

STARTUNED®

Information for the Independent Mercedes-Benz Service Professional

June 2016

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INSIDE:

DUAL-CLUTCH TRANSMISSION
TIRES, WHEELS, AND SO MUCH MORE
ENGINE MECHANICALS
AMG GT-S COLLISION REPAIR

Mercedes-Benz



Who's Your *Partner* in Success? Mercedes-Benz's

You've chosen your career as an ISP (Independent Service Provider) because you enjoy maintaining, diagnosing, and repairing motor vehicles. One of the most challenging pieces of your business is parts procurement.

Finding the right parts at the right price and being certain they will arrive when promised can be a challenge.

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A PartsPro dealer has the tools in place to better meet the needs of their esteemed wholesale customers.

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On occasion we all need a helping hand. Your PartsPro dealer is there to assist. Whether it means providing diagnostic assistance, information on supplies or special tools, or anything else you may need, your PartsPro dealer is there to assist you in repairing your customers' Mercedes-Benz vehicles and getting them back on the road as fast as possible.

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Of course, you'll continue to have the peace of mind that installing only Genuine Mercedes-Benz parts can provide. |



STARTUNED®

June 2016

Welcome to *StarTuned*®, the magazine for independent service technicians working on Mercedes-Benz vehicles. Your Mercedes-Benz dealer sponsors *StarTuned*® and provides the information coming your way in each issue.

Mercedes-Benz wants to present the information you need to know to diagnose and repair Mercedes-Benz vehicles accurately, quickly and the first time; text, graphics, on-line and other technical sources combine to make this possible.

Feature articles, derived from approved company sources, focus on being useful and interesting.

Our digest of technical information can help you solve unanticipated problems quickly and expertly.

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

The best or nothing.

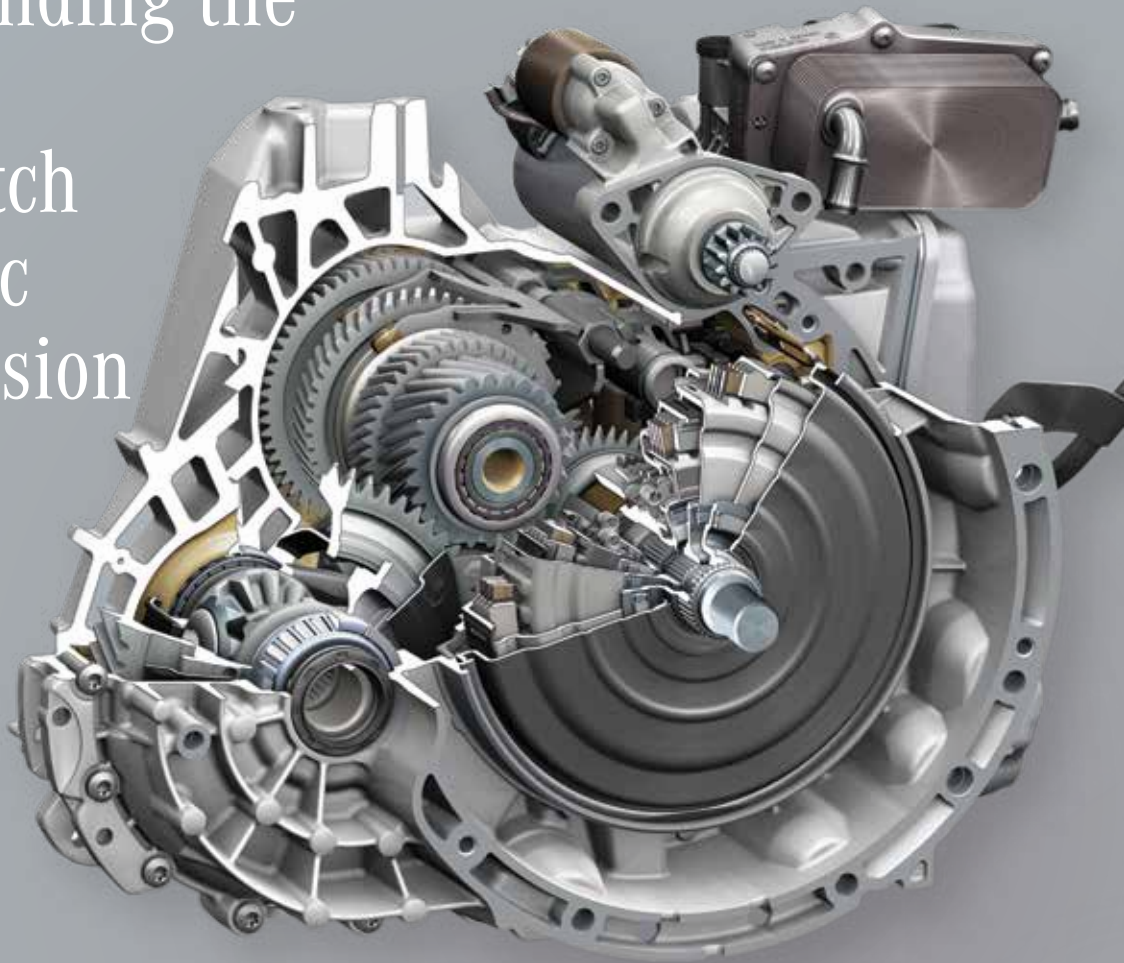


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Understanding the 7-Speed Dual-Clutch Automatic Transmission

Like two sticks? Ingenious technology yields the smooth and efficient 7G-DCT



Technology advances constantly. Engines become more efficient and powerful. Braking distances are shorter than ever. Comfort and convenience systems become more sophisticated so drivers can focus their attention more on driving. Engine management systems are more thoroughly integrated than ever before. And safety systems help to reduce accidents, and to help protect drivers and passengers from injury when accidents occur.

Amidst all of this, there is a constant need to improve

drivetrains, including automatic transmissions. Engineers are continually searching for ways to increase the number of forward speeds in pursuit of improved performance, drivability, and fuel economy. At the same time, market forces dictate the need for smoothing the shifting of gears such that the transition is all but unnoticeable.

All of these demands and challenges may seem insurmountable. Yet brilliant minds within the Mercedes-Benz family

continue to design automatic transmissions that meet and exceed the needs of the marketplace.

And so it is with the 7G-DCT dual-clutch 7-speed automatic transmission. First introduced about five years ago, this transmission is a brilliant piece of engineering — relatively simple in concept, yet glassy smooth in shifting and very reliable and durable.

Specific benefits of this design include:

- Short shift times
- Compact design

- Comprehensive integration of all transmission-related functions –hydraulic, electronic, and mechanical
- Unusually efficient and smooth transition between gears
- High customer satisfaction

This dual-clutch transmission can be operated in any of three modes the driver may select – Manual, Sport, or Economy (M, S, or E). Vehicles equipped with this transmission also feature an electronic version of what might be considered the most novel “prindle” ever offered in a motor vehicle – P-R-N-D-1-2-3-4-5-6-7.

A Look Inside

The essence of the 7G-DCT transmission is a blend of what are essentially two manual transmissions, each engaged by its own clutch assembly, and all controlled by an electronic management system.

This transmission is not unlike two manual transmissions, operating on two separate mainshafts, both powered by a common equivalent of a cluster gear. Synchronizers are surprisingly similar to those used in manual transmissions, with several key differences. One

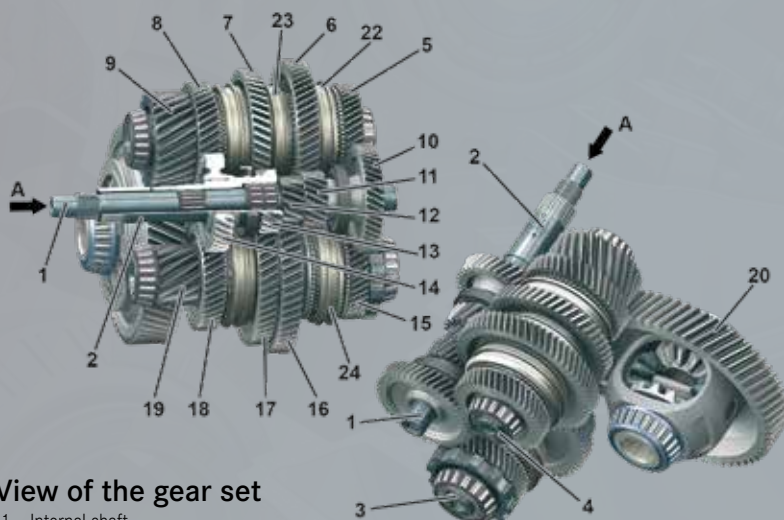
“mainshaft” contains the gears and synchronizers for the odd-numbered gears – 1, 3, 5, and 7. The other contains the even numbered gears – 2, 4, and 6 plus reverse. These are considered “sub-transmissions.”

Only one gear at a time is engaged in each sub-transmission. However, the electronic management system is so “smart” that it pre-selects and engages the next appropriate gear in the other sub-transmission in anticipation of changing driving conditions. So the shift pattern actually moves from one sub-transmission to the other, and back to the first as the need arises for a subsequent gear.

The beauty of this arrangement is that, with each successive gear pre-selected, gear changes are quick yet silky-smooth, nearly to the point of being unnoticeable.

Individual gears are selected by synchronizer sleeves and synchro rings that bear a striking resemblance to those used in manual transmissions. And, as in manual transmissions, gears are pre-meshed with their mates on the “cluster gear,” and locked to their mainshaft by the synchronizers.

Your own experience with manual transmissions will remind you that shifting in and out of higher gears is smooth and easy. However as you get to the lower gears, shifting becomes a bit harder. This is a function of the torque characteristics of the gear ratios.



View of the gear set

- | | |
|---|---|
| 1. Internal shaft | 14. Hollow shaft fixed gear (4th gear/6th gear) |
| 2. Hollow shaft | 15. 5th gear idler gear |
| 3. Output shaft 1 | 16. 1st gear idler gear |
| 4. Output shaft 2 | 17. 2nd gear idler gear |
| 5. 7th gear idler gear | 18. 4th gear idler gear |
| 6. 3rd gear idler gear | 19. Output shaft fixed gear 1 |
| 7. Reverse gear idler gear | 20. Spur gear (pinion differential) |
| 8. 6th gear idler gear | 22. Sliding sleeve (3rd gear/7th gear) |
| 9. Output shaft fixed gear 2 | 23. Sliding sleeve (reverse gear) |
| 10. Internal shaft fixed gear (5th gear/7th gear) | 24. Sliding sleeve (1st gear/5th gear) |
| 11. Internal shaft fixed gear (3rd gear) | |
| 12. Internal shaft fixed gear (1st gear) | |
| 13. Hollow shaft fixed gear (2nd gear/reverse gear) | |

A. Engine Torque



Recognizing the physics of these gear ratios, Mercedes-Benz engineers came up with an ingenious design that allows for smoother shifts among all gears, including lower gears. They have achieved this by building in multiple synchronizers in the lower-speed gears.

