. With traction controls, the system needs accurate information about whether the pedal is pressed or not, so current brake switches include several switches in the same unit. Some of them are normally open; some are normally closed. The reason for this is because a problem with the switch – typically a short or an open – is unlikely to affect both circuits in the complementary ways that would be necessary to provide false information. If the control unit gets contradictory information, it will set a code for the switch.



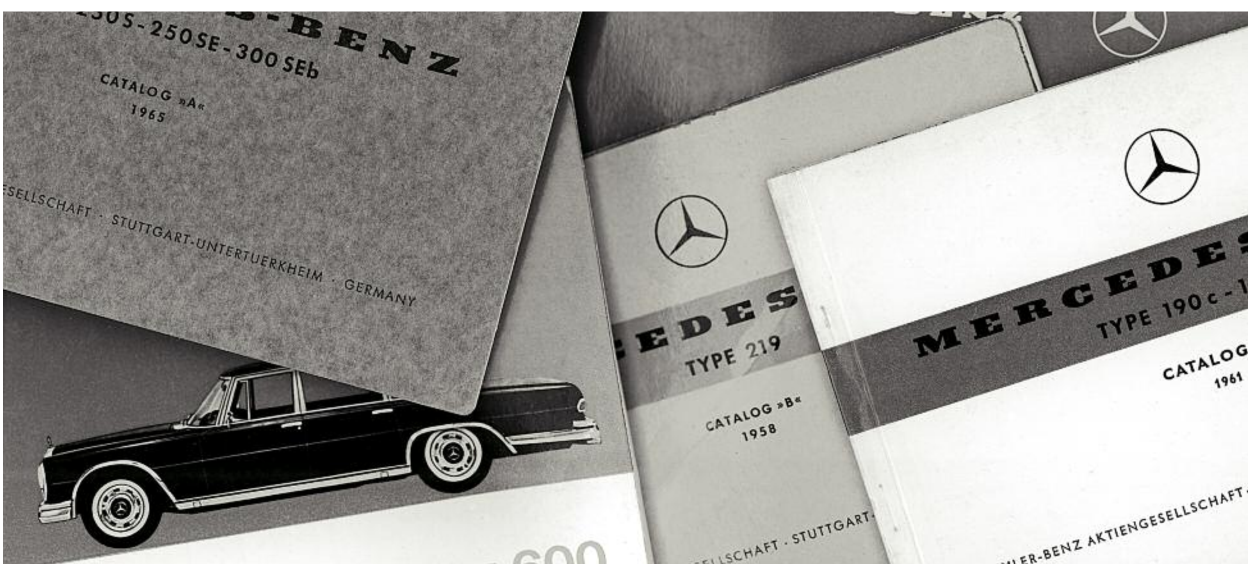
CONTROL UNITS

Control Units seldom fail because of the numerous protection measures to insulate them from overvoltage, water and impact damage. Most of them, in addition, are located in some of the safest places on the car, less likely than any vehicle contents but the passengers to encounter trouble. Nonetheless, some people manage to drive into lakes or otherwise zap the microprocessor boxes. It's always a hard decision to replace a control unit except in those rare instances when there is visible external physical damage to the device, because nobody wants to recommend an expensive part that sometimes proves not to be the cure for the problem. The last thing you want, though, is a replacement part that doesn't work, itself, and the best way to be confident of this is to get a Genuine Mercedes-Benz Part. If you haven't checked lately, you might be surprised to find the lower prices for control units, resulting in part from manufacturing economies.

GASKETS

Gaskets aren't very sexy parts. They're not electronic or digital or computerized. Not sexy, that is, until you consider the consequences when one fails. The difference in a Genuine Mercedes-Benz gasket is that it fits exactly and is of just the right material and dimensions to do the job as the engineers originally intended. The carmaker also has the advantage of more experience with the vehicles than any other source can claim. That means there can be a continuous program of improvement for all parts, even such 'ordinary' ones as gaskets of all sorts.