Specifically, this transmission uses three synchronizer cones for engaging first, second and third gears. The three friction surfaces combine to allow the gears to be slowed or speeded up more quickly and with less force than with fewer synchronizers. The result is shorter and smoother shift times, which translate into smoother and quicker gear changes.

Similarly, two synchronizers are used in fourth through seventh gear. The progression to higher gears requires less synchronization to achieve similarly smooth and speedy gear changes. And a single synchronizer is used for reverse gear, where there is only one gear ratio involved, and reverse gear is selected far less often than forward speeds.

The synchronizers are all operated by electro-hydraulically-controlled shift forks. The control module receives input data from a variety of sources and sensors and determines which gear is to be pre-selected.

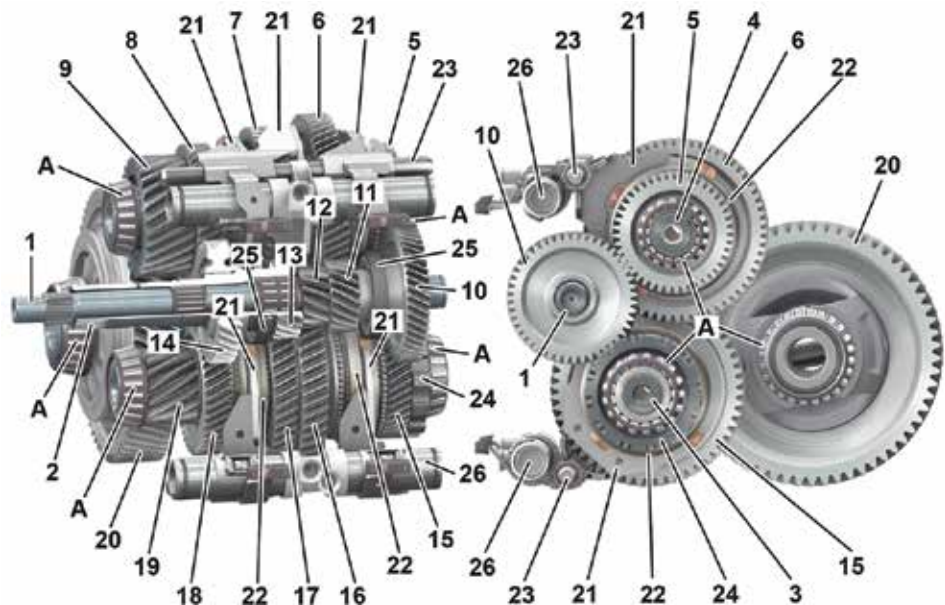
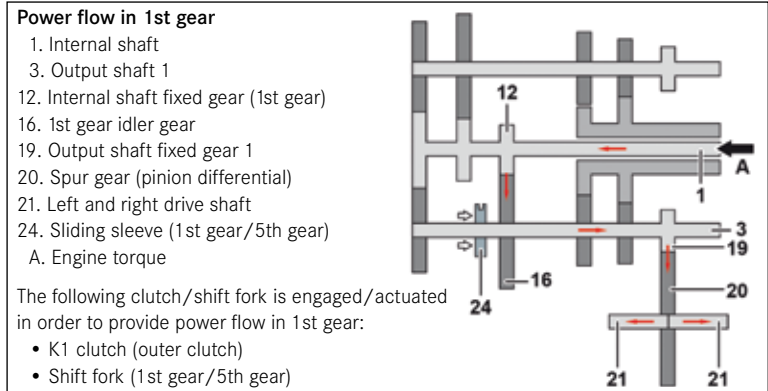
Each of the two “mainshafts” has its own separate multi-disc clutch mechanism. Like the synchronizers, the clutches, immersed in transmission fluid, are operated electro-hydraulically by the transmission control unit. Each clutch “module” incorporates two individual clutches, each with four disc pairs. This arrangement affords smooth yet firm

engagement and disengagement for a satisfying yet barely noticeable transition from one gear to another.

Another interesting feature is the use of permanent magnets attached to the shift forks. These magnets provide inputs to the transmission control unit to identify which gear(s) are engaged at any given time.

Here’s How It Works

Engine torque is transmitted through the transmission from the crankshaft to a dual-mass flywheel. Power then



Gear set

- | | | |
|---|---|---|
| <ol style="list-style-type: none"> 1. Internal shaft 2. Hollow shaft 3. Output shaft 1 4. Output shaft 2 5. 7th gear idler gear 6. 3rd gear idler gear 7. Reverse gear idler gear 8. 6th gear idler gear 9. Output shaft fixed gear 2 10. Internal shaft fixed gear (5th gear/7th gear) | <ol style="list-style-type: none"> 11. Internal shaft fixed gear (3rd gear) 12. Internal shaft fixed gear (1st gear) 13. Hollow shaft fixed gear (2nd gear/reverse gear) 14. Hollow shaft fixed gear (4th gear/6th gear) 15. 5th gear idler gear 16. 1st gear idler gear 17. 2nd gear idler gear | <ol style="list-style-type: none"> 18. 4th gear idler gear 19. Output shaft fixed gear 1 20. Spur gear (pinion differential) 21. Shift fork 22. Sliding sleeve 23. Shift rod 24. Park pawl gear 25. Sensor rotor 26. Gear actuator cylinder <p>A. Tapered roller bearing</p> |
|---|---|---|

flows through the central shaft, which contains fixed gears. These gears are in constant mesh with those on the two “mainshafts,” but remember that the gears on the mainshafts are free-wheeling about their shafts until a synchronizer assembly locks a selected gear to the shaft. The transmission control unit directs one of the two clutch modules to engage, and power is then taken through the mainshaft/output shaft for the selected gear.

A novel and innovative feature of this dual-clutch transmission is the differential ring gear, which is in constant mesh with fixed gears on the two output shafts. When a gear is selected and the appropriate clutch is engaged, power then flows through the fixed drive gear on the output shaft and to the differential gear, which then provides propulsion to the drive wheels of the car.

The other mainshaft/output shaft and its fixed differential drive gear then free-wheel while power is directed through the other output shaft. The mechanical action, including both the clutch action and the gear selection and synchronization, are surprisingly similar to those of a manual transmission. But, being electronically-controlled, they provide much smoother, faster, and more positive gear selection and engagement.

Oil Is A Key Player

The oil in this dual-clutch transmission performs a number of key roles. As noted earlier, the entire power transmission role is controlled electro-hydraulically. So,

the transmission oil controls every moving/mechanical component within the transmission. It actuates the multi-plate clutch modules, it provides movement for the synchronizer assemblies, it lubricates all of the gears and moving parts, and all other actuators as well. In addition, it performs an important cooling function, especially critical given the friction generated by the inter-acting components.

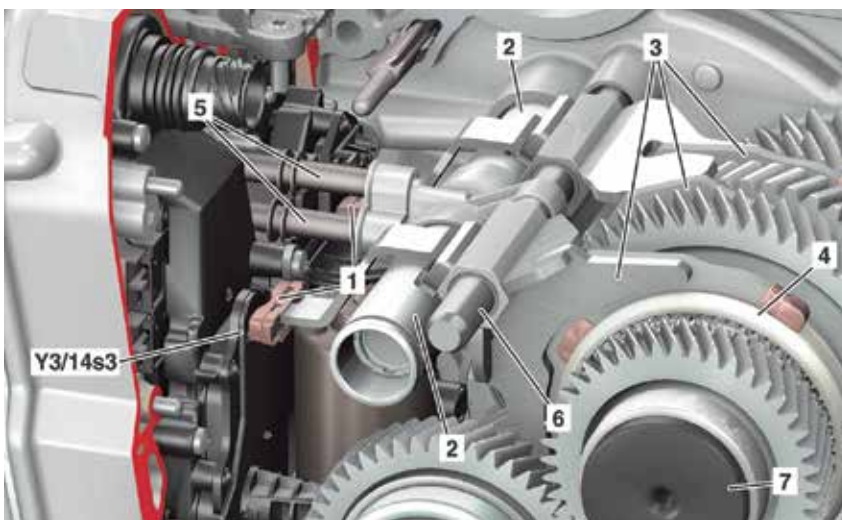
Because the oil supply and flow are so critical, this transmission actually incorporates three different oiling supply systems:

- Splash lubrication
- A primary mechanically-driven vane-type oil pump
- An electric auxiliary oil pump

Splash lubrication assures that the gears and bearings receive adequate lubrication. The primary mechanical pump provides pressurized oil to the electro-hydraulically actuated dual clutches and synchronizers. This pump is gear-driven, with a drive gear permanently attached to the dual clutch, constantly powered whenever the engine is running. The driven gear is attached to the mechanical primary pump, which is located in the transmission housing behind the dual clutch. This mechanical pump provides anywhere from 3.5 bar (50 psi) to 22 bar (320 psi) based on direction from the transmission control unit.

The electrically-driven auxiliary oil pump is mounted on the transmission control unit. Its role is to supplement the primary mechanical pump under certain conditions, including low rpm operation, during ECO start/stop operation, and to provide supplemental cooling at elevated transmission oil temperatures.

This pump is helpful at low engine speeds as may be encountered off-idle or during coast. This electric pump also provides operating pressure in ECO start/stop mode. With the engine off, all actuators return to their basic no-load state, so no gears can be engaged and no clutches engages without an adequate supply of oil pressure. This electric pump minimizes any delay between a start-off request and actual start-up of the engine.



Sectional view of internal shift operation

- | | |
|---|--------------------------------------|
| 1. Permanent magnet | 5. Oil pipe |
| 2. Gear actuator cylinder | 6. Shift rod |
| 3. Shift fork | 7. Output shaft 2 |
| 4. Sliding sleeve of synchronization device | Y3/14s3 Shift fork 3 position sensor |

Furthermore, under heavy load conditions, such as driving in mountainous country or when towing, the transmission control unit will monitor the operating temperatures of the clutch plates and oil and will activate the electric auxiliary pump as needed to provide supplemental cooling to these critical components. The electric auxiliary transmission oil pump provides up to 8 bar (116 psi) depending on demands from the transmission control unit.

The transmission oiling system includes a transmission oil heat exchanger that acts as an interface between the transmission oil and the engine coolant. A separate pump provides a flow of metered engine coolant through the transmission oil heat exchanger. The flow is regulated based on transmission oil temperature. This heat exchanger is of a stacked plate design, and is located on top of the transmission housing.

Innovative Parking Pawl

As with other ingenious systems and components in the dual-clutch 7-speed transmission, the parking pawl mechanism is likewise innovative and effective. Like the clutches and synchronizers, the parking pawl mechanism is electro-hydraulic in operation. In essence, it is a “Park by wire” system. It includes a select lever, a pawl lift solenoid, a pawl position sensor, a switch-over valve, and the parking lock mechanism, all operated by the electronic transmission control unit.