CLASSIC MANUALS



You may have customers with classic Mercedes-Benz vehicles or your shop may do restoration work or keep a classic or two just as demonstration vehicles. There are about 400,000 classic Mercedes-Benz cars still in use. The German-American carmaker has reprinted many classic manuals for about 70 percent of the classic cars built between 1946 and 1985. Service manuals, spare parts lists, illustrated parts catalogs, owner's manuals, maintenance booklets, and technical data books are available. These publications are reprinted just as originally, in the same paper, in the same colors. The books are also available wholesale to independent shops specializing in Mercedes-Benz vehicles.

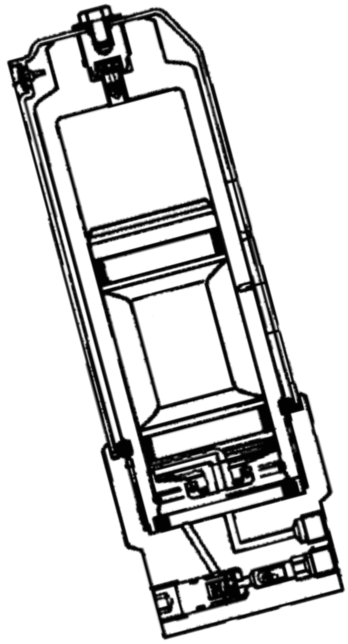
StarTuned

Factory Service Bulletins

These suggestions and solutions for technical problems come from service bulletins and other technical sources at Mercedes-Benz. They are selected and rewritten for independent repair shops. Your Genuine Mercedes-Benz Parts source can obtain any item designated by a part number. This issue of Factory Service Bulletins focuses on brake bleeding on vehicles with ASR.

Brake Bleeding with ASR

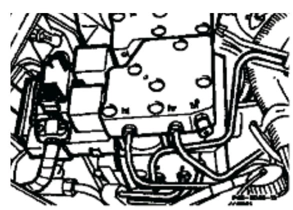
Brake bleeding for ASR proceeds just like brake bleeding with ABS, and like that system bleeding is most often needed to flush the fluid. It's not that brake fluid has a shorter useful life with the traction control systems; it's that there are very expensive machined components in the hydraulic circuit, components lubricated internally only by the brake fluid. You can buy many drums of brake fluid for less than the cost of the simplest of the hydraulic units on any of the traction control systems, so there's no economy in stretching the calendar for a fluid flush. Earlier vehicles with ASR called for a full fluid flush every year or 12,000 miles, "preferably in the Spring" (at *StarTuned* we assume this is because the risk of contaminated brake fluid grows with the temperature, so flushing just before the year warms is a good choice). Later cars (after April of 1991) stretched this to every two years or 24,000 miles. But to wait more miles or a longer time than that is to risk easily avoidable damage to very valuable equipment.



There is brake fluid under high pressure in the pressure reservoir, fluid that won't come out by just bleeding the brakes through the wheel calipers. You have to bleed the reservoir itself and flush the pressurizing pump to get all the fluid out.

Here's the brake-bleeding procedure for a vehicle with ASR: First, with the ignition off, release any pressure at the reservoir. Do so by opening the bleeder marked "SP" on the hydraulic control unit. Open this bleeder at least one full turn and leave it open until the fluid-flow stops. Then close it. As with all brake bleeding, use a hose to direct the flow of waste oil into a container to protect the vehicle paint.

Next, with a vacuum pump (or even a turkey baster, permanently retired from the kitchen) draw the master cylinder fluid level down to within 10 mm of the bottom of the reservoir. Don't draw the fluid any lower than this, or you risk introducing air into the system, and then your flush procedure will be unnecessarily complicated to pump the air through and out. Connect a pressure bleeder to the master cylinder reservoir (or top it up with clean fluid, if you prefer to bleed using the pedal and an assistant). Mercedes-Benz technical information suggests a fluid volume of 80 cc's per caliper if there is no air to flush from the system and 500 cc's per if there is. Considering the replacement cost of the mechanical and electrical hydraulic-circuit components, you may want to incline to the latter figure in either case.