The parking pawl can be activated manually by the vehicle’s DIRECT SELECT lever. It can also engage under a variety of other conditions, such as when the driver’s door is opened while the engine is running. This is a safety feature to assure that the vehicle cannot be left unattended unless it is in Park.

The parking pawl mechanism is integrated with the dual clutch transmission system, and is activated by one of two systems, depending on whether Park has been selected by use of the DIRECT SELECT lever, or if it has been engaged by some alternate method.

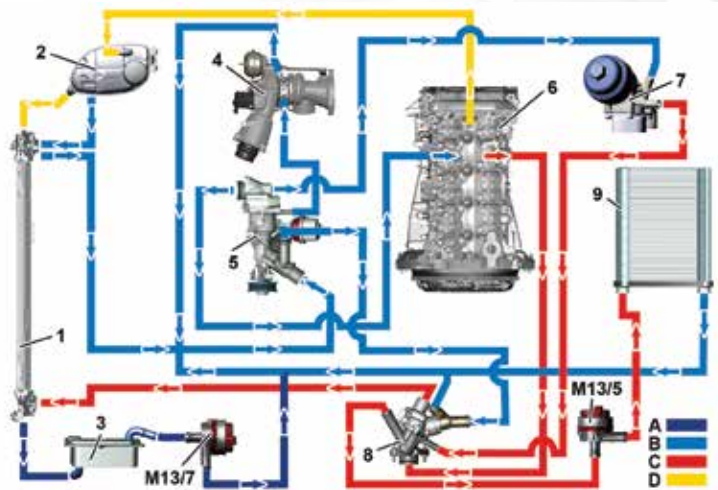
When the parking pawl is engaged by way of the DIRECT SELECT lever, the park detent engages the teeth of the park pawl gear, and is held in place by means of the spring-

loaded pressure cone. A locking pin locks the piston in place, which puts pressure on the pressure cone itself by means of the pressure cone spring. This mechanical apparatus secures the transmission in Park even when there is no hydraulic pressure present.

When Park is selected by any means other than via the DIRECT SELECT lever, the pressure cone and the park detent are in the same position such that the park pawl gear can rotate freely. The piston is pushed against the force of the piston spring and is locked in place by the locking pin, which is activated by the park pawl lift solenoid.

In order to change the park pawl position, the transmission control unit actuates the lift solenoid which, in turn, moves the locking pin out of the catch of the piston. Then the piston is pressurized on one side in the direction dictated by whether Park was selected by the DIRECT SELECT lever or by some other means. The transmission control unit energizes the park pawl switchover valve, directing oil pressure to the appropriate piston chamber for piston actuation.

Regardless of the means by which Park is engaged, a permanent magnet attached to the piston provides a signal to the park pawl position sensor, which relays this



Coolant circuit, schematically illustrated on engine 270

1. Radiator
2. Coolant expansion reservoir
3. Transmission oil heat exchanger
4. Turbocharger
5. Coolant pump
6. Engine 270
7. Engine oil/coolant heat exchanger
8. Thermostat
9. Heater heat exchanger

- M13/5 Coolant circulation pump (with code (581) Comfort automatic air conditioning)
- M13/7 Transmission cooling coolant circulation pump

- A Low-temperature cooling circuit coolant return
- B Coolant return to engine
- C Coolant feed
- D Coolant circuit ventilation

information to the transmission control unit, so that it “knows” when the transmission is actually in Park.

Technicians should be aware that there is a procedure for releasing the parking pawl in the event of a failure in the power supply or hydraulic pressure control system. You can use an external power supply to energize and release the park pawl piston against the piston spring pressure. But note that it is not possible to release the park pawl without hydraulic pressure.

Finally, the park pawl mechanism in this transmission, obviously, is designed to prevent the vehicle from moving when in Park. If for any reason the parking pawl does not engage, the driver will be advised of a failure in the parking pawl mechanism by a warning light on the instrument panel. In this case the driver has the option of firmly engaging the parking brake. If, by unusual coincidence, the parking brake is also inoperative, the driver will be alerted accordingly, both by warning lamps in the instrument cluster and also by means of a message on the multi-function display. In such circumstances the vehicle will not be secured, and will have to be prevented from rolling by some alternative direct mechanical means.

Home Sweet Home

The 7G-DCT is a particularly well-thought-out transmission. As such, engineers were careful to build in a limp-home provision. In the event of a major problem in the transmission, the driver will be alerted by a message in the multi-function display, and also with an audible signal. Depending on the nature of the problem, the driver may experience a significant change in the operation of the transmission, such as only certain gears being functional or unusual shift quality.

If one of the two sub-transmissions experiences a problem, it is likely that none of the gears associated with that cluster will be available. So if there’s a problem in sub-transmission number 1, the driver will likely lose access to speeds 1, 3, 5, and 7. If there is a problem within sub-transmission number 2, then the driver may well lose the availability of speeds 2, 4, 6, and Reverse. In such cases, the gears in the still-functioning sub-transmission will likely still be operational, albeit absent those gears on the other sub-unit.

Similar symptoms may appear if a gear control valve fails. The vehicle would still be able to be driven using the gears available in the other sub-transmission.

If both clutch units fail, such as might happen during a major loss of operating hydraulic pressure, or possibly due to a problem related to the electronics, the vehicle will no longer be able to move under its own power. If this is an intermittent issue, the driver may be able to “limp home” to a repair shop after cycling through an ignition sequence. And if the problem should persist after cycling, then the vehicle will likely be inoperable and will have to be towed.

Another condition that can affect transmission operation is excessively-overheated transmission oil. This is possible under certain high-stress conditions, such as repeated starts uphill, while towing, or in high ambient temperatures.

Under such conditions, the transmission oil may overheat, despite the very efficient heat exchanger fitted. If transmission oil reaches a pre-determined temperature threshold, the transmission control module will alert the engine control module, which will, in turn, reduce engine power until transmission oil temperature drops below the threshold. Under such conditions, the transmission will be prevented from operating in any manual mode until the oil has cooled. This arrangement will allow the operator to continue to drive modestly until the oil has cooled or until he/she can reach a service shop for appropriate diagnosis and repair.

Service Considerations

As you would expect, any disassembly and servicing of the dual-clutch transmission requires a host of special tools and training. As such, pretty much any internal failure within this transmission is best dealt with by replacement with a vehicle-appropriate rebuilt unit from your local Mercedes-Benz parts professional.

Since these transmissions are electronically controlled, all servos, solenoids, etc. are contained within the housing and are essentially non-serviceable for the independent repair shop.

As for routine maintenance, the only scheduled service is regular replacement of the transmission oil. The oil change interval for these transmissions is every five years or 100,000 miles. The only approved oil for this transmission is Shell DCT M 1, available from your local Mercedes-Benz dealership parts department. |

Tires, Wheels, and So Much More

You can't just choose "Round and Black" anymore...



Tire and wheel selection used to be much more simple. All you really needed to know about tires was the diameter and aspect ratio, and pretty much anything “round and black” would fit and work just fine. You could select any brand you liked, and any tread pattern that suited your customer’s taste.

Similarly with wheels, all you needed to know was bolt pattern and rim diameter, and you could choose a rim width you liked and hope that the wheel would fit over the brake components. Your customer might like the OE look, or aftermarket bling, but it didn’t really matter.

The situation is very much different today, certainly with Mercedes-Benz vehicles. Discriminating motorists choose Mercedes-Benz vehicles because they want the finest in comfort, luxury, and performance. And the vehicle’s wheel/tire package is an integral part of the vehicle’s ride and handling characteristics, as well as a critical component in the vehicle’s safety systems.

As with every other system in Mercedes-Benz vehicles, engineers have carefully designed wheel/tire packages to conform to exacting



“MO” on the sidewall stands for “Mercedes-Original.” It means that the company has tested and approved the tire.

standards of ride and handling, as well as assuring precision interface with safety systems including ABS and stability control systems. So when choosing or recommending replacement tires or wheels, there’s much you need to know.

There’s “MO” than meets the eye

We’re all familiar with what have become conventional tire sidewall markings. They include the usual tire size and maximum inflation specifications, and also speed ratings, load index, UTQG rating, and mud/snow designation where appropriate. But all of this is supporting information for tire selection and recommendation, and these features alone are not sufficient to restore OE-level ride, handling, and safety systems to their original specs.

And while these specs and markings are useful, they don’t necessarily provide assurance that tires meet the exacting standards designed into the wheel and tire package by the engineers who carefully designed these vehicles.

In order to assure compliance with OE ride and safety standards, Mercedes-Benz has established strict criteria for replacement tires. Such tires, offered by virtually all of the leading tire manufacturers, can be identified by an “MO” designation on the sidewall. These tires, certified as Mercedes Original, have been developed in collaborative efforts between Mercedes-Benz design engineers and tire manufacturer engineers. They are designed and tested to assure compliance with as many as

fifty different parameters, including lateral force performance, directional stability, performance verification in a wide range of driving conditions and road surfaces, and even sensitivity to vibrations on a tire oscillation test bench.

MOE tires are Mercedes Original Extended tires, commonly referred to as “run-flat” tires, and are built with reinforced sidewalls and other design features which allow a driver to continue up to 50 miles on a flat tire, depending on vehicle load. These tires, like MO tires, are tested to very high standards similar to those for MO tires.

You might be surprised to learn that Mercedes-Benz has a very aggressive tire program available to independent repair shops through Mercedes-Benz dealership parts departments. They offer very competitive pricing, they normally stock a deep inventory of MO and MOE tires, and typically offer same-day or next-day availability.

Cars in your shop may be on their second or third set of tires, depending on miles driven, and so the original size, make, and style of tire for a particular vehicle may not be apparent. Your local Mercedes-Benz dealer’s parts professional can help. By entering a vehicle’s VIN into his system, he can often identify which tires a vehicle was born with. This way, you can install tires exactly like the originals to restore like-new performance.

Note that sizing, and even tire brand and model, may not be sufficient information for selecting replacements. Tire manufacturers may offer a particular tire both with and



without the MO or MOE rating. So it is important to specify this rating when purchasing tires for your customers, and your dealership parts department will supply you with such tires from their extensive inventory.

You might ask, “What should I expect from MO/MOE tires compared to those without these ratings?” The answers are many, due to the design, construction, and rubber compounds built into these tires. Your customer can expect better wet and dry traction, longer tread life, smoother ride, and low tire noise. These are substantial benefits.

Surely you’ve had customers who want to “move up a size or two” when choosing replacement tires, usually in a misguided attempt to “improve” ride and handling. This is wrong on many fronts. First, moving to a larger tire rarely provides improvement in either ride or handling. Rather, it most likely will compromise the R&D efforts that went into making a Mercedes-Benz handle so well in the first place.