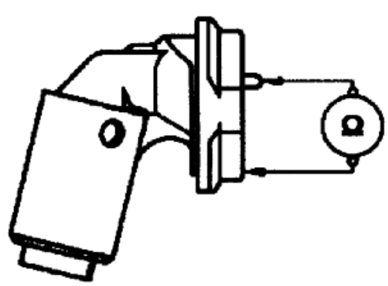


ASR systems using a pressure reservoir (not all!) have a bleeder marked "SP" on the hydraulic unit. Step One in flushing the brake fluid is to open that bleeder one full turn until all the brake fluid stops flowing.

Once clear, new fluid flows from each caliper bleeder, confirm that the reservoir holds enough fluid, reopen the bleeder marked "SP" on the hydraulic control unit (protective hose still connected) and start the engine. The pressurizing pump will try to fill the pressure reservoir. This can't happen with the bleeder open, of course, so let the fluid run until it is also clear, new fluid entirely without bubbles. Don't let the master cylinder bottle run empty! Finally, close the bleeder and allow the pump to complete filling the pressure reservoir. When the pump shuts off, turn off the engine, disconnect the power bleeder and top the master cylinder up to the indicated level. Double-check that the vent aperture in the master cylinder reservoir cap is clear.

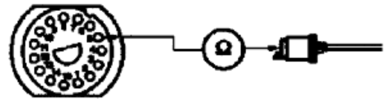
126 (but others similar)

If the oil level lamp comes on with the engine running but the correct oil level, especially when making left turns, there are several possible causes. If you've already opened up the crankcase as we've described in our article on oil pan gasket replacement, it might be worthwhile making these checks just for insurance (you don't want the lamp on after you've done the gasket job, and you certainly don't want to wonder whether you did something to trigger the problem).



The oil level float switch is a grounding device. If the oil level falls below the minimum, it connects its electric circuit to ground, turning on the warning lamp on the dash. It could fail by either constantly grounding the circuit or never grounding it. Proper function occurs when the oil activates the sensor.

One possible cause could be a defective oil level float switch itself. Check that with your ohmmeter, measuring between the pin of the oil level switch and ground. If you find a resistance above 0.10 Ohms, you've found a nonfunctional oil level switch. If not, move on to the next step



The wire from the oil level float sensor switch to the instrument panel transits terminal 5 of the 15-pole connector at the back of the instrument cluster. If this circuit is shorted or open-circuited, the oil level sensing system cannot function accurately.

To check the continuity of the sensor wire, remove the instrument cluster. You'll recall the technique to do this from our article on heater cores, in which we removed the instrument cluster. Special hooks disengage it from the instrument panel, and you then have access to the electrical connector. Using your Ohmmeter, measure between the terminal of the wire at the float level sensor and terminal 5 of the 15-pole connector at the back of the instrument panel. If the reading is above 0.10 Ohm, you've found an open-circuited wire. If there is secure continuity from sensor to instrument panel and if you know from the previous test that the switch itself is working properly, the only remaining possibility is a problem with the instrument panel itself.

Testing ASR Function

Here's how to confirm the ASR system is properly working on a two-wheel-drive vehicle. Lift the rear wheels (or preferably the whole vehicle on a hoist for safety) and secure the car so it cannot move. Make certain no people, tools, shop equipment or other objects are close to the drivewheels or driveshaft. Connect an exhaust tube to channel the exhaust outside the shop.

Start the engine and put the car in drive. Push the accelerator pedal to the floor gradually. You should hear and feel the brake activation slow the wheels immediately after they start to turn. The engine rpm should not rise above about 1000 rpm. You'll also hear the high-pressure pump running. Be prepared to rapidly cease this test should the system not function properly. The engine management system should not let the engine rise above redline, but that would still be too high a wheel and tire speed for safety in the confines of a shop. Once you've confirmed that the system is working properly – or that it isn't – terminate this test.