But deviating from the OE tire size can lead to the proverbial unintended consequences, independent of the impact on ride and handling characteristics. Today’s Mercedes-Benz vehicles are designed with advanced electronic control systems that rely on a variety of inputs from the four corners. These inputs are likely to be compromised by a change in tire size or aspect ratio. Such inputs may include wheel speed, drive ratio, and even suspension travel. Plus, the situation is even more critical on vehicles equipped with 4Matic all-wheel-drive systems, where the interrelationship of all four wheels is even more critical.

What about wheels?

As you might expect, there are many factors to be considered when it comes to wheel replacement. You

may need to replace a single damaged wheel. Or perhaps your customer wants to spring for a fancy set of alloy rims. There’s much to think about.

If you’re replacing a damaged wheel, then you can appreciate the need to choose a replacement of the proper size and style. But no so fast! You can’t just look up make, model and year in a generic chart or catalog and hope to come up with the proper wheel.

Many Mercedes-Benz vehicles are factory-equipped with a “staggered” wheel setup in which the front wheels are a different size and/or offset from the rear wheels. So you can’t just pick a new wheel from a catalog or, worse yet, buy a used wheel from a scrap yard. And having a Mercedes-Benz wheel repaired, or exchanged for a repaired wheel, is not a good option. The company specifically recommends against any type of wheel repair, since a repaired rim is not going to provide the same level of safety and performance as a new OE wheel. By far, the best option is to provide the VIN to the parts professional at your local Mercedes-Benz dealership so they can determine exactly which type and size of rim is correct for the car you’re working on.

If your customer is interested in switching to aftermarket wheels, the issue becomes more complicated. Certainly rim width, diameter, and offset/back spacing are

critical for providing acceptable levels of ride and handling. But there are other factors to consider as well. Offset that varies from OE can cause inordinately high loading on wheel bearings and suspension components. There can be fitment issues with brake calipers and rotors, as well as hub centers. And it’s possible that such wheels can affect alignment enough that caster, camber, and toe may exceed the limits of adjustability in the vehicle. If alignment remains beyond specifications, the result will be an ill-handling vehicle, increased turning radius, accelerated suspension wear and, of course, accelerated tire wear.

But it goes much deeper than that. The advanced electronic systems in late-model Mercedes-Benz vehicles rely on accurate inputs from all four wheels. Systems involved include



While nobody in this country should be driving over 100 mph, Mercedes-Benz gives us the right info for the chassis.



Each vehicle will have its own label indicating acceptable wheel and tire sizes. Of particular note here is the notation that summer tires are of the “staggered” configuration, with larger tires on the rear. However winter tires should be of the same size front and rear.

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The best or nothing.



anti-lock brake systems (ABS), ESP stability control systems, DISTRONIC Plus (DSR) systems, and Brake Assist (BAS) systems. Faulty or out-of-spec inputs to any of these systems will compromise their performance and effectiveness.

There are other concerns with aftermarket wheels. Mercedes-Benz factory wheels are hub-centric, not lug-centric. This means that the wheels are indexed axially by the fit of the center of the wheel to the hub, and not by the lug bolts and holes. But because the manufacturers of aftermarket wheels try to consolidate wheel designs so that a given wheel can fit many different makes and models, the center hole may not be precision-machined for proper indexing. Absent such precision, these wheels are almost guaranteed to cause unwanted, annoying, and possibly dangerous vibration.

As with tires, your customer may want to move to larger diameter wheels with lower-profile tires. Again, not a good idea. Lower profile tires with shallower sidewalls are less able to cushion road bumps and irregularities, resulting in a harsher ride. At the same time, they are less able to protect rims from relatively minor pothole damage. Such wheel and tire packages can also negatively affect speedometer accuracy, as well as the adverse interaction with electronic control systems as described above.

Larger diameter wheels raise the vehicle's center of gravity, leading to increased body roll when cornering, and also impact acceleration and responsiveness due to their effect on the final drive ratio. Other problems associated with larger wheels and tires include potential interference with wheel wells and suspension components, increased turning radius, bottoming-out of the suspension, and premature wear of suspension components.

Bear in mind that cars factory-equipped with AMG options will likely have equipment that will affect wheel and tire selection. An example would be larger brake rotors and calipers, which typically require different wheels that provide additional clearance for these larger brake components.

Service procedures are key

When it comes to mounting wheels and tires, MBUSA has specific procedures that they recommend in order to prevent wheel and tire damage and to assure the integrity and performance of the wheel/tire assembly.

To begin with, Mercedes-Benz recommends against mounting cold tires, since they will be too rigid to flex during the mounting process. They recommend that tires be at least 60 degrees F (15 degrees C) for mounting. And no heating procedure should be used other than allowing tires to warm naturally to room temperature. So you should never use a heat gun, hair dryer, or radiant heater to warm cold tires.

Wheels should be cleaned in the bead area to assure proper sealing, and valve stems should be replaced every time. If a tire has a light spot, the tire and wheel should be selectively matched during tire mounting to assure radial trueness of the wheel/tire assembly. Genuine Mercedes-Benz wheels are often marked to indicate light spots. MO tires are likewise often marked accordingly.

Factory alloy wheels are typically lightest at the valve

stem hole, and tires will have a color dot on their outboard side.

If a vehicle has the same size tires at all four corners, Mercedes-Benz recommends installing a single new tire or a pair of new tires at the front of the car. Naturally unidirectional tires should be mounted accordingly. Torquing and re-torquing procedures for lug bolts varies by model, so consult STAR TekInfo for specifics.

Mercedes-Benz specifically recommends against any kind of repair to any wheels or tires. Repairs to wheels can compromise their integrity, and plugging puncture holes is specifically not approved by the company, regardless of the location of the puncture. Also, the company recommends that tires older than six



While this tire and wheel combo may look stylish, it will definitely cause problems. Advise your customers to stick with stock.



This aftermarket rim is cracked! You're not likely to see that with Mercedes-Benz Original Equipment wheels.

years old be taken out of service, and tires classified as M&S should be taken out of service after four years from the date of manufacture.

If tire rotation is called for, it can only be performed if the wheels and tires at all four corners are the same. If so, Mercedes-Benz recommends rotating from front to rear on the same side of the car. However if the wheels/tires are



It is important to avoid damage to TPC sensors when mounting or dismounting tires. Make sure your tire-changer's apparatus is oriented away from the valve stem and the sensor within.



After wheel and tire service it will be necessary to re-activate the TPMS/TPC system, and then test-drive the vehicle to allow the system to re-learn pressure settings and parameters.

“staggered” with different sizes front and rear, then rotation is not recommended.

Wheels can be cleaned using commercially-available mild cleaning products. When deeper cleaning is called for, your local dealership can supply a special alloy wheel cleaner, part number A 001 986 3471 that is very effective in removing stubborn dirt. After cleaning, you should treat the surfaces with polish and gloss preserver.

Tires can be cleaned with appropriate cleaning products. But Mercedes-Benz does caution against the use of high-powered cleaning machines or pressure washers on tire surfaces. The very high pressures put out by these machines can damage sidewalls.

If tires must be stored, it is recommended that they be cleaned thoroughly first and marked with position on the vehicle and direction of rotation. Tires should be stored indoors to avoid possible damage from sunlight, heat, moving air and ozone, which can degrade the elasticity and strength of the tire. Best to store tires in a cool, dry location, and avoid contact with gasoline, oil or greases, which can dissolve the rubber.

But what about TPMS?

Tire Pressure Monitoring Systems may be referred to as TPM (Tire Pressure Monitor) or TPC (Tire Pressure Control) systems, but they all refer to the same system, whose role is to monitor the air pressure in each tire and relay that information through CAN-B, which can alert the driver when pressure in one or more tires falls below a pre-established threshold. Powered by an internal

battery, these sensors send a signal about once a minute under normal operating conditions, and about once a second when a low pressure is detected.

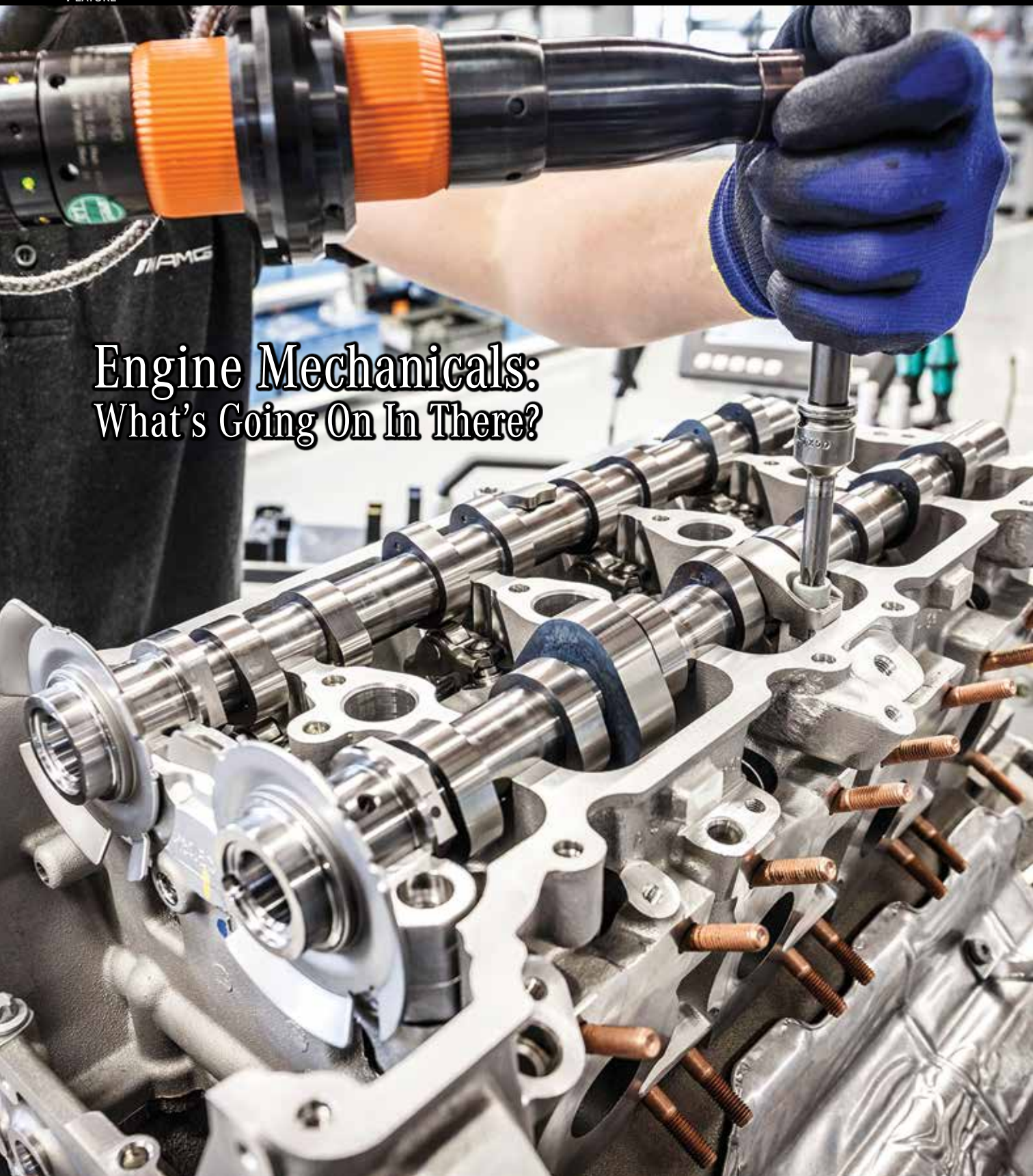
These systems tend to be largely trouble-free, as are the sensors inside the wheels. But a few servicing cautions are in order. If you're unsure whether an older model is equipped with TPC, a quick look at the valve stem will tell the tale. TPC-equipped vehicles will have an aluminum valve stem, not rubber or steel, and if TPC-equipped, will have a sensor mounted to the valve stem inside of the tire. Note that TPC valve stems should have plastic valve stem caps in order to prevent galvanic action and corrosion that can develop between a metal valve stem cap and the aluminum valve stem.