The same considerations account for why the Mercedes-Benz technical information includes the precaution in several places that you should never tow an ASR-equipped vehicle with the front wheels raised, the drivewheels on the ground and the engine running. While we at StarTuned have to throw in the towel in the attempt to think of a reason why anyone would want to tow a car in that way, it is certainly clear that he'd destroy the tires, brakes and other components if he did.

Sorting Out Problems

This could help expedite an ASR diagnosis: If the ASR light comes on while driving and stays on until the ignition is turned off, but the accelerator pedal feels and functions normally, you've most probably found a failed pressure pump (either return/pressure or the charging pump), a bad pressure reservoir or a leak in the hydraulic circuits. If the ASR light comes on under the same circumstances, but the accelerator pedal is harder to push and the engine power output is noticeably reduced, the problem is more likely in the electronic accelerator system rather than in ASR.

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McConnell Automotive
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Jack Ingram Motors
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Tuscaloosa
Leigh Automotive
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Mercedes-Benz of Chandler
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Rusnak/Arcadia
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Mercedes-Benz of Bakersfield
661-836-3737

Belmont
Autobahn Motors
650-637-2333

Beverly Hills
Beverly Hills
310-659-2980

Buena Park
House of Imports
714-562-1100

Calabasas
Calabasas Motorcars
818-591-2377

Carlsbad
Hoehn Motors
760-438-4454

Chico
Courtesy Motors Auto Center
530-893-1300

El Dorado Hills
Mercedes-Benz of Eldorado Hills
916-567-5100

Encino
Auto Stiegler
818-788-0234

Escondido
Mercedes-Benz of Escondido
760-745-5000

Fremont
Claridge's
510-623-1111

Fresno
Mercedes-Benz of Fresno
559-438-0300

Glendale
Calstar Motors
818-246-1800

Laguna Niguel
Mercedes-Benz of Laguna Niguel
949-347-3700

La Jolla
Heinz Gietz Autohaus
858-454-7137

Long Beach
Mercedes-Benz of Long Beach
562-988-8300

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

Modesto
Modesto European
209-522-8100

Monterey
Mercedes-Benz of Monterey
831-375-2456

Newport Beach
Fletcher Jones Motor Cars
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
626-792-0226

Pleasanton
Mercedes-Benz of Pleasanton
925-463-2525

Riverside
Walter's
909-688-3332

Rocklin
Von Housen Motors
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
Beshoff
408-239-2300