Also, you may not be aware that TPC radio signals cannot penetrate wheels nor the steel belts in the tread area of tires; they can only pass through the sidewalls of the tires. And, in model years 2006 and earlier, Mercedes-Benz vehicles used different types of sensors than vehicles made after that. So it is important to always order replacement sensors and valve stems using the vehicle's VIN. The parts professional at your local Mercedes-Benz dealer will be happy to help assure that you get the correct part for the vehicle you're servicing.

When mounting or dismounting tires on TPC-equipped rims, you want to be sure that your tire changing machine does not contact or interfere with the TPC sensor. You'll want to orient the tire/wheel assembly to avoid such interference.

Following related parts replacement or depressurization, it will be necessary to re-activate the TPC system and have it “learn” the new readings. This will require a test drive of as little as a couple of minutes, or as much as 20 miles or 20 minutes. |

Engine Mechanicals: What's Going On In There?



In a commercial setting (as opposed to a laboratory), actually seeing the condition of the parts inside an engine is impossible without heavy disassembly, even if you have a boroscope. So, you have to extrapolate from what various tests, both traditional and high-tech, can tell you, plus think about “the big picture” before you take things apart and maybe make a big mistake.

We’re sure you’ve noticed that more and more gasoline engines are getting up toward 300,000 miles without major repairs. Good maintenance is of course necessary for reaching these heretofore unheard of mileages, but ingenious engineering and continuously-improving materials have certainly contributed.

Still, after any car (even a Mercedes-Benz, probably the longest-lived vehicles in the world) reaches those huge odometer numbers, an old saying applies: “Something’s gotta give.” Add in the unfortunate fact that many motorists don’t bother to have proper maintenance performed and you can see why you’re still being brought internal engine problems, whether wear, breakage, or deposits. While these failures don’t happen nearly as often as they did in the past, repairs are very much more expensive today so they can represent a large portion of your income. That is, if you do your diagnosis accurately.

Any technician who tells you he’s never made a wrong call on internal engine diagnosis must have a short

memory. We see it happen all the time: condemning a rod bearing when that knock is actually emanating from a loose wrist pin, blaming a miss on valves when it’s really due to a rounded-off cam lobe, or even removing a cylinder head when an ignition problem is causing the symptoms. We hope the following will help you avoid such embarrassment and wasted time.

First off, collect all the clues and evidence you can before rendering the engine inoperable. When you hear something inside, it’s, well, inside, so even if you aren’t 100% correct, you may not have wasted time by dismantling that engine.

Listen up

As we often say in the pages of *StarTuned*[®], listening patiently to the customer is crucial. Exactly what is the complaint? Unhealthy-sounding noises, rough idle, poor power, messy oil leaks, high oil consumption, low oil pressure, or even (horrors!) steam or blue smoke at the tailpipe? In the same conversation, try to find

out what repairs have been made by other shops, and if oil and filter changes have been done regularly. Also, it makes sense to take a test drive with the customer so you can be sure you’re both talking about the same thing.

Before you do anything else, look the vehicle over. That means using a good light under the hood, removing the oil filler cap to get an idea of maintenance history, reading the odometer, and just generally getting an impression, which we always call “the big picture.”

If you haven’t started the engine before, do so now before you start testing. Uneven or long cranking points to weak compression. Listen for noises and look for smoke or steam. If the idle is rough, there are quite a few potential causes.

Now is probably a good time to do a bulletin search. A pattern failure that’s been identified can be a Godsend to your shop.

Nothing obvious so far? Then you might as well hook up your scan tool. You might find codes, although something like an OBD II P0300

Left: That engine was perfect when it left the Mercedes-Benz factory. What happened? Usually, lack of maintenance, overheating, or just a tremendous number on the odometer.





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One remanufactured engine pulls the plug on climate-damaging CO₂ and saves 447 days of power for one laptop.



(random misfire) isn't really useful info. If you have XENTRY, you can go to the compression test routine and just press "start." The system will take care of everything. Even on older vehicles back to the mid-1990s, you can kill individual cylinders to identify a miss.

Electronic diagnosis is fine as far as it goes, but here we're going to talk about more direct troubleshooting. Those of you who are veteran techs can consider it a refresher, and if you're just starting out in this business you might learn some traditional means you've never encountered before.

Compression: You can't leave home without it

Insufficient compression can be the result of neglected maintenance, severe overheating, something broken in the valve train, or simply a huge number on the odometer. Blown head gaskets, once common, aren't anymore because of the adoption of MLS (Multi-Layer Steel) head gaskets.

But before you start thinking about burned or sticking valves, valve train or camshaft drive or lift troubles, faulty ring sealing, or damaged pistons, make sure ignition is okay using your scope or a kV probe.

Old-fashioned mechanics would pull one spark plug wire at a time to find out if a particular cylinder had little or no effect on idle quality and speed, which is still a useful trick for older cars. As already mentioned, the equivalent can be done with a scan tool on modern cars.

Certainly, you've done the tried-and-true dry/wet compression test in your career, and nobody can dispute



We once saw a tech remove an intake manifold to fix a supposed vacuum leak when the real problem was a perforated duct downstream of the MAF.



Our propane wand has helped us find vacuum leaks for decades. If idle speeds up when the flammable gas is introduced into a certain area, that's where to look.

its continuing usefulness. There are subtleties in the procedure that many techs have never given any thought to, however. For example, you should record the first and fourth jumps of the needle. In a healthy engine, the first jump will be half or more of the fourth. A uniform leak from something like a burned valve will cause pressure to build gradually starting at a very low number for the first pulse, and not reaching anything like the specified psi. Worn-out or broken rings, on the other hand, will produce a big first bounce, but not reach the spec either as they'll start to leak.

Next, squirt some oil into each cylinder. If the reading rises considerably, the rings or the bores are probably at fault. In cases where there's little difference, think valves.

Experienced judgment comes in when deciding how much difference among cylinders indicates that a repair must be done. For a perfect idle and like-new performance, a variation of over 10 psi is an issue. But as long as the customer isn't a perfectionist, quite a bit more than that can be tolerated. The trouble is, once a valve starts leaking erosion is going to make it get worse pretty quickly.

Even though there are excellent electronic means of diagnosing internal engines these days, there's still nothing that can give you a better inside picture of the pressure tightness of that cylinder than the traditional dry/wet compression test. But don't just look at the maximum reading. Instead, observe how the needle jumps with each of four impulses.



We've seen internal engine work done when the real problem was in the ignition system. This kV tester was handy in the old days, and is still useful on vintage models.



In spite of what we said about MLS gaskets earlier, low compression in two adjacent cylinders implicates a violated head/block seam. Check for evidence of compression at the radiator filler, and look for coolant in the oil or on the spark plugs. Also, you can hold the probe on an exhaust analyzer over the radiator filler neck to detect HC (hydrocarbon). Lots of techs still use old-fashioned bubble-type combustion leak testers. If you fill the system, leave the cap off, then start the engine and coolant floods out, you've pretty surely found a blown head gasket.

Hissssss

The cylinder leakage test has been done ever since service garages have had air compressors. With the valves

closed (TDC with the crank locked), use an air-hold to put full shop psi into the spark plug holes and listen. Hissing at the intake points to the inlet valve, and the same sound at the tailpipe indicates the exhaust.

Don't be fooled if you hear air escaping at the oil filler hole — rings have end gaps, after all. If you compare cylinders, you should be able to find out if one lets more air pass than the others. Looking for bubbles in the radiator will tip you off to a leaky head gasket or a cracked casting.

To make this test less subjective, you can use a cylinder leak-down gauge — actually two gauges in tandem — to find out what percentage of the shop pressure is escaping. With the spark

plugs out, bump the engine over until the cylinder in question is at TDC of its compression stroke. Don't jump to any unfortunate conclusions if an older engine produces a big percentage. As long as there's consistency among cylinders and the idle is okay, this isn't grounds for major repairs. Late models normally show very low numbers, on the order of 10%. A high reading on one cylinder that has no recorded misfires might have a particle of carbon holding a valve open.

Keep in mind that other things besides faulty valve or cylinder sealing can result in low compression. Valve train failures such as a bad cam lobe can restrict cylinder filling. Check lift before removing that head. Also, no compression at all may be caused by a hole in a piston.

Whenever you run into a sudden no-start and the compression readings are irregular, a jumped timing chain is probable. With interference engines, you'll have to remove the head anyway for the replacement of bent valves.

Negative pressure

We should mention the use of the venerable vacuum gauge. While it won't give you definitive information, it can at least reinforce the results of other tests. With the engine warm and at idle, you should expect to see something on the order of 15 to 20 in. Hg. A steady low reading may be caused by a vacuum leak or late valve timing due to a worn or jumped camshaft drive mechanism. If the needle drops at regular intervals, suspect a leaking valve, whereas if such drops occur irregularly, a sticking valve is

indicated. Floating over a wide range suggests a bad head gasket seal. Rapid needle vibration is evidence of loose valve guides.

A clogged cat or dented exhaust pipe will interfere with cylinder filling. Hold 2,500 rpm. The reading should drop when you first open the throttle, then stabilize. If it continues to fall, there's excessive backpressure.

Knuckles on a wooden door

Knocking is a deep, distinctive sound, and it always means expensive trouble. We typically see rod bearing shells that still look good at over 200K, but once the Babbitt is gone the steel backing is going to take a toll of those journals. So, we don't get many simple bearing jobs anymore. Also, at high mileages the big ends of the rods are going to be stretched out of shape, meaning that the head has to come off and the piston/rod assemblies out.

It's pretty hard to tell a worn-out rod bearing knock from that caused by a loose piston pin, but it doesn't really

matter. You'll have to remove the oil pan in either case. If the appearance and the clearances of the bearings are okay, a wrist pin must be at fault and the job will escalate.

This brings up the question of whether it's worth it to tie up a bay long enough to do a major engine repair (machine work?), or if it would be better for both the sake of the customer and the profitability of your business to buy and install a remanufactured unit from your local Mercedes-Benz dealer's parts department. Collect the numbers for both routes and have a discussion with the car's owner.

Elixir of life

Without a steady supply of clean oil, the best internal combustion engine in the world will melt itself down into a lump of very expensive scrap metal in no time. The pump moves volume and the clearances turn that into pressure. The flow of liquid lubricant must be maintained.

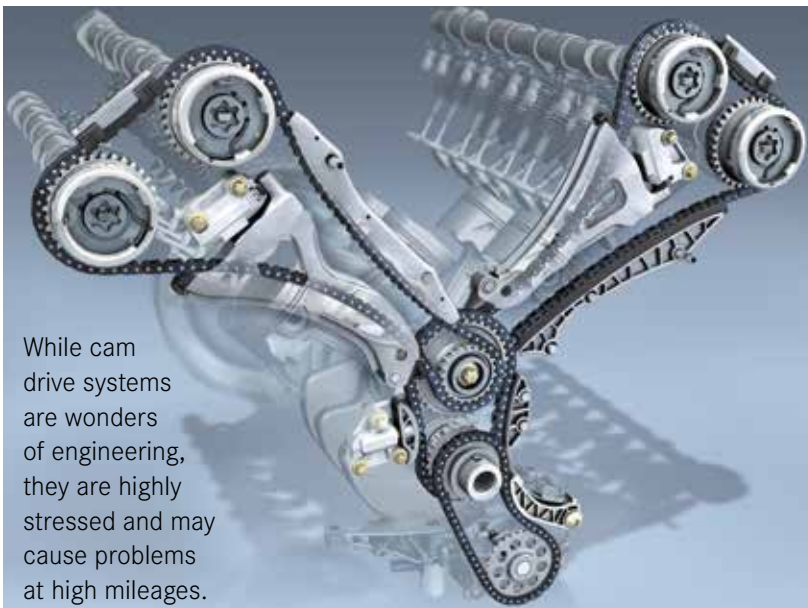
Whenever you get a low oil pressure complaint, the first things to check for

are the level in the crankcase and the contamination level of the lubricant. Use an accurate mechanical gauge as techs have sometimes been tricked into removing the oil pan when a faulty sending unit was the real problem. When you take your readings, remember that the engine has to be at normal operating temperature — we've seen 40 psi cold drop to 6 psi hot. Remember that a pump or bypass relief valve problem, or the presence of low viscosity oil, may be the culprit, not worn-out bearings.

In cases where the needle jumps up and down, think a low level or a leak at the pickup. Steady low pressure is probably due to worn-out bearings. If the pump is bad, it will cause low pressure, too, but since it's the best-lubricated component in the engine, it's the last thing to suspect. |



Very few techs use an old-fashioned vacuum gauge anymore, but it can at least give you an idea of an engine's pumping ability. Compare the readings to those in the data stream.



While cam drive systems are wonders of engineering, they are highly stressed and may cause problems at high mileages.



Once you're sure of your diagnosis, the question becomes whether it makes more sense to fix that engine, or to install a reman from Mercedes-Benz.

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Genuine Mercedes-Benz Supplies and Parts for Service On Time



In the main internal engine diagnostics article, we stressed the importance of good maintenance for engine longevity. Service is your business, so you already know how important regular maintenance is not only for the engine, but for all the systems in a vehicle. Have you ever made the effort to explain this to your customers?

Your customers bought a Mercedes-Benz for its safety and reliability. If you ask them, most will tell you that they expect their cars to be 100% reliable, and get (rightly) upset when it isn't. They use their cars to live their lives: earn money at work, transport the family, get groceries, and other basic needs. So for most people, their car is their most important possession, even more so than their house: You can live in your car, but you can't drive your house to work.

For these reasons, regular maintenance is critically important to keeping the car reliable. It's also a chance for your experienced Mercedes-Benz technician to check all of the vehicle systems for potential issues that might compromise reliability or safety.

Genuine Mercedes-Benz maintenance components and fluids really are the best. This is partly because the engineers who designed the vehicles in the first place help specify the characteristics of the products. But beyond that, the company runs a continuous testing program, tracks the results, and turns them



Guidelines for antifreeze are extremely important today. There's never a reason to use anything but the exact O.E. formula.

into statistics. The Mercedes-Benz Genuine Parts Testing Program is much more comprehensive and appropriate to our market than you probably know. The testing is designed to measure the actual impact the quality of the part or fluid has on the customer. In other words, for real-world situations, not for some ivory-tower ideal.

Testing is done in the U.S., which assures that the findings are really market-appropriate. This country has special conditions (there's nothing in Europe equal to Death Valley, for example), different fuel blends, bigger engines, and unique regulations. This is true road testing; it's not done on a dynamometer.

In every case, Mercedes-Benz employs independent laboratories to be sure the results are from an objective third party and are not skewed by brand loyalty.

Here are some examples of the testing and the products it results in:

Air Filters:

Air filters are tested for 2,000 miles over the same route. The tests have proved that the use of Genuine air filters has a substantial impact on fuel efficiency. Especially with diesels, performance goes down when an aftermarket part is installed.

Benefits of the use of Genuine Mercedes-Benz air filters include:

- Up to 60% more airflow
- High-quality filter material that holds up well against snow, water, and other harsh road conditions
- Protects the engine from harmful dirt particles, gravel, and other debris
- The soft rubber gasket fits perfectly and seals tightly, helping prevent unfiltered air from entering the engine
- Captures 28% more soot over its lifetime than other brands
- Lasts up to 3X longer than some after-market alternative

Oil Filters:

Genuine Mercedes-Benz oil filters offer great benefits:

- Last up to 45% longer than aftermarket parts
- Proven reliability even under harsh conditions
- Filter out hazardous dirt particles as small as .5 micron
- Made with high-quality fleece material that resists deformation

Cabin Filters:

The time required for the installation of cabin filters adds up. Genuine Mercedes-Benz units can be installed more quickly because they don't have to be modified to make them fit, and sealing is optimized. The seal is tested for blow-by with special equipment that measures particles in the air.

Benefits:

- Up to 2X better filtration over the course of the part's lifetime
- Removes up to 150% more potentially harmful particles smaller than .1 micron than aftermarket versions
- Made with high-quality charcoal layers

Windshield Wipers:

With Genuine M-B parts, their curve matches that of the windshield of each model, so the pressure on the blade/glass interface is optimized. While competing wiper blades are made of poured rubber, Genuine Mercedes-Benz blades are extruded, which gives better performance and a 20% lower wear rate – they're tested for 1.5M cycles! Many also have a helpful wear indicator that changes color when replacement is needed, which amounts to a great sales tool.

Installation can be easier and faster, too, without all the confusion of the various attachment parts of aftermarket versions. If you look at it over the course of a year, this can add up to hundreds of dollars worth of labor.

To sum up the benefits:

- Genuine blades can provide up to 800,000 more wiping cycles than aftermarket brands
- Resist extreme ice, snow, and rain conditions
- Most equipped with maintenance indicator
- Precise curvature and pressure points are unique to each model

Brakes Parts

In a previous *StarTuned*[®] article, we explained why Genuine Mercedes-Benz brake parts were the best things to use because they were engineered and tailored for the characteristics of the specific model involved, not just generically one-size-fits-all. Also, they receive rigorous testing in real-world traffic conditions.

Benefits include:

- Genuine Mercedes-Benz brakes tested lowest in vibration versus aftermarket components
- As few as one brake noise event per month,

- compared to up to 200 with other brands
- Consistent braking performance regardless of driving conditions
- High-quality back plate construction resists corrosion
- Soft pads eliminate virtually all brake noises

Beyond maintenance

But maintenance isn't the only part of achieving your "service on time" goal that gets a boost from using Genuine Mercedes-Benz components and fluids. Think repair parts. Fast and easy availability and perfect fit and function also contribute.

MBUSA offers a powerful tool that can streamline your parts-sourcing research efforts: The EPC (Electronic Parts Catalog), a comprehensive and easy-to-use parts look-up system. It's a big help and time-saver in searching for exactly the right part, assuring that you'll always get the correct thing the first time (which is often not the case in the aftermarket). This will go a long way toward avoiding the scheduling disasters that can make customers unhappy with you. Visit <http://epc.startekinfo.com>. The download is included in your STAR TekInfo subscription. We believe you'll actually enjoy using it.

Something that's not often mentioned is the problem you may have finding a specific part for an older model – Mercedes-Benz owners typically keep their vehicles for a long, long time, so it's likely that you'll often have cars in your bays that qualify as vintage, or even classic. You can waste a lot of time and end up frustrated searching for parts for these venerable vehicles from the aftermarket, whereas the EPC covers them in detail, and inventories are scrupulously maintained even for what are sometimes called "heritage automobiles."

There's more to electronic parts sourcing aids. MBUSA has launched the new mbwholesaleparts.com. Among its useful features are model designation charts and technical information resources that will help you order the right parts and make installations easier.

Those electronic aids combined with the superior quality, competitive pricing, and excellent warranty protection you get when you make the commendable decision to purchase genuine Mercedes-Benz parts will contribute to your peace of mind and reputation.

Value

Mercedes-Benz doesn't have an arrogant take-it-or-leave-it parts pricing policy, as some other auto makers do. The company does yearly evaluations to make sure its prices are competitive. It's often found that certain parts, fuel filters for instance, are more expensive from aftermarket suppliers. And there's never an issue with quality, fit, or warranty protection when you go genuine.

We've talked about Genuine Mercedes-Benz Parts many times before in *StarTuned*®, but not only are these the best parts for your customer's cars, they're the best for you, the independent service center, as well. They keep your customers happy (and coming back), and in the rare case where something goes wrong, the Genuine Parts Limited Warranty is there to back you up solidly. You see, the parts themselves are engineered by Mercedes-Benz to perform exactly as the vehicle designers wanted, they fit perfectly to save you installation time, and independent testing shows they are just plain better. After all, "the best or nothing" isn't just a catchphrase, it's a way of life. |



The EPC (Electronic Parts Catalog) is sophisticated and comprehensive. You'll always get the right part the first time. Visit <http://epc.startekinfo.com>.



When sourced from Mercedes-Benz, big assemblies such as this 7G-TRONIC transmission have the industry's strictest quality control, and carry unequalled warranties. They're also often the subject of aggressive price-cutting programs.