San Jose
Smythe European
408-983-5200

San Luis Obispo
Kimball Motor
805-543-5752

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

Santa Barbara
Cutter Motors
805-682-2000

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

Santa Rosa
Smothers European
707-542-4810

Stockton
Berberian European Motors
209-944-5511

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

Torrance
Mercedes-Benz of South Bay
310-303-3500

Van Nuys
Keyes European
818-461-3900

Walnut Creek
Stead Motors of Walnut Creek
925-937-1655

West Covina
Penske Motorcars
626-859-1200

Colorado

Colorado Springs
Phil Long European Imports
719-575-7950

Denver
Murray Motor Imports
303-759-3400

Littleton
Mercedes-Benz of Littleton
303-738-7700

Connecticut

Danbury
Mercedes-Benz of Danbury
203-778-6333

Fairfield
Mercedes-Benz of Fairfield
203-368-6725

Greenwich
Mercedes-Benz of Greenwich
203-869-2850

Hartford
New Country Motor Cars
866-346-2369

New London
Carriage House of New London
860-447-3361

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

Delaware

Milford
I.G. Burton
302-424-3042

Wilmington
Mercedes-Benz of Wilmington
800-800-1949

Florida

Clearwater
Lokey Motor
727-530-1661

Coral Gables
Bill Ussery Motors
305-445-8593

Daytona Beach
Mercedes-Benz of Daytona Beach
386-274-4775

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

Ft. Pierce
Coggin Motor Mall
772-466-7000

Ft. Walton Beach
Quality Imports
850-863-2161

Gainesville
Kraft Motorcar
352-332-7571

Jacksonville
Brumos Motor Cars
904-724-1080

Lakeland
Robert G. Waters
863-688-8111

Maitland
Mercedes-Benz of Orlando
407-645-4222

Melbourne
Continental Motorcars
321-956-0600

Miami
Mercedes-Benz of Miami
305-919-8000

Naples
Mercedes-Benz of Naples
239-643-5006

Pensacola
Centennial Imports
850-432-9903

Pompano Beach
Autohaus Pompano
954-943-5000

Sarasota
Glauser
941-923-3441

St. Petersburg
Crown Eurocars
727-526-3738

Tallahassee
Capital Eurocars
850-574-3777

Tampa
Mercedes-Benz of Tampa
813-870-0010

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

Georgia

Albany
Hentschel Motorcars
912-883-2040

Athens
Mercedes-Benz of Athens
706-549-6600

Atlanta
Carriage House Imports
770-964-1600

Atlanta
RBM of Atlanta
770-390-0700

Atlanta
Mercedes-Benz of Buckhead
404–846-3500

Augusta
Rader
706-860-1111

Columbus
Columbus Motor
706-327-3636

Deluth
Atlanta Classic
770-279-3600

Macon
Jackson Automotive
478-477-4858

Savannah
Critz
912-354-7000

Hawaii

Honolulu
Theo Davies Euromotors
808-592-5600

Idaho

Boise
Lyle Pearson
208-377-3900

Pocatello
Robert Allen
208-232-1062

Illinois

Arlington Heights
Mark Motors
847-259-4455

Barrington
Motor Werks of Barrington
847-381-8900

Bourbonnais
Napleton's Autowerks
815-933-8221

Champaign
Sullivan-Parkhill Imports
217-352-4161

Chicago
Mercedes-Benz of Chicago
312-944-0500

DeKalb
Brian Bemis Imports
815-758-5451

Lake Bluff
Knauz Continental Autos
847-234-1700

Lincolnwood
Loeber Motors
847-675-1000

Loves Park
Napleton's Autowerks
815- 636-6600

Marion
Foley-Sweitzer
618-997-1313

Naperville
Mercedes-Benz of Naperville
630-305-4560

Normal
Sud's Motor Car
309-454-1101

Northbrook
Autohaus on Edens
847-272-7900

Orland Park
Mercedes-Benz of Orland Park
708-460-0400

Pekin
Sud's
309-347-3191

Peru
J.P. Chevrolet GEO Nissan
815-223-7000

Springfield
Isringhausen Imports
217-528-2277

Westmont
Laurel Motors
630-654-8100

Indiana

Evansville
D-Patrick
812-473-6500

Fort Wayne
Shaver Imports
260-432-7200

Highland
Terry Shaver Imports
219-924-2400

Indianapolis
World Wide Motors
317-580-6810

Lafayette
Mike Raisor Imports
765-448-4582

Mishawaka
Gurley-Leep Motorwerks
219-256-1500

Iowa

Davenport
Lujack's Northpark
563-388-8610

Des Moines
Mercedes-Benz of Des Moines
515-334-8339

Iowa City
Chezik-Sayer Imports
319-337-6100

Kansas

Shawnee Mission
Aristocrat Motors
913-677-3300

Topeka
Sunflower Motors
785-266-8480

Wichita
Scholfield Auto Plaza
316-688-5000

Kentucky

Ashland
Sim Fryson Motor
606-329-2288

Bowling Green
Bowling Green Imports
270-745-0001

Lexington
James Motor
859-268-1150

Louisville
Tafel Motors
502-896-4411

Louisiana

Alexandria
Walker Automotive
318-445-6421

Baton Rouge
Audubon Imports
225-490-3101

Lafayette
Moss Motors
337-235-9086

Metairie
Benson Motor
504-456-3727

Shreveport
Holmes European Motors
318-212-1212

Maine

Bangor
Quirk Auto Park of Bangor
207-941-1017

Falmouth
Performance Motors
207-781-3207

Maryland

Annapolis
Mercedes-Benz of Annapolis
410-268-2222

Bethesda
Euro Motorcars
301-986-8800

Cockeysville
Valley Motors
410-666-7777

Hagerstown
Mercedes-Benz of Hagerstown
301-733-2301

Owings Mills
R & H Motor Cars
410-363-3900

Salisbury
Pohanka TM
410-548-3411

Silver Spring
Herb Gordon
301-890-3030

Massachusetts

Boston
Westwood
781-688-1000

Boyston
Wagner
508-869-6766

Haverhill
Smith Motor
978-372-2552

Hyannis
Trans-Atlantic Motors
508-775-4526

Lynnfield
Flagship Motorcars
781-596-9700

Natick
Foreign Motors West
508-655-5350

Somerville
Chambers Motorcars of Boston
617-666-4100

West Springfield
Lewbar Imports
413-733-5102

Westwood
Mercedes-Benz of Westwood
781-688-1000

Michigan

Acme
Black Forest Motors
231-938-2840

Ann Arbor
Auto-Strasse
734-663-3300

Bloomfield Hills
Mercedes-Benz of Bloomfield Hills
248-644-8400

Grand Blanc
Grand Blanc Motorcars
810-695-4400

Grand Rapids
Betten Imports
616-241-2671

Kalamazoo
Orrin B. Hayes
269-345-0167

Novi
Mercedes-Benz of Novi
248-426-9600

Okemos
Williams
517-484-1341

Rochester
Mercedes-Benz of Rochester
248-652-3800

Minnesota

Bloomington
Feldmann Imports
952-837-6300

Maplewood
Maplewood Imports
651-483-2681

Minnetonka
Sears Imported Autos
952-546-5301

Mississippi

Gulfport
Bert Allen Imports
228-864-6622

Jackson
Higginbotham
601-956-4211

Missouri

Columbia
Legend
573-875-5000

Creve Coeur
Plaza Motor
314-301-1715

Ellisville
Tri-Star Imports
636-458-5222

Joplin
Frank Fletcher Mercedes-Benz
888-474-4551

Springfield
Elite
417-889-5750

Montana

Missoula
DeMarois Olds-GMC
406-721-4000

Nebraska

Lincoln
Husker
402-479-7600

Omaha
Mercedes-Benz of Omaha
402-384-9999

Nevada

Las Vegas
Fletcher Jones Imports
702-364-2758

Reno
Von Housen's Motors
916-924-8000

New Hampshire

Greenland
Dreher-Holloway
603-431-8585

Manchester
Holloway Motor Cars
of Manchester
603-669-6788

New Jersey

Bridgewater
Millennium
908-685-0800

Cherry Hill
Mercedes-Benz of Cherry Hill