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Mercedes-Benz AMG GT-S Collision Repair

The mostly cast aluminum structural components of the 2016 AMG GT S cannot be repaired if damaged. Access to replacement aluminum structural parts will be restricted to only those technicians who have received Mercedes-Benz certified aluminum welding and other specialized repair training. Here are a few AMG GT S differences that will require aluminum and other advanced repair skills.



The 2016 Mercedes-Benz AMG GT S is a race-bred, pure sports car with a low-slung, aerodynamic aluminum spaceframe.

The 2016 AMG GT S from Mercedes-Benz is a race-bred supercar with a fire-breathing 4.0-litre dual-turbo V8 that kicks out a maximum torque of 650 Nm before it even reaches 1,800 rpm, and delivers 503 hp. It muscled from 0 to 60 mph in 3.6 seconds, on its way to a top speed of 192 mph. A front mid-engine fitted low in the body, a dual-clutch transmission mounted over the rear axle, and rear wheel drive work together to ensure optimum weight distribution for superb driving dynamics.

AMG gave the GT S a respectable fighting weight by using aluminum for over 90 percent of its body. A front cross-member of magnesium reduces weight ahead of the engine, which combined with the aluminum spaceframe and driveline layout

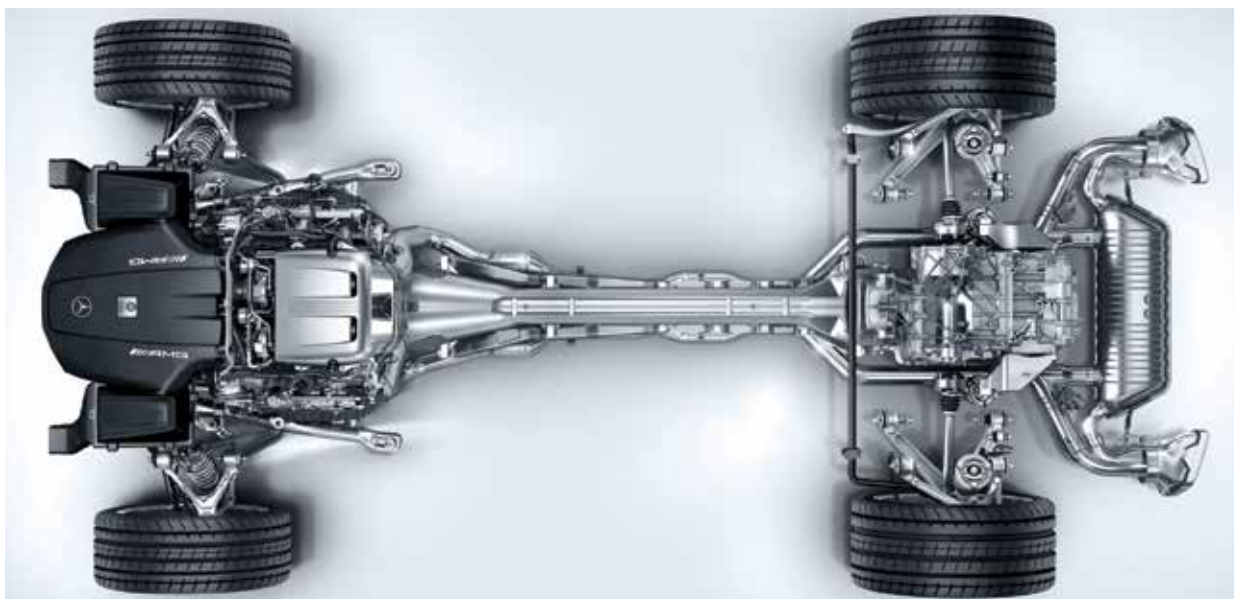
helps give the GT S a 47/53 front-to-rear weight split. This slightly rear-tipped load distribution ensures that drive and suspension forces provide the best possible lateral and longitudinal dynamics, and cuts forward pitch during braking.

The aluminum-intensive body gives the AMG GT S both outstanding fuel economy and structural stability for better handling characteristics. It also means that we've gone far beyond just door panels and front hood, to where now almost all of the structural components of the body-in-white are made of aluminum. There are still bolt-on aluminum parts, including hood, front fender and door panels, for which collision repair is often a simple remove-and-replace procedure. With an

aluminum-intensive vehicle such as the new AMG GT S, however, most structural components now require aluminum welding skills.

Aluminum: Different, but not more difficult than steel

Aluminum alloys melt at lower temperatures than steel. The range between the minimum amount of heat you must apply in order to begin reshaping aluminum and the maximum it can take without the metal being permanently weakened is narrow. Riveting and adhesive bonding are used extensively in aluminum repair as a way to minimize the risk of heat damaging a replacement part, or affecting adjacent components that may be heat-sensitive. These cold-joining



The 2016 AMG GT S with its aluminum spaceframe, front mid-engine, and dual-clutch transmission mounted over the rear axle has a 47/53 percent front-to-rear weight split, giving it the perfect load distribution for outstanding road-handling characteristics.



techniques are also very useful when joining aluminum to polymers and other materials that have even lower melting points.

Aluminum is also a better thermal conductor than steel, so you must use lower heat settings and monitor the temperature in the heat-affect zone to avoid exceeding the limit, or overheating nearby components.

The untouchables: Cast or extruded structural components

Many structural components are made of cast aluminum. In addition to offering weight reduction and structural stability, cast aluminum components can be precisely tailored to handle load requirements of specific areas, and to dissipate high impact forces along designed paths. Strut towers and pillars are examples of cast aluminum parts. Attempts to cold straighten or heat cast aluminum parts can rearrange the internal structure of the metal, causing it to lose a significant amount of its original strength.

Longitudinal members (frame rails) that once were made of layers of metal welded together are today made by extrusion – pressing heated aluminum through dies to

form multiple hollow internal cells for reduced weight, and rigid walls for strength and stiffness. Extruded parts cannot easily be straightened, and not without loss of integrity of their complex internal structure.

Different skills

MIG/MAG welding of aluminum involves different skills from those used to weld steel. The welding rate is significantly higher than that of steel. The welder must be held at an angle of approximately 75° to 80°. If held too flat, the heat and protective gas dissipates too quickly over the surface. This can lead to faulty welding results.

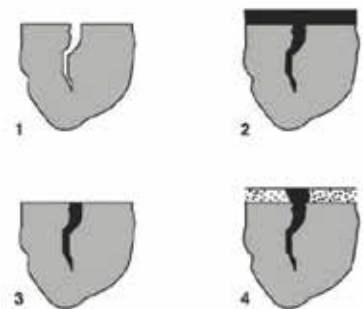
Mercedes-Benz collision repair is divided into four levels based on the skill level required to properly complete the repairs. Levels 1 and 2 are for bolt-on and adhesive bonded or riveted parts, respectively. Any technician with standard Mercedes-Benz training can perform Level 1 and Level 2 repairs.

Level 3 is for welded, non-structural parts, including sheet metal. Level 3+ covers repair of structural components that must be welded. Special training is required for technicians who perform Level 3 and Level 3+ repairs. Technicians

that have not received training in Mercedes-Benz welding and aluminum repair procedures are not allowed to perform any Level 3 or 3+ repairs on Mercedes-Benz vehicles. Sales of welded structural repair components are restricted to Mercedes-Benz certified collision repair facilities.

Work-hardening: Greater risk in aluminum than steel

Work-hardening occurs when bending stress causes metal to become harder in the bent area. Some hardening is an intentional by-product of the panel forming process at the factory. Work hardening also occurs due to collision impact, and when damage is hammered out during the repair process. This can lead to an aluminum panel becoming brittle and forming cracks. It takes less bending stress to cause excess work-hardening in aluminum than in steel.



Aluminum stress cracks can be microscopic and difficult to see with the naked eye. Detection involves a four-step process using dye penetrant. First, clean the surface to remove debris, oils, and other contaminants that may hide fine cracks. Second, apply a dye penetrant. Keep wetting the surface for up to 30 minutes to allow penetration into microscopic openings. Third, wipe excess dye penetrant from the surface, leaving only dye that has penetrated into cracks. Fourth, apply a developer to draw the dye penetrant to the surface. This makes the crack visible by contrast of the dye penetrant against the developer material.



The 2016 AMG GT S body-in-white is over 90 percent aluminum.



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Hammer and heat

Re-straightening of Mercedes-Benz structural components is prohibited. Pulling operations increase the risk of cracking in cast or extruded aluminum components, and should be avoided if possible. Sheet aluminum used for hood and door outer panels may be reshaped using drawing-in and planishing.

Work-hardening makes cold-straightening aluminum a bit more difficult. You may be able to tap out minor dents, but for larger areas you must also add heat to soften the metal. To draw in a dent, Mercedes-Benz recommends applying heat between 150° C (300° F) to 450° C (840° F), then cooling the area down quickly. The rapid temperature change causes the surface to contract and the aluminum to resume its original shape.

Unlike working from the outside in when using planishing tools on steel, with aluminum you start tapping in the center of the dent. Press toward the outer edges of the damaged area. To avoid tearing or gouging soft aluminum surfaces, replace sharp-edged and hard steel repair tools with plastic, wood, or aluminum tools.

Thermal expansion within the heat affect zone must be limited. Use thermal pens, self-adhesive temperature measuring strips, or an infrared thermometer/pyrometer to monitor heat buildup. Follow manufacturer guidelines on the use of temperature checking tools.

They may look alike, but...

All aluminum materials are not the same in their composition, strength, and what is most important for collision technicians, response to heat and cold-working repair techniques.

Mercedes-Benz engineers have balanced a variety of chemical formulation factors, including tensile strength (how much the metal can stretch without breaking), ductility (the amount of bending a material can take without cracking), formability during manufacturing, compatibility with other materials in the vehicle, long-term corrosion resistance, and many more. This ability to fine-tune the chemical formulation of the alloy means that the aluminum used in a Mercedes-Benz vehicle may not only perform differently from that of other manufacturers,



The 2016 AMG GT S uses forged aluminum double wishbones and hub carriers at all four wheels, giving its state-of-the-art Adaptive Suspension system the rigidity needed for excellent road-handling performance while also reducing unsprung weight.

but may also require very different repair procedures.

Even if you've had some aluminum repair training, there may be procedures that are specific to Mercedes-Benz that you are not already aware of. Always check in the Mercedes-Benz Workshop Information System (WIS) for specific procedures before finalizing your repair plan.

For example, the cast aluminum used for many structural components on the AMG GT S is a proprietary formula that features enough plasticity that it can absorb a high amount of collision impact without breaking. Mercedes-Benz hands-on collision repair training includes a demonstration cast aluminum plate that is bent, then placed in a vise and bent back, all without cracking or breaking. This bend-but-don't-break property is intended primarily to help protect vehicle occupants in a collision. Once it bends, work hardening occurs. This alters in unpredictable ways the future load-carrying capacity and impact resistance of the component. Even if you could straighten the component, which is highly unlikely, it is not safe for reuse.