856-663-0984

Edison
Ray Catena Motor Car
732-549-6600

Englewood
Benzel-Busch
201-567-1400

Fairfield
Globe
973-227-3600

Freehold
David Michael
888-362-8867

Lawrenceville
Mercedes-Benz of Princeton
609-771-8040

Little Silver
Contemporary Motor Cars
732-842-5353

Millville
Quality Lincoln Mercury Hyundai
856-327-3000

Morristown
Mercedes-Benz of Morristown
973-267-9200

Newton
Intercar
973-383-8300

Paramus
Prestige Motors
201-265-7800

Union
Ray Catena Motor Car
908-964-4000

West Atlantic City
Precision Cars of AtlanticCity
877-5MB-PARTS

New Mexico

Albuquerque
Premier Motorcars
505-821-4000

New York

Bayside
Helms Brothers
718-631-8181

Binghamton
Feduke Motors
607-772-0700

Brooklyn
Sovereign Motor Cars
718-258-5100

Fayetteville
Romano Motors
315-637-4500

Goldens Bridge
Estate Motors
914-232-8122

Huntington
Mercedes-Benz of Huntington
631-549-2369

Latham
Keeler Motor Car
518-785-4197

Long Island City
Silver Star Motors
718-361-2332

Massapequa
Sunrise Motors
631-789-1600

Nanuet
Mercedes-Benz of Nanuet
845-624-1500

New York
Mercedes-Benz Manhattan
212-629-1600

Rochester
Holtz House of Vehicles
716-424-4740

Rockville Centre
Lakeview
516-766-6900

Roslyn
Rallye Motors
516-625-1600

Smithtown
Competition Imports
631-265-2204

Southampton
Mercedes-Benz of Southampton
631-283-0888

Wappingers Falls
Friendly Motorcars
845-298-0600

White Plains
Mercedes-Benz of White Plains
914-949-4000

Williamsville
Mercedes-Benz of Buffalo
716-633-0088

North Carolina

Asheville
Skyland
828-667-5213

Cary
Mercedes-Benz of Cary
919-380-1800

Charlotte
Beck Imports of the Carolinas
704-535-6400

Fayetteville
Valley Motors
910-487-0000

Greensboro
Mercedes-Benz of Greensboro
336-856-1552

Hickory
Hendrick Motors
828-322-5640

Raleigh
Leith
919-876-5432

Wilmington
Bob King Autohaus
910-799-3520

Winston-Salem
Mercedes-Benz of Winston-Salem
336-760-4580

North Dakota

Fargo
Valley Imports
701-277-1777

Ohio

Akron
Ganley
330-733-7511

Bedford
Mercedes-Benz of Bedford
440-439-0100

Canton
Kempthorn Motors
330-452-6511

Centerville
Ross Motor Cars
937-433-0990

Cincinnati
Mercedes-Benz of Cincinnati
610-984-9080

Columbus
Ed Potter
614-299-2144

Dublin
Crown Eurocars
614-799-4666

Forest Park
Mercedes-Benz of Cincinnati
513-851-8800

Mansfield
Weidner Motors
419-529-7800

North Olmsted
Mercedes-Benz of North Olmsted
440-716-2700

Sylvania
Vin Devers
419-885-5111

Tiffin
Coppus Motors
419-447-8131

Willoughby
Leikin Motor
440-946-6900

Youngstown
Fred Martin Ford
330-793-2444

Oklahoma

Oklahoma City
Mercedes-Benz of Oklahoma City
405-236-1224

Tulsa
Jackie Cooper Imports
918-249-9393

Oregon

Bend
Mercedes-Benz of Bend
541-749-2500

Eugene
Mercedes-Benz of Eugene
541-687-8888

Medford
Crater Lake Motors
541-773-3673

Portland
Mercedes-Benz of Portland
503-228-8351

Salem
Valley Motor
503-585-1231

Wilsonville
Mercedes-Benz of Wilsonville
503-454-5000

Pennsylvania

Allentown
Knopf
610-439-1555

Camp Hill
Sun Motor Cars
717-737-3030

Devon
Mercedes-Benz of Devon
610-688-7905

Doylestown
Keenan Motors
215-348-0800

Erie
Contemporary Motorcar
814-868-8622

Ft. Washington
R&S Imports
215-646-6045

Greensburg
Bud Smail Motorcars
724-838-1200

Lancaster
Mercedes-Benz of Lancaster
717-569-2100

Reading
Tom Masano
610-777-6587

State College
Leitzinger Imports
814-238-2447

Washington
John Sisson Motors
724-206-6000

West Chester
Mercedes-Benz of West Chester
800-220-7278

Wexford
Bobby Rahal Motorcar
724-935-9300

Wilkes-Barre
Motorworld
570-829-3500

Puerto Rico

Carolina
Garage Isla Verde
787-620-1313

Rhode Island

Tiverton
Viti
401-624-6181

Warwick
Inskip
401-821-1515

South Carolina

Charleston
Baker Motor of Charleston
843-852-4000

Columbia
Dick Dyer and Associates
803-786-8888

Conway
Fowler Motors
843-347-4271

Florence
Newsome
843-662-8711

Greenville
Carlton Motorcars
864-213-8000

Hilton Head Island
Modern Classic Motors
843-681-8500

South Dakota

Sioux Falls
Vern Eide Motorcars
605-362-9500

Tennessee

Chattanooga
Long of Chattanooga
423-855-3726

Kingsport
Rick Hill Imports
423-224-2117

Knoxville
Mercedes-Benz of Knoxville
865-777-2222

Memphis
Mercedes-Benz of Memphis
901-345-6211

Nashville
Mercedes-Benz of Nashville
615-742-8000

Texas

Austin
Mercedes-Benz of Austin
512-454-6821

Beaumont
Mike Smith Autoplex
German Imports
409-840-2000

Bedford
Park Place Motorcars
817-359-4700

Corpus Christi
Ed Hicks Imports
361-854-1955

Dallas
Park Place Motorcars
214-526-8701

El Paso
Mercedes-Benz of El Paso
915-778-5341

Harlingen
Cardenas Autoplex
956-425-6000

Houston
Mercedes-Benz of Houston Greenway
713-986-6400

Houston
Mercedes-Benz of Houston North
281-873-6000

Houston
Star Motor Cars
713-868-6800

Laredo
Powell Watson Motors
956-722-5182

Lubbock
Mercedes-Benz of Lubbock
800-698-7993

Midland
Britt Imports
915-699-7993

Plano
Ewing Autohaus
972-599-0909

San Antonio
Mercedes-Benz of San Antonio
210-366-9600

Sugar Land
Mercedes-Benz of Sugar Land
281-276-7600

Temple
Garlyn Shelton Imports
254-771-0128

Texarkana
Pete Mankins Pontiac-Cadillac
903-793-5661

Tyler
Classic-Tyler Motors
903-581-0600

Waco
Allen Samuels Chevrolet-GEO
254-772-8850

Wichita Falls
Patterson Auto Center
940-766-0293

Utah

Salt Lake City
Ken Garff Imports
801-521-6111

Vermont

Shelburne
The Automaster
802-985-8482

Virginia

Alexandria
Mercedes-Benz of Alexandria
703-241-2150

Arlington
American Service Center
703-525-2100

Charlottesville
Brown European Imports
434-817-3380

Fredericksburg
Noble Cars
540-373-5200

Hampton
Tysinger Motor
757-865-8000

Lynchburg
Kenneth Hammersley Motors
434-385-6226

Richmond
David R. McGeorge
804-755-9300

Roanoke
West Motor
540-344-6284

Vienna
H.B.L.
703-442-8200

Virginia Beach
Phillips
757-499-3771

Washington

Bellevue
Mercedes-Benz of Bellevue
425-455-8535

Bellingham
Wilson Toyota
360-676-0600

Fife
Mercedes-Benz of Tacoma
253-922-6820

Pasco
McCurley Imports
509-547-5555

Seattle
Phil Smart
206-324-5959

Spokane
Mercedes-Benz of Spokane
509-455-9100

Yakima
Hahn Motor
509-453-9171

West Virginia

Charleston
Smith Company Motor Cars
304-746-0600

Morgantown
University Motors
304-296-4401

Parkersburg
Astorg Motor
304-422-6403

Wisconsin

Appleton
Enterprise Motorcars
920-749-2020

Glendale
Concours Motors
414-290-1400

Madison
Z European
608-258-4000

Wausau
Rosemurgy International
Auto Mall, Inc.
715-675-7775

West Allis
International Autos
414-543-3000