It's curtains for you

You'll need a separate room or curtained-off area for conducting aluminum repairs. This "clean room" is required to prevent cross-contamination between aluminum and steel particles. If dust from grinding, welding, or sanding steel settles on aluminum, it reacts with moisture in the air to form galvanic corrosion, which degrades and eventually eats through the aluminum.

The clean room must have an explosion-proof exhaust system. This is to reduce the presence of aluminum dust particles, which, in the right proportions in the air, can explode violently if a spark or other ignition source is introduced.

Aluminum repair star

Aluminum repair training is part of the requirement to become a Mercedes-Benz certified collision repair facility. The equipment, tools, and training cost to become certified must be balanced against the potential repair volume in your market area.

The training goes beyond theory to provide extensive hands-on practice in real-world procedures. It will give you a great comfort level with how cold-straightening techniques and application of temperature should be handled differently for aluminum versus steel. You'll learn how to assess damage to aluminum structural components, what can or cannot be repaired, and if and where sectioning is permitted. You'll test different setup parameters for creating durable joints using computer-controlled MIG/MAG welding equipment. You'll set up frame benches with model-specific, dedicated fixture sets for anchoring and component positioning.

After training, you'll be an expert at obtaining the precise structural alignment necessary to restore the buttery smooth road-handling and industry-leading safety of a Mercedes-Benz vehicle. You'll also be one of the few able to acquire the OEM parts required for structural repairs. Mercedes-Benz, like many OEMs, restricts sales of certain aluminum structural components to its certified collision centers only.

Materials and repair procedures can change frequently, even within the same model year for a given vehicle, so maintaining your expertise will require frequent training/certification. Always refer to the Workshop Information Systems (WIS) for the most up to date repair procedures.

Precious metal

Tightening fuel economy standards and significant technological advances in aluminum manufacturing encouraged Mercedes-Benz to increase its use of aluminum in recent years. The aluminum-intensive AMG GT S is a harbinger of things to come. Let it encourage you to increase your training in how to repair this precious metal. |

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Product Name	Part Number	Quantity	Product Description	Recommended Consumer App.
Mercedes-Benz SPEC.				
Mobil 1 Formula M 5W-40	BQ 1 09 0197	Bulk - No Equipment	Fully synthetic formulas designed specifically for gasoline passenger cars	Low SPAsh. Available at most MB dealers
	BQ 1 09 0195	6/1 Quart Cases		
	BQ 1 09 0196	55 Gallon Drum		
Genuine Mercedes-Benz Oil MB 229.5 Specification SAE 5W-40	A0009898301USB6	12x1 Quart Cases	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.5 Specification	Mercedes-Benz Engines that require 229.5 Specification Oil
	A0009898301USB8	55 Gallon Drum		
	A0009898301USB9	Bulk - No Equipment		
Mobil 1 0W-40	BQ 1 09 0010	Bulk - No Equipment	Fully synthetic formulation designed to meet the requirements of many European vehicles	Porsche A40. Many European vehicles. HT/TS applications.
	BQ 1 09 0015	6/1 Quart Cases		
	BQ 1 09 0016	55 Gallon Drum		
Mobil 1 ESP X1 0W-30	BQ 1 09 0184	Bulk - No Equipment	Advanced full synthetic formulas designed specifically for diesel passenger cars that have particulate filters	Low SPAsh. Available at most MB dealers
	BQ 1 09 0182	6/1 Quart Cases		
	BQ 1 09 0183	55 Gallon Drum		
Genuine Mercedes-Benz Oil MB 229.52 Specification SAE 5W-30	A0019893701USA9	Bulk - No Equipment	Fully Synthetic formula specifically designed for Mercedes-Benz engines that require the 229.51 and 229.52 Specification requirements	Mercedes-Benz Engines that require 229.51 Specification Oil
	A0019893701USA6	6x1 Quart Cases		
	A0019893701USA8	55 Gallon Drum		
Mobil 1 5W-50	BQ 1 09 0133	16 Gallon Keg	Higher viscosity, advanced full synthetic formula designed for performance vehicles	Porsche A40. HT/HS applications.
	BQ 1 09 0194	6/1 Quart Cases		
Mobil ATF 134	BQ 1 09 0166	55 Gallon Drum	Extra high performance automatic transmission fluid formulated with selected HVI base oils	Recommended for use in Mercedes-Benz automatic gearboxes
M-B Genuine ATF 134FE	A0019897703USA8	55 Gallon Drum		
Mobil 1 ESP Formula MB 5W-30	BQ 1 09 0165	12x1 Liter Cases	Advanced full synthetic formulas designed specifically for passenger car diesels that have particulate filters	Low SPAsh. Available at most MB dealers.
AdBlue® 1/2 Gal.	A 000 583 0107	1/2 Gallon Bottle	Non-toxic solution that transforms harmful Nitrogen Oxide (NOx) emissions from diesel-powered vehicles into harmless water vapor and nitrogen	Recommended for use in Mercedes-Benz, Volkswagen + BMW AdBlue® (DEF) applications
Diesel Exhaust Fluid 55 Gal	BQ 1 47 0002	55 Gallon Drum		
Mobil 1 5W-30	BQ 1 09 0017	6/1 Quart Cases	Advanced full synthetic formulation designed to meet the requirements of many domestic, including GM, and imported vehicles	Vehicles that require 5W-30. Corvette approved.
	BQ 1 09 0018	55 Gallon Drum		
Mobil 1 10W-30	BQ 1 09 0019	6/1 Quart Cases	Advanced full synthetic formula designed for domestics and imports	Vehicles that require 5W-30 or 10W-30
	BQ 1 09 0020	16 Gallon Keg		
	BQ 1 09 0021	55 Gallon Drum		
Mobil 1 5W-20	BQ 1 09 0083	6/1 Quart Cases	Advanced full synthetic formulation designed to meet the requirements of many newer vehicles including Hondas, Fords, Chryslers, and newer Toyotas	Vehicles that require 5W-20
	BQ 1 09 0084	55 Gallon Drum		
Mobil 1 0W-20 AFE	BQ 1 09 0169	6/1 Quart Cases	Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance	Most vehicles that specify 0W-20 (newer Toyotas and Hondas), 5W-20 and certain hybrids
	BQ 1 09 0168	55 Gallon Drum		
Mobil 1 0W-30 AFE	BQ 1 09 0174	6/1 Quart Cases	Advanced full synthetic formulation designed for enhanced fuel economy and cold weather performance	Most vehicles that specify 5W-30 or 10W-30
Mobil 1 Synthetic ATF	BQ 1 09 0164	6/1 Quart Cases	Multi-vehicle, fully synthetic fluid designed to meet the demanding requirements of modern passenger vehicles	Vehicles that require Dexron III, Ford Mercon and Mercon V performance levels
	BQ 1 09 0163	55 Gallon Drum		
Mobil 1 15W-50	BQ 1 09 0023	55 Gallon Drum	Boosted, higher viscosity, advanced full synthetic formula designed for performance vehicles	HT/HS applications. Racing and Flat tappet applications
	BQ 1 09 0022	6/1 Quart Cases		
Mobil 1 Gear Oil (Mobil 1 Gear Lube 75W-90)	BQ 1 09 0085	12/1 Quart Cases	Exceeds the most severe service requirements in both conventional and limited slip applications	SUITABLE for use in modern high performance automobiles like SUV's, Vans and Light duty trucks requiring API GL-5 level performance

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Product Name	Part Number	Quantity	Product Description	Recommended Consumer App.
Mercedes-Benz SPEC.				
Mobil Special 5W-30	BQ 1 09 002464	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ
	BQ 1 09 0171	12/1 Quart Cases		
	BQ 1 09 003064	55 Gallon Drum		
Mobil Special 10W-30	BQ 1 09 003164	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ
	BQ 1 09 0172	12/1 Quart Cases		
	BQ 1 09 003764	55 Gallon Drum		
Mobil Special 10W-40	BQ 1 09 003864	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks where a higher viscosity API SN/SMSL/SJ oil is preferred or recommended
	BQ 1 09 0173	12/1 Quart Cases		
	BQ 1 09 004464	55 Gallon Drum		
Mobil Special 5W-20	BQ 1 09 012464	Bulk - No Equipment	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks requiring an API SN/SM/SL/SJ
	BQ 1 09 0170	12/1 Quart Cases		
	BQ 1 09 013264	55 Gallon Drum		
Mobil Special 20W-50	BQ 1 09 004664	55 Gallon Drum	Formulated from quality base stocks combined with modern performance additives to give the engine the expected protection and performance under a wide variety of operating conditions	Recommended for gasoline fueled automobiles and light duty trucks where a higher viscosity API SN/SMSL/SJ oil is preferred or recommended
Mobil Delvac 1300 Super 15W40	BQ 1 09 0053	Bulk - No Equipment	Extra high performance diesel engine oils that help extend engine life in the most severe on and off-highway applications while delivering outstanding performance in modern, high-output, low-emission engines including those with Exhaust Gas Recirculation (EGR) and After-treatment Systems with Diesel Particulate Filters (DPFs) and Diesel Oxidation Catalysts (DOCs)	Specifically recommended for the latest low-emissions, high performance diesel applications equipped with aftertreatment systems using Diesel Particulate Filter (DPF) and Diesel Oxidation Catalyst (DOC) technologies
	BQ 1 09 0058	12/1 Quart Cases		
	BQ 1 09 0059	4/1 Gallon Cases		
	BQ 1 09 0060	55 Gallon Drum		
	BQ 1 09 0179	6/1 Quart Cases		
Mobil Delvac 1300 Super 10W30	BQ 1 09 0086	Bulk - No Equipment		
Mobil Delvac 1 5W40	BQ 1 09 0051	4/1 Gallon Cases	Fully synthetic supreme performance heavy duty diesel engine oil that helps extend engine life while providing long drain capability and fuel economy for modern diesel engines operating in severe applications	Recommended for use in all super high performance diesel applications, including modern low emission engine designs with Exhaust Gas Recirculation (EGR)
	BQ 1 09 0052	55 Gallon Drum		
Mobil Grease XHP 222	BQ 1 09 0078	60/14 oz Cartridge	Formulated to provide excellent high temperature performance with superb adhesion, structural stability and resistance to water contamination	Recommended for industrial and marine applications, chassis components and farm equipment
	BQ 1 09 0079	120 lb Keg		
	BQ 1 09 0080	400 lb Drum		
	BQ 1 09 0098	40/14 oz Cartridge		
Mobil Lube HD Plus 80W90	BQ 1 09 0096	120 lb Keg	Extra high performance, automotive lubricant formulated from select base oils and an advanced additive system specifically for limited-slip differentials	Recommended for use in limited-slip differentials, axles, and final drives requiring API GL-5 level performance
	BQ 1 09 0097	400 lb Drum		



